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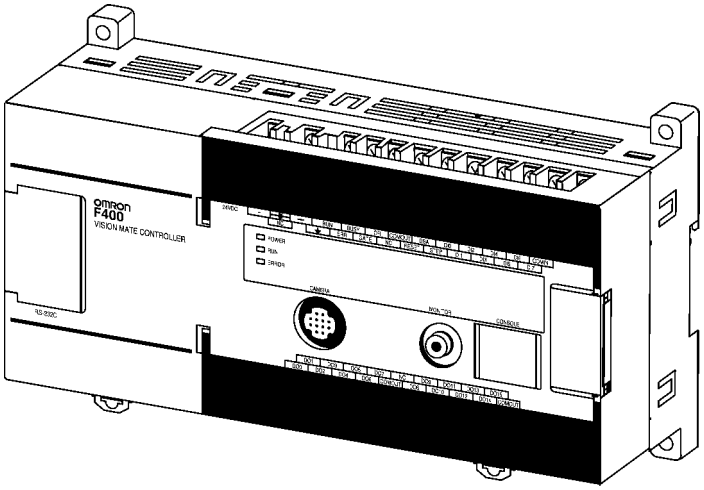
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F400 Color Vision Sensor

Operation Manual

Produced June 1999



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Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to property.

⚠ **DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ **WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ **Caution** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

Visual Aids

The following headings will help you locate different types of information.

Note Indicates information of particular interest for efficient and convenient operation of the product.

→ Indicates pages where additional information can be found.

1. Indicates a procedure. The step numbers in the procedure correspond to the numbers in any related illustrations.

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About this Manual:

This manual describes the measurement conditions, settings, and external device communications methods for the F400 Color Vision Sensor. The F400 can take measurements using color information.

The F400 supports two scene modes that can be used for measurement: Color Pickup Mode and Color Filter Mode. The features of these two scene modes are as follows:

Color Pickup Mode: Only the specified color is extracted and measured.

Color Filter Mode: A color filter is applied to create an easily measurable image. Color combinations that are hard to distinguish in gray images because of low contrast in brightness, such as green and yellow, can be recognized and measured.

Please read this manual and other related manuals carefully and be sure to understand the information provided before attempting to install or operate the F400. The manuals for the F400 are outlined in the following table.

Manual	Contents	Cat. No.
Introduction Manual	Provides introductory information about the F400. This manual is designed for first-time users of the F400 and describes features of color gray measurement, basic operations of the F400, and the main F400 applications.	Z131-E1-1
Setup Manual	Describes hardware, wiring, and connections required to install the F400.	Z130-E1-1
Operation Manual	Describes F400 functions. Explains measurement settings and methods for communications with external devices.	Z135-E1-1

Section 1 Introduction describes features, measurement modes, and menu tree of the F400 Color Vision Sensor.

Section 2 Basic Operations describes the overall flow of F400 application and basic operations.

Section 3 Settings describes how to set measurement conditions for F400 visual inspections.

Section 4 Checking and Executing Measurements describes how to monitor if correct measurements are being performed with the set measurement conditions. It also describes how to perform measurements.

Section 5 System Settings describes the system setting procedures for the F400.

Section 6 Communications with External Devices describes the communications settings and I/O formats for communications with external devices.

Section 7 Troubleshooting lists the errors that may occur during F400 operation, along with their probable causes and remedies.

⚠WARNING Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product, or product failure. Please read each section in its entirety and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.

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PRECAUTIONS

This section provides general precautions for using the F400 Color Vision Sensor.

The information contained in this section is important for the safe and reliable application of the F400 Color Vision Sensor. You must read this section and understand the information contained before attempting to set up or operate a F400 Color Vision Sensor.

1 Safety Precautions xii
2 General Precautions xii

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1 Safety Precautions

⚠ WARNING Cover the terminal blocks with the Terminal Block Protection Covers. Uncovered terminal blocks can result in electric shock.



⚠ WARNING Use DC power supplies with safe extra low-voltage circuits on the secondary side for the main F400 power supply and power supplies for the terminal blocks. Excessively high voltages can result in electric shock.



⚠ Caution Do not touch fluorescent or halogen lights while the power is ON or immediately after the power is turned OFF. These lights generate heat and can cause burns.



⚠ Caution Do not use the F400 in environments with flammable or explosive gases.

⚠ Caution Install the F400 away from high-voltage equipment or motors to ensure safety during operation and maintenance.

⚠ Caution Use the power supply cables and crimp terminals of specified sizes.

⚠ Caution Use at the power supply voltages specified in this manual.

⚠ Caution Be sure to securely tighten the screws when mounting F400 components.

⚠ Caution Do not dismantle, repair or modify any F400 components.

⚠ Caution Dispose of F400 components as industrial waste.

⚠ Caution To prevent damage from static electricity, use a wrist strap or another device for preventing electrostatic charges when touching terminals or connector signal lines.

⚠ Caution Do not turn OFF the power while a message is being displayed indicating that processing is being performed. Data in memory will be destroyed, and the F400 may not operate correctly the next time it is started.

2 General Precautions

The user must operate the product according to the performance specifications described in the operation manuals.

Before using the product under conditions which are not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment, and other systems, machines, and equipment that may have a serious influence on lives and property if used improperly, consult your OMRON representative.

Make sure that the ratings and performance characteristics of the product are sufficient for the systems, machines, and equipment, and be sure to provide the systems, machines, and equipment with double safety mechanisms.

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SECTION 1
Introduction

This section describes features, measurement modes, and menu tree of the F400 Color Vision Sensor.

1-1 Features 2
1-2 Measurement Modes 4
1-2-1 Color Pickup and Color Filter Modes 4
1-2-2 Additional Color Filter Mode 4
1-3 Menu Trees 5

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1-1 Features

Color Images

Color information from a color image can be used when performing measurements. Select one of the two F400 measurement modes, called scene modes, depending on the application. The two modes are Color Pickup Mode and Color Filter Mode.

Refer to the *Introduction Manual (Z131)* for information on color (hues and saturation) and applications.

Color Pickup Mode

The Color Pickup mode is used to extract only specified colors. Simply click the color to be displayed on the screen to register it as a pickup color. Up to 8 colors can be registered per scene.

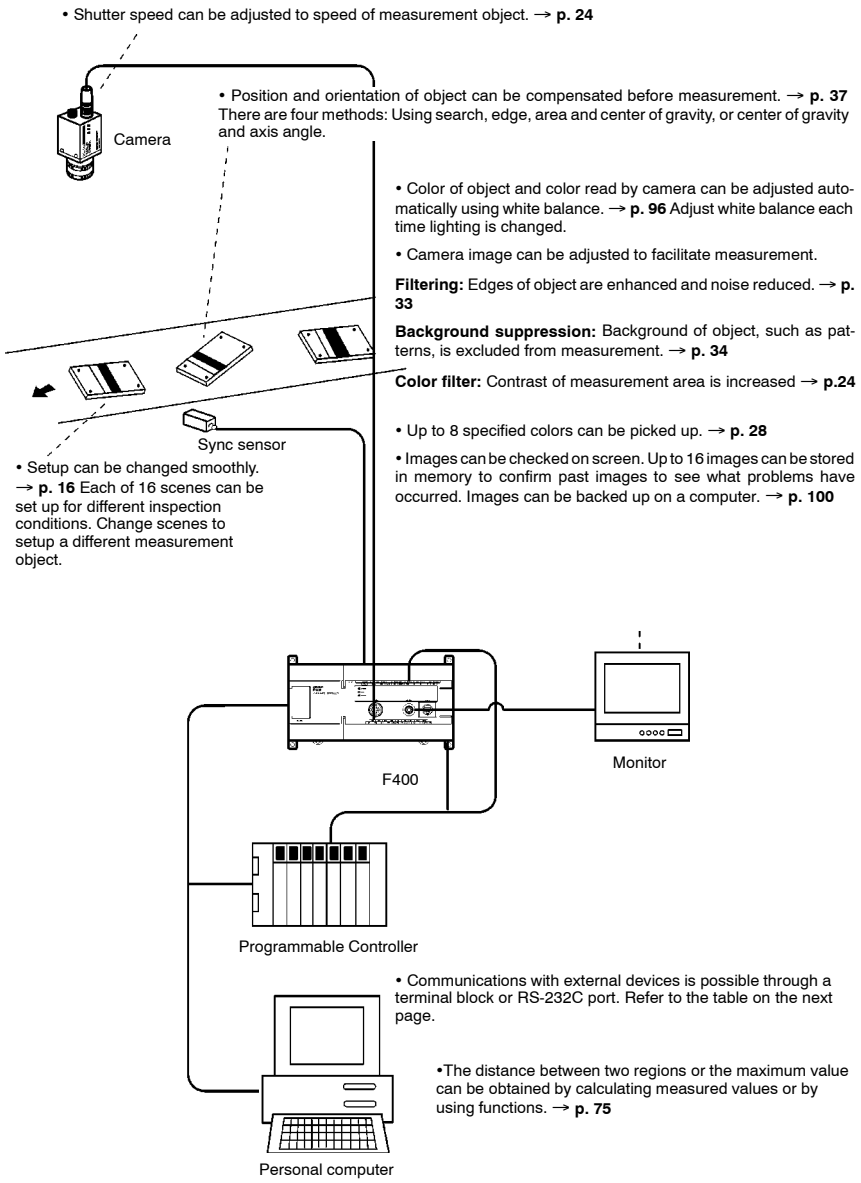
Applications include separation by color, such as for ice cream separation or for wiring checks.

Color Filter Mode

A color filter can be applied to create an easily measurable image. There are five color filters: Red, green, blue, colorgray, and gray. The colorgray filter is used to convert a color image to a grayscale image with 256 gradations by using hue and saturation settings. The colorgray filter enables measurement of color combinations, such as green and yellow, with low contrast in brightness making them hard to distinguish in gray images.

Applications include detection of small defects, such as surface defects on bottle caps, and inspection free from background distortion, such as inspecting the amount of adhesive that has been coated on a surface.

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Input/Output	Terminal block	RS-232C
Trigger input	Yes	Yes
Measurement values output	No	Yes
Judgement output (OK/NG)	Yes	No

Terminal blocks: → **p. 112**

RS-232C port: → **p. 119**

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1-2 Measurement Modes

There are five measurement modes. Different modes are available depending on the scene mode.

1-2-1 Color Pickup and Color Filter Modes

Search → **p. 55, 144**
Density searches are used when inspecting the shape of specific objects. The object is measured using a registered measurement pattern called a model. The position of the object and the degree of conformity, called the correlation, with the model are calculated.

Edge → **p. 63, 140**
The edge measurements are used to find the coordinates of edges of the measurement object. The width of an object can be calculated by using an equation to subtract edge coordinates.

Area and Center of Gravity → **p. 67, 147**
The binary center of gravity and area can be used to calculate the size (i.e., the area) and the position (i.e., the center of gravity) of the measurement object.

Center of Gravity and Axis Angle → **p. 67, 147**
The binary axis angle can be used to calculate the orientation (i.e., the binary axis) of the measurement object, in addition to the center of gravity and area. Binary axis searches increase processing time, so binary center of gravity and area searches should be used when only the center of gravity and area are required.

1-2-2 Additional Color Filter Mode

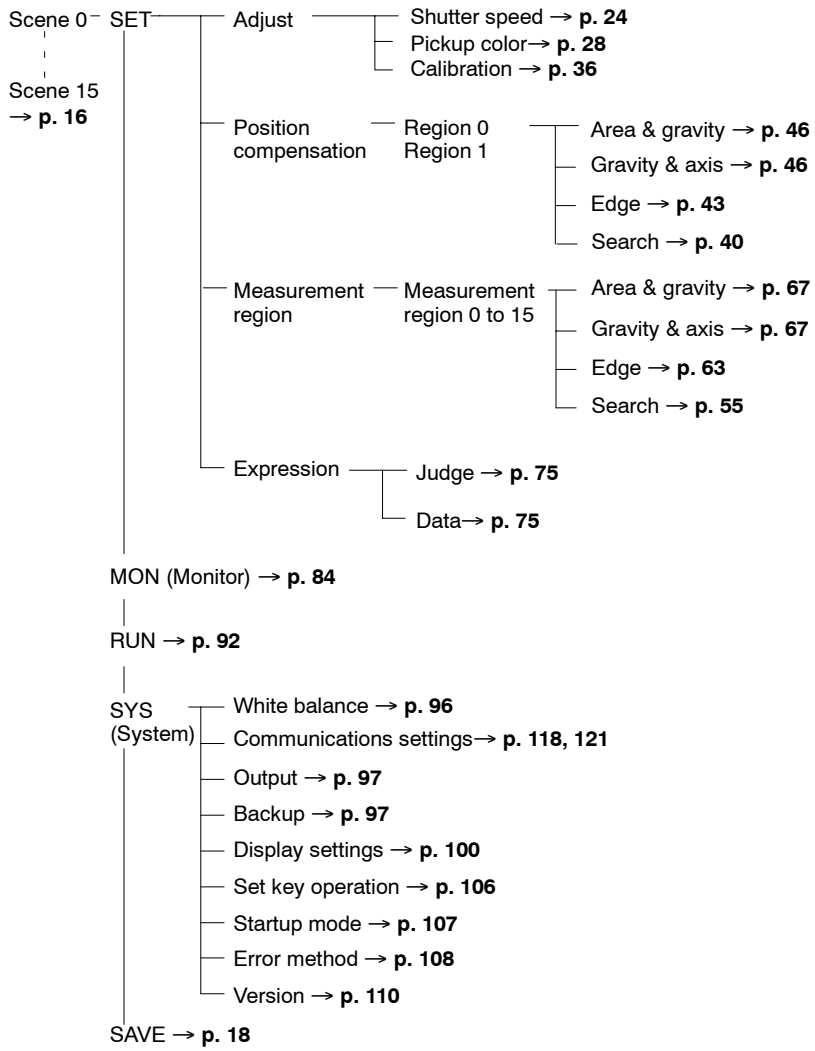
Surface Defects → **p. 52, 142**
The measurement object can be inspected for surface defects. Areas that are largely different in densities are detected as defects.

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1-3 Menu Trees

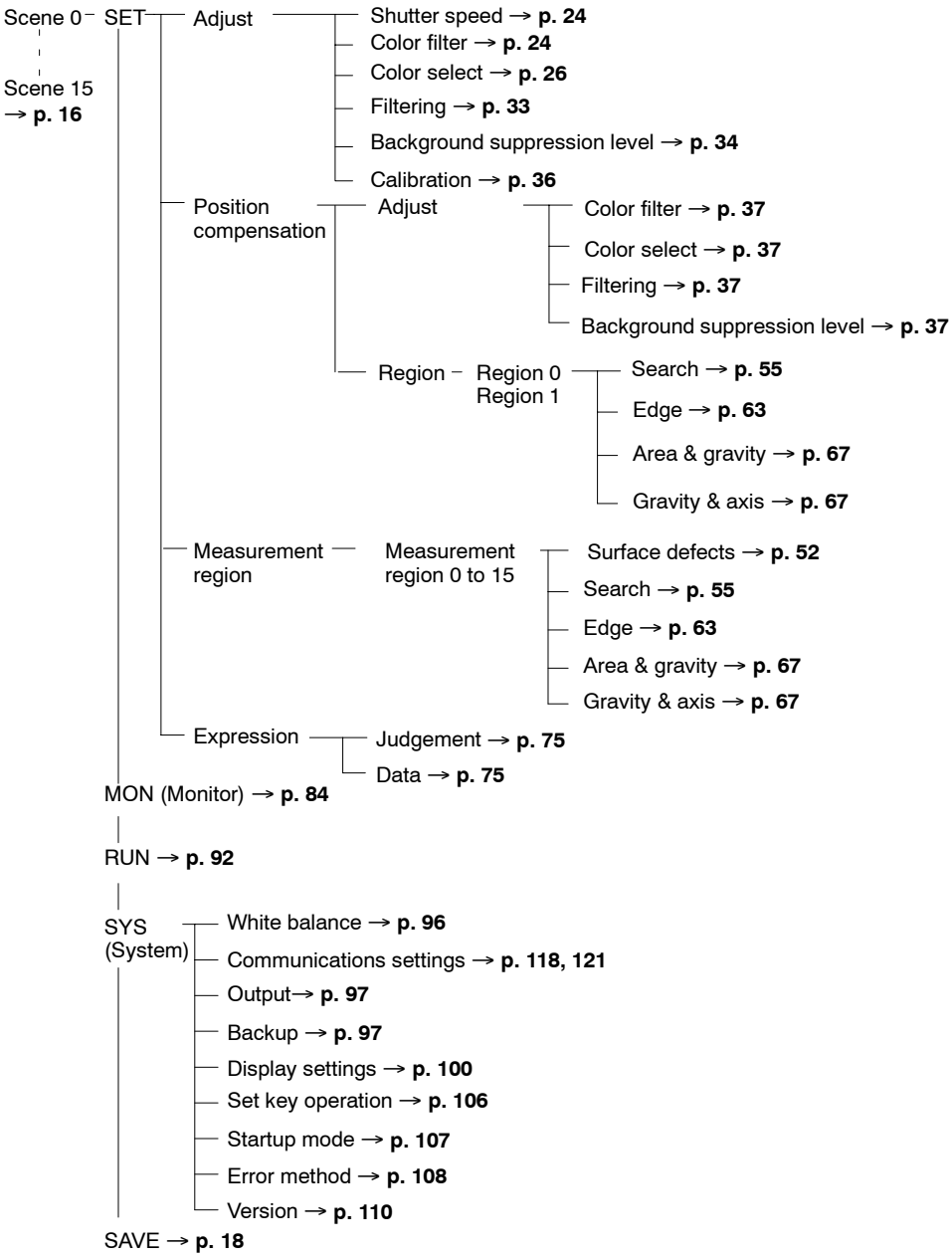
Color Pickup and Color Filter Modes have different menu hierarchies. The menu hierarchies are outlined in the following diagrams. The same hierarchy exists under each scene.

Color Pickup



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Color Filter



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SECTION 2
Basic Operations

This section describes the overall flow of F400 application and basic operations.

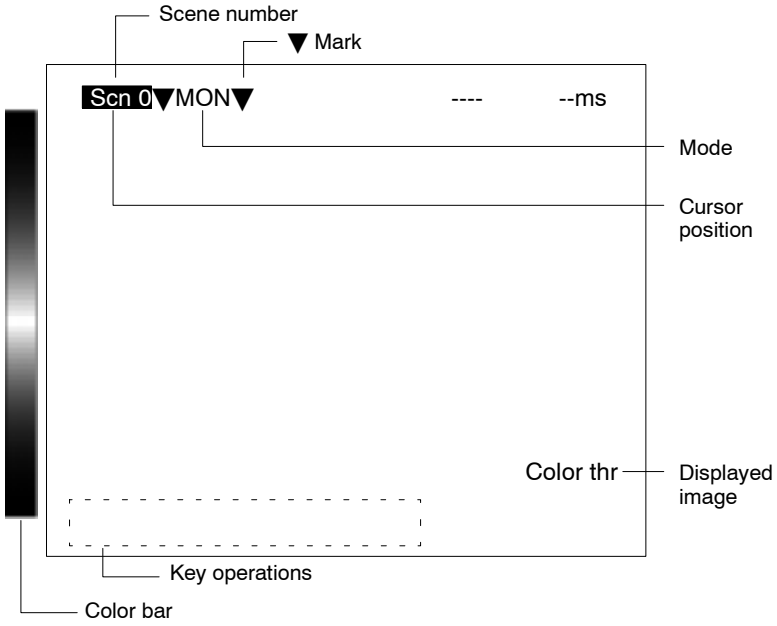
2-1 Menu Operations 8
2-1-1 Screen Displays 8
2-1-2 Input Devices 8
2-1-3 Menu Tree 10
2-1-4 Inputting Values 10
2-1-5 Drawing Measurement Regions 12
2-2 Starting and Quitting 14
2-2-1 Starting 14
2-2-2 Selecting Scene Modes 15
2-2-3 Changing Scenes 16
2-2-4 Copying and Clearing Scenes 17
2-2-5 Quitting 18

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2-1 Menu Operations

2-1-1 Screen Displays *— Filter/Pickup —*

The F400 is operated by selecting functions from the screen. Highlighted text indicates the current cursor position. The screen is shown in the following diagram.



Scene Number The current scene number is displayed. There are 16 scenes that can be created to change the measurement conditions easily.

▼ Mark Options will appear when an item with the ▼ mark is selected.

Mode The current operating mode is displayed. The modes are Set, Monitor, Run, System, and Save. The operating modes are described in the following table.

Mode	Meaning
SET	Used to set measurement conditions.
MON (Monitor)	Used to confirm whether or not the measurement is being performed correctly under the set conditions and make adjustments if required. In this mode, measurement results are displayed on the video monitor only and are not output to an external device.
RUN	Used to perform object measurements. Outputs measurement results to an external device via terminal blocks or RS-232C.
SYS (System)	Used to make F400 system settings.
SAVE	Saves settings to flash memory. Always save altered settings before exiting.

Cursor Position The selected text is highlighted.

Displayed Image The type of image displayed on the video monitor is shown. Refer to *Section 5-4-2 Changing Displayed Images*. →**p. 103**

Key Operations The keys that can be used and their corresponding functions are displayed at the bottom of the screen.

Color Bar The F400 will be in Color Filter Mode if the color bar is displayed and in Color Pickup Mode if the color bar is not displayed.

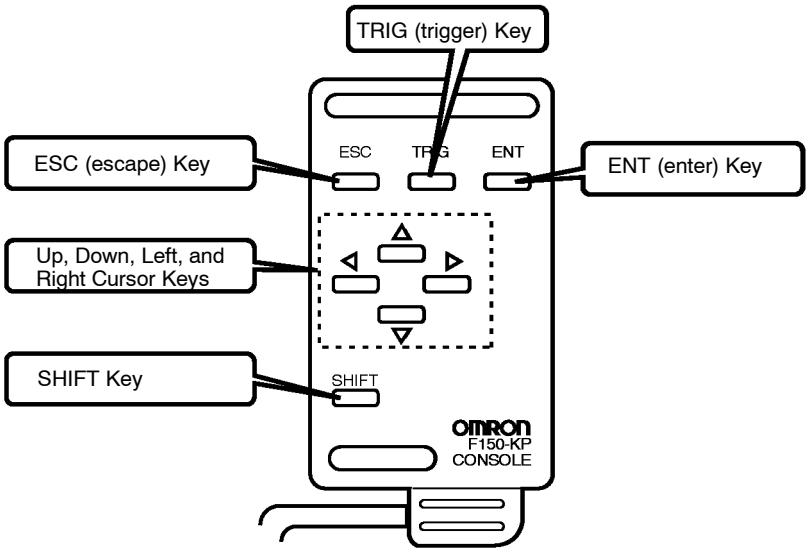
2-1-2 Input Devices *— Filter/Pickup —*

The menu operations are performed from either the Console or the RS-232C port.

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Console

The Console is used to perform menu operations. Be sure to familiarize yourself with Console operations before actually using the menus.



Key	Function
ESC: Escape Key	ESC Key functions differ depending on the screen currently displayed. Refer to the explanations for individual screens. (See note.) Interrupts processing and returns the user to the previous menu display.
TRIG: Trigger Key	Starts object measurement. Picks up a color when in Color Pickup Mode.
ENT: Enter Key	Executes a function or sets a value.
Up and Down Keys	Used to move the cursor up and down to select items. The **Up** Key will increase a value by 1 and the **Down** Key will decrease a value by 1. Continue pressing the **Up** or **Down** Key to quickly increase or decrease a value.
Left and Right Keys	Used to move the cursor left or right to select items.
SHIFT Key	Must be pressed in combination with another key to have any effect. Specific functions are assigned to **SHIFT** + ***another key*** for specific screens. (See note.) Refer to the explanations for individual screens.

Note Possible to change assigned key functions or to assign new functions such as changing scenes or displays. Changed key allocations are effective only in the Monitor or Run mode. Refer to *Section 5-5 Key Allocation*. →**p. 106**

RS-232C Port

There are keyboard key combinations for input via RS-232C that correspond to the Console keys when in Run Mode. Refer to *Section 6-2-3 Input Command List*. →**p. 122**

The keyboard key combinations are shown in the following table. The key codes shown on the right in the following table can be input from an external device to perform the same functions as the Console keys shown on the left.

Console key	RS-232C input	
	Key	Code
ESC	CTRL + [	($1B)
TRIG	CTRL + A	($01)

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Console key	RS-232C input	
	Key	Code
ENT	CTRL + M	($0D)
Up Key	CTRL + E	($05)
Down Key	CTRL + X	($18)
Left Key	CTRL + S	($13)
Right Key	CTRL + D	($04)
SHIFT + ESC	TAB, CTRL + I	($09)
SHIFT + TRIG	CTRL + T	($14)
SHIFT + ENT	CTRL + R	($12)
SHIFT + Up Key	CTRL + W	($17)
SHIFT + Down Key	CTRL +Z	($1A)

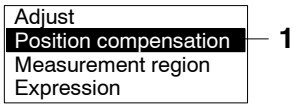
Note
1. Commands cannot be input during menu operation.
2. Input **CTRL + Q** to re-input commands to change from the menu operation to command input.

2-1-3 Menu Tree *— Filter/Pickup —*

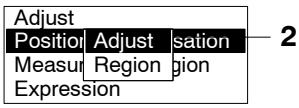
F400 menus are hierarchical. The cursor is moved to the required functions to set measurement conditions. Use the following procedure to move around the menu tree.

Menu Tree: →**p. 5**

1. Move the cursor to the desired function using the **Up**, **Down**, **Left**, and **Right** Cursor Keys.



2. Press the **ENT** Key. In this example, the cursor will move to the **Adjust** menu. Repeat this step to move to lower levels.



3. Press the **ESC** Key. The display will move to the previous menu level (i.e., the screen shown in step (1)).

2-1-4 Inputting Values *— Filter/Pickup —*

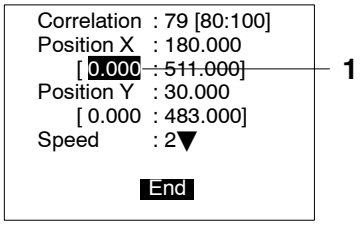
This section explains how to input numeric values when setting measurement conditions. There are two input methods.

Specifying the Input Digit

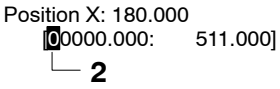
Specifying the input digit is used mainly for setting judgements and system conditions.

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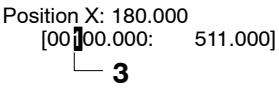
1. Move the cursor to the item for which a value is to be changed and press the **ENT** Key. The cursor size will change to a cursor the size of a single digit.



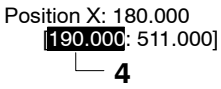
2. Using the **Left** and **Right** Keys, move the cursor to the digit to be changed.



3. Use the **Up** and **Down** Keys to change the value.
   The **Up** Key will increase the value by 1 and the **Down** Key will decrease the value by 1.



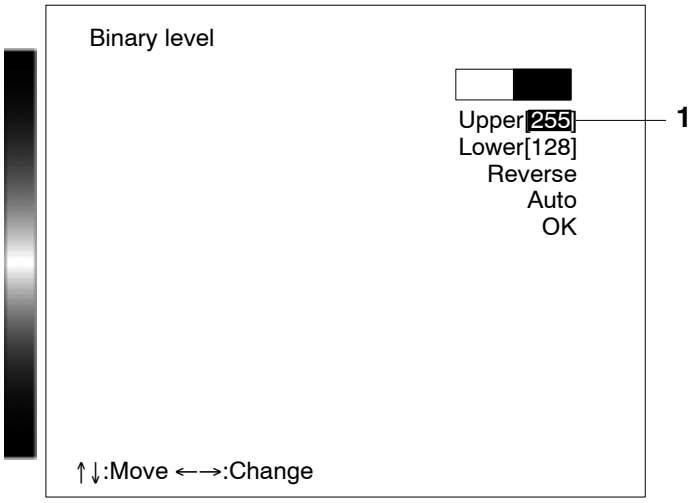
4. Press the **ENT** Key when all digits have been changed as desired. The value will be set.



Increasing and Decreasing Values

Values are increased or decreased mainly when setting binary levels and background suppression levels.

1. Move the cursor to the item for which the value is to be changed.



2. Using the **Left** and **Right** Keys, change the numeric value. The **Right** Key will increase the value by 1 and the **Left** Key will decrease the value by 1. The **SHIFT** + **Right** Key will increase the value by 10. The **SHIFT** + **Left** Key will decrease the value by 10.

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3. Use the **Up** and **Down** Keys to move to the next item. The numeric value will be set.

Upper[200]
Lower[128]—— **3**

2-1-5 Drawing Measurement Regions *— Filter/Pickup —*

This section explains drawing methods for model and measurement regions.

Use the **Up**, **Down**, **Left**, or **Right** Keys to move from one drawing point to another.

Press the **Shift** Key together with any one of these keys to move at a faster rate.

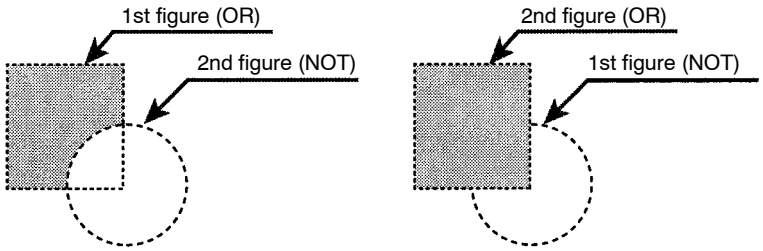
Types of Drawings

Type		Drawing method
Box		Set two diagonally opposing corners.
Ellipse		Set two diagonally opposing corners of a rectangle enclosing the ellipse.
Circle		Set the center and radius.
Circumference		Set the center and radius. and then the line width.
Polygon		Specify up to 10 neighboring vertices. After specifying the last point, press the **ENT** Key twice and it will be joined to the first point and the region will be drawn.

Note The type and number of drawings that can be created depends on the function in which the drawings are being used.

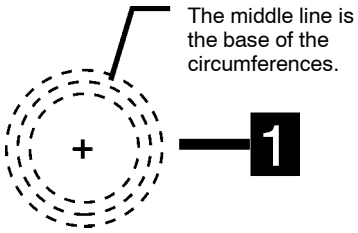
Drawing Method (OR/NOT)

Drawing mode	Meaning
OR	Registers drawings as models or regions. If multiple drawings are made, all drawings will be registered as one region.
NOT	Used to delete part of a region.



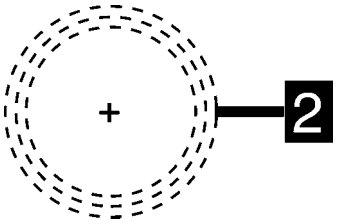
Example 1: Drawing a Circumference

1. Using the Cursor Keys, set the center of the circle and press the **ENT** Key. The center of the circle will be set. Use the **SHIFT** + **Cursor** Keys to move the cursor quickly.

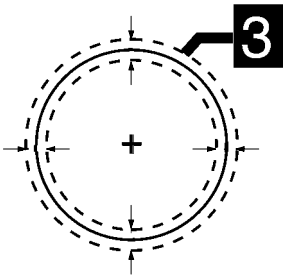


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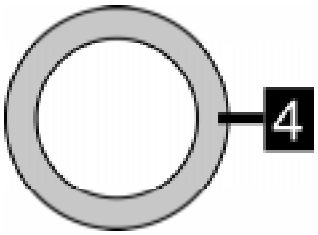
2. Use the **Up** and **Down** Keys to specify the radius and press the **ENT** Key. The arrows for specifying the line width for the circumference will be displayed.



3. Use the **Up** and **Down** Keys to set the line width. The arrows for specifying the line width will be displayed.

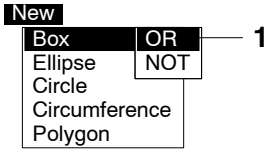


4. Press the **ENT** Key. The drawing will be set and the drawn region will be displayed in white.

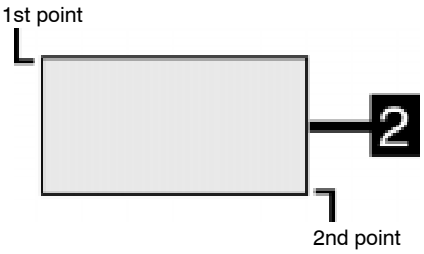


Example 2: Deleting Part of a Drawing

1. Select OR mode in the first drawing (a box for this example) and press the **ENT** Key. The arrow for drawing a box will be displayed.

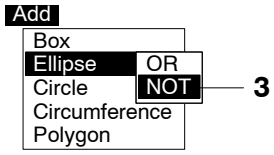


2. Set two diagonally opposing corner points to draw the box. Use the **SHIFT** + **Cursor** Keys to move the cursor quickly.

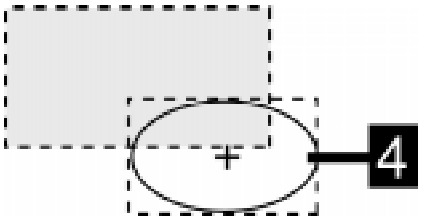


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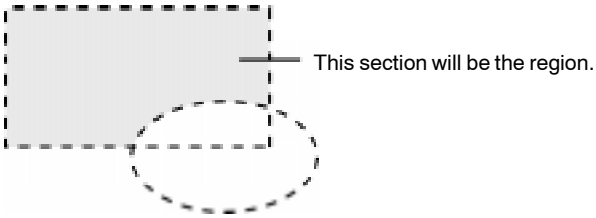
3. Select NOT mode in the second drawing (an ellipse in this example) and press the **ENT** Key. The arrow for drawing an ellipse will be displayed.



4. Set two diagonally opposing corner points of a rectangle enclosing the ellipse to draw the ellipse.



The overlapping section of the box and ellipse will be deleted.



2-2 Starting and Quitting

2-2-1 Starting *— Filter/Pickup —*

Use the following procedure to start and quit operation.

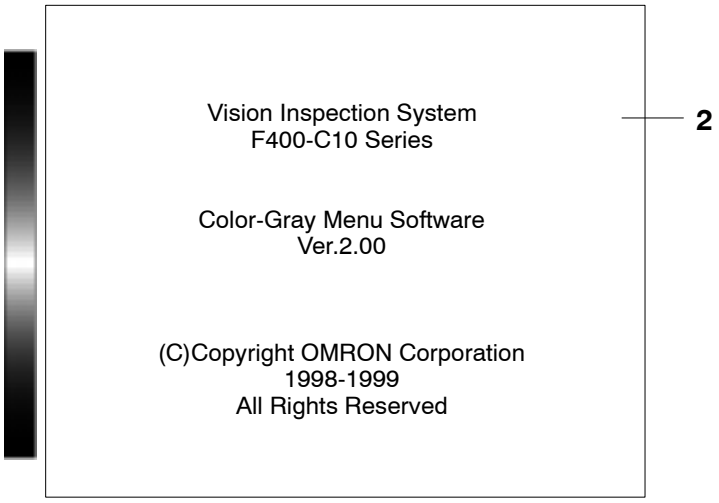
Note Be sure to refer to the *Setup Manual (Z130)* when connecting components or wiring the power supply or grounding the unit.

Setup Manual →***2-2 Connections* and *2-3 Power Supply and Ground***

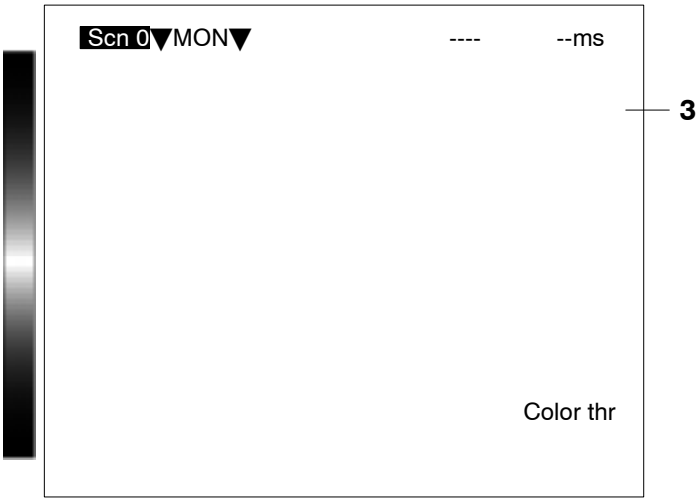
1. Be sure that the basic F400 components have been connected correctly. →***Setup Manual***
2. Turn ON the power supply to the monitor.

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3. Turn ON the power supply to the F400.
   The title page will be displayed.



4. After a short pause, the main F400 screen will be displayed.
   The following screen will appear the first time power is turned ON.



Note The startup scene and startup mode that appear when power is turned ON can be set. Use these settings to make daily operation more efficient once the F400 is ready for actual operation. → ***Startup Mode*** **on p. 107**

2-2-2 Selecting Scene Modes — *Filter/Pickup* —

The F400 has two scene modes: Color Filter and Color PickUp. Select the appropriate measurement mode for the application.

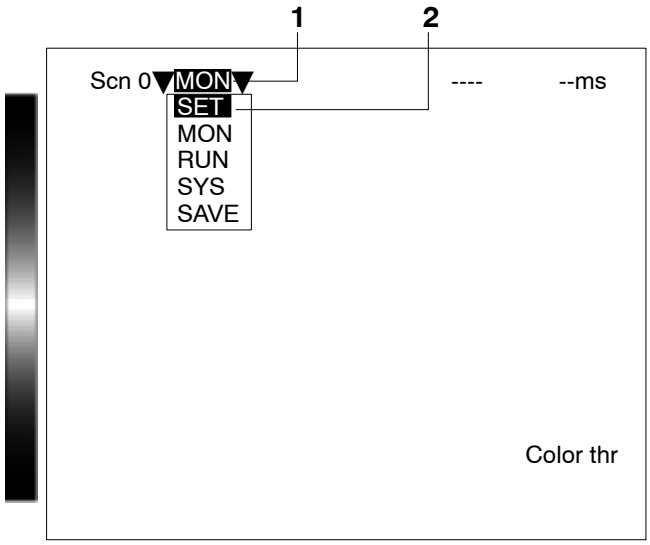
Refer to *Features* in the *Introduction Manual (Z131)* →**p. 5**

Select the scene mode when setting conditions for a scene for the first time.

1. Select **MON** (Monitor) and press the **ENT** Key

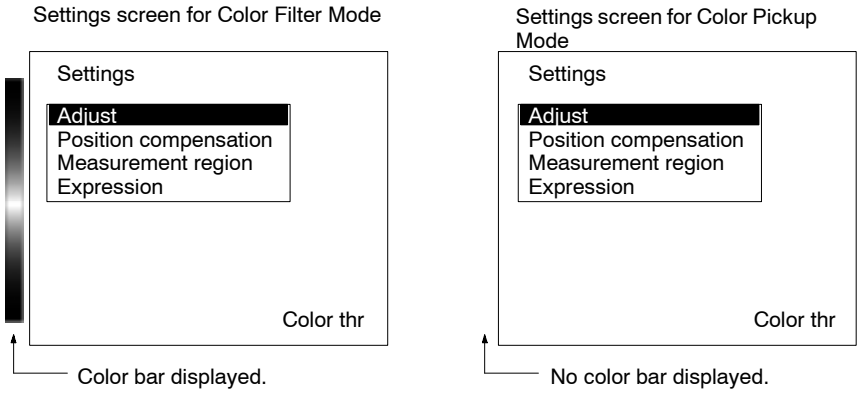
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2. Select **SET** to display a list of scene processing options. The options will not be displayed if measurement conditions are already set for the selected scene number. The scene number must be changed or the settings cleared before the options can be changed.



3. Select either ***Color filter*** or ***Color pickup*** and press the **ENT** Key. The settings screen for the selected scene mode will be displayed.





Note Changing between Color Filter and Color Pickup Modes

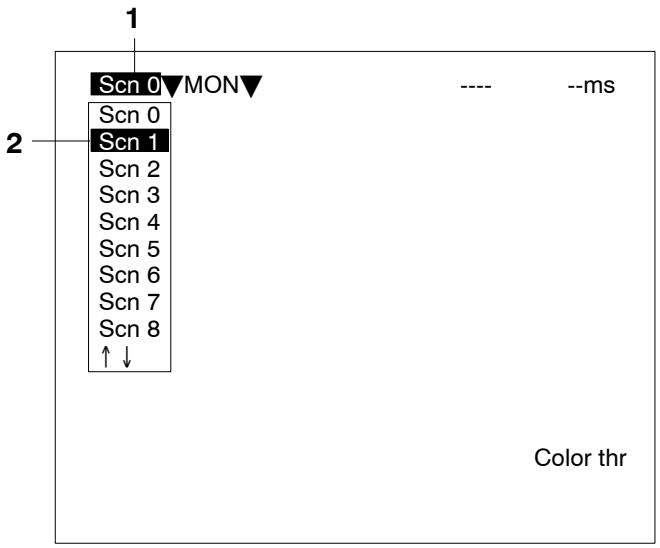
To change the scene mode for selected scenes, clear the scene and then change the scene mode. →***Copying and Clearing Scenes*** **on p. 17**

2-2-3 Changing Scenes *— Filter/Pickup —*

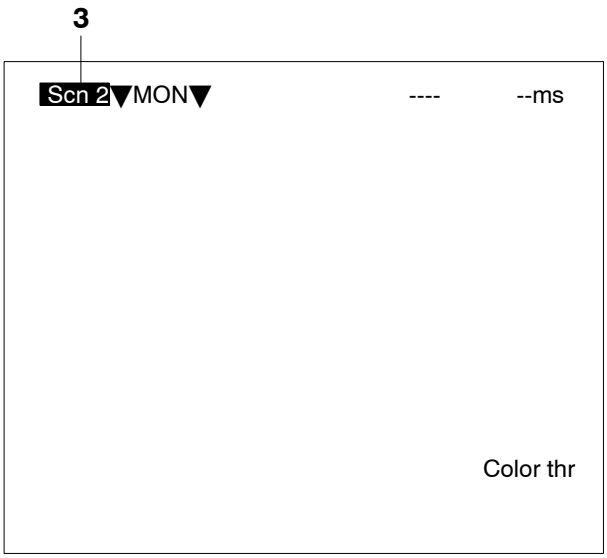
All the settings for measurement conditions are input for a specific scene. Up to 16 scenes can be set, numbered from 0 to 15. Scenes can be changed to switch between different measurement conditions for different measurement setups or measurement objects. Scene 0 will be displayed by default when the power is turned ON. Setup can be changed by simply changing scenes. Refer to *Scene* in the *Glossary* on page 145.

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1. Place the cursor on the scene number displayed on the screen (Scn 0 in this example) and press the **ENT** Key. A list of scene numbers will be displayed. Move the cursor using the **Down** Key to display the next group of scene numbers from 9 to 15.
2. Select a new scene number.



3. Press the **ENT** Key to display the selected scene.



Note Commands to switch scenes can be input from external devices when in Monitor or Run Mode.

Refer to *I/O Format* in *6-1 Terminal Blocks* and *List of Input Commands* in *RS-232C*. →**p. 112, 122**

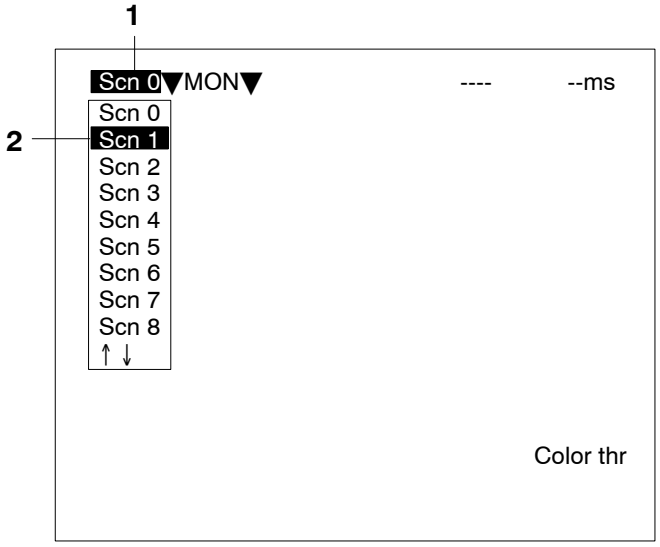
2-2-4 Copying and Clearing Scenes *— Filter/Pickup —*

This section explains how to copy and clear scene data. Clear scene data before changing the scene mode to either Color Filter or Color Pickup Mode.

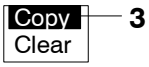
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1. Place the cursor on the scene number displayed on the main screen (Scn 0 in this example) and press the **ENT** Key. A list of scene numbers will be displayed. Move the cursor using the **Down** Key to display the next group of scene numbers from 9 to 15.

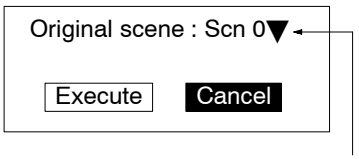
2. Press **SHIFT** + **ESC** Keys on the scene number to be copied or cleared. The two processing options will be displayed.



3. Select ***Copy*** or ***Clear***. A confirmation message will be displayed.

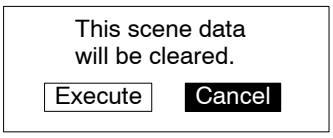


When ***Copy*** is selected



Place the cursor on **Scn 0** and press the **ENT** Key to display a list of scene numbers.

When ***Clear*** is selected



4. Move the cursor to **Execute** and press the **ENT** Key. The data for the selected scene will be copied or cleared and the display will return to the main screen.

2-2-5 Quitting

— Filter/Pickup —

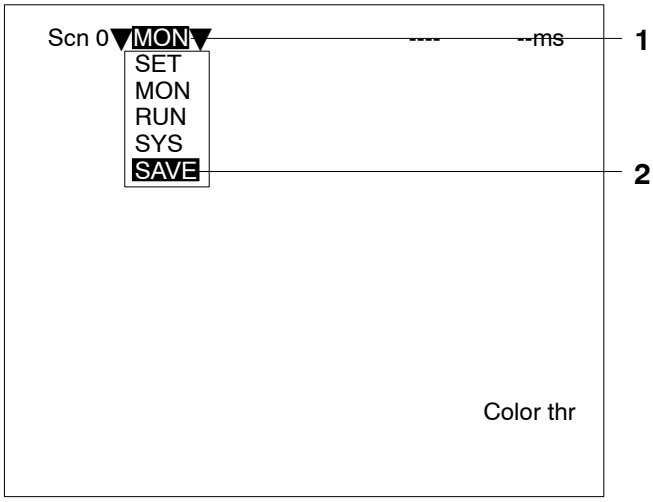
The user can quit the F400 and turn OFF the power at any time except while saving or loading data. Save all measurement settings to flash memory before quitting. The data in flash memory is loaded each time the F400 is started. Any changes made will be lost unless they are saved to the flash memory.

Note The measurement images and sample images in memory are also cleared when the power is turned OFF. These images cannot be saved to flash memory, but they can be backed up on a computer if required. Refer to *5-3 Backup*. →**p. 97**

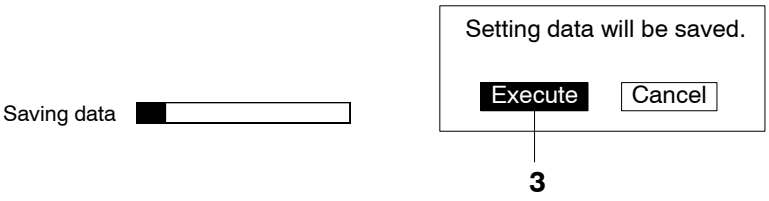
1. Move the cursor to ***MON*** and press the **ENT** Key. A list of operation modes will be displayed.

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2. Select ***SAVE***. A confirmation message will be displayed.



3. Move the cursor to **Execute** and press the **ENT** Key. The save will be executed and a progress box will be displayed.



Note Do not input the RESET command or turn OFF the power while saving data. The data may be lost, and the F400 may not operate properly the next time it is started.

When the data has been saved, the display will return to the main screen.

4. Turn OFF the power to the F400.

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SECTION 3
Settings

This section describes how to set measurement conditions for F400 visual inspections.

The following headings are used in this section to indicate the measurement modes to which an operation is applicable.

— Color Filter —
— Color Pickup —
— Filter/Pickup —

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3-1 Adjusting Images

Images displayed on the video monitor can be adjusted for easier measurement. Before adjusting the image on the monitor, however, adjust lighting and camera focus to clearly display the measurement object in the center of the screen.

Note White Balance
Depending on the inspection environment and type of lighting, even white images read by the camera may appear somewhat colored. Refer to the *2-6 Lighting* in the *Setup Manual (Z130)* for information on lighting methods. Adjust the white balance before setting the light and adjusting the image. *White Balance* → **p. 96**

Different adjustments are possible depending on the scene mode and type of image. Refer to the following table for items that can be adjusted.

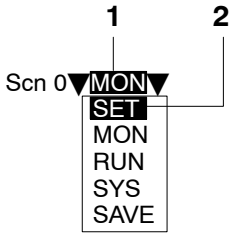
Color Filter Mode

Image		Color filter	Shutter speed	Calibration	Color selection	Background suppression	Filtering
Color		Yes	Yes	Yes	No	No	No
Color Filter Image	Colorgray	No	Yes	Yes	Yes	Yes	Yes
	Red	No	Yes	Yes	No	Yes	Yes
	Green	No	Yes	Yes	No	Yes	Yes
	Blue	No	Yes	Yes	No	Yes	Yes
	Gray	No	Yes	Yes	No	Yes	Yes

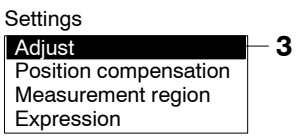
Color Pickup Mode

Image	Shutter speed	Color pickup	Calibration
Color	Yes	Yes	Yes
Pickup color	Yes	Yes	Yes

1. Move the cursor to the operation mode in the main screen (Monitor in this example) and press the **ENT** Key. A list of modes will be displayed.
2. Move the cursor to ***SET*** and press the **ENT** Key. A list of setting modes will be displayed.

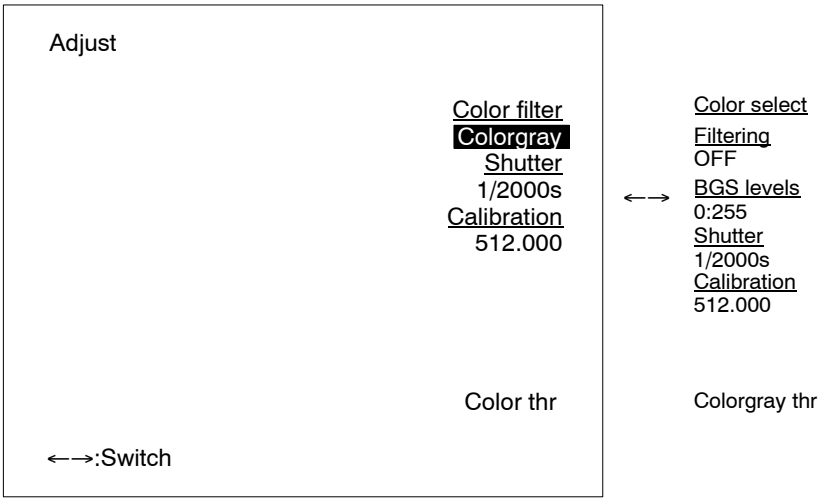


3. Move the cursor to ***Adjust*** and press the **ENT** Key. The Adjust (image adjustment) Window will be displayed.

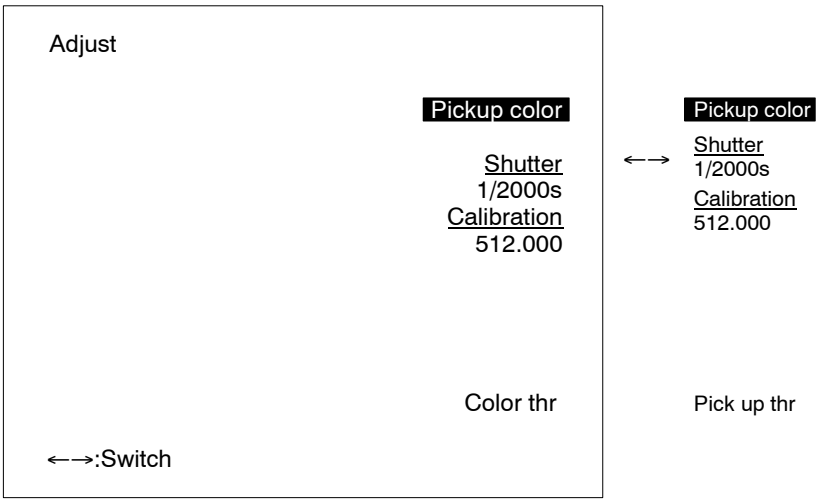


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Color Filter Mode



Color Pickup Mode



Adjustment items are underlined. Use **Left** or **Right** Key to change the displayed item.

Note

1. If adjustment items are hard to read, use the **SHIFT** + **ESC** Keys to switch between clear and filled backgrounds. Select the background that makes the screen most legible. Refer to *5-4 Display Settings.*
2. When temporarily switching between through or freeze images while performing image adjustment, use the **SHIFT** + **Up** Key or **SHIFT** + **Down** Key to select the appropriate type of display for the image.

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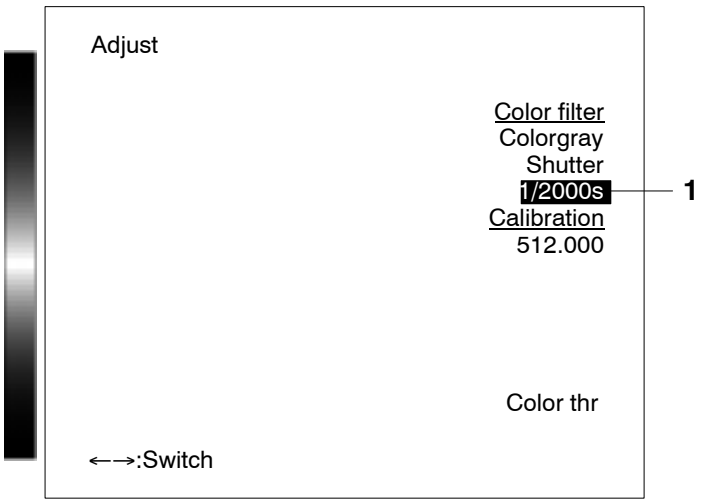
3-1-1 Shutter Speed *— Filter/Pickup —*

Change the shutter speed when the object is moving quickly, causing the image to be blurred. The shutter speed can be changed for any displayed image.

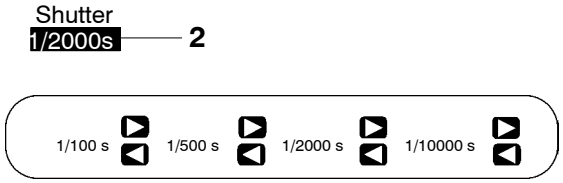
Movement speed	Shutter speed
Slow	1/100 s
	1/500 s
	1/2000 s*
Fast	1/10000 s

*Default value

1. Move the cursor to ***Shutter*** on the screen for the image to be adjusted and press the **ENT** Key. The Shutter Speed Window will be displayed. Use the **Left** and **Right** Keys to change the list of options if ***Shutter*** does not appear on the list.



2. Use the **Left** and **Right** Keys to change the shutter speed. Check the image while changing the shutter speed.



3. Press the **ENT** Key. The shutter speed setting will be saved and the display will return to the Adjust (image adjustment) Window.

3-1-2 Applying Color Filters *— Color Filter —*

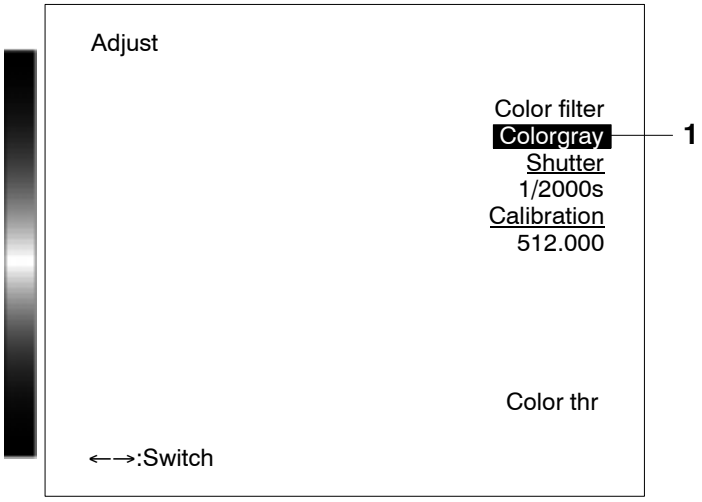
A color filter can be applied to the image read by the camera to emphasize particular colors and make a grayscale image for easier measurement. The F400 has five color filters. Select a filter color that will make the color to be detected lighter (e.g., surface defects or marks). This section explains how to select color filters.

Refer to the *Introduction Manual (Z131)* for information on colors. → **p. 39**

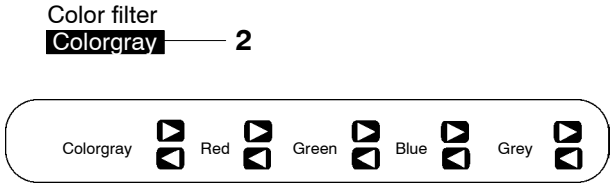
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Color	Function
Red	Emphasizes (lightens) red.
Green	Emphasizes (lightens) green
Blue	Emphasizes (lightens) blue.
Gray	Changes to a grayscale image (standard black and white image).
Colorgray	Creates a filter to suit the color to be detected.

1. Move the cursor to the color filter (Colorgray in this example) and press the **ENT** Key. The Color Filter Window will be displayed. Use the **Left** and **Right** Keys to change the list of options if ***Color Filter*** does not appear on the list.



2. Use the **Left** and **Right** Keys to change the color filter. Check image while changing the color filter.



3. Press the **ENT** Key. The color filter setting will be saved and the display will return to the Adjust (image adjustment) Window.

Note The selected color filter will be used for measurement. A different color filter can be set for position displacement compensation.

Refer to *3-2-1 Adjusting Images for Easier Position Compensation* → **p. 38**

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3-1-3 Creating a Color Filter *— Color Filter —*

When the F400 color filters cannot emphasize a particular color in an image, a new filter is created to suit the detection color. The color image is converted to a grayscale image based on the hue and saturation settings. Adjust the hue and saturation settings while referring to the displayed image and create a filter that best emphasizes the detection color. This section explains the procedure for creating color filters.

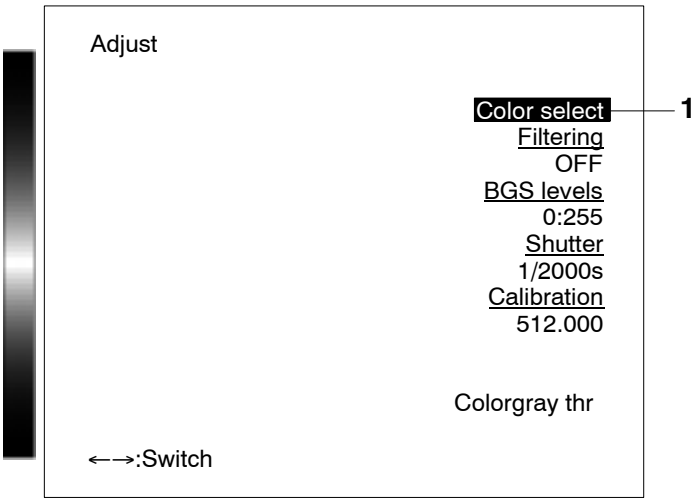
Refer to the *Introduction Manual (Z131)* for information on colors. → **p. 39**

Hue	The colors red, yellow, green, blue, and purple. Select the color that will highlight the section to be detected in the gray image.
Color band	The range of colors to be measured based on the set color.
Saturation	The vividness of the color. Areas outside the saturation range are changed to white or black and excluded from measurement. The saturation range is set using upper and lower limits.

Color filters are created by selecting the Colorgray filter function. Set a colorgray filter in advance using the **Color Filter** settings.

Refer to *3-1-2 Applying Color Filters* → **p. 24**

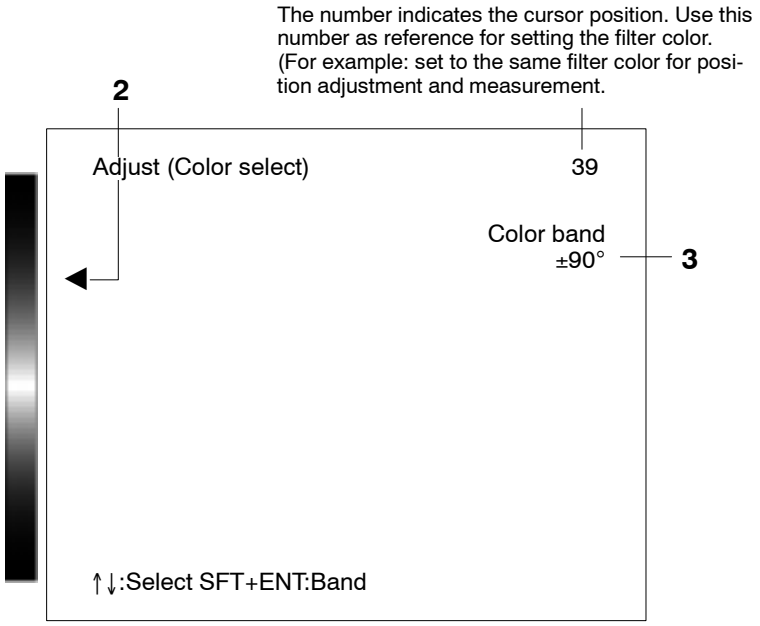
1. Move the cursor to ***Color select*** and press the **ENT** Key. The Color Selection Window will be displayed. The image will be converted to a color grayscale image and a ◀ mark will appear on the color bar. Use the **Left** and **Right** Keys to change the list of options if ***Color select*** does not appear on the list.



2. Use the **Up** and **Down** Keys to move the ◀ mark and select the color. The image displayed on the screen will change as the ◀ mark scrolls through the colors. Press **SHIFT** + **Up** and **Down** Keys to scroll through the colors quickly. Use the **Left** and **Right** Keys to switch to a color image and check the color.

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3. Press the **SHIFT + ENT** Keys to select the color band. Pressing the **SHIFT + ENT** Keys will alternately change between ±90° and ±180°.



4. Press the **ENT** Key. The set color and color band settings will be saved. Perform steps 5 to 9 to set the saturation range, otherwise go straight to step 10.

Note The selected color filter is used for measurement. A different color filter can be set for position displacement compensation.

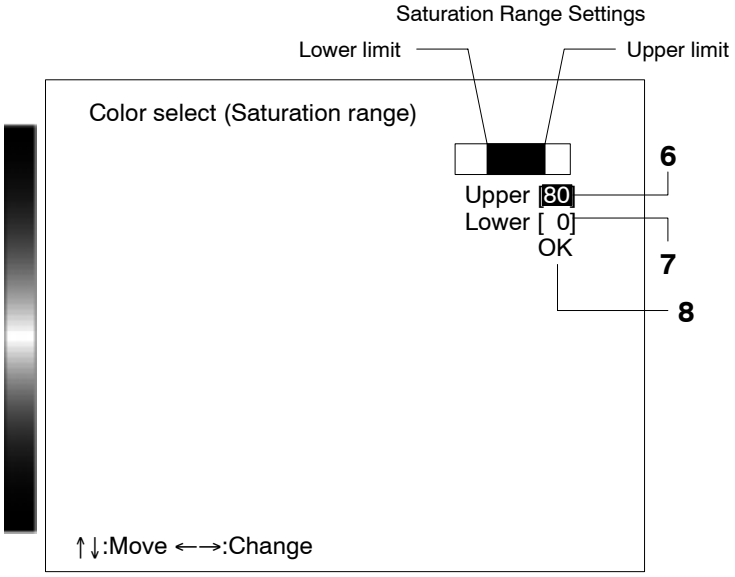
Refer to *3-2-1Adjusting Images for Easier Position Compensation* → **p. 38**

Setting the Chroma Range

5. Press the **SHIFT + ESC** Keys. The Saturation Range Settings Window will be displayed.

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6. User the **Left** and **Right** Keys to change the upper limit. The displayed image will change as the setting is changed. Use the **SHIFT** + **Left** and **Right** Keys to increase or decrease the value by 10.



7. Repeat the same operation to change the lower limit.
8. Move the cursor to ***OK*** and press the **ENT** Key. The display will return to the Color Selection Window.
9. Press the **ENT** Key again. The saturation range will be saved.
10. Press the **ESC** Key to close the Color Selection Window. The display will return to the Adjust (image adjustment) Window.

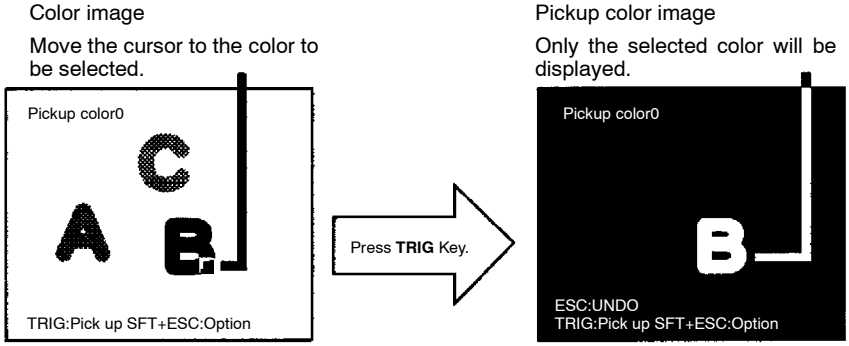
3-1-4 Picking Up Measurement Colors *— Color Pickup —*

Simply click the desired color to extract and measure it. All other colors will be treated as background. The extracted color is called the pickup color. Up to 8 pickup colors can be registered. Display the Adjust (image adjustment) Window for Color Pickup Mode before starting color pickup.

Refer to *2-2-2 Selecting Scene Modes.* → **p. 15**

Selecting a Color

First, select the color to be picked up in the color image. The F400 will extract the selected color and will automatically switch to a pickup color image. All other areas of the image will be changed to black in the display. Repeat the color selection process until all the desired colors have been extracted.



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Changing Cursor Size

If the cursor size does not match the size of section to be extracted, press the **SHIFT + ENT** Keys to change the cursor size. (Max. 64 x 64 pix.)

Changing Background Color of Pickup Color

If the image is hard to see because the pickup color is similar to the background color, press the **SHIFT + TRIG** Keys to change the background color that is available in five different gradations.

Display Image and Margin

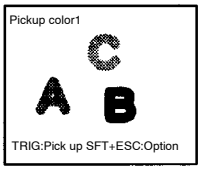
Press the **SHIFT + ESC** Keys on the color pickup display to display a dialog. Using this dialog, change the display image or set the color parameter range for extracting colors considering noise.



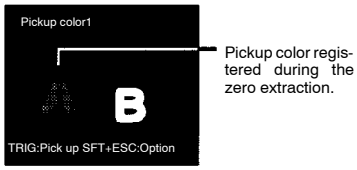
Display Image

Colors can be extracted though monitoring image colors while switching the display image between color image and two types of pickup color images.

Color image	Pickup image	Pickup image for all pickup colors
The color image is displayed.	The pickup color currently being extracted will be displayed.	All of the registered pickup colors will be displayed.



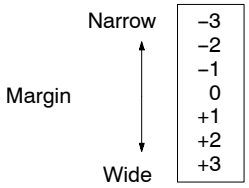




Margin

When the margin is positive (+): Color parameter range will be widened by the set margin for color pickup.

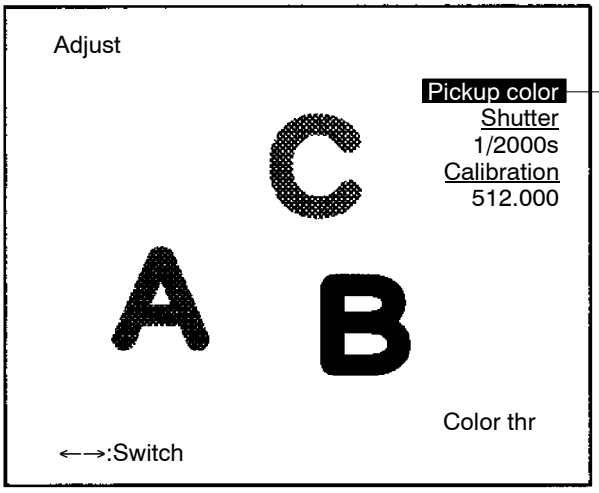
When the margin is negative (–): Color parameter range will be narrowed by the set margin for color pickup and the colors outside the range will be treated as noise.



- If all the colors subject to measurement cannot be picked up, set the margin to a positive value.
- If colors not subject to measurement are also picked up with much noise, set the margin to a negative value.

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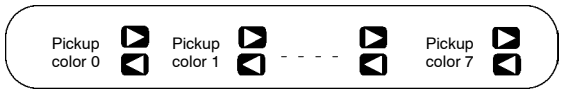
1. Move the cursor to ***Pickup color*** and press the **ENT** Key. The Pickup Color Number Selection Window will be displayed.



2. Use the **Left** and **Right** Keys to select the pickup color number to be registered. The image read by the camera will not be displayed if no pickup colors have been registered for the selected number. The pickup image will be displayed for registered pickup color numbers.



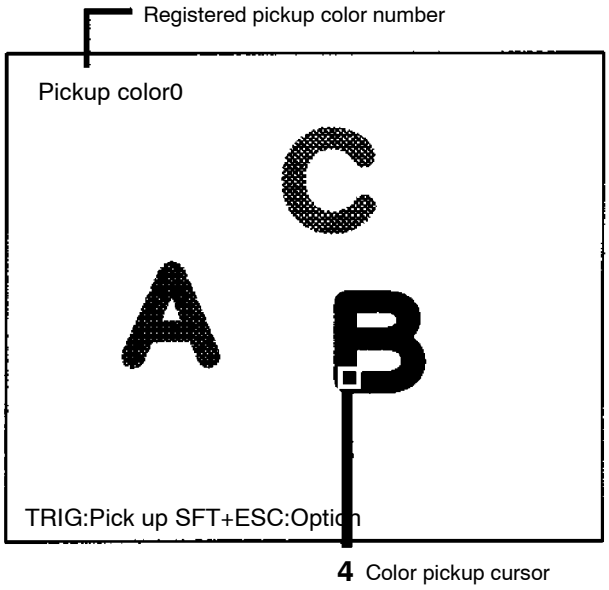
Use the **Left** and **Right** Keys to scroll through the pickup color numbers 0 to 7 in order.



3. Press the **ENT** Key. The Color Pickup Window will be displayed and the color pickup cursor will appear.
4. Move the cursor to the section for which the color is to be extracted and press the **TRIG** Key. Color pickup will be performed for the specified section of the image. The image will then change to a pickup color image and the selected color will be displayed.
   If the picked up color is hard to see, press the **SHIFT** + **TRIG** Keys to select one of

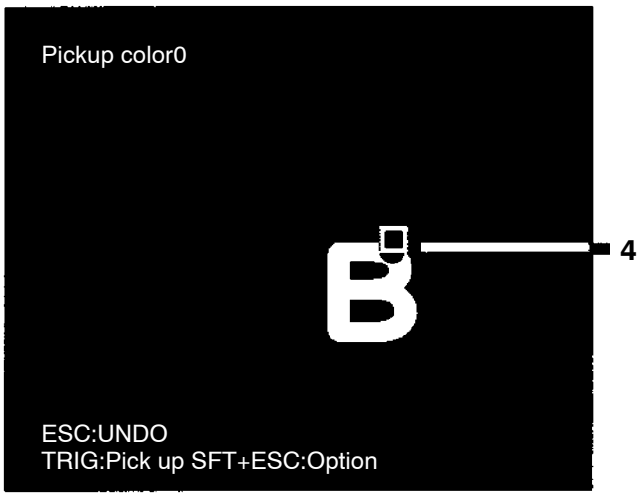
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five background gradations. Select the background gradation that will show the pickup color in greatest contrast.
To change the display image or pickup color margin, press the **SHIFT + ESC** Keys.



5. Move the cursor to the next section to be extracted and press the **TRIG** Key. Repeat this procedure to pick up all the colors for measurement.

   Press the **ESC** Key to cancel colors selected using the **TRIG** Key. The last pickup color selection will be canceled.

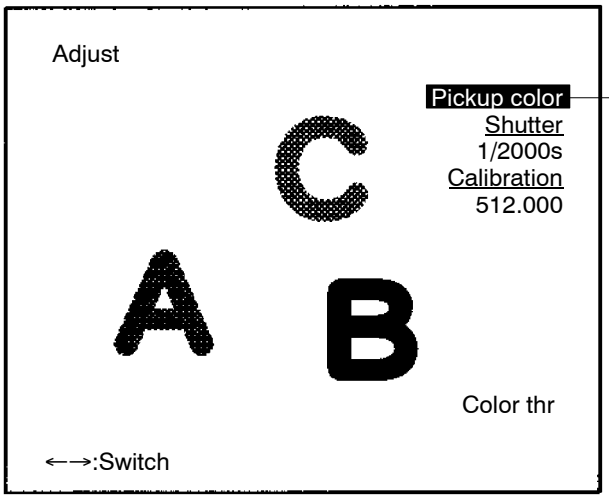


6. Press the **ENT** Key when all the desired colors have been extracted. The pickup colors will be registered and the display will return to the Pickup Color Number Selection Window. Repeat steps 2 to 5 to register more pickup colors.

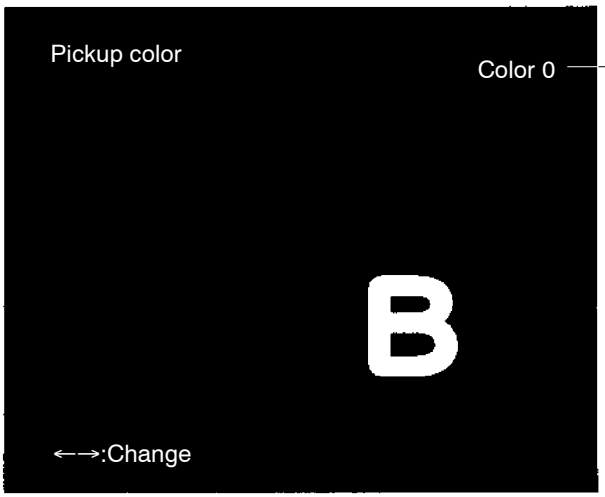
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Changing and Clearing Pickup Colors

1. Move the cursor to ***Pickup color*** and press the **ENT** Key. The Pickup Color Number Selection Window will be displayed.

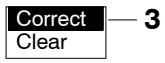


2. Use the **Left** and **Right** Keys to display the pickup color number to be changed or cleared and press the **ENT** Key. The processing options will be displayed.



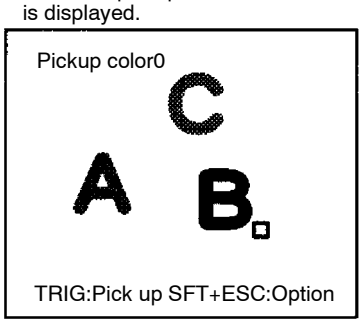
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3. Select either ***Correct*** or ***Clear*** and press the **ENT** Key.



When ***Correct*** is selected

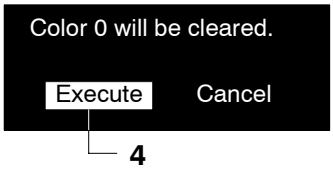
The color pickup cursor is displayed.



Next, perform the same steps as for color pickup.

When ***Clear*** is selected

A confirmation message is displayed.



4. When **Clear** has been selected, move the cursor to ***Execute*** and press the **ENT** Key. The selected pickup color settings will be cleared and the display will return to the Adjust (image adjustment) Window.

3-1-5 Filtering — *Color Filter* —

The image read by the Camera can be manipulated to create an image that is easier to measure, by using smoothing or edge enhancement.

Smoothing displays a smoothed image with reduced noise. Smoothing allows suppression of the effects of uneven lighting due to an uneven or damaged surface.

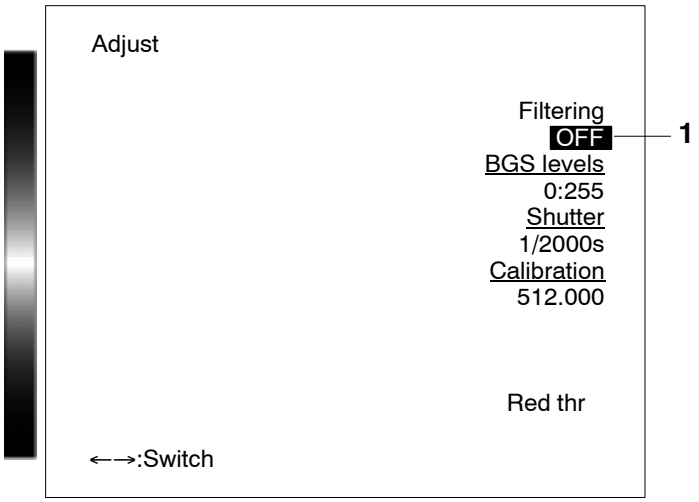
Edge enhancement displays an image with enhanced edges between bright and dark regions to compensate for blurred images.

Filtering can be performed only on images to which a color filter has been applied.

Filtering method	Function
OFF	No filtering.
Smoothing	Displays a smooth image with reduced noise. Select either weak or strong smoothing.
Enhance edges	Displays an image with enhanced edges between bright and dark regions.
Extract edges	Displays an image with the edges between the bright and dark regions extracted.

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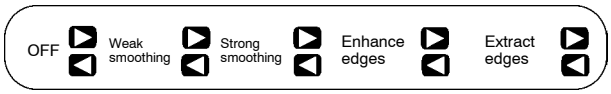
1. Move the cursor to the ***Filtering*** method (OFF in this example) and press the **ENT** Key. The Filtering Window will be displayed. Use the **Left** and **Right** Keys to change the list of options if ***Filtering*** does not appear on the list.



2. Use the **Left** and **Right** Keys to select the filtering method. Check the image while selecting the appropriate filtering method.



Use the **Left** and **Right** Keys to switch between weak smoothing, strong smoothing, edge enhancement, and edge extraction.



3. Press the **ENT** Key. The filtering settings will be saved and the display will return to the Adjust (image adjustment) Window.

Note The selected filtering method is used for measurement. Different filtering can be set for position displacement compensation.

Refer to *3-2-1 Adjusting Images for Easier Position Compensation* → **p. 38**

3-1-6 Background Suppression *— Color Filter —*

Background suppression (BGS) changes image areas with densities below the lower limit to 0, and image areas with densities above the upper limit to 255. Image areas with densities between the lower and upper limits are graded from 0 to 255 so that only images with densities between the lower and upper limits are measured.

Monitor the image and set the upper and lower limits of the density to eliminate the background.

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Example

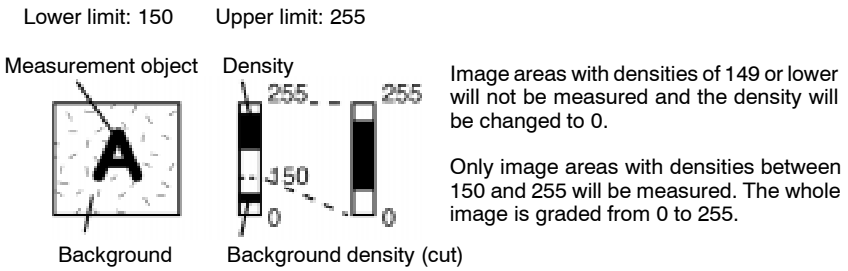
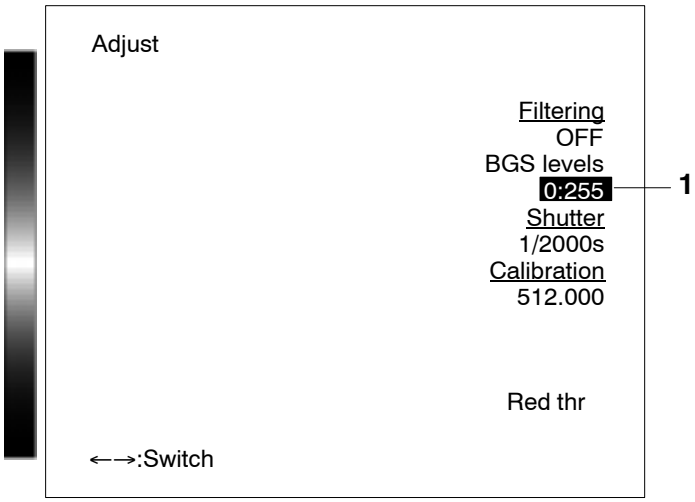


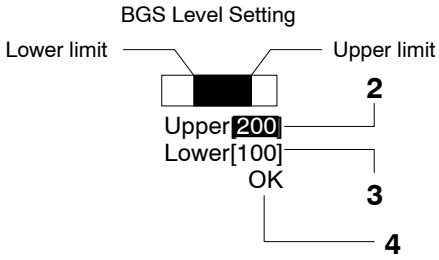
Image areas with densities of 149 or lower will not be measured and the density will be changed to 0.

Only image areas with densities between 150 and 255 will be measured. The whole image is graded from 0 to 255.

1. Move the cursor to ***BGS levels*** (0:255 in this example) and press the **ENT** Key. The BGS Levels Setting Window will be displayed. Use the **Left** and **Right** Keys to change the list of options if ***BGS levels*** does not appear on the list.



2. Use the **Left** and **Right** Keys to alter the upper limit. The displayed image will change when the numeric values are changed. Use the **SHIFT** + **Left** and **Right** Keys to increase or decrease the numeric value by 10.
3. Change the lower limit the same way.



4. Move the cursor to ***OK*** and press the **ENT** Key.

Note The selected BGS level is used for measurement. Different BGS levels can be set for position displacement compensation.

Refer to *3-2-1 Adjusting Images for Easier Position Compensation* → **p. 38**

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3-1-7 Output Calibration *— Filter/Pickup —*

Calibration can be set to output the measurement results in physical units, such as mm.

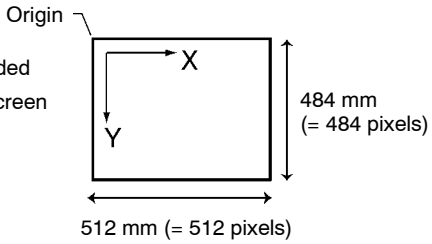
Set the relationship between the physical coordinates and the camera coordinates to convert the measurement results from pixels to physical units, such as μm, mm, or cm.

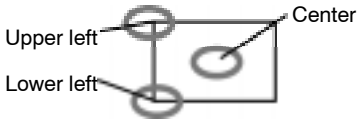
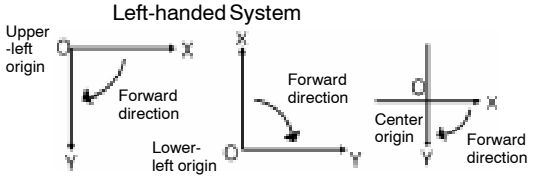
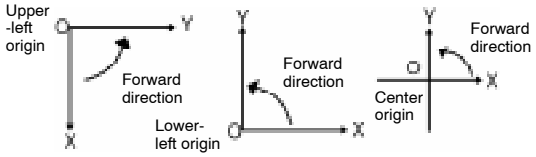
If calibration data is not set, the default settings will remain, and measurements using the camera coordinates will be output.

For details, refer to *Glossary*. → **p. 142**

Default Settings

Coordinate system: Left-handed
Origin: Upper left corner of screen
Magnification: 1.000
Units: mm/pix

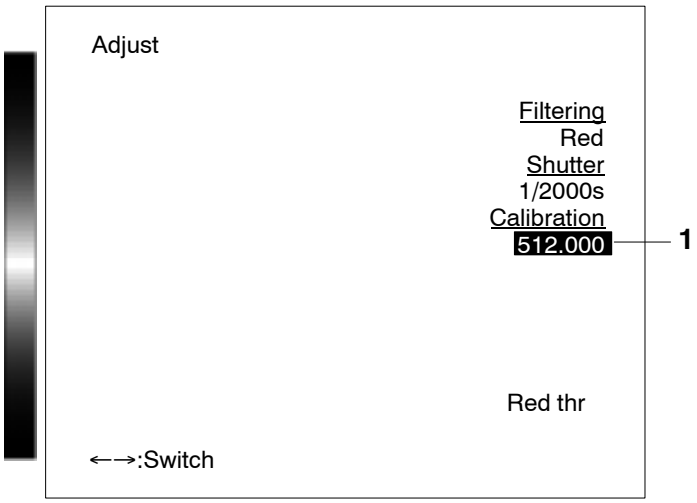


Setting	Options	Meaning
Origin	Upper left* Lower left Center	Select the position of the origin (0,0) of the coordinate system on the screen. 
Coordinate system	Right-handed Left-handed*	Select the coordinate system. The positive direction for angles will depend on the coordinate system. Left-handed System  Right-handed System 
Magnification	0.001 to 9.999 (1.000*)	Set the actual measurement to which 1 pixel will correspond. For example, an actual length of 10 mm could correspond to 100 pixels on the screen. 10 (mm)/100 (pix) = 0.1 (mm/pix). The magnification, therefore, would be 0.1.
Units	μm/pix, mm/pix*, or cm/pix	Set the units for conversion.

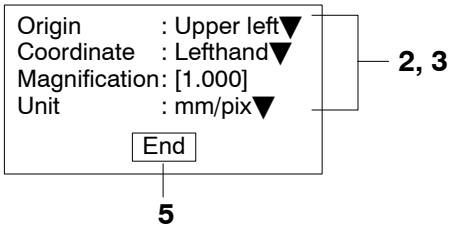
Note The default settings are indicated by an asterisk (*).

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1. Move the cursor to ***Calibration*** and press the **ENT** Key. The Calibration Setting Window will be displayed. Use the **Left** and **Right** Keys to change the list of options if ***Calibration*** does not appear on the list.



2. Move the cursor to the item to be changed and press the **ENT** Key. Options are available for items indicated by a ▼mark. The magnification is changed by changing the numeric value.
3. Press the **ENT** Key. The settings will be saved.



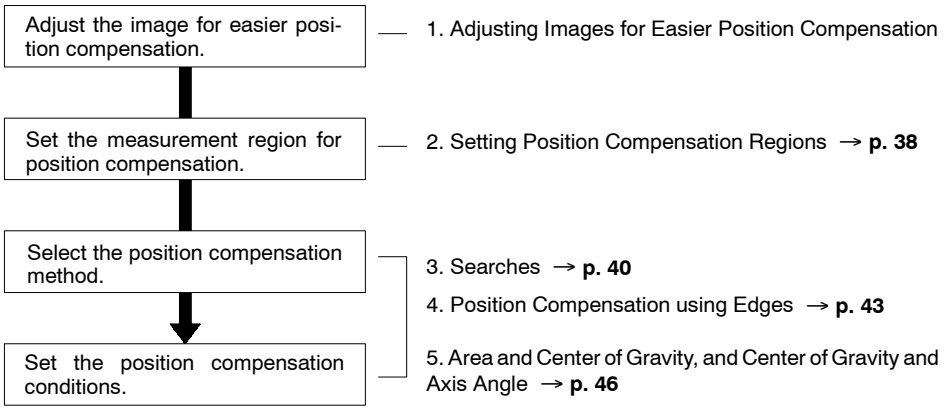
4. Repeat steps 2 and 3 to change other settings.
5. When all settings have been made, move the cursor to ***End*** and press the **ENT** Key. The calibration settings will be saved and the display will return to the Adjust (image adjustment) Window.

3-2 Position Compensation

Use position displacement compensation when the position and orientation of the measurement objects are not consistent. The position of the measurement object is compared to a reference position, the amount of displacement is calculated, and the image is scrolled by that amount before a measurement is performed.

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Flow of Operation



3-2-1 Adjusting Images for Easier Position Compensation

— Color Filter —

Different image conditions can be set for measurement and position compensation. Refer to the procedures for setting measurement image conditions; the setting methods are the same.

Applying Color Filters to Images

Different color filters can be applied for measurement and for position compensation.

Refer to *3-1-2 Applying Color Filters* → **p. 24**

Creating a Color Filter

Different color filters can be created for measurement and for position compensation.

Refer to *3-1-3 Creating a Color Filter* → **p. 26**

Filtering

Different filtering can be performed for measurement and for position compensation. For example, smoothing may be selected to reduce noise for measurement and edge enhancement may be selected for position compensation to highlight the edges of the measurement object.

Refer to *3-1-5 Filtering* → **p. 33**

Background Suppression

Different background suppression can be performed for measurement and for position compensation.

Refer to *3-1-6 Background Suppression* → **p. 34**

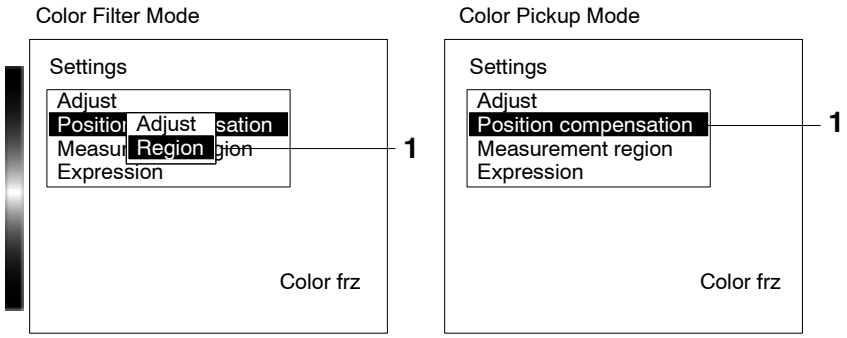
3-2-2 Setting Position Compensation Regions

— Filter/Pickup —

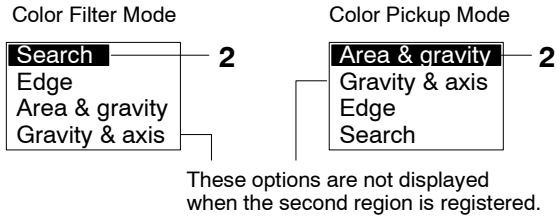
The F400 has four methods of position compensation: Search, edge enhancement and extraction (edge), area and center of gravity, and center of gravity and axis angle. A measurement region must be set before position compensation can be performed. Up to two regions can be set for each scene.

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1. Move the cursor to ***SET/Position compensation/Region*** and press the **ENT** Key. The Position Compensation Selection Window will be displayed. The window shown in step 2 will be displayed if ***Position compensation*** is selected in Color Pickup Mode.



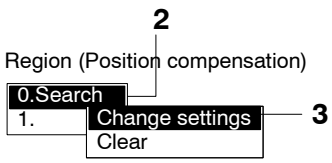
2. Select the position compensation method and press the **ENT** Key. The setting options for the selected method of position compensation will be displayed. The method selected here will be registered for region 0. Refer to the procedures for each position compensation method for subsequent steps.



Changing and Clearing Measurement Regions

Settings for registered position compensation methods are changed and cleared on the Settings Window for the measurement region number. To change the position compensation method, clear the selected method and then register another method.

1. Move the cursor to ***Set/Position compensation/Region*** and press the **ENT** Key. If region 0 has been registered, the window for selecting measurement region numbers will be displayed.
2. Select either ***Change settings*** or ***Clear*** as desired and press the **ENT** Key.



Changing Settings

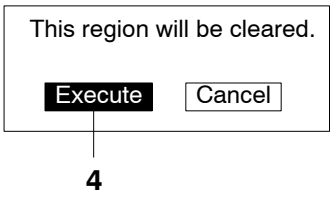
The settings window for the selected position compensation method will be displayed. Refer to the procedures for each position compensation method for subsequent steps.

Clearing Settings

A confirmation message will be displayed.

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3. If ***Clear*** has been selected, move the cursor to ***Execute*** and press the **ENT** Key.



Note The measurement regions selected here are for position compensation. Separate measurement regions can be set for measurement.

Refer to *3-3-1 Measurement Regions* → **p. 50**

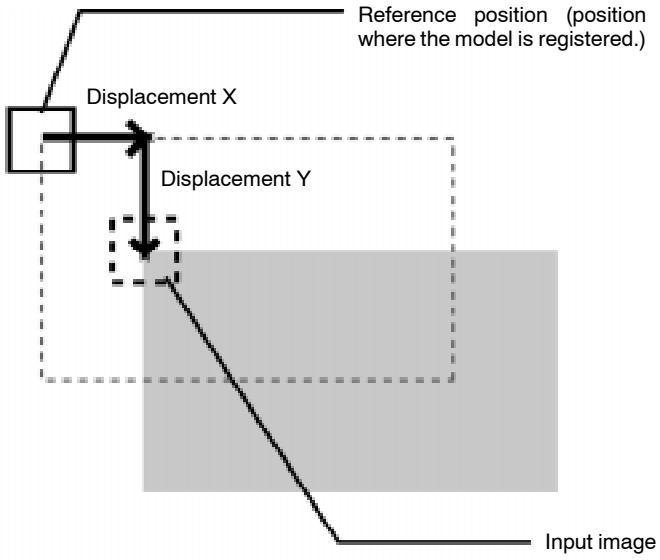
3-2-3 Searches — *Filter/Pickup* —

This section explains position displacement compensation using searches. The search method must be selected for the position compensation region in advance.

Refer to *3-2-2 Setting Position Compensation Regions* → **p. 38**

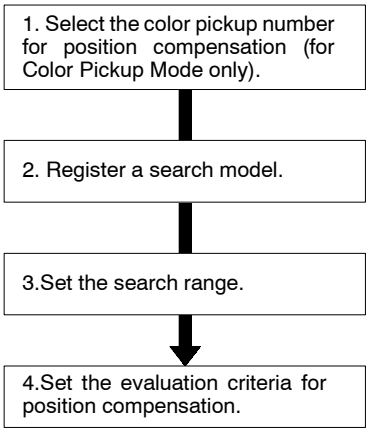
Searches

Position compensation is performed using a registered measurement pattern called a model. The area of the image that most highly correlates with the model is found, the amount of displacement is calculated, and the image is scrolled by the detected amount of displacement before measurements are performed.



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Procedure



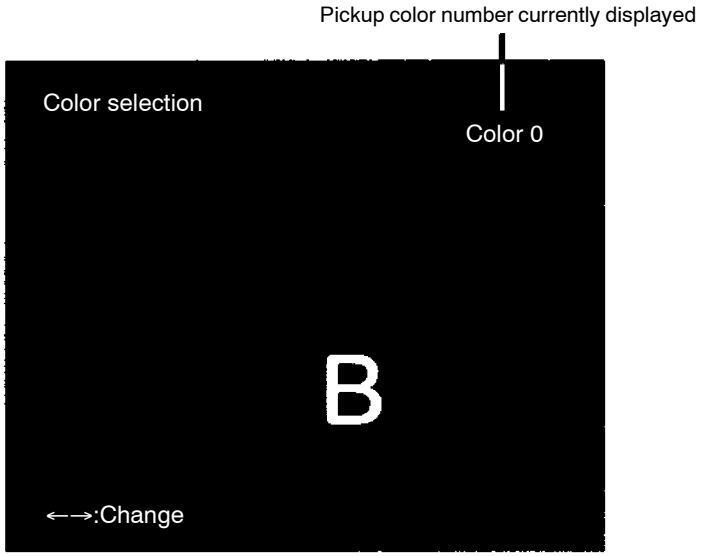
Note

1. Searches selected here are for position compensation.
   Refer to *3-3-3 Searches* for measurement applications. → **p. 55**
2. Position compensation methods are changed or cleared in the Region Settings Window.
   Refer to *3-2-2 Setting Position Compensation Regions*. → **p. 38**

Selecting Color Pickup Numbers for Position Compensation (Color Pickup Mode Only)

Select a color for position compensation from the registered pickup colors. The procedure is the same as for measurement.

Refer to *Selecting Color Pickup Numbers for Measurement* under *3-3-3 Searches* → **p. 56**



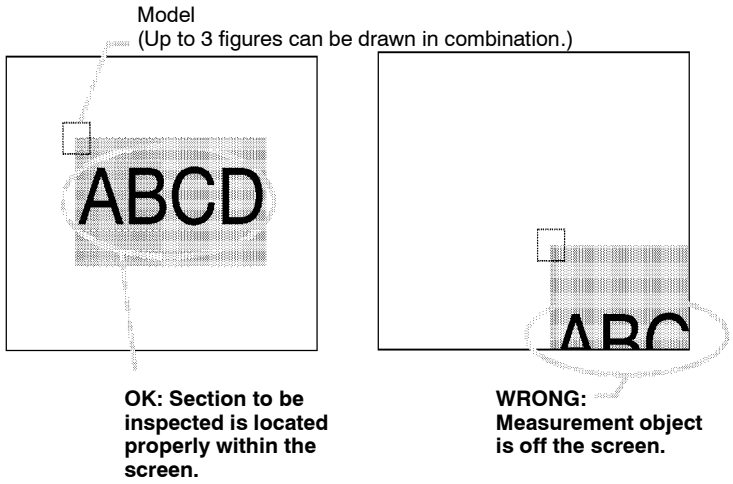
Registering a Model

A characteristic part of the measurement image, such as a mark or corner, is registered as a model. The model can be of any size.

Since the position in which the model is registered serves as a reference position for position compensation, place the object so that it is properly located within the screen before registering it as a model. The procedure is the same as for measurement.

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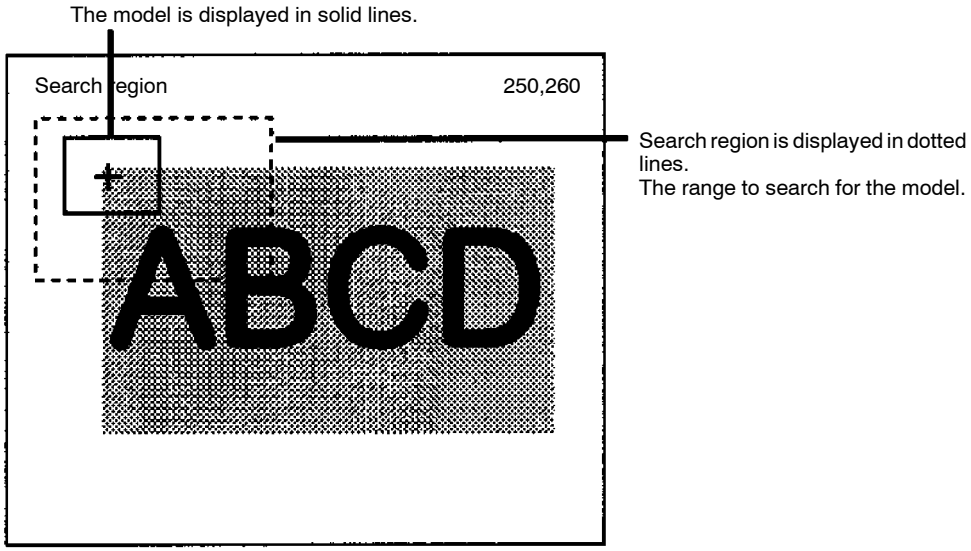
Refer to *Registering a Model* under *3-3-3 Searches* → **p. 58**



Setting the Search Region

Set a range in which to search for the model. The search can be made on the whole input screen. However, the search range can be limited to reduce the processing time and increase the accuracy. The procedure is the same as for measurement.

Refer to *Setting the Search Region* under *3-3-3 Searches* → **p. 61**



Setting Evaluation Criteria

Criteria are set for the correlation with the model to enable checking whether or not the correct position compensation model has been found. If the correlation with the model is too low, the wrong position may be found. Set the upper and lower limits for the correlation.

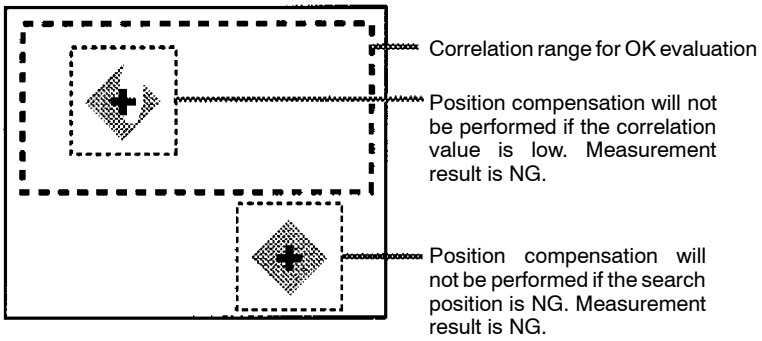
The procedure is the same as for measurement.

Refer to *Setting Evaluation Criteria* under *3-3-3 Searches* → **p. 62**

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Evaluation and Processing

Evaluation	Processing
OK	Position compensation is performed before measurement.
NG	The object is measured without position compensation. Regardless of the measurement result, however, an overall evaluation of NG will be output to the OR terminal.



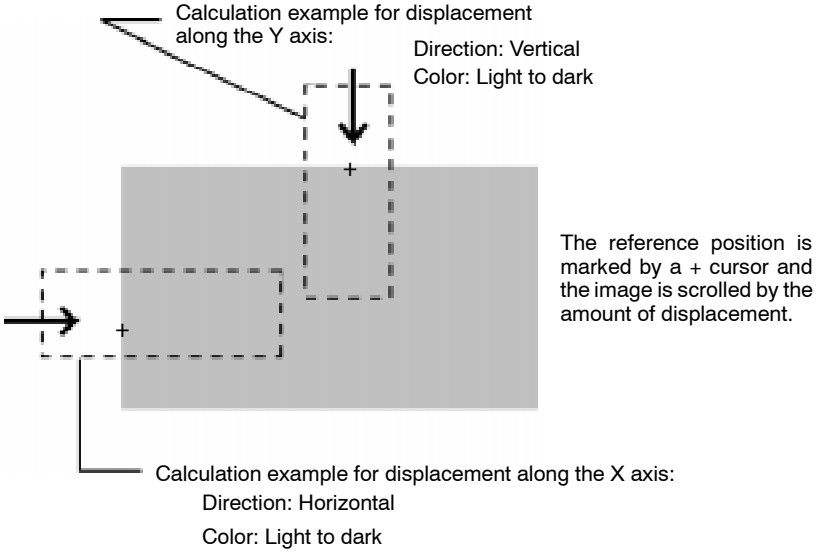
3-2-4 Position Compensation using Edges *— Filter/Pickup —*

This section explains position compensation using edge processing. Select ***Edge*** in the position compensation region in advance.

Refer to *3-2-2 Setting Position Compensation Regions* → **p. 38**

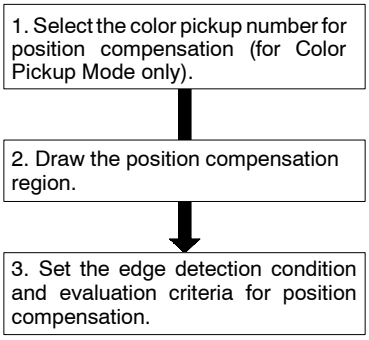
Edge Processing

The light and dark regions between measurement object colors are found. The position of the measurement object is compared to a reference position, the amount of displacement is calculated, and the image is scrolled by that amount before a measurement is performed.



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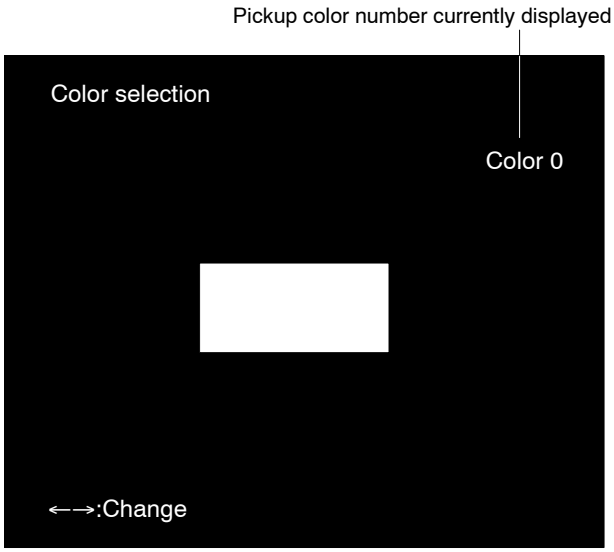
Procedure



Selecting Color Pickup Numbers for Position Compensation (Color Pickup Mode Only)

Select a color for position compensation from the registered pickup colors. The procedure is the same as for measurement.

Refer to *3-3-4 Edge Processing* → **p. 63**



Note

1. Edge processing selected here is for position compensation.

   Refer to *3-3-4 Edge Processing* for measurement applications. → **p. 63**

2. Position compensation methods are changed or cleared in the Region Settings Window.

   Refer to *3-2-2 Setting Position Compensation Regions*. → **p. 38**

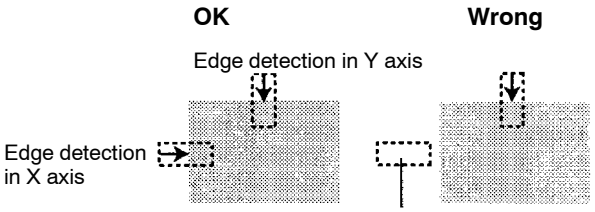
Drawing Position Compensation Regions

Draw a position compensation region. Draw one box for one region to include the edges. When a region has been drawn, edge positions are measured. Since these positions become reference positions, draw the region after placing a measurement object so that sections to be inspected do not exceed beyond the screen area.

The procedure is the same as for object measurement.

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Refer to *3-3-4 Edge Processing* for measurement applications. → **p. 63**



Detection is not possible unless the edges are within the position compensation region. Determine the size and position of the region considering the movement range of a measurement object.

Scroll Method

Scroll method: Select a method that is appropriate for the amount of displacement.

Simultaneous mode:

Performs position compensation in X and Y directions simultaneously. This mode is normally selected.

Priority mode:

Scrolls in one direction and then the other direction. The region 0 is processed first. Select this mode when there is a large displacement.

For more information, refer to the *Glossary*. → **p. 140**

Edge Detection Condition and Setting Evaluation Criteria for Position Compensation

The method of edge detection and evaluation criteria for the position coordinates (X and Y) are set to determine whether or not the edges for position compensation has been found correctly.

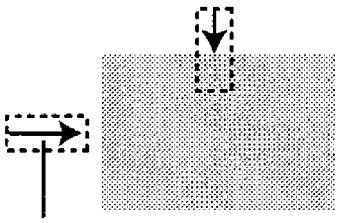
The procedure is the same as for object measurement.

Refer to *3-3-4 Edge Processing* for measurement applications. → **p. 63**

Evaluation and Processing

Evaluation	Processing
OK	Position compensation is performed before measurement.
NG	The object is measured without position compensation. Regardless of the measurement result, however, an overall evaluation of NG will be output to the OR terminal.

Example



Position compensation will not be performed if density changes beyond the specified level are not found. Measurement result is NG.

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3-2-5 Area and Center of Gravity, and Center of Gravity and Axis Angle

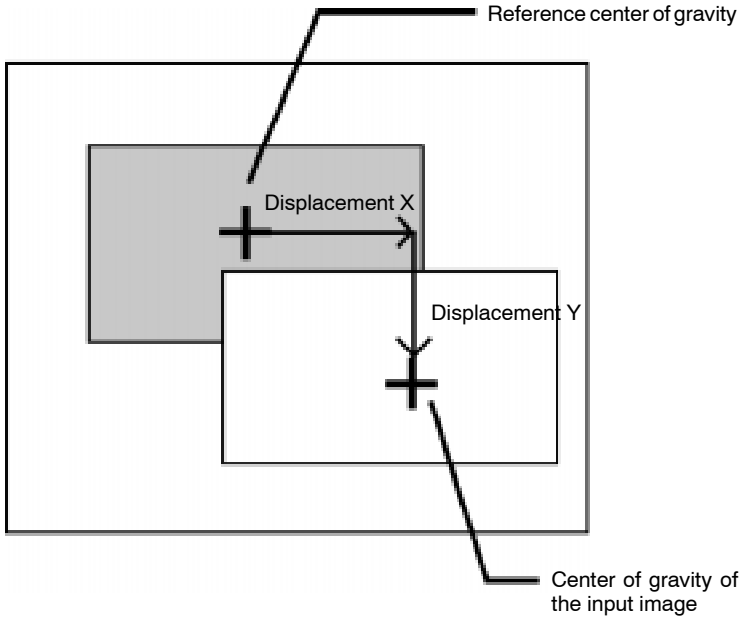
— Filter/Pickup —

Gray images with 256 gradations are processed into binary data; black pixels (0) and white pixels (1). The F400 uses the white pixels to measure the object. Select area and center of gravity, or center of gravity and axis angle in the position compensation region in advance.

Refer to *3-2-2 Setting Position Compensation Regions*. → **p. 38**

Area and Center of Gravity

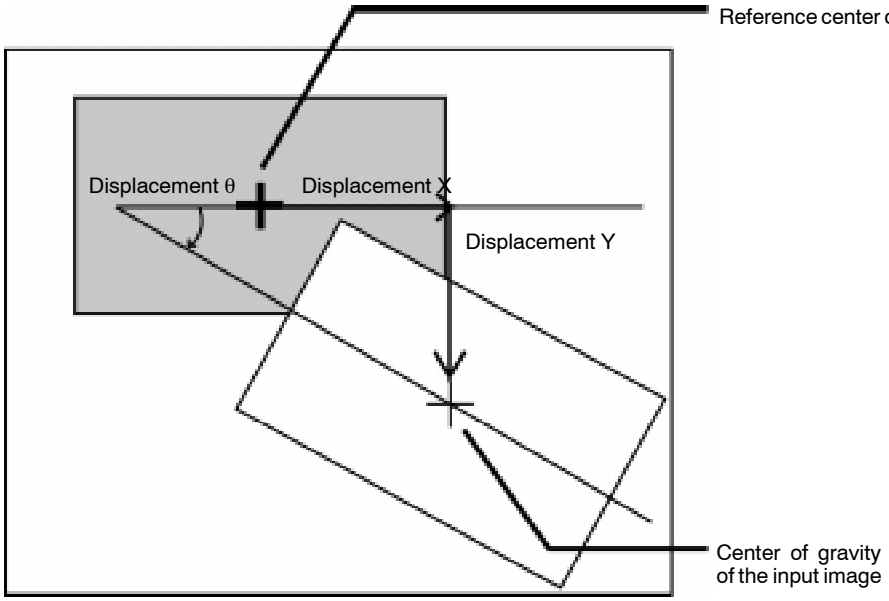
The center of gravity is calculated for the white pixels, and the displacement from the reference position is calculated.



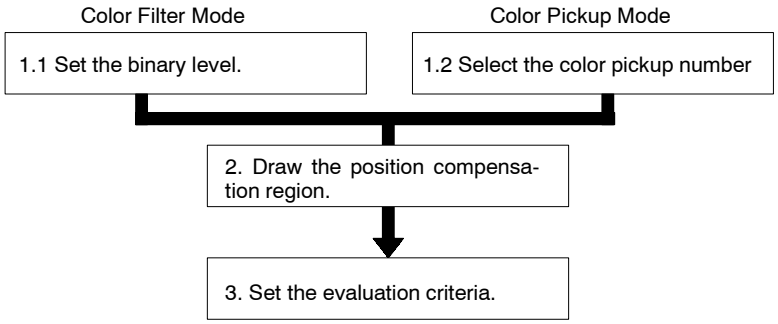
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Center of Gravity and Axis Angle

The center of gravity and the axis angle are calculated, and the displacement from the reference position is calculated.



Procedure



Note

1. The center of gravity and axis angle selected here are for position compensation.

   Refer to *3-3-5 Area and Center of Gravity, or Center of Gravity and Axis Angle* for information on settings for measurement → **p. 67**

2. Position compensation methods are changed or cleared in the Region Settings Window.

   Refer to *3-2-2 Setting Position Compensation Regions*. → **p. 38**

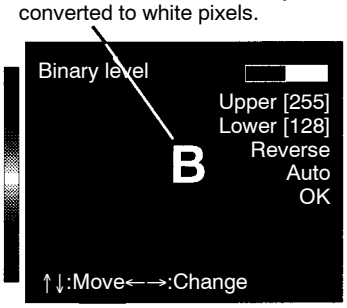
Setting Binary Levels for Position Compensation (Color Filter Mode Only)

Set the level for processing gray images with 256 gradations into binary images. Since the F400 uses the white pixels to measure the object, adjust the binary level so that the area for which the center of gravity and axis angle are to be calculated is white.

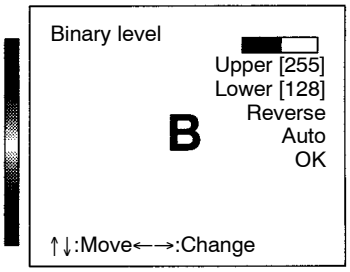
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The procedure is the same as for object measurement. Refer to *Setting Binary Levels* under *3-3-5 Area and Center of Gravity, or Center of Gravity and Axis Angle*. → **p. 69**

OK: The measurement object is converted to white pixels.



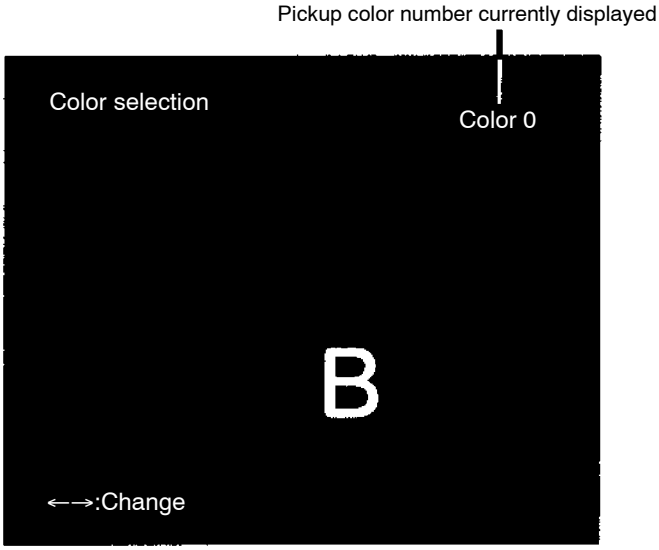
Wrong



Selecting Color Pickup Numbers for Position Compensation (Color Pickup Mode Only)

Select a color for position compensation from the registered pickup colors. The procedure is the same as for measurement.

Refer to *Selecting Color Pickup Numbers* under *3-3-5 Area and Center of Gravity, or Center of Gravity and Axis Angle*. → **p. 70**



Drawing the Position Compensation Region

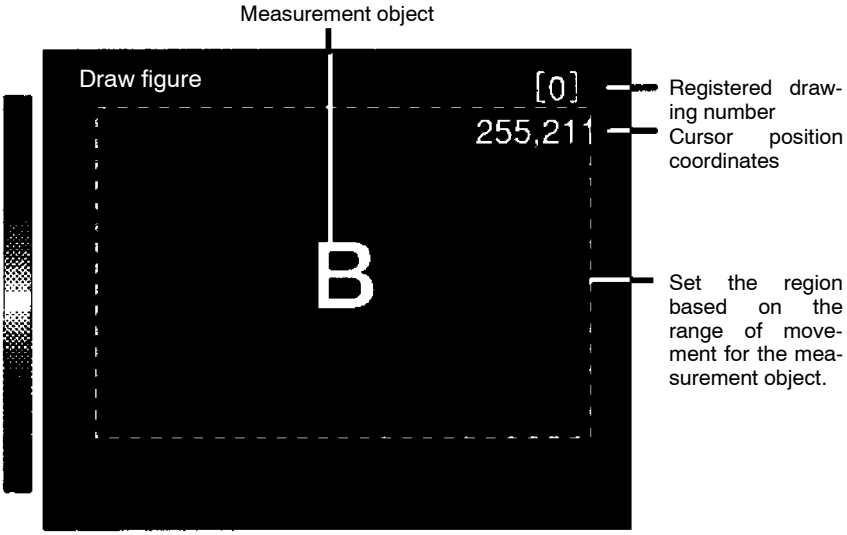
Set the position and size of the region, taking into consideration the range of movement of the measurement object. The center of gravity and axis angle of the white pixels in the region will be found. Regions can be drawn by combining up to 3 figures.

Once the region is drawn, the center of gravity will be calculated. This center of gravity will become the reference position. Position the measurement object so that the measurement region is completely within the screen and then draw the region.

The procedure is the same as for object measurement.

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Refer to *Drawing Measurement Regions* under *3-3-5 Area and Center of Gravity, or Center of Gravity and Axis Angle*. → **p. 71**



Setting Evaluation Criteria for Position Compensation

Criteria for area is set to determine whether or not the measurement object is properly within the measurement region.

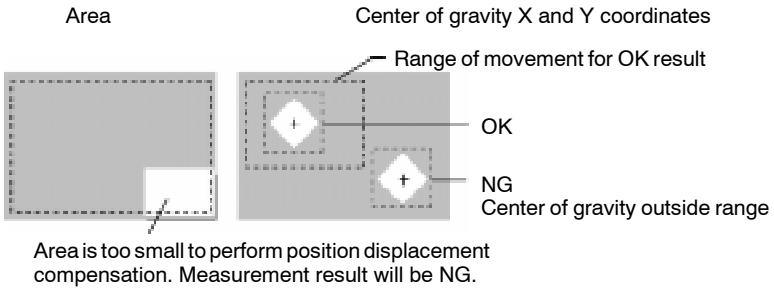
The procedure is the same as for object measurement.

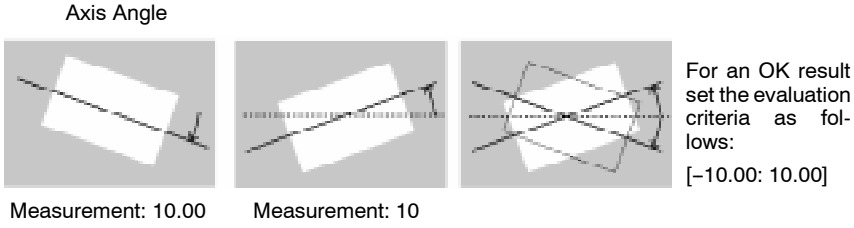
Refer to *Setting Evaluation Criteria* under *3-3-5 Area and Center of Gravity, or Center of Gravity and Axis Angle*. → **p. 73**

Position Compensation Evaluation and Processing

Evaluation	Processing
OK	Position compensation is performed before measurement.
NG	The object is measured without position compensation. Regardless of the measurement result, however, an overall evaluation of NG will be output to the OR terminal.

Example





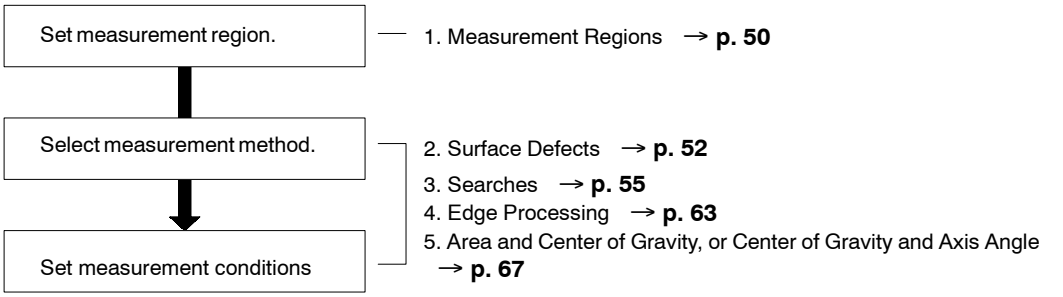
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3-3 Measurement Methods

The measurement methods for the F400 are outlined in the following table. The available methods differ between scene modes.

Mode	Surface defect	Search	Edge	Area and center of gravity	Center of gravity and axis angle
Color filter	Yes	Yes	Yes	Yes	Yes
Color pickup	No	Yes	Yes	Yes	Yes

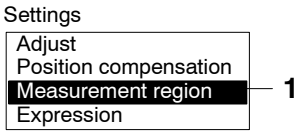
Procedure



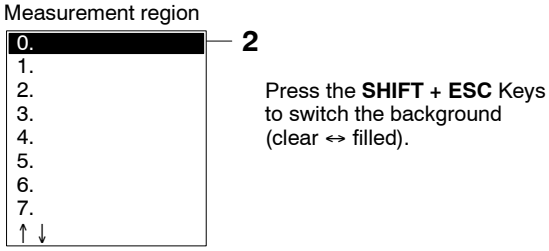
3-3-1 Measurement Regions *— Filter/Pickup —*

The F400 has 16 measurement regions for each scene and different measurement methods and evaluation criteria can be set for each region.

1. Move the cursor to ***SET/Measurement region*** and press the **ENT** Key. The window for selecting the region number will be displayed.



2. Select the measurement region number. Using the **Down** Key, move the cursor to display measurement region numbers 8 to 15.



3. Press the **ENT** Key. The number will be set and a list of measurement methods will be displayed. The list of options will differ depending on the scene mode.



Refer to the procedures for each measurement method for subsequent steps.

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Note The measurement region selected here is for measurement. Different measurement regions can be set for position compensation.

Refer to *3-2-2 Setting Position Compensation Regions* → **p. 38**

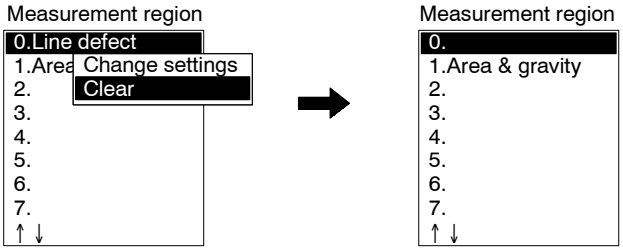
Changing and Clearing Measurement Regions

Settings for registered measurement methods are changed and cleared on the Settings Window for the measurement region number. To change the measurement method, clear the selected method and then register another method.

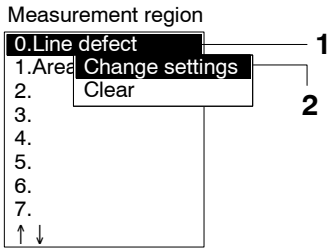
Example

The following example shows how to change the measurement method registered for region 0 from line defect to circle defect detection.

1. Clear the ***Line defect*** setting from the measurement region.
2. Register ***Circle defect*** as the measurement method.



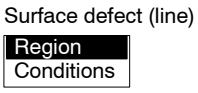
1. In the selection window for measurement region numbers, select the number of the region to be changed or cleared and press the **ENT** Key. A list of options will be displayed.



2. Select either ***Change settings*** or ***Clear*** as desired and press the **ENT** Key.

Changing Settings

The settings window for the selected position compensation method will be displayed. Refer to the procedures for each measurement method for subsequent steps.

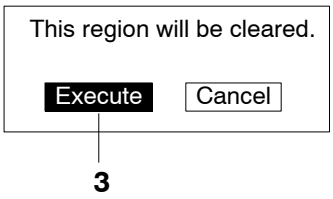


Clearing Settings

A confirmation message will be displayed.

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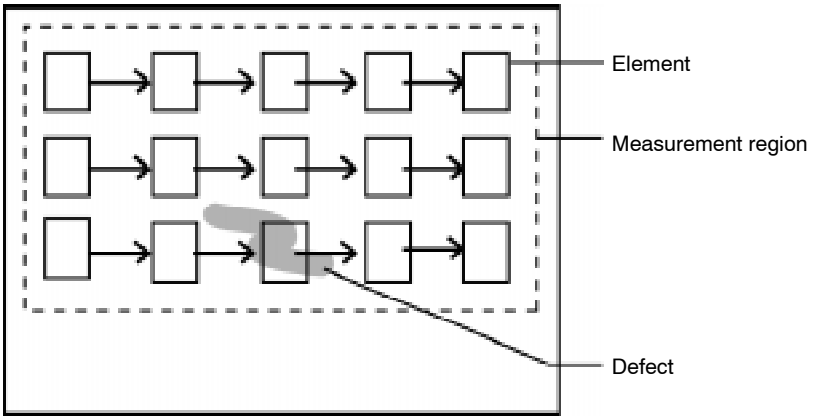
3. If ***Clear*** has been selected, move the cursor to ***Execute*** and press the **ENT** Key. The setting will be cleared and the display will return to the window shown in step 1.



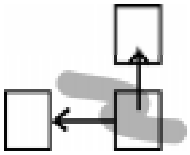
3-3-2 Surface Defects *— Color Filter —*

Inspections can be made for surface defects by searching for areas with large differences in density. The density of each element in the measurement region is calculated, the differences in densities are compared, and the position with the most defects is detected.

1. The element is moved a little at a time within the measurement region and the density of the element is calculated at each position.



2. The density of the element is compared with the densities of the elements above and to the left, and the difference is the defect. The larger density difference will be the defect for that element.

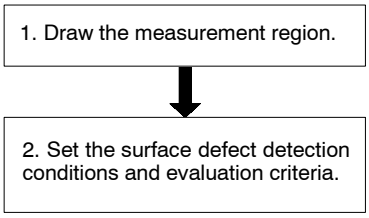


3. Defects are compared with the evaluation criteria and an OK/NG judgement given.

Note Measurement is performed using differences in density. If there are marks, patterns, or letters in the measurement region, these will be detected as defects and the measurement will be incorrect. Use the search method when inspecting measurement regions with marks, patterns, or letters.

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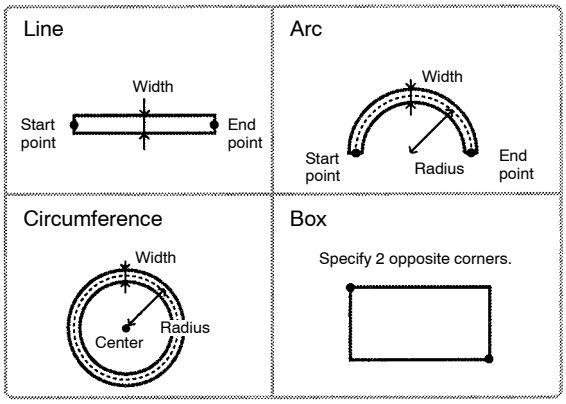
Procedure



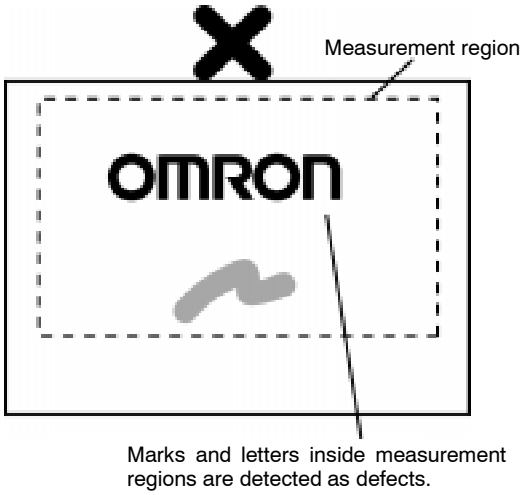
Refer to *3-3-1 Measurement Regions* → **p. 50**

Drawing Measurement Regions

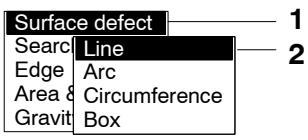
Select a measurement region from a line, arc, circumference, and box.



Note Do not draw a measurement region in a section with marks, patterns, or letters. These will be detected as defects and the measurement will be incorrect.

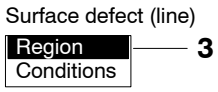


1. Move the cursor to ***SET*/*Measurement region*/*Surface defect***. A list of shapes will be displayed.



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2. Select the shape to be drawn and press the **ENT** Key. A list of defect processing options will be displayed.
3. Select ***Region***. The cursor for drawing regions will be displayed.

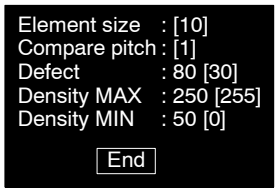


4. Draw the measurement region.

   Once the measurement region has been drawn properly, the display will return to the window shown in step 3.

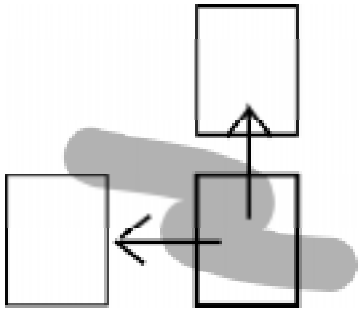
Setting Surface Defect Detection Condition and Evaluation Criteria

Set upper and lower limits for the range for OK results.



The measurement result for the displayed image is shown before the brackets ([ ]). Use these are a reference in setting values.

Defect and density

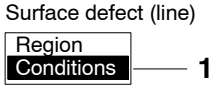


The density of the element is compared with the densities of the elements above and to the left, and the larger difference is the defect.

Display	Options	
Element size	4 to 80 (10*)	Sets the size of the element. Set the size to suit the size of the defect to be detected. The larger the element, the faster the processing.
Compare pitch	1 to 6 (1*)	Sets the pitch (number of elements) for element movement. Set the pitch to suit the size of the defects for inspection and elements. The compare pitch does not affect the processing speed.
Defect	0 to 255 (30*)	Sets the value for an OK result. An OK/NG judgement will be made based on a comparison with the average density of the neighboring elements.
Density MAX Density MIN	0 to 255 (MAX: 255*) (MIN: 0*)	Sets the density range for an OK result for the elements within the measurement region.

Note The default settings are indicated by an asterisk (*).

1. Move the cursor to **Conditions** and press the **ENT** Key. The Condition Settings Window for defect measurement will be displayed.



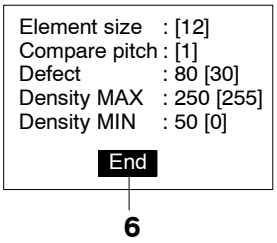
2. Move the cursor to the evaluation criteria to be changed and change the settings.

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Input numeric values in the brackets ([ ]). Refer to *2-1-4 Inputting Values*. → **p. 10**



3. When the setting changes are completed, move the cursor to ***End*** and press the **ENT** Key. The evaluation criteria will be saved and the display returned to the window shown in step 1.



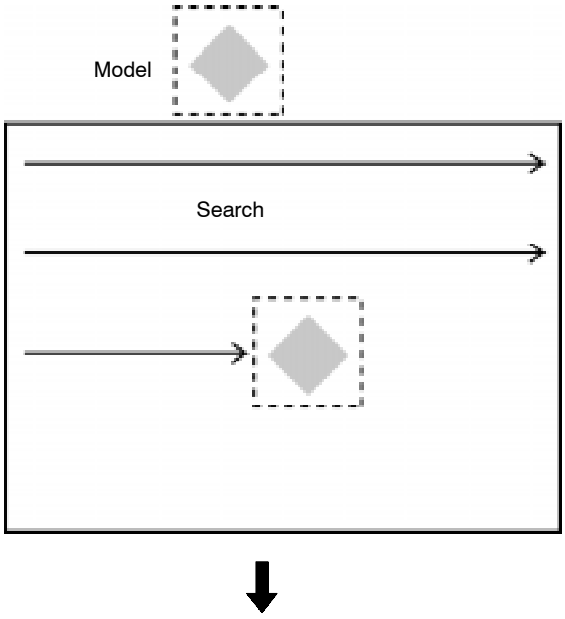
3-3-3 Searches *— Filter/Pickup —*

Searches are used when inspecting objects with constant shapes. The objects are measured using a registered measurement pattern called a model.

Features

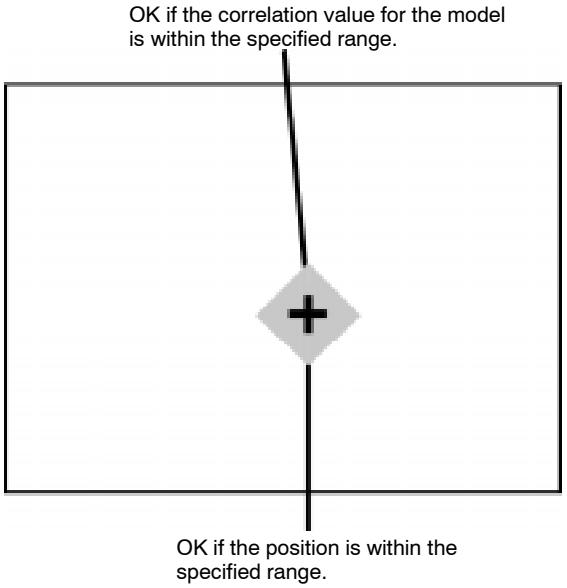
The position of the object (X, Y) and the degree of conformity (called the correlation) with the model can be calculated.

The part of the input image that most corresponds to the model is found.

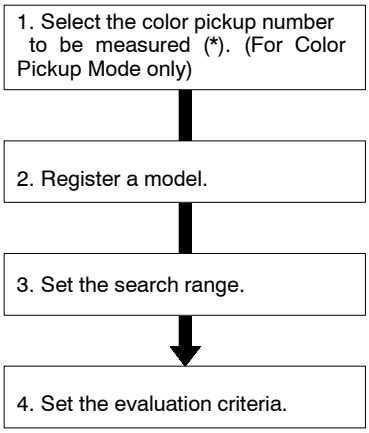


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The extent of conformity with the model is shown as the correlation value. The OK/NG judgement is determined by comparing the correlation value and the position with an evaluation criteria.



Procedure



Note

1. The search processing selected here is for object measurement. Separate search processing can be set for position compensation.

   Refer to *3-2-3 Searches* → **p. 40**

2. Measurement methods are changed and cleared in the Region Settings Window.

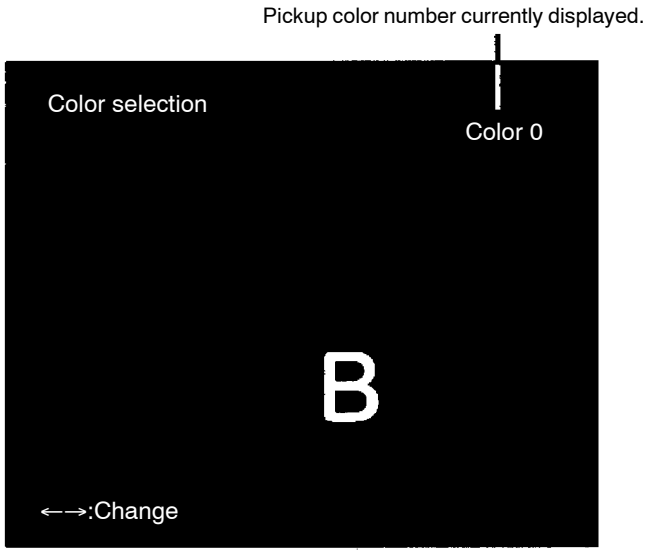
   Refer to *3-3-1 Measurement Regions* → **p. 50**

Selecting Color Pickup Numbers for Measurement (Color Pickup Mode Only)

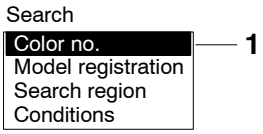
Select a color for measurement from the registered pickup colors. Up to 8 colors can be registered with the F400.

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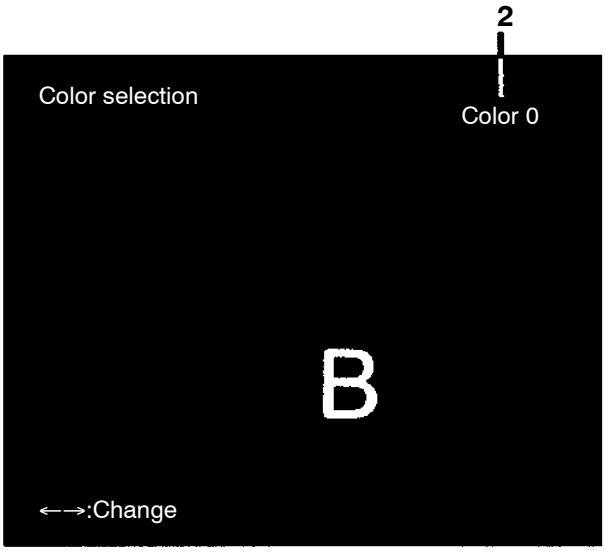
Refer to *3-1-4 Picking Up Measurement Colors*. → **p. 28**

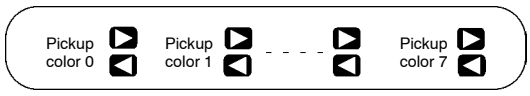


1. Move the cursor to ***Color no.*** and press the **ENT** Key. The Pickup Color Selection Window will be displayed.



2. Use the **Left** and **Right** Keys to display the measurement color on the screen. The color displayed on the screen will change as the selected pickup number changes. Confirm the measurement color on the screen.



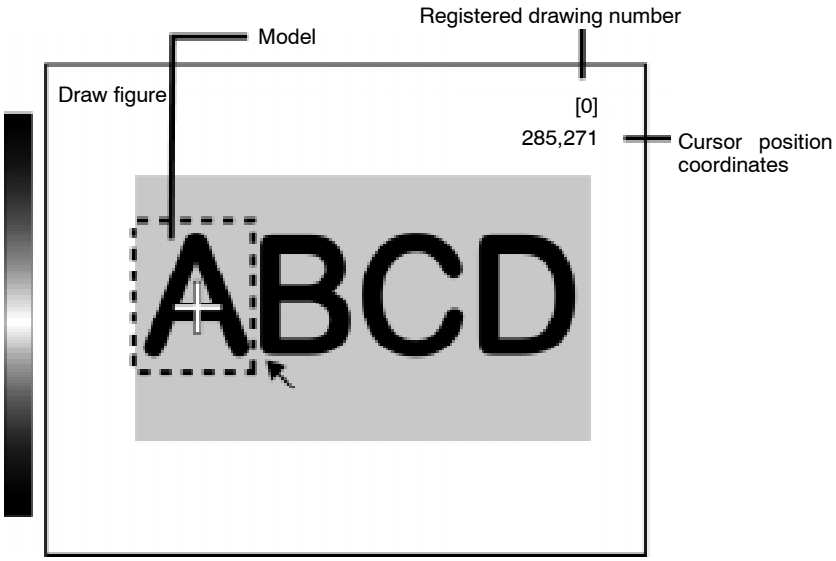


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3. Once the correct color has been displayed, press the **ENT** Key. The measurement pickup color will be selected and the display will return to the screen shown in step 1.

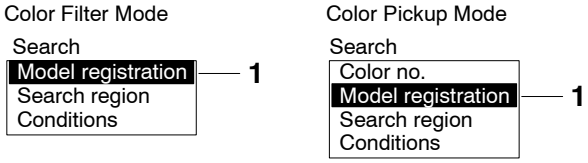
Registering a Model

Sections to be inspected are registered as models. Models can be of any size.

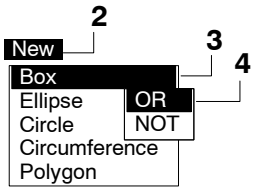


Up to three figures can be drawn in combination.

1. Move the cursor to ***Model registration*** and press the **ENT** Key. The Draw Figure Window will be displayed.



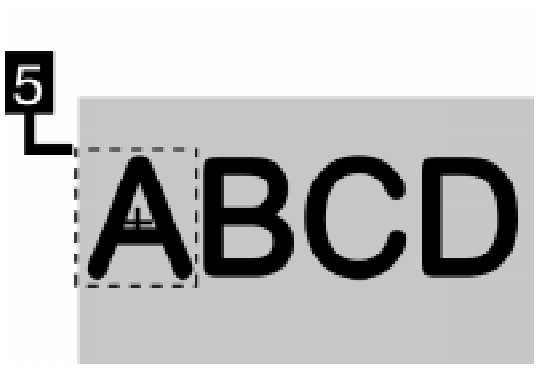
2. Move the cursor to **New** and press the **ENT** Key. The Drawing Selection Window will be displayed.
3. Select the shape to be drawn. A list of drawing methods will be displayed.
4. Select **OR** or **NOT**. The model drawing cursor will be displayed.



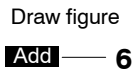
5. Draw the shape in the region to be registered as the model. When one drawing has been completed, a message to confirm whether or not another drawing is to be added will be displayed.

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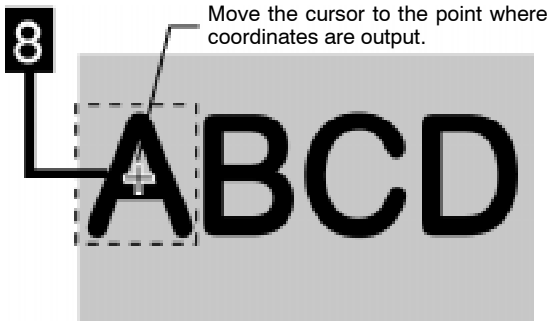
Refer to *2-1-5 Drawing Measurement Regions*. → **p. 12**



6. Move the cursor to ***Add*** if a drawing is to be added and press the **ENT** Key. Repeat steps 3 to 5.



7. When all drawings have been completed press the **ESC** Key. The cursor will be displayed.
8. Move the cursor to the point where coordinates (X, Y) are output as a search position and press the **ENT** Key. The coordinates will be set, the model will be saved, and the display will return to the window shown in step 1.



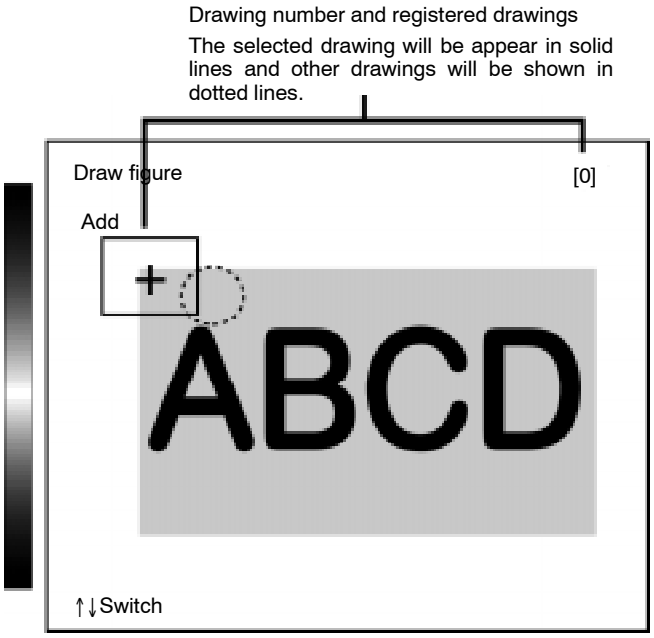
Note After three drawings have been made the ***Add*** message will not appear.

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Changing and Clearing Drawings

Drawings are cleared in the Draw Figure Window.

1. Use the **Up** and **Down** Keys to select the drawing to be changed or cleared. The selected drawing will be displayed in solid lines.



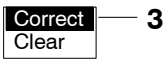
2. Press the **ENT** Key. The processing options will be displayed.
3. Select ***Correct*** or ***Clear*** and press the **ENT** Key.

Correct

The drawing cursor will be displayed. Correct the drawing.

Clear

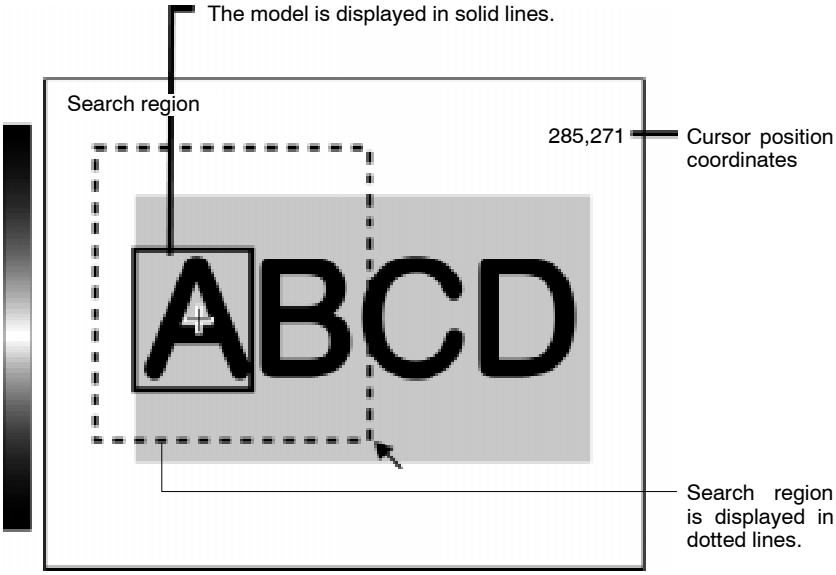
The drawing will be cleared.



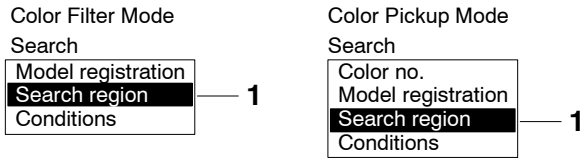
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Setting Search Region

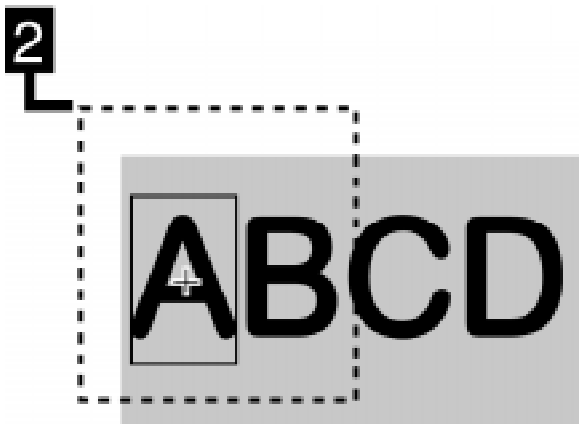
Set the region to search for the model. The search can be made on the whole input screen. However, the search region can be limited to reduce the processing time and increase the accuracy.



1. Move the cursor to ***Search region*** and press the **ENT** Key. The cursor for drawing search regions will be displayed.



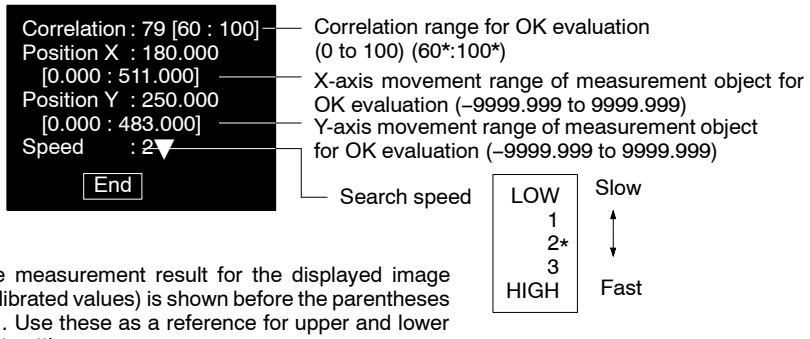
2. Draw the search region for the model. Exit the drawing to return to the window shown in step 1.



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Setting Evaluation Criteria

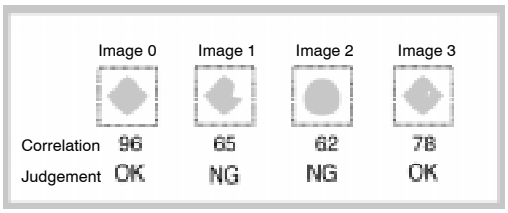
Evaluation criteria are set for the correlation with the model and the coordinates where the model was found. Set upper and lower limits for an OK result for both the model correlation and model coordinates.



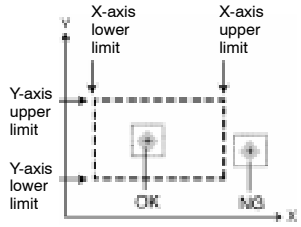
The measurement result for the displayed image (calibrated values) is shown before the parentheses ([ ]). Use these as a reference for upper and lower limit settings.

Default settings are indicated by an asterisk (*).

Correlation set to 70:100



X and Y Axes

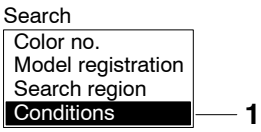


1. Move the cursor to ***Conditions*** and press the **ENT** Key. The Condition Settings Window will be displayed.

Color Filter Mode



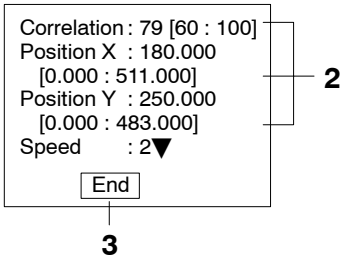
Color Pickup Mode



2. Change the evaluation criteria. Input numeric values in the brackets ([ ]).

   Refer to *2-1-4 Inputting Values*. → **p. 10**

3. When the evaluation criteria have been set, move the cursor to ***End*** and press the **ENT** Key. The evaluation criteria will be saved and the display will return to the window shown in step 1.

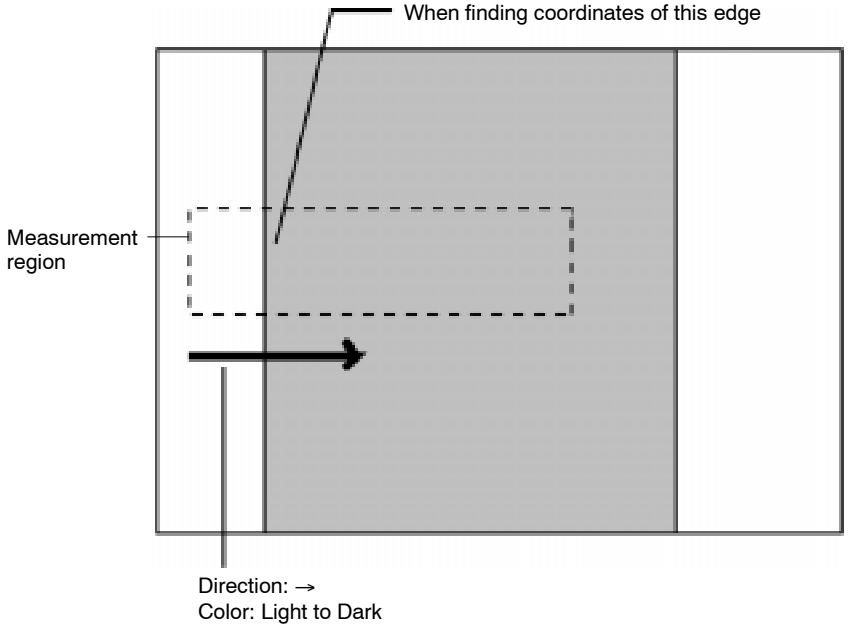


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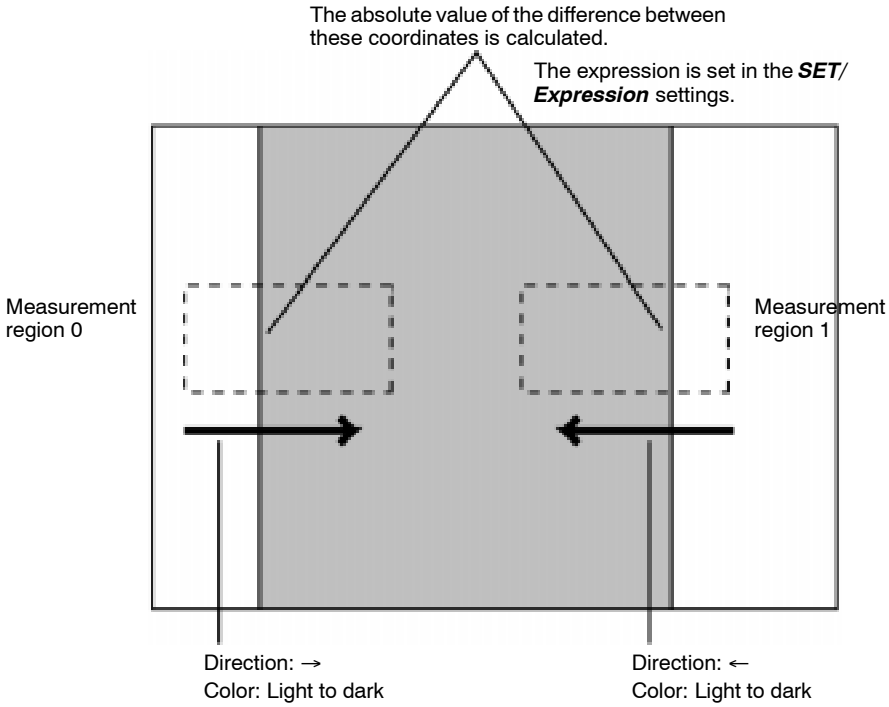
3-3-4 Edge Processing *— Filter/Pickup —*

With edge processing, the position where the color of the measurement object changes (the edge) is found, the position, width, or other values for the measurement object are determined, and measurements are performed. The direction for the edge search and the color changes can be set for each region.

Finding Edge Positions

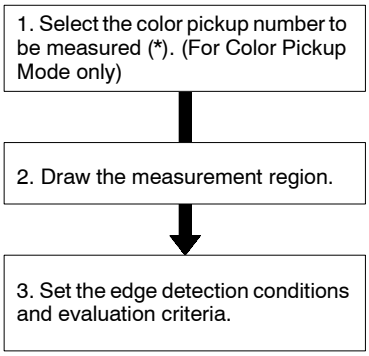


Finding Width



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Procedure



Note

1. The edge processing selected here is for object measurement. Separate edge processing can be set for position compensation.

   Refer to *3-2-4 Position Compensation Using Edges*. → **p. 43**

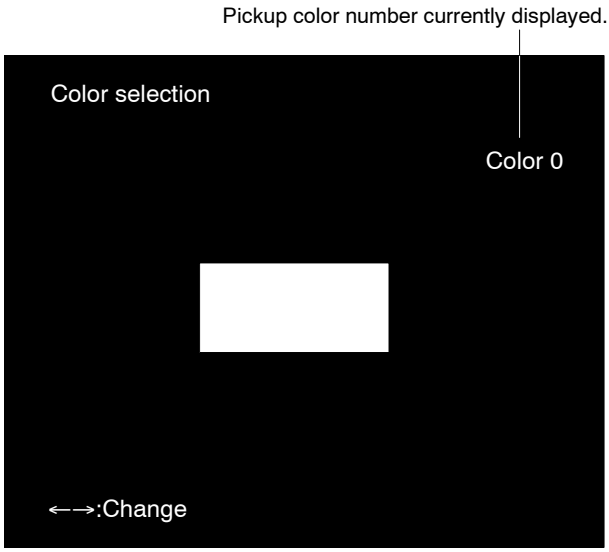
2. Measurement methods are changed and cleared in the Region Settings Window.

   Refer to *3-3-1Measurement Regions* → **p. 50**

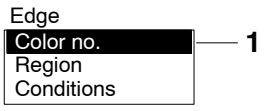
Selecting Color Pickup Numbers for Measurement (Color Pickup Mode Only)

Select the colors to be used in measurement from the registered pickup colors. Up to 8 colors can be registered in the F400.

Refer to *3-1-4 Picking Up Measurement Colors*. → **p. 28**

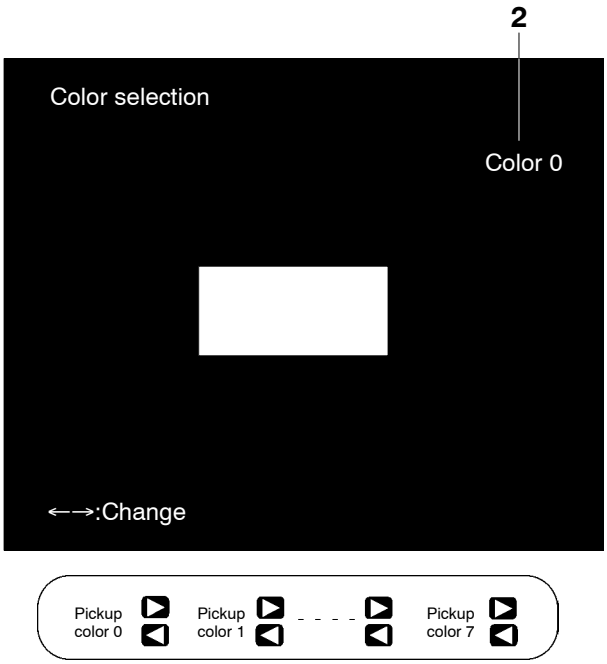


1. Move the cursor to ***Color no.*** and press the **ENT** Key. The Pickup Color Selection Window will be displayed.



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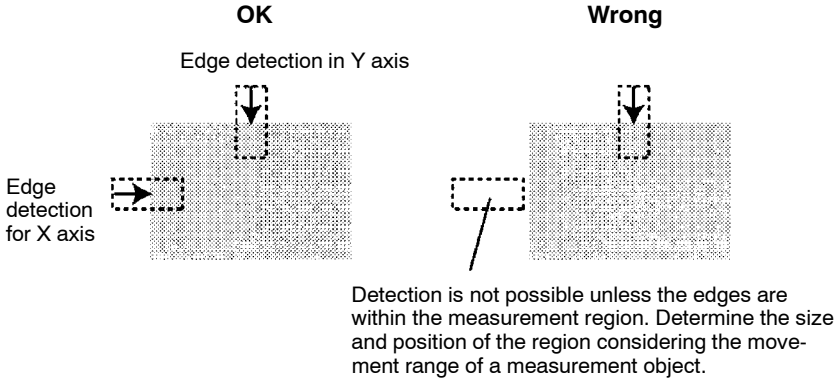
2. Use the **Left** and **Right** Keys to display the measurement color on the screen. The color displayed on the screen will change as the selected pickup number changes. Confirm the measurement color on the screen. Use the **Left** and **Right** Keys to move through pickup colors 0 to 7 in order.



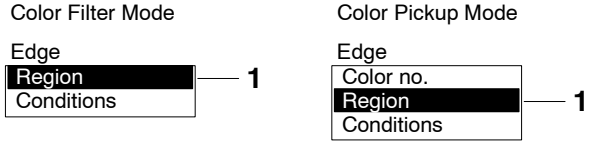
3. Once the color is displayed, press the **ENT** Key. The pickup color for measurement will be selected and the display will return to the window shown in step 1.

Drawing Measurement Regions

Draw a measurement region. Draw one box for one region to include the edges.



1. Move the cursor to ***Region*** and press the **ENT** Key. The Draw Figure Window will be displayed.

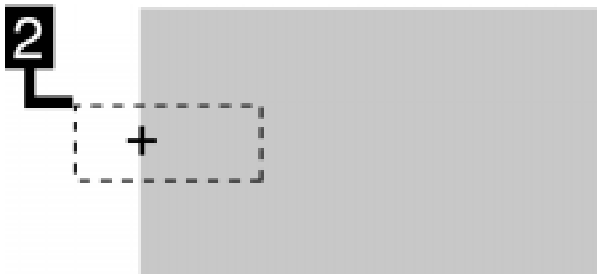


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2. Draw the edge measurement region.

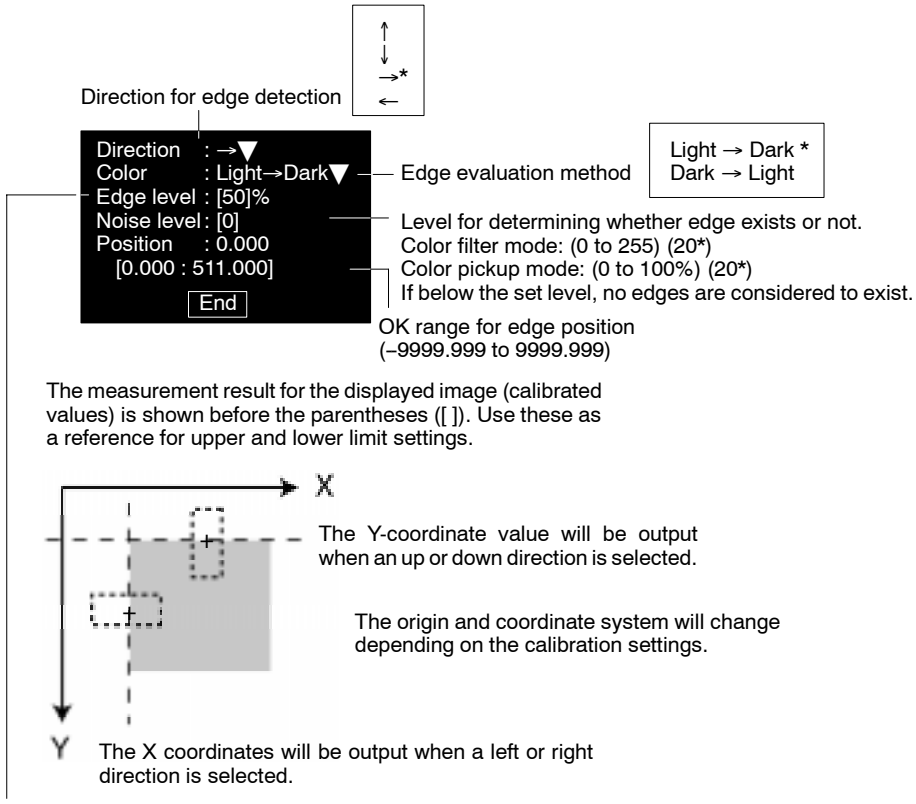
   Refer to *2-1-5 Drawing Measurement Regions* for information on drawing methods for measurement regions. → **p. 12**

   When the drawing has been completed, the display will return to the screen shown in step 1. The registered drawing will be displayed in solid lines.



Setting Edge Detection Condition and Evaluation Criteria

Set the evaluation criteria for edges.



Levels of Density Change for Edge Detection

Edge level (0 to 100) (50*)

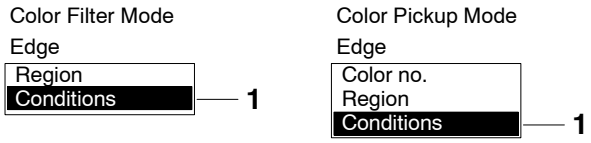
Set the level of density change for the edge.

Refer to the *Glossary* for details about condition settings. → **p. 140**

Note Default settings are indicated by an asterisk (*).

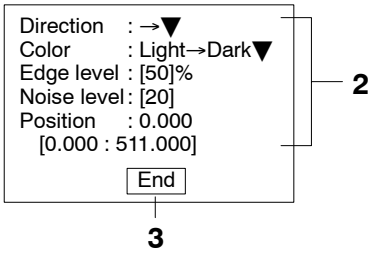
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1. Move the cursor to ***Conditions*** and press the **ENT** Key. The Evaluation Criteria Settings Window will be displayed.



2. Move the cursor to the desired item and change the evaluation criteria. Items with a ▼ mark have further options available. Input numeric values for items with brackets ([ ]).

   Refer to *2-1-4 Inputting Values*. → **p. 10**



3. When the evaluation criteria changes have been completed, move the cursor to ***End*** and press the **ENT** Key. The evaluation criteria will be saved and the display will return to the window shown in step 1.

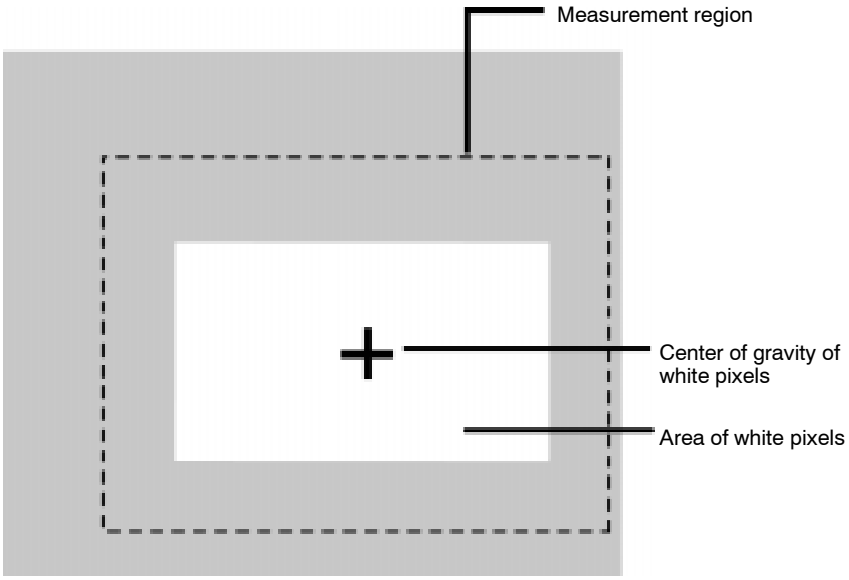
3-3-5 Area and Center of Gravity, and Center of Gravity and Axis Angle

— Filter/Pickup —

Density images with 256 gradations are read by the Camera. Binary processing involves separating these density images into black pixels (picture elements) (0) and white pixels (1). The F400 uses the white pixels to measure the object.

Area and Center of Gravity

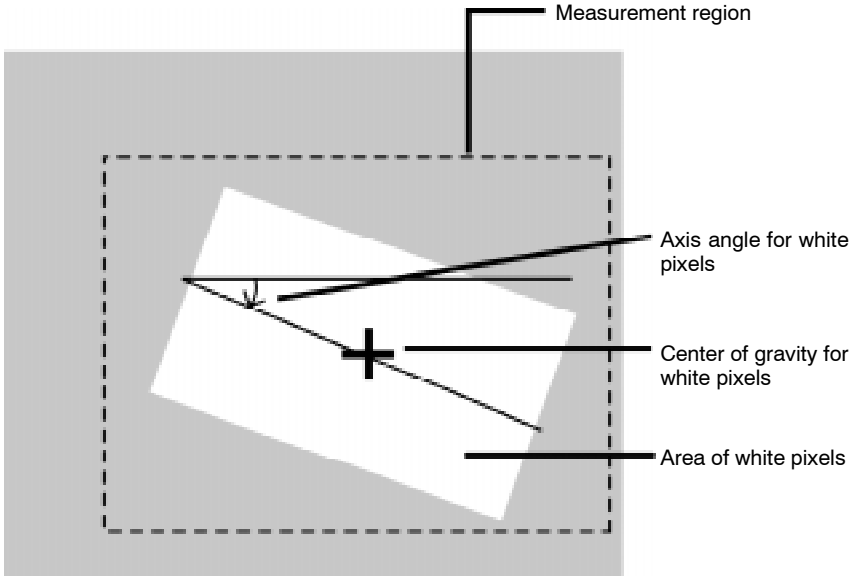
The area and center of gravity of white pixels is found.



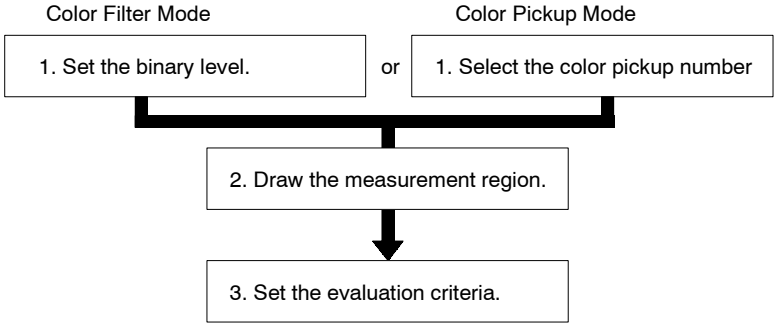
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Center of Gravity and Axis Angle

The center of gravity and axis angle for the white pixels is found. Finding the axis angle increases processing time. Select the area and center of gravity method when the axis angle is not required.



Procedure



Note

1. The area and center of gravity, or the center of gravity and axis angle processing selected here is for object measurement. Separate processing can be set for position compensation.

   Refer to *3-2-5 Area and Center of Gravity, and Center of Gravity and Axis Angle*. → **p. 46**

2. Measurement methods are changed and cleared in the Region Settings Window.

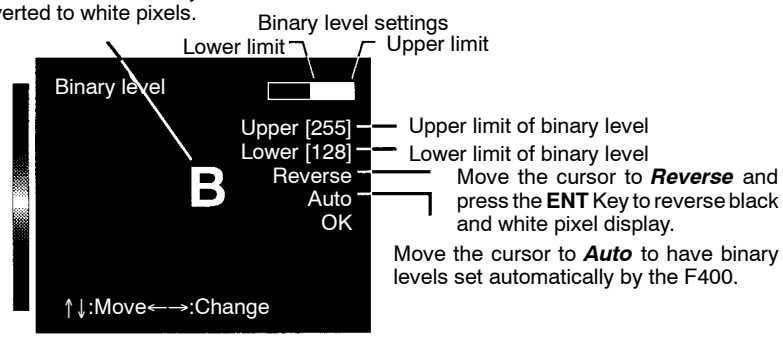
   Refer to *3-3-1 Measurement Regions* → **p. 50**

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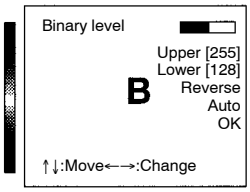
Setting Binary Levels (Color Filter Mode Only)

Set the level for processing gray images with 256 gradations into binary images. Since the F400 uses the white pixels to measure the object, adjust the binary level so that the measurement object turns into white pixels.

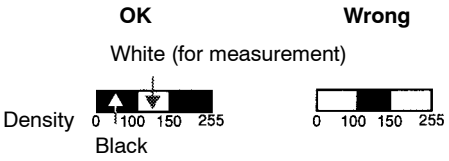
OK: The measurement object is converted to white pixels.



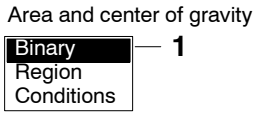
Wrong



The binary level can also be set so that only the intermediate density becomes the subject for measurement. However, the level cannot be set to exclude this intermediate level.



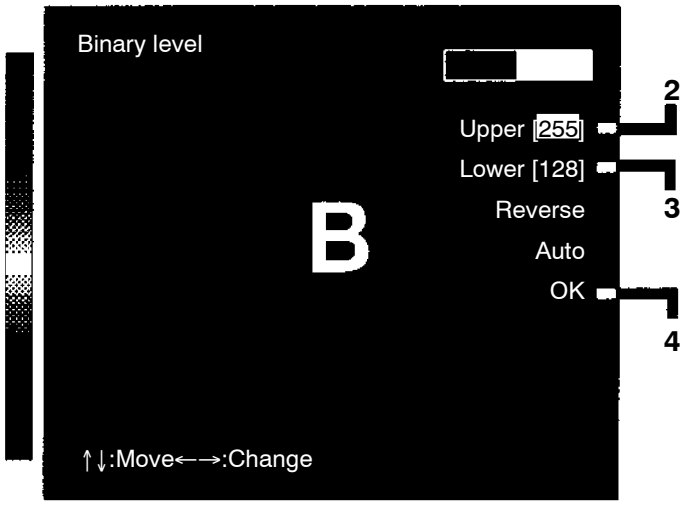
1. Move the cursor to ***Binary*** and press the **ENT** Key. The Binary Level Settings Window will be displayed.



2. Move the cursor to the upper limit and use the **Left** and **Right** Keys to change the numeric value.

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3. Change the lower limit the same way.

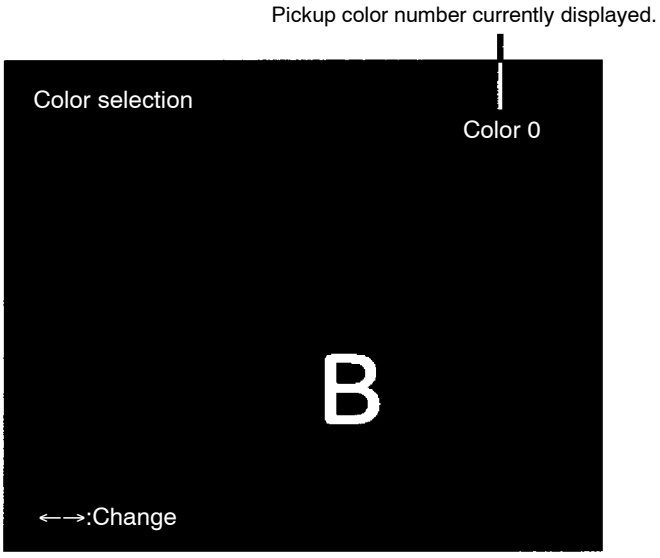


4. Move the cursor to **OK** and press the **ENT** Key. The binary levels will be set and the display will return to the window shown in step 1.

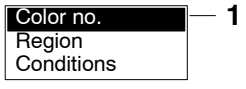
Selecting Color Pickup Numbers (Color Pickup Mode Only)

Select the colors to be used in measurement from the registered pickup colors. Up to 8 colors can be registered in the F400.

Refer to *3-1-4 Picking Up Measurement Colors*. → **p. 28**

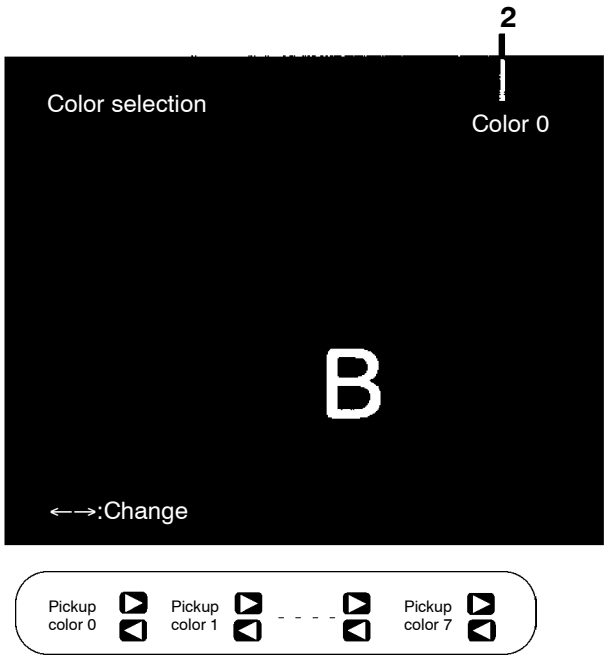


1. Move the cursor to ***Color no.*** and press the **ENT** Key. The Pickup Color Selection Window will be displayed.



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2. Use the **Left** and **Right** Keys to display the measurement color on the screen. The color displayed on the screen will change as the selected pickup number changes. Confirm the measurement color on the screen. Use the **Left** and **Right** Keys to move through pickup colors 0 to 7 in order.



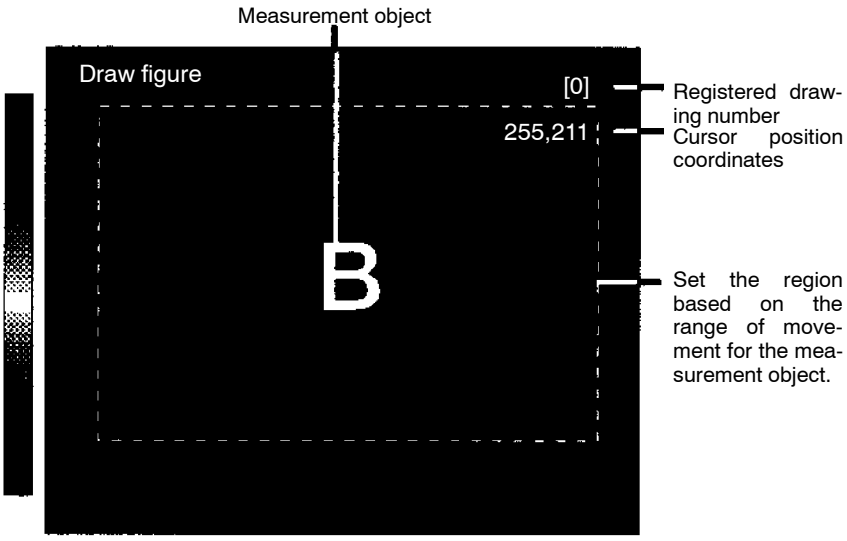
3. Once the color is displayed, press the **ENT** Key. The pickup color for measurement will be selected and the display will return to the window shown in step 1.

Drawing Measurement Regions

The center of gravity and axis angle of the white pixels in the region will be found.

Shape and Number of Drawings

A combination of three figures can be drawn.

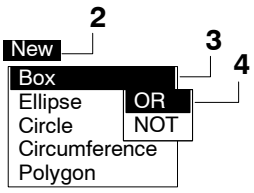


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1. Move the cursor to ***Region*** and press the **ENT** Key. The window for drawing figures will be displayed.

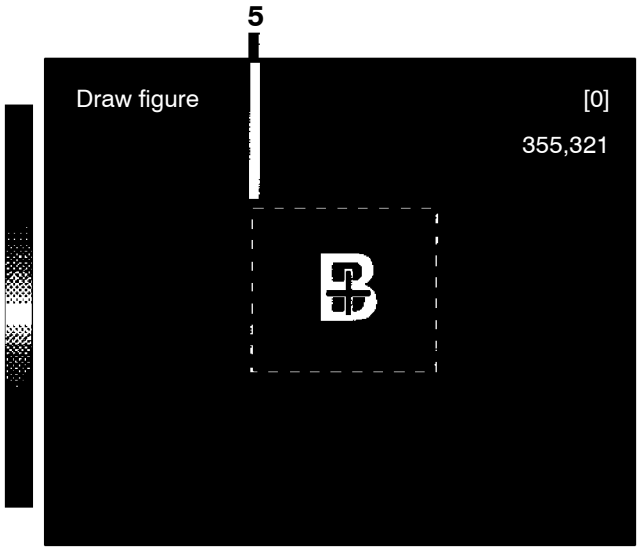


2. Move the cursor to ***New*** and press the **ENT** Key. A list of drawing shapes will be displayed.
3. Select the shape to be drawn. A list of drawing methods will be displayed.
4. Select **OR** or **NOT**. The region drawing cursor will be displayed.

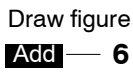


5. Draw the measurement region. When one drawing has been completed, a message to confirm whether or not another drawing is to be added will be displayed.

   Refer to *2-1-5 Drawing Measurement Regions*. → **p. 12**



6. Move the cursor to ***Add*** if a drawing is to be added and press the **ENT** Key. Repeat steps 3 to 5.



7. When all drawings have been completed, press the **ESC** Key. The measurement regions will be saved and the display will return to the window shown in step 1.

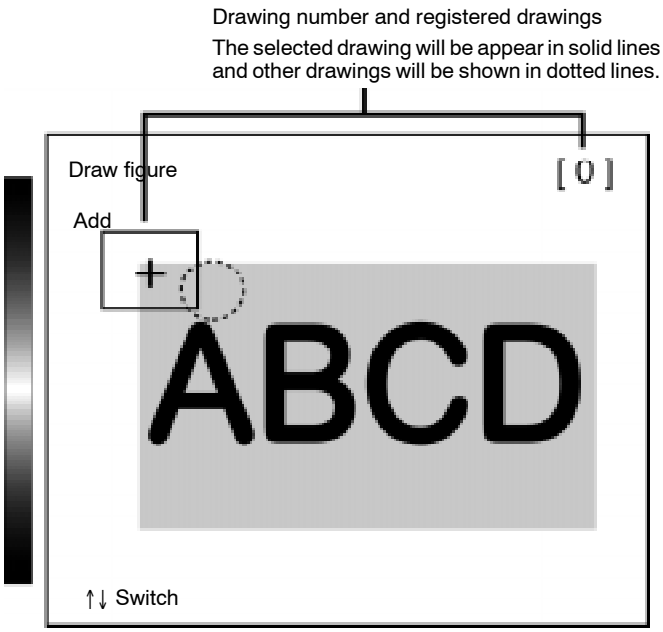
Note After three drawings have been made, the ***Add*** message will not appear.

Correcting and Clearing Drawings

Drawings are cleared in the Draw Figure Window.

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1. Use the **Up** and **Down** Keys to display the drawing to be changed or cleared. The selected drawing will be displayed in solid lines.



2. Press the **ENT** Key. The processing options will be displayed.
3. Select ***Correct*** or ***Clear*** and press the **ENT** Key.

Correct

The drawing cursor will be displayed. Correct the drawing.

Clear

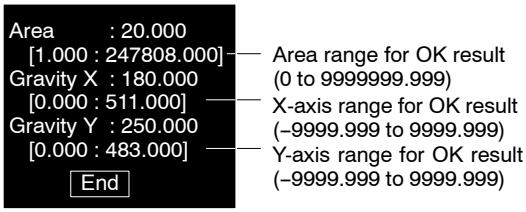
The drawing will be cleared and the display will return to the one in the above step 1.



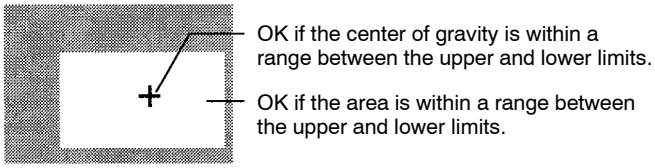
Setting Evaluation Criteria

Set the area and center of gravity, or the center of gravity and axis angle evaluation criteria.

Area and Center of Gravity

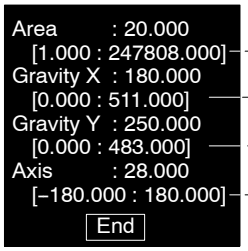


The measurement result for the displayed image (calibrated values) is shown before the parentheses ([ ]). Use these as a reference for upper and lower limit settings.



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Center of Gravity and Axis Angle



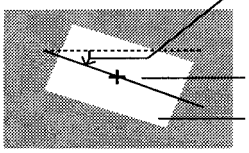
Area range for OK result (0 to 9999999.999)

X-axis range for OK result (–9999.999 to 9999.999)

Y-axis range for OK result (–9999.999 to 9999.999)

Axis angle range for OK result (–180.000 to 180.000)

The measurement result for the displayed image (calibrated values) is shown before the parentheses ([ ]). Use these as a reference for upper and lower limit settings.



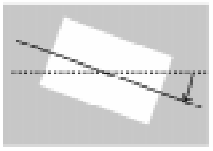
OK if the axis angle is within a range between the upper and lower limits.

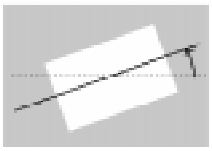
OK if the center of gravity is within a range between the upper and lower limits.

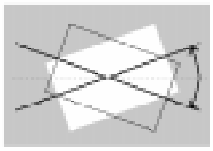
OK if the area is within a range between the upper and lower limits.

Example

Axis Angle







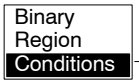
For an OK result, set the evaluation criteria as follows:

[–10.00: 10.00]

Measurement: 10.00 Measurement: –10

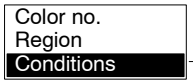
1. Move the cursor to ***Conditions*** and press the **ENT** Key. The Condition Settings Window will be displayed.

Color Filter Mode



1

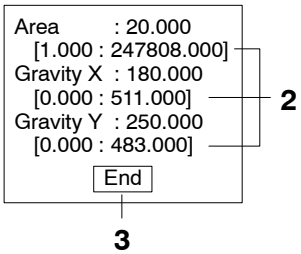
Color Pickup Mode



1

2. Change the evaluation criteria. Input numeric values in the brackets ([ ]).
   Refer to *2-1-4 Inputting Values*. → **p. 10**

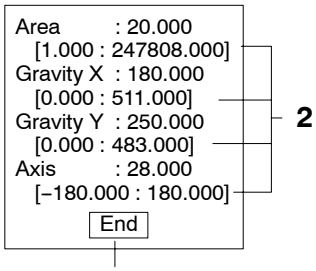
Area and gravity



2

3

Gravity and axis



2

3

3. When the evaluation criteria changes have been completed, move the cursor to ***End*** and press the **ENT** Key. The evaluation criteria will be saved and the display will return to the window shown in step 1.

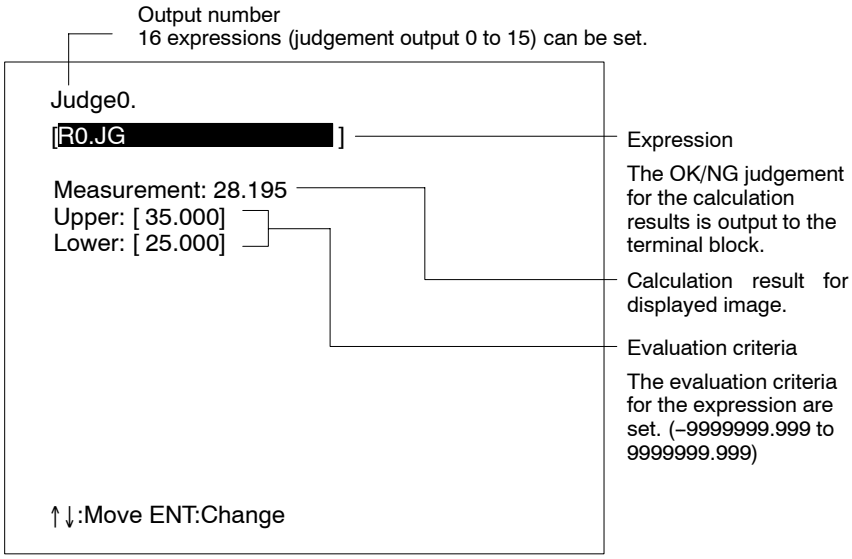
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3-4 Expressions *— Filter/Pickup —*

Outputs to external devices via the terminal blocks or RS-232C can be set. Even if the expression is not used, overall evaluation of drawn regions will be output to the OR terminal of the terminal block.

Terminal Block Outputs

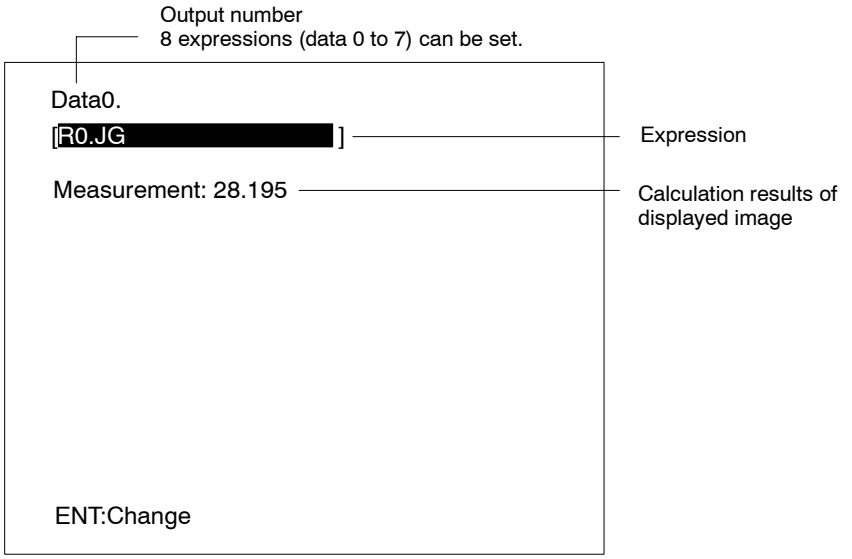
- Evaluation results for each region can be output.
- Measurement values for each region can be calculated and OK/NG judgement for the calculation results can be made.



RS-232C Outputs

- Measurement values can be output.
- Calculation results can be output.

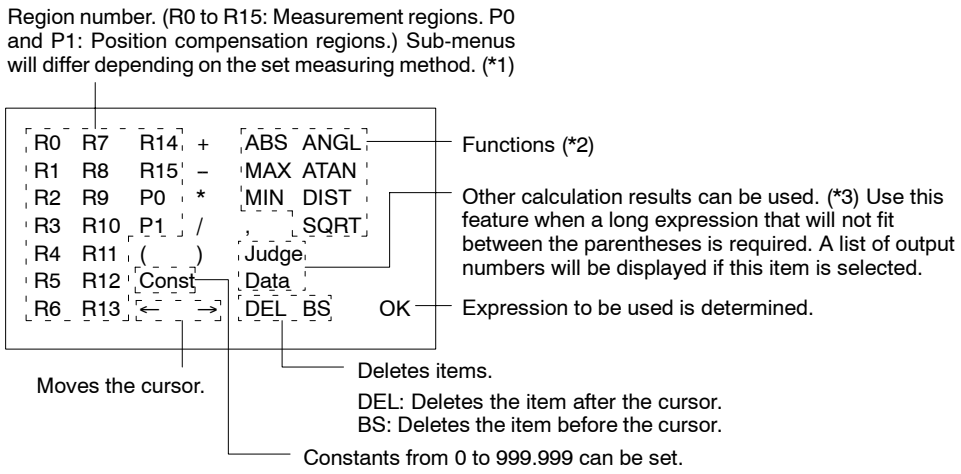
The information output for output numbers 0 to 7 can be set. Information is output in order starting from output #0.



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Note For information on output formats, refer to *6-1-1 I/O Format* under *Terminal Blocks*. → **p. 112**
and *6-2-4 I/O Format* under *RS-232C*. → **p. 123**

Setting Items



Sub-menus (*1)

Submenus when R0 to R15 or P0 to P1 is selected are as shown in the following tables.

Surface Defect Measurements

Measurement item	Meaning
Judge: JG	Evaluation result
Defect: F	Measured defect
Density MAX: GA	Maximum density inside measurement region
Density MIN: GI	Minimum density inside measurement region

Edge Measurements

Measurement item	Meaning
Judge: JG	Measurement result
Edge position: EG	Measured edge position coordinates
Reference position: RE	Coordinates for drawn region
Displacement: DE	Difference between coordinates for measurement and reference values

Search Measurements

Measurement item	Meaning
Judge: JG	Evaluation result
Search position: X	X coordinate of found model position
Search position: Y	Y coordinate of found model position
Reference position: RX	X coordinate of registered model position
Reference position: RY	Y coordinate of registered model position
Displacement: DX	Difference between X coordinates for measurement and reference values
Displacement: DY	Difference between Y coordinates for measurement and reference values
Correlation: CR	Correlation with model

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Area and Center of Gravity or Center of Gravity and Axis Angle Measurements

Measurement item	Meaning
Judge: JG	Evaluation result
Gravity: X	Gravity coordinate X of measurement result
Gravity: Y	Gravity coordinate Y of measurement result
Reference: RX	X coordinate when measurement region drawn
Reference: RY	Y coordinate when measurement region drawn
Displacement: DX	Difference between X coordinates for measurement and reference values
Displacement: DY	Difference between Y coordinates for measurement and reference values
Area: MA	Area of measurement result
Reference area: RM	Area when measurement region drawn
Differential area: DM	Difference between measured area and reference area
Inverted area: VM	Difference between measurement region and measurement area
Axis angle: AG*	Axis angle of measurement result
Reference axis: RA*	Axis angle for drawn measurement region
Differential axis: DA*	Difference between measured and reference axis angles

Note Items indicated with an asterisk (*) are shown only for center of gravity and axis angle measurements.

Judge JG

When “JG” is set for a judgement output expression, the following two levels of judgement are made.

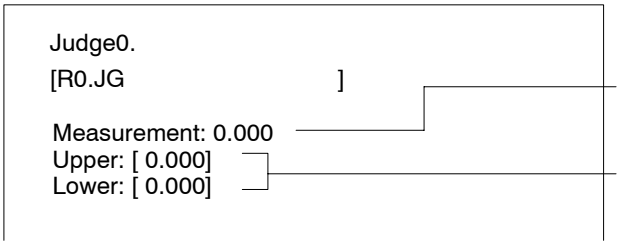
1. Judgement is made according to the evaluation criteria set for each region. Either “0.000” or “–1.000” will be output as a measurement value.

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2. Judgement is made on the measurement value obtained above according to the upper and lower limits of the judgement item set by the “JG.”
   Judgement results will be output to external devices.

(Example)

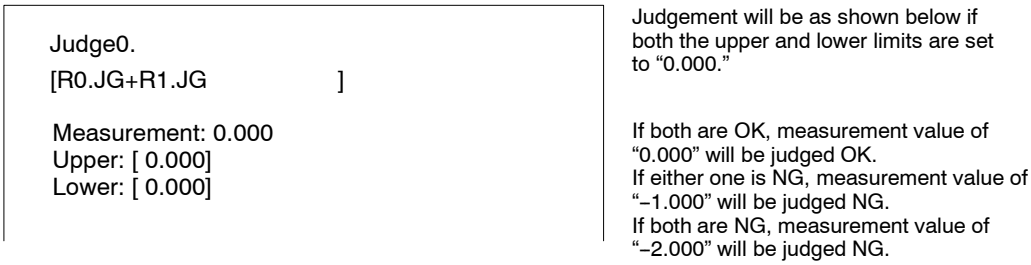
Judgement results for region 0 are output to judgement output 0.



When “JG” is set for a judgement output expression, the first judgement shown above is made. If OK, “0.000” will be output to external devices. If NG, “–1.000” will be output to external devices.

(Application Example)

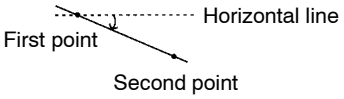
When finding an overall judgement for the regions 0 and 1



Functions (*2)

Function	Meaning	Arguments
ABS	Gives the absolute value. ABS(*argument*)	1
MAX	Gives the larger of two arguments. MAX(*argument 1, argument 2*)	2
MIN	Gives the smaller of two arguments. MIN(*argument 1,argument 2*)	2
SQRT	Calculates the square root. If the argument is negative, the calculation result will be 0 and the judgement will be NG. SQRT(*argument*)	1

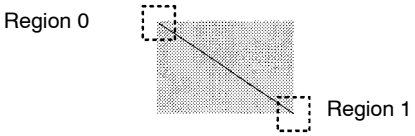
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Function	Meaning	Argu-ments
ANGL	Calculates the angle between two straight lines joining two points, such as the center of gravity or the center of a model. The angle from a horizontal line is calculated. The result will be in the range of −180° and 180°.  ANGL(*Y component, X component*) • Example: Set the following to calculate the angle between straight lines joining the center of gravity for region 0 and the center of gravity for region 1. ANGL(R1.Y−R0.Y,R1.X−R0.X) If both arguments are 0, the result will also be 0 and the judgement will be NG.	2
ATAN	Calculates the arc tangent for the Y component/X component. The result is given as a radian of $-\pi$ to π. ATAN(*Y component, X component*) • Example: Set the following to calculate the angle between a straight line joining the center of gravity for region 0 and the center of gravity for region 1 and a horizontal line. ATAN(R1.Y−R0.Y,R1.X−R0.X) If both arguments are 0, the calculation result will also be 0 and the judgement will be NG.	2
DIST	Calculates the distance between two points, such as the center of gravity or the center of the model. DIST(*X coordinate of first point, Y coordinate of first point, X coordinate of second point,Y coordinate of second point*) • Example: Set the following to calculate the distance between the center of gravity for region 0 and center of gravity for region 1. DIST(R0.X,R0.Y,R1.X,R1.Y) • The following calculation is performed internally. $\sqrt{(R1.X-R0.X)^2+(R1.Y-R0.Y)^2}$	4

Using Other Expression Values (*3)

Other expression values can be used for evaluation by selecting ***Judge*** and ***Data***. Use this function if the expression does not fit within the range set by the brackets ([]). Judge 0 to 15 are displayed as “PR.0 to PR.15” and Data 0 to 7 as “RS.0 to RS.7.”

Example 1: Obtain the length of a straight line connecting two points and add 120.25 to that value.



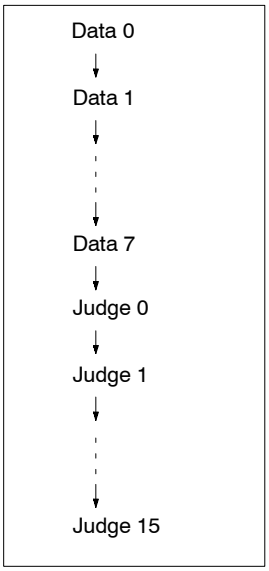
Set as follows for Judge 0 and Judge 1 respectively.

Judge 0.
[DIST(R0.X,R0.Y,R1.X,R1.Y)] Constant 120.25 cannot be set because the number of digits is excessive

Judge 1.
[PR.0+120.25] Constant 120.25 is added to the calculation result of Judge 0.

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Note When using PR.☐ or RS.☐ in the expressions, use the larger output number. Since the calculation is made according to the following procedure, the previous calculation result will be substituted if PR.☐ or RS.☐ is used in the smaller output number.



If the above example is reversely set

Judge 0.
[PR.0+120.25]

Since Judge 0 will be calculated before Judge 1, the previous calculation result will be substituted for PR.1.

Judge 1.
[DIST(R0.X,R0.Y,R1.X,R1.Y)]

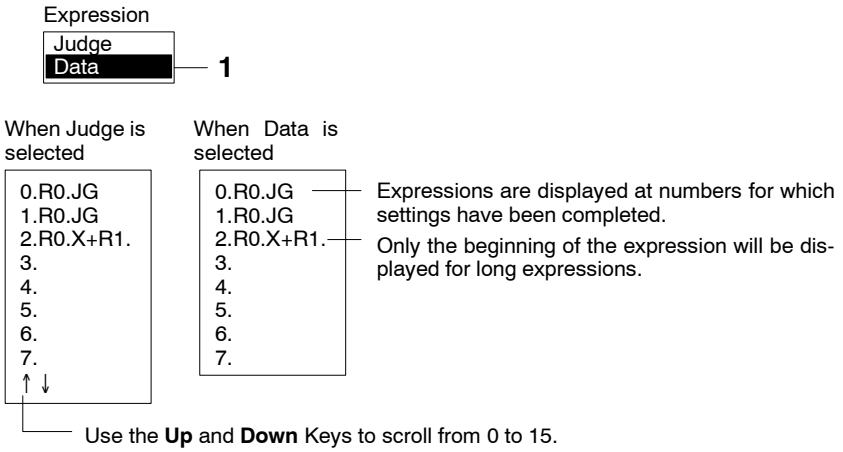
Example 2: Output the number of measurements

Set an expression for the Expression/Data to output values.

Data 0.
[RS.0+1]

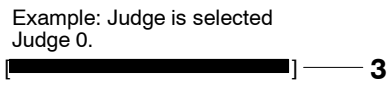
Since RS.0 becomes “0” when the power is turned OFF or when set to the Set mode, the number of measurements is also reset.

1. Move the cursor to ***Judge*** or ***Data*** of the ***SET/Expression.***

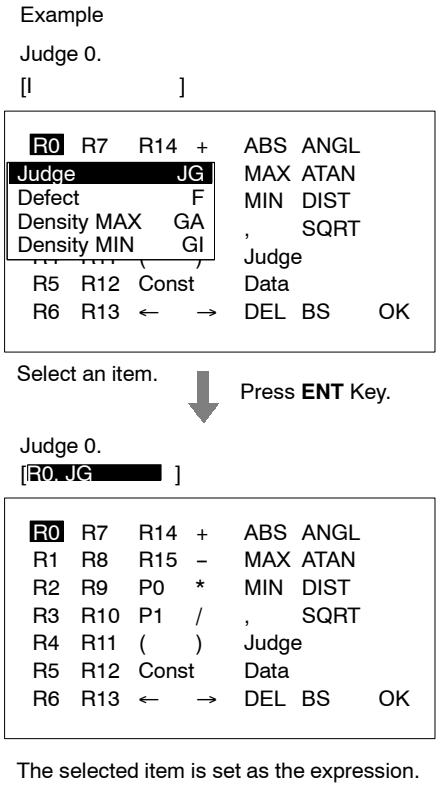


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2. Move the cursor to the number for which an expression will be set and press the **ENT** Key. The Edit Expressions Window will be displayed.
3. Move the cursor to the brackets ([ ]) where the expression is to be input and press the **ENT** Key. A list of items will be displayed.



4. Select the desired item and press the **ENT** Key. The selected item will be set in the expression and displayed in the brackets ([ ]).



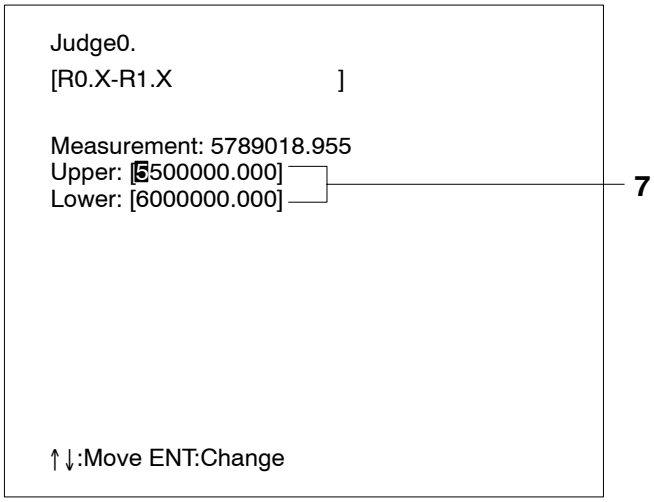
The selected item is set as the expression.

5. Repeat step 4 to set the next item.
6. Once the expression settings have been completed, move the cursor to ***OK*** and press the **ENT** Key. The expression will be saved.

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7. When ***Judge*** has been selected, the evaluation criteria for OK/NG judgements must be set. Input numeric values in the brackets ([ ]). Set upper and lower limits for OK judgement.

   Refer to *2-1-4 Inputting Values*. → **p. 10**



8. When all settings have been completed, press the **ESC** Key to exit the Edit Expressions Window. The expressions will be saved and the display will return to the window shown in step 1.

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SECTION 4
Checking and Executing Measurements

This section describes how to monitor if correct measurements are being performed with the set measurement conditions. It also describes how to perform measurements.

4-1 Checking Measurements 84
4-1-1 Adjusting Evaluation Criteria while Viewing Measurements 85
4-2 Measuring 92
4-2-1 Adjusting Evaluation Criteria during Measurement 93

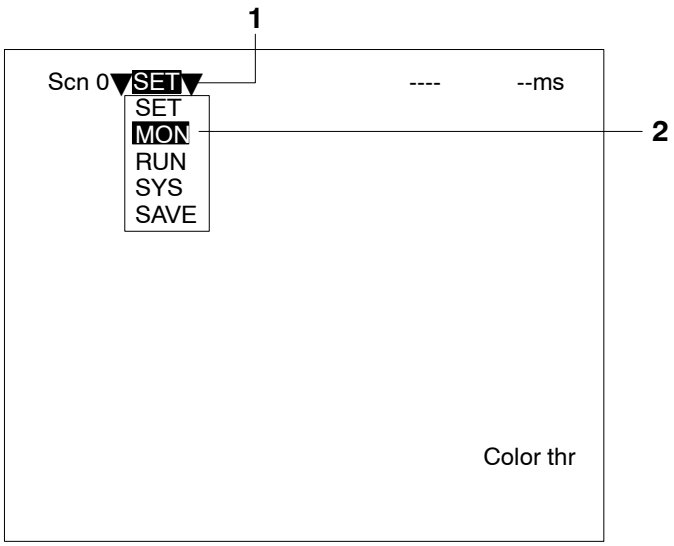
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4-1 Checking Measurements *— Filter/Pickup —*

This section explains how to check if measurements can be correctly performed for the displayed scene using the set measurement conditions.

Measurement commands can be input from an external device via the terminal blocks or RS-232C but the measurement results cannot be output back to the device; they can only be checked on-screen. When performing measurement on a through image, stop the measurement object first. If measurement is performed on a moving image, the image input timing will be delayed, and a proper image will not be obtained.

1. Move the cursor to the operating mode in the main window (***SET*** in this example) and press the **ENT** Key. The Operation Mode Selection Window will be displayed.

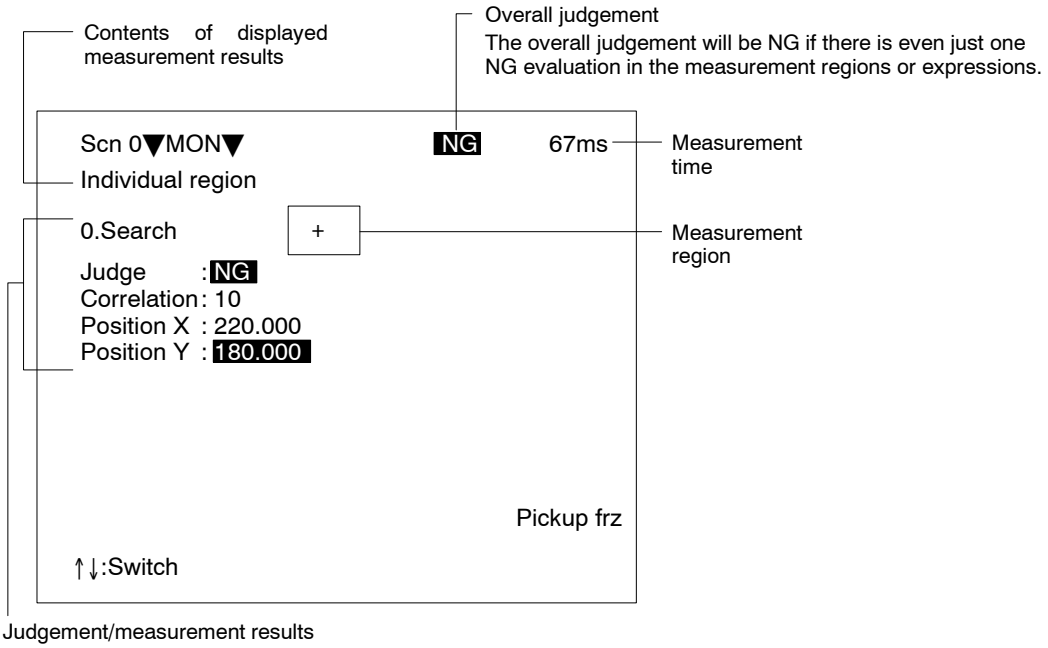


2. Move the cursor to ***MON*** and press the **ENT** Key. The F400 is now in Monitor mode. Monitor mode is automatically started immediately after exiting from Set mode.
3. Press the **TRIG** Key or input a measurement command from an external device. The measurement will be executed and the measurement results displayed.

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4-1-1 Adjusting Evaluation Criteria while Viewing Measurements

This section explains how to adjust evaluation criteria in Monitor mode while displaying measurement results and referring to the measurement values. Press the **SHIFT + ESC** Keys, go to ***Display image*** and select the items to be displayed. → *5-4-1 Measurement Screen Settings* **p. 100**



Note

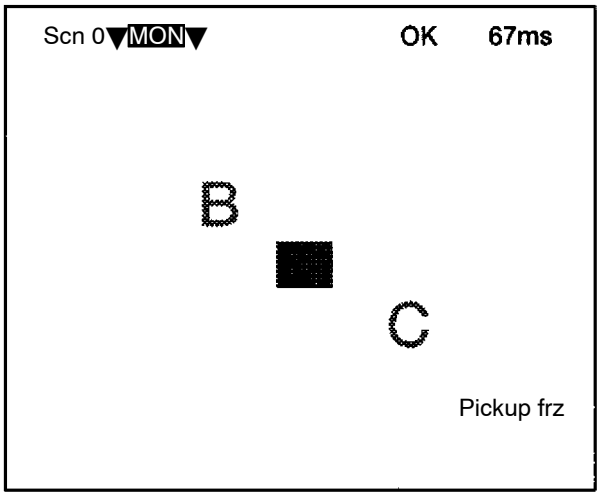
1. Press the **SHIFT + Up**/**Down** Keys to switch the display image.
2. To store a measurement image to memory, press **SHIFT + ESC**. The relevant settings window will be displayed. → *5-4-1 Measurement Screen Settings* **p. 100**
3. To perform measurement for the still image or memory image currently being displayed, press the **SHIFT + TRIG** Keys. Measurement will be performed and the measurement results will be displayed.
4. After all measurement results have been displayed, input the next STEP signal or press the **TRIG** Key. If the next STEP signal is input or the **TRIG** Key is pressed while measurement results are still being displayed, the display will be interrupted and the next measurement will be performed.

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Displaying Measurement Results on the Screen

None

If set to ***None***, only the overall judgement will be displayed.



Position Compensation

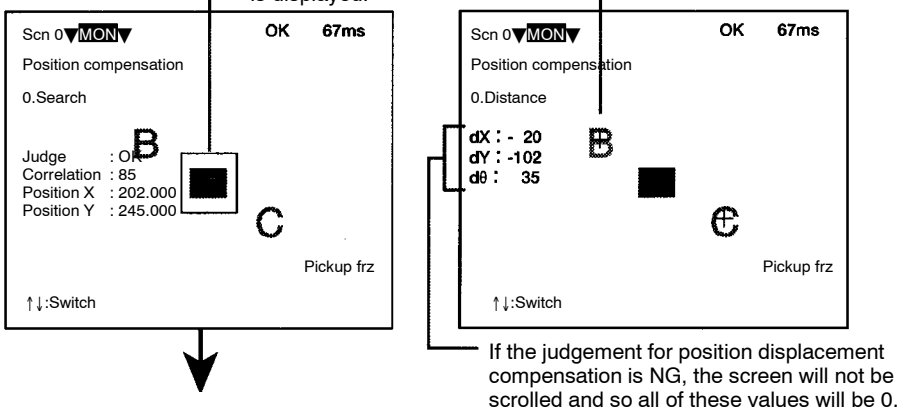
The results for position displacement compensation can be displayed. There are 4 screens: 2 for the measurement results of each position compensation region and 2 for the displacement distances (distanced scrolled) of the regions. Use the **Up** and **Down** Keys to switch between the screens. The image displayed is the image after filtering and background suppression for position displacement compensation.

Position compensation region 0,1

Displacement distance 0, 1 (difference between the reference position and the measurement position)
"1.Distance" is only displayed when Edge Priority mode is set. (First and second displacement distances are displayed.)

Position compensation region is displayed.

The arrow cursor is at the measurement position.



If the judgement for position displacement compensation is NG, the screen will not be scrolled and so all of these values will be 0.

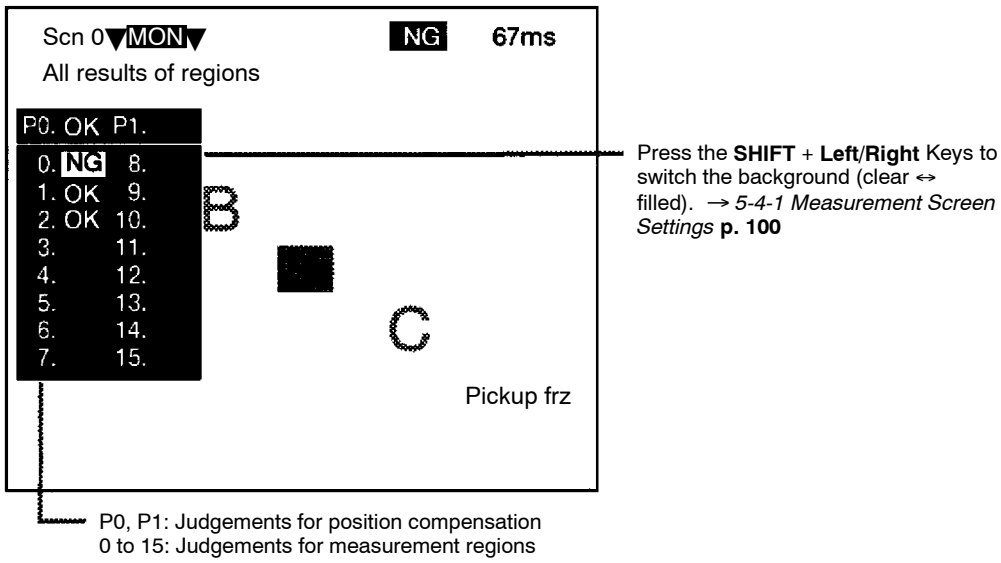
If the **SHIFT** + **ENT** Keys are pressed while the screen for the individual region is displayed, the screen for changing conditions will be displayed, and the evaluation criteria can be changed while monitoring the measurement values. However, while this screen is displayed, measurement will not be performed, even if a trigger or a STEP signal is input.

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Note The measurement results that are displayed can also be set in ***SYS/Display settings***. → *5-4-1 Measurement Screen Settings* **p. 100**

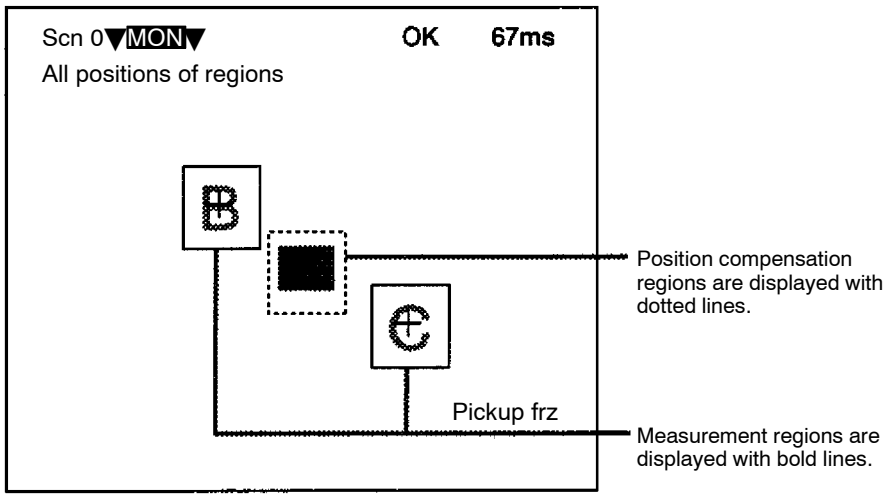
All Results of Regions

Position compensation and judgements for all the regions are displayed in one list.



All Positions of Regions

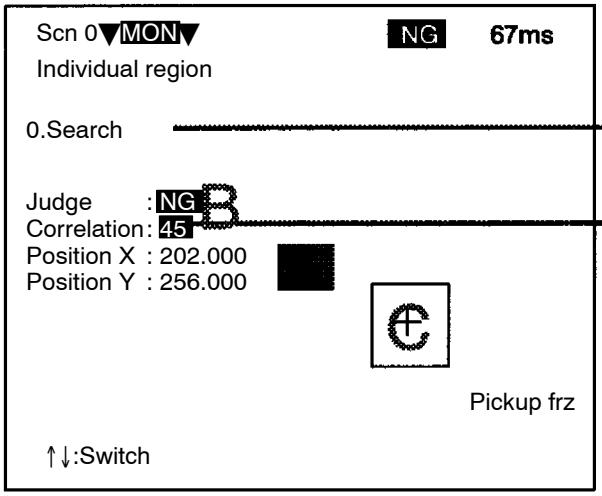
Outlines of all the set measurement regions are displayed.



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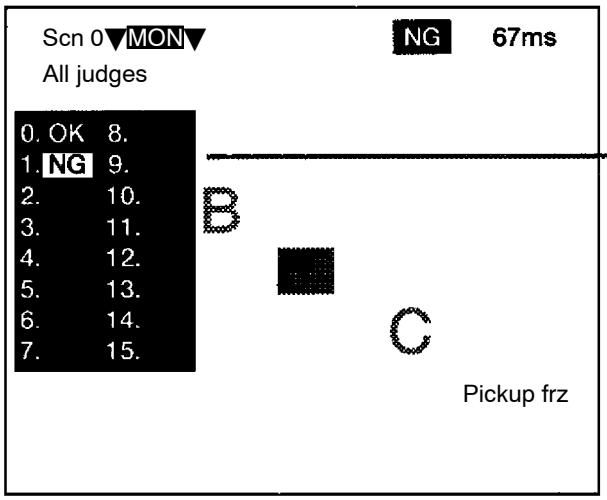
Individual Region

The measurement values for each region are displayed separately. If the **SHIFT** + **ENT** Keys are pressed from this screen, the screen for changing conditions will be displayed, and the evaluation criteria can be changed while monitoring the measurement values. However, while this screen is displayed, measurement will not be performed, even if a trigger or a STEP signal is input.



All Judges

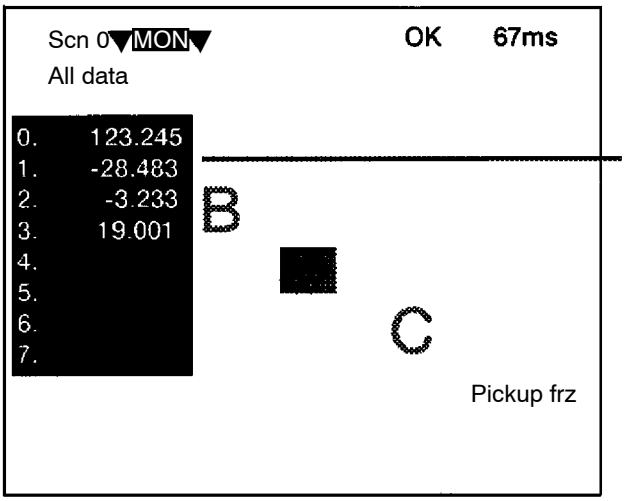
Judgement results for the judge output expressions are displayed in one list.



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All Data

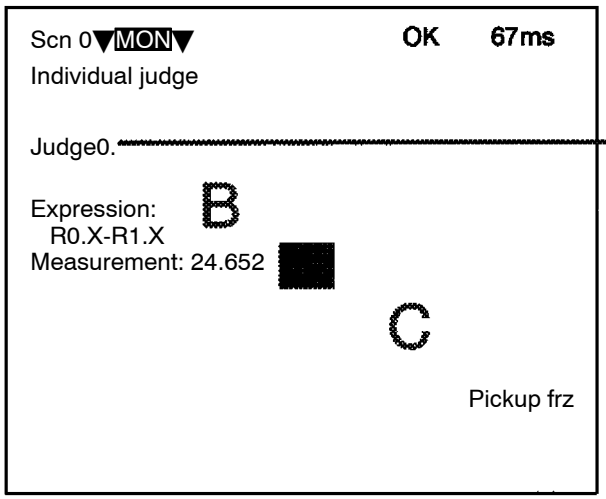
Measurement results for the data output expressions are displayed in one list.



Pressing **SHIFT** + **Left**/**Right** Keys to switch the background (clear ↔ filled). → *5-4-1 Measurement Screen Settings* **p. 100**

Individual Judge, Individual Data

Calculation results for the each of the output expressions are displayed individually. If the **SHIFT** + **ENT** Keys are pressed while this screen is displayed, the screen for changing conditions will be displayed, and the evaluation criteria can be changed while monitoring the calculation results. However, while this screen is displayed, measurement will not be performed, even if a trigger or a STEP signal is input.



Switch the displayed item using the **Up**/**Down** Keys.
Individual judge (0 to 15)
Individual data (0 to 7)

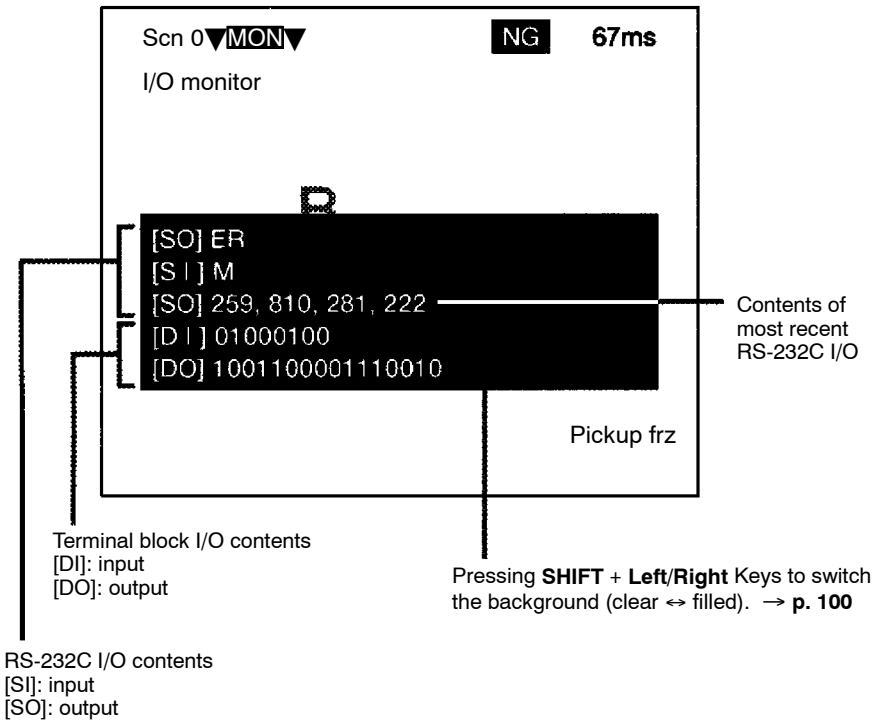
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I/O Monitor

Contents of output from the F400 to an external device, or input from an external device to the F400 are displayed. The list displayed is read-only.

RS-232C (3 lines max.): I/O data is displayed unedited as character strings. When a measurement is performed, the rows displayed will scroll upwards.

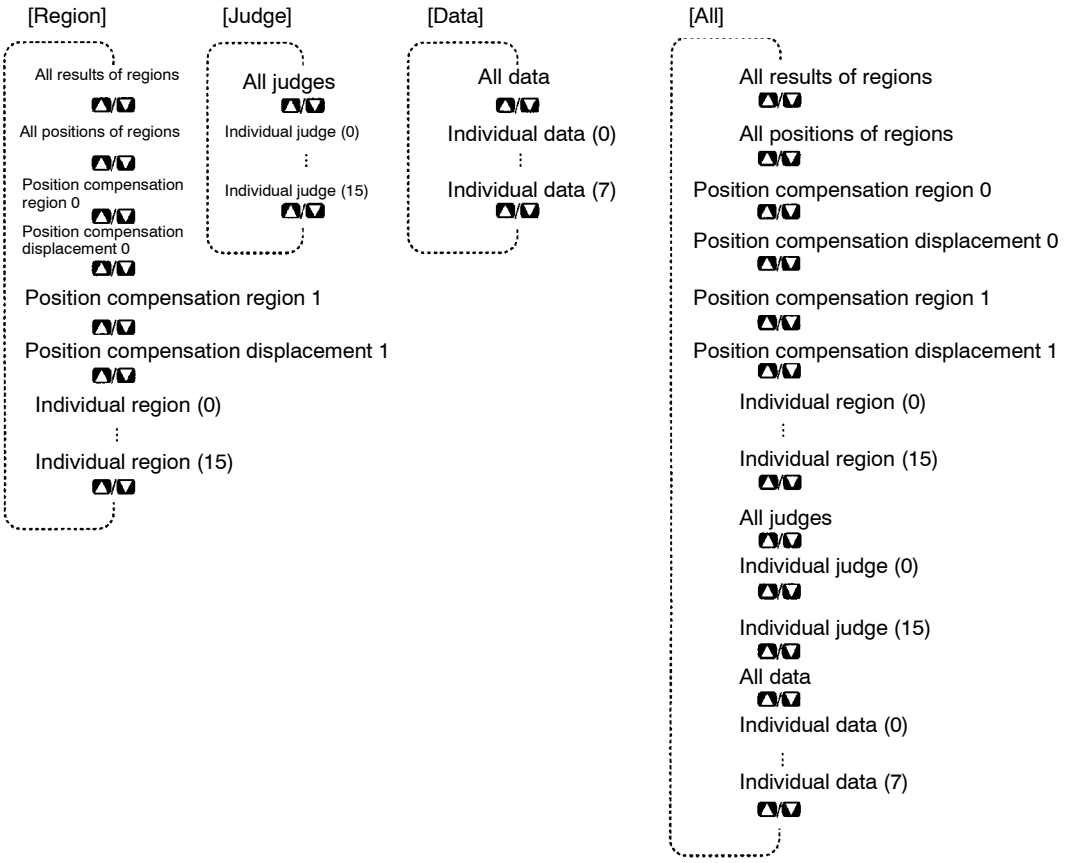
Terminal block (always 2 lines): Data is displayed in binary format. (0: OFF, 1: ON)



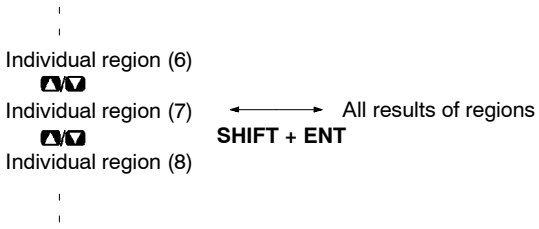
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Display Order for Measurement Values

If the items in the square parentheses ([ ]) are selected, display images can be switched in the orders indicated by using the **Up**/**Down** Keys.



Note By allocating ***Individual/All*** to a console key combination in ***System/Set key operation***, it is possible to jump between individual data and combined lists. → *5-5 Key Allocation* **p. 106**
Example: If ***Individual/All*** is allocated to **SHIFT+ENT:**

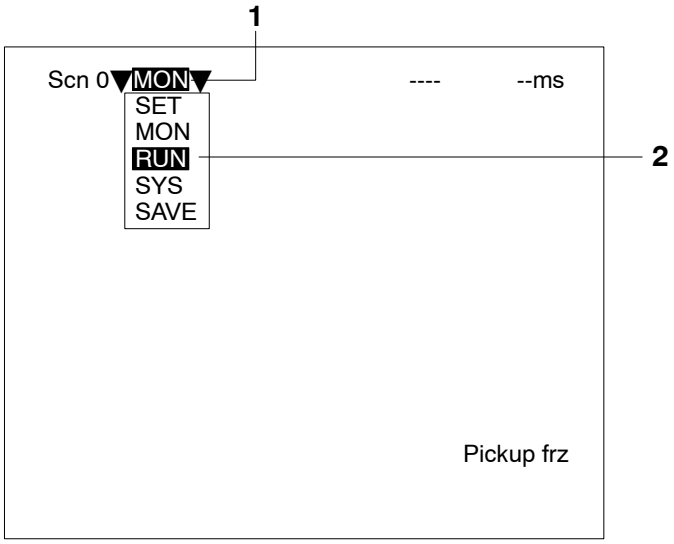


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4-2 Measuring *— Filter/Pickup —*

This section explains how to perform measurement under the conditions set for the displayed scene and how to output measurement results to an external device. When performing measurement on a through image, stop the measurement object first. If measurement is performed on a moving image, the image input timing will be delayed, and a proper image will not be obtained.

1. Move the cursor to the operating mode in the main window (***MON*** in this example) and press the **ENT** Key. The Operating Mode Selection Window will be displayed.



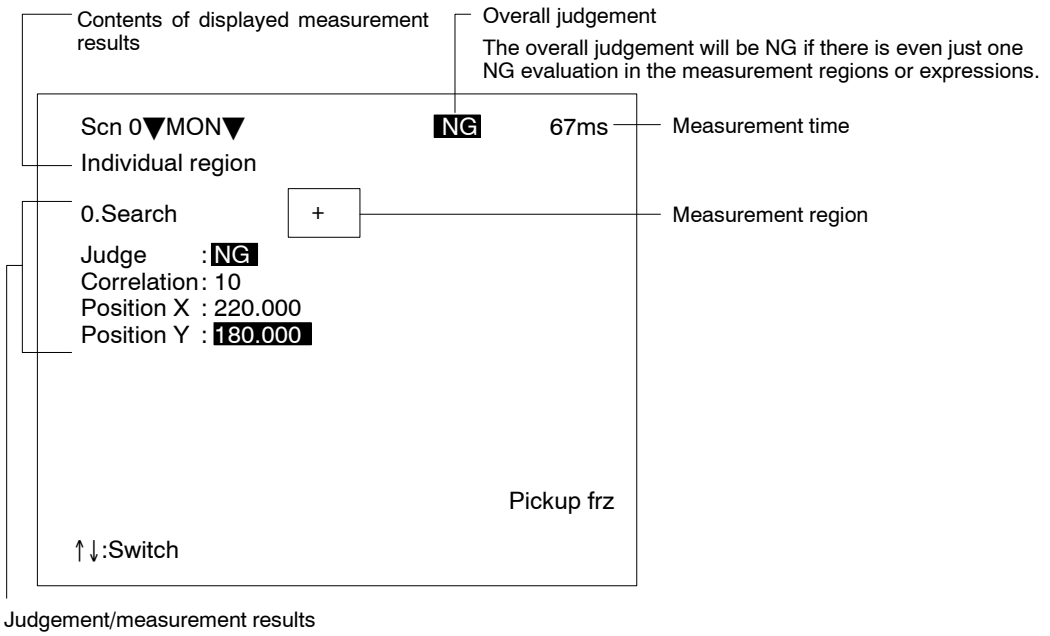
2. Move the cursor to ***RUN*** and press the **ENT** Key. The F400 will enter Run mode.
3. Press the **TRIG** Key or input a STEP signal. A measurement will be executed. The overall judgement will be displayed and the measurement results output to an external device. In addition to triggers and STEP signals, there are various other commands that can be input from external devices. Refer to *Section 6 Communications with External Devices*. → **p. 111**

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4-2-1 Adjusting Evaluation Criteria during Measurement

This section explains how to adjust evaluation criteria in Run mode while displaying measurement results and referring to the measurement values.

The operations that can be performed and values that can be displayed are the same as for Monitor mode. Refer to *4-1-1 Adjusting Evaluation Criteria while Viewing Measurements* → **p. 85**



Note

1. Press the **SHIFT** + **Up**/**Down** Keys to switch the display image.
2. To store a measurement image to memory, press **SHIFT** + **ESC**. The relevant settings window will be displayed. → *5-4-1 Measurement Screen Settings* **p. 100**
3. To perform measurement for the still image or memory image currently being displayed, press the **SHIFT** + **TRIG** Keys. Measurement will be performed and the measurement results will be displayed.
4. After all measurement results have been displayed, input the next STEP signal or press the **TRIG** Key. If the next STEP signal is input or the **TRIG** Key is pressed while measurement results are still being displayed, the display will be interrupted and the next measurement will be performed.

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SECTION 5
System Settings

This section describes the system setting procedures for the F400. For the communications specifications setting procedures, refer to *Section 6 Communications with External Devices*.

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5-1 White Balance

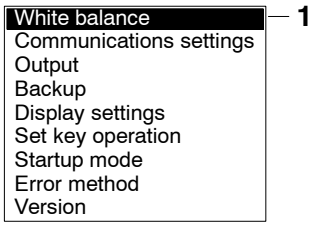
— Filter/Pickup —

Depending on the environment or the kind of light, the image read by the Camera may appear tinted, even if it is white.

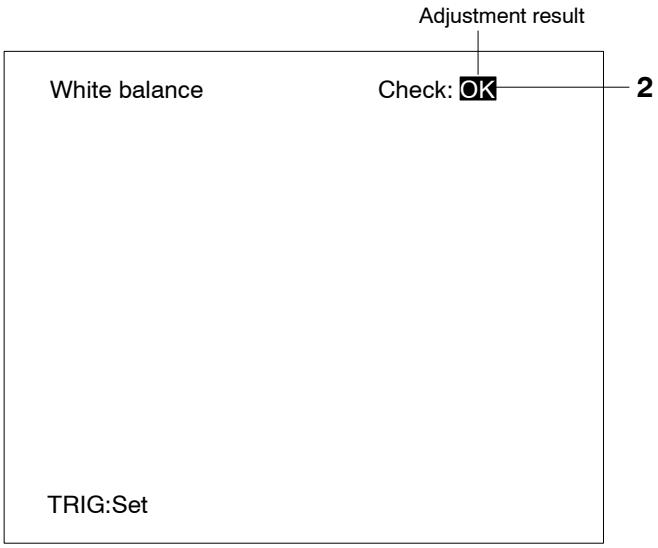
For correct measurement, the sensitivity of R.G.B. must be adjusted so that the image will really appear in white in accordance with the light source. This is called the adjustment of white balance.

Note Adjust the white balance before setting the light and adjusting the image.

1. Move the cursor to ***SYS/White balance***, and press the **ENT** Key.
   The White Balance Window will be displayed.



2. Take an image of a white object (e.g., white paper), and adjust the brightness at the center of the screen.
   The adjustment result is displayed in the upper-right corner of the screen. If the intensity at the center of the screen is at a suitable level for the white balance, the message *Check: OK* will be displayed. Adjust the lighting until this message appears.
   If *Check: Under* is displayed, adjustment cannot be performed because the image is too dark. Either increase the level of illumination or widen the aperture of the Camera.
   If *Check: Over* is displayed, adjustment cannot be performed because the image is too bright. Either decrease the level of illumination or reduce the aperture of the Camera.



3. When the *Check: OK* message is displayed, press the **TRIG** Key to complete the operation. The display will return to the window displayed in step 1.

Note Press the **SHIFT** + **TRIG** Keys to return to the default setting.

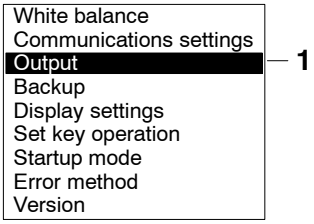
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5-2 Output Destination

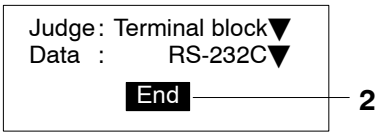
The F400 can output judgements and data for measured objects to an external device. The output destinations for this model are fixed and so the following procedure can only be used to confirm the destinations. The contents of outputs are set in ***SET/Expression***. → *3-4 Expressions* **p. 75**

Output item	Output destination
Judge	Terminal block
Data	RS-232C

1. Move the cursor to ***SYS/Output***, and press the **ENT** Key. The output destinations will be displayed.



2. Move the cursor to ***End*** and press the **ENT** Key. The display will return to the window displayed in step 1.



5-3 Backup

5-3-1 Operations Using the F400 *— Filter/Pickup —*

With the F400, a backup copy of data can be made to a personal computer via the RS-232C port. There are 4 types of data for which backups can be made (shown below). This function is useful for using the same settings with other machines.

It is recommended that data is backed up in case of data loss or machine malfunction.

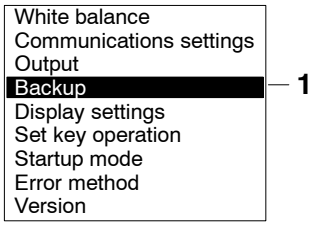
Data	Contents
System data	Communications settings, display settings, set key operation settings, startup mode settings, and error method settings are saved.
Scene data	Screen adjustment settings, position compensation settings, measurement region settings, and expressions settings for each screen are saved.
System and scene data	Both system and scene (0 to 15) data are saved.
Image data	Measurement images stored in memory can be saved in BMP format. This is the most common image format for Windows 95/98, enabling the images to be displayed on a personal computer screen.

Note Do not turn OFF the power while a message is being displayed in any save or load operations. Data in memory will be destroyed, and the F400 may not operate correctly the next time it is started.

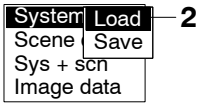
1. Move the cursor to ***SYS/Backup***, and press the **ENT** Key.

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The screen for selecting data to be saved or loaded will be displayed.

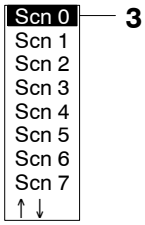


2. Select the type of data and ***Load*** or ***Save***.
   If ***Scene data*** or ***Image data*** is selected, the screen for selecting the scene number or the image number will be displayed.

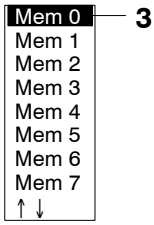


3. Select the scene number or the image number.
   A confirmation message will be displayed.

When scene data is selected

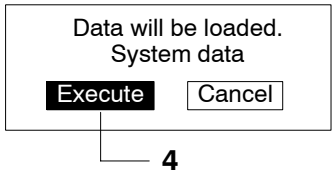


When image data is selected

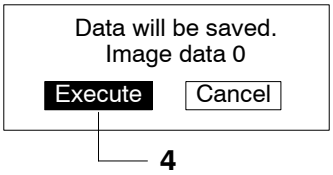


4. Move the cursor to ***Execute*** and press the **ENT** Key.

When load is selected
Example: Loading system data

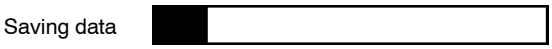


When save is selected
Example: Saving image data



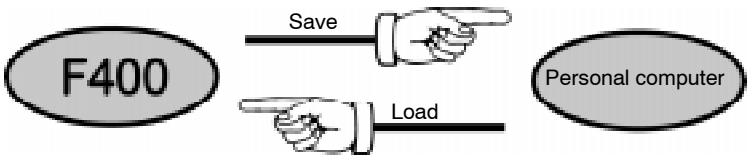
The save or load operation will be executed, and the execution status will be displayed at the bottom of the screen.

Example: When save is selected



When the operation has been completed, the display will return to the window shown in step 3.

Note The direction of data flow is shown below.



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5-3-2 Operation Examples for the Personal Computer

— Filter/Pickup —

Communications are performed using Xmodem (-CRC or -SUM) protocol.

This section explains data transfer using the Hyper Terminal provided by Windows 95/98/NT 4.0. In this example, an RS-232 cable is connected to the COM1 port of the personal computer. Alter the example to suit your COM port number. If communications software other than Hyper Terminal is being used, refer to the manual for that software.

Note Do not turn OFF the power while a message is being displayed in any save or load operations. Data in memory will be destroyed, and the F400 may not operate correctly the next time it is started.

Saving Data to the Personal Computer

1. Connect the COM 1 port on the personal computer and the F400 using an RS-232C cable. When the COM 1 port is being used as a mouse port, make the settings for the COM 2 port instead.
2. Make the F400 communications settings.

Note The default communications settings are shown in the following table. These setting can normally be used.

Item	Setting
Baud rate	38,400 bps
Data length	8 (bits)
Parity bit	None
Stop bits	1 (bit)
Delimiter	CR
Flow control	None
Time out	5S

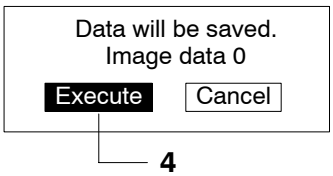
3. Start the HyperTerminal for COM 1, and set the communications specifications in the following way.

Note The same communications settings must be used on both the F400 and the modem on the personal computer.

Item	Setting
Speed	38,400 bps
Data bits	8 (bits)
Parity bit	None
Stop bits	1 (bit)
Flow control	None (Xmodem protocol is used.)

4. Perform save operations at the F400.

   The Data Transfer Window will be displayed.



5. Select ***Transfer/Receive File*** from the Hyper Terminal menu. Specify where the file is to be saved and set the protocol to ***Xmodem***.

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6. Select ***Receive*** and input the file name.

   The data will be transferred from the F400 to the personal computer.

   During communications, the F400 will generate a timeout error if there is no response from the external device for more than 30 s. An error message will be displayed on the screen, and the error terminal on the terminal block will turn ON.

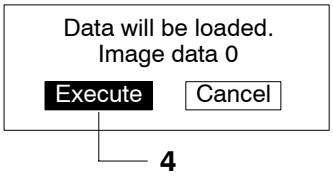
Loading Data from the Personal Computer

1. Follow steps 1 to 3 in the above procedure to connect the F400 and the personal computer.
2. Select ***Transfer/Send File*** from the Hyper Terminal menu. Select the file to be sent and set the protocol to ***Xmodem***.
3. Select **Send**.

   The Data Transfer Window will be displayed.
4. Perform load operations at the F400.

   The data will be transferred from the personal computer to the F400.

   During communications, the F400 will generate a timeout error if there is no response from the external device for more than 30 s. An error message will be displayed on the screen, and the error terminal on the terminal block will turn ON.



5-4 Display Settings

5-4-1 Measurement Screen Settings *— Filter/Pickup —*

The following explains the settings procedures for the background color for characters displayed on the screen and menu boxes, conditions for storing images to memory, and displayed contents for measurement results.

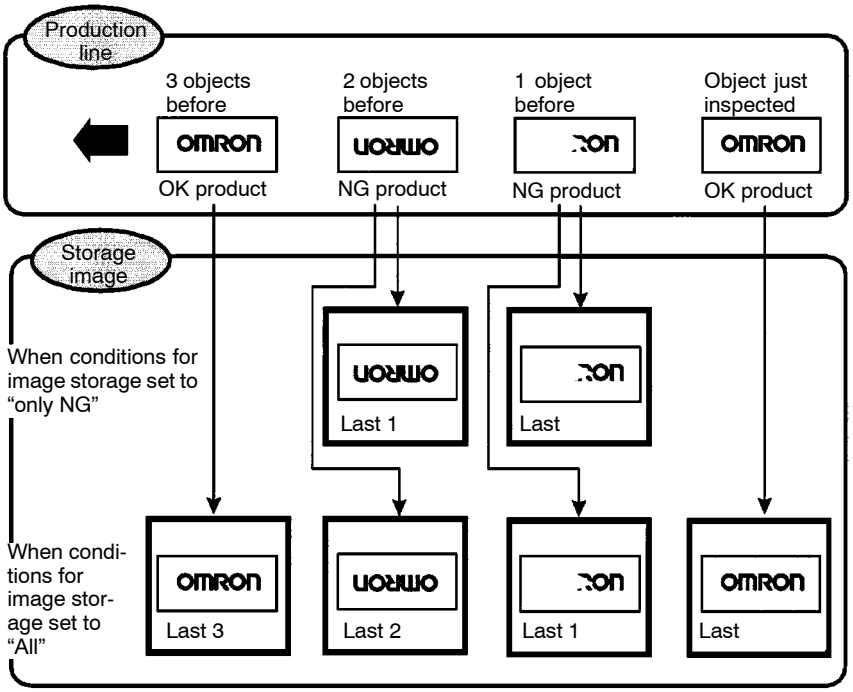
Image Types to be Stored and Measurement Result Display

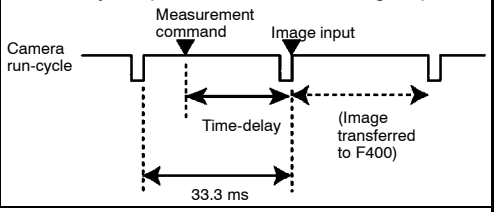
The F400 can store up to 16 measured images. It is possible to set the F400 to only store images which resulted in NG judgements, or to store all images regardless of the measurement result. Also, measurement results and other information can be displayed on the measurement screens and monitor screens. Make settings to determine which information will be displayed.

Note Stored images are cleared when the power is turned OFF. Save the images by backing them up to a personal computer.

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Image Storage Function

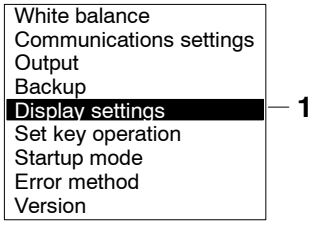


Item	Details	
Character color	White (default setting), black, green, blue, red, yellow	Sets the color of screen characters.
Background color	White, black (default setting), green, blue, red, yellow	Sets the background color for menu boxes.
Display image	Select the display status for the screen. Color: image before adjustment Measurement image: image after adjustment	
	Color freeze Measurement image freeze	Displays a still image (updated each time a measurement is performed.) When inspecting moving objects, select "freeze."
	Color through (default setting) Measurement image through	Displays the image currently being taken by the Camera. If measurement is performed in through state, depending on the input timing of the Measurement command, there will be a time-delay of up to 33.3 ms before image input. 
Display result	Select the data displayed for measurement results. (The default setting is "None.") For details refer to *4-1-1 Adjusting Evaluation Criteria while Viewing Measurements*. → **p. 85**	

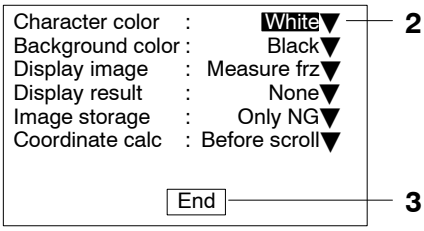
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Item	Details	
Image storage	Select the conditions for storage of measured images.	
	None	Nothing stored.
	Only NG (default setting)	Only images with NG judgements are stored. (However, the most recent image is stored regardless of the judgement.)
	All	All images are stored regardless of the judgement.
Coordinates calculation	Select the coordinates for output.	
	Before scroll (default setting)	Output made using the coordinate values before position displacement compensation.
	After scroll	Output made using the coordinate values after position displacement compensation.

1. Move the cursor to ***SYS*/*Display settings***, and press the **ENT** Key.
   The Settings Window will be displayed.



2. Move the cursor to the item to be changed and press the **ENT** Key.
   The settings will be displayed. Select the required setting.

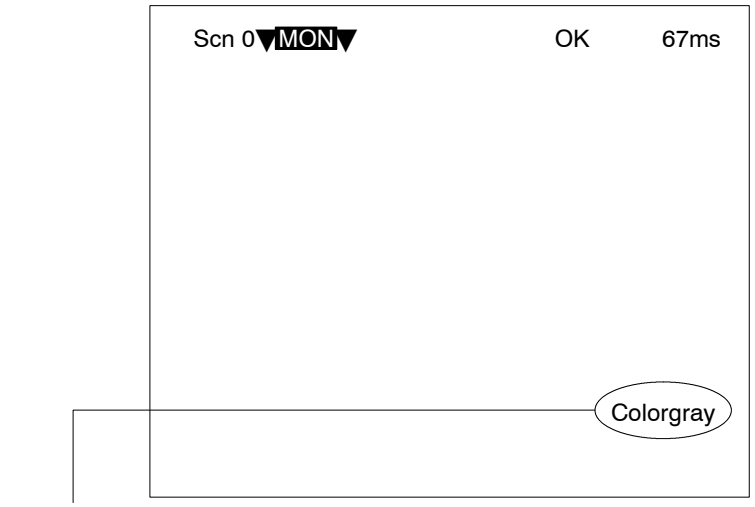


3. When setting has been completed, move the cursor to ***End*** and press the **ENT** Key. The settings will be saved.

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5-4-2 Changing the Display Image *— Filter/Pickup —*

When in Monitor or Run mode, stored images can be displayed on the screen. By displaying a stored image on the screen, the reason for a previous NG judgement can be checked. Also, measurement can be re-performed on the stored image with different evaluation criteria. The message in the lower-right corner of the screen indicates the type of image being displayed.

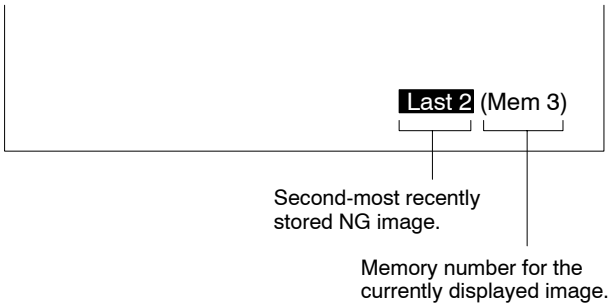


(Refer to the following table.)

Display		Details
Freeze/through		The image that has just been measured is displayed. Whether this image is a freeze image or a through image depends on the settings in ***SYS/Display***.
	Color frz Color thr	The image taken by the Camera is displayed without adjustment.
	□frz □thr	An adjusted image is displayed. One of the following appears in □: Color Filter Mode: Colorgray, Red, Green, Blue, Gray Color Pickup Mode: Pickup
_(Mem □)		A previously stored image is displayed. Up to 16 (Mem 0 to 15) images are stored in accordance with the conditions for storage of measured images (only NG or All). When the image is to be backed up to a personal computer, specify a memory number in □.
	Last (Mem □)	The measured image most recently stored is displayed. If this image had an NG judgement, “Last” will be in reverse black/white.

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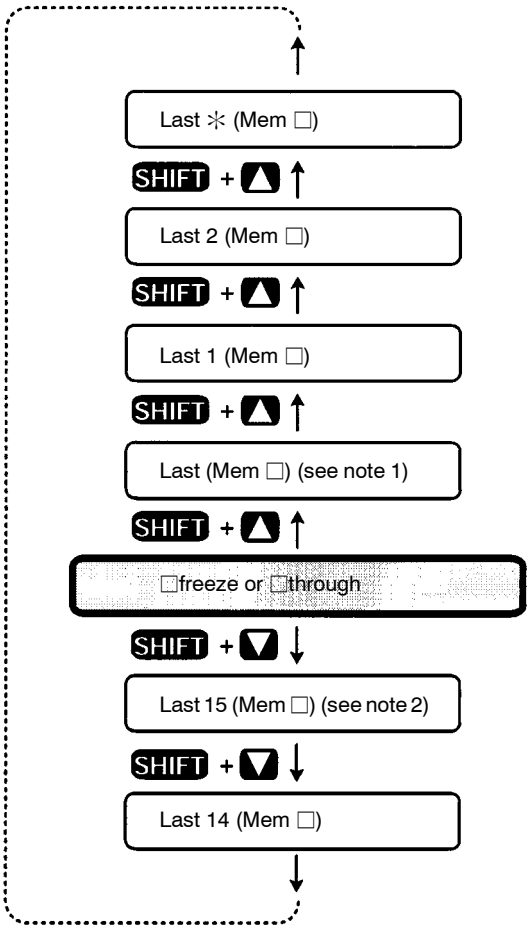
Display		Details
	Last ⁜ (Mem □)	The ⁜ after “Last” contains the number indicating how many screens previously the image was stored. Up to 16 previous images can be displayed. “Last ⁜” will be in reverse black/white for NG images.
	...(Mem □)	Either no image is stored in memory, or an image other than a measurement image (eg. an image loaded from a personal computer) is displayed.



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Switching Screens

Screens can be switched in Monitor mode or Run mode using the **SHIFT** + **Up**/**Down** Keys.



Note

1. Under the following conditions, the images for "Last (Mem □)" and "[Measure frz]" will be the same.
   Display image: Set to [Measure frz]
   Image memory: Set to all.
   or
   Display image: Set to [Color frz]
   Image memory: Set to only NG.
   Last measurement was NG.
2. If the following conditions apply, the number of stored images will not exceed 14.
   Image memory: Set to only NG
   Last measurement was OK.

If the adjustments or color filter conditions are different for the position compensation and actual measurement, 2 screens will be stored in memory for one measurement. These screens will be displayed in the following way:

Last ⁎-P (Mem □): Position compensation measurement image
Last ⁎-M (Mem □): Actual measurement image

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5-5 Key Allocation *— Filter/Pickup —*

The allocation of functions to console keys can be changed. These settings are only valid in Monitor and Run modes.

Selection	Function
None	There are no functions for keys with this setting.
Display settings	Displays the ***SYS/Display*** menu.
Previous image	Switches to previous stored image.
Next image	Switches to next stored image.
Change background	Switches the background color (clear or filled) for the measurement results list. (Only possible for "All results of regions," "All judges," "All data," and I/O Monitor Screen.)
Judge conditions	Displays the Setting Screen for the evaluation criteria.
Individual/All	Jumps to "All results of regions" or "All positions of regions." Valid while the screens displaying measurement results for regions, judge, data, or "All" are displayed.
Previous scene	Switches to previous scene.
Next scene	Switches to next scene.
I/O monitor	Switches to the I/O Monitor Screen
Clear images (see note 1)	Displays a confirmation message for clearing stored images.
Erase characters (see note 2)	Displays the settings menu for character display.

Note 1. The "Clear images" function clears all stored images. The images are cleared when the power is turned OFF. Use this method to clear images when changing the scene mode (Color Filter ↔ Color Pickup) and making condition settings.

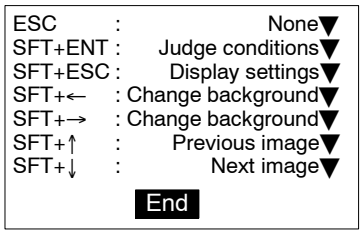


2. The "Erase characters" function can be used to delete characters displayed on the screen and to switch to monochrome images in order to prevent image burning of the screen.

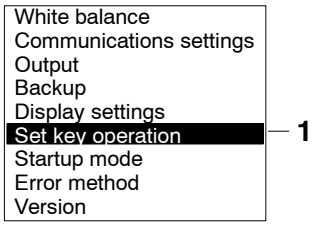


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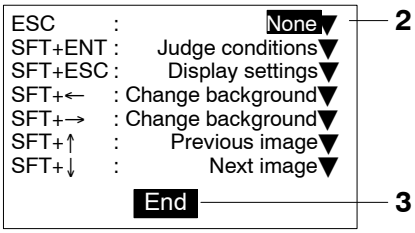
The default key allocations are as shown below:



1. Go to ***SYS/Set key operation*** and press the **ENT** Key. The Setting Screen will be displayed.



2. Move the cursor to the item to be changed and press the **ENT** Key. A selection list will be displayed.



3. When the required settings have been made, move the cursor to ***End*** and press the **ENT** Key. The set conditions will be saved.

5-6 Startup Mode

— Filter/Pickup —

Use the following procedure to set the startup scene and mode that will be used when the power is turned ON.

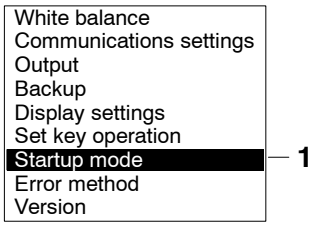
If the F400 is set to start in Run Mode for the scene where the desired measurement conditions are registered, measurement of objects can be started immediately by simply turning the power ON and pressing the **TRIG** Key.

When this setting is set to ***OFF***, the F400 will start up in the most recently saved status.

The default setting is for scene 0 and MON (Monitor) mode.

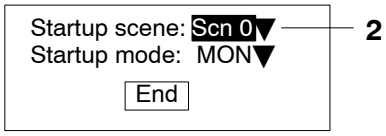
1. Move the cursor to ***SYS/Startup mode***, and press the **ENT** Key.

   The Setting Window will be displayed.

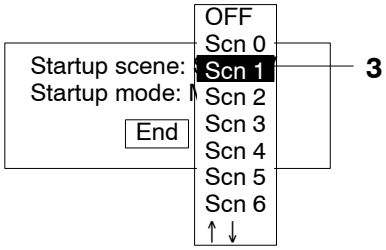


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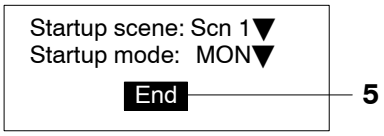
2. Move the cursor to ***Startup scene***, and press the **ENT** Key.
   The settings will be displayed.



3. Move the cursor to the desired scene and press the **ENT** Key.
   The setting will be saved.
4. Set the startup mode in the same way.



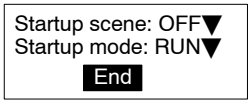
5. When all the desired settings have been made, move the cursor to **End** and press the **ENT** Key.
   The settings will be saved, and the display will return to the window shown in step 1.



Example:

Startup scene: OFF

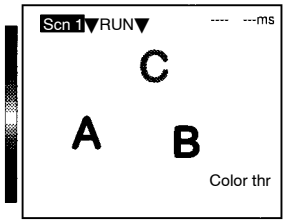
Startup mode: Run



After setting measurement conditions for scene 1, save the settings.

The next time the power is turned ON:

Run Mode for scene 1 will be started. Measurement can be performed immediately.



5-7 Error Settings

— Filter/Pickup —

While the BUSY signal is ON, the F400 is processing data and cannot receive STEP signals. The ERR terminal can be set to turn ON in order to notify an external machine that a STEP signal has not been received while the BUSY signal is ON.

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The BUSY signal will turn ON under the following conditions:

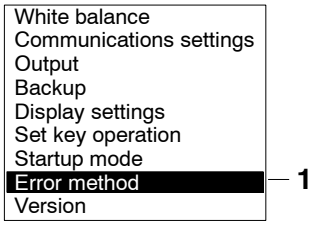
When the F400 is in Set or System Mode.

When the F400 is executing measurement or commands in Monitor or Run Mode.

Selection	Contents
ERR ON (default setting)	During processing (i.e.: BUSY terminal ON), if the STEP signal comes ON, the ERR terminal will be turned ON and measurement will not be performed. The next time a STEP signal is input with the BUSY terminal OFF, the ERR terminal will go OFF.
OFF	During processing (i.e.: BUSY terminal ON), even if the STEP signal comes ON, the ERR terminal will not come ON. Measurement will not be performed.

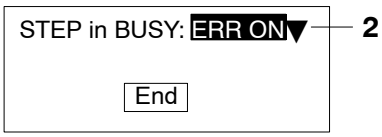
1. Move the cursor to ***SYS/Error method***, and press the **ENT** Key.

   The Setting Window will be displayed.



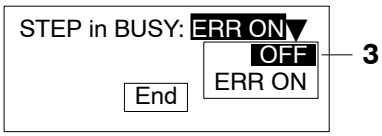
2. Move the cursor to ***STEP in BUSY*** and press the **ENT** Key.

   The settings will be displayed.



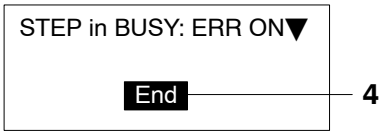
3. Move the cursor to ***OFF*** or ***ERR ON*** and press the **ENT** Key.

   The setting will be saved.



4. Move the cursor to ***End*** and press the **ENT** Key.

   The setting will be saved, and the display will return to the window shown in step 1.

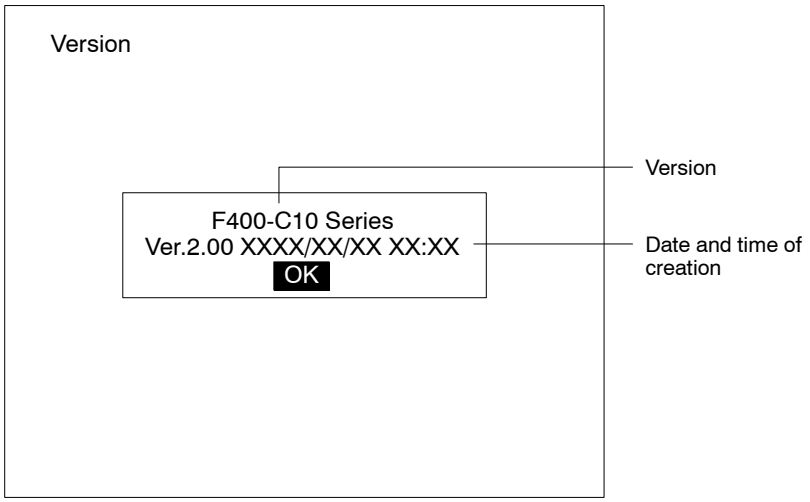


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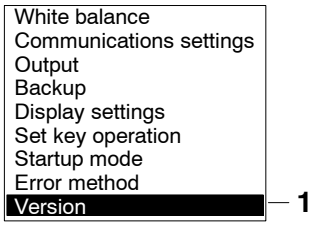
5-8 Version

— Filter/Pickup —

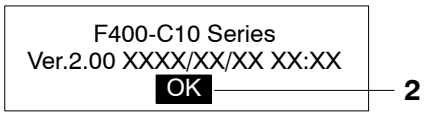
Use the following procedure to check the version of the system software.



1. Move the cursor to ***SYS/Version***, and press the **ENT** Key.
   The system version information will be displayed.



2. Move the cursor to ***OK*** and press the **ENT** Key to exit.



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SECTION 6
Communications with External Devices

This section describes the communications settings and I/O formats for communications with external devices.

6-1 Terminal Blocks 112
6-1-1 I/O Format 112
6-1-2 Terminal Signal Operation and Timing 112
6-1-3 Setting Communications (Terminal Block) 118
6-2 RS-232C Port 119
6-2-1 Flowcharts 119
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6-2-3 Input Command List 122
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6-1 Terminal Blocks *— Filter/Pickup —*

This section describes the communications settings and I/O formats for communications with external devices via the terminal block.

6-1-1 I/O Format

Inputs

The following commands can be input in Run Mode.

STEP Input

One measurement will be performed when the STEP signal turns ON. (STEP signal can also be input in Monitor Mode.)

DI0 to DI7 Inputs

The DI0 to DI7 inputs can be used to execute measurements continuously or to switch scenes as shown in the following table.

DI7 is the input trigger. A delay of at least 1 ms must, be provided after DI0 to DI6 are set before DI7 is turned ON.

Command	DI inputs								Function
	Execute	Command			Operand				
	7	6	5	4	3	2	1	0	
Continuous measurement	1	0	0	1	*	*	*	*	Measurement is performed continually during command input.
Switching scenes	1	0	1	0	Scene no.				Switches the scene.
Example	1	0	1	0	0	0	1	0	Switches to scene 2.

0: OFF
1: ON
*: Status is not read by F400, i.e., the status does not matter.

Outputs

The judgements for expressions or regions can be output by allocating them to terminals, DO0 to DO15. The overall judgement is output to the OR terminal.

The data is only output in Run mode. There is no output to the terminals in Monitor mode.

The F400 can be set to turn ON terminals for either OK or NG results. The default is for output to be ON for NG results.

OR Terminal

The overall judgement is output to the OR terminal. This overall judgement will be NG if there is even just one NG judgement for the set measurement regions or expressions.

DO Terminals

The outputs made to the terminals are as follows:

DO terminals	Output
0 to 15	The judgements for the expressions set in ***Expression/Judge*** (in Set mode) allocated to DO 0 to DO 15 will be output.

⚠ Caution The initial status of the output terminals is OFF. The terminals, however, may turn ON for approximately 0.5 s when the power is turned ON. Be sure to allow for this when reading the status at an external device.

Refer to *3-4 Expressions* → **p. 75**

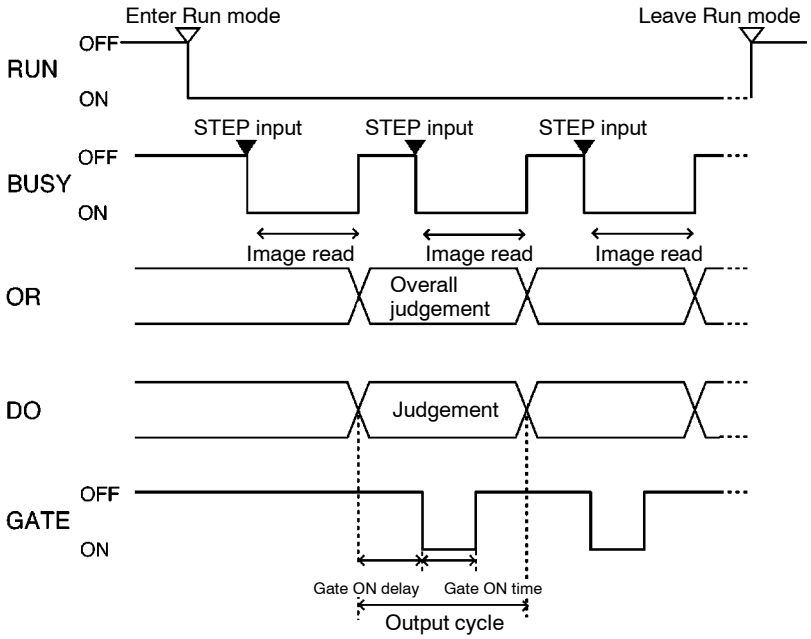
6-1-2 Terminal Signal Operation and Timing *— Filter/Pickup —*

When performing communications without handshaking, the F400 outputs the measurement results without synchronizing with the external device. Read the measurement results at the external device while the GATE terminal is ON.

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No Handshaking

Using the STEP Signal as a Measurement Trigger



Output Terminals

Terminal	Function
RUN	Turns ON during Run mode.
BUSY	Shows that the F400 is reading an image, changing a scene, etc. Do not input the next command while the BUSY signal is ON. Otherwise, commands may not be properly executed.
OR	Outputs the overall judgements. (Can be set to turn ON for either OK or NG judgement.) The overall result will be NG if there is one or more NG judgements for the measurement regions or output expressions. → *6-1-3 Setting Communications (Terminal Block)* **p. 118**
DO 0 to DO 15	Output the judgements for the items allocated to the terminals. (Can be set to turn ON for either OK or NG judgement.) → *6-1-3 Setting Communications (Terminal Block)* **p. 118**
GATE	This signal notifies the external device when the F400 is outputting valid data. Used to time the reading of the measurement result at the external device. The time that GATE is turned ON can be set as required for the external device to correctly read the measurement result. Make the output time shorter than the duration of the measurement (STEP input interval). If the cycle is longer, the output timing will fall behind as measurements are repeated.

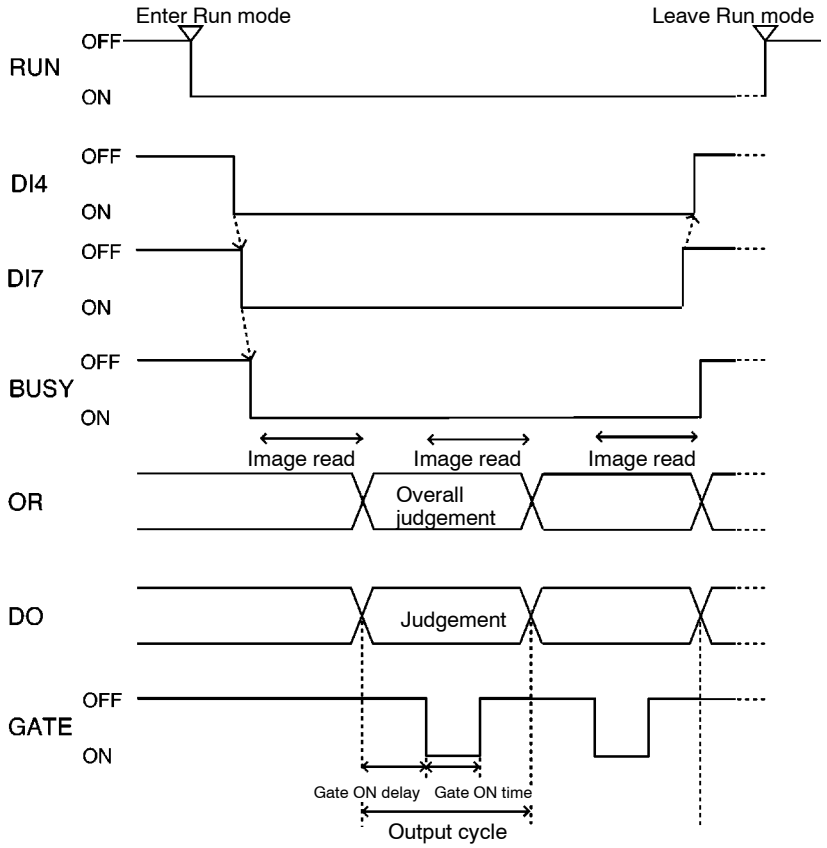
Input Terminals

Terminal	Function
STEP	Inputs a measurement trigger from a photoelectric sensor or other external device. One measurement will be taken on the rising edge of the STEP signal. Turn ON the STEP for at least 0.5 ms.

Note When the STEP signal is input while BUSY is ON, the ERR terminal turns ON. Refer to *5-7 Error Settings*. → **p. 108**

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Performing Continuous Measurements



Output Terminals

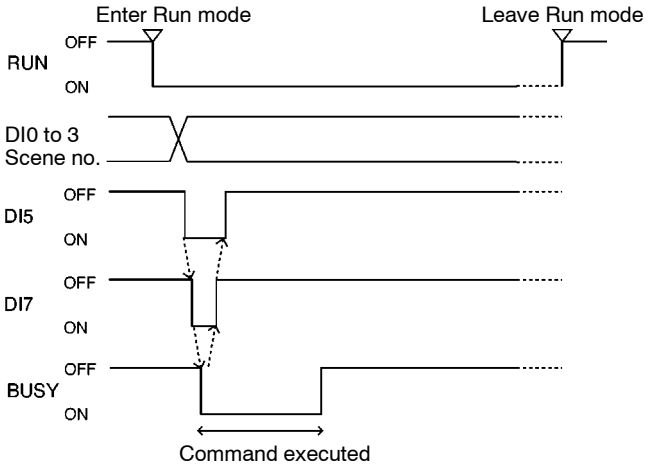
Terminal	Function
RUN	Turns ON during Run mode.
BUSY	Shows that the F400 is reading an image, changing a scene, etc. Do not input the next command while the BUSY signal is ON. Otherwise, commands may not be properly executed.
OR	Outputs the overall judgements. (Can be set to turn ON for either OK or NG images.) The overall result will be NG if there is one or more NG judgements for the measurement regions or output expressions. → *6-1-3 Setting Communications (Terminal Block)* **p. 118**
DO 0 to DO 15	Output the judgements for the items allocated to the terminals. (Can be set to turn ON for either OK or NG judgement.) → *6-1-3 Setting Communications (Terminal Block)* **p. 118**
GATE	This signal notifies the external device when the F400 is outputting valid data. Used to time the reading of the measurement results at the external device. The time that GATE is turned ON can be set as required for the external device to correctly read the measurement results. Make the output time shorter than the duration of the measurement (STEP input interval). If the cycle is longer, the output timing will fall behind as measurements are repeated.

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Input Terminals

Terminal	Function
DI0 to 3	OFF
DI 4	ON
DI5 to 6	OFF
DI 7	Execution signal. Set DI0 to 6 to ON, wait at least 1 ms and then turn ON DI7. The BUSY terminal will turn ON during continuous measurement.

Changing Scenes



Output Terminals

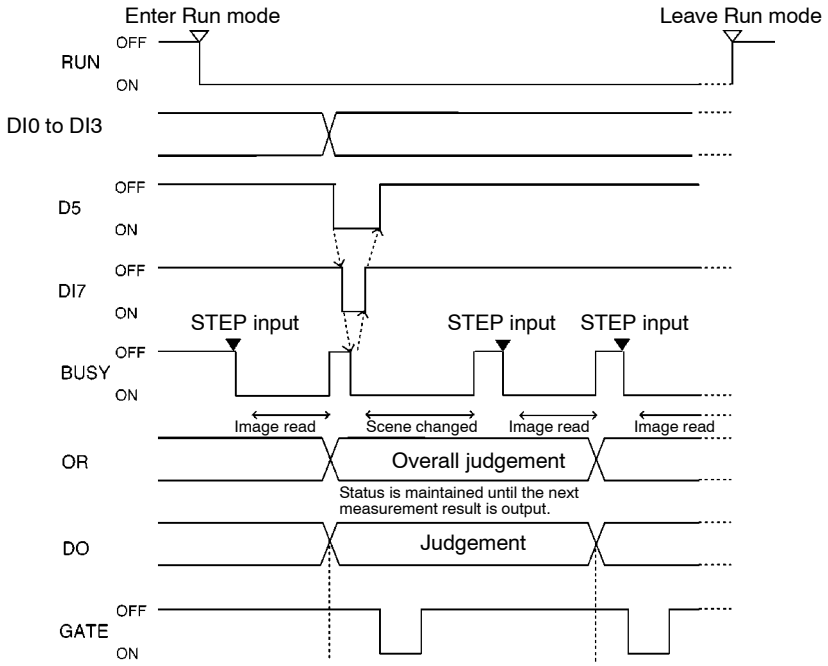
Terminal	Function
RUN	Turns ON during Run mode.
BUSY	Shows that the F400 is reading an image, changing a scene, etc. Do not input the next command while the BUSY signal is ON. Otherwise, commands may not be properly executed.

Input Terminals

Terminal	Function
DI 0 to DI 3	Sets the scene number. (0 to 15)
DI4	OFF
DI 5	ON
DI6	OFF
DI 7	Execution signal. Set DI0 to 6 to ON, wait at least 1 ms and then turn ON DI7. The BUSY terminal will turn ON while the scene is being changed. Turn OFF the DI7 terminal after confirming the BUSY terminal is turned ON, and turn OFF DI0 to 6.

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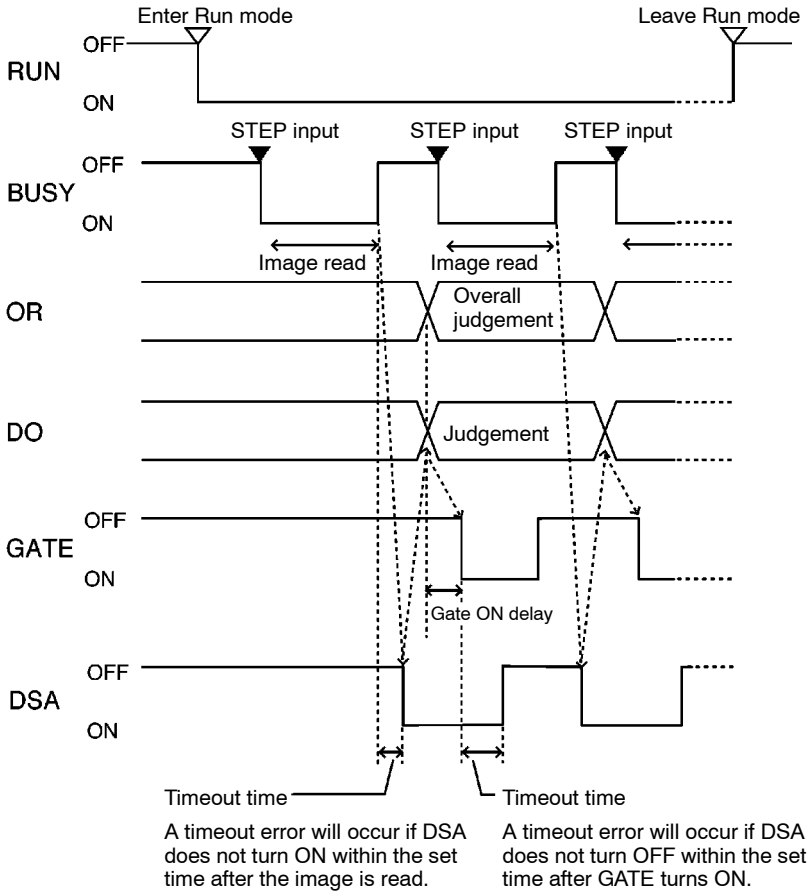
The following timing chart shows changing the scene and then reading images.



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Using Handshaking

When communications are performed with handshaking, the F400 outputs measurement results in sync with external devices. This is an effective way to output several measurement results in order, allowing data to be properly transferred.



The function of all terminals except DSA is the same as for communications without handshaking. The DSA terminal is used only with handshaking.

DSA Terminal

Terminal	Function
DSA	Requests the next data output from the external device. The F400 will not output data until this terminal is turned ON. Turn ON the DSA terminal when the external device is ready to receive data and the F400 has finished measurement. The BUSY terminal is ON during measurement, i.e., measurement will be completed when the BUSY terminal turns OFF. Use the BUSY signal to time reading measurement results.

Note When the STEP signal is input while BUSY is ON, the ERR terminal turns ON. Refer to *5-7 Error Settings*.

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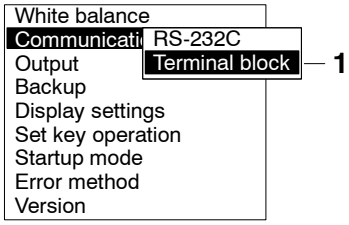
6-1-3 Setting Communications (Terminal Block) *— Filter/Pickup —*

This section explains the operations necessary to set communications specifications. The items that can be set and their descriptions are listed below.

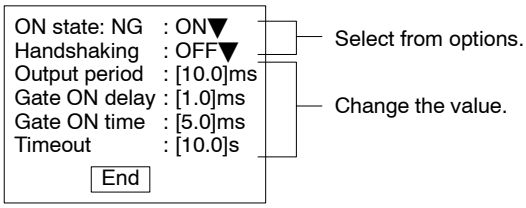
Item		Description
Output polarity ON state	ON: OK	Turns ON the OR and DO0 to DO15 terminals when the evaluation result is OK.
	ON: NG*	Turns ON the OR and DO0 to DO15 terminals when the evaluation result is NG.
Handshaking	OFF*	Used to output the measurement result without synchronizing with the external device. This is the default setting.
	ON	Used to output the measurement result while synchronizing with the external device.
Output period (Only effective without handshaking)	2.0 to 10,000.0 ms (10.0 ms*)	Set the output period for the measurement result. Set a value between 2.0 and 10,000.0 ms that is greater than the Gate ON delay time + Gate ON time, and less than the measurement interval. If this cycle is longer than the measurement interval, the output timing will fall behind as the measurements are repeated.
Gate ON delay	1.0 to 1,000.0 ms (1.0 ms*)	Set the time from when the result is output to the terminal block to when the GATE signal is turned ON. This time is used to wait until the data output becomes stable. Set a time between 1.0 and 1,000.0 ms that is longer than the delay time for the external device.
Gate ON time (Only effective without handshaking)	1.0 to 1,000.0 ms (5.0 ms*)	Set the time during which the GATE signal is ON. Set a value between 1.0 and 1,000.0 ms so that the external device can read the measurement result.
Timeout (Only effective with handshaking)	0.5 to 120.0 s (10.0 s*)	A timeout error will occur if there is no response from the external device within the set time.

Note Default settings are indicated by an asterisk (*).

1. Move the cursor to ***SYS/Communications settings/Terminal block***, and press the **ENT** Key. The Communications Specifications Setting Screen will be displayed.

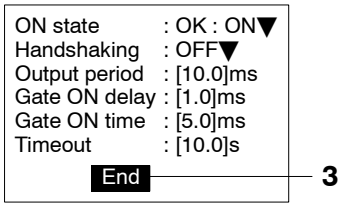


2. Move the cursor to the item to be changed and press the **ENT** Key. Options are available for items indicated by a ▼mark. New values can be input in the parentheses.



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3. When the item has been changed, move the cursor to ***End*** and press the **ENT** Key. The communications specifications will be saved and the display will return to the window shown in step 1.



6-2 RS-232C Port

Communications can be made with external devices such as personal computers via the RS-232C port in Normal mode.

6-2-1 Flowcharts *— Filter/Pickup —*

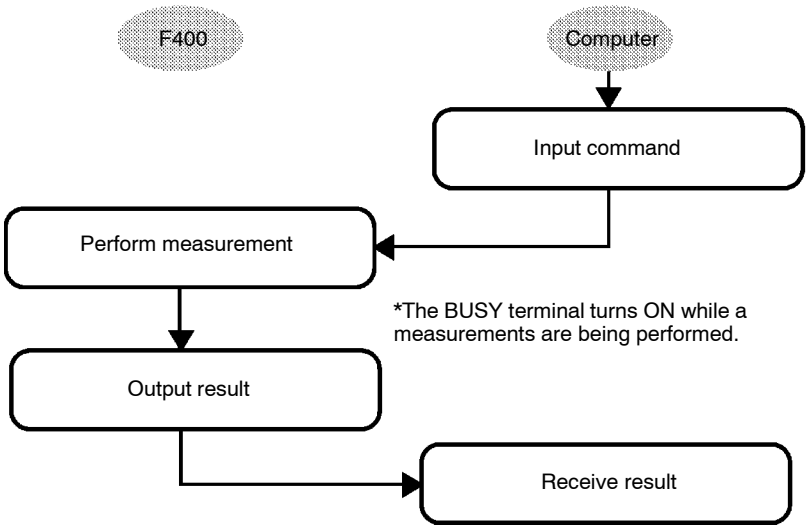
Setting Mode
Command inputs are not accepted.

Monitor Mode
Command inputs are accepted. However, measurement results are not output to external devices. Only the command execution result (OK or ER) is output.

Run Mode
Commands can be input and measurement results can be output.

Measurement Commands

I/O via the RS-232C Port

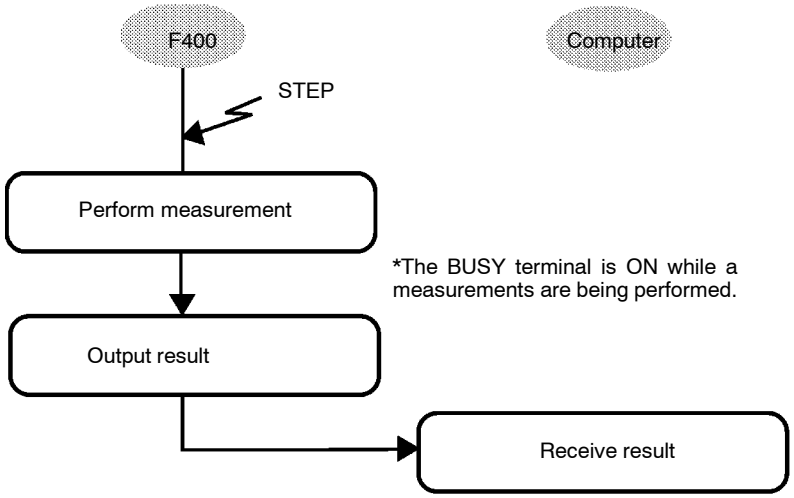


Note When RS/CS or Xon/Xoff is selected for flow control, the F400 will determine that either the line has been interrupted or the personal computer is not functioning normally and generate a timeout error if there is no response within the set time. An error message will be displayed on the video monitor and the error terminal on the terminal block will turn ON.

Refer to *3-4 Setting Outputs* for information on outputs to the RS-232C port → **p. 75**

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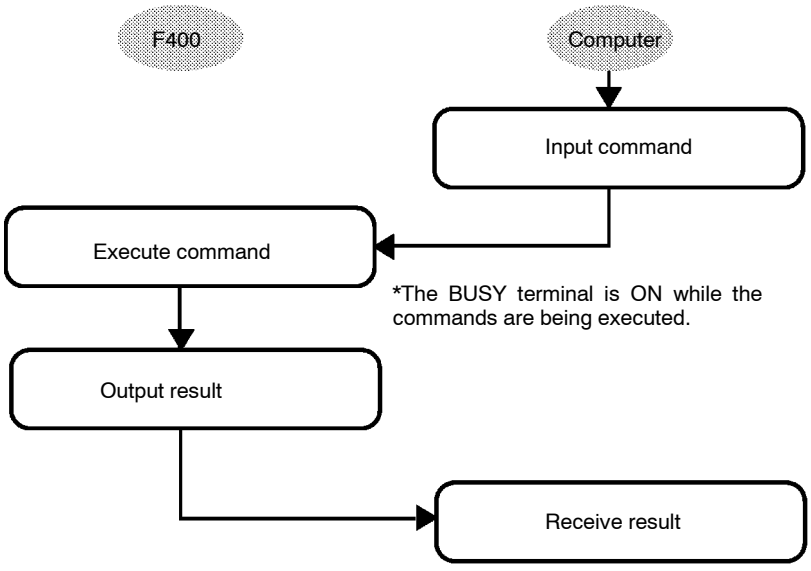
STEP Signal as Measurement Trigger



Note When RS/CS or Xon/Xoff is selected for flow control, the F400 will determine that either the line has been interrupted or the personal computer is not functioning normally and generate a timeout error if there is no response within the set time. An error message will be displayed on the video monitor and the error terminal on the terminal block will turn ON.

Non-measurement Commands

The following timing chart shows the basic flow of command execution.



Note When RS/CS or Xon/Xoff is selected for flow control, the F400 will determine that either the line has been interrupted or the personal computer is not functioning normally and generate a timeout error if there is no response within the set time. An error message will be displayed on the video monitor and the error terminal on the terminal block will turn ON.

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6-2-2 Setting Communications (RS-232C) *— Filter/Pickup —*

The RS-232C port can be used to save and load data, on an external device. This section describes the setting used for the RS-232C port.

The same communications settings must be used on both the F400 and the external device.

Item	Setting	
Baud rate	2400, 4800, 9600, 19200, 38400* (bps)	Use the same settings on the IBM PC/AT or compatible computer.
Data length	7, 8* (bits)	
Parity bit	None*, even, odd	
Stop bits	1*, 2 (bits)	
Delimiter	CR*, LF, CR+LF	
Flow control	None*	Flow control not performed.
	RS/CS	Flow control performed with hardware. Use a cable that connects the F400 and the RS signals and CS signals from the external device. Data is sent when the CS signal from the external device is ON.
	Xon/Xoff	Flow control performed by the software. Data is sent in accordance with the Xon/Xoff code sent from the external device.
Timeout	1 to 120 s (5 s*)	Used for setting the time for generating a timeout error in second units.

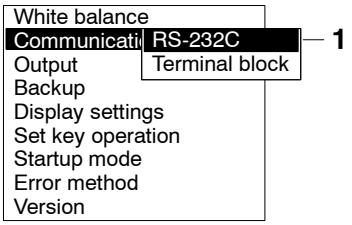
Note The default settings are indicated by an asterisk (*).

Xmodem Protocol

When using save or load commands (IMGLOAD, IMGSAVE, SCNLOAD, SCNSAVE), set the communications settings as shown below.

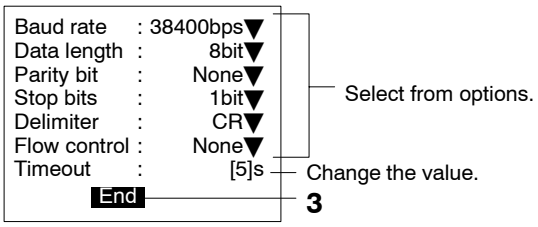
Data length	8 bits
Parity bit	None
Stop bits	1 bit
Flow control	None

1. Move the cursor to ***SYS*/*Communications settings*/*RS-232C***, and press the **ENT** Key. The Communications Specifications Setting Screen will be displayed.



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2. Move the cursor to the item to be changed and press the **ENT** Key. Options are available for items indicated by a ▼mark. New values can be entered in the parentheses.



3. When the item has been changed, move the cursor to ***End*** and press the **ENT** Key. The communications settings will be saved and screen 1 above will be returned.

Note Flow control is used to perform communications while monitoring the status of the external device.

6-2-3 Input Command List — *Filter/Pickup* —

The following commands can be input from the a computer or other host device connected to the RS-232C port. Commands are input in ASCII. The terms in parentheses indicate abbreviations for the commands. The full command name or its abbreviation can be used.

Before inputting commands, be sure that the F400 and external device communications settings are the same.

Commands that Control Operation

The following commands are used to control F400 operation.

Command	Function
MEASURE (M)	Performs one measurement. Performs one measurement on a stored image being displayed. Starts continuous measurement. Stops continuous measurement.
MENUKEY	Switches from RS-232C input to menu operation.
RESET	Resets the F400.
SCENE	Reads the scene number currently displayed. Changes the scene.

Commands that Read Measurement Results

The following commands read the results of the most recent measurement.

Command	Function
POSIDATA (PD)	Reads position compensation result and position compensation amount.
MEASDATA (MD)	Reads measurement results.
EXP	Reads measurement values of expressions.

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Commands for Saving or Loading Data

The following commands make backups for data set at the F400 and images stored in memory in the personal computer.

Command	Function
DATASAVE	Saves all data to flash memory.
SCNLOAD	Loads scene data from an external device.
SCNSAVE	Saves scene data to an external device.
IMGLOAD	Loads image data from an external device.
IMGSAVE	Saves data for images stored in memory to an external device.

Commands that Read/Change Settings

The following commands read or set measurement conditions.

Command	Function
POSIPARA (PP)	Reads or sets the parameters for position compensation regions.
MEASPARA (MP)	Reads or sets the parameters for measurement regions.
EXPPARA (EP)	Reads or sets the parameters for expressions.

6-2-4 I/O Format *— Filter/Pickup —*

Input Format

The commands are input in ASCII. Both upper-case letters and lower-case letters are available.

a) b) c)

`MEASDATA` *<Measurement_region_number>* *<Parameter>delimiter*

a) Variables are indicated in italics in pointed brackets< >. Actual values must be input for the variables.

b) Leave a space between parameters except before the delimiter.

c) A delimiter is required at the end of the command.

Note The delimiters have been omitted from the commands and responses in this manual except where required for clarity. Be sure to allow for delimiters in programming.

Output Format

Measurement results are output in ASCII in order from the smallest output number to the largest. When a command is input, OK or ER will be output when the F400 output has ended. Do not input the next command until this output is received.

Measurement correctly performed:

<Measurement_results_for_output_0>
<Measurement_results_for_output_1>
<Measurement_results_for_output_2>
<Measurement_results_for_output_3>
<Measurement_results_for_output_4>
<Measurement_results_for_output_5>
<Measurement_results_for_output_6>
<Measurement_results_for_output_7>delimiter
OKdelimiter

The measurement results are output in order of output numbers.

Numbers consisting of a 7-digit integer component and a 3-digit decimal component will be output in the order of the output number. The integer component digit varies depending on the measurement values, but the decimal component digit remains at 3.

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If set to calibrate, the output values are those after calibration.

Values between –9,999,999.999 and 9,999,999.999 are output.

If the measurement is less than –9,999,999.999, the output will be –9,999,999.999.

If the measurement is greater than 9,999,999.999, the output will be 9,999,999.999.

If judgement is set, the following values will be output:
OK: 0
NG: –1

"ER" will be output if the measurement is not correctly made.

Command Formats

The formats for commands are given here in alphabetical order.

DATASAVE: Data Save

DATASAVE is used to save all data to flash memory.

Input

`DATASAVE`

Output

Data correctly saved: `OK`
Data not correctly saved: `ER`

Note Do not turn OFF the power until a response has been received.

EXP: Expression

EXP is used to read the results of expressions.

Input

`EXP` *<Output_type> <Output_number>*

- Specify 0 for Judge (terminal block) or 1 for Data (RS-232C port) as the output type.
- Specify the output number as follows:

Output type	Output number
Judge	0 to 15
Data	0 to 7

Output

The specified result will be output from the F400.
Reading performed correctly: *<measurement>delimiter* `OK`*delimiter*
Reading not performed correctly: `ER`

Example

Input: `EXP 0 0`
Reads the result (measurement value) of the expression set in output terminal 0 (DO 0).
Output: `28.195` *delimiter* `OK` *delimiter*
The measurement value is 28.195.

EXPPARA: Expression Parameter

EXPPARA is used to read and set evaluation criteria for terminal block outputs.

Reading Evaluation Criteria

Input

`EXPPARA` (*or* `EP`) *<Judge_output_number> <Parameter>*

- Specify a value 0 to 15 for the judge output number.
- The meanings of the parameters are as follows:

Parameter	Meaning
0	Upper limit for expression
1	Lower limit for expression

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Output

The specified criteria (upper limit or lower limit) will be output from the F400.
Data correctly read: *<criteria>delimiter* `OK` *delimiter*
Input command incorrect: `ER`

Example

Input: `EXPPARA` (or `EP`) `0 0`
The upper limit of the evaluation criteria set for output terminal 0 (DO 0) of the terminal block is read.
Output: `100.000` *delimiter* `OK` *delimiter*
The upper limit is set to 100.000.

Setting Evaluation Criteria

Input

`EXPPARA` (or `EP`) *<Judge_output_number> <Parameter> <Value>*

- Specify a value 0 to 15 for the judge output number.
- Select only the parameter to be changed. The values for all other parameters will remain unchanged. Leave a space between the parameter type and value.
- The meanings of the parameters are as follows:

Parameter	Meaning
0	Upper limit for output expression (–9999999.999 to 9999999.999)
1	Lower limit for output expression (–9999999.999 to 9999999.999)

Output

The following response will be made from the F400:
Settings correctly performed: `OK`
Settings incorrectly performed: `ER`

Example

Input: `EXPPARA 0 0 150.000`
The upper limit for the criteria for judge 0 is changed to 150.000.
Output: `OK`

IMGLOAD: Image Load

IMGLOAD is used to load image data from the external device.

Input

`IMGLOAD` *<Memory_image_number>*

- Specify a memory image number between 0 and 15. The image data is loaded using the Xmodem (-CRC or -SUM) protocol.
- The F400 will begin preparations when the IMGLOAD command is input. Once the preparations have been completed, the READY signal will be turned ON. Wait until the external device receives the READY signal before starting to transfer data.
- Only BMP format image data can be loaded.

Output

The following response will be made from the F400.
Data correctly loaded: `OK`
Data not correctly loaded: `ER`

Example

Input: `IMGLOAD 2`
Image data is loaded from the external device to memory image 2.
Output: `OK`

IMGSAVE: Image Save

IMGSAVE is used to save data of memory images to the external device.

Input

`IMGSAVE` *<Memory_image_number>*

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- Specify a memory image number between 0 and 15. The image data is saved using the Xmodem (-CRC or -SUM) protocol.
- The memory image is transferred in BMP format.

Output
The following response will be made from the F400.
Data correctly saved: `OK`
Data not correctly saved: `ER`

Example
Input: `IMGSAVE 2`
The data from memory image 2 will be saved to the external device.
Output: `OK`

MEASPARA (MP): Measure Parameter

MEASPARA is used to read and set measurement region parameters.

Reading Measurement Region Parameters

Input
`MEASPARA` *<Region_number>* *<Parameter>*

- Specify a region number between 0 and 15.
- The parameter will change according to the measurement method registered in the specified measurement region. For details of parameters, refer to the parameter list.

Output
The following criteria will be output from the F400.
Data correctly read: *<criteria>delimiter* `OK` *delimiter*
Input command incorrect: `ER`

Example
Input: `MP 0 1`
The lower limit of X criteria for the search registered in region 0 will be read.
Output: `200.000` *delimiter* `OK` *delimiter*
The lower limit of X criteria is set to 200.000.

Setting Measurement Region Parameters

Input
`MEASPARA` *<Region_number>* *<Parameter>* *<Value>*

- Specify a region number between 0 and 15.
- The parameter will change according to the measurement method registered in the specified measurement region. For details of parameters, refer to the parameter list.
- Select only the parameter to be changed. Values for all other parameters will remain unchanged.
- Leave a space between the parameter type and value.

Output
The following response will be made from the F400:
Parameter correctly set: `OK`
Parameter incorrectly set: `ER`

Example
Input: `MP 0 1 400`
The lower limit of X criteria for the search registered in region 0 will be changed to 400.000.
Output: `OK`

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List of Parameters (Same for MEASPARA and POSIPARA)

Surface Defect Measurements

Parameter	Contents
0	Defect (0 to 255)
1	Density upper limit (0 to 255)
2	Density lower limit (0 to 255)
3	Element size (4 to 80)
4	Element compare pitch (1 to 6)
5 to 10	*Region changes according to figure drawn. (see below)

Parameter	Box	Line	Circle	Arc
5	Upper-left corner X coordinate (0 to 511)	Starting point X coordinate (0 to 511)	Center X coordinate (0 to 511)	Center X coordinate (0 to 511)
6	Upper-left corner Y coordinate (0 to 483)	Starting point Y coordinate (0 to 483)	Center Y coordinate (0 to 483)	Center Y coordinate (0 to 483)
7	Lower-right corner X coordinate (0 to 511)	End point X coordinate (0 to 511)	Radius (1 to 512)	Radius (1 to 512)
8	Lower-right corner Y coordinate (0 to 483)	End point Y coordinate (0 to 483)	Thickness (1 to 64)	Thickness (1 to 64)
9	---	Thickness (1 to 64)	---	Starting angle (–180.00 to 180.00)
10	---	---	---	End angle (–180.00 to 180.00)

Edge Measurements

Parameter	Contents
0	Upper limit of criteria (–9,999.999 to 9,999.999)
1	Lower limit of criteria (–9,999.999 to 9,999.999)
2	Upper-left corner X coordinate of region (0 to 511)
3	Upper-left corner Y coordinate of region (0 to 483)
4	Lower-right corner X coordinate of region (0 to 511)
5	Lower-right corner Y coordinate of region (0 to 483)
6	Edge search direction (↑: 0, ↓: 1, →: 2, ←: 3)
7	Edge search color (light→dark: 0, dark→light: 1)
8	Edge level (0 to 100)

Search Measurements

Parameter	Contents
0	Upper limit of X criteria (–9,999.999 to 9,999.999)
1	Lower limit of X criteria (–9,999.999 to 9,999.999)
2	Upper limit of Y criteria (–9,999.999 to 9,999.999)
3	Lower limit of Y criteria (–9,999.999 to 9,999.999)
4	Upper limit of correlation criteria (0 to 100)
5	Lower limit of correlation criteria (0 to 100)
6	Upper-left corner X coordinate of region (0 to 511)
7	Upper-left corner Y coordinate of region (0 to 483)
8	Lower-right corner X coordinate of region (0 to 511)
9	Lower-right corner Y coordinate of region (0 to 483)
10	Model reference position X coordinate (0 to 511)
11	Model reference position Y coordinate (0 to 483)
12	Search speed (0: Low, 1 to 3, 4: High)

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Area and Center of Gravity, Center of Gravity and Axis Angle

Parameter	Contents
0	Upper limit of X criteria for center of gravity (–9,999.999 to 9,999.999)
1	Lower limit of X criteria for center of gravity (–9,999.999 to 9,999.999)
2	Upper limit of Y criteria for center of gravity (–9,999.999 to 9,999.999)
3	Lower limit of Y criteria for center of gravity (–9,999.999 to 9,999.999)
4	Upper limit of area criteria (0 to 9,999,999.999)
5	Lower limit of area criteria (0 to 9,999,999.999)
6	Upper-left corner X coordinate of region (0 to 511)
7	Upper-left corner Y coordinate of region (0 to 483)
8	Lower-right corner X coordinate of region (0 to 511)
9	Lower-right corner Y coordinate of region (0 to 483)
10	Upper limit of binary level (0 to 255)
11	Lower limit of binary level (0 to 255)
12	Binary level reversal (0: no reversal, 1: reversal)
13*	Upper limit of axis angle criteria (–180.000 to 180.000)
14*	Lower limit of axis angle criteria (–180.000 to 180.000)

Note Items with asterisks (*) are for center of gravity and axis angle measurements only.

MEASURE (M): Measure

MEASURE is used to perform measurements one at a time or to stop and start continuous measurements.

Performing One Measurement

Input

`MEASURE` (or `M`)

Output

The following response is output from the F400:
Measurement correctly performed: *<measurement_result> delimiter* `OK` *delimiter*
Measurement incorrectly performed: `ER`

Performing One Measurement on Currently Displayed Stored Image

Input

`MEASURE` (or `M`)

Output

The following response is output from the F400:
Measurement correctly performed: *<measurement_result> delimiter* `OK` *delimiter*
Measurement incorrectly performed: `ER`

Starting Continuous Measurements

Input

`MEASURE` (or `M`)`/C`

Output

The following response is output from the F400:
Measurement correctly performed: `OK` *delimiter* (once) *<continuous_measurements_results>*
Measurement incorrectly performed: `ER`

Stopping Continuous Measurements

Input

`MEASURE` (or `M`)`/E`

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Output
The following response is output from the F400:
Correctly performed: OK
Incorrectly performed: ER

MENUKEY

MENUKEY is used to change the RS-232C input to menu operation. No execution result (OK/ER) will be output from the F400 for this command.

Input
MENUKEY

Output
Nothing is output for this command.

To return to command input, press the **CTRL**+**Q** Keys.

MEASDATA (MD): Measure Data

MEASDATA is used to read measurement results.

Input
MEASDATA (or MD) *<Region_number> <Parameter>*

- Specify a region number between 0 and 15.
- The parameter will change according to the measurement method registered in the specified measurement region. For details of parameters, refer to the parameter list.

Output
The following measurement value will be output from the F400.
Parameter correctly read: *,<measurement_value> delimiter* OK *delimiter*
Input command incorrect: ER

Example
Input: MD 0 2
X criteria measured in the search of region 0 will be read.
Output: 200.000 *delimiter* OK *delimiter*
The measurement value of the X coordinate is 200.000.

List of Parameters (Same for MEASDATA and POSIDATA)

Surface Defect Measurements

Parameter	Contents
0	Judgement (0: OK, –1: NG, –2: not measured)
1	Defect
2	Maximum density
3	Minimum density

Edge Measurements

Parameter	Contents
0	Judgement (0: OK, –1: NG, –2: not measured)
1	Edge measurement value
2	Edge criteria position
3	Displacement

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Search Measurements

Parameter	Contents
0	Judgement (0: OK, –1: NG, –2: not measured)
1	X coordinate measurement value
2	Y coordinate measurement value
3	Model reference position X coordinate
4	Model reference position Y coordinate
5	Displacement in the X direction
6	Displacement in the Y direction
7	Correlation value

Area and Center of Gravity, Center of Gravity and Axis Angle Measurements

Parameter	Contents
0	Judgement (0: OK, –1: NG, –2: not measured)
1	Measurement value of X coordinate of center of gravity
2	Measurement value of Y coordinate of center of gravity
3	X coordinate of reference position for center of gravity
4	Y coordinate of reference position for center of gravity
5	Displacement in the X direction
6	Displacement in the Y direction
7	Measurement area
8	Reference area
9	Area difference (measurement area – reference area)
10	Inverted area (measurement region area – measurement area)
11*	Axis measurement
12*	Axis reference
13*	Axis displacement

Note Items with asterisks (*) are for center of gravity and axis angle measurements only.

POSIDATA (PD): Position Data

POSIDATA is used to read the position compensation result and the position compensation amount.

Reading the Position Compensation Result

Input

`POSIDATA` *<Position_compensation_region_number>* *<Parameter>*

- Specify a position compensation region number of 0 or 1.
- The parameter will change according to the position compensation method registered in the specified position compensation region. The parameters are the same as those for the MEASDATA command. For details of parameters, refer to that section.

Output

The specified measurement will be output from the F400.
Parameter correctly read: *<measurement_value> delimiter* `OK` *delimiter*
Input command incorrect: `ER`

Example

Input: `POSIDATA 0 2`
The X coordinate measurement value compensated for in the search of position compensation region 0 is read.
Output: `200.000` *delimiter* `OK` *delimiter*
The measurement value for the X coordinate is 200.000.

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Reading the Position Compensation Amount

Input

`POSIDATA 2` <*Parameter*>

Parameter	Contents
0	Displacement in the X direction
1	Displacement in the Y direction
2	Rotational displacement

Output

The specified measurement will be output from the F400.
Parameter correctly read: <*measurement_value*> *delimiter* `OK` *delimiter*
Input command incorrect: `ER`

Example

Input: `POSIDATA 2 0`
The position compensation in the X direction is read.
Output: `95.650` *delimiter* `OK` *delimiter*
The position compensation in the X direction is 95.650.

POSIPARA (PP): Position Parameter

POSIPARA is used to read and set the parameters for the position compensation region.

Reading Parameters for the Position Compensation Region

Input

`POSIPARA` (or `PP`) <*Position_compensation_region_number*> <*Parameter*>

- Specify a position compensation region number of 0 or 1.
- The parameter will change according to the position compensation method registered in the specified position compensation region. The parameters are the same as those for the MEASPARA command. For details of parameters, refer to that section.

Output

The specified parameter will be output from the F400.
Parameter correctly read: <*value*> *delimiter* `OK` *delimiter*
Input command incorrect: `ER`

Example

Input: *PP 0 1*
The lower limit for the X criteria for the search registered in position compensation region 0 is read.
Output: `200.000` *delimiter* `OK` *delimiter*
The lower limit for the X criteria is 200.000.

Setting Parameters for the Position Compensation Region

Input

`POSIPARA` (or `PP`) <*Position_compensation_region_number*> <*Parameter*> <*Value*>

- Specify a position compensation region number of 0 or 1.
- The parameter will change according to the position compensation method registered in the specified position compensation region. The parameters are the same as those for the MEASPARA command. For details of parameters, refer to that section.
- Select only the parameter to be changed. Values will remain unchanged for all other parameters.
- Leave a space between the parameter and the value.

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Output
The following response will be output from the F400:
Parameter set correctly: OK
Parameter not set correctly: ER

Example
Input: *PP 0 1 400*
The lower limit for the X criteria for the search registered in position compensation region 0 is changed to 400.000.
Output: OK

RESET: Reset

RESET is used to reset the F400.
No execution result (OK/ER) will be output from the F400 for this command.

Input
RESET

Output
Nothing is output for this command.

SCENE: Scene

SCENE is used to read or set the scene number.

Reading the Scene Number

Input
SCENE

Output
The current scene number is output.
Scene number correctly read: *<scene_number> delimiter* OK *delimiter*
Input command incorrect: ER

Example
Input: SCENE
Output: 0 *delimiter* OK *delimiter*
Scene 0 is displayed.

Setting the Scene Number

Input
SCENE *<Scene_number>*

Output
Scene correctly switched: OK
Scene not correctly switched: ER

Example
Input: SCENE 2
The measurement scene will be changed to scene 2.
Output: OK

SCNLOAD: Scene Load

SCNLOAD is used to load scene data from the computer or other external device connected to the RS-232C port.

Input
SCNLOAD *<Scene_number>*

- Specify a scene number between 0 and 15. The scene data is transferred using the Xmodem (-CRC or -SUM) protocol.
- The F400 will begin preparations when the SCNLOAD command is input. Once the preparations have been completed, the READY signal will be turned ON. Wait until the external device receives the READY signal before loading scene data.

Output
Data correctly loaded: OK
Data not correctly loaded: ER

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Example

Input: `SCNLOAD 2`

Data will be loaded to scene 2 from an external device.

Output: `OK`

SCNSAVE: Scene Save

SCNSAVE is used to save scene data to the external device.

Input

`SCNSAVE` <*Scene_number*>

- Specify a scene number between 0 and 15. The scene data is transferred using the Xmodem (-CRC or -SUM) protocol.

Output

The following response will be output from the F400.

Data correctly saved: `OK`

Data incorrectly saved: `ER`

Example

Input: `SCNSAVE 2`

Scene data form scene 2 is saved to the external device.

Output: `OK`

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SECTION 7
Troubleshooting

This section lists the errors that may occur during F400 operation, along with their probable causes and remedies.

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If a message marked with ERR is displayed, the error indicator for the F400 and the error terminal on the terminal block will turn ON.

Message	Probable Cause and Remedy
Adjusting white balance is failed.	Adjustment of RGB was not possible. The RGB cannot be adjusted properly if the image from the camera is too bright or too dark. Use the lens aperture and lighting to adjust the brightness at the center of the screen before re-attempting operation.
Camera is not connected.	The Camera Cable is not connected properly to the F400. Stop operations, turn OFF the power supply, check that the Camera Cable is connected properly, and turn ON the power supply again.
Draw at least one OR figure.	NOT is used to delete part of a drawn diagram. Draw a graphic in OR mode first.
Illegal syntax in equation.	An equation has been incorrectly set. Check the that the following conditions are true before re-attempting operation: •There are the same number of right and left parentheses. •There is not more than one region number in a row. •There is not more than one operator in a row. •There is not more than one constant in a row. •There is not more than one function in a row without a variable in between them. •There are not too few or too many function variables.
Incorrect data format received.	The data being sent to the external device via the RS-232C port is in an incorrect format. Stop operations and turn OFF the power supply. Check that the following conditions are true before resuming operation: •The RS-232C cable is correctly connected. •The terminal block is correctly wired. •The communications settings for communications with the external device have been correctly set. If the error still occurs after performing the above checks, the F400 unit may be faulty. Contact your nearest OMRON representative.
Insufficient flash memory.	Data cannot be saved because there is insufficient flash memory available. Decrease the size of the region to be registered, or delete regions stored in memory that are no longer required before re-attempting operation. If the error persists, the flash memory itself may be damaged. Contact your OMRON representative.
Insufficient work memory.	Models and regions cannot be saved because there is insufficient work memory available. Perform one of the following operations and re-attempt registration: •Reduce the size of the model or region to be registered. •Delete models and regions that are no longer required.
Set different colors for character and background.	The same color is selected for characters and menu background. •Characters cannot be read if the same color is used for characters and background. Select different colors for them.
Set parameters so that Output Period ≧ Gate ON delay + Gate ON time.	The output period in the communications settings has been incorrectly set. Reset the settings so that Output period ≧ Gate ON delay + Gate ON time

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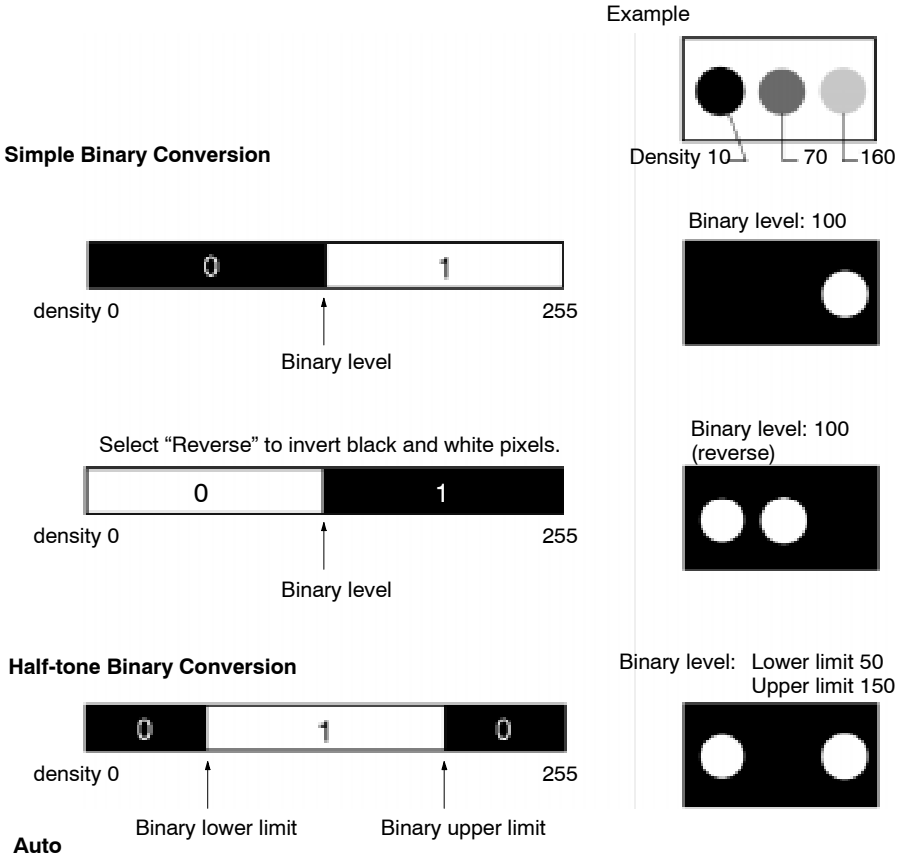
Message	Probable Cause and Remedy
Set parameters so that Rectangle area + Margin*2 > 0.	Cursor frame or margin could not be set. •Widen the cursor frame to match the margin setting or increase the margin setting.
Timeout error.	Transfer has been interrupted due to a timeout error for communications with the external device. Stop operations, turn OFF the power supply. Check that the following conditions are true before resuming operation: •The RS-232C cable is correctly connected. •The terminal block is correctly wired. •The communications settings for communications with the external device have been correctly set. If the error still occurs after performing the above checks, the F400 unit may be faulty. Contact your OMRON representative.

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Glossary

Binary Conversion

Conversion to a binary image involves separating the grayscale image into black pixels (0) and white pixels (1). (Pixels are the basic picture element.) The binary level is the level used to distinguish between 0 and 1. Measurements are performed for the white areas.



Auto

If “Auto” is selected, the density distribution of the grayscale image is analyzed, and the binary lower limit is automatically set.

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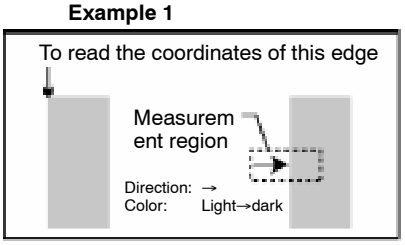
Edges

Images can be measured by determining the coordinates of the edge of a measured object. An edge is detected by a change in density.

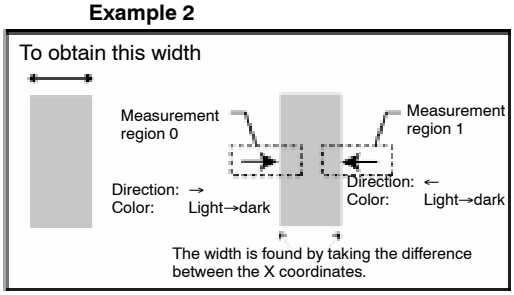
The edge conditions can be set separately for each region.

- Direction: Select →, ←, ↑, or ↓.
- Color: Select light→dark or dark→light.

Example 1

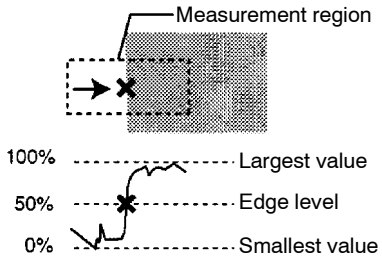


Example 2



- Edge level:
  Set the change in density to be recognized as an edge. Normally, the default value of 50% is sufficient. Edge detection is performed in the following way.

1. The density distribution for the entire measurement region is obtained.
2. The smallest and largest density values are taken as 0% and 100%, respectively.
3. Positions where the density changes as specified in the edge level setting are detected as edges.



- Noise level:
  Level for determining whether edge exists or not.

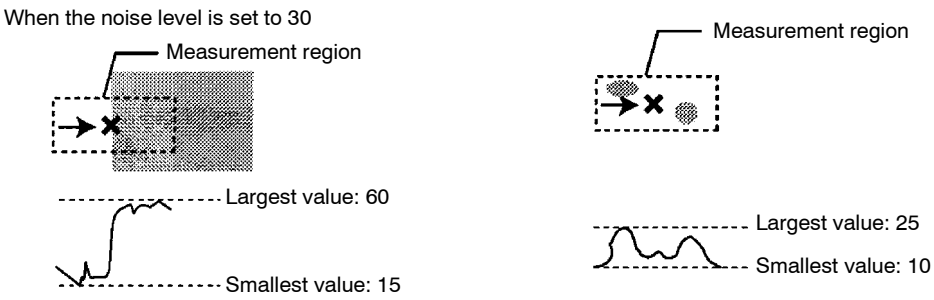
  If below the set level, no edges will be considered to exist. Normally, it can be set to the default value. However, if edges are not properly detected due to noise, adjust the setting level.

  For example, noise levels should be raised if noise causes faulty detection.

  If the difference between the largest value and smallest value is smaller than the noise level, no edges will be considered to exist. (NG)
  If the difference between the largest value and smallest value is equal to or larger than the noise level, edges will be considered to exist and measurement is performed.

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Example 3



60–15 > 30: Subject to edge measurement

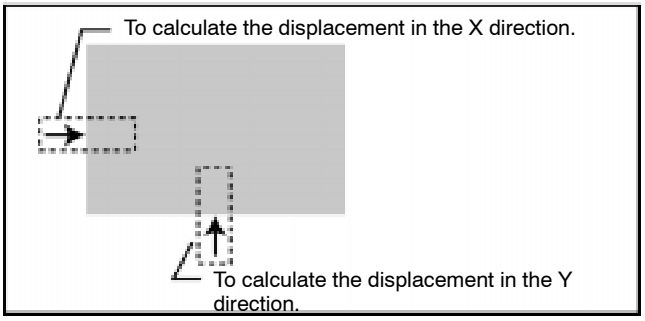
25–10 < 30: No edges considered to exist. (NG)

Color Filter Mode: 0 to 255 (default setting: 20)
Since the image is a gray one, set a density value.

Color Pickup Mode: 0 to 100% (default setting: 20%)
Since the read image is a binary image, set a percentage as a threshold between "0 (black)" or "1 (white)."

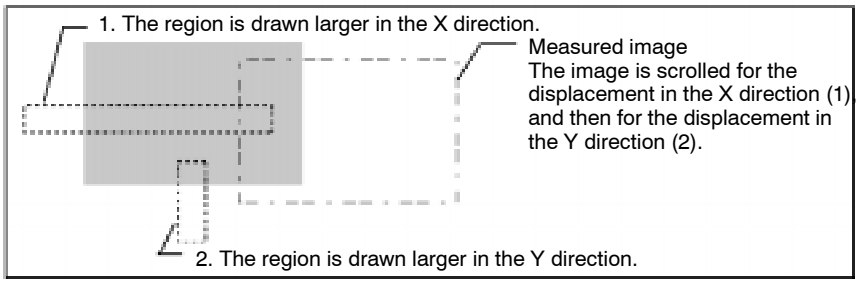
This method can also be used for position compensation. Normally, position compensation is performed in Simultaneous Mode to simultaneously compensate in both the X and Y directions.

Example 4



If the displacement is too large, use Priority Mode. In this mode, the image is scrolled for the displacement in one direction and then in the other direction, ensuring stable position compensation. The region that is drawn first is processed first.

Example 5



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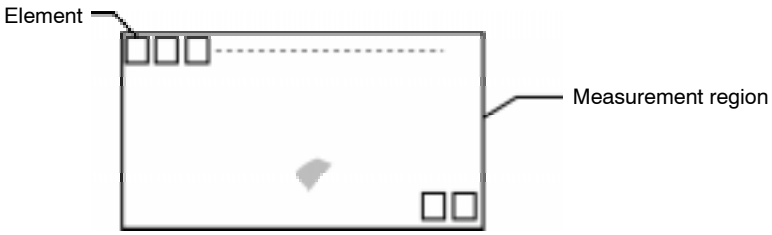
Colorgray Filter

It is possible to create a filter for the object to be detected. The hue and saturation for the object to be detected are set. Refer to *Introduction Manual (Z131)* for details.

Surface Defect

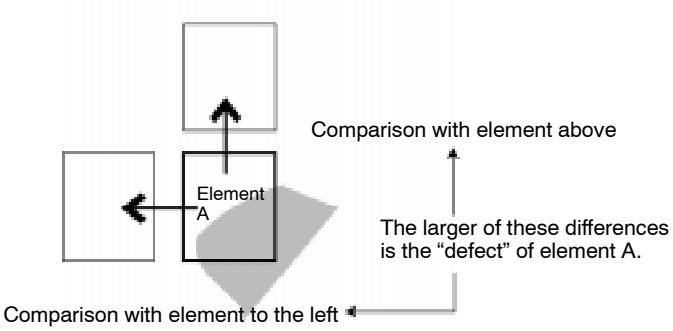
One of the measurement methods used by the F400. Surface defect measurements detect uneven or damaged areas caused by uneven density.

1. Small boxes are created inside the measurement region. These boxes are called elements, and the density is calculated for each element.



The size of the boxes and the space between them can be changed from the menus.

2. The density of each element is compared with that of the element on its left and the element above. The larger of these two differences is the “defect” of that element.



3. The defects are calculated for all of the elements. The measurement region is judged to have a defect if the largest defect is greater than the evaluation criteria.

   Several samples should be taken to determine a suitable judgement criteria.

Note Measurements are performed using differences in density. If there are marks, patterns, or letters in the measurement region, these will be detected as defects and the measurement will be incorrect. Use the Search Method for measurements when inspecting measurement regions with marks, patterns, or letters. The image is compared with a model to determine the degree of conformity called the “correlation.”

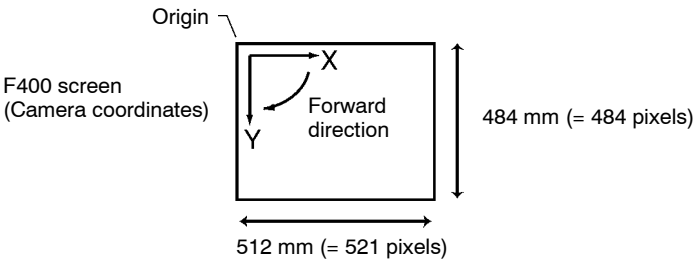
Calibration

Images are made up of many points, with each point having its own density. These points, which are the smallest units that make up an image, are called “pixels.” The F400 obtains measurements from the density of the pixels. “Calibration” is used to convert the measurement results in pixels to actual dimensions. To perform calibration, the relationship between actual coordinates and camera coordinates (e.g., coordinate system, position of origin, magnification, etc.) must be set.

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The default settings are as follows:

- Coordinate system: Left-handed system
- Origin: Upper-left corner of screen
- Magnification: 1.000
- Unit: mm/pix

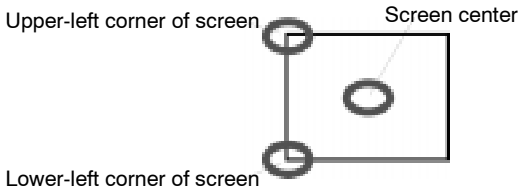


Coordinate System

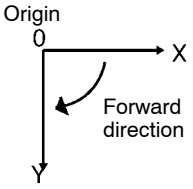
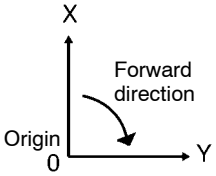
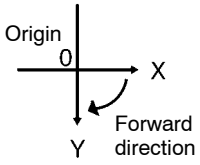
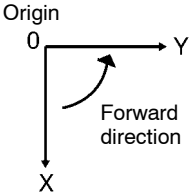
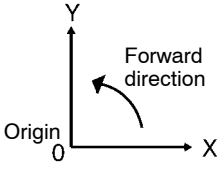
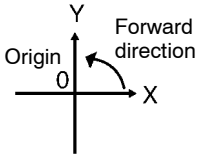
The coordinate system is set for either left-handed or right-handed coordinates.

Origin

The position of the origin (0,0) is specified.



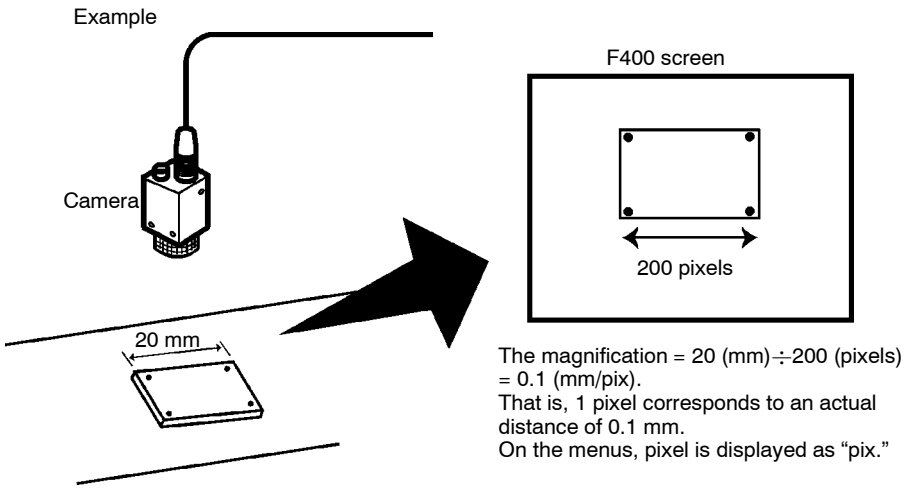
Coordinate System and Origin

System	Upper-left corner of screen	Lower-left corner of screen	Screen center
Left-handed system			
Right-handed system			

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Magnification and Unit

The magnification and unit can be set to convert pixels to actual dimensions.

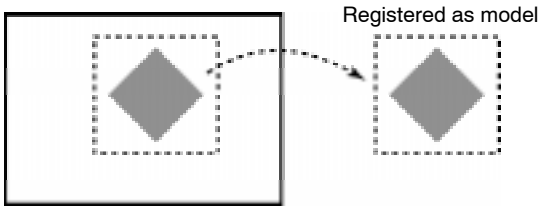


The magnification = 20 (mm) ÷ 200 (pixels) = 0.1 (mm/pix).
That is, 1 pixel corresponds to an actual distance of 0.1 mm.
On the menus, pixel is displayed as “pix.”

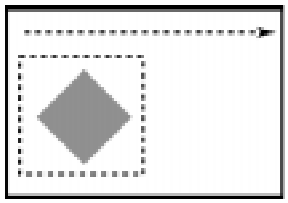
Search

One of the measurement methods used by the F400. This method is a convenient way of inspecting the shape of an object. The steps for this method are as follows:

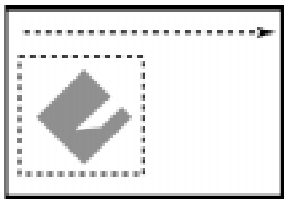
1. A good sample of the image pattern is registered. This pattern is the “model.”



2. The part within the input image that is most similar to the model is detected, and the degree of similarity to the model is expressed as a correlation value. The correlation value is between 1 and 100. The closer the correlation, the higher the correlation value. The value will be lower if the shape is different or if there are parts missing. Improper (NG) shapes can be detected with this method by setting a threshold value as a dividing line between good and improper shapes.



Correlation value: 95



Correlation value: 52

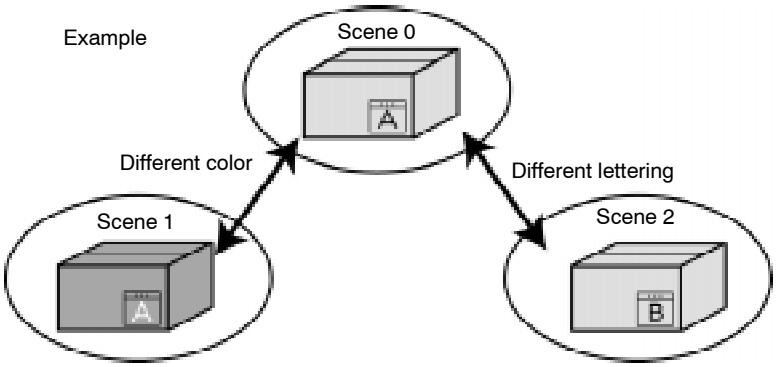
Part of the shape is missing so the correlation value is low.

Shape measurements not only give correlation values but also the position coordinates for the model can also be obtained and can be used for position compensation.

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Scenes

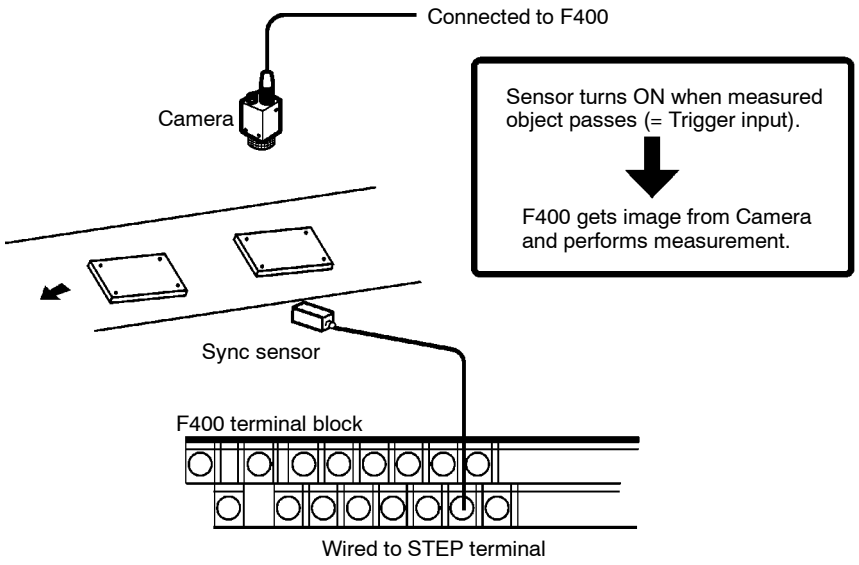
The F400 contains 16 scenes, numbered 0 to 15. Different measurement conditions can be set for each scene and so 16 different sets of conditions (e.g., inspection conditions for product A, inspection conditions for product B, etc.) can be set. If the measurement object is changed on a daily basis, inspection can be performed simply by changing the scene, allowing more efficient operation. Further, backups can be made of the data set for each scene (scene data) to a personal computer. If 16 scenes are not enough, save scene data to a personal computer and then reload them as necessary.



Trigger

The trigger input is the signal to start measurement. It can also be used as a signal to start operations such as image input. The simplest way to input a trigger is to press the TRIG Key on the console. In practice, a trigger is usually input using the STEP terminal on the terminal block as a trigger for measurements, or from a peripheral device, such as a personal computer, via RS-232C.

Example: Trigger using STEP terminal



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White Balance

The white can be balanced to adjust the color of images.

Depending on the environment or the kind of light, the image read by the Camera may appear tinted, even if it is white.

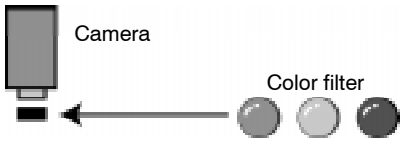
For correct measurement, the sensitivity of R.G.B. must be adjusted so that the image will really appear in white in accordance with the light source. This is called the adjustment of white balance.

Adjust the white balance before setting the light and adjusting the image.

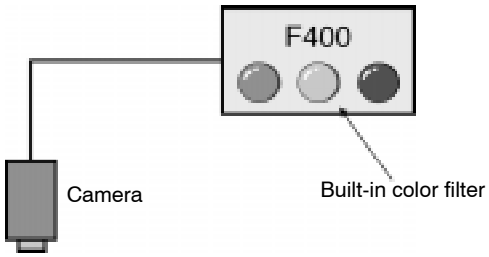
To do this, simply project a white object (for example paper) and press the TRIG Key. The compensation parameters will be automatically calculated using the projected image as a base.

Color Filter

Color filters are commonly called optical filters. Color filters are mounted in front of cameras to adjust the image. Choose a filter according to the color to be emphasized.



The filter is built into the F400 and can be changed simply using the console.



- Red: Enhances red.
- Green: Enhances green.
- Blue: Enhances blue.

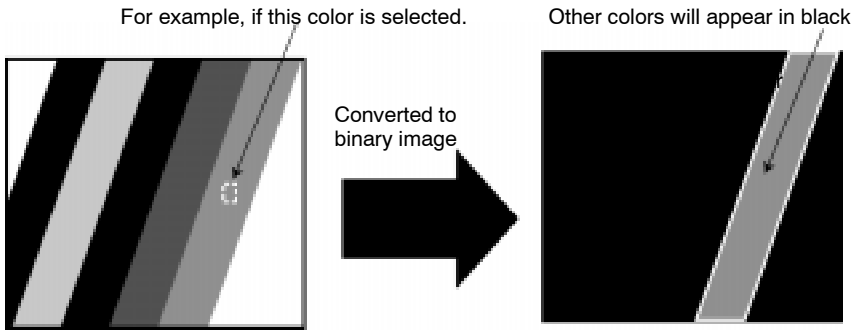
In addition to these 3 color filters, other filters can be created electronically to suit requirements. These kinds of filter are called colorgray filters. These filters can be customized for the color to be emphasized.

Refer to *Introduction Manual (Z131)* for details.

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Color Pick Up

Specified colors can be picked up from a color image. Color images are converted to binary images and processed by the F400. The selected color will be converted to white (1) pixels, all other colors will be converted to black pixels (0), and measurements will be performed for the white areas only. The white areas are painted with the color selected for extraction, and displayed on the screen.



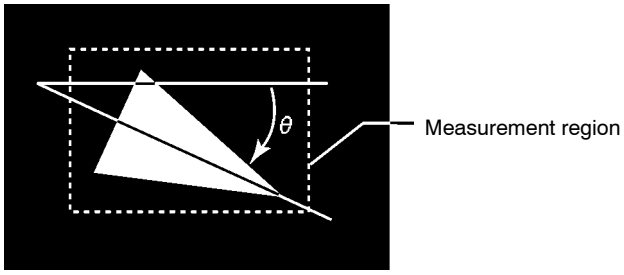
Refer to *Introduction Manual (Z131)* for details.

Center of Gravity and Axis Angle

One of the measurement methods used by the F400. Center of gravity and axis angle measurements are the same as area and center of gravity measurements except that the angle of an axis is used to obtain the inclination of the object. When the axis angle is used, the measurement time is increased. If only the area and center of gravity of the object are required, use the area and gravity method.

Axis Angle

A 256-gradation grayscale image is converted into black and white pixels to create a binary image, and measurements are performed for the white area. This area is approximated with an enclosing ellipse, and the angle of the direction of the major axis of that ellipse is called the axis angle.



The coordinates for the center of gravity of an object can be found with this method, so it can also be used for position compensation.

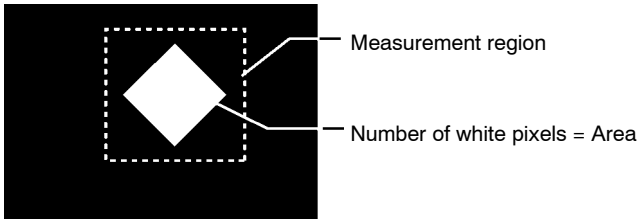
Area and Center of Gravity

One of the measurement methods of the F400. An area and center of gravity measurement is used to find the size and position of an object. A 256-gradation grayscale image is converted into black and white pixels to create a binary image, and measurements are performed for the white area. The white pixels inside the measurement area are counted, and the total number is output as the area.

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Area

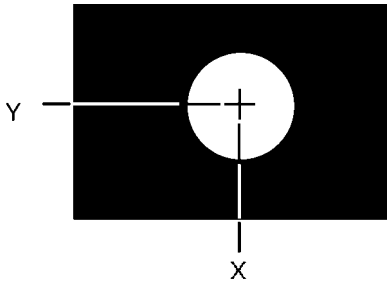
The area is the number of white pixels inside the measurement region.



Note If the area (number of white pixels) of an object inside the measurement region is the same as that of the model, it will be deemed to be good, even if the shape is different from the model. When discriminating objects according to shape, use the search measurement method.

Center of Gravity

The center of gravity of a white pixel image is the position of the point at which the image would balance if it were cut out and pasted on heavy paper. The center of gravity for a circle would be its center, and the gravity for a rectangular would be the intersection point of lines connecting diagonally opposing corners. This method can be used for position compensation by obtaining the coordinates of the center of gravity.



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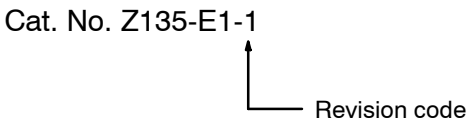
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Revision History

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
1	June 1999	Original production

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