SHARP®

Version 1.0
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Compact Color Image Sensor Camera

IV-C35M

User's Manual (Introduction and Hardware)

Thank you for purchasing the SHARP IV-C35M compact color image sensor camera.
Read this introductory user's manual carefully to thoroughly familiarize yourself with the functions and proper procedures for operation.
Store this user's manual in a safe place. We are confident that the manual will be helpful whenever you encounter a problem.
In addition to this manual, there are other IV-C35M manuals as follows. Read them in conjunction with this manual.

IV-C35M
- User's Manual (Introduction and Hardware: **This manual**)
- User's Manual (Function and Operation)
- Instruction Manual

Manual type	Major subjects	How to use
IV-C35M User's Manual (Introduction and Hardware)	- Outline of the IV-C35M (features and functions) - Description of the hardware - Startup method - General performance specifications. - Example of operation and instruction	- Become acquainted with the IV-C35M - Learn how to install the IV-C35M and wire it up - When mastering the outline of operation
IV-C35M User's manual (Function and Operation)	- Detailed explanations of all the measurement functions. - How to make menu selections for each measurement - Details of inputting and outputting data and communications with other devices. - Troubleshooting	- Learn how to specify measurement /inspection conditions, good or NG judgment conditions, etc. - Lear how to connect a programmable controller or personal computer. - Learn what to do if a problem occurs.

Notes

- This manual was written with the utmost care. However, if you have any questions or inquiries concerning the product, please feel free to contact our dealers or service agents.
- Copying all or part of this booklet is prohibited.
- The contents of this manual may be revised or modified for improvement without prior notice.

Safety Precautions

Read this user's manual and the attached documents carefully before installing, operating, or performing any maintenance, in order to keep the machine working correctly. Make sure you understand all of the equipment details, safety information, and cautions before using this machine. In this user's manual, the safety precautions are divided into "Dangers" and "Cautions" as follows.

Danger : Improper handling is likely to lead to death or serious injury.

Caution : Improper handling may lead to injury or damage to equipment.

Even when only a Caution is given, serious results may occur depending on the circumstances. In all cases, important points are described. Be sure to follow the advice given.

The following symbols are used to prohibit or explain required action.

: This means do not do what is described. For example, prohibited disassembly is shown as  .

: This means an action you must take. For example, a ground connection that must be made is shown as  .

(1) Installation

Caution

- Use only in the environments specified in the instruction manual, or user's manual.
  Electric shock, fire or malfunction may result if used in high temperature, high humidity, dusty or corrosive environments, or if excessive vibration or impact occurs.
- Install the equipment only as described in the manual.
  An improper installation may cause the equipment to fail, breakdown, or malfunction.
- Never leave wire cuttings or any other foreign matter lying about.
  A fire, breakdown or malfunction may result from inappropriate objects left near the equipment.

(2) Wiring

Caution

- Do not connect any camera not specified by SHARP to the controller.
  Connecting any other camera to the controller may damage the controller or the camera.
- Connect only to the specified power source.
  Connection to the wrong power source may cause a fire.
- Wiring should be performed by a qualified electrician.
  Improper wiring may lead to a fire, machine failure or electric shock.

(3) Use

Danger

- Don't touch the terminals while the power is turned ON or you may receive an electric shock.
- Assemble an external emergency stop circuit and interlock circuit (external to the IV-C35M compact color image sensor camera). Otherwise a breakdown or damage to other equipment may occur due to a problem with the IV-C35M.

Caution

- Take special care to follow all safety guidelines if you are changing the parameters for the operating conditions or performing an "enforced output," "run," or "stop" during operation. Misoperation may damage the machine or cause an accident.
- Turn ON the power supplies in the specified sequence. Turning ON the supplies in the wrong order may lead to a machine breakdown or cause an accident.

(4) Maintenance

Warning

- The controller contains a lithium battery. Do not expose the IV-C35M directly to flames as the battery may explode and seriously injure people nearby.

Prohibit

- Don't disassemble or modify the camera.
  Fires, breakdowns or malfunctions may occur, if the camera is disassembled.

Caution

- Turn OFF the power source before connecting or disconnecting the IV-C35M.
  If you don't, electric shocks, malfunctions or breakdowns may occur.

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Chapter 1: Outline

The IV-C35M compact color image sensor camera has an integrated color image processing function to inspect and measure images, that could not be inspected or measured using a monochrome camera. Thanks to SHARP's unique partial image capture function and a high-speed gray search function, it will reduce overall processing time. It will not only contribute to high-speed, high-efficiency inspection and measurement processes, but also help you keep your prices competitive.

1-1 Features

■ **A variety of color filters and a color extraction function clearly distinguish subtle differences in tone and density.**

In addition to filtering the three primary colors (red, green, and blue), the IV-C35M can make accurate images of objects using brightness and other optional filters.

Original color image

Conventional monochrome processing
If the hue or color saturation is very similar between adjacent areas, the images cannot be evaluated.

Conventional gray image processing
The density of this image can be measured. However, the hue and color saturation cannot be evaluated.

● **Color filter functions for the three primary colors (RGB) and brightness and 5 optional filters.**

Select the color components and brightness of an area you want to evaluate, and display just the specified component brighter. Then convert it to a 256 gray scale or binary image.
The color filter can be set to display the specified color brightly after gray scale image processing. This is effective in evaluating subtle differences in color, or for finding flaws or dirt that have similar colors or tones.

R (red) filter
Displays red areas more brightly.

G (green) filter
Displays green areas more brightly.

B (blue) filter
Displays blue areas more brightly.

Brightness filter
Displays areas that are within the specified brightness range (within the specified upper and lower limits) more brightly.

Custom filter
Specify the optimum color filter parameters to use, based on the original image conditions. The optional filter is effective if the RGB filters are not used to show areas as brighter.

- **Specify a color to extract from the original image.**
  The controller eliminates all areas of the image except those that have the specified color. Then, it converts what is left into a binary image. This color extraction function not only works with hue and saturation, but also with brightness. Therefore, achromatic objects that cannot be processed using a color filter can still be extracted.
  The controller can extract up to 8 colors in one object type. By specifying multiple object types, it can be used to evaluate even more colors.

Color extraction
For example, you can extract just the blue area of the letter E in the image on left.

■ The measurement menu has been improved further by adding new menu items.

In addition to conventional measurement menu items, new items have been added for color related functions including evaluating the color of objects, uneven color inspection, color positional measurement, and fault inspection. You can select the menu program items that match your application from 18 measurement menu items.

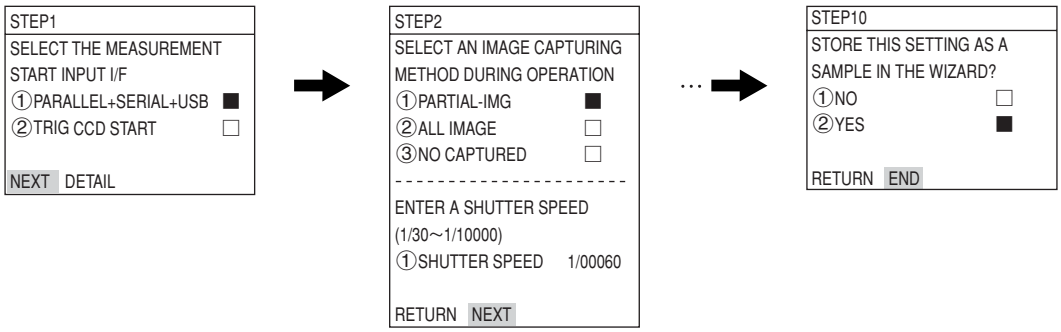
Color filer		Color extraction
Gray image	Binary image	Binary image
- Fault inspection - Position deviation measurement - Degree of match inspection - Lead inspection - Point measurement - Multiple position measurement - Multiple degree of match inspection	- Area measurement by binary conversion - Object identification by binary conversion - Count objects by binary conversion - BGA/CSP inspection - Point measurement	- Color evaluation - Color unevenness inspection - Color position measurement - Area measurement by binary conversion - Object identification by binary conversion - Count objects by binary conversion

* When a monochrome camera is connected to the IV-C35M, the color evaluation, color unevenness inspection, and color position measurement features cannot be used.

Items in red are new menu items.

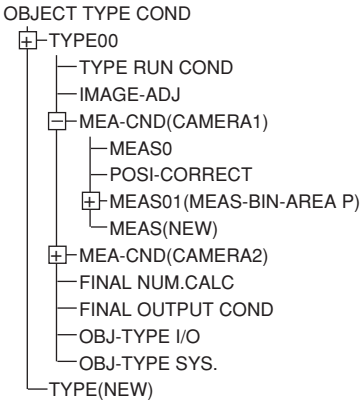
■ Easy operation menu

- **Setting wizard**
  The IV-C35M wizard asks you to make selections using a questionnaire, thus allowing anyone to set up the measurement operations and preferences, and decrease the chance of mistaken settings.



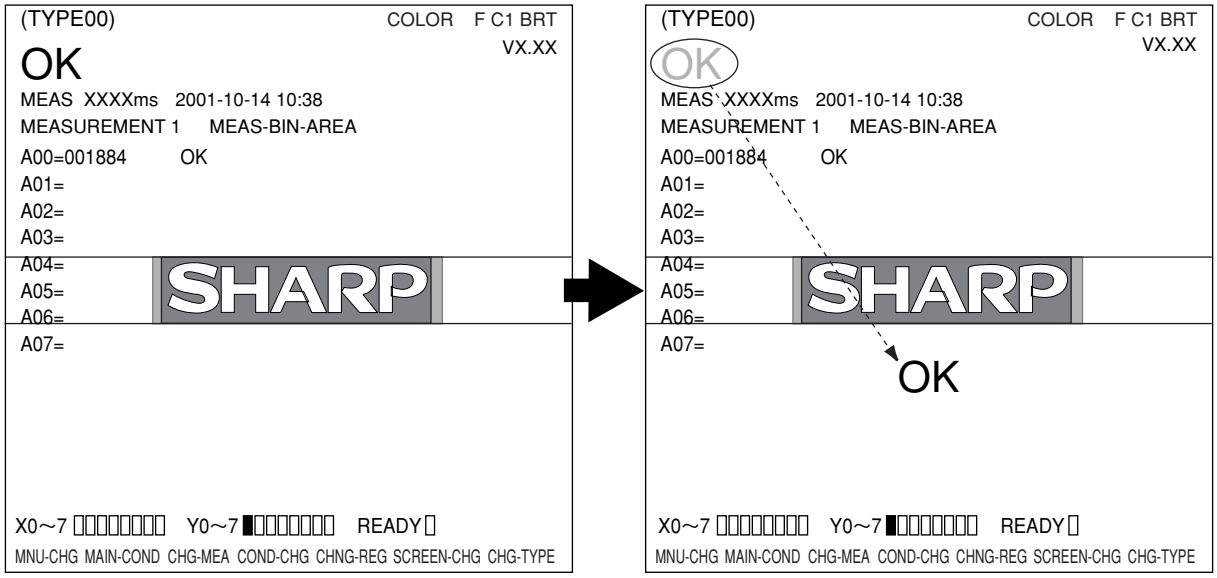
● **Tree menu**

The tree structure menu lets you find the setting parameter you need easily. Using the short cut function, you can move directly to a desired menu.



■ Operation screen editing function

You can move, remove, enlarge, and decrease the size of the information displayed on the operation screen.



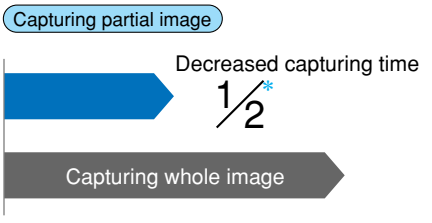
■ Shorten the cycle time by connecting two cameras

The two IV-C30C5 color cameras or two IV-S30C3/C4 high-speed monochrome cameras can be simultaneously connected to IV-C35M controller. By connecting two cameras, your system can reduce the processing time by positioning two areas at the same time, and then inspecting two areas at the same time. By triggering the cameras at the same time, the system can capture two images, and display the images above and below each other, or left and right.

Note: Combined use of a color camera and a high-speed monochrome camera is not possible.

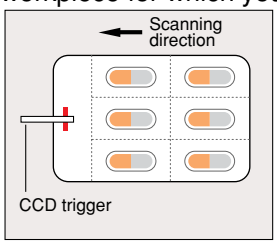
● **High-speed processing now possible using a color camera or a high-speed monochrome camera and partial image capture**

Sharp's unique partial image function offers high-speed image capture.



* When capturing 240 lines from vertical 480 lines.

- **CCD trigger function does not need an external sensor**
  After a trigger window is setup, the IV-C35M does not need an external sensor if it is scanning moving objects. To set up a trigger, you can select from color, binary image conversion, average density, gray search, and edge detection techniques. The gray search mode is useful for a workpiece for which you cannot easily establish the density range.



- **Shutter speed freely set**
  The shutter speed can be set anywhere between 1/30 and 1/10000 second for each object type. Practically, this means that the light level can be adjusted without changing the lighting equipment for each object type. The random shutter function is used to close the shutter when a trigger event is detected, so that precise still images of moving objects can be scanned.

■ CE approval applied for, widely accepted in international markets

The reliability of the IV-S30 means that it can be used in units destined for overseas markets.

■ Displays and transfers NG images while measurements are being made

While in measurement, NG images and NG history of the IV-C35M can be seen. Using the USB communication, the controller transfers NG images to a personal computer in approximately 7 seconds. This is convenient to investigate NG images for feedback for designing, and contributes to quality improvement.

- **Automatically stores NG images on a flash memory card.**
  The controller is equipped with an interface for a compact flash memory card. When a compact flash memory card is inserted in the controller housing, NG images can be stored on the card.
  A flash memory card can store up to 264 NG images.
  * 512x480 pixels: When a 192 MB capacity flash memory card is used.

- **Read the OK/NG results easily by looking at a colored display of the measurement area and evaluation result information.**
  Since the IV-C35M can display the measurement area in any color and the results of the evaluation can be display in any specified color, you can easily see for yourself if the result is OK or NG.
  This function is available even when a monochrome camera is connected.

■ Customize to your own specification

An IV-S30LB1 image processing library and IV-S30SP parameter setting support software are both available. Using these tools, the menu screen can be modified to suit your specialized needs to create your own unique image processing system.

1-2 Color extraction

The color extraction function extracts a color in a certain area from the original image, and registers it as a reference color. The controller converts areas of color that are within the upper and lower limit ranges of hue, saturation, and brightness of the reference color to binary images, as well as colors outside of these ranges.
Then, the controller measures these binary images with conventional measurement procedures.

■ Effects of extracting color

Original color image

Extracting color

Available measurement programs that can be used with the color extraction function are area measurement by binary conversion, object counting by binary conversion, object identification by binary conversion, color evaluation, color unevenness inspection, and color position measurement.

1-3 Color filter

Color filter is to filter red, green, blue, brightness, or optionally, the captured image, and display the filtered color as bright gray.
Then, the controller measures these gray images with conventional measurement

Filter types

R (red) filter	Displays red areas more brightly.
G (green) filter	Displays green areas more brightly.
B (blue) filter	Displays blue areas more brightly.
Brightness filter	Displays areas that are within the specified brightness range (within the specified upper and lower limits) more brightly.
Custom filter	Specify the optimum color filter parameters to use, based on the original image conditions.

The color filter function can be used with positional deviation measurement, degree of match inspection, lead inspection, BGA/CSP inspection, area measurement by binary conversion, object counting by binary conversion, object identification by binary conversion, point measurement, multiple position measurement, multiple degree of match inspection, and fault inspection.

1-4 Measurement program

The IV-C35M integrates the following measurement programs.

Color extraction mode: Color evaluation, color shading (uneven color) inspection, color position measurement, area measurement by binary conversion, object identification by binary conversion, and counting objects by binary conversion.

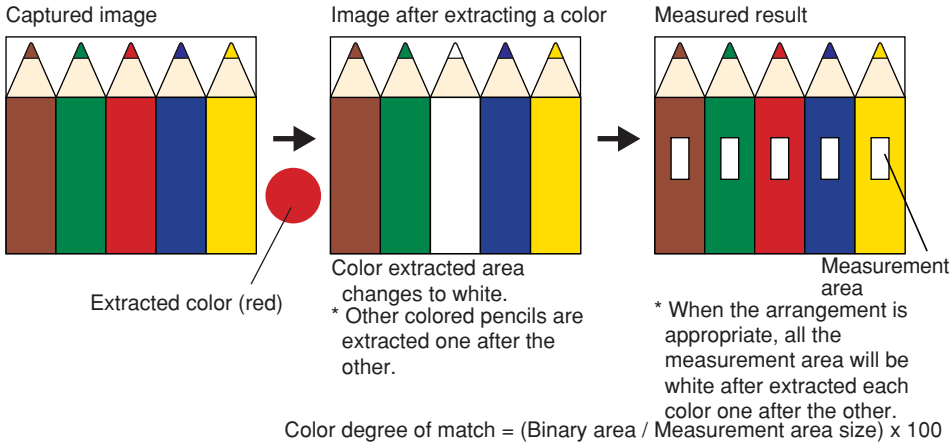
Color filter mode: Fault inspection, position deviation measurement, degree of match inspection, lead inspection, BGA/CSP inspection, area measurement by binary conversion, counting objects by binary conversion, object identification by binary conversion, point measurement, multiple position measurement, and multiple degree of match inspection.

You can select operating condition parameters to suit your application of the IV-C35M.

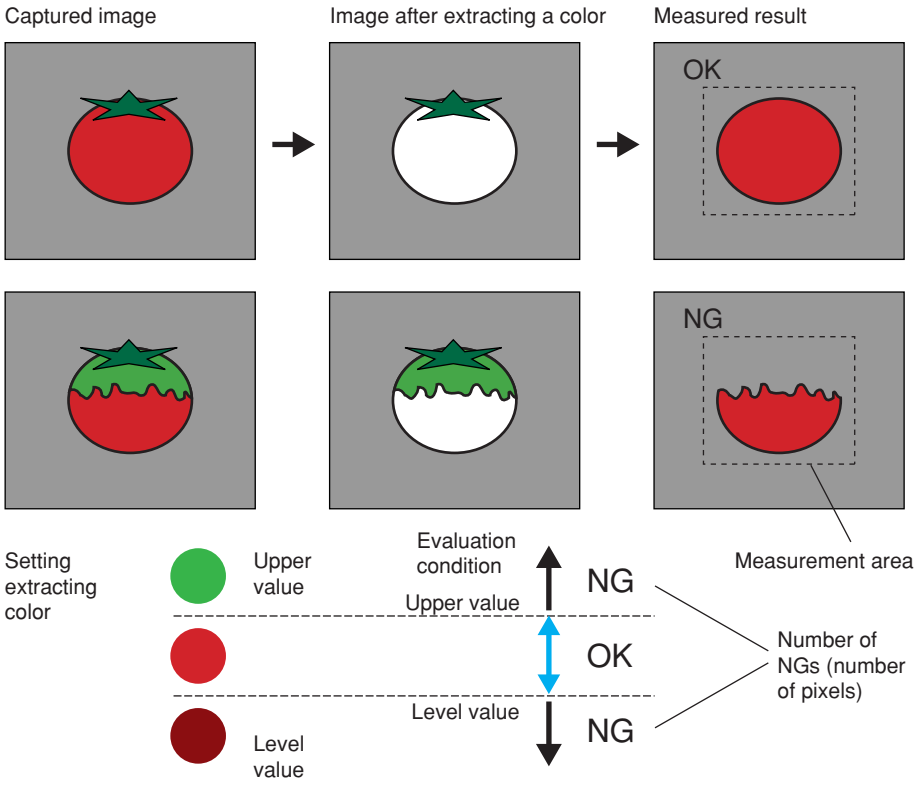
A description of each screen area is shown below.

[1] Color extraction mode

(1) Color evaluation

Purpose	Evaluate whether the extracted color matches the reference.
Application	Inspect arrangement of colored pencils (Check if the colored pencils are arranged in proper order.)
Example	 Color degree of match = (Binary area / Measurement area size) x 100 **[Inspection procedures]** Capture image → Color extraction (binary conversion) → Measurement **[Measurement results]** ・Binary area ・Color degree of match ・Average hue ・Average saturation

(2) Color unevenness inspection (color shading inspection)

Purpose	Evaluate color unevenness based on the size of certain extracted areas of color that are outside the reference color range.
Application	Evaluate ripeness of tomatoes.
Example	

[Inspection procedures]

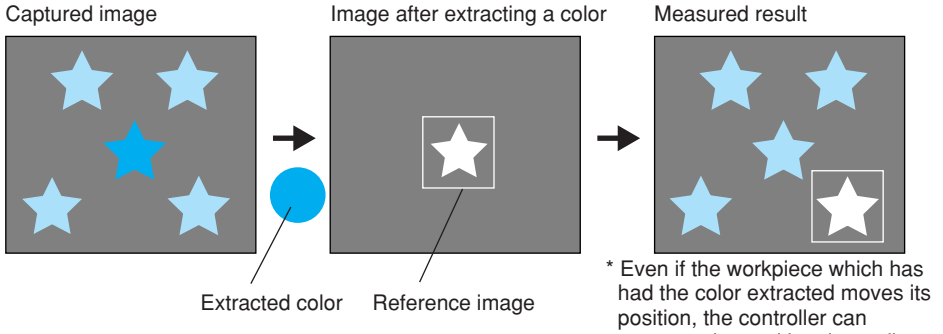
Capture image → Set evaluation conditions (upper and lower limit values) → Measurement

[Measurement results]

- Number of objects
- Total area
- Area of each object
- Max./min. hue
- Max./min. saturation
- Number of objects having faulty hue
- Number of objects having faulty saturation

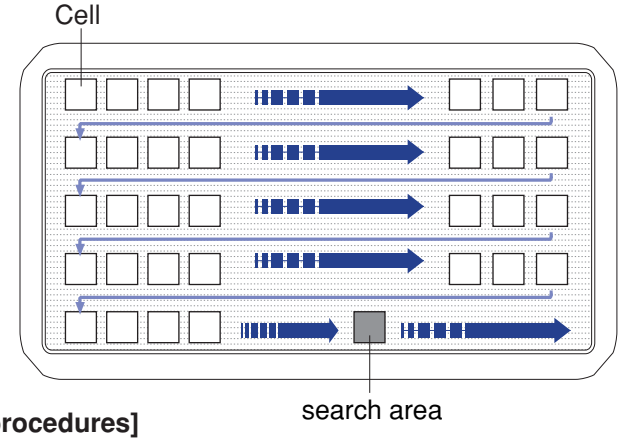
1

(3) Color positional measurement

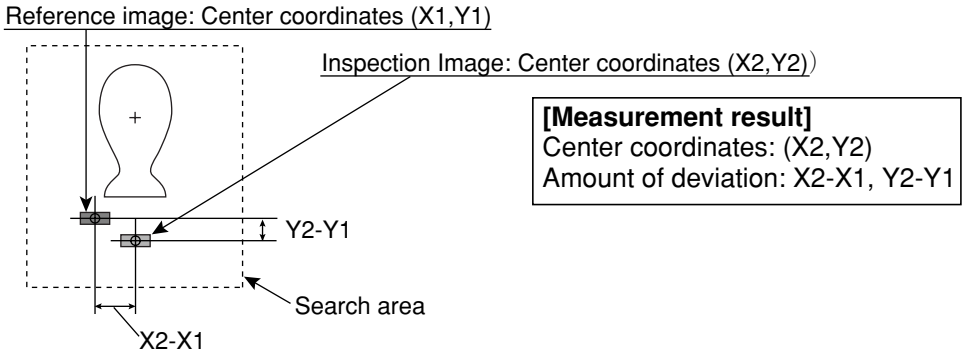
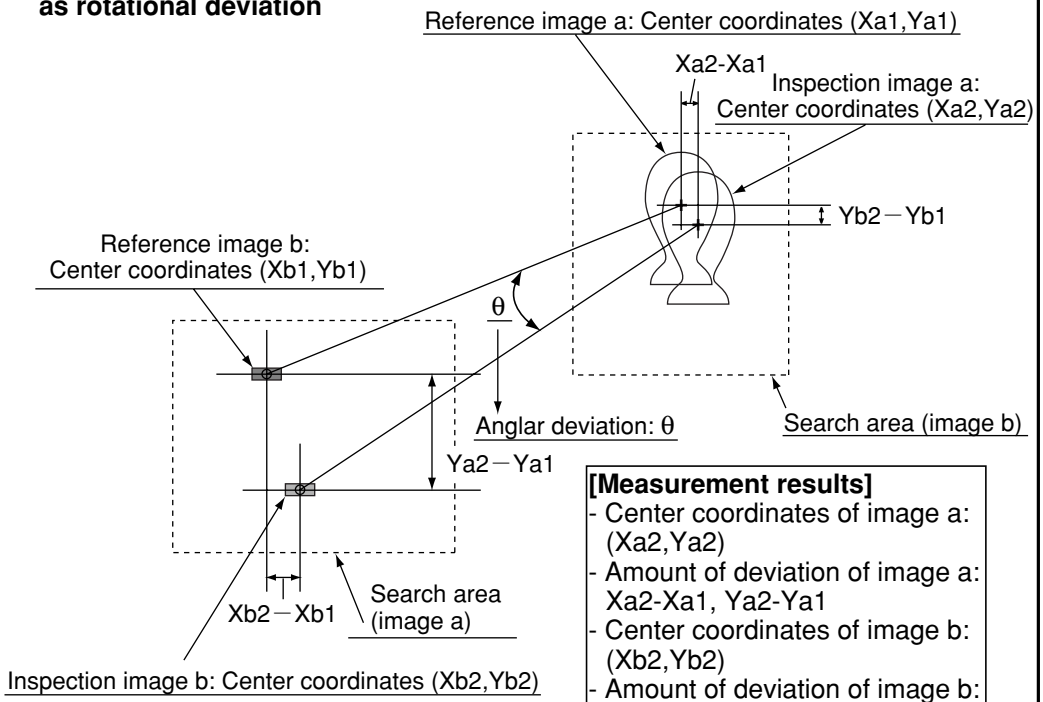
Purpose	Measure the position coordinates of a workpiece with the same extracted color as the reference color.
Application	Positioning workpieces or parts. Positional deviation inspection.
Example	■ **1 point search**  * Even if the workpiece which has had the color extracted moves its position, the controller can measure the positional coordinate of this workpiece. **[Inspection procedures]** Binary conversion of the reference image → Register → Measurement **[Measurement results]** ・Coordinate of the reference image ・Positional deviation of a workpiece from the reference image. ・Color degree of match ・Edge detection ・Angular deviation

[2] Color filter mode

(1) Fault inspection

Purpose	Detect flaws or dirt on a workpiece that color was emphasized using a color filter function.(Using a gray search function after filtering a color, the controller detects cells having the maximum density and minimum density in the search area. It can measure the maximum density difference with all of the area (total difference), a position that has maximum density difference with an adjacent cell (adjacent difference).
Application	Detect flaws or dirt on a workpiece that are the same color as was emphasized using a color filter function.
Example	● Inspection of whole of color LCD monitor screen  **[Inspection procedures]** Captured image → Specify search area → Specify a cell → Measurement **[Measurement results]** ・Average hue ・Average saturation ・Binary area ・Color degree of match

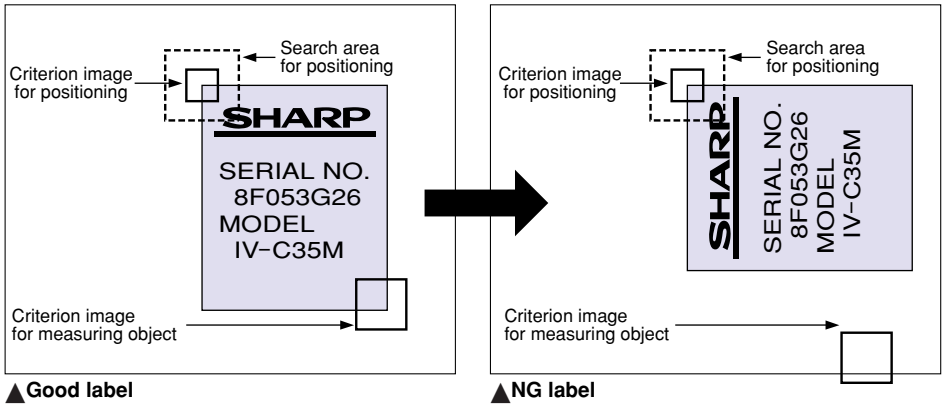
(2) Positional deviation measurement

Purpose	The gray scale search function and edge detection function* make possible measuring positional deviation as well as the absolute position. - It is also possible to detect the position of sub-pixel units with great accuracy. - A rotation angle of 360° can be detected. (When a one point gray search is selected).
Application	Used to determine the position of machine parts and substrates.
Example	**[Determining the location of the positioning (the fiducial mark) mark that identifies the position of the substrate]** **(1) 1 point search: Detecting the deviation in position in X and Y directions**  **(2) 2 point search: Determining positional deviation in X and Y directions as well as rotational deviation**  * Gray scale search / edge detection function Gray scale search: Compares a workpiece image with the 256-level gray-scale reference image to find an area that matches the reference image. ⇨ See G-6. Edge detection: Finds the boundary between light and dark areas in an image. ⇨ See G-3. - The deviation angle θ, determined in the 2-point search, is used to readjust the rotation of the image for measurements 1 to 4.

1

(3) Degree of match inspection

Purpose	Compare a good criterion image to a test image by inspecting matching levels using the gray scale search function. (Determine whether the part is acceptable or NG by checking similarities between the criterion image and the workpiece (test) image.)
Application	Detect positional deviation of labels, detect contamination of different parts, inspect the mounting of electronic parts on PC boards, detect mis-prints, inspect for missing electric parts such as terminals, and simple letter inspection.
Example	● **Detecting label deviations on packages**



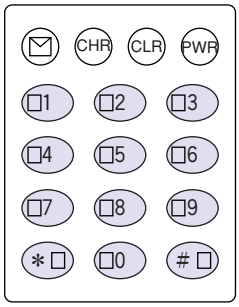
▲**Good label** ▲**NG label**

[Measurement results]
- Degree of match compared with the reference image
- Detected coordinates (X/Y) of the measurement image.
- Light level in the measured image (average light level/absolute value of difference)

- Inspection procedure
① Conduct a gray scale search of the criterion image position
② Correct the position of the object being measured from the coordinates for the criterion image obtained in item ① above.
③ If the matching level of the test image is low, the IV-C35M can determine that the label position is NG.

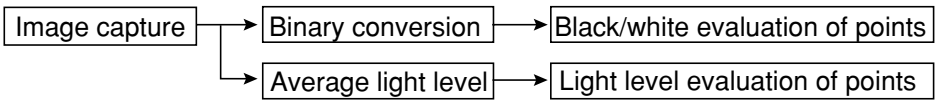
(4) Point measurement

Purpose	Evaluate whether workpieces are present or not at multiple specified points. - Gray processes or converts to binary the image and evaluates whether specified pixel area is white or black. - Obtains average density of specified pixel area, and evaluates whether the density is within the specified range.
Application	Existence inspection of packing parts, inspect lighting conditions of mobile phones, LEDs, and fluorescent tubes, and sorting products.
Example	● **Inspection for LED lightings on mobile phones**

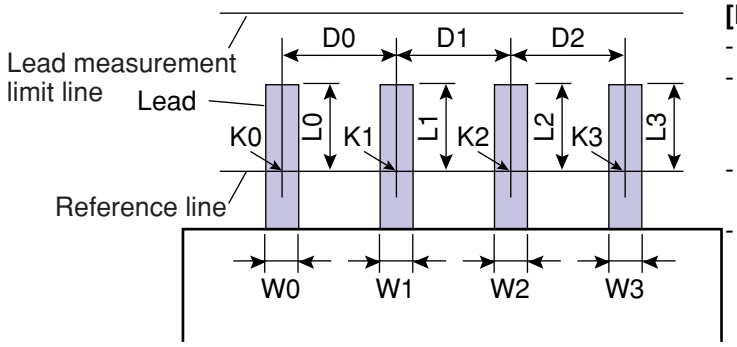


Number of points (max.)
: 128 points at average light levels
256 points in binary images
Point size: 2 m x 2 n pixels
(m, n = 1 to 16)

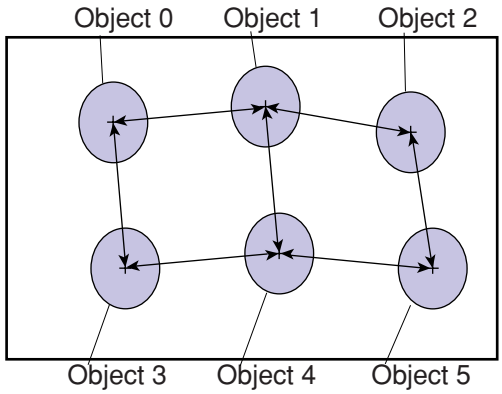
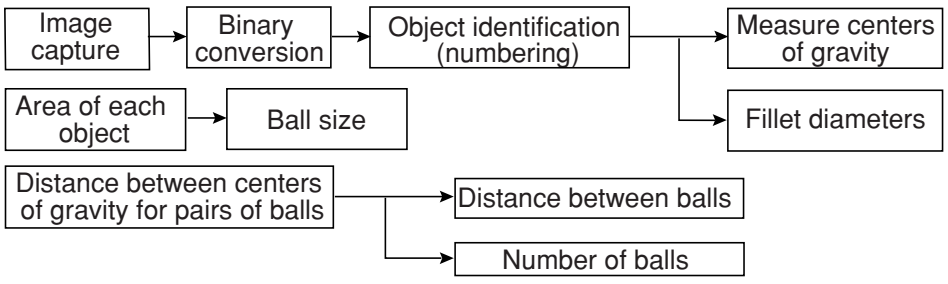
・Inspection procedures



(5) Lead inspection (Gray processing using a brightness filter)

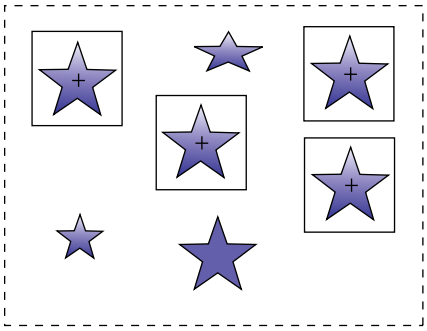
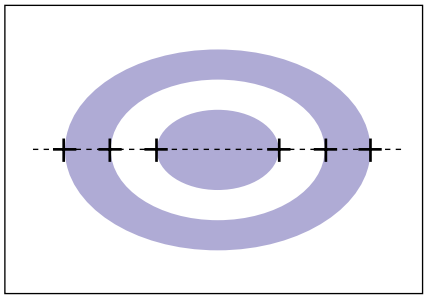
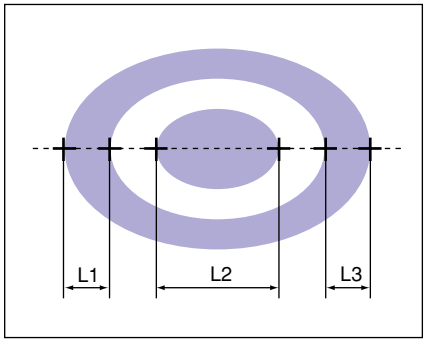
Purpose	Based on positional information obtained from the gray scale search function, inspect the condition of the IC leads and connector pins. (No. of lead pins that can be detected in one image: Max. 128.)
Application	Inspect the IC leads and connector pins.
Example	● **Inspect the layout of the IC leads and connector pins**  **[Lead inspection]** - Number of leads K - D0 to D2: Distance between leads - W0 to W3: Lead width - L0 to L3: Lead length **- Inspection procedure** ① Determine the measurement points (K0 to K3) from the mid points of the leads and the reference line. ② Calculate the distances between the leads (D0 to D2) using the measurement points. ③ Calculate the lead lengths (L0 to L3) from the measurement points (K0 to K3) toward the lead measurement limit line.

(6) BGA/CSP inspection (Gray processing using a brightness filter)

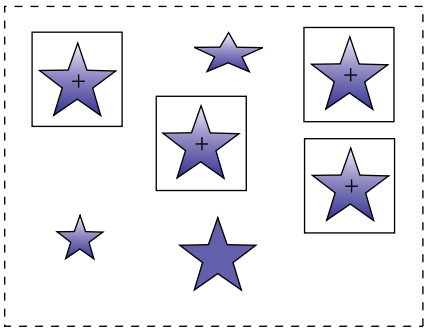
Purpose	Measure the center of gravity, area of each object, number of objects, and fillet diameter using a color that was emphasized by the color filter function.
Application	Inspecting BGA/CSP solder balls.
Example	● **Measurement of 6 balls**  **[Measurement results]** - Number of objects: K - Area of each object: R0 to R127 - Distance between centers of gravity: (DX0, DY0) to (DX127, DY127) - Fillet diameters: FX, FY **- Inspection procedure** 

1

(7) Multiple position measurement

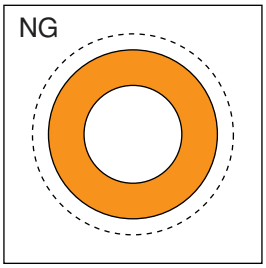
Purpose	The IV-C35M can detect up to 128 workpieces whose images exceed the specified matching level (gray search) or threshold value (edge detection) compared with the reference image. - The positional deviation measurement needs to have a number of positions registered for measurement. However, this measurement only requires you to register one position and reduces the set up time.
Application	Position measurement of workpieces having complicated density conditions, that could not be measured by conventional binary conversion and density processing.
Example	● **Gray search** Reference image   Four workpieces detected **[Measured results]** - Number of images detected - Coordinates and degree of match detected for each image ● **Edge detection**  **[Measurement results]** - Number of points detected - Coordinates detected for each points  This is useful for obtaining the distance between the coordinates of a position. - L1 to L3 can be calculated by measuring distances and angles.

(8) Multiple degree of match inspection

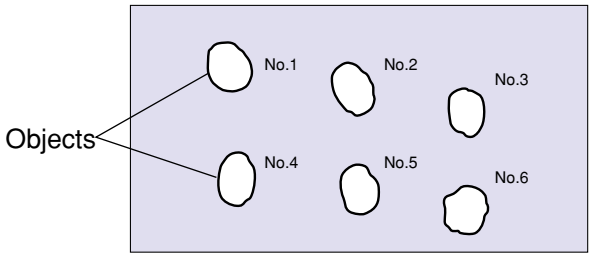
Purpose	Using the gray search function, the IV-C35M can detect up to 128 workpieces whose captured image exceeds the required degree of match with the reference
Application	Position measurement of workpieces having complicated density conditions, that could not be measured by conventional binary conversion and density processing.
Example	Reference image   Four workpieces detected **[Measurement results]** - Number of images detected - Degree of match, density (average/absolute difference), and detected coordinates

[3] Common for both color extraction and color filter modes

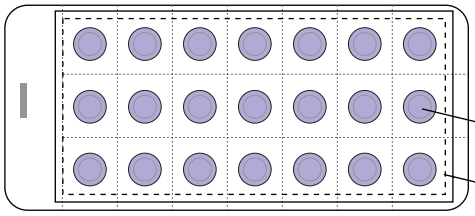
(1) Area measurement by binary conversion

Purpose	Measure the area of the color extracted or the area of the workpiece of a color on a emphasized using a color filter, and evaluate existence of the workpiece and size.
Application	Inspecting contamination of different type of caps (inspects by measuring area of a certain color) Sorting parts (puts a different color mark for each type of part and finds certain color to sort parts)
Example	● **Inspect contamination of different caps**  **[Measurement results]** ・Workpiece area **- Inspection procedures** Capture image → Color extraction (binary conversion) → Specify evaluation conditions (upper and lower limits → Measurement (area value)

(2) Object identification (labeling) by binary conversion

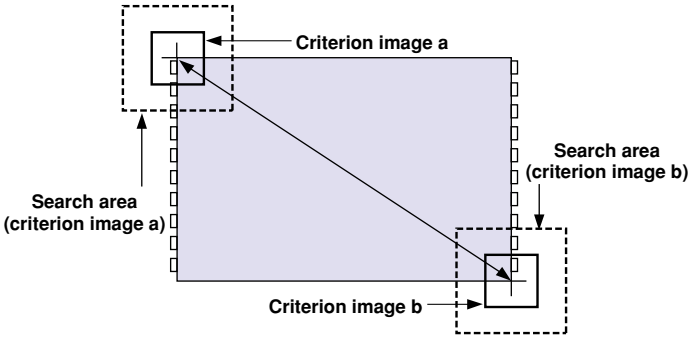
Purpose	When there are several objects and the measuring position is arbitrary, the presence or absence of objects and the size of the objects can be determined. - The specified pixel area is converted to a binary image. The number of objects, total size of the white area (the objects) and the area, center of gravity, main axis angle, fillet diameter, center point, and circumference of each white area can be measured.
Application	Counting the number of food products or parts, measuring the sloped angle or center of gravity of parts, and measuring the size of food products.
Example	● **Measurement of 6 objects**  **[Measurement result]** - Object identification (numbering), number of objects present, total area. - Area of each object (No.1 to No. 6), center of gravity, main axis angle, fillet diameter, circumference, and center point of each object. **- Inspection procedure** Image capture → Color extraction (binary conversion) → Object identification (numbering) → Measurement (area, gravity center, main axis angle, fillet diameter, circumference, and center point)

(3) Count objects by binary conversion

Purpose	Count the number of separate colored areas on a workpiece that were extracted color or with a color emphasized by using a color filter.
Application	Inspecting LED lighting indication on mobile phones, missing pills on sheets.
Example	 **- Inspection procedure** Capture image → Color extraction (binary conversion) → Measure (quantity, total area size)

(4) Distance and angle measurement

This measurement setting screen can be accessed from the measurement condition setting screen of the positional deviation measurement, degree of match inspection, object identification by binary conversion (gravity center measurement: Yes), multiple position measurement, and multiple degree of match inspection.

Purpose	Measure the distance and angle of two points using the center detection function in a gray scale search and the edge detection function, as well as center of gravity detection by functions. - This function can measure the following distances and angles: distance between two points, X coordinate distance, Y coordinate distance, the angle between three points, the horizontal angle of two points, and the vertical angle of two points. - The following points and lines can be set: center point, circle center point, gravity center, point where two straight lines cross, and line passing through two points.
Application	Measurement of mounted electronic parts
Example	● **Measuring IC packages**  Register criterion image a and b by matching edges of the IC package. **- Measurement procedures** ① Find the center points of criterion images a and b using a 2-point gray scale search. ② Determine the distance between the two center points.

Chapter 2: Precautions for Use

Pay attention to the points below when handling the IV-C35M.

(1) Installation

- Each device in the IV-C35M system must be installed in an environment as specified in this manual. (Operating ambient temperature: 0 to 45˚C, operating ambient humidity: 35 to 85%RH (non-condensing.))
- Do not install the devices in the following locations. Installation in any of these locations may cause electrical shock, fire, or malfunction of the devices.
  1. Places exposed to direct sunlight
  2. Places with exposed to corrosive gases
  3. Places with excessive amounts of dust, salt, or metal powder in the air.
  4. Places exposed to water

(2) Mounting

Make sure to tighten the mounting and terminal screws securely and check everything before supplying power. A loose screw may cause faulty operation.

(3) Power source

- Do not use the IV-C35M (power supply for the controller) power supply with any other equipment.
- Do not turn OFF the power while the menu is displayed or while communicating with external equipment. Turning OFF the power may erase the data settings.

(4) Connection of cameras

Note that the IV-C35M cannot be connected with EIA cameras that are available on the market.

(5) Measurement settings

Make sure to specify 4000 ms (4 seconds) or less for the measurement processing time on each measurement item (MEASUREMENT 0 CAMERA 1, MEASUREMENT 0 CAMERA 2, and MEASUREMENT 1 to 4). For example, if the various tasks require 7000 ms of measurement processing time, assign 3500 ms to MEASUREMENT 1 and 3500 ms to MEASUREMENT 2 so that each of the assigned processing times is less than 4000 ms.

If the measurement processing time exceeds 4000 ms, the IV-C35M assumes that an abnormal operation has occurred and may try to reset the system.

(6) Data saving

- The data set by using the remote keypad is temporarily stored in the memory (RAM) of the IV-C35M. However, it is not stored in the flash memory yet. Therefore, make sure to save the data settings before returning to the operation screen from any condition settings menu by pressing the SET key. If you do not save the data, the data will disappear when you turn OFF the power to the IV-C35M controller.
- We recommend that you save the data settings and reference images on a floppy diskette using the IV-S30SP parameter setting support software for the IV-C35M.

(7) Storing the devices

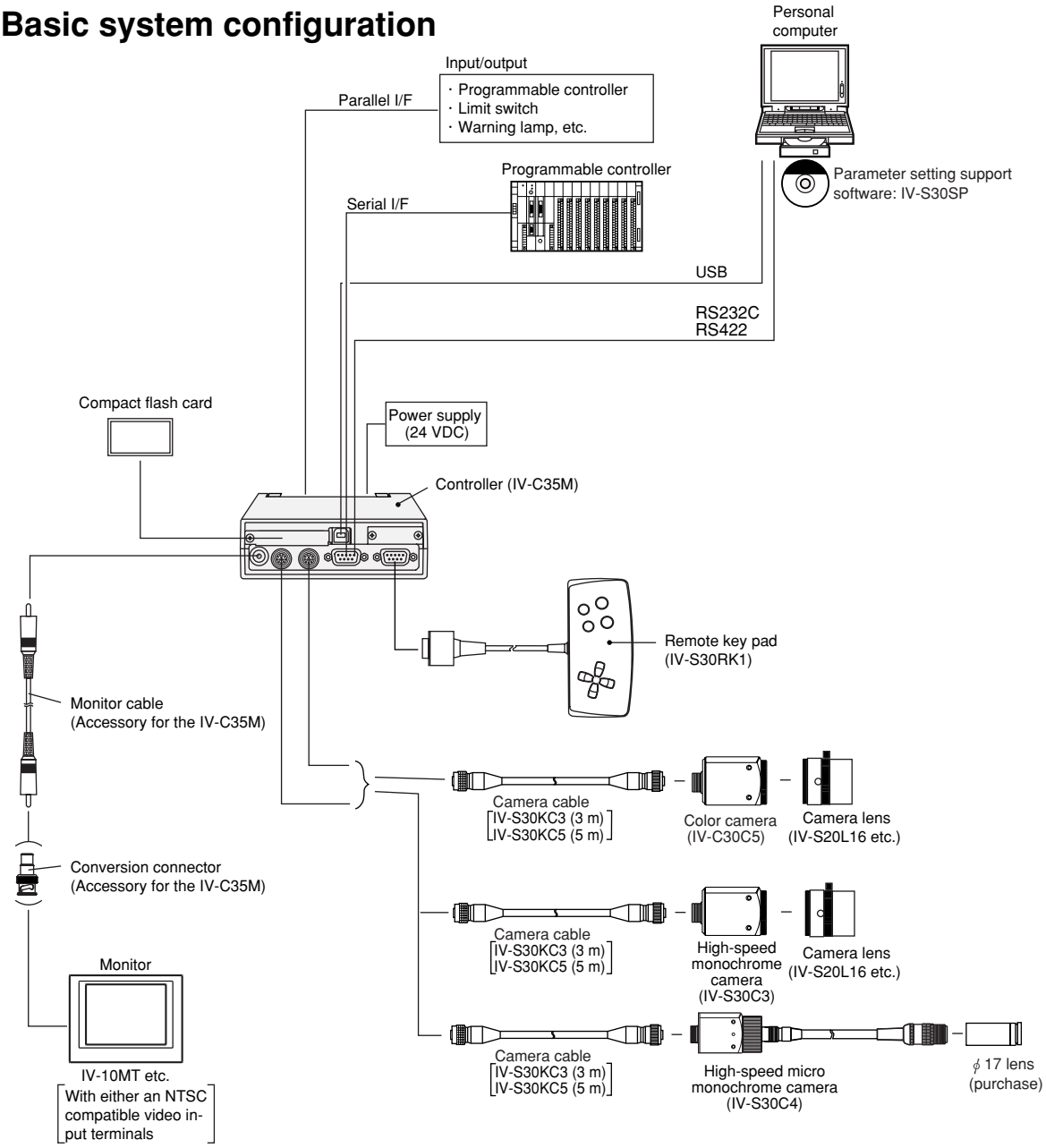
Do not put any object on top of any of the devices, or the device may malfunction.

(8) Maintenance

Be careful not to get any dirt or stains on the CCD surface or camera lens. This may cause mis measurement.

Chapter 3: System Configuration

3-1 Basic system configuration



- A maximum of two cameras can be connected to the IV-C35M.
- Mixed use of IV-C30C5 color camera and IV-S30C3/C4 high-speed monochrome camera is not available.

  Note: The IV-C35M cannot be connected with EIA cameras that are available on the market.

IV-C35M		camera
Camera mode	Camera connector	
Color mode	CAMERA1	IV-C30C5
	CAMERA2	IV-C30C5
Monochrome mode	CAMERA1	IV-S30C5, IV-S30C4
	CAMERA2	IV-S30C3, IV-S30C4

■ Product lines

Item name			Model name	Specification or details
Camera	Color		IV-C30C5	Camera main housing (without lens or camera cable)
	Monochrome	High-speed	IV-S30C3	Camera main housing (without lens or camera cable)
		Micro, high-speed	IV-S30C4	Camera main housing (without lens or camera cable)
Camera cable			IV-S30KC3	Cable for camera, 3 m
			IV-S30KC5	Cable for camera, 5 m
Camera lens			IV-S20L16	C mount lens with a 16 mm focal length
Remote keypad			IV-S30RK1	Keys for remote entry
LCD monitors			IV-10MT	Bare chassis type
			IV-10MTV	Model with a mounting frame
			IV-10MTK	Model with a built-in remote keypad and a mounting frame
Monochrome monitor			IV-09MT	Monochrome 9 inch monitor
LED lighting equipment			IV-60LD	Integrated light source and controller in one housing
Parameter setting support software			IV-S30SP	Runs on Windows95/98/Me/NT4.0/2000
Image processing library			IV-S30LB1	Runs on Windows95/98/Me/NT4.0/2000

- For details about the IV-S30SP, IV-S30LB1, IV-09MT, IV-10MT, and IV-60LD, see the individual instruction manuals.

3-2 System configuration examples

This section outlines the system configurations for measurement using an external trigger, as follows:
- Measurement using a photo sensor.
- Measurement using CCD trigger.
- Measurement triggered by a command from a personal computer.

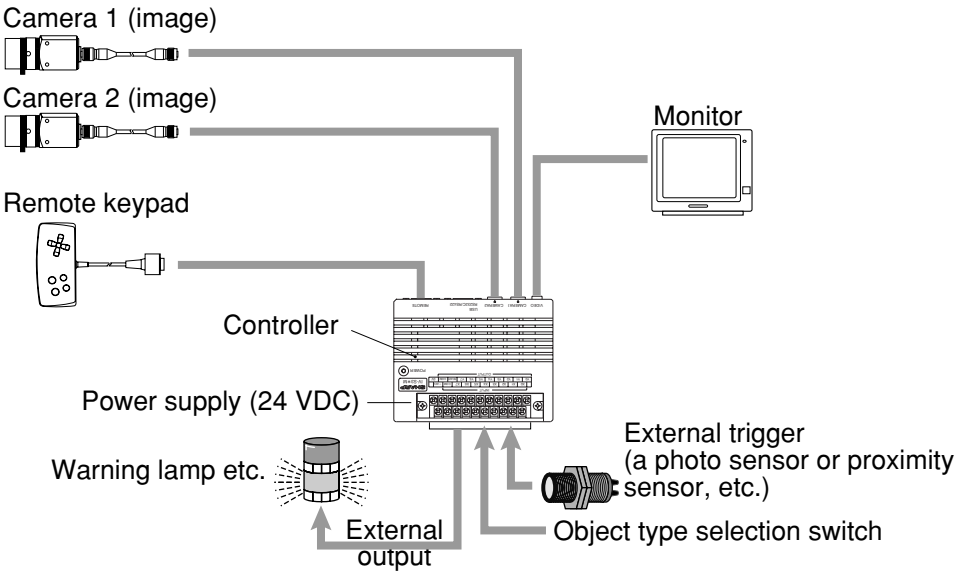
⇨ See "Chapter 21: Setting the Input/Output Conditions" in the IV-C35M User's Manual (Function and Operation).

[1] System configuration example for measurement triggered by an external trigger, such as a photo sensor

(1) When IV-C35M is used in a stand-alone mode

- **Purpose/application**

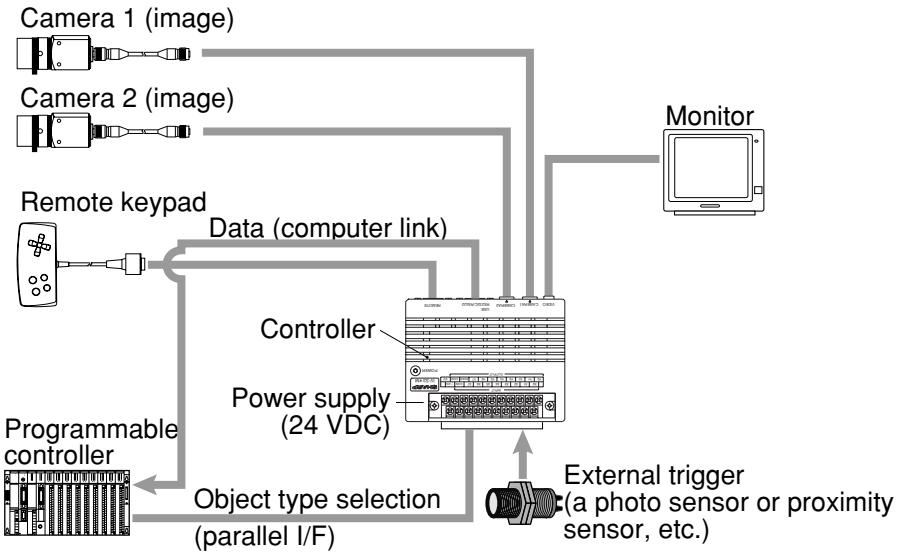
Measurement is started by an external trigger (a photo sensor or proximity sensor), and the measurement result is output externally (warning lamp). The object type number is selected by an external switch.



(2) When a programmable controller is connected

- **Purpose/application**

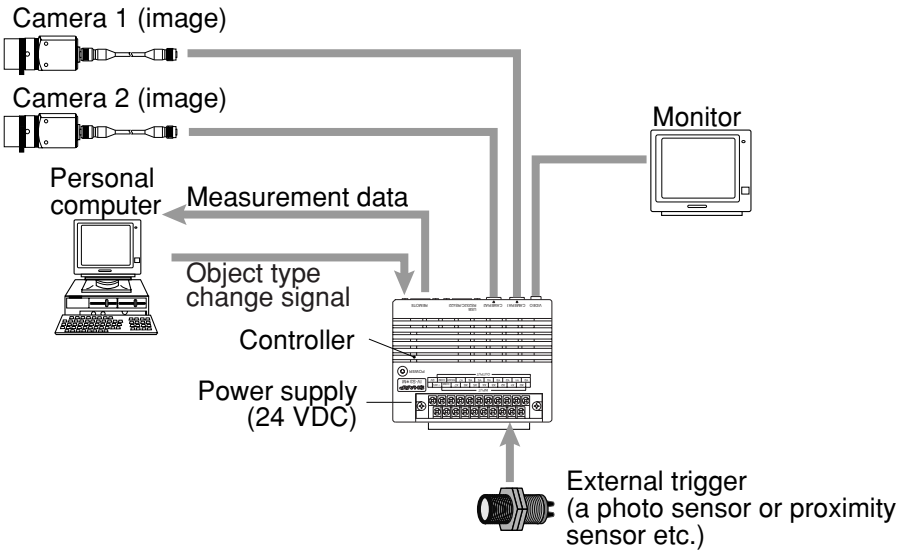
Measurement is started by an external trigger (a photo sensor or proximity sensor), and the measurement data is output to a programmable controller. The object type number is selected by the programmable controller.



(3) When a personal computer is connected

- **Purpose/application**

  Measurement is started by a CCD trigger (sampling start input: personal computer), and the measurement data is output to a personal computer. The object type number is selected by the personal computer.



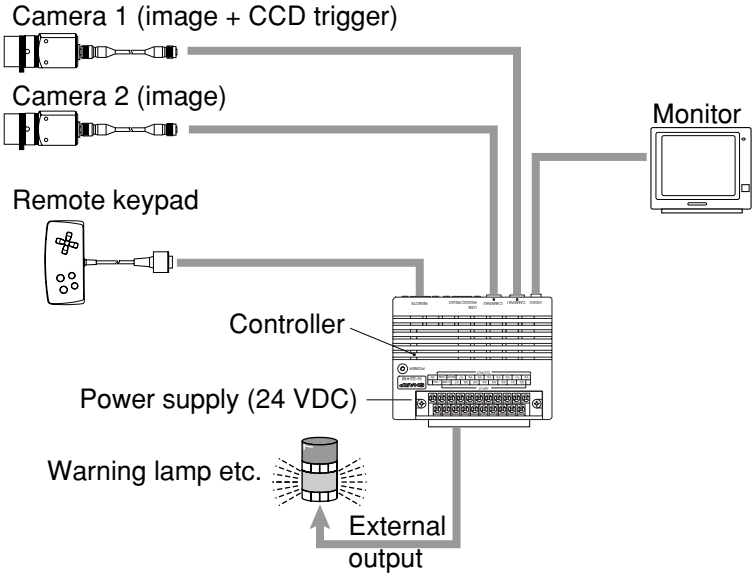
[2] System configuration example for measurement triggered by the internal CCD sensor trigger

The internal CCD trigger can be used with camera 1, but with camera 2.

(1) When IV-C35M is used in a stand-alone mode

- **Purpose/application**

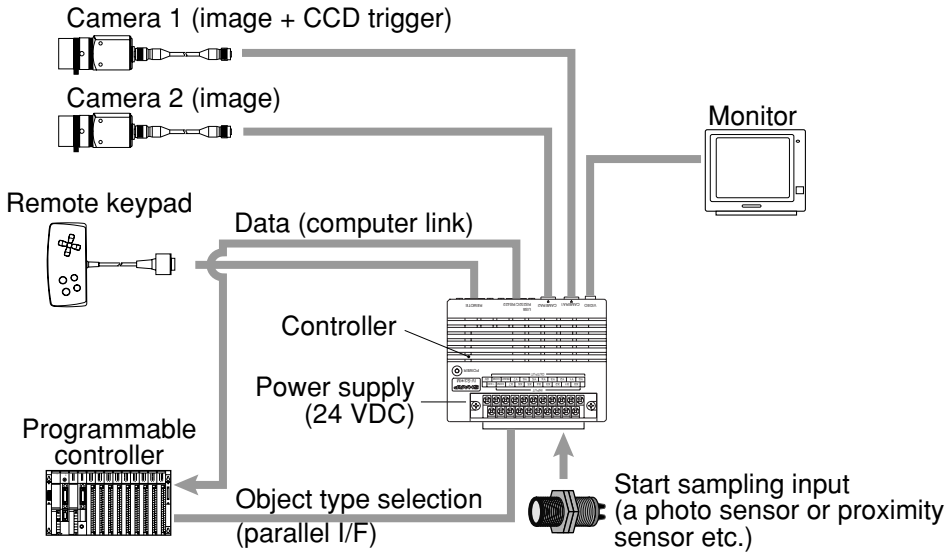
  Measurement is started by a CCD trigger, and the measurement result is output externally (warning lamp etc.). In this case, sampling operation is automatically started.



(2) When a programmable controller is connected

- **Purpose/application**

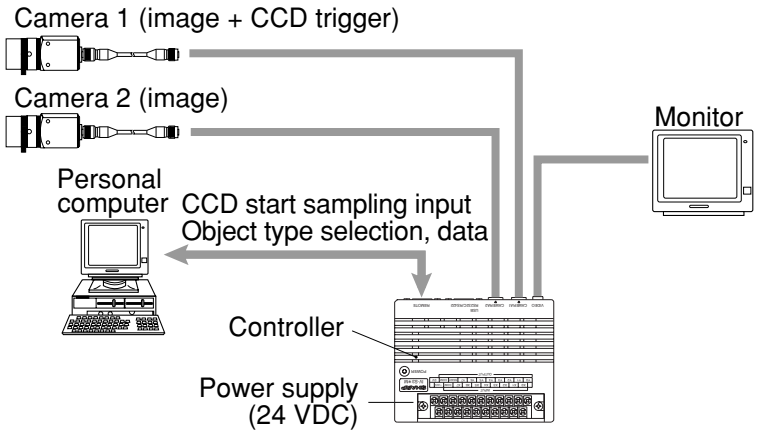
  Measurement is started by a CCD trigger (sampling start input: a photo sensor etc.), and the measurement data is output to a programmable controller. The object type number is selected by the programmable controller.



(3) When a personal computer is connected

- **Purpose/application**

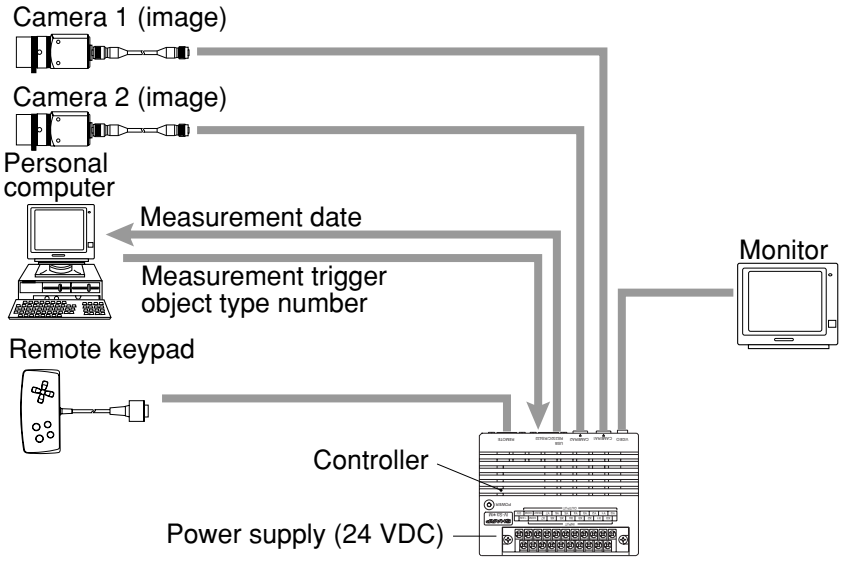
  Measurement is started by a CCD trigger (sampling start input: personal computer), and the measurement data is output to a personal computer. The object type number is selected by the personal computer.



[3] System configuration example for measurement triggered by a command from a personal computer

- **Purpose/application**

  Measurement is started by a trigger from a personal computer, and the measurement data is output to the personal computer. The object type number is selected by the personal computer.

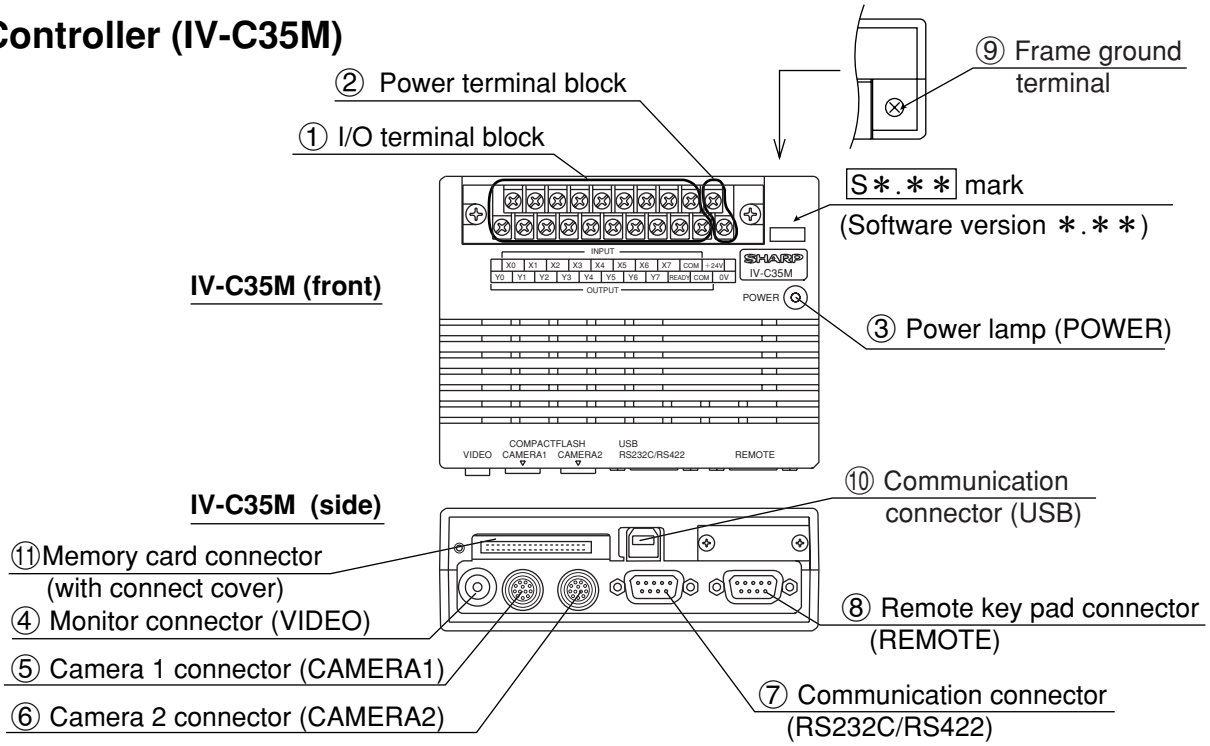


Chapter 4: Part Names and Functions

This section describes the names and functions of the controller, camera (camera body, camera converter, camera lens and camera cable), and the remote keypad which comprise the IV-C35M system.

⇨ See section in Chapter 5 "Connection and Installation Methods" for details about the housing brackets and camera angle bracket.

4-1 Controller (IV-C35M)

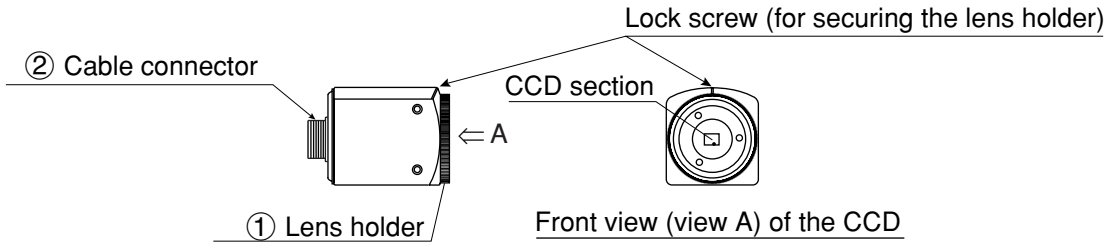


	Name	Function
①	I/O terminal block [INPUT: X0 to X7, C (+) OUTPUT: Y0 to Y7, READY, COM]	This block has 8 input terminals and 9 output terminals. - External devices are connected to these terminals for input and output (parallel I/F).
②	Power terminal block (+24V, 0V)	Commercially available constant-voltage power supply (24 V DC ± 10%, 700 mA or more) is connected here.
③	Power lamp (POWER)	When the power is applied to the controller, the green lamp will light.
④	Monitor connector (VIDEO)	A monitor is connected here. - The monitor connector is an RCA female connector .
⑤	Camera 1 connector (CAMERA1)	The camera cable connector is connected here. - The camera connected to the CAMERA 1 position is camera 1, and the camera connected to the CAMERA 2 position is camera 2.
⑥	Camera 2 connector (CAMERA2)	
⑦	Communication connector (RS232C/RS422: 9-pin D-sub female, rock screw M2.6)	This connector is used to connect a personal computer for communications (general purpose serial I/F) or to connect a programmable controller for a computer link.
⑧	Remote key pad connector (REMOTE)	The remote keypad connector is used to make selections from the menus on the screen (to set parameters). It is connected here.
⑨	Frame ground terminal	Be sure to ground the housing frame ground terminal together with the frame ground of the constant-voltage power supply in accordance with class 3 grounding procedures.
⑩	Communication connector (USB)	This connector is used to connect a cable to a USB port on a personal computer. - The USB port only functions with Windows 98/Me.
⑪	Memory card connector (COMPACTFLASH)	Connect a memory card (compact flash) that will be used to save setting parameters, NG images, etc

4-2 Camera

[1] Camera

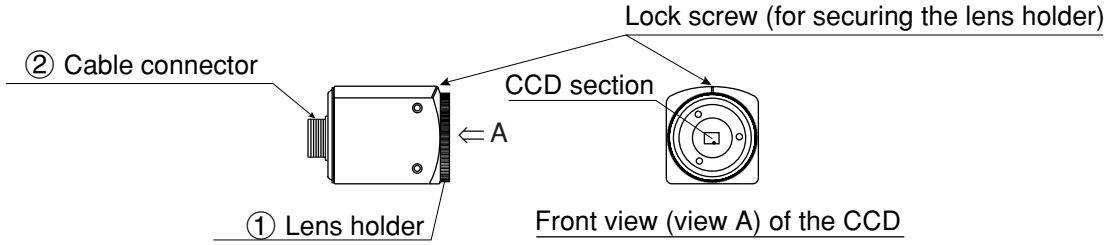
(1) Color camera (IV-C30C5)



	Name	Function
①	Lens holder	The holder is used to make fine adjustment to the distance (back plane focus) between the CCD section and camera lens using a focus fixed lens. (The distance has been adjusted before shipment. Usually, it does not need to be adjusted.) - To adjust it, loosen the upper lock screw, and turn the lens holder counter-clockwise. The maximum allowable distance is 1.5 mm.
②	Cable connector	Connect this connector to the camera cable (IV-S30KC3/KC5).

- To connect a color camera (IV-C30C5) to the IV-C35M controller, use the camera cable (IV-S30KC3/KC5) shown above.

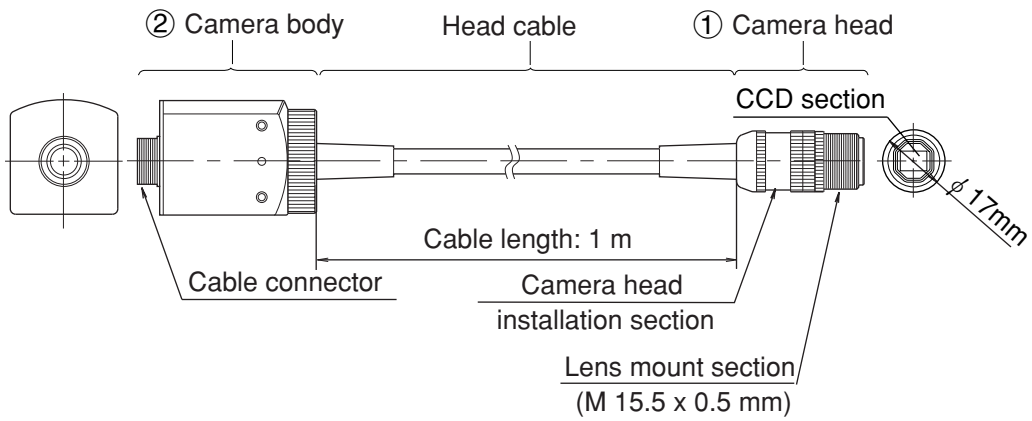
(2) High-speed monochrome camera (IV-S30C3)



	Name	Function
①	Lens holder	The holder is used to make fine adjustment to the distance (back plane focus) between the CCD section and camera lens using a focus fixed lens. (The distance has been adjusted before shipment. Usually, it does not need to be adjusted.) - To adjust it, loosen the upper lock screw, and turn the lens holder counter-clockwise. The maximum allowable distance is 1.5 mm.
②	Cable connector	Connect this connector to the camera cable (IV-S30KC3/KC5).

- To connect a high-speed monochrome camera (IV-S30C3) to the IV-C35M controller, use camera cable (IV-S30KC3/KC5) shown above.

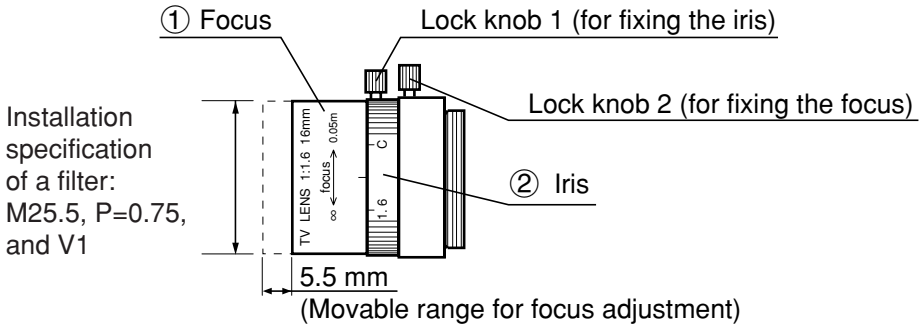
(4) Micro, high-speed monochrome camera (IV-S30C4)



	Name	Function
①	Camera head	Install a (commercially available) lens - The maximum external diameter of the camera head is ø17 mm, and the one for lens mount is M 15.5 x 0.5 mm.
②	Camera body	Connect to the camera connector of the camera cable (IV-S30KC3/KC5)

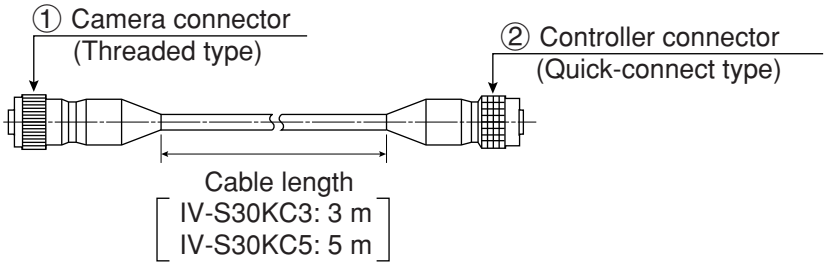
- To connect micro, high-speed monochrome camera (IV-S30C4) to the IV-C35M controller, use the camera cable (IV-S30KC3/KC5) shown above.

[2] Camera lens (IV-S20L16)



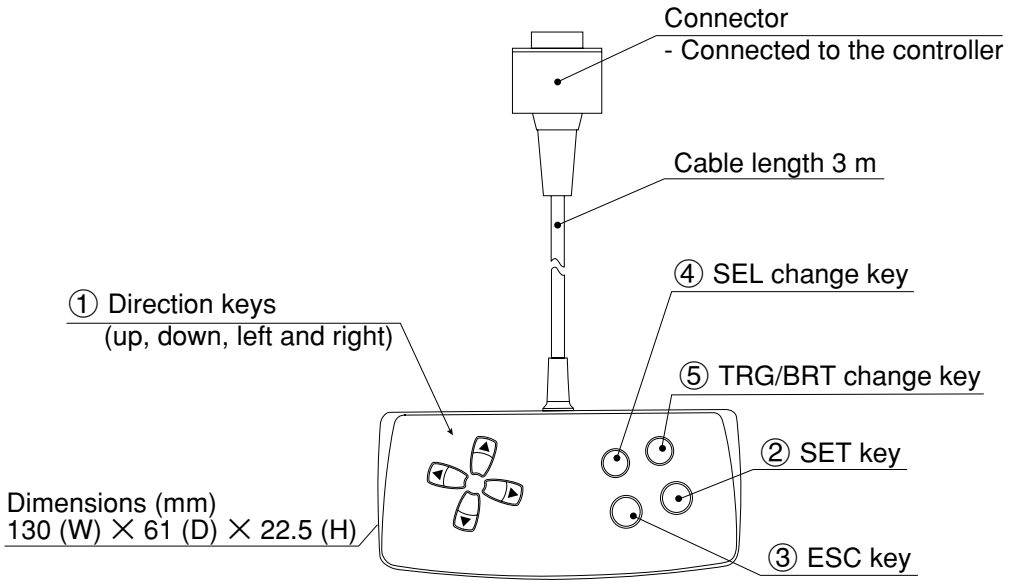
	Name	Function
①	Focus	To focus an image -The focall enght (distance from an object) is 50 mm to infinity (from the front of lens).
②	Iris	To adjust the image brightness. -The iris a perture can be set from 1.6mm to closed.

[3] Camera cable (IV-S30KC3/KC5)



	Name	Function
①	Camera connector	Connect to a connector for camera cable of the camera (IV-C30C5,IV-S30C3/S30C4).
②	Controller connector	Connect to camera 1 connector or camera 2 connector of the IV-C35M controller.

4-3 Remote keypad (IV-S30RK1)



	Key name	Function	Description
①	Direction keys* (up, down, left and right)	Selecting an item on a menu screen	Select an item with the up, down, left and right keys.
		Setting a window	Set each coordinate.
		Setting a value	- Select a digit or an item with the left and right keys, and then specify a value with the up and down keys. - Specify a value with the up, down, right and left keys.
		To enter nested menus	———
②	SET key	Determine a highlighted item	———
		Determine the setting value	
③	ESC key	Returning a setting to its original state before being changed	On the REG-COND screen, - Press the left arrow key + ESC key to change between a display of all items and just one item at a time.
		Returning to the previous menu	
④	SEL key	Use to select the display of object images: choose between "F" (Freeze) and "T" (Through) and between "BRT" (bright) and "DRK" (dark).	- When the screen is changed from "Through" to "Freeze," the IV-S30 will capture an image. - Change the brightness of the image displayed on the screen. On the setting screen, - Press the left arrow key and the SEL key to change between Through and Freeze. - Press the right arrow key and the SEL key to change between Bright and Dark.
⑤	TRG/BRT key	Start measurement input	Press this key on the operation screen, and a new measurement is triggered.
		Move the cursor to the function menu at the upper area.	———
		Displays popup menu.	

* The direction keys have an auto-repeat function.

Chapter 5: Connection and Installation Methods

5-1 Installation conditions

[1] Lighting equipment

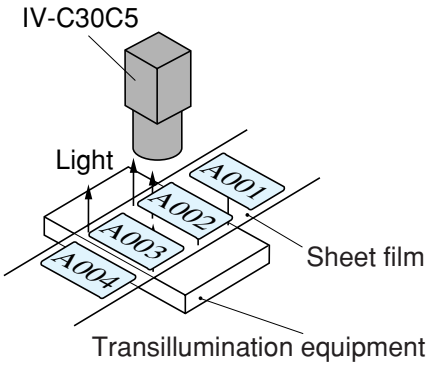
Lighting for the workpieces is an important factor in image processing. The lighting conditions affect the measurement results. Select the proper lighting equipment.

- Make sure there is uniform illumination of the whole measurement field where object images will be taken.
- Use flicker-free lighting equipment, such as a high frequency fluorescent lamps or halogen lamps.
- Consult us about the right lighting equipment for your application.

(1) Backlighting

Light should uniformly illuminate the field behind an object, so that the IV-C35M measure the object with it's shadow. Since the shadow picture will be converted to binary values, reliable measurements can be executed.

Example:

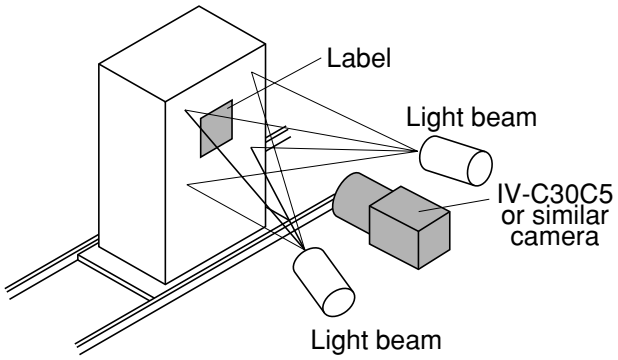


Color letter inspection on film

(2) Reflective lighting

A light shone on the front of an object with angle will be reflected, and the IV-C35M will pick up the reflected light. If too much light is reflected, such as from a metallic surface or similar materials, a proper image may not be obtained.

Example:

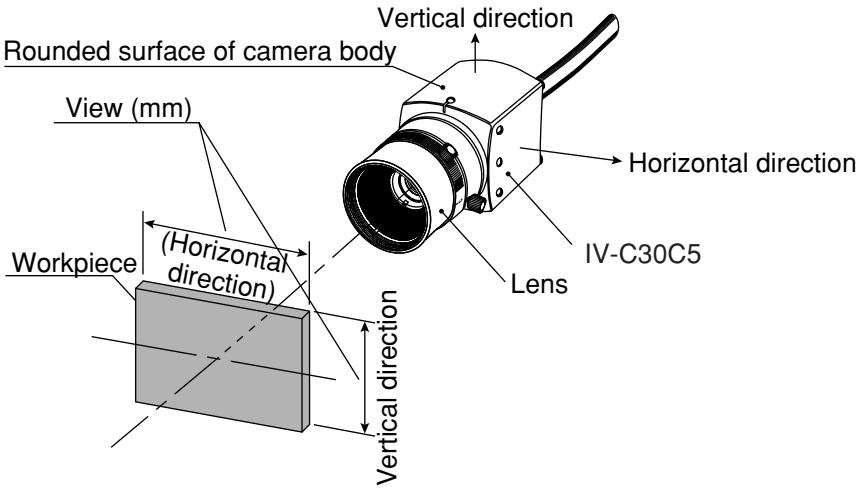


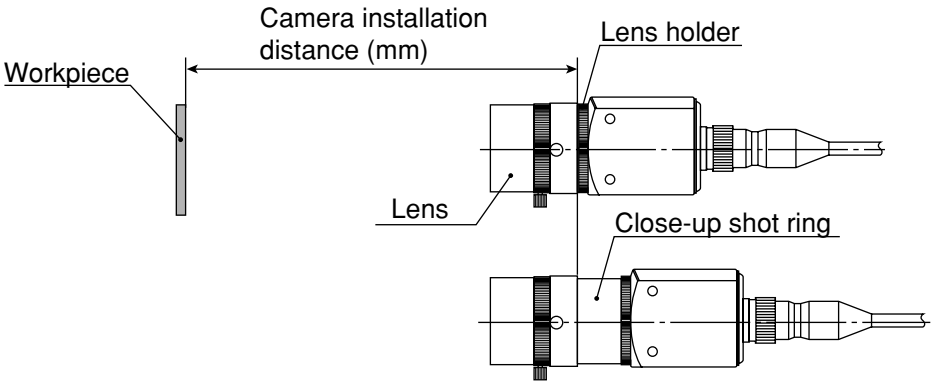
Label detection

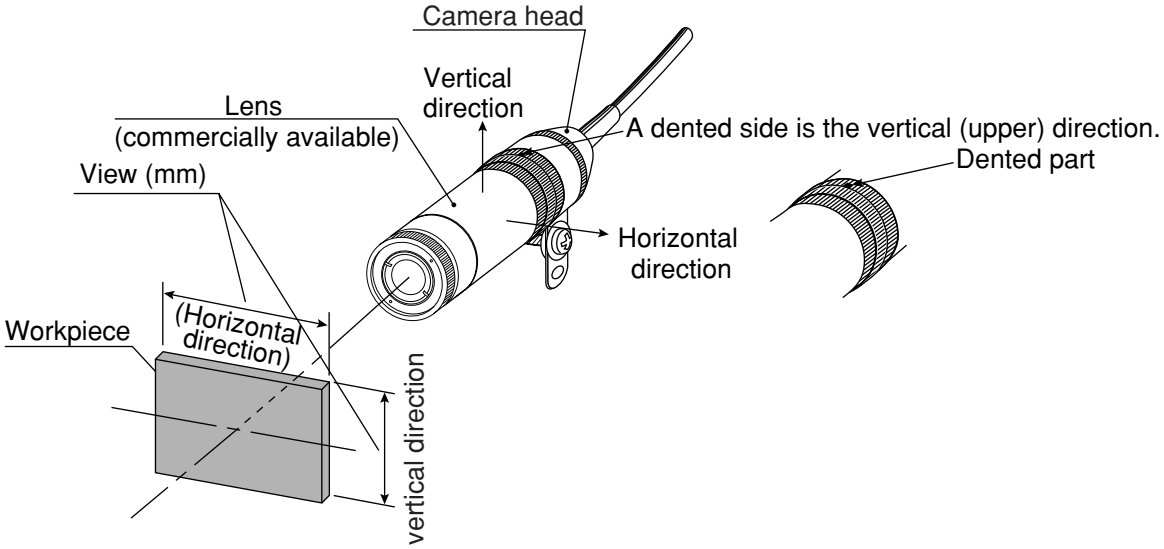
[2] Optimum lens and resolution

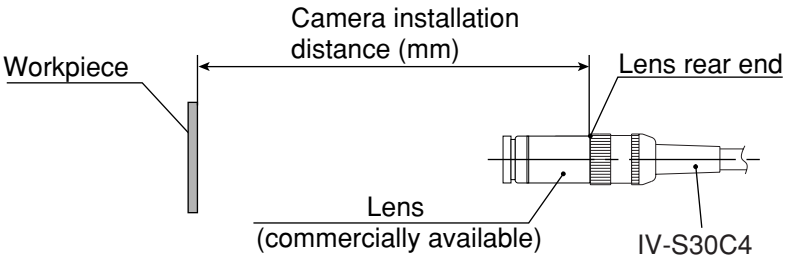
The optimum lens for your system can be selected, based on the camera installation distance and the field of view (workpiece size).

● **When the IV-C30C5, IV-S30C3 camera is used**









There is a relationships as shown on page 5-4 to page 5-6, among the camera installation distance, the field of view (in the vertical/horizontal direction), the lens focal length f, the aperture setting, the focal length, and the resolution.

[Example]

When the IV-C30C5 camera is used, the camera installation distance is 500 mm, and the field of view (in the horizontal direction) is 110 mm, the optimum lens can be selected as described in the following procedure. The required information is taken from the table on page 5-4.

Camera installation distance (mm)	Lens focal length f=16mm			
	View (mm)		Focal length (mm)	Resolution (μm)
	Vertical	Horizontal		
450	96.3	102.8	16.6	200.7
500	107.4	114.6	16.5	223.9
600	129.6	138.3	16.4	270.1

1) 2) 3)

1) Selecting the lens focal length f

Follow the line for a camera installation distance of 500 mm for the view (in the horizontal direction) that is closest to 110 mm, which is 114.6 mm. A 114.6 mm field of view is shown in the column for a lens focal length f, of 16 mm. Therefore, a lens with focal length of 16 mm is considered to be optimum.

2) Considering the focal length

The actual focal length, 16.5 mm, is longer than the lens focal length, f = 16 mm, by 0.5 mm. However, if the camera installation distance of 500 mm is within the focal range (distance from an object) of the actual lens (f = 16 mm), you can use it.

1. The focus range of the IV-S20L16 camera lens (f = 16 mm) built into the controller is from 50 mm to infinity. Therefore, the camera installation distance of 500 mm is within the focal range, and the IV-S20L16 lens can be used.
2. When another lens (with a focal range of 16 mm) is used, if its focal range exceeds 500 mm, install a commercially available C mount close-up shot ring. Use a ring that is 0.5 mm thick (16.5 - 16 = 0.5 mm).

3) Resolution

When the displayed image fills the whole monitor screen, and the view (in the horizontal direction) is 114.6 mm wide, the resolution is 223.9 μm.

$$\frac{114.6\ \text{mm}}{512\ \text{(pixel count)}} \fallingdotseq 223.9\ \text{m}$$

⇨ See "G-9" for the definition of resolution.

Notes

- The values shown in the tables on page 5-4 to 5-6 are only reference data for installation. These values may vary, according to the characteristics of lenses you are using. When using any lens, check the data using the actual equipment.
- When the IV-C30C5, IV-S30C3 camera is used.
  - If you want to use a camera lens other than the IV-S20L16, buy a lens with a C type lens base. (The IV-S20L16 has a C type lens base.)
  - A lens with too short focal length (f = 4.2 mm or 8 mm) will distort the edges of the field of view.
- When the IV-S30C4 camera is used
  - Use a commercially available ø17 mm lens.
  - When a wide-angle lens is used, the distortion at the edges will be larger.

■ Relation among the camera installation distance, the field of view, and the focal length

● When the IV-C30C5, IV-S30C3 camera is used

Camera installation distance (mm)	Lens focal length f=8mm				Lens focal length f=16mm				Lens focal length f=25mm			
	View (mm)		Focal length (mm)	Resolution (μm)	View (mm)		Focal length (mm)	Resolution (μm)	View (mm)		Focal length (mm)	Resolution (μm)
	Vertical	Horizontal			Vertical	Horizontal			Vertical	Horizontal		
55	14.2	15.2	10.0	29.6	—	—	—	—	—	—	—	—
60	16.4	17.5	9.7	34.2	9.8	10.4	21.8	20.4	5.0	5.3	42.9	10.4
70	20.9	22.3	9.4	43.5	12.0	12.8	20.7	25.0	6.4	6.8	38.9	13.3
80	25.3	27.0	9.1	52.7	14.2	15.2	20.0	29.6	7.8	8.3	36.4	16.3
90	29.7	31.7	9.0	62.0	16.4	17.5	19.5	34.2	9.2	9.9	34.6	19.2
100	34.2	36.5	8.8	71.2	18.6	19.9	19.0	38.9	10.7	11.4	33.3	22.2
120	43.1	45.9	8.7	89.7	23.1	24.6	18.5	48.1	13.5	14.4	31.6	28.1
140	51.9	55.4	8.5	108.2	27.5	29.4	18.1	57.4	16.3	17.4	30.4	34.0
160	60.8	64.9	8.5	126.7	32.0	34.1	17.8	66.6	19.2	20.5	29.6	40.0
180	69.7	74.4	8.4	145.2	36.4	38.8	17.6	75.9	22.0	23.5	29.0	45.9
200	78.6	83.8	8.4	163.7	40.8	43.6	17.4	85.1	24.9	26.5	28.6	51.8
250	100.8	107.5	8.3	210.0	51.9	55.4	17.1	108.2	32.0	34.1	27.8	66.6
300	123.0	131.2	8.2	256.2	63.0	67.3	16.9	131.4	39.1	41.7	27.3	81.4
350	145.2	154.9	8.2	302.5	74.1	79.1	16.8	154.5	46.2	49.3	26.9	96.2
400	167.4	178.6	8.2	348.7	85.2	90.9	16.7	177.6	53.3	56.8	26.7	111.0
450	189.6	202.2	8.1	395.0	96.3	102.8	16.6	200.7	60.4	64.4	26.5	125.8
500	211.8	225.9	8.1	441.2	107.4	114.6	16.5	223.9	67.5	72.0	26.3	140.6
600	256.2	273.3	8.1	533.8	129.6	138.3	16.4	270.1	81.7	87.1	26.1	170.2
700	300.6	320.6	8.1	626.3	151.8	162.0	16.4	316.4	95.9	102.3	25.9	199.8
800	345.0	368.0	8.1	718.8	174.0	185.7	16.3	362.6	110.1	117.5	25.8	229.4
900	389.4	415.4	8.1	811.3	196.2	209.3	16.3	408.9	124.3	132.6	25.7	259.0
1000	433.8	462.7	8.1	903.8	218.4	233.0	16.3	455.1	138.5	147.8	25.6	288.6
1100	478.2	510.1	8.1	996.3	240.6	256.7	16.2	501.4	152.7	162.9	25.6	318.2
1200	522.6	557.5	8.1	1088.8	262.8	280.4	16.2	547.6	166.9	178.1	25.5	347.8
1300	567.0	604.8	8.1	1181.3	285.0	304.1	16.2	593.9	181.2	193.2	25.5	377.4
1400	611.4	652.2	8.0	1273.8	307.2	327.7	16.2	640.1	195.4	208.4	25.5	407.0
1500	655.8	699.5	8.0	1366.3	329.4	351.4	16.2	686.4	209.6	223.6	25.4	436.6
1600	700.2	746.9	8.0	1458.8	351.6	375.1	16.2	732.6	223.8	238.7	25.4	466.2
1700	744.6	794.3	8.0	1551.3	373.8	398.8	16.2	778.9	238.0	253.9	25.4	495.8
1800	789.0	841.6	8.0	1643.8	396.0	422.5	16.1	825.1	252.2	269.0	25.4	525.4
1900	833.4	889.0	8.0	1736.3	418.2	446.2	16.1	871.4	266.4	284.2	25.3	555.0
2000	877.8	936.4	8.0	1828.8	440.4	469.8	16.1	917.6	280.6	299.3	25.3	584.6
2500	1099.8	1173.2	8.0	2291.3	551.4	588.2	16.1	1148.9	351.6	375.1	25.3	732.6
3000	1321.8	1410.0	8.0	2753.9	662.4	706.6	16.1	1380.2	422.7	450.9	25.2	880.6
3500	1543.8	1646.8	8.0	3216.4	773.4	825.1	16.1	1611.4	493.7	526.7	25.2	1028.7
4000	1765.8	1883.6	8.0	3678.9	884.4	943.5	16.1	1842.7	564.8	602.5	25.2	1176.7
4500	1987.8	2120.4	8.0	4141.4	995.4	1061.9	16.1	2074.0	635.8	678.2	25.1	1324.7
5000	2209.8	2357.2	8.0	4604.0	1106.4	1180.3	16.1	2305.2	706.8	754.0	25.1	1472.7
5500	2431.8	2594.0	8.0	5066.5	1217.4	1298.7	16.0	2536.5	777.9	829.8	25.1	1620.7
6000	2653.8	2830.9	8.0	5529.0	1328.4	1417.1	16.0	2767.7	848.9	905.6	25.1	1768.7
6500	2875.8	3067.7	8.0	5991.5	1439.4	1535.5	16.0	2999.0	920.0	981.4	25.1	1916.7
7000	3097.8	3304.5	8.0	6454.1	1550.4	1653.9	16.0	3230.3	991.0	1057.1	25.1	2064.7
7500	3319.8	3541.3	8.0	6916.6	1661.4	1772.3	16.0	3461.5	1062.0	1132.9	25.1	2212.7

Camera installation distance (mm)	Lens focal length f=35mm				Lens focal length f=50mm				Lens focal length f=75mm			
	View (mm)		Focal length	Resolution	View (mm)		Focal length	Resolution	View (mm)		Focal length	Resolution
	Vertical	Hori-zontal	(mm)	(μm)	Vertical	Hori-zontal	(mm)	(μm)	Vertical	Hori-zontal	(mm)	(μm)
55	—	—	—	—	—	—	—	—	—	—	—	—
60												
70												
80	4.6	4.9	62.2	9.5								
90	5.6	6.0	57.3	11.6								
100	6.6	7.0	53.8	13.7								
120	8.6	9.2	49.4	18.0	3.3	3.6	103.2	7.0				
140	10.7	11.4	46.7	22.2	4.8	5.1	87.3	9.9				
160	12.7	13.5	44.8	26.4	6.2	6.6	78.7	12.9				
180	14.7	15.7	43.4	30.7	7.6	8.1	73.4	15.8				
200	16.7	17.9	42.4	34.9	9.0	9.6	69.7	18.8				
250	21.8	23.3	40.7	45.5	12.6	13.4	64.1	26.2				
300	26.9	28.7	39.6	56.0	16.1	17.2	61.0	33.6	8.8	9.3	105.4	18.3
350	32.0	34.1	38.9	66.6	19.7	21.0	59.0	41.0	11.1	11.9	98.9	23.2
400	37.0	39.5	38.4	77.2	23.2	24.8	57.6	48.4	13.5	14.4	94.7	28.1
450	42.1	44.9	38.0	87.7	26.8	28.6	56.6	55.8	15.9	16.9	91.8	33.1
500	47.2	50.3	37.6	98.3	30.3	32.4	55.9	63.2	18.2	19.5	89.6	38.0
600	57.3	61.2	37.2	119.5	37.4	39.9	54.7	78.0	23.0	24.5	86.6	47.9
700	67.5	72.0	36.8	140.6	44.5	47.5	54.0	92.8	27.7	29.6	84.6	57.7
800	77.6	82.8	36.6	161.8	51.6	55.1	53.4	107.6	32.4	34.6	83.2	67.6
900	87.8	93.6	36.4	182.9	58.8	62.7	53.0	122.4	37.2	39.7	82.2	77.5
1000	97.9	104.5	36.3	204.0	65.9	70.2	52.7	137.2	41.9	44.7	81.4	87.3
1100	108.1	115.3	36.2	225.2	73.0	77.8	52.4	152.0	46.6	49.8	80.7	97.2
1200	118.2	126.1	36.1	246.3	80.1	85.4	52.2	166.8	51.4	54.8	80.2	107.1
1300	128.4	136.9	36.0	267.5	87.2	93.0	52.0	181.6	56.1	59.9	79.7	116.9
1400	138.5	147.8	35.9	288.6	94.3	100.6	51.9	196.4	60.9	64.9	79.4	126.8
1500	148.7	158.6	35.8	309.8	101.4	108.1	51.8	211.2	65.6	70.0	79.1	136.7
1600	158.8	169.4	35.8	330.9	108.5	115.7	51.6	226.0	70.3	75.0	78.8	146.5
1700	169.0	180.2	35.7	352.0	115.6	123.3	51.5	240.8	75.1	80.1	78.5	156.4
1800	179.1	191.1	35.7	373.2	122.7	130.9	51.4	255.6	79.8	85.1	78.3	166.3
1900	189.3	201.9	35.7	394.3	129.8	138.5	51.4	270.4	84.5	90.2	78.2	176.1
2000	199.4	212.7	35.6	415.5	136.9	146.0	51.3	285.2	89.3	95.2	78.0	186.0
2500	250.2	266.9	35.5	521.2	172.4	183.9	51.0	359.2	113.0	120.5	77.4	235.3
3000	300.9	321.0	35.4	626.9	207.9	221.8	50.9	433.2	136.6	145.8	76.9	284.7
3500	351.6	375.1	35.4	732.6	243.5	259.7	50.7	507.2	160.3	171.0	76.7	334.0
4000	402.4	429.2	35.3	838.4	279.0	297.6	50.6	581.2	184.0	196.3	76.4	383.3
4500	453.1	483.4	35.3	944.1	314.5	335.5	50.6	655.2	207.7	221.5	76.3	432.7
5000	503.9	537.5	35.2	1049.8	350.0	373.4	50.5	729.2	231.4	246.8	76.2	482.0
5500	554.6	591.6	35.2	1155.5	385.5	411.3	50.5	803.2	255.0	272.1	76.0	531.3
6000	605.4	645.8	35.2	1261.2	421.1	449.1	50.4	877.2	278.7	297.3	76.0	580.7
6500	656.1	699.9	35.2	1367.0	456.6	487.0	50.4	951.2	302.4	322.6	75.9	630.0
7000	706.8	754.0	35.2	1472.7	492.1	524.9	50.4	1025.3	326.1	347.8	75.8	679.4
7500	757.6	808.1	35.2	1578.4	527.6	562.8	50.3	1099.3	349.8	373.1	75.8	728.7

● **When the IV-S30C4 camera is used**

Camera installation distance (mm)	Lens focal length f=7.2mm				Lens focal length f=15mm				Lens focal length f=24 mm			
	Vertical direction	Vertical direction 7.50			Vertical direction	Vertical direction 15.00			Vertical direction	Vertical direction 24.00		
	Workpiece size (Hmm)	Workpiece size (Hmm)	Focal length (mm)	Resolution (μm)	Workpiece size (Hmm)	Workpiece size (Hmm)	Focal length (mm)	Resolution (μm)	Workpiece size (Hmm)	Workpiece size (Hmm)	Focal length (mm)	Resolution (μm)
55	18.7	20.0	9.0	39.0	—	—	—	—	—	—	—	—
60	21.1	22.5	8.8	43.9	8.8	9.3	18.2	18.3	4.1	4.4	30.9	8.6
70	25.8	27.5	8.6	53.8	11.1	11.9	17.6	23.2	5.6	6.0	29.1	11.7
80	30.5	32.6	8.4	63.6	13.5	14.4	17.1	28.1	7.1	7.6	28.0	14.8
90	35.3	37.6	8.3	73.5	15.9	16.9	16.8	33.1	8.6	9.2	27.3	17.9
100	40.0	42.7	8.2	83.4	18.2	19.5	16.6	38.0	10.1	10.7	26.8	21.0
120	49.5	52.8	8.1	103.1	23.0	24.5	16.2	47.9	13.0	13.9	26.2	27.1
140	59.0	62.9	8.0	122.8	27.7	29.6	16.0	57.7	16.0	17.1	25.8	33.3
160	68.4	73.0	7.9	142.6	32.4	34.6	15.9	67.6	18.9	20.2	25.5	39.5
180	77.9	83.1	7.9	162.3	37.2	39.7	15.8	77.5	21.9	23.4	25.3	45.6
200	87.4	93.2	7.8	182.0	41.9	44.7	15.7	87.3	24.9	26.5	25.1	51.8
250	111.1	118.5	7.8	231.4	53.8	57.3	15.5	112.0	32.3	34.4	24.9	67.2
300	134.7	143.7	7.7	280.7	65.6	70.0	15.4	136.7	39.7	42.3	24.7	82.6
350	158.4	169.0	7.7	330.1	77.4	82.6	15.4	161.3	47.1	50.2	24.6	98.1
400	182.1	194.2	7.7	379.4	89.3	95.2	15.3	186.0	54.5	58.1	24.5	113.5
450	205.8	219.5	7.6	428.7	101.1	107.9	15.3	210.7	61.9	66.0	24.5	128.9
500	229.5	244.8	7.6	478.1	113.0	120.5	15.3	235.3	69.3	73.9	24.4	144.3
600	276.8	295.3	7.6	576.7	136.6	145.8	15.2	284.7	84.1	89.7	24.3	175.1
700	324.2	345.8	7.6	675.4	160.3	171.0	15.2	334.0	98.9	105.5	24.3	206.0
800	371.5	396.3	7.6	774.1	184.0	196.3	15.2	383.3	113.7	121.2	24.3	236.8
900	418.9	446.8	7.6	872.8	207.7	221.5	15.1	432.7	128.5	137.0	24.2	267.6
1000	466.3	497.4	7.6	971.4	231.4	246.8	15.1	482.0	143.3	152.8	24.2	298.5
1100	513.6	547.9	7.6	1070.1	255.0	272.1	15.1	531.3	158.1	168.6	24.2	329.3
1200	561.0	598.4	7.6	1168.8	278.7	297.3	15.1	580.7	172.9	184.4	24.2	360.2
1300	608.3	648.9	7.5	1267.4	302.4	322.6	15.1	630.0	187.7	200.2	24.2	391.0
1400	655.7	699.4	7.5	1366.1	326.1	347.8	15.1	679.4	202.5	216.0	24.1	421.8
1500	703.1	750.0	7.5	1464.8	349.8	373.1	15.1	728.7	217.3	231.8	24.1	452.7
1600	750.4	800.5	7.5	1563.5	373.4	398.4	15.1	778.0	232.1	247.5	24.1	483.5
1700	797.8	851.0	7.5	1662.1	397.1	423.6	15.1	827.4	246.9	263.3	24.1	514.3
1800	845.1	901.5	7.5	1760.8	420.8	448.9	15.1	876.7	261.7	279.1	24.1	545.2
1900	892.5	952.0	7.5	1859.5	444.5	474.1	15.1	926.0	276.5	294.9	24.1	576.0
2000	939.9	1002.6	7.5	1958.1	468.2	499.4	15.1	975.4	291.3	310.7	24.1	606.8
2500	1176.7	1255.2	7.5	2451.5	586.6	625.7	15.0	1222.1	365.3	389.6	24.1	761.0
3000	1413.5	1507.8	7.5	2944.9	705.0	752.0	15.0	1468.7	439.3	468.6	24.1	915.2
3500	1650.3	1760.4	7.5	3438.2	823.4	878.3	15.0	1715.4	513.3	547.5	24.1	1069.4
4000	1887.1	2013.0	7.5	3931.6	941.8	1004.6	15.0	1962.1	587.3	626.4	24.0	1223.5
4500	2123.9	2265.6	7.5	4424.9	1060.2	1130.9	15.0	2208.8	661.3	705.4	24.0	1377.7
5000	2360.7	2518.2	7.5	4918.3	1178.6	1257.2	15.0	2455.4	735.3	784.3	24.0	1531.9
5500	2597.5	2770.8	7.5	5411.7	1297.0	1383.5	15.0	2702.1	809.3	863.3	24.0	1686.1
6000	2834.3	3023.4	7.5	5905.0	1415.4	1509.8	15.0	2948.8	883.3	942.2	24.0	1840.2
6500	3071.1	3276.0	7.5	6398.4	1533.8	1636.1	15.0	3195.5	957.3	1021.1	24.0	1994.4
7000	3307.9	3528.6	7.5	6891.7	1652.2	1762.4	15.0	3442.2	1031.3	1100.1	24.0	2148.6
7500	3544.7	3781.2	7.5	7385.1	1770.6	1888.7	15.0	3688.8	1105.3	1179.0	24.0	2302.8

● **Table of magnifications and viewing size**

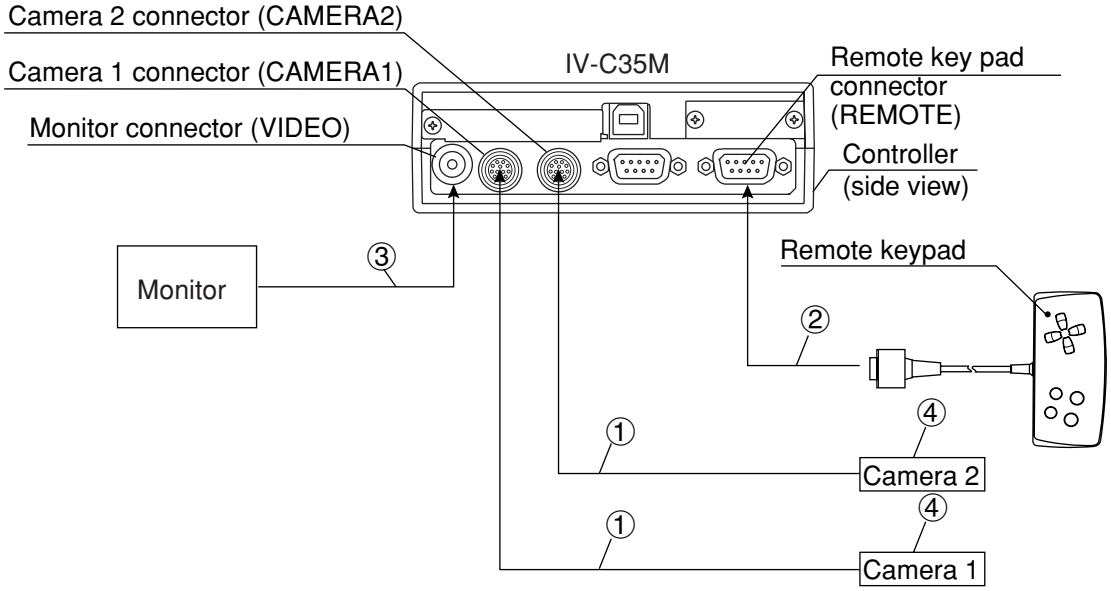
(Vertical size x Horizontal size x Diagonal size) mm

Magnification	1/3" viewing field	14" monitor magnification
×0.14	25×27×36.6	8.3
×0.16	22×23×32.2	9.4
×0.18	20×21×29.2	10.6
×0.2	18×19×26.3	11.8
×0.3	12×13×17.5	17.8
×0.5	7.2×7.7×10.53	29.6
×0.75	4.8×5.1×7.02	44.4
×0.8	4.5×4.8×6.58	47.4
×1	3.6×3.8×5.26	59.3
×2	1.8×1.9×2.63	118.6
×4	0.9×0.96×1.316	237.2
×4.5	0.8×0.85×1.170	266.8
×6	0.6×0.64×0.877	355.8
×8	0.45×0.48×0.658	474.4
×10	0.36×0.38×0.526	593
×12	0.3×0.32×0.439	711.6

5-2 Installing, connecting and wiring the IV-C35M controller

[1] Connecting equipment to the controller

Connect the cameras (up to 2 cameras), remote keypad, and monitor to the controller (IV-C35M).



① Connect the camera cable (IV-S30KC3/KC5) connector or a connector of the main interface cable supplied with the IV-C35M to the camera 1 (CAMERA1) and camera 2 (CAMERA2) connectors on the controller.

Note: Only connect or disconnect the camera connectors while the power is OFF.

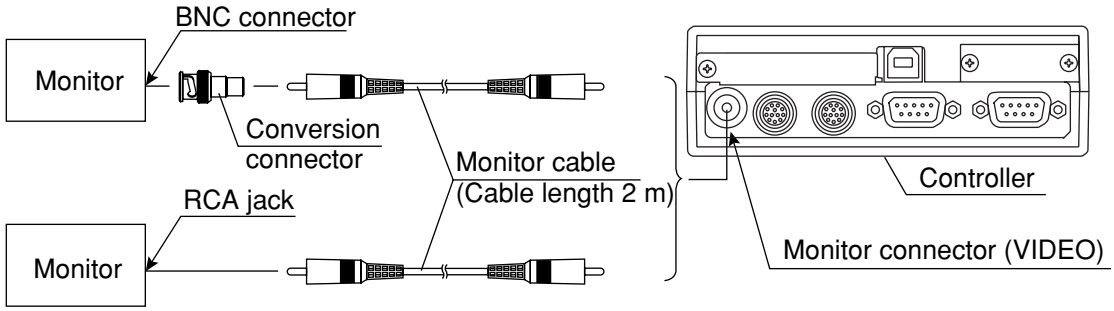
- Push the convex side of the connector into the concave side of the mating connector. When the connector is all the way on, it clicks.
- To disconnect the connector, hold the plug of the connector, and pull it straight out.
- A camera connected to the camera 1 connector (CAMERA1) is treated as camera 1 by this system, and a camera connected to the camera 2 connector (CAMERA2) is treated as camera 2.

Note: You must have a camera connected to the camera 1 connector.

② Plug the remote keypad (IV-S30RK1) connector into the remote keypad connector (REMOTE) on the controller.

③ Connect the monitor to the monitor connector (VIDEO: RCA jack) on the controller using the monitor cable (supplied with the controller) and a conversion connector (supplied with controller). If the monitor has an RCA jack, the conversion connector is not required.

- Use a monitor with either an EIA or NTSC compatible video input terminal.
- Connect the cable to the monitor connector straight and treat it carefully.

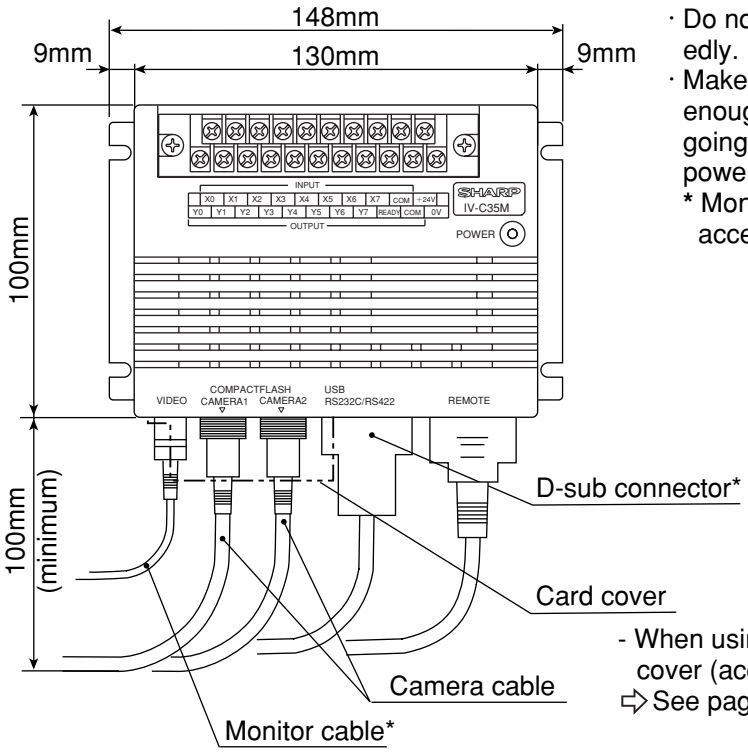


- If you need a monitor cable longer than 2 m, you can purchase a one at a video store.

④ For details about connecting and installing cameras, see page 5-16 and after in this manual.

■ **Leave enough space around the controller (IV-C35M)**

In order to connect camera cables, the remote key pad cable, monitor cable and D-sub connector to the controller, the following space (min.) is required.

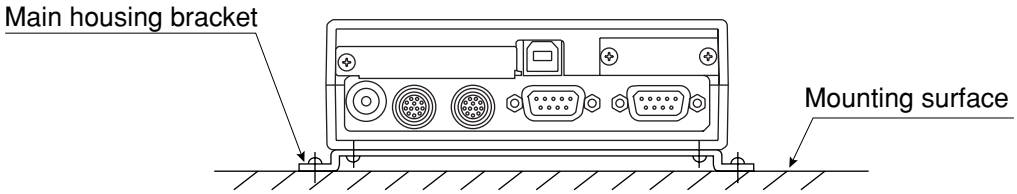


· Do not bend the camera cables repeatedly.
· Make sure the installation location allows enough space for the input/output wires going to the I/O terminal block and the power terminal block on the controller.
***** Monitor cable and D-sub connector are accessories of the IV-C35M controller.

- When using a memory card, install a card cover (accessory) on the IV-C35M housing.
⇨See page 6-17.

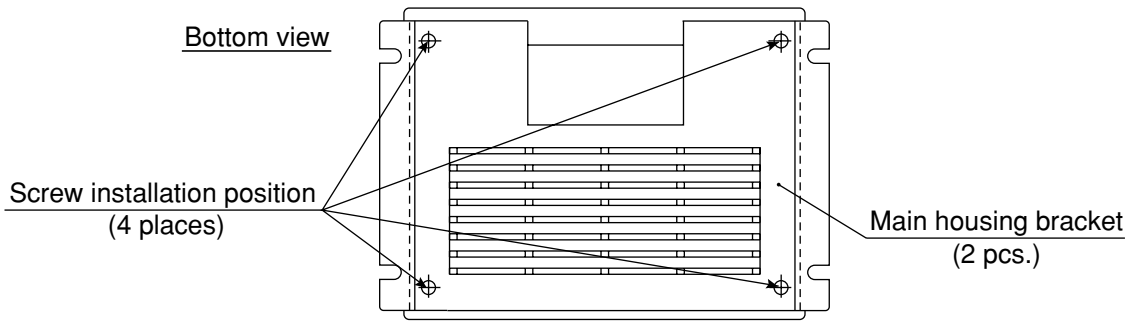
[2] Installation

To install the IV-C35M controller, secure the bottom of the housing on the mounting surface with the two main housing brackets (supplied with the controller.)

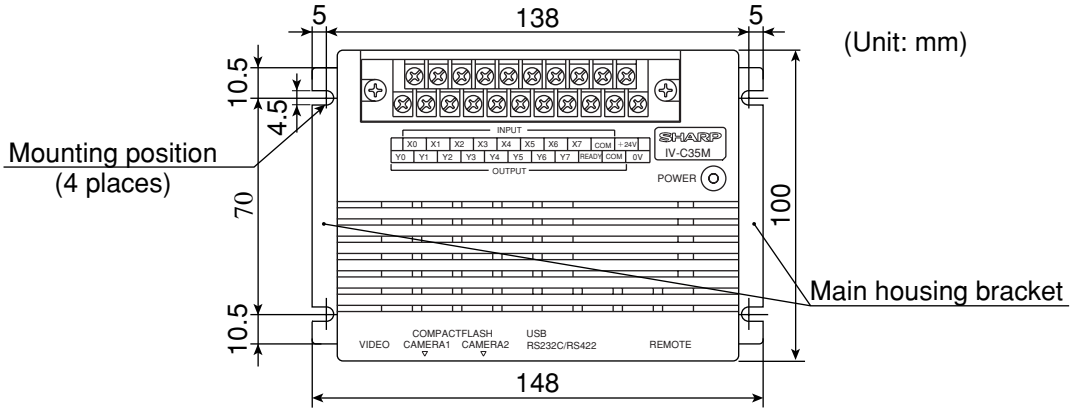


● **Mounting procedure**

1. Install the main housing angle bracket at the bottom of the IV-C35M housing, and secure using 4 screws (M3 x 6: Accessory).



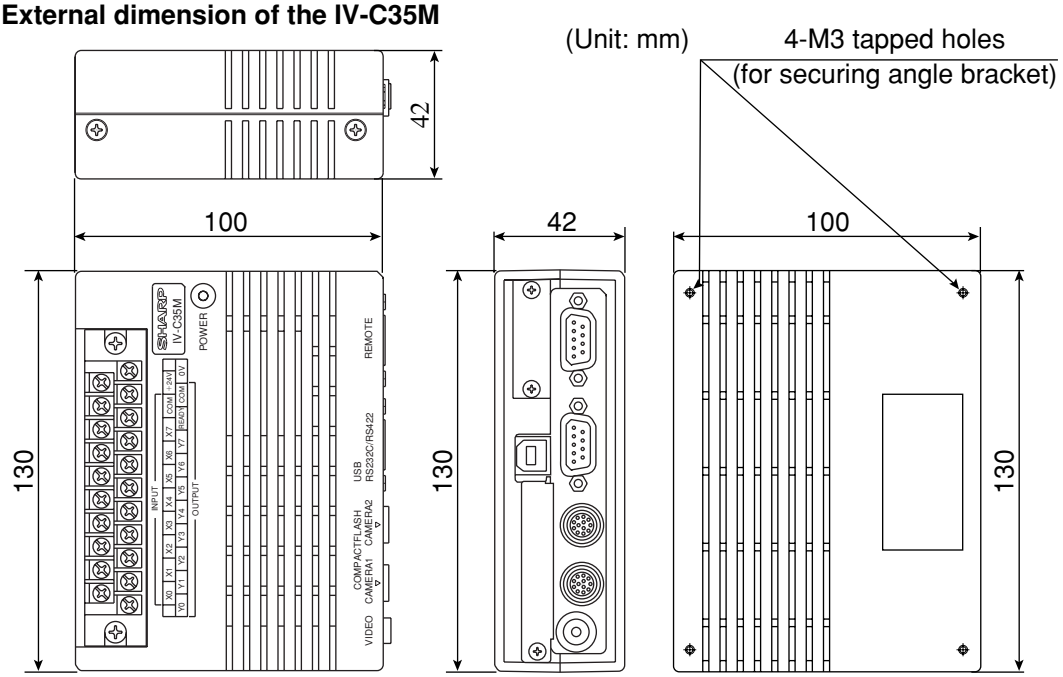
2. Using installation holes (4.5 mm width and 4 positions) of the main housing angle bracket, install the IV-C35M main housing on a panel.



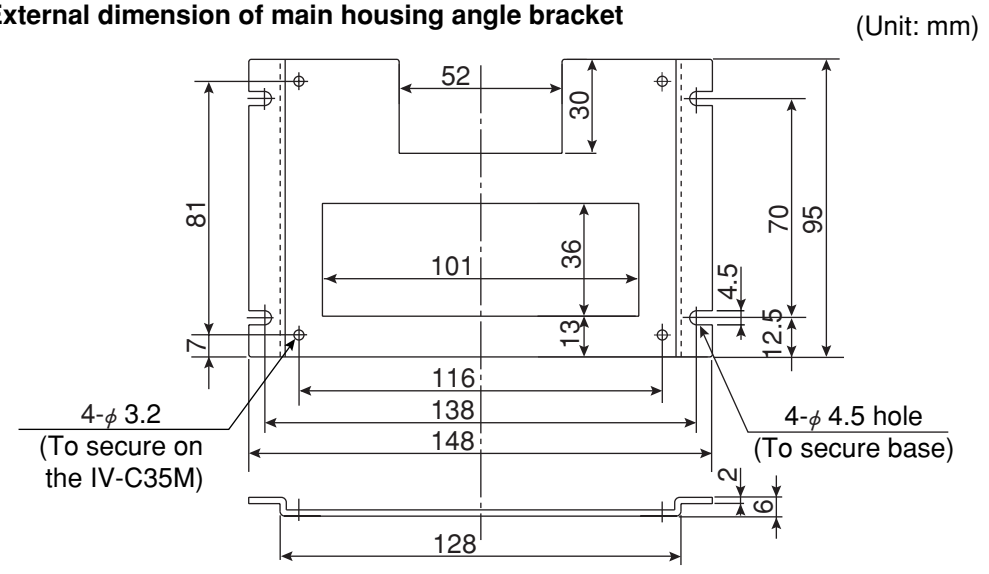
⇨ The external dimensions of the main housing brackets and the controller are shown on the following page.

5

● **External dimension of the IV-C35M**



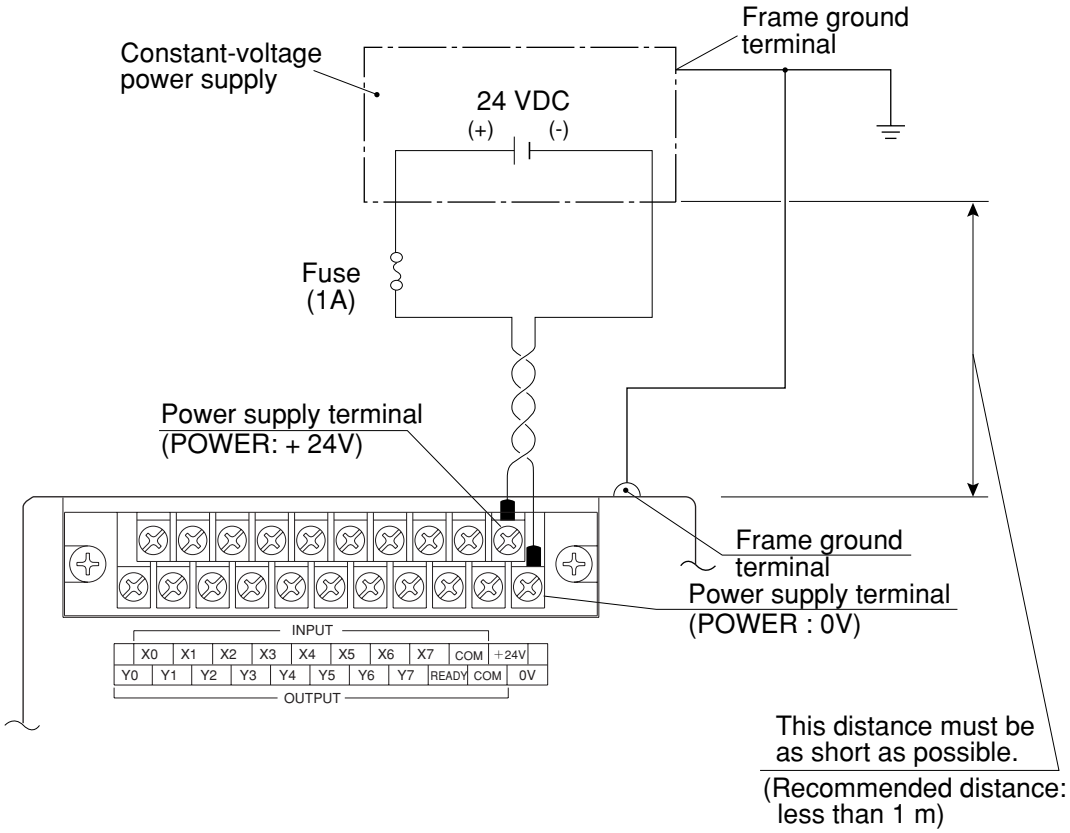
● **External dimension of main housing angle bracket**



[3] Connecting a power supply

Connect a commercially available constant-voltage power supply to the power terminals (POWER: +24 V, 0 V) on the controller (IV-C35M). Use a 24 VDC ±10%, 1200 mA or more constant-voltage power supply.

- Use an individual power supply to supply power to the controller. If the power supply is used to power other equipment, measurement errors may occur.
- Check the polarity of the power supply terminals, +24 V and 0 V. If power is supplied with the polarity inverted, the controller may be damaged.
- Only connect or disconnect the camera cable and other equipment while the power is OFF.



Note

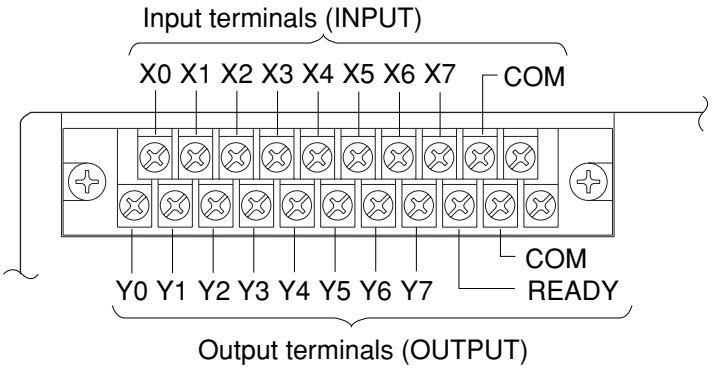
To improve the noise resistance of the constant-voltage power supply connected to the controller (IV-C35M), observe the following precautions.

- Ground the FG terminal of the constant-voltage power supply according to the class 3 grounding.
- The power line between the controller and the constant-voltage power supply must be as short as possible. (Recommended distance: less than 1 m)
  Do not run the power supply line near any noise generating sources, such as electric motor lines.
- Use twisted-pair wire for the power supply line.

[4] Connecting to the input/output terminals (parallel I/F)

8 input terminals and 9 output terminals are available on the input/output terminal block on the controller (IV-C35M).
The input terminal block has INPUT terminals X0 to X7 and COM , and the output terminal block has OUTPUT terminals Y0 to Y7, READY and COM .

- **Input/output terminal block on the controller**



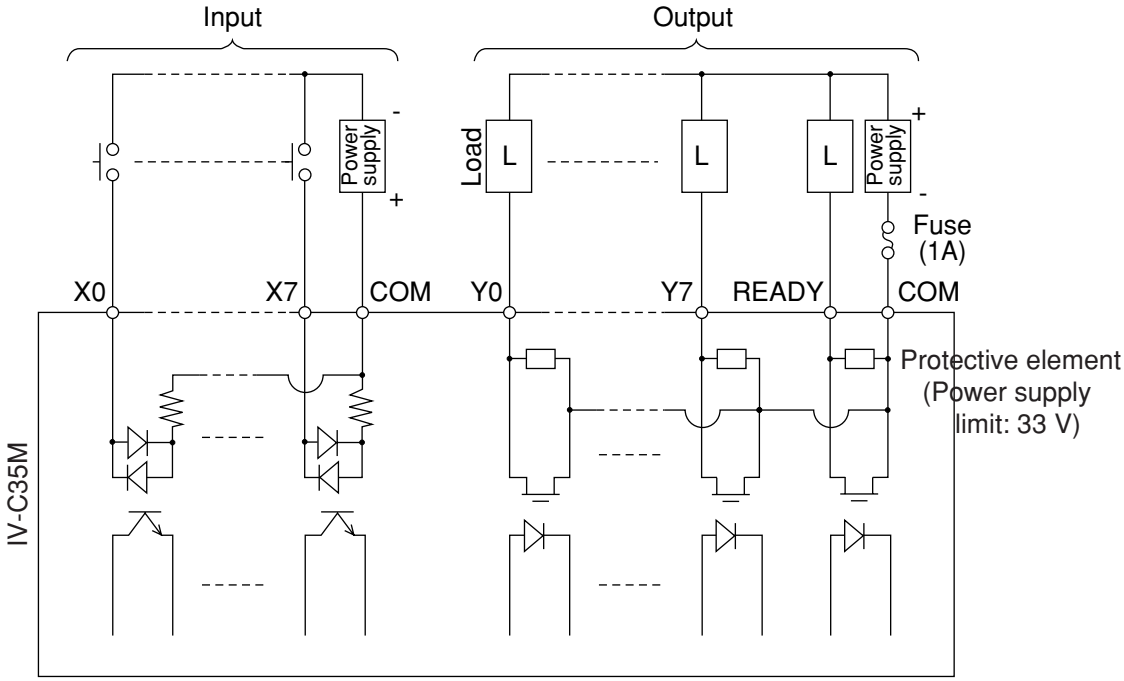
Terminal block	Interrupt processing input (1 terminal)	External trigger (X0)
	Input (7 terminals)	Object type change (X1 to 5): 5 terminals External input (X6 and 7): 2 terminals
	Common for input (1 terminal)	(+) or (-) common
	Output (9 terminals)	READY: 1 terminal Logical output set by user (Y0 to 7): 8 terminals
	Common for output (1 terminal)	(+) or (-) common
	Power supply (2 terminals)	24 VDC: 1 terminal, 0 V: 1 terminal

- **I/O port**

The input/output terminals are isolated by photocouplers, to prevent malfunctions due to noise. Use them within the rated range. The specifications of the input/output ports are listed below.

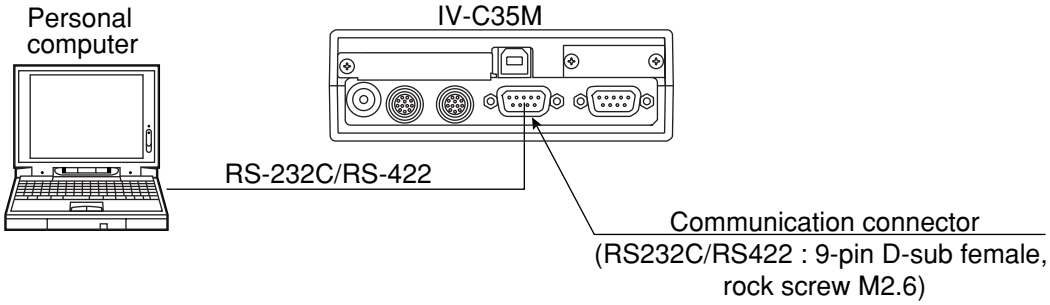
Item		Rating
Input	Rated input voltage	12/24 VDC
	Input voltage range	10.8 to 26.4 VDC
	Input voltage level	ON: 10.5 V or less OFF: 5 V or more
	Input current level	ON: 3 mA or less OFF: 1.5 mA or more
	Input impedance	3.3 k ohm
	Response time	1 ms or less (OFF to ON, ON to OFF)
Output	Rated output voltage	12/24 VDC
	Load voltage range	10.8 to 26.4 VDC
	Rated max. output current	100 mA DC
	Output type	MOS FET open drain
	Drop of ON voltage	1.2V or less (100mA)
	Isolation method	Photo MOS isolation
	Response time	3 ms or less (OFF to ON, ON to OFF)

- **Wiring to the controller (IV-C35M)**

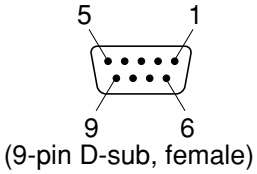


[5] Connection for communications with personal computer (general purpose serial I/F)

Connect a personal computer to the communication connector (RS232C/RS422) on the controller (IV-C35M).
A 9-pin D-sub, male connector is included with the controller.



- **The controller pin arrangement of the communication connector (for RS-232C)**



Communication standard	Pin No.	Signal name	Details	Direction
RS-232C	2	RD	Received data (Personal computer ⇨ Controller)	Input
	3	SD	Transmitted data (Controller ⇨ Personal computer)	Output
	5	SG	Signal ground	—
RS-422C	4	TA	Transmitted data (IV-C35M ⇨ Personal computer)	Output
	7	TB		
	8	RA	Received data (Personal computer ⇨ IV-C35M)	Input
	9	RB		
Connector case		FG	Frame ground	—

(1) When communicating through the RS-232C port

- The controller pin arrangement of the communication connector (for RS-232C)

Personal computer

DOS/V, IBM-PC		
	PC98 series	
9-pin D-sub	25-pin D-sub	Signal name
Pin No.	Pin No.	
Connector case	Connector case	FG
3	2	SD
2	3	RD
5	7	SG
7	4	RS
8	5	CS
6	6	DSR
1	8	CD
4	20	DTR

Communication connector on the IV-C35M (RS232C/RS422: 9-pin D-sub)

Pin No.	Signal name	Function
Connector case	FG	Frame ground
2	RD	Received data
3	SD	Transmitted data
5	SG	Signal ground
1	FL1	Memory protection 1
6	FL2	Memory protection 1

*(RS-232C)

Note: When terminal 1 and 6 are opened, flash memory protection will be ON. If you do not want to use a flash memory in serial, we recommend not to short circuit terminal 1 and 6.

* The maximum length of the communication cable depends on the communication speed.

Communication speed (kbps)	Cable length
9.6, 19.2	15 m or less
38.4, 57.6, 115.2	2 to 3 m

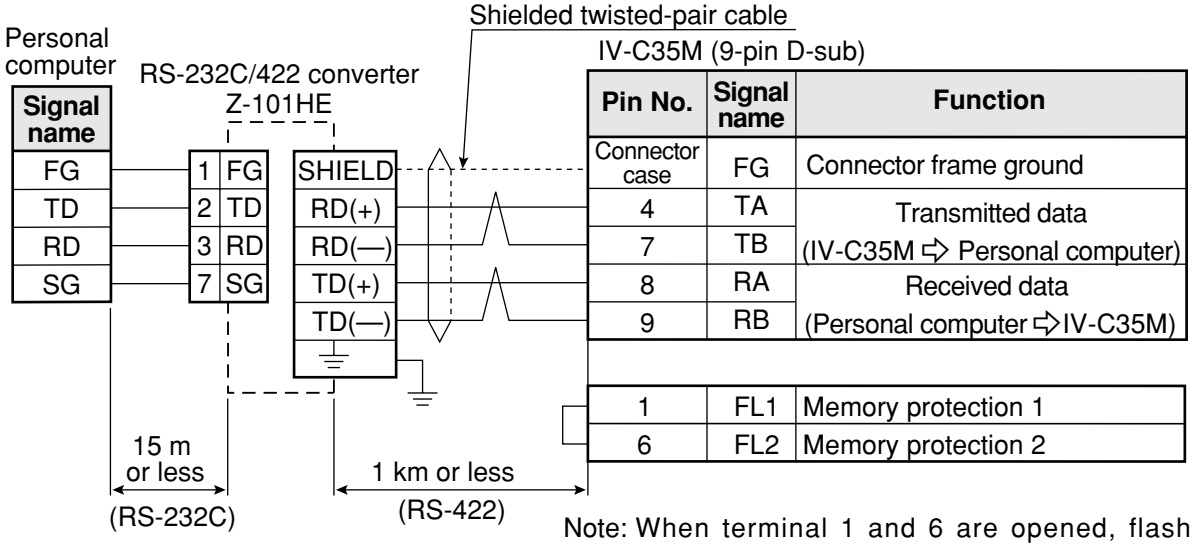
- Conduct a communication test before using the devices for measurements.

(2) When communicating through the RS-422

4-line system or 2-line system of RS422 shall be set as serial communication on the "I/O condition settings."

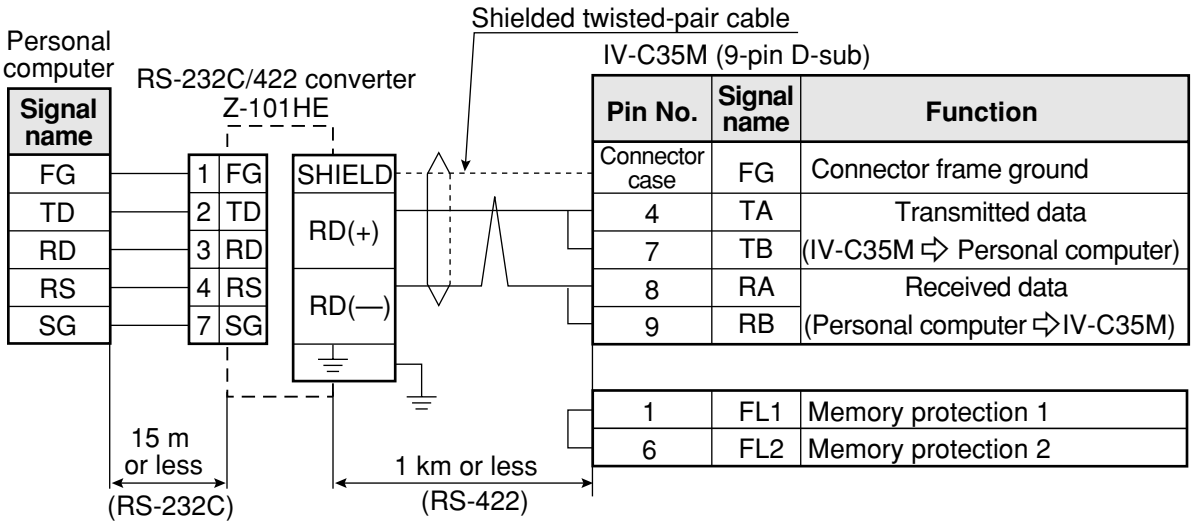
⇨ See "Chapter 21: Setting the Input/Output Conditions" in the IV-C35M User's Manual, Function and Operation.

● **4-wire system**



Note: When terminal 1 and 6 are opened, flash memory protection will be ON. If you do not want to use a flash memory in serial, we recommend not to short circuit terminal 1 and 6.

● **2-wire system**

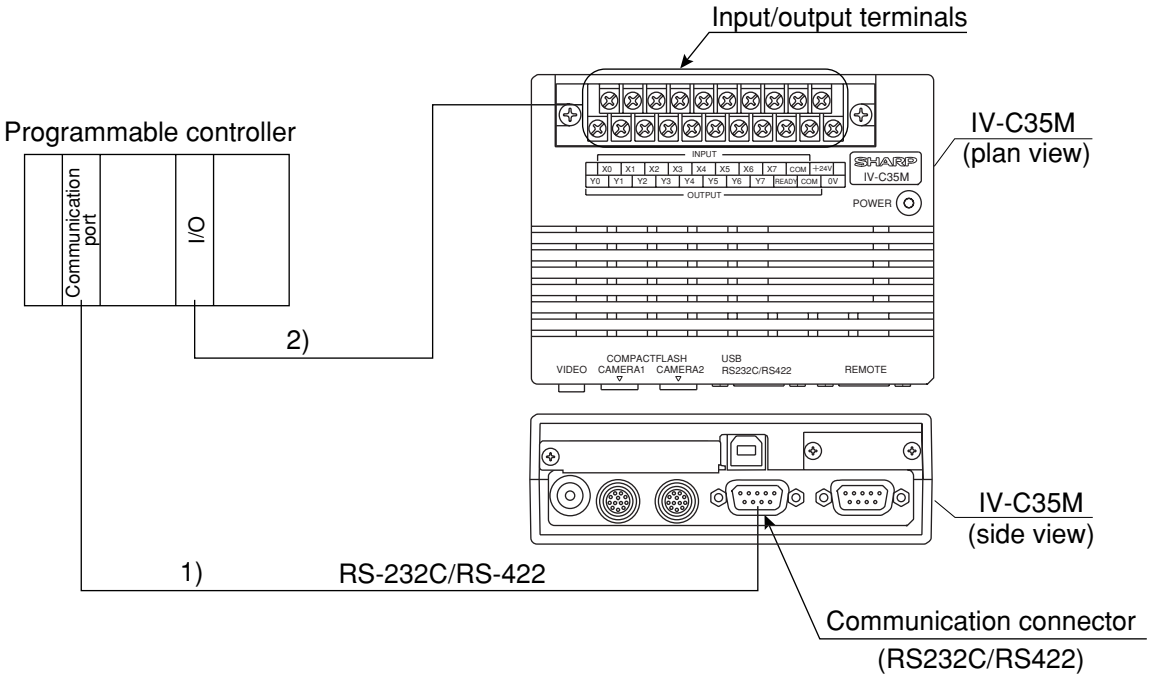


Pin No.	Signal name	Function
Connector case	FG	Connector frame ground
4	TA	Transmitted data
7	TB	(IV-C35M ⇨ Personal computer)
8	RA	Received data
9	RB	(Personal computer ⇨IV-C35M)
1	FL1	Memory protection 1
6	FL2	Memory protection 2

Note: When terminal 1 and 6 are opened, flash memory protection will be ON. If you do not want to use a flash memory in serial, we recommend not to short circuit terminal 1 and 6.

[6] Connecting a programmable controller using the computer link function

Connect a programmable controller to the communication connector (RS232C/RS422) and the input/output terminals on the controller (IV-C35M).



1) Connect the computer link connector (RS-232C/RS-422) of a programmable controller to the communication connector (RS232C/RS422: 9-pin D-sub, female) on the controller.
   ⇨ See "Chapter 23 : Computer Link" in the IV-C35M User's Manual (Function and Operation).
   - In the case of RS-232C, the maximum communication cable length depends on the communication speed.
   ⇨ See page 5-14.

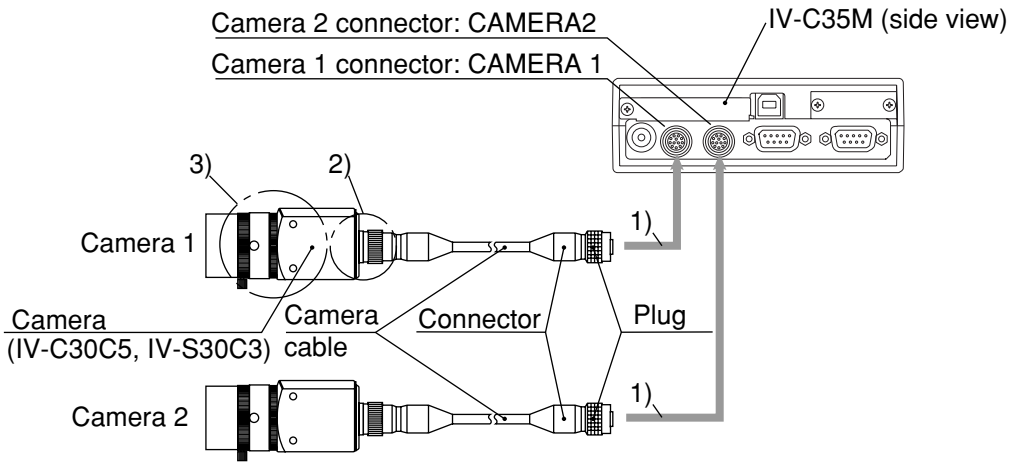
2) Connect the input/output terminals of the programmable controller to the input/output terminals on the controller.
   ⇨ See page 5-12.

5-3 Installing and connecting the IV-C30C5, IV-S30C3/S30C4 camera

[1] Installing and connecting the IV-C30C5, IV-S30C3 color and high-speed monochrome cameras

(1) Connections

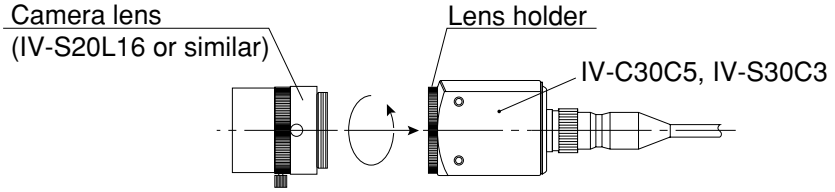
Up to two IV-C30C5 color cameras or IV-S30C3 high-speed monochrome cameras can be connected to the following controllers using camera cables.



1) Connect the IV-S30KC3/S30KC5 camera cable(s) to the CAMERA 1 and CAMERA 2 connectors on the controller.
   - To connect them, match the keyed portion of the connectors and press in. When they are firmly connected, you will hear a click.
   - To unplug a connector, hold the plug housing and pull it straight out.
   - Any camera plugged into the CAMERA 1 connector will be system camera 1 and any camera plugged into the CAMERA 2 connector will be system camera 2 in the IV-C35M system.

   Note 1: Make sure to turn OFF the power before connecting or disconnecting the cameras.

   Note 2: If there is only one camera, make sure to connect it as system camera 1.
2) Plug the other end of the camera cable into the IV-C30C5, IV-S30C3 and tighten the securing ring on the plug housing.
3) Screw the IV-S20L16 camera lens (or similar) into the lens holder on the IV-C30C5, IV-S30C3 until it is secure.



Remarks

- You cannot use different types of cameras at the same time with the same controller (color and high-speed monochrome camera cannot be mixed). When an IV-C30C5 or IV-S30C3 is connected to the controller, the other cameras that can be connected to the controller are as follows:

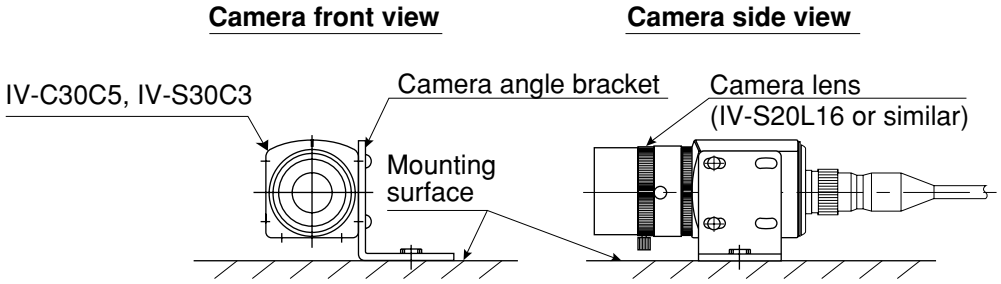
Camera	Compatible second cameras
Color camera (IV-C30C5)	———
High-speed monochrome camera (IV-S30C3)	IV-S30C4 (Micro, high-speed monochrome camera)

- Do not connect the IV-C30C5 color camera to other controller such as IV-S33MX etc.

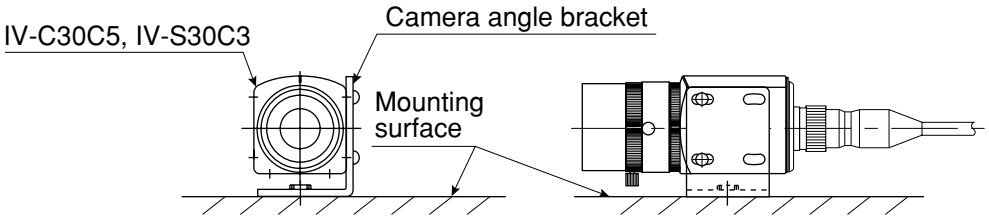
(2) Installing the camera body

Attach the camera (IV-C30C5, IV-S30C3) on the mounting surface with the camera angle bracket (supplied with the camera).

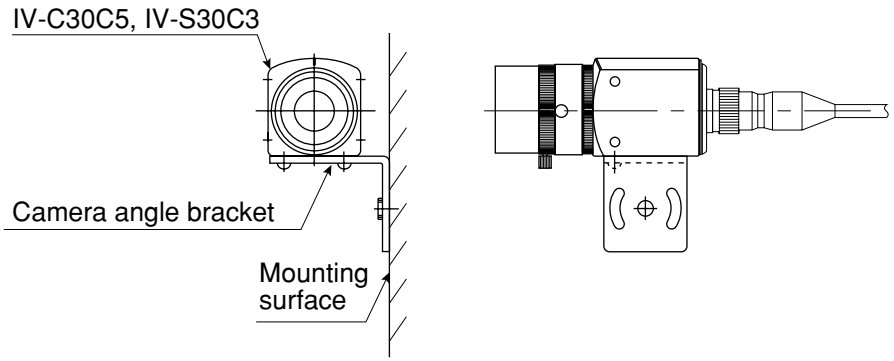
- Installation example 1



- Installation example 2



- Installation example 3



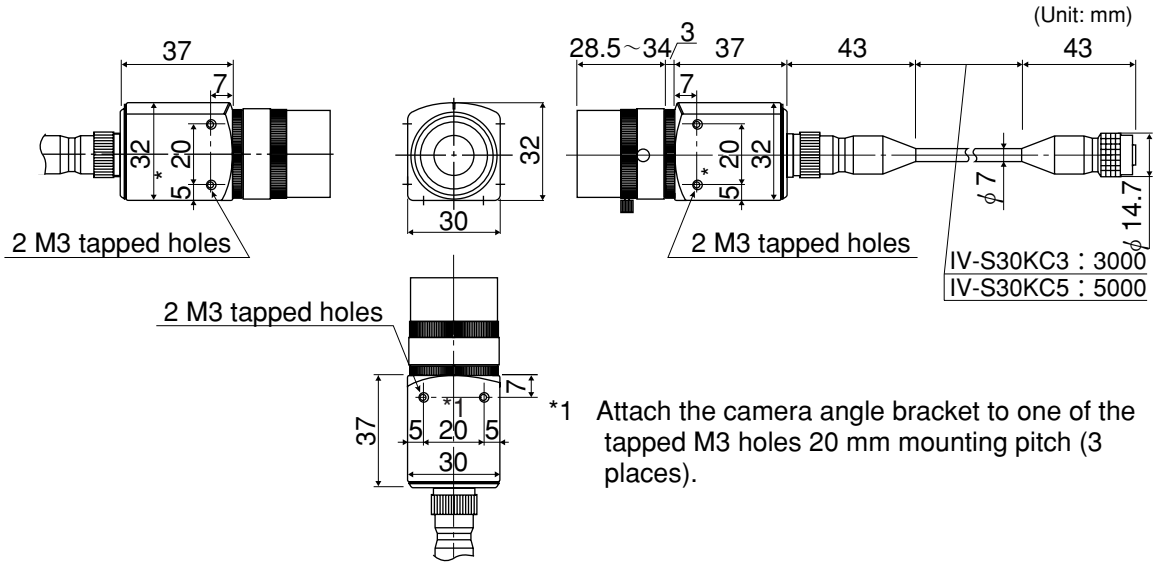
■ **Installation procedure**

1. Attach the camera angle bracket to the tapped M3 hole on the camera body (20 mm mounting pitch: one of three holes). Two screws (M 3 x 6) are supplied with the camera for attaching the angle.
2. Attach the camera controller angle to the mounting surface with the slotted holes 3.2 mm wide (20 mm mounting pitch) or 1/4-20 UNC threaded hole.

The external dimensions of the camera angle bracket and the IV-C30C5, IV-S30C3 camera body are shown on the following page.

- **External dimensions when the IV-S20L16 camera lens and IV-S30KC3/KC5 camera cable are connected to the IV-C30C5/IV-S30C3 camera.**

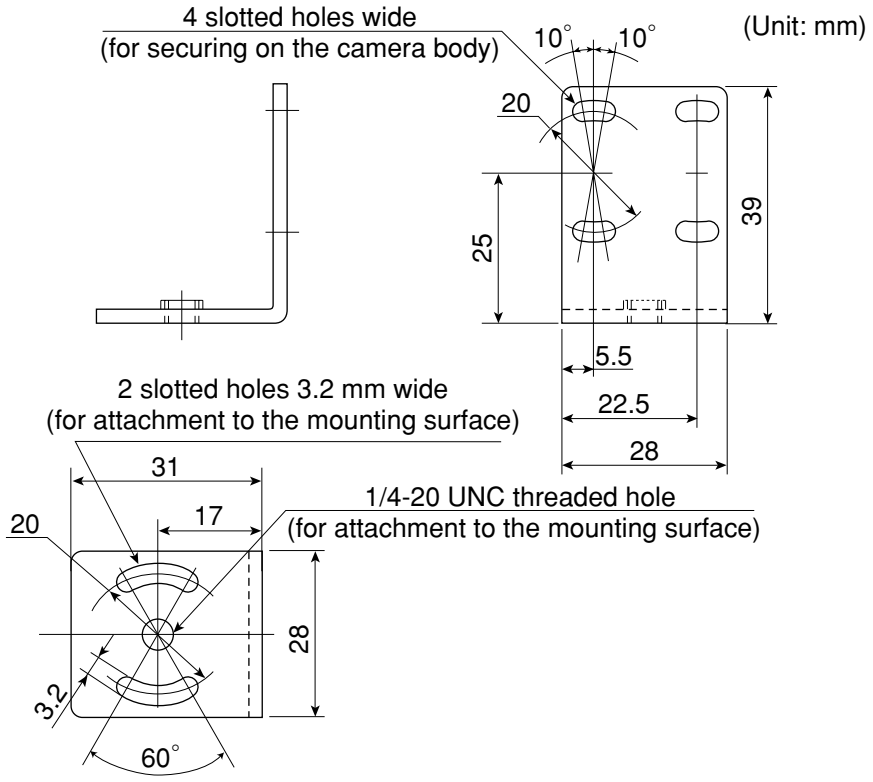
(Unit: mm)



*1 Attach the camera angle bracket to one of the tapped M3 holes 20 mm mounting pitch (3 places).

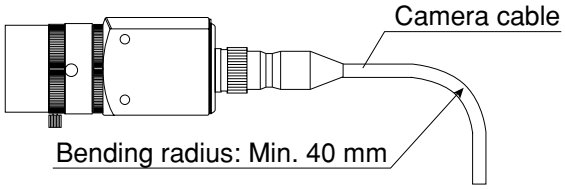
- **External dimensions of camera angle bracket**

(Unit: mm)



Note

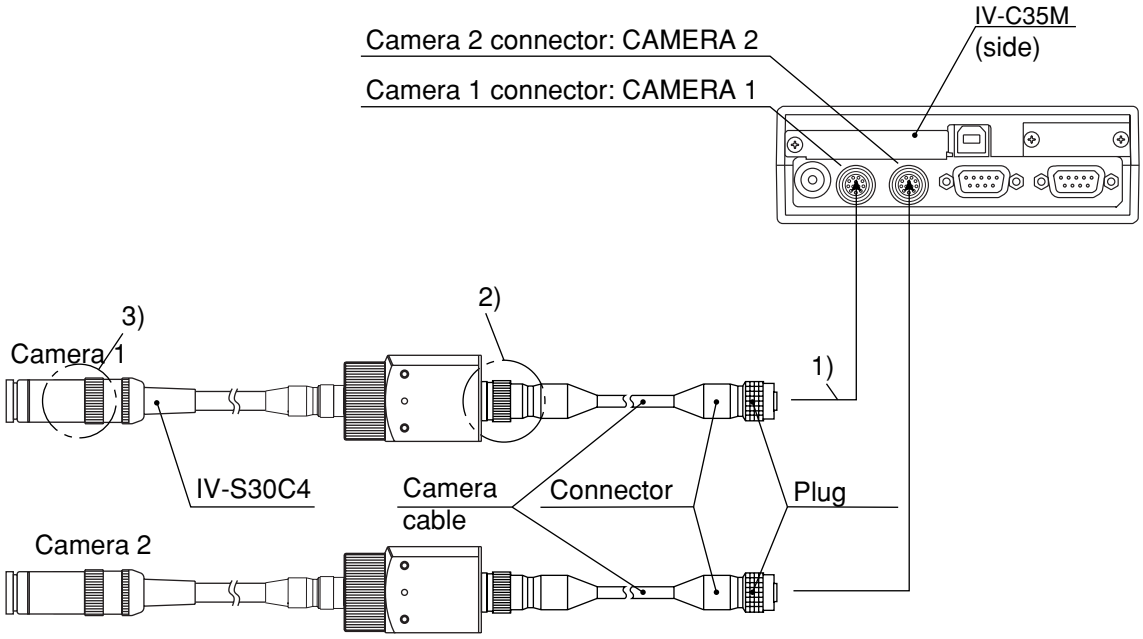
- When the camera cable (IV-S30KC3/KC5) is bent, its bending radius should be larger than 40 mm.
  If the camera cable will be bent repeatedly during operation, design the cable layout so that the bending radius is 75 mm or more and use components that can be flexed up to 2 million times.



[2] Installing and connecting the IV-S30C4 micro, high-speed monochrome cameras

(1) Connections

Up to two IV-S30C4 micro, high-speed cameras can be connected to the following controllers using camera cables.



1) Connect the IV-S30KC3/S30KC5 camera cable(s) to the CAMERA 1 and CAMERA 2 connectors on the controller.
   - To connect them, match the keyed portion of the connectors and press in. When they are firmly connected, you will hear a click.
   - To unplug a connector, hold the plug housing and pull it straight out.
   - Any camera plugged into the CAMERA 1 connector will be system camera 1 and any camera plugged into the CAMERA 2 connector will be system camera 2 in the IV-C35M system.

   Note 1: Make sure to turn OFF the power before connecting or disconnecting the cameras.
   Note 2: If there is only one camera, make sure to connect it as system camera 1.

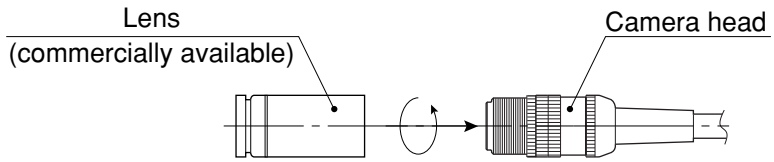
Remarks

- You cannot use different types of cameras at the same time with the same controller (color and high-speed monochrome camera can not be mixed). When an IV-S30C4 is connected to the controller, the other cameras that can be connected to the controller are as follows:

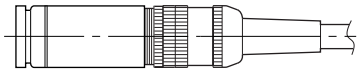
Camera	Compatible second cameras
Micro, high-speed monochrome camera (IV-S30C4)	IV-S30C3 (high-speed monochrome camera)

2) Plug the camera connector on the camera cable (camera conversion cable) into the cable connector on the IV-S30C4 camera and screw it down to secure the connection.
3) Screw a commercially available lens into the camera head of the IV-S30C4.

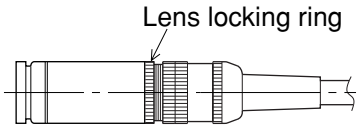
.



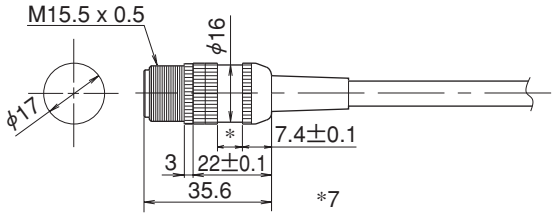
STEP 1 Screw the lens in until the camera image is focused.



STEP 1 Secure the lens using the lens locking ring on the camera head

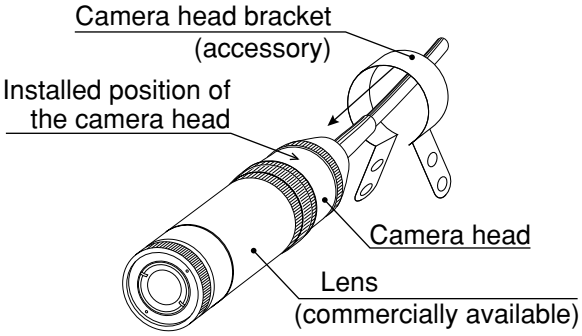


● **External dimensions of the IV-S30C4 camera head** (Unit: mm)

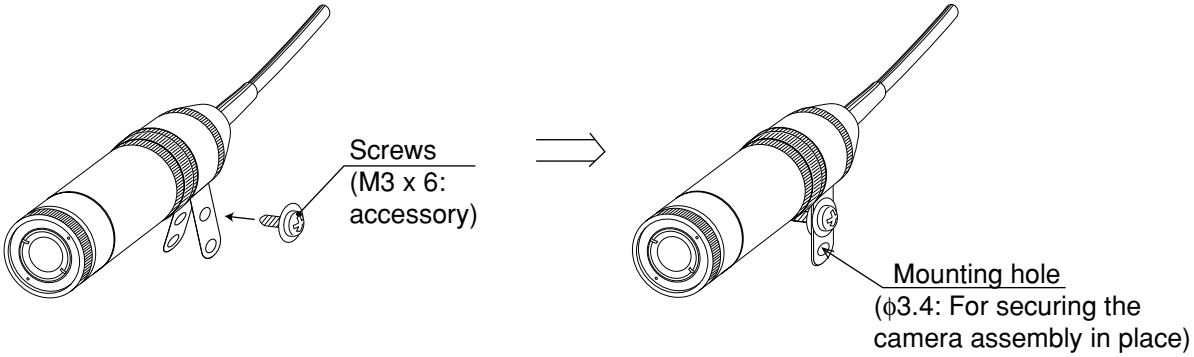


(2) Installation of the camera head

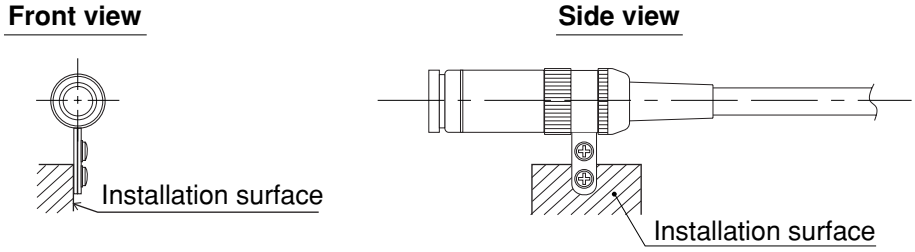
1. Put the camera head through the bracket (supplied with the IV-S30C4) from the cable side and slide the camera head into position.



2. Secure the camera head bracket using the M3x6 screws that come with the IV-S30C4.



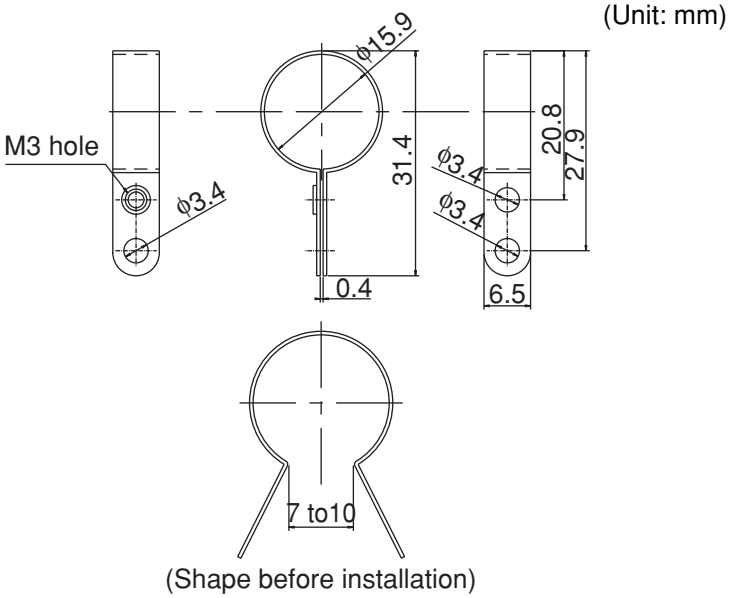
3. Secure the camera head assembly in place using the mounting hole (ø3.4) on the camera head bracket.



Note: The camera head bracket supplied with the camera is for simple installations and is not vibration-damping. To meet specific needs, the user may have to make a specialized bracket.

● **External dimensions of the camera head bracket**

(Unit: mm)

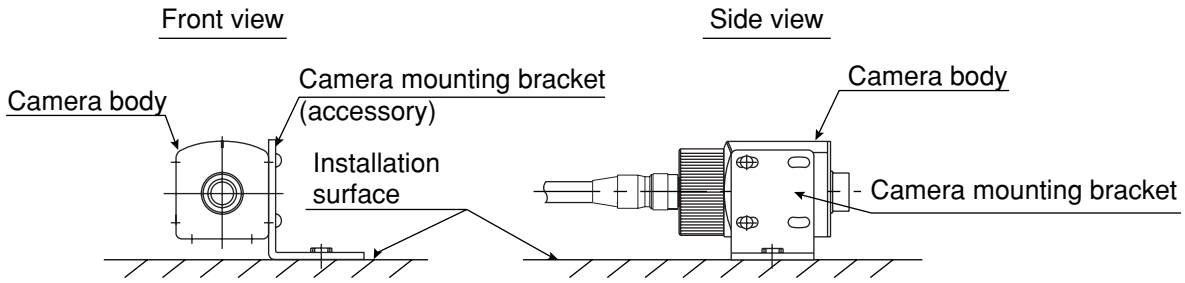


(Shape before installation)

(3) Installation of the camera body

1. Attach the camera mounting bracket (comes with the IV-S30C4) to the three M3 tapped holes (spacing: 20 mm) on the camera body using the M3x6 installation screws that come with the IV-S30C4.
2. Secure the camera mounting bracket on the installation surface using a 3.2 mm long, 20 mm difference screw or a 1/4-20 UNC screw hole.

[Installation example]



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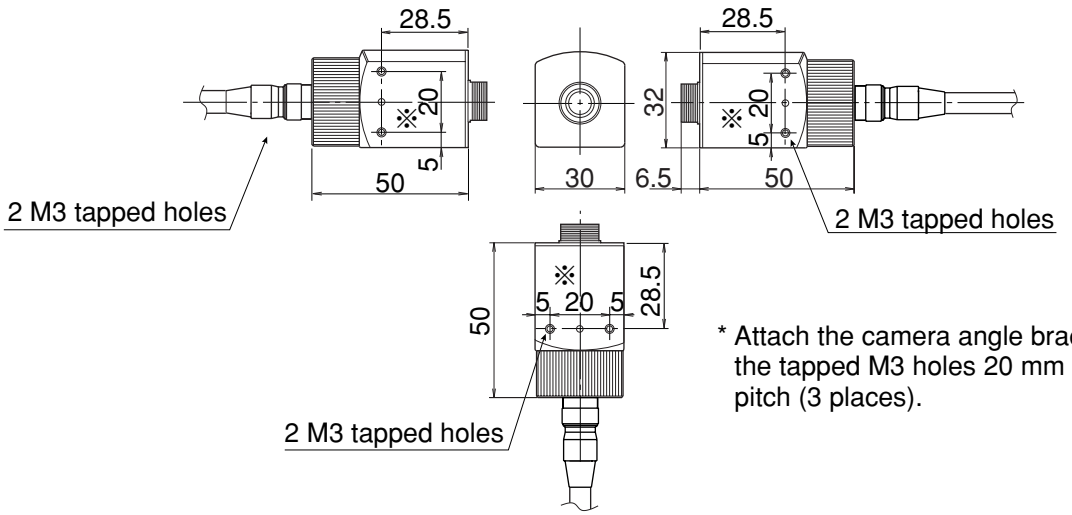
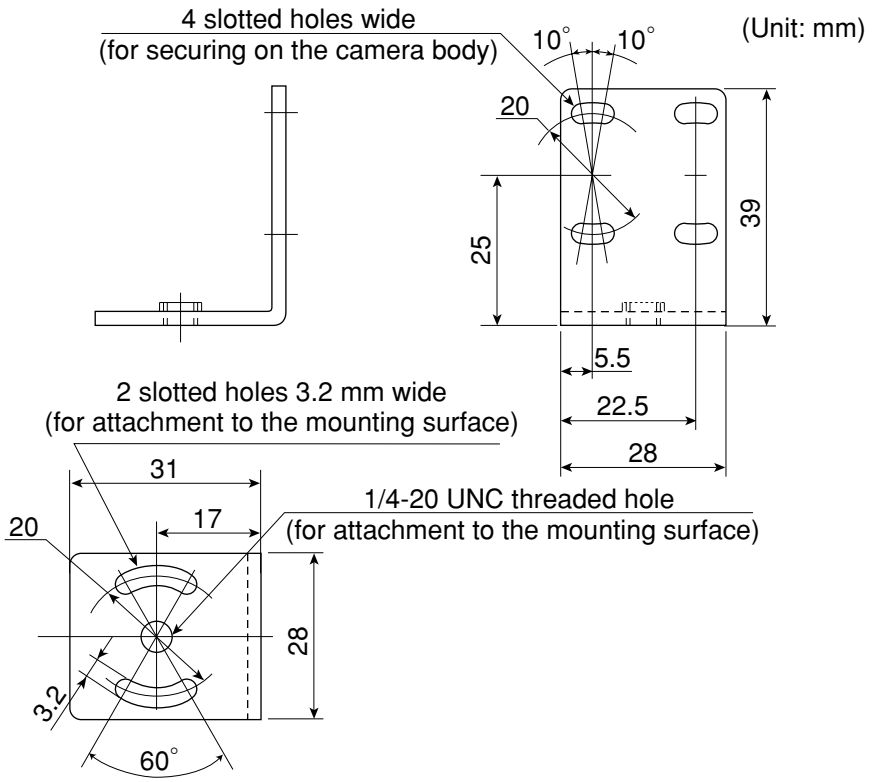
● **External dimensions of the IV-S30C4 camera body**

(Unit: mm)



* Attach the camera angle bracket to one of the tapped M3 holes 20 mm mounting pitch (3 places).

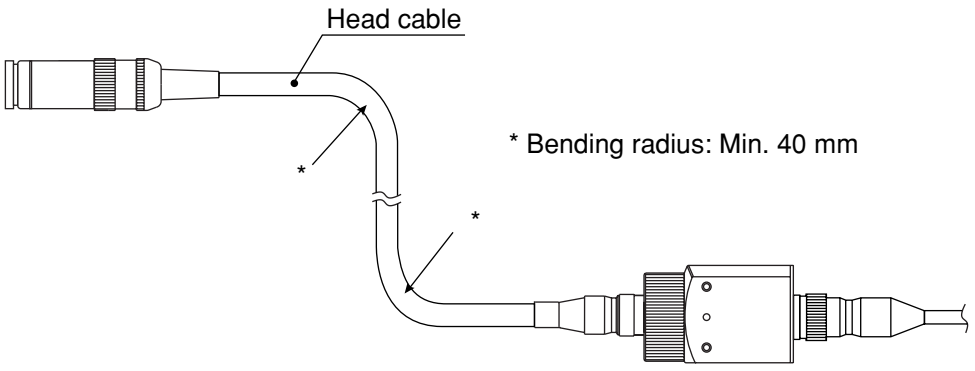
● **External dimensions of camera angle bracket**



5

Note

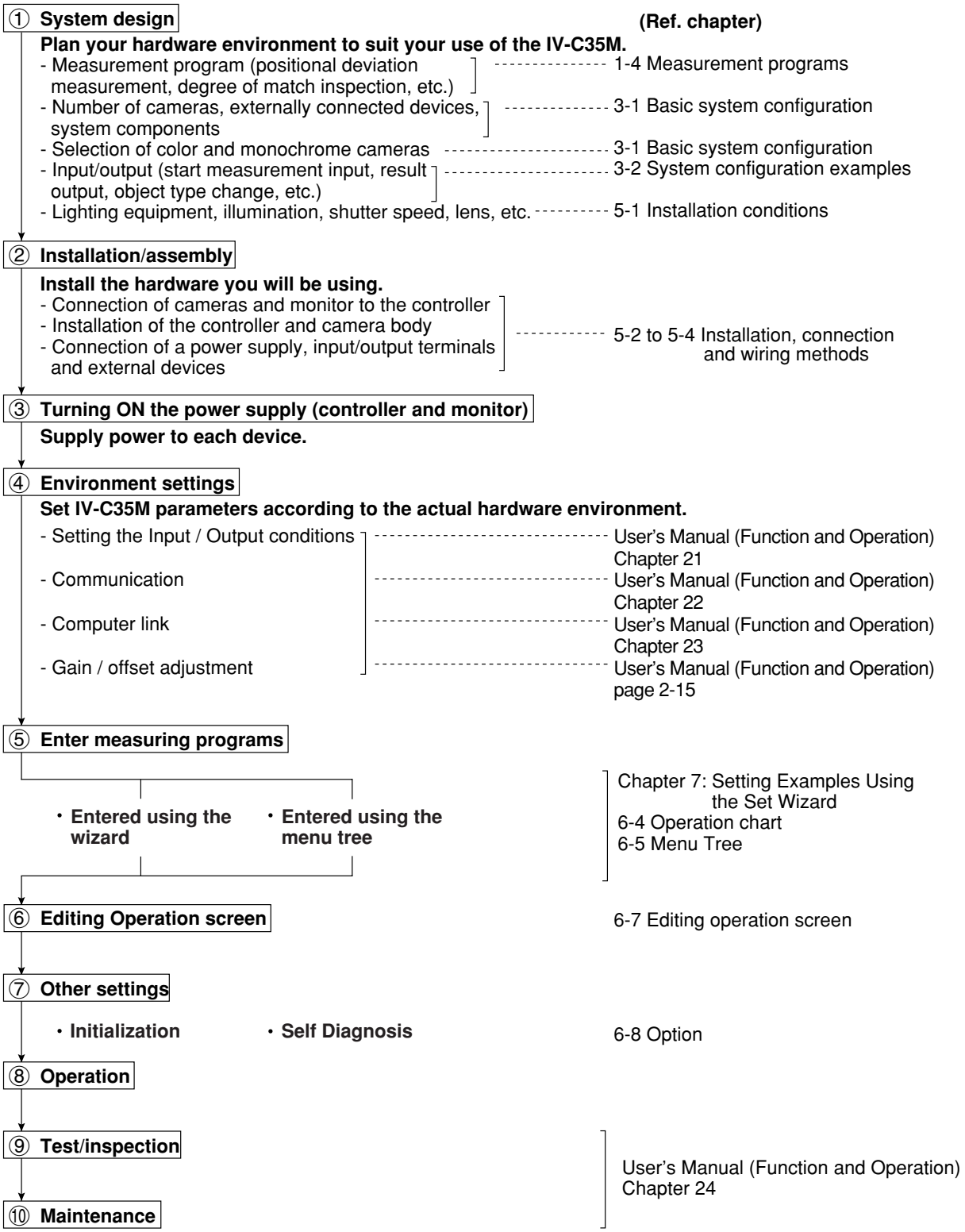
- When the camera head cable is bent, its bending radius should be larger than 40 mm. If the camera cable will be bent repeatedly during operation, design the cable layout so that the bending radius is 75 mm or more and use components that can be flexed up to 2 million times.



Chapter 6: Setting and Operating Outlines

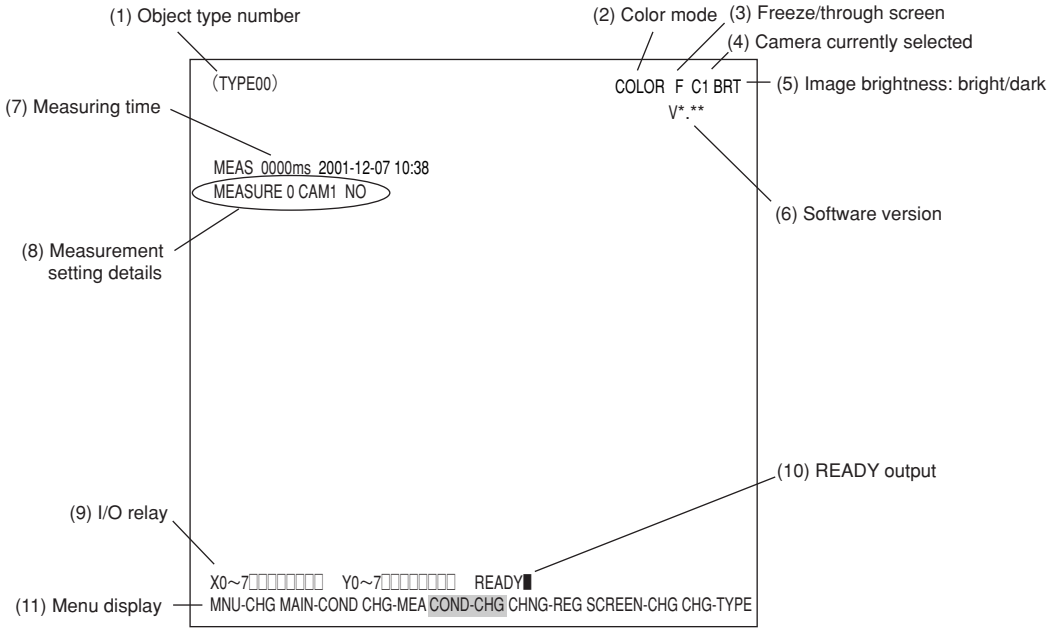
6-1 Setting and operating procedures

This paragraph describes the rough operation sequence of the IV-C35M.



6-2 Description of the operation screen

When the IV-C35M is started, the operation screen shown below will appear.
Each area of the operation screen is described below.



(1) Displays the number of the currently selected object. (Object numbers can range from 00 to 31.)

(2) Indicates whether the current captured image is in color mode or monochrome mode.

Screen display	Description
COLOR	Appears when "color" is selected on the camera selection
No indication	Appears when "monochrome" is selected on the camera selection

(3) Select whether to display captured images on the screen as freeze images or through images.

Display method	Description
Through image	- Displays the stream of images captured by the camera. - Used for adjusting the camera focus and image properties.
Freeze image	- Displays the single image captured at the start of making measurements. - Used to set each of the measurement conditions and operating conditions.

To switch the image between "Through" and "Freeze" modes, press the SEL key on the remote keypad, and then press the up and down arrow keys.

(4) Indicates which camera is currently selected
C1: Camera 1 (the camera connected to the "CAMERA1" connector)
C2: Camera 2 (the camera connected to the "CAMERA2" connector)

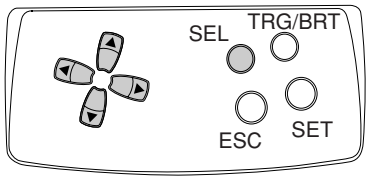
(5) The brightness of the captured image can be set to one of two levels.

Screen display	Description
BRT	Display the captured image without changing its brightness.
DRK*	Display the captured image at 1/2 the actual brightness

* This is effective when the characters on screen are difficult to read as the screen is dark.

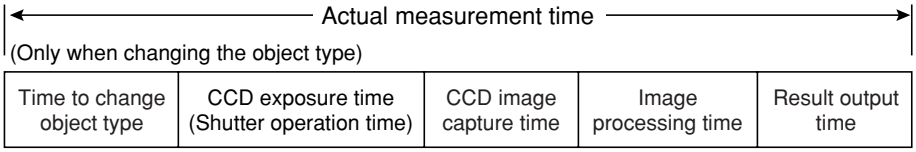
How to select the brightness level

On any screen, except the operation screen, move the cursor to the "F" (freeze) or "T" (through) position on the upper part of the screen by pressing the SEL key. Then, press the left or right arrow key to move the cursor to the "BRT" (bright) or "DRK" (dark) indicator. Press the up or down arrow key to switch between bright and dark.



(6) Displays the software version.

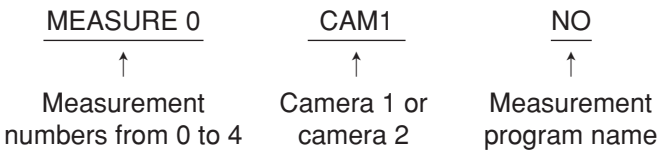
(7) Displays the measurement time currently assigned.



- Serial communication time is not included.
- Set the controller as follows to reduce the measurement time.

1. Increase the shutter speed.
2. Select the "partial" image capture feature for the CCD.
3. Select "NO" for the measurement results display (message display, pattern display, and binary image display).

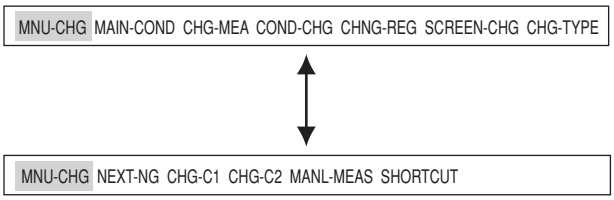
(8) Display setting details of each measurement.



(9) Displays the status of input relays X0 to X7: OFF [□], ON [■].
Displays the status of output relays Y0 to Y7: OFF [□], ON [■].

(10) Displays the status of the ready output: OFF [□], ON [■].

(11) The menu bar at the bottom has two rows. When this menu is selected, the second row will appear.



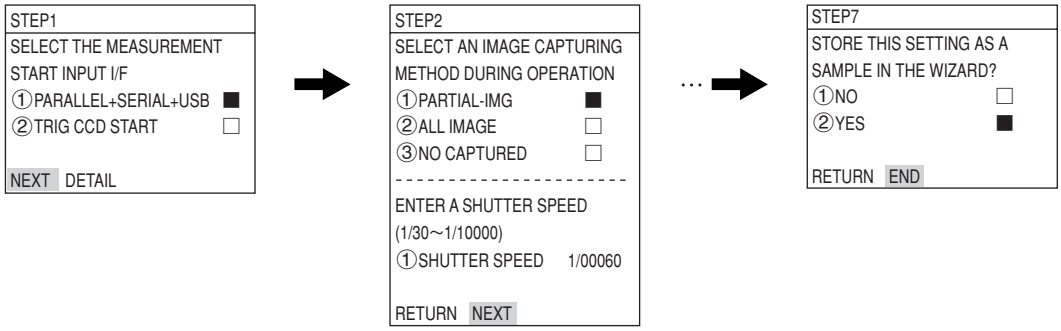
The details of each item on this menu bar are shown on the next page.

■ Details of each item on the menu bar

Item on the menu bar	Description	Display detail on the screen
MAIN-COND (main conditions)	Displays the MAIN screen.	SYS-CND OBJECT TYPE COND SET WIZARD EDIT MAIN OPS MENU OPTION ENVIRONMENT SETTING MEMORY CARD
CHG-MEA (Change measurement)	Press the up and down arrow keys to change the display of the evaluation results for each measurement number. (Measurement 0 camera 1 -> measurement 0 camera 2 -> Measurement 1 -> Measurement 2 -> Measurement 3 -> Measurement 4)	MEASURE0 CAM1 NO This part changes.
COND-CHG (Change the measurement conditions)	Displays the condition change selection list. Change the conditions that get displayed by pressing the up and down arrow keys. For details about the measurement conditions, see "Chapter 3: Instruction and Hardware" in Function and Operation. For details about the distance and angle conditions, see page 18-2 in Function and Operation. For details about the numeric value calculation conditions, see page 19-6 in Function and Operation.	MEA-CND DST&ANG COND... NUMERIC CALC COND-CHG CHNG-REG
CHNG-REG (change registration)	Change the display of the set of stored details between [A00] - [A07] and [A08] - [A15] using the up and down arrow keys	
SCREEN-CHG (change screen)	Displays the screen change selection list. Select a screen using the up and down arrow keys. Note: The OPS-MAIN, JDG-COND-CHG, and PC-MNTR do not appear on the popup menu unless "YES" is selected for each corresponding item on "TYPE RUN COND" menu. Only the currently available screens are listed. When an NG image is stored, "NG-IMG-DISP" can be selected, press the SET key and the monitor will change to the NG image display screen.* ⇨ See page 1-22 in IV-C35M User's Manual, Function and Operation.	OPS-MAIN JDG-COND-CHG PC-MNTR SCREEN-CHG CHG-TYPE
CHG-TYPE (change the object type)	Displays the object type selection list. Select an object type by pressing the up and down keys. This is enabled when Manual Object Type Change is set to "YES."	(TYPE00) This part changes. MEAS 0000ms MEASURE0 CAM1 NO
NEXT-NG * (change the NG image)	List the NG screens that can be selected. Select a screen using the up and down keys.	
CHG-C1 (change the Camera 1 image position)	Moves the image from Camera 1 up and down the screen using the up and down arrow keys. Note: This is enabled when "CAM1&2" or "CAM1&NG IMG" is selected in ①MONITOR OUTPUT on the TYPE RUN COND menu (operating conditions).	
CHG-C2 (change the Camera 2 image position)	Moves the image from Camera 2 up and down the screen using the up and down arrow keys. Note: This is enabled when "CAM1&2" or "CAM1&NG IMG" is selected in ①MONITOR OUTPUT on the TYPE RUN COND (operation conditions).	
MANL-MEAS (Manual measurement)	Manually move the two crosshair cursors, and measure distance between these two points, as well as coordinate distance on X and Y axes. Note: Unless "MANL-MEAS" is selected on the "⑪EXTENSION FUNC" line in the TYPE RUN COND (operation conditions), this screen cannot be displayed.	MANL-MEAS ①CURSOR1-COORD MOVE(224.208) ②CURSOR2-COORD MOVE(287.271) DIST-BETW-2PT 089.0 DIST-BETW-X 063.0 DIST-BETW-Y 063.0
SHORTCUT	Displays a short cut screen.	【PLACE】 ①SHORTCUT1 NO ②SHORTCUT2 NO ③SHORTCUT3 NO

6-3 Wizard

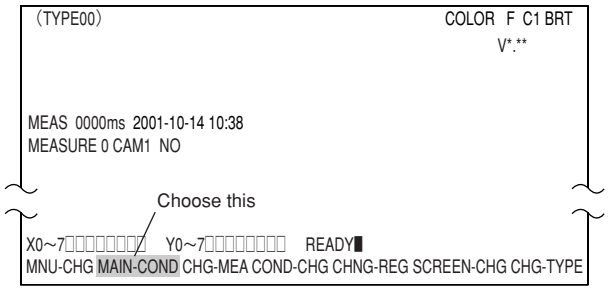
The "Wizard" is a program that helps users make settings for measurement operations easily and without making mistakes. The controller asks you a series of questions at each step and you simply answer these to complete the settings.
The wizard is convenient for making settings when beginners and inexperienced operators are operating the machine. However, operators who are familiar with the operation may save a lot of time by using other setting methods.



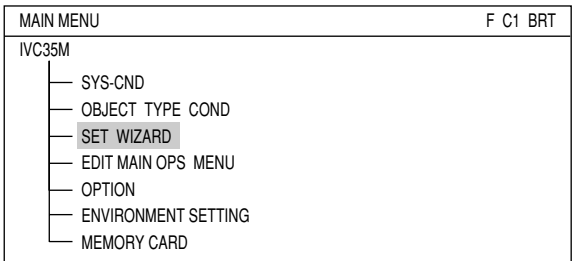
[1] How to start the standard wizard

■ Basic operation

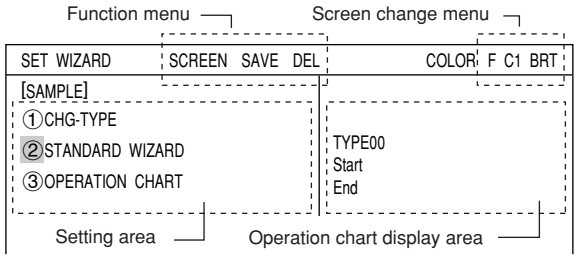
1. Move the cursor to the "MAIN-COND" item on the lower menu using the left and right arrow keys, and press the SET key.



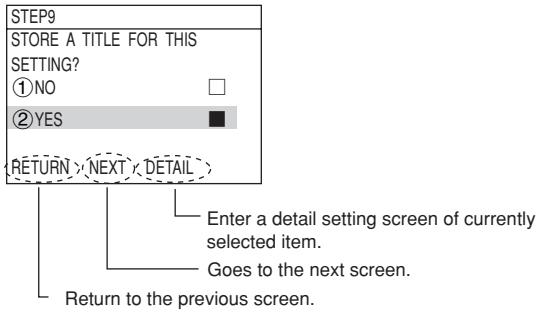
2. The "MAIN MENU" will appear.
Move the cursor to the "SET WIZARD" item using the up and down keys and press the SET key.



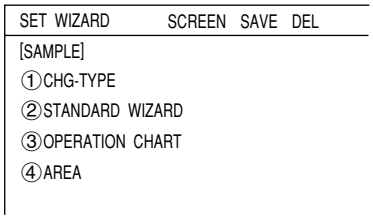
3. Move the cursor to the "②STANDARD WIZARD" and press the SET key. The SET WIZARD program will start.



4. Answer the questions at each step, from STEP 1 to the final step (the step which displays the "End" item")



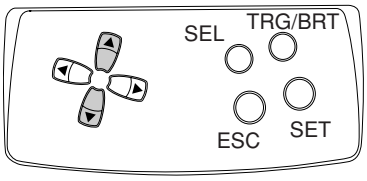
5. After storing the sample in the final step, the sample name will appear on the ④ line as shown on the figure right.



[2] Other operations in the "Set wizard" program

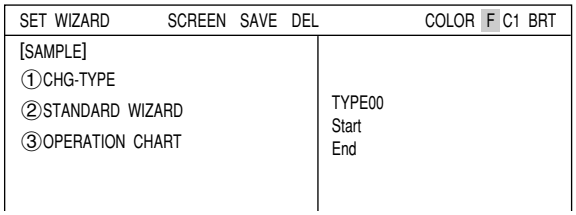
1. Up/down/left/right keys

When the "Set Wizard" program screen appears, the cursor is on the "①CHG-TYPE" item. Press the up and down keys and the cursor will move to "②STANDARD WIZARD" or "③OPERATION CHART." (For the details about the operation chart, see page 6-4.) In this operation the left and right keys are not used.

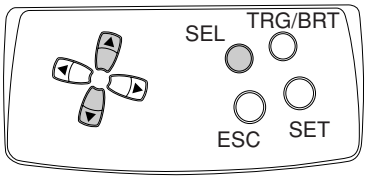


2. SEL key

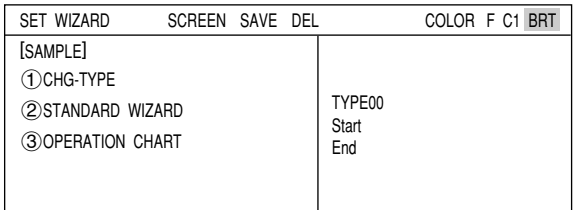
Move the cursor to the "②STANDARD WIZARD" line. Then press the SEL key. The cursor will jump to "F" (freeze) in the upper menu area. Press the up and down key to change between "F" (freeze) and "T" (through) display of images.



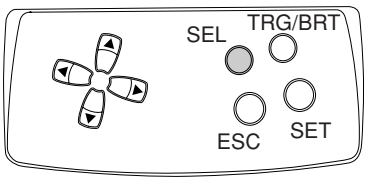
"F" (freeze): Static image (Capture an image with the camera and display it on the monitor.
"T" (through): Dynamic images (display the sequence of images coming from the camera on a real time basis. As the object moves, the display of the object will also move.)



When the cursor is at "F" (or "T") and you press the left or right key, the cursor will move to the "BRT" (bright) (or "DRK" (dark)) position. Now press the up or down key to change the screen between bright and dark.
"BRT": Bright screen
"DRK": Dark screen

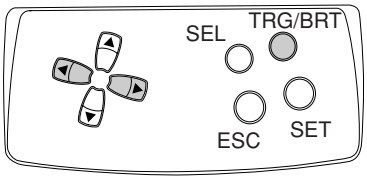


Press the SEL key again and the cursor will jump back to "②STANDARD WIZARD."

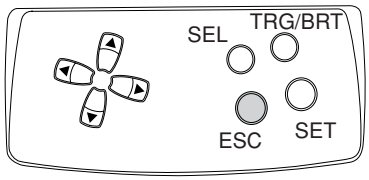


3. TRG/BRT key

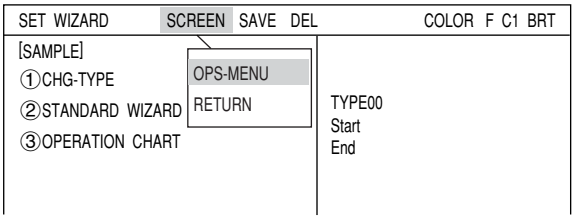
Move the cursor to the "②STANDARD WIZARD" line using the up and down arrow keys. Then press the TRG/BRT key. The cursor will jump to "SCREEN" in the upper menu area. Press the left and right arrow keys to move the cursor between the "SAVE" and "DEL (delete)" items.
Press the TRG/BRT key again to bring the cursor back to the "②STANDARD WIZARD" item.



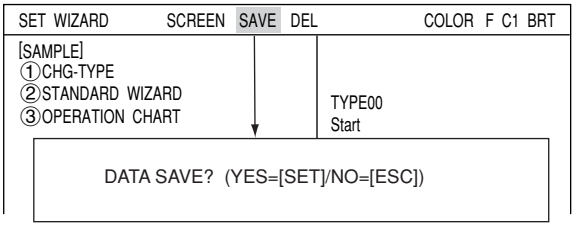
4. ESC key
Press the ESC key to return to the previous screen.



- **SCREEN**
  Move the cursor to "SCREEN" and press the SET key. A pop up menu will appear. Select the desired item using the up and down arrow keys and press the SET key.
  "OPS-MENU": Return to the operation screen.
  "RETURN": Return to the MAIN MENU.

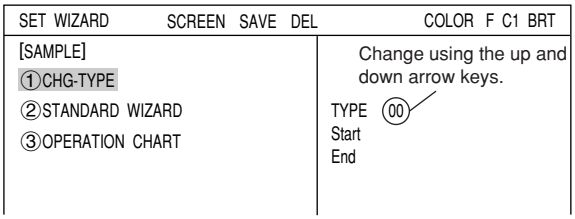


- **SAVE**
  Move the cursor to the "SAVE" and press the SET key. The Save Settings screen will appear. Press the SET key and select "YES," the current setting data will be stored in flash memory. If you press the ESC key and select "NO," the controller will close the screen without saving the current setting data.



- **DEL**
  Deletes the sample selected.

- **① CHG-TYPE**
  Move the cursor to "①CHG-TYPE" and press the up or down arrow key. The object number shown on the right side of the monitor will change. Use the number to determine the object type number to set using the standard wizard. (Or, use the number to select an object number operation chart to display. See page 6-9).



For details about the setting measurement conditions using the Set Wizard,
⇨ See "Chapter 7: Setting Examples Using the Set Wizard."

6-4 Operation chart

As each setting is made using the wizard, the operation chart keeps track of the settings and displays them as an operation chart. You can see all settings you have made so far, or jump back to a specific step on the operation chart.

This section describes how to use the operation chart. The operation chart shows the measurement decisions that were made and saved as a chart. You can easily see the major flow of the measurement process and you can determine the execution timing for processes other than image processing (such as numeric and ladder processing). Also, you can change the settings for each step.

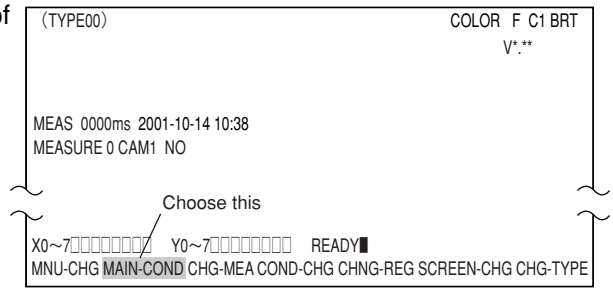
TYPE00

Start
STEP1 : PARALLEL+SERIAL+USB
STEP2 : CAPTURE IMG/PARTIAL-IMG
STEP3 : COLOR IMAGE CORRECT
STEP4 : MEAS1/CAM1
STEP5 : MEAS1/F/BIN-AREA
STEP6 : MEAS1/WINDOW/MASK,1
STEP7 : MEAS1/MEAS CND
STEP8 : MEAS1/EVALUATION
STEP9 : MEAS1/CALC
STEP10 : MEAS1/OUT
STEP11 : FINAL NUMERIC CALC
STEP12 : FINAL OUTPUT COND
STEP13 : SERIAL OUTPUT/ANY
STEP14 : OPS MENU COND
STEP15 : CALIBRATION/YES
STEP16 : MOVE ALL WINDOW/YES
STEP17 : TITLE/YES
End

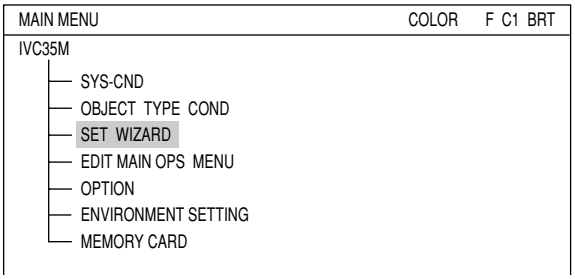
[1] Method for displaying the operation chart

6

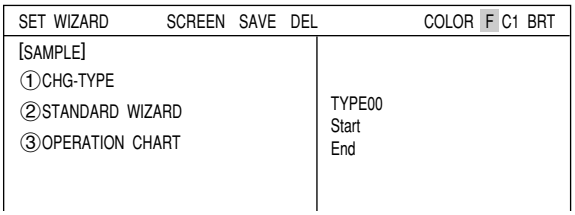
1. Move the cursor to "MAIN-COND" at the bottom of the operation screen and press the SET key.



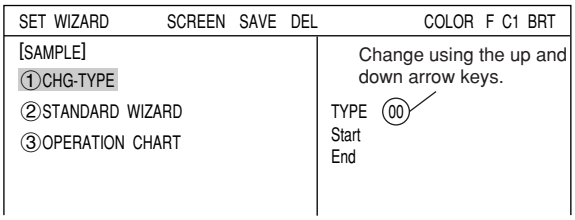
2. The "MAIN MENU" will appear.
   Move the cursor to "SET WIZARD" using the up and down arrow keys, and press the SET key.



3. The "SET WIZARD" screen will appear.



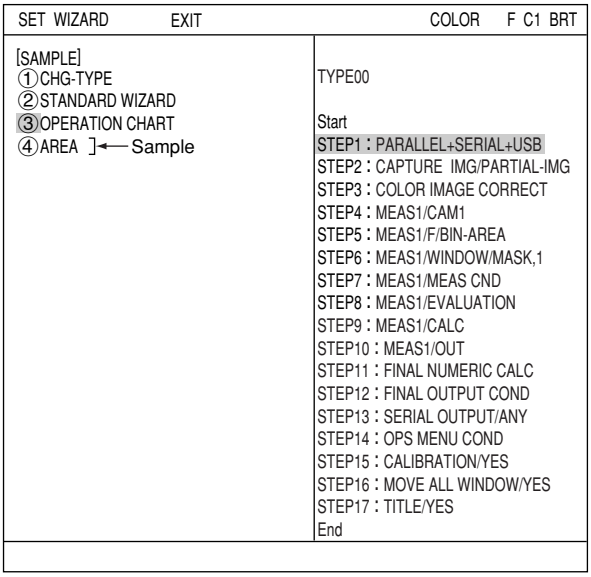
4. Change the object type number on the operation chart to the desired object type number.
   Select "①CHG-TYPE" and press the SET key. Then press the up and down arrow keys to change the object type number.
   After selecting a number, press the ESC key.



5. Move the cursor to "③OPERATION CHART" using the up and down arrow keys and press the SET key. The operation chart for the selected object type will be displayed on the right side of the screen.

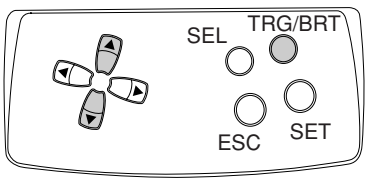
   Reference: To use a sample operation chart, move the cursor to the sample number desired and press the SET key. (Ex.: ④)

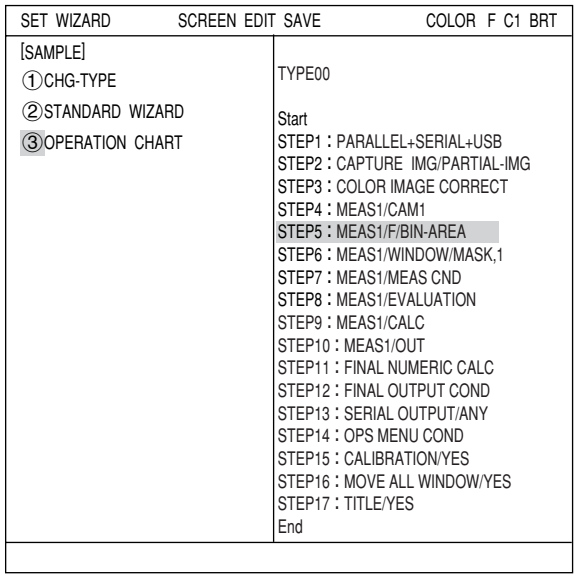
   Note: If no measurement conditions are set, the screen will not display any operation chart when you select "③OPERATION CHART."



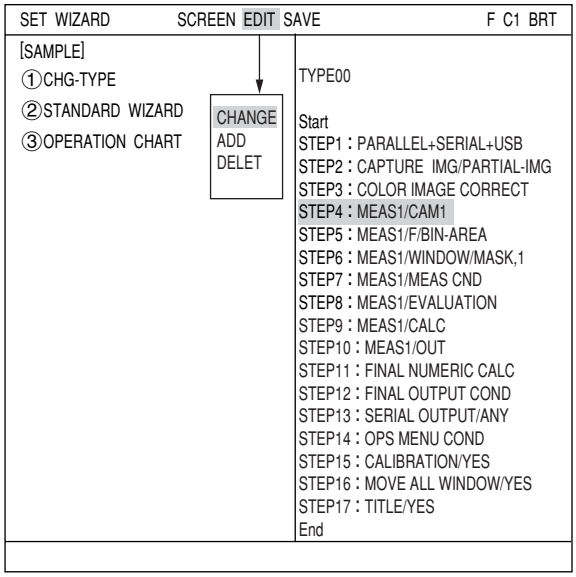
[2] How to edit an operation chart

1. While looking at an open operation chart, select the item you want to edit using the up and down arrow keys. Press the TRG/BRT key, and move the cursor to "EDIT" in the upper function menu. Then, press the SET key.

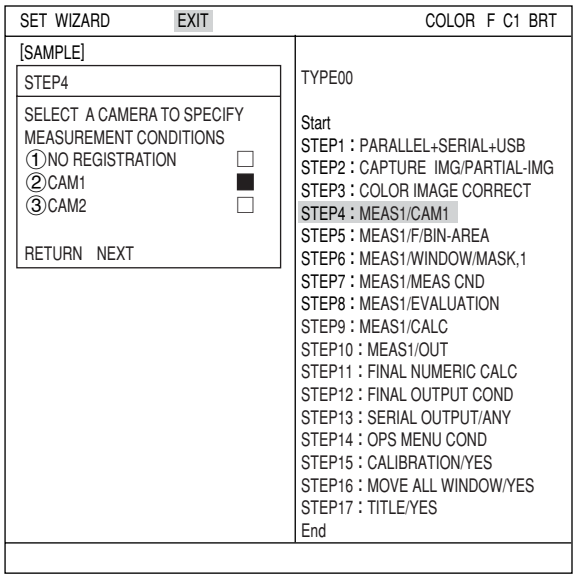




2. A pop up menu will appear and you can chose "CHANGE," "ADD," or "DELET" from it.
   Or, while the cursor is in the "③OPERATION CHART," move the cursor to any desired step number and press the SET key. You can then edit that step. (You cannot delete a step using this access method.)



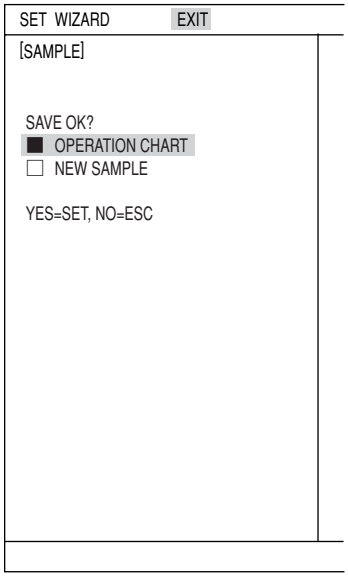
3. To quit editing, press the TRG/BRT key and move the cursor to "EXIT" in the upper function menu. Then, press the SET key. (Or, press the ESC key twice.)



4. The screen will ask "SAVE OK?." Move the cursor to "OPERATION CHART" or "NEW SAMPLE" using the up and down arrow keys, and press the SET key.

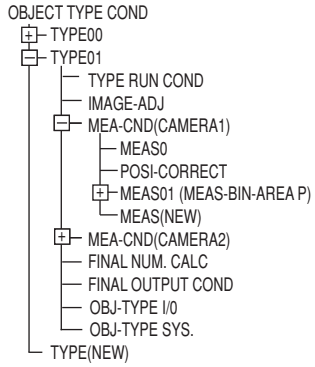
   - The changes will be written into the current operation chart.
   - Save as new sample (The original operation chart will not be changed.)

   Note: To change the sample, you can select "NOW SAMPLE" or "NEW SAMPLE."

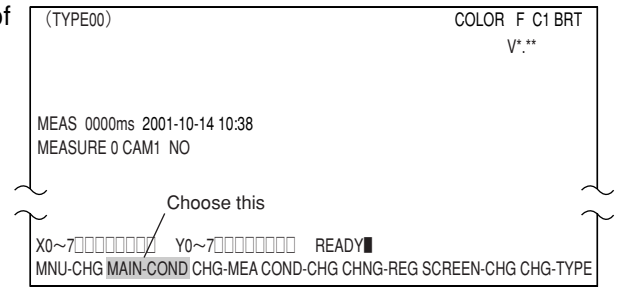


6-5 Menu tree

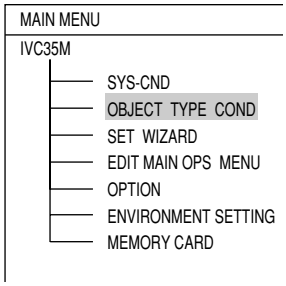
This section describes each of the settings using the menu tree.



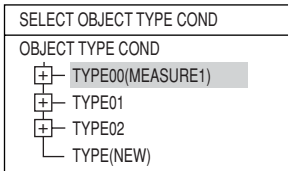
1. Move the cursor to "MAIN-COND" at the bottom of the Operation screen and press the SET key.



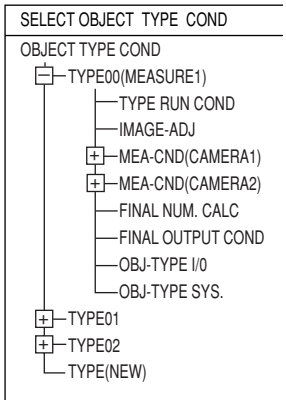
2. The "MAIN MENU" will appear.
   Move the cursor to "OBJECT TYPE COND" using the up and down arrow keys, and press the SET key.



3. A menu tree is displayed for each setting or registered object type.
   To create a new object type, move the cursor to "TYPE(NEW)" and press the SET key. The lowest, not yet assigned number will be selected. (Default value is TYPE00.)

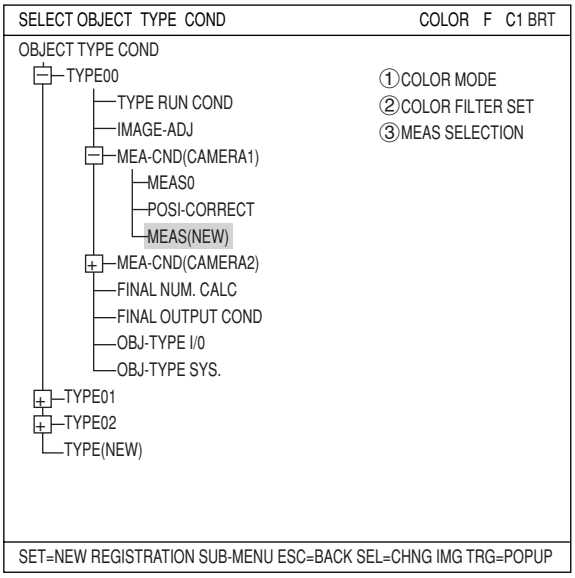


4. Move the cursor to the object type number you want to change using the up and down keys. Press the right arrow key and the sub menu will be displayed. A plus sign "⊞" means that there are other sub-menus below the marked menu. A minus sign "⊟" means that the sub menus are already displayed. By pressing the left arrow key on the "⊟" sign, the sub menu display will be closed.



5. Move the cursor to the item on the menu that you want to set using the up and down arrow keys. Press the SET key to begin setting this item.

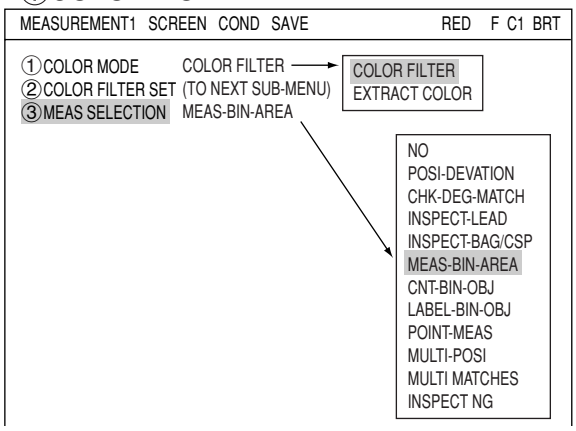
   Ex.: To select binary area measurement using camera 1, move the cursor to "MEA-CND (CAMERA1)" and press the SET key. Next, select "MEAS(NEW)" in the sub menu and then press the SET key.



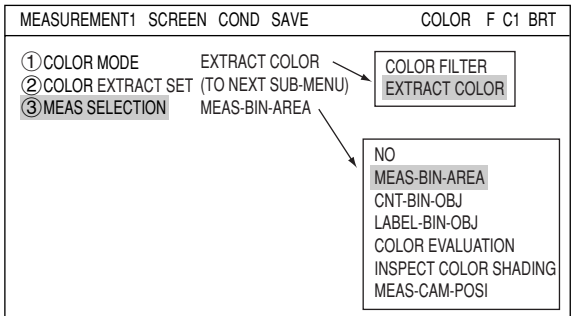
6

6. Select either "COLOR FILTER" or "EXTRACT COLOR" from the "①COLOR MODE" line. On the "③MEAS SELECTION" line, press the SET key, and then from the pop-up menu, select "MEAS-BIN-AREA" and press the SET key.
   ⇨ For detail about the color filter, see page 3-5.

When "COLOR FILTER" is selected on the "①COLOR MODE"



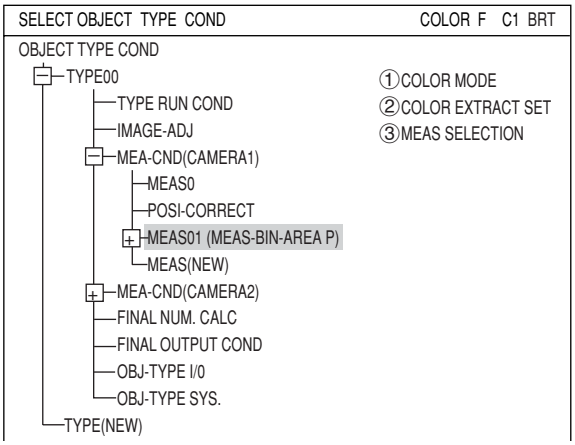
When "EXTRACT COLOR" is selected on the "①COLOR MODE"



   ⇨ For details about the extract color, see page 3-10.

7. After making your selection, press the ESC key to return the cursor to the menu tree. Item "MEAS01 (MEAS-BIN-AREA P*)" will be given a "⊞" sign on the menu tree.
   * When the "COLOR FILTER" is selected on the "① COLOR MODE," "F" will be added on this line.

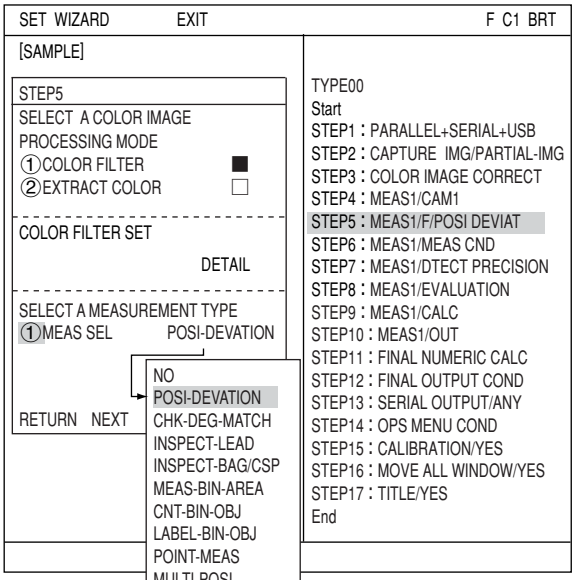
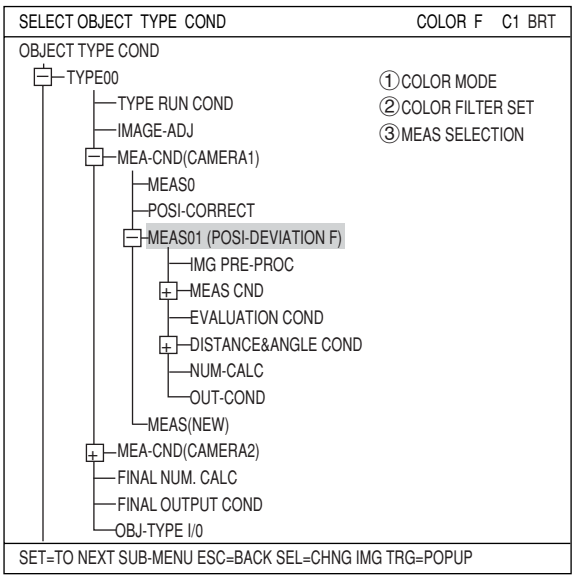
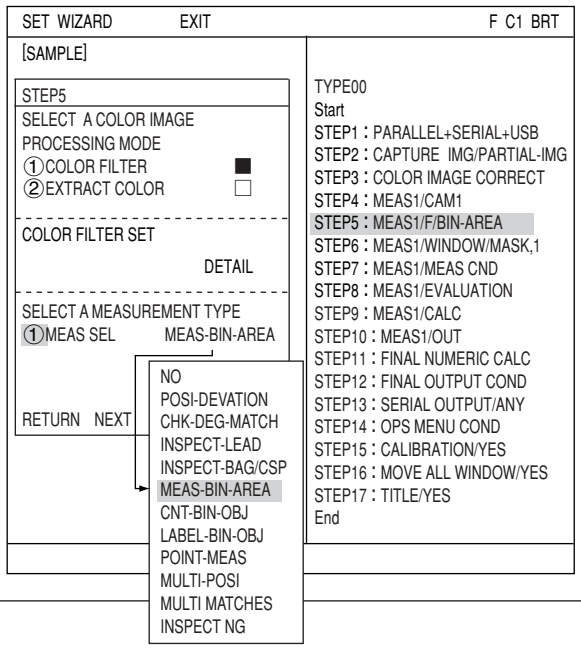
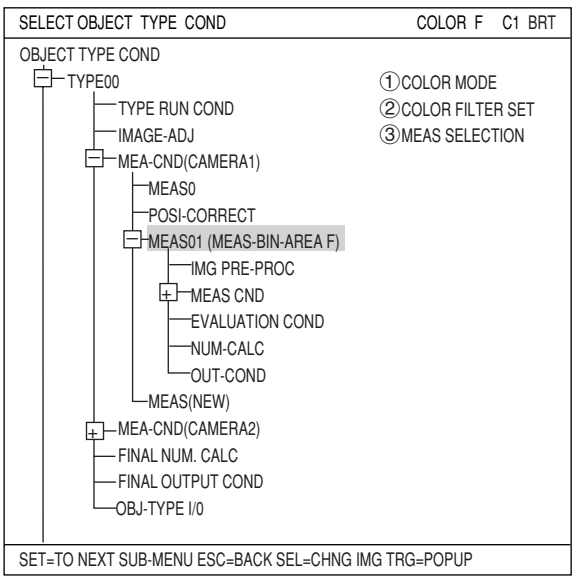
8. Move the cursor to "MEAS01 (MEAS-BIN-AREA P)" and press the right arrow key. Now the sub menu will appear and your can set each item used for binary area me measurement.



6-6 Relationship between the set wizard program, the operation chart, and the menu tree

If you change the operation chart using the set wizard, the menu tree will also change. If you change a setting on the menu tree, the operation chart in the set wizard will also be changed.

Ex.: Change measurement type from "positional deviation measurement" to "area measurement by binary conversion."

	Set wizard operation chart	Menu tree
Positional deviation measurement		
Area measurement by binary conversion		

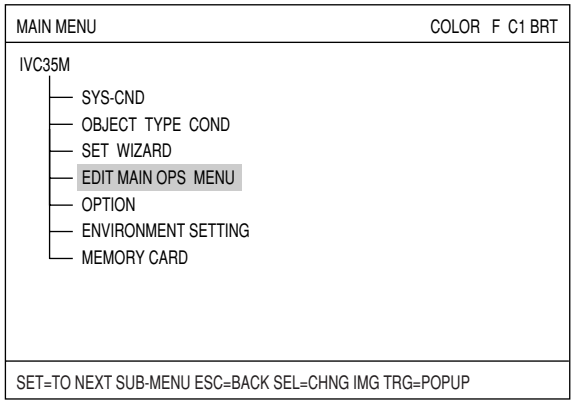
If you change the positional deviation measurement to area measurement by binary conversion using the set wizard program, the corresponding item on the menu tree will also change.

6-7 Editing operation screen

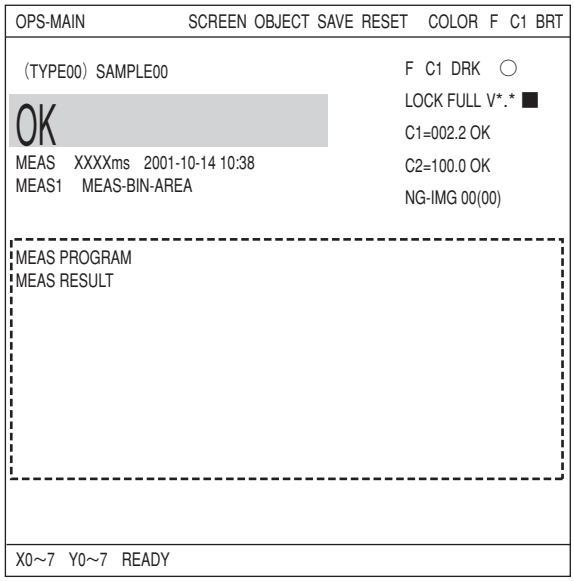
In this controller, the operation screen display can be changed. You can move, enlarge, reduce, or hide any block of text.

(1) Move the cursor to "MAIN-COND" on the operation screen and press the SET key.

(2) Move the cursor to "EDIT MAIN OPS MENU" and press the SET key.



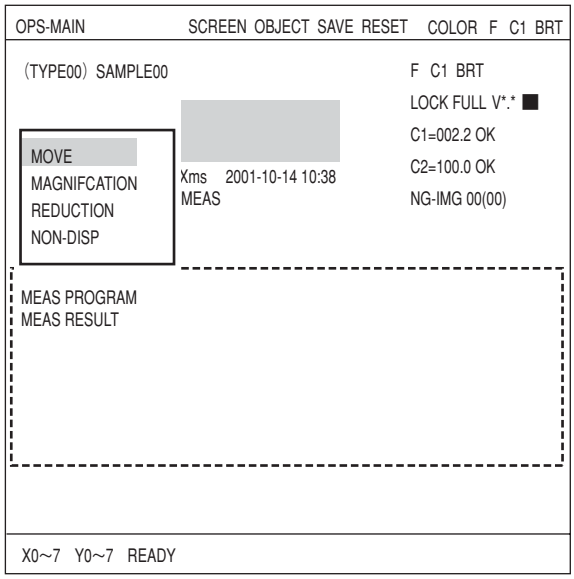
(3) Now the operation screen will appear. Select a block of text you want to edit using the up, down, left, and right arrow keys, and press the SET key. A pop up menu will appear and you can select from move, enlarge, reduce, and hide. (In this example, the block of text "OK" is selected.)



- **MOVE**
  Select "MOVE" using the SET key. Now the highlighted block of text can be moved using the up, down, left, and right arrow keys. When the text is in the desired new position, press the SET key again.

- **MAGNIFCATION/REDUCTION**
  Move the cursor to the "ENLARGE, REDUCE" line and press the SET key. The highlighted block of text can be enlarged or reduced.

- **NON-DISP**
  Move the cursor to the "NON-DISP" line and press the SET key. The highlighted block of text will be deleted.

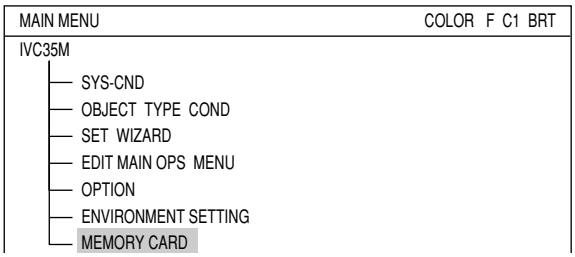


6-8 Option

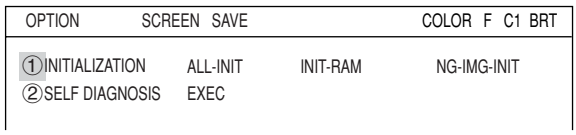
With the IV-C35M, you can initialize the measurement settings, and run a self-diagnosis from the option menu.

Setting method

Display the "OPTION" from the "MAIN MENU."



Select the operation you want, such as "①INITIALIZATION" or "②SELF-DIAGNOSIS."



① **INITIALIZATION**

Select "ALL-INT" or "INT-RAM" and the following message will appear.

MEM. INIT.? (YES=[SET], NO=[ESC])

Press the SET key to start the initialization. The bar shown below will appear and display the progress of the initialization.

INITIALIZATION

REFERENCE IMG ■■

SYSTEM I/O ■

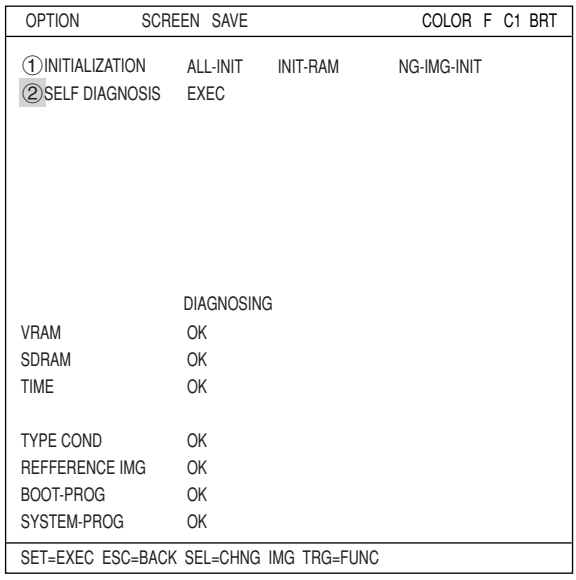
OBJECT TYPE COND ■■■■■■■□□□

After the initialization is complete, the word "INITIALIZING" will change to "COMPLETE INIT." Press the ESC key to return to "MAIN MENU."

② **SELF DIAGNOSIS**

Select "②SELF DIAGNOSIS" and press the SET key twice. The controller will execute a self-diagnosis and display the results of the diagnosis, as shown right. If the diagnosis results are normal, "OK" will be displayed. If the results are abnormal, "NO" will be displayed.

When the diagnosis is complete, the "DIAGNOSING" display will change to "COMPLETE DIAGNOSIS." Press ESC key to return to the "MAIN MENU."

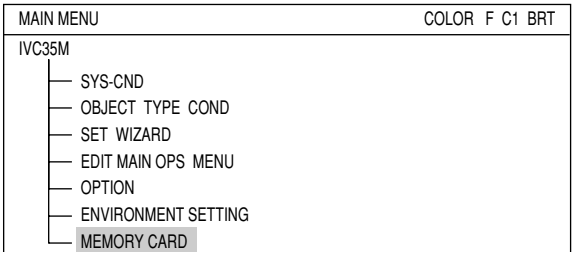


6-9 Environment settings

The IV-C35M can change the display color of each items displayed on the screens.

How to enter the environment setting screen

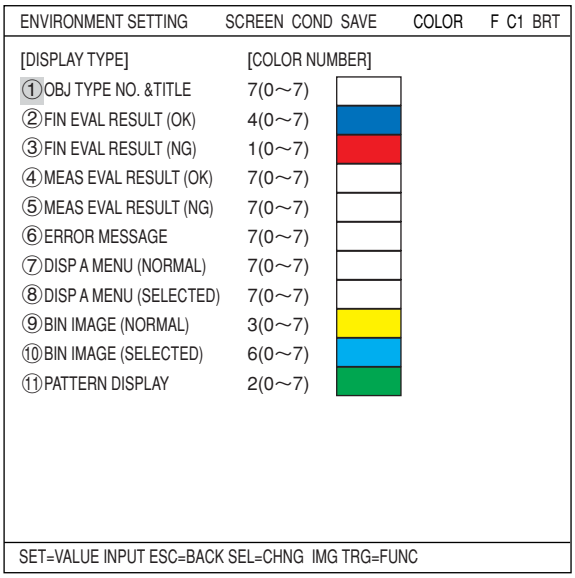
To change color of each item, enter the "ENVIRONMENT SETTING" screen. To enter the "ENVIRONMENT SETTING" screen, on the "MAIN screen," select the "ENVIRONMENT SETTING" and press the SET key.



Setting method

Select an item to change display color from ① to ⑪, and press the SET key, and select the color number using up and down arrow keys. The frame at right changes color. Color numbers are allocated as follows.

Color No.	0	1	2	3	4	5	6	7
Display color	Black	Red	Green	Yellow	Blue	Magenta	Cyan	White



Available colors of each item are as follows.

Display items	Available colors
①OBJ TYPE NO.&TITLE	0 (black), 7 (white)
②FIN EVAL RESULT(OK)	0 (black), 1 (red), 4 (blue), 7 (white)
③FIN EVAL RESULT(NG)	0 (black), 1 (red), 4 (blue), 7 (white)
④MEAS EVAL RESULT(OK)	0 (black), 7 (white)
⑤MEAS EVAL RESULT(NG)	0 (black), 7 (white)
⑥ERROR MESSAGE	0 (black), 7 (white)
⑦DISP A MENU(NORMAL)	0 (black), 7 (white)
⑧DISP A MENU(SELECTED)	0 (black), 7 (white)
⑨BIN IMAGE(NORMAL)	0 to 7 (all colors)
⑩BIN IMAGE(SELECTED)	0 to 7 (all colors)
⑪PATTERN DISPLAY	0 to 7 (all colors)

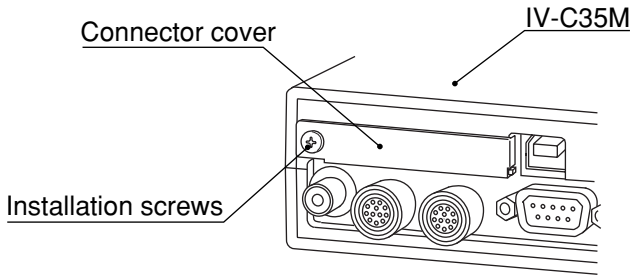
6-10 Memory card

The IV-C35M can store measurement parameters etc. into a memory card.

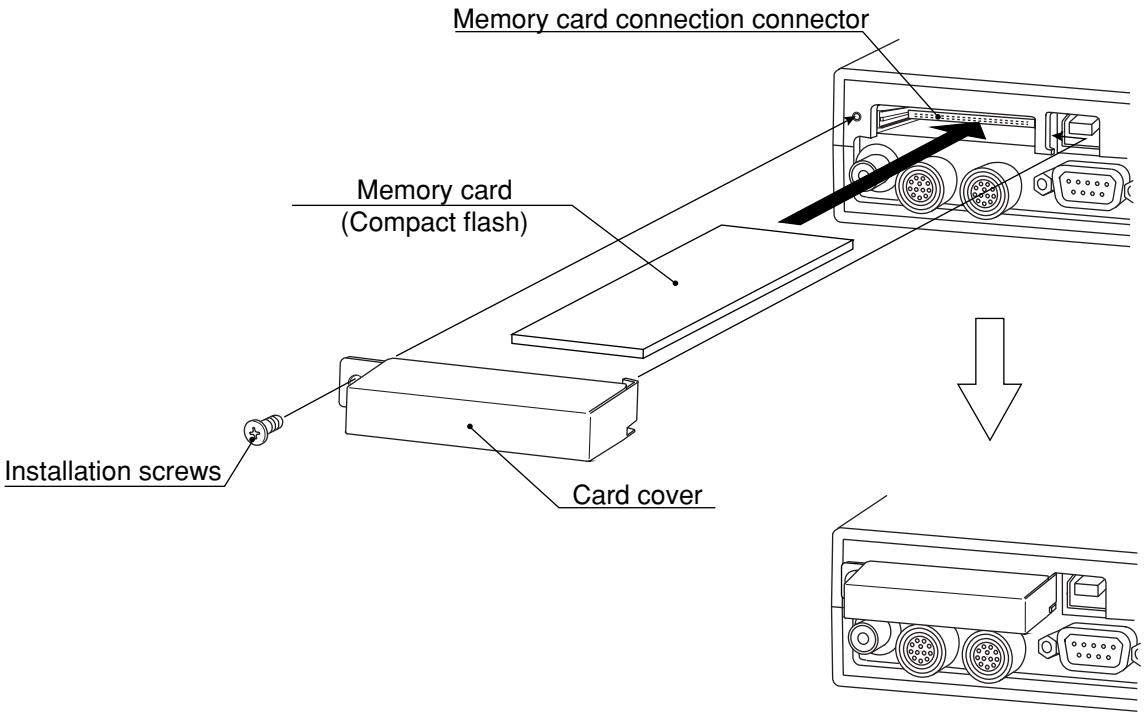
[1] Installation of a memory card

When you want to store NG images or data using a memory card (compact flash), install a memory card following the procedures below.

1. Remove the installation screws on the connector cover, and then remove the connector cover.

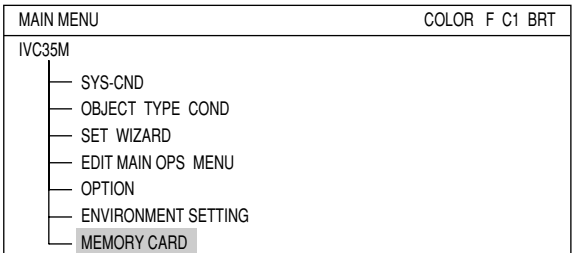


2. Connect the memory card to the memory card connection connector of the IV-C35M, install the card cover, and secure the installation screws that were used to fix the connector cover.



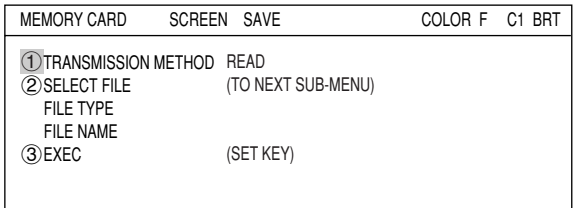
[2] Storage method

To save data into a memory card, display the "MEMORY CARD" screen by selecting "MEMORY CARD" on the "MAIN MENU" screen.



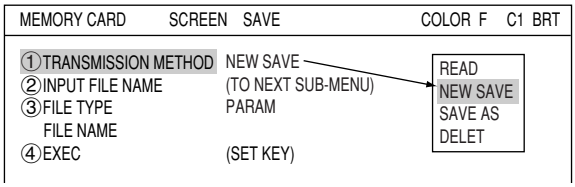
① TRANSMISSION METHOD

Select whether to transfer data from the memory card or save data to the memory card. Select from "READ," "NEW SAVE," "SAVE AS," or "DELETE."



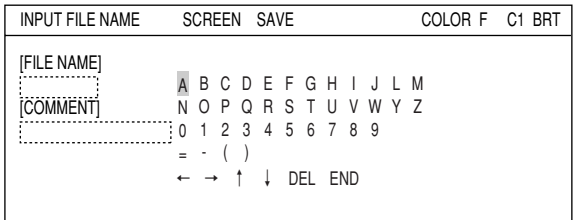
When "NEW SAVE" is selected

When "NEW SAVE" is selected on the "①TRANSMISSION METHOD," the screen shown right will appear.



② INPUT FILE NAME

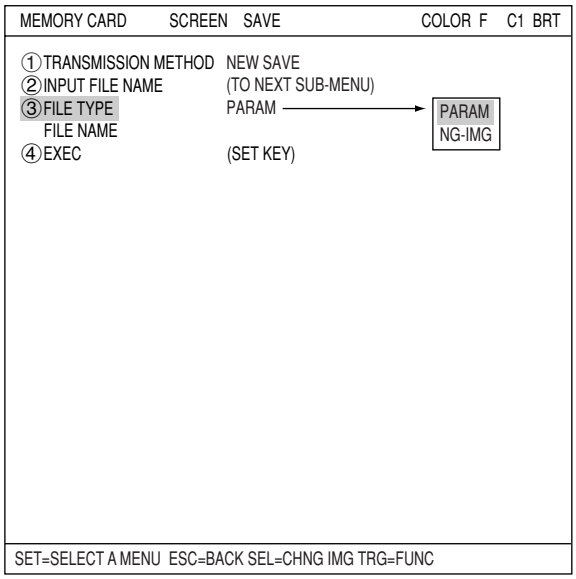
Select "②INPUT FILE NAME (TO NEXT SUB-MENU)" using the up and down arrow keys, and press the SET key; "INPUT FILE NAME" screen will appear. Enter "FILE NAME" and "COMMENT" on this screen.



Note: To move the cursor from the "FILE NAME" block to the "COMMENT" box, select the down arrow key on the screen and press the SET key.

③ FILE TYPE

Select file type to save.



④ **EXEC**

After completing entry, select "④EXEC" and press the SET key.
A screen shown below will appear and the controller will start saving data to the memory card.

SAVING...

When this screen disappears, saving is complete.

When "READ" or "SAVE AS" is selected

② SELECT FILE (TO NEXT SUB-MENU)

Select "②SELECT FILE (TO NEXT SUB-MEN)" using the up and down arrow keys, and press the SET key to go to a sub menu.

MEMORY CARD	SCREEN SAVE	COLOR F C1 BRT
①TRANSMISSION METHOD	READ	
②SELECT FILE	(TO NEXT SUB-MENU)	
FILE TYPE	PARAM	
FILE NAME	AAA	
③EXEC	(SET KEY)	

On the "FILE LIST" screen, file names currently stored in the memory card are displayed. Select a file to read or overwrite, and press the SET key.

FILE LIST	SCREEN SAVE	COLOR F C1 BRT
PAGE NO.		
①PAGE CHNG		

FILE NAME	TYPE	SIZE	RENEWAL DATE	MODEL	COMMENT
SMPL1	PARAM	210	0115		Sample1

The selected file name will be displayed under the "FLE TYPE" line.

MEMORY CARD	SCREEN SAVE	COLOR F C1 BRT
①TRANSMISSION METHOD	READ	
②SELECT FILE	(TO NEXT SUB-MENU)	
FILE TYPE	PARAM	
FILE NAME	AAA	
③EXEC	(SET KEY)	

③ **EXEC**

Select "③EXEC" and press the SET key.
A screen shown below will appear.

MEMORY CARD	SCREEN SAVE	COLOR F C1 BRT
①TRANSMISSION METHOD	READ	
②SELECT FILE	(TO NEXT SUB-MENU)	
FILE TYPE	PARAM	
FILE NAME	AAA	
③EXEC	(SET KEY)	

UNDER ACCESS...

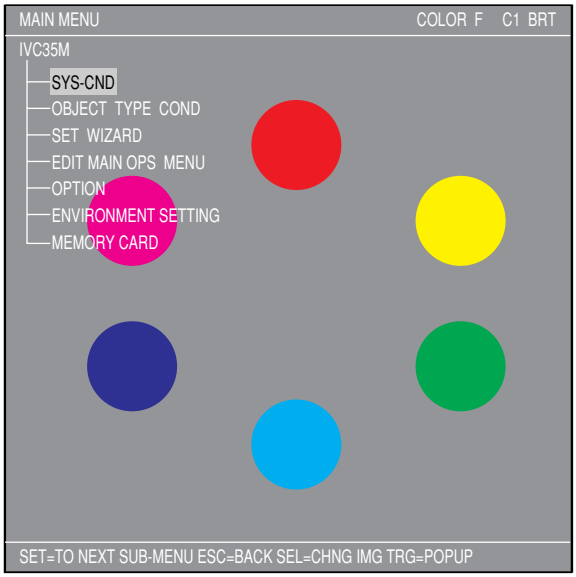
Note: When "SAVE AS" is selected, "UNDER ACCESS..." will appear on the screen.

Chapter 7: Setting Examples Using the Set Wizard

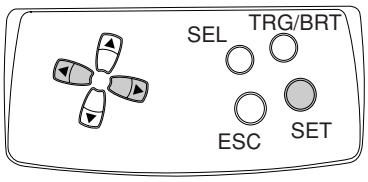
7-1 Color evaluation

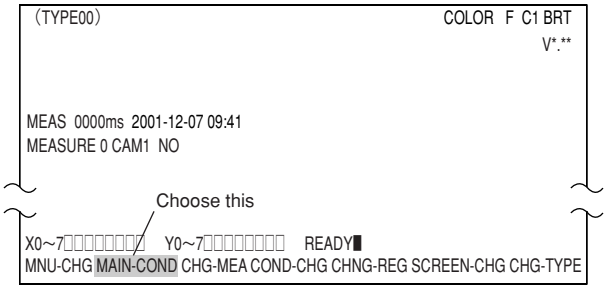
This function selects specified color from objects with multiple colors, and converts this area to binary. Then, the controller measures area, color degree of match, average hue, and average saturation.
Use the remote keypad for this operation.

⇨ See page 4-5 and 6-6 for detail of the operation of each key on the remote keypad.

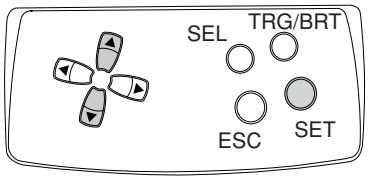


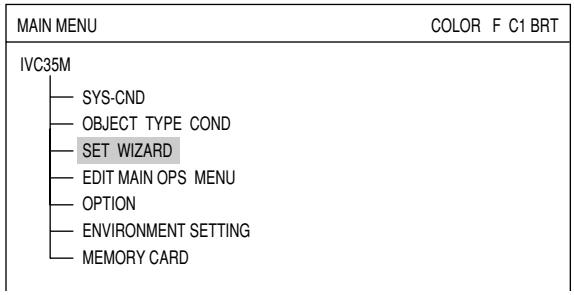
(1) Move the cursor to "MAIN COND" using the left and right arrow keys and press the SET key.



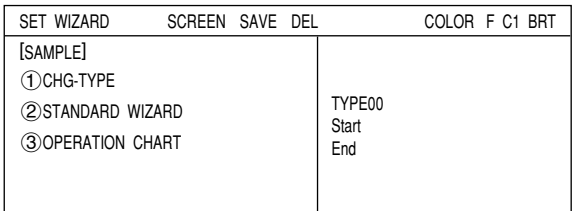


(2) The "MAIN MENU" will appear.
Move the cursor to the "SET WIZARD" item using the up and down arrow keys, and press the SET key.

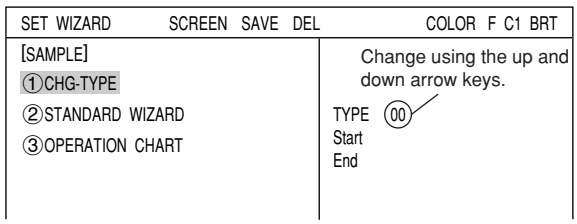




(3) The "SET WIZARD" screen will appear.



(4) Enter an object type number.
Move the cursor to "①CHG-TYPE," using the up and down arrow keys, and press the SET key. "①CHG-TYPE" will be highlighted. Next, press the up and down arrow keys and the "TYPE00" display on the right will change. Each time you press the up key, the type number will increase by one, from 00 to 31 and then back to 00. Each time you press the down key, the type number will decrease by one, first from 00 to 31 and then from 31 down to 00. Holding down either of these keys advances the number rapidly. Finally, press the ESC key to confirm the selected number.



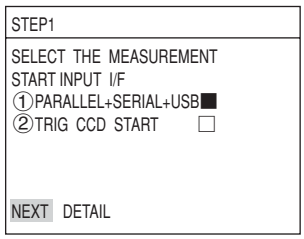
(5) Move the cursor to "②STANDARD WIZARD" and press the SET key. The set wizard will start.

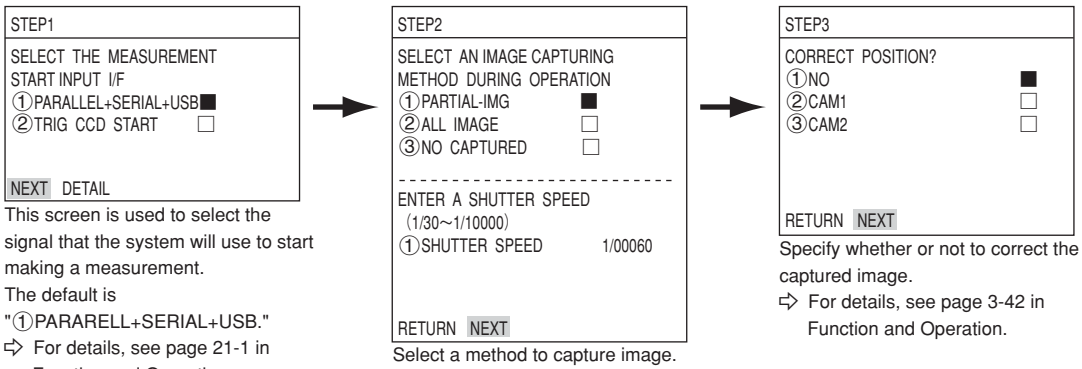
= In this example, the settings on the screens from the STEP1 to STEP 3 (CORRECT POSITION) are not changed. Select "NEXT" on each of these screens to go to the next screen. =

How to go to next step while leaving the current step in the Set Wizard unchanged.

(1) Press the up or down arrow key several times to move the cursor to the "NEXT" item.

(2) Press the SET key.



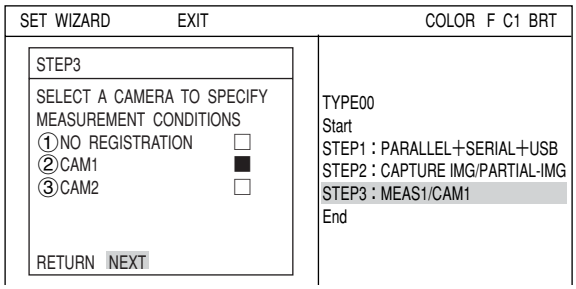


This screen is used to select the signal that the system will use to start making a measurement.
The default is "①PARARELL+SERIAL+USB."
⇨ For details, see page 21-1 in Function and Operation.
CCD trigger
⇨ For details, see page G-2.

Select a method to capture image.
The default is "①PARTIAL-IMG."

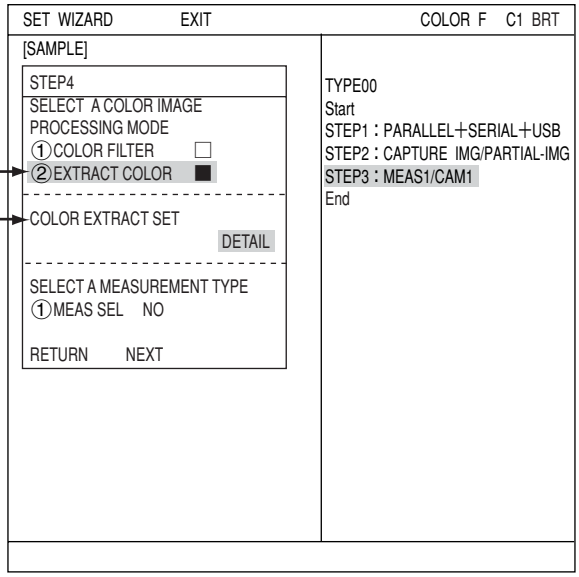
Specify whether or not to correct the captured image.
⇨ For details, see page 3-42 in Function and Operation.

(6) Select a camera in order to specify measurement conditions
Move the cursor to "②CAM1" or "③CAM2" using the up and down arrow keys, and press the SET key.
Note: If you select "NO REGISTRATION", you cannot set the measurement conditions.

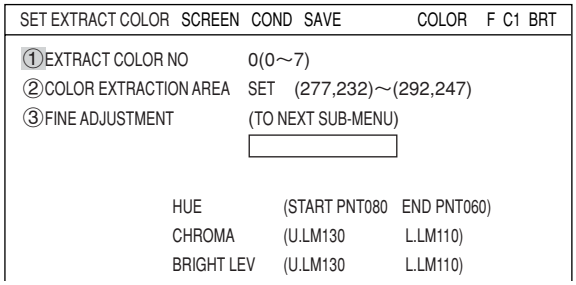


(7) Select color image processing mode
Move the cursor to "②EXTRACT COLOR" and press the SET key.

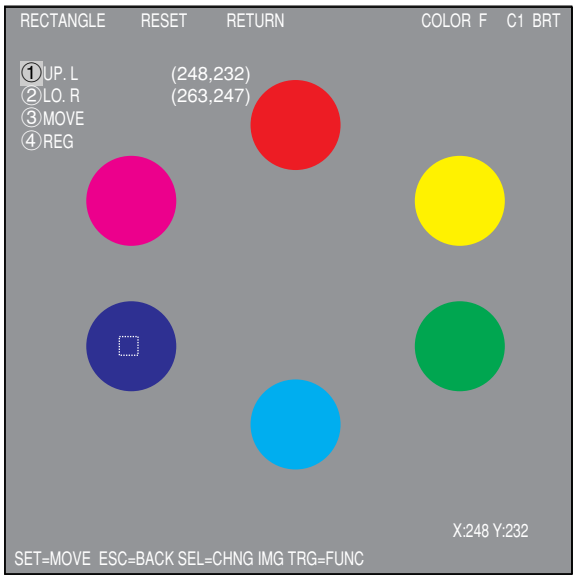
Next move the cursor to "COLOR EXTRACT SET" using the up and down arrow keys and press the SET key. Select "DETAIL" to enter the "SET EXTRACT COLOR" screen.



① **EXTRACT COLOR NO.**
Enter the register number of the extracted color that is used for measurement (enter 0 in this example). Eight colors from 0 to 7 can be registered as reference colors. These can be used for each measurement, independently.



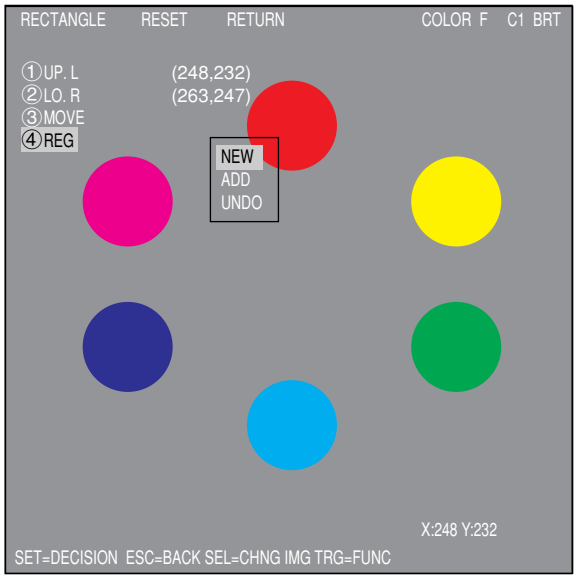
② **COLOR EXTRACTION AREA**
Select "②COLOR EXTRACTION AREA" using the up and down arrow keys, and press the SET key to enter the setting screen.



1. Press the SEL key to move the cursor to the "F" (freeze image) that is at upper right of the screen. Press the up and down arrow keys to change from "F" to "T" (through image). The image of Camera 1 changes to through image and current image through the camera is displayed on the monitor.
2. Adjust focus and aperture of the camera lens to make clear the image of the object to measure.
3. After the image is adjusted to clear, change the image from "T" to "F" using the up and down arrow keys. By changing the image from "T" to "F," the IV-C35M stores the image.
4. Move the coordinate of "①UP.L" and "②LO.R" to determine position and size of the color extraction area, and press the SET key. (In this example, extract blue color.)

Note: If you want to move the color extraction area without changing shape and size, select "③MOVE."

Register extracted color
Select "④REG" using the up and down arrow keys and then press the SET key. From the popup menu, select "NEW" or "ADD."

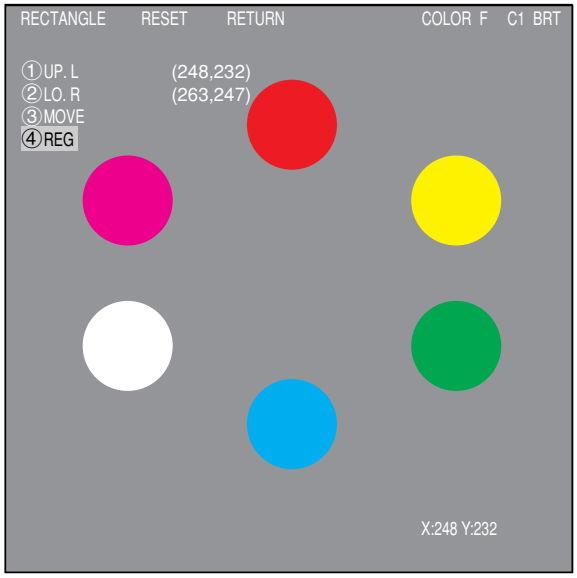


After the colors are registered, the "REGISTRATION WAS COMPLETED" message appears.

REGISTRATION WAS COMPLETED, PRESS SET KEY.

Press the SET key again, the selected area is converted to binary, and this color is registered as extraction color number 0.

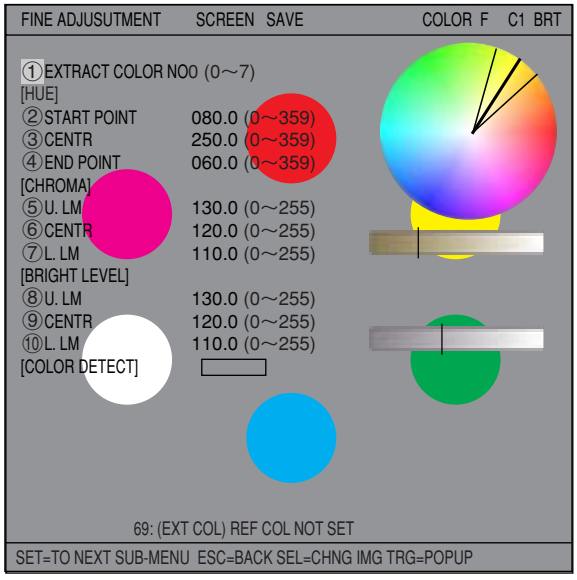
Press the ESC key to return to the previous screen.



③ FINE ADJUSTMENT
On "③FINE ADJUSTMENT" line, press the SET key to enter the sub-menu screen.
The screen shows "HUE," "CHROMA," (color saturation) and "BRIGHT LEV" of the registered extracted color with numeric values and graphs.

Dotted lines on each graph are upper and lower limits, and the solid line is the center value.

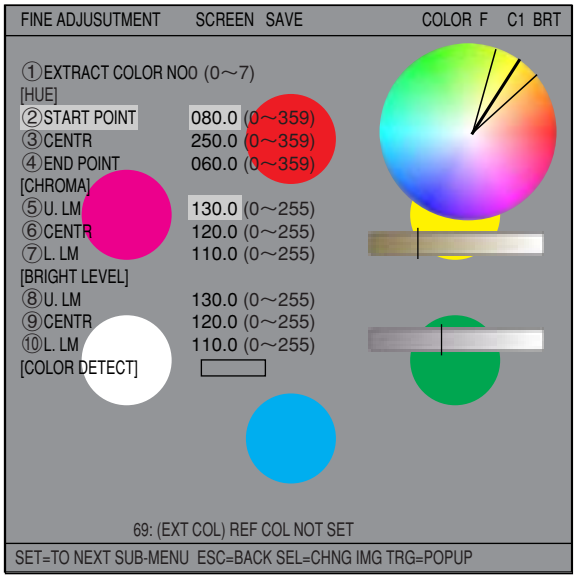
adjust the upper and lower limit values.



Ex.: Change "②START POINT" of hue.

Increase value of the "②START POINT" of hue and the start point of the hue and chroma (saturation) graph moves. The center value also changes accordingly.
Select "③④CENTR" and" END POINT" and change numeric values so that each position can be shifted.
By moving "③CENTR," both start and end points slide accordingly.

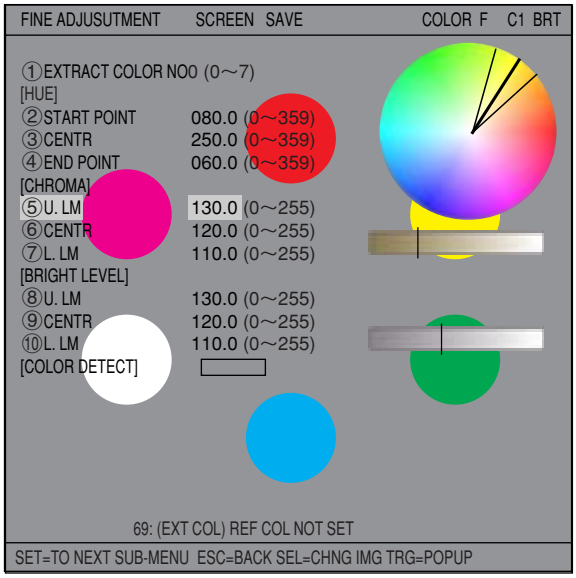
Note: To extract and covert to binary wider range hue, set start and end points of hue wider.



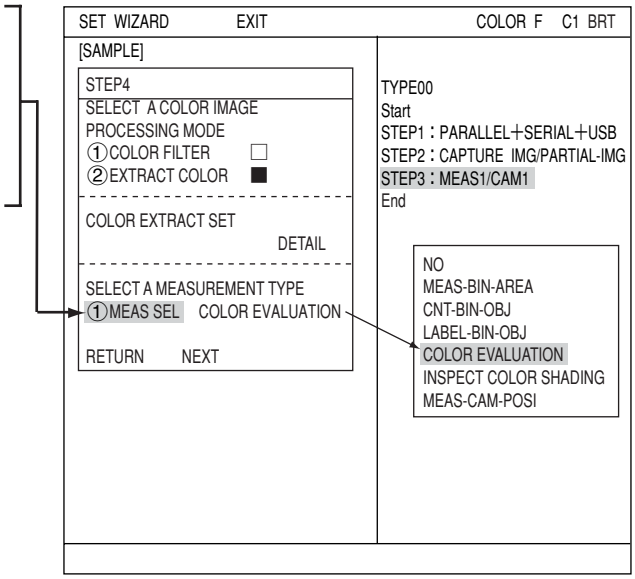
Ex.: Change upper and lower limits of saturation (chroma).

Increase or decrease values of "⑤U.LM" and "⑦L.LM" for saturation, the upper and lower limit range on the bar graph can be widen or narrowed.
Moving the "⑥CENTR," both upper and lower limits slides accordingly.

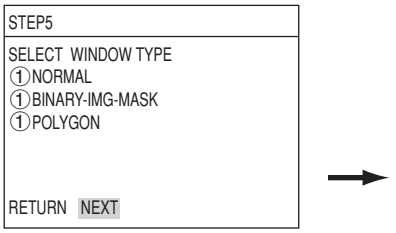
After fine adjustment is complete, press the ESC key three times to return to the "SET WIZARD" screen.



(8) Next, move the cursor to the "①MEAS SEL" line using the up and down arrow keys, and press the SET key. Select "COLOR EVALUATION" from the popup menu. Then, select "NEXT" to move to the next screen.



= In this example, the settings on the screens are not changed. Select "NEXT" on each of these screens to go to the next screen. =



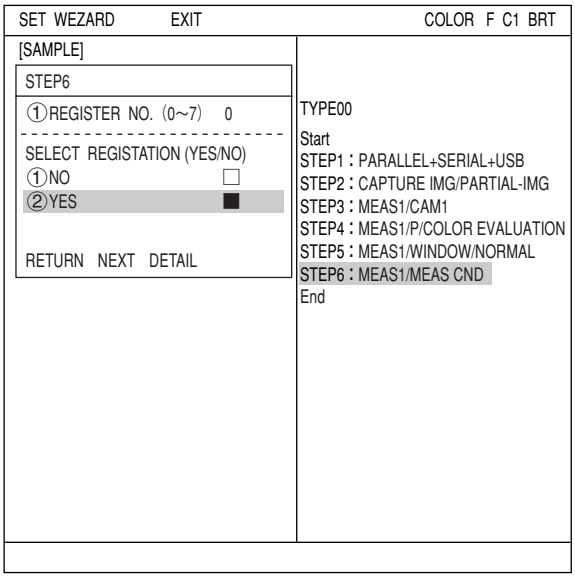
(9) Select a registration number

Move the cursor to "①REGISTER NO. (0 ~ 7)" and press the SET key. While this item is highlighted, press the up and down arrow keys and press the SET key when the number you want appears.

Next, move the cursor to "②YES" on the "SELECT REGISTRATION (YES/NO)" line and press the SET key.

The "DETAIL" item will appear in the lower menu. Move the cursor to "DETAIL" and press the SET key.

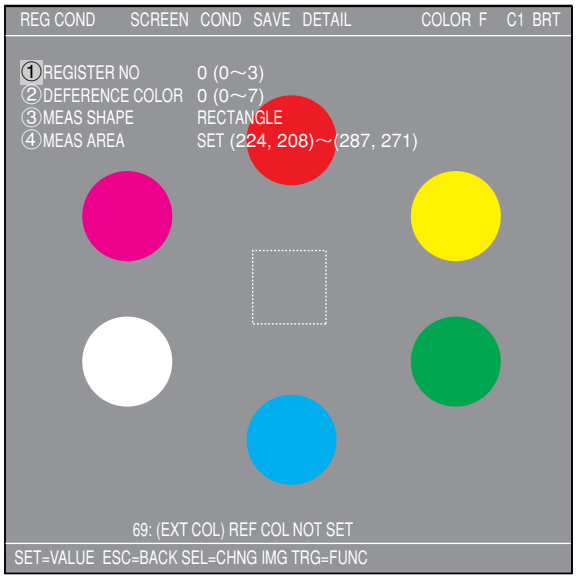
Now "REG COND" screen will appear.



(10) Setting the registration conditions

① **REGISTER NO.**

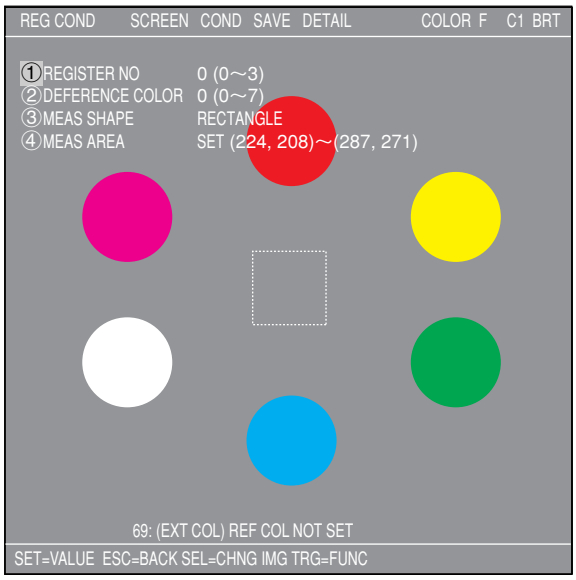
The previously specified register number is displayed. To change the register number, press the SET key. While the number is highlighted, press the up and down arrow keys to change it.



Next, adjust the image you want to measure.

1. Press the SEL key to move the cursor to the "F" position in the upper function menu. Press the up and down arrow keys to change the "F" to "T." Now the image from "CAM1" will be displayed as a through image on the monitor.

   Note: When the image is difficult to see, change the image setting between "BRT" and "DRK." After changing from the "Freeze" to the "Through" image display, press the left key once and then press the up key once. The "Dark" image setting can be selected.



2. Adjust the focus and aperture of the camera lens to obtain a clear image of the object.
   ⇨ See pages 5-3.

3. After the measurement object image is clearly visible, change the image mode back to "F" (Freeze) using the up and down arrow keys.
   By switching the image display mode from "T" to "F," the image will be captured by the IV-C35M controller.

   Note: Whenever you want to register a reference image, the image display mode should be changed to "F."

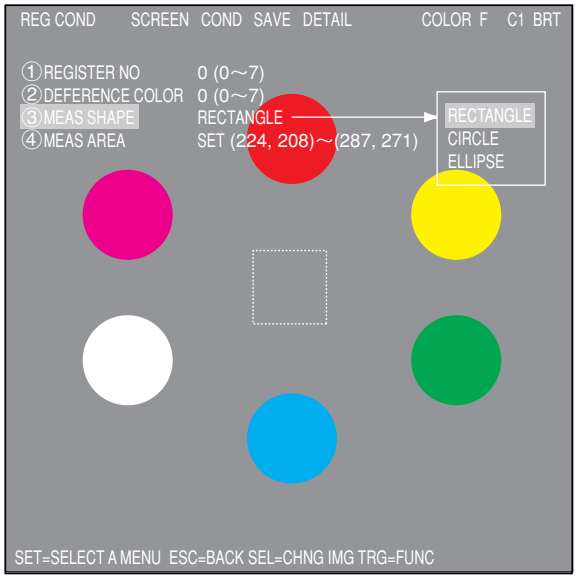
4. Press the SEL key and move the cursor from the upper function menu to the "REG COND" screen.

② REFERENCE COLOR

Select the reference color number that was registered in the color extraction. (In this example select 0.)

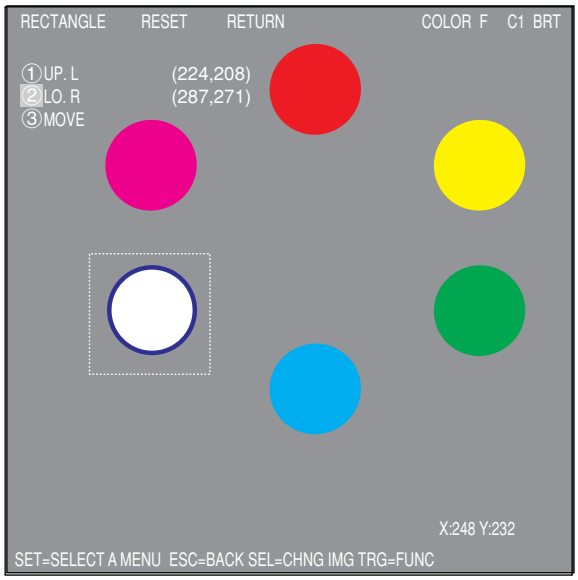
③ MEAS SHAPE

Move the cursor to this line and press the SET key. A popup menu will appear.
Move the cursor to "RECTANGLE", "CIRCLE" or "ELLIPSE" and press the SET key. In this example, select "RECTANGLE."



④ MEAS AREA

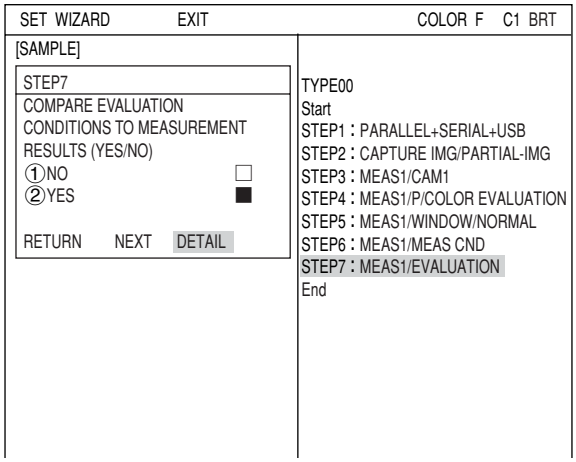
Move the cursor to this line and press the SET key. The "SET" line will be highlighted. Press the SET key again and the "RECTANGLE" setting screen will appear.
Adjust the size of the rectangle by setting "①UP.L" and "②LO.R" (upper left and lower right corners) in order to establish the reference image area.



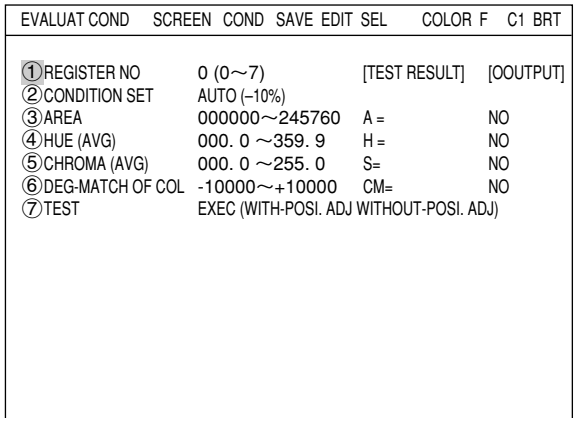
UP.L	The upper left corner of the rectangle can be moved up, down, left, and right.
LO.R	The lower right corner of the rectangle can be moved up, down, left, and right.
MOVE	The rectangle can be moved up, down, left, and right. Select "③MOVE" and press the SET key to display a cross hair cursor on the screen. Now, move the rectangle by pressing the up, down, left, and right arrow keys. When it is in position, press the SET key to confirm it.

(11) Select whether or not to set the evaluation conditions for measured results.
Select "②YES" and press the SET key.

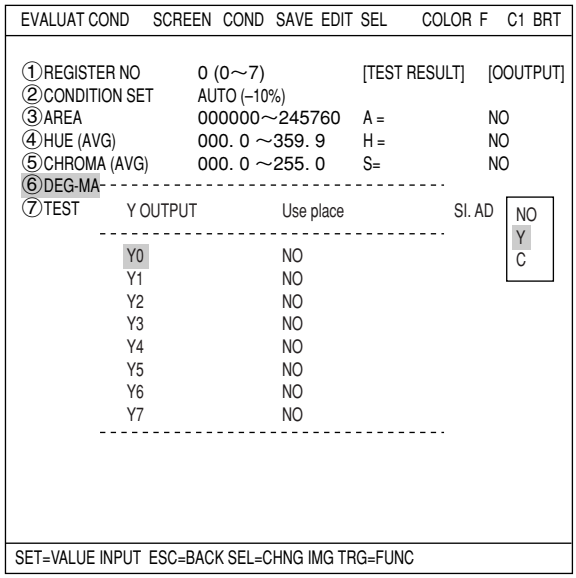
The "DETAIL" item will appear on the lower part of the screen. Move the cursor to "DETAIL" and press the SET key.



The "EVALUAT COND" screen will appear.
Select "①REGISTER NO." using the up and down arrow keys. Change the number to "0" using the up and down arrow keys. Then press the SET key.



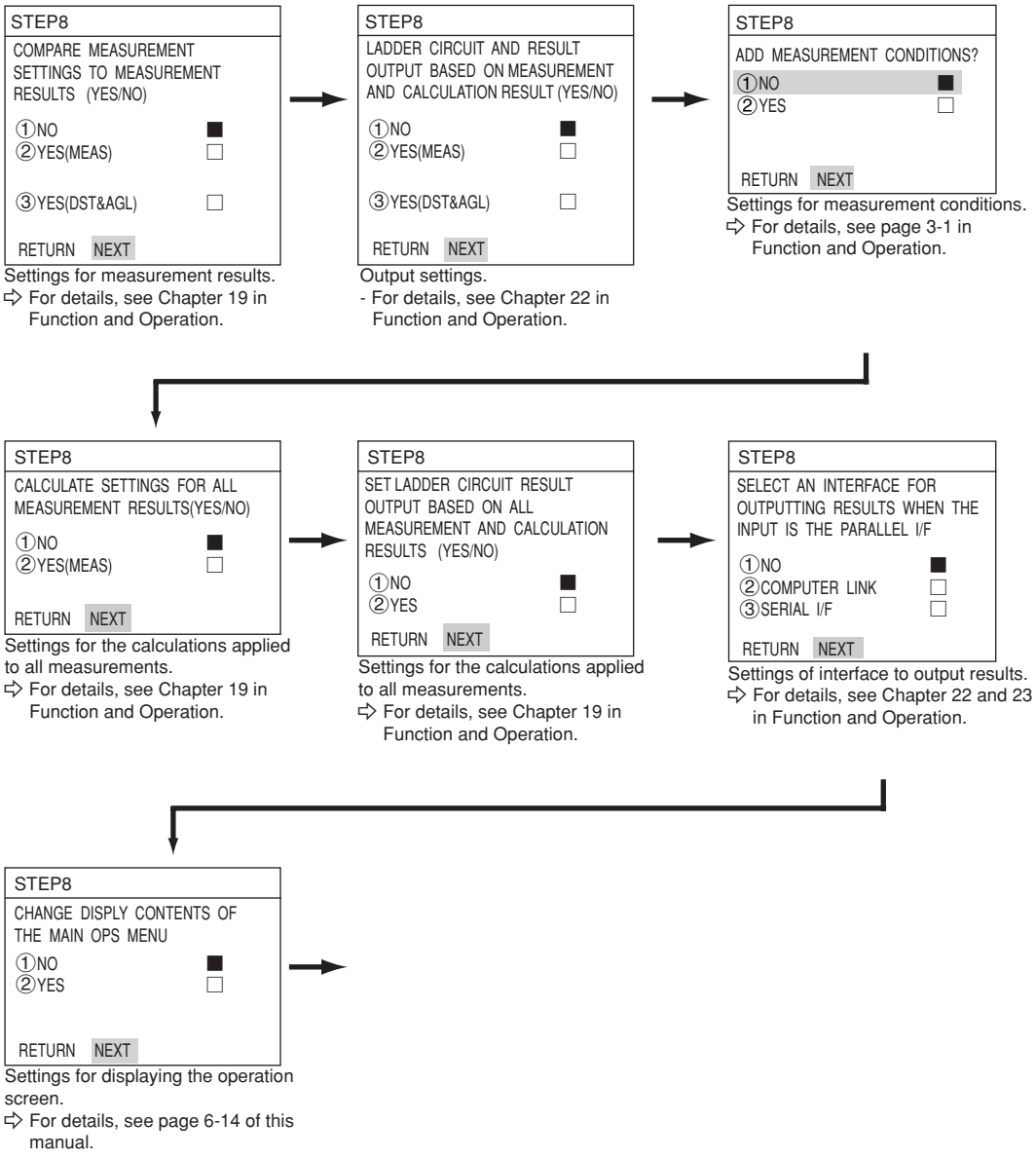
Select "②CONDITION SET," "⑥DEG-MATCH OF COL," using the up and down arrow keys, and enter upper and lower limit values. Use the left and right arrow keys to change between each digit and use up and down arrow keys to change values of each digit.
Select a digit using the left and right arrow keys. Select a number using the up and down arrow keys. For example, when selecting "⑥DEG-MATCH OF COL," determine values, and then press the SET key. Then move the cursor to "NO" on the "OUTPUT" column using the left and right arrow keys.
After the value is correct, press the SET key. Then press the left and right keys to move the cursor to "OUTPUT." Now press the SET key. A popup menu will appear and you can choose "NO," "Y," or "C."
Note: "Y" is for terminal block. "C" is for auxiliary relay.



Move the cursor to "Y" and press the SET key. Then select the Y0 and press the SET key. Now the evaluation results will be output to the Y0 terminal.
⇨ For details about the evaluation conditions, see page 3-28 in Function and Operation.

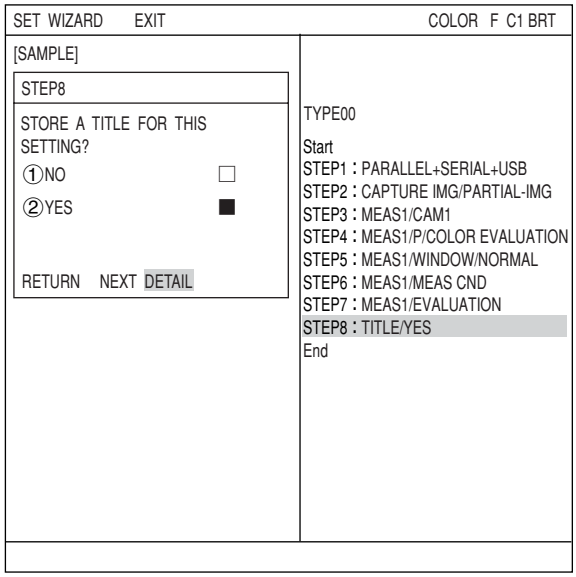
After the settings are complete, press the ESC key to return to the "SET WIZARD" screen.

= In this example, the settings on the STEP8 (COMPARE MEASUREMENT SETTINGS) to STEP 78 (MAIN OPS MENU) are not changed. Select "NEXT" on each of these screens to go to the next screen. =



7

(12) STORE A TITLE FOR THIS SETTING?
After making this series of settings, select "②YES" to save the settings as a group. By selecting "② YES," "DETAIL" will appear in the lower menu. Select "DETAIL" and press the SET key.

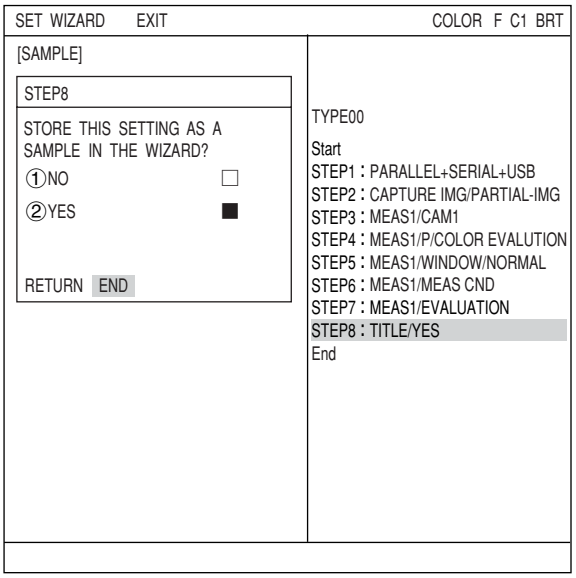


The "STR OBJ TITLE" screen will appear. Enter a name using the up, down, left, and right arrow keys. Then, select "END" and press the SET key.
* In this example, "AREA" is entered as the title.

The monitor will return to the "SET WIZARD" screen. Select "NEXT" and press the SET key to go to the next screen.

(13) STORE THIS SETTING AS A SAMPLE IN THE WIZARD?
Select "①NO" or "②YES" and then "END." Finally, press the SET key.

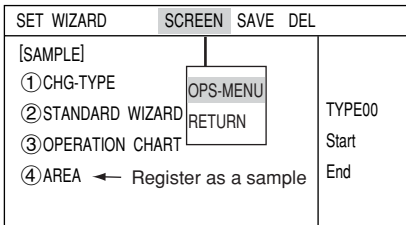
If you selected "②YES" to store the settings, move the cursor to "END" and press the SET key. The wizard will shut down.



(14) The sample is registered with the title you assigned to on the "SET WIZARD" screen.

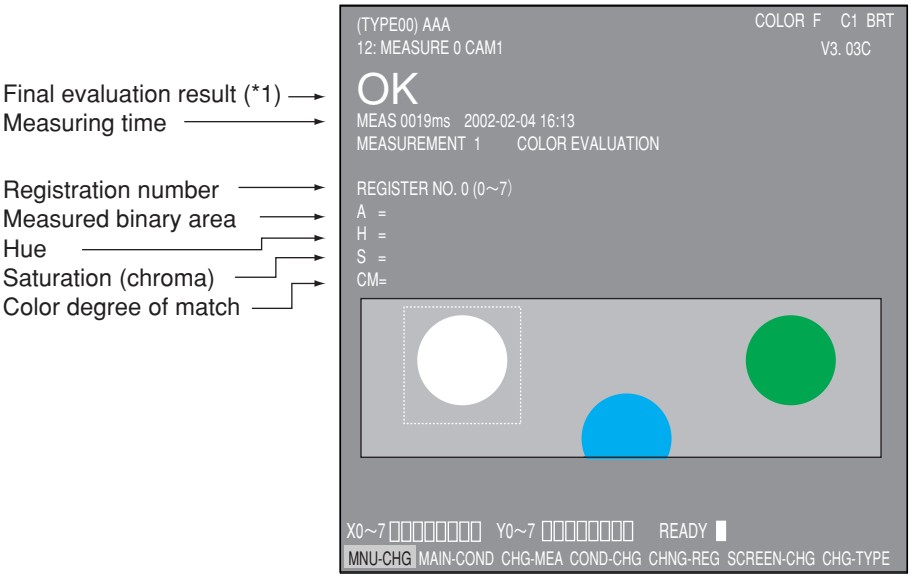
Note 1: If no title was assigned, the sample settings are simply listed as "Sample *"

Note 2: A maximum of eight sample settings can be assigned.



(15) The monitor will return to display the operation screen.
To return to the operation screen, press the ESC key twice, or move the cursor to "SCREEN" in the upper menu area using TRG/BRT key and select "OPS-MENU" from the popup menu.

(16) Execute a measurement.
While the operation screen is displayed, press the TRG/BRT key. The measurement results will be displayed on the screen.



*1 The final evaluation result will be displayed as "OK" in the upper left corner of the screen when all of the items have been evaluated acceptable.
If there is a single unacceptable item, "NG" will be displayed.

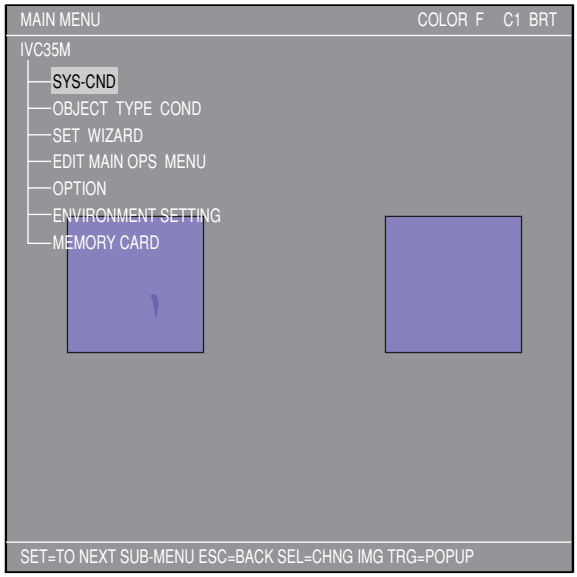
*2 When the final evaluation result is OK, Y0 is turned ON, and a filled box ■ is displayed. (When the result is NG, an empty box □ is displayed.)

7-2 Fault inspection

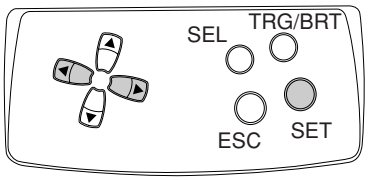
Flaws having a little difference of color or contract could not be found with gray processing of conventional monochrome cameras. The IV-C35M can easily evaluate flaws having little difference of color and contrast.

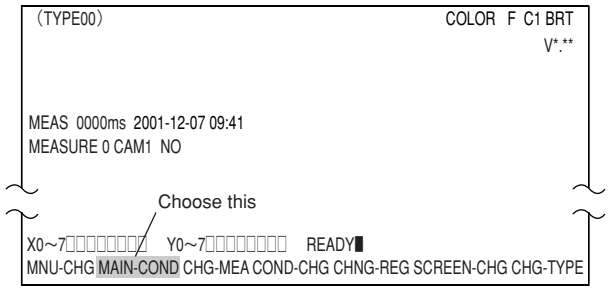
Use the remote keypad for this operation.

⇨ See page 6-6 for detail of the operation of each key on the remote keypad.

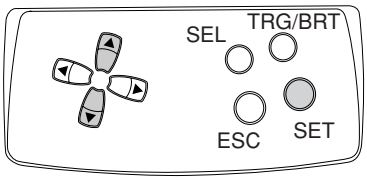


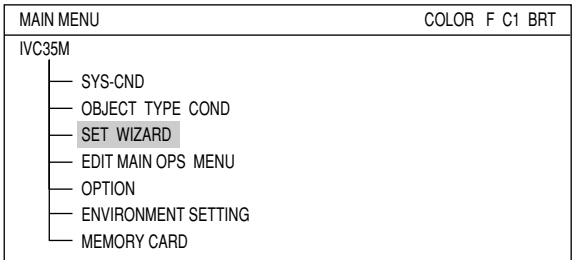
(1) Move the cursor to "MAIN COND" using the left and right arrow keys and press the SET key.



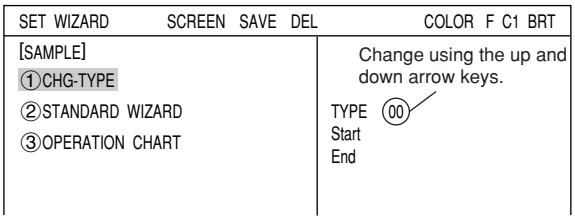


(2) The "MAIN MENU" will appear.
Move the cursor to the "SET WIZARD" item using the up and down arrow keys, and press the SET key.

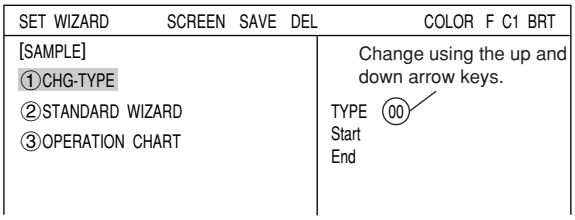




(3) The "SET WIZARD" screen will appear.



(4) Enter an object type number.
Move the cursor to "①CHG-TYPE," using the up and down arrow keys, and press the SET key. "①CHG-TYPE" will be highlighted. Next, press the up and down arrow keys and the "TYPE00" display on the right will change. Each time you press the up key, the type number will increase by one, from 00 to 31 and then back to 00. Each time you press the down key, the type number will decrease by one, first from 00 to 31 and then from 31 down to 00. Holding down either of these keys advances the number rapidly. Finally, press the ESC key to confirm the selected number.



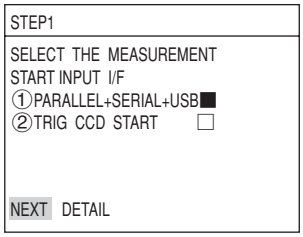
(5) Move the cursor to "②STANDARD WIZARD" and press the SET key. The set wizard will start.

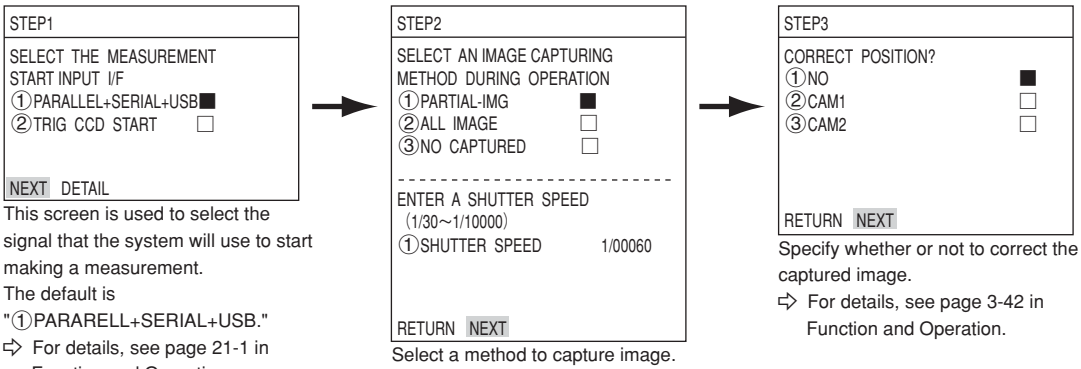
= In this example, the settings on the screens from the STEP1 to STEP 3 (CORRECT POSITION) are not changed. Select "NEXT" on each of these screens to go to the next screen. =

How to go to next step while leaving the current step in the Set Wizard unchanged.

(1) Press the up or down arrow key several times to move the cursor to the "NEXT" item.

(2) Press the SET key.



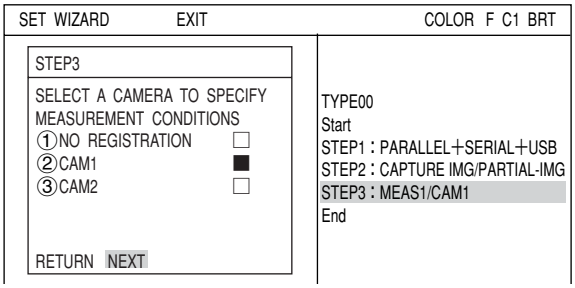


This screen is used to select the signal that the system will use to start making a measurement.
The default is "①PARARELL+SERIAL+USB."
⇨ For details, see page 21-1 in Function and Operation.
CCD trigger
⇨ For details, see page G-2.

Select a method to capture image.
The default is "①PARTIAL-IMG."

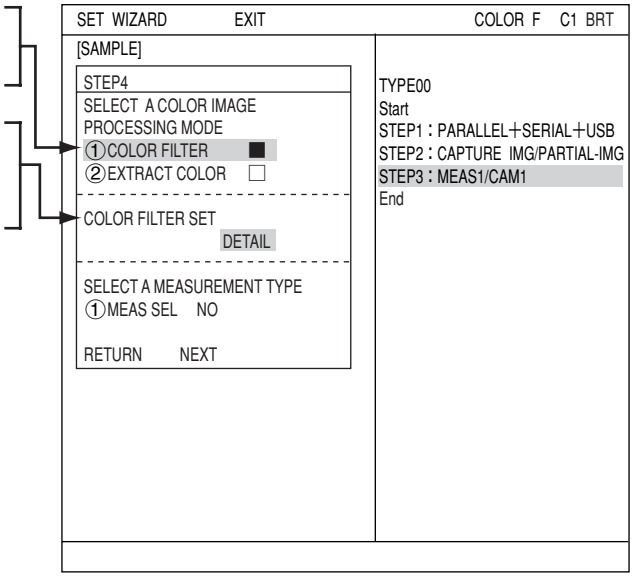
Specify whether or not to correct the captured image.
⇨ For details, see page 3-42 in Function and Operation.

(6) Select a camera in order to specify measurement conditions
Move the cursor to "②CAM1" or "③CAM2" using the up and down arrow keys, and press the SET key.
Note: If you select "NO REGISTRATION", you cannot set the measurement conditions.

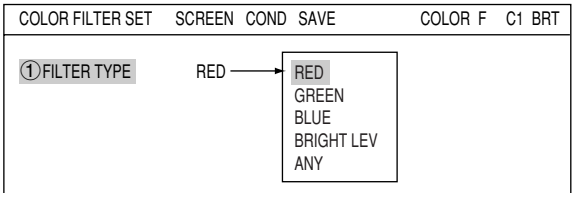


(7) Select an image-processing method
Move the cursor to "①COLOR FILTER" and press the SET key.

Next move the cursor to "COLOR FILTER SET" using the up and down arrow keys and press the SET key. Select "DETAIL" to enter the "COLOR FILTER SET" screen.



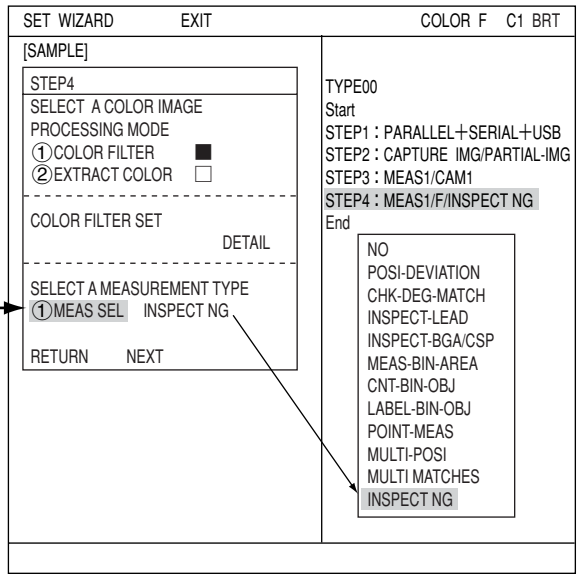
(8) On the "①FILTER TYPE" item, select a filter from the popup menu.



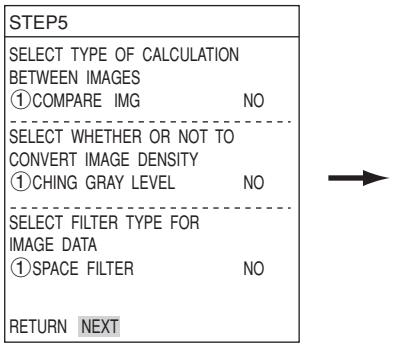
RED	Displays red areas more brightly.
GREEN	Displays green areas more brightly.
BLUE	Displays blue areas more brightly.
BRIGHT LEV	Displays areas that are within the specified brightness range (within the specified upper and lower limits) more brightly.
ANY	Specify the optimum color filter parameters to use, based on the original image conditions.

After the settings are complete, press the ESC key to return to the "SET WIZARD" screen.

(9) Move the cursor to the "①MEAS SEL" line using the up and down arrow keys, and press the SET key. Select "INSPECT NG" from the popup menu. Then, select "NEXT" to move to the next screen.



= In this example, the settings on the screens are not changed. Select "NEXT" on each of these screens to go to the next screen. =



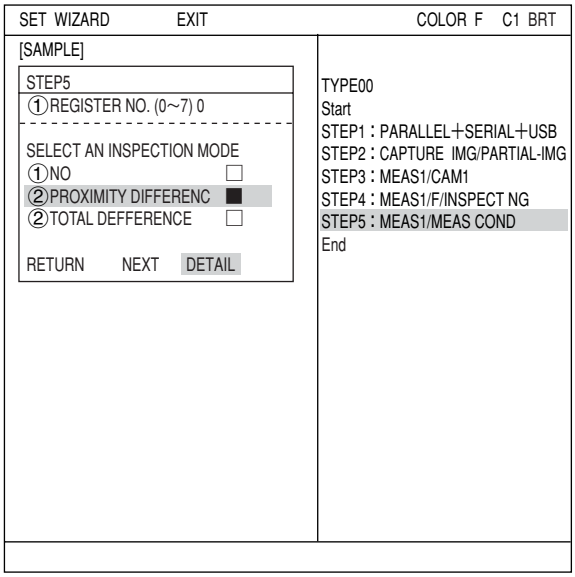
Select whether or not to process the captured image.
Calculation between images ⇨ See page 3-30 in Function and Operation
Density conversion ⇨ See page 3-33 in Function and Operation
Space filter ⇨ See page 3-34 in Function and Operation

(10) Select a registration number
Move the cursor to "①REGISTER NO. (0 ~ 7)" and press the SET key. While this item is highlighted, press the up and down arrow keys and press the SET key when the number you want appears.

Next, move the cursor to "②PROXIMITY DIFFERENC" on the "SELECT AN INSPECTION MODE" line and press the SET key.

The "DETAIL" item will appear in the lower menu. Move the cursor to "DETAIL" and press the SET key.

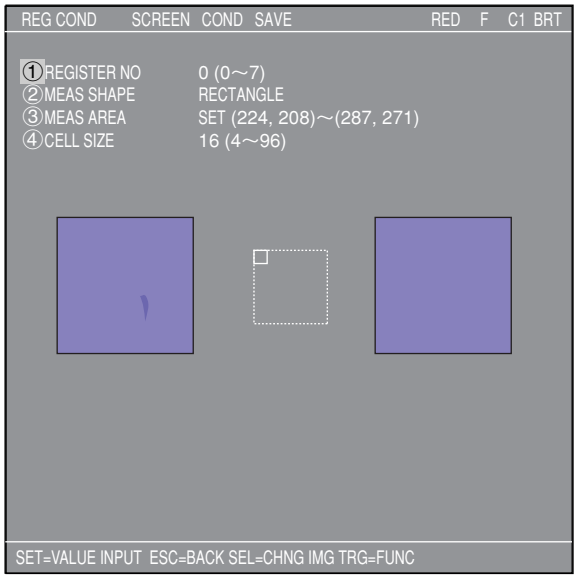
Now "REG COND" screen will appear.



(11) Setting the registration conditions

① **REGISTER NO.**

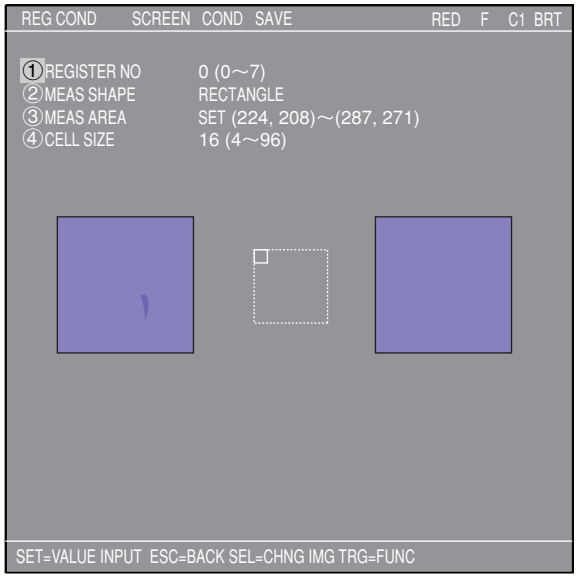
The previously specified register number is displayed. To change the register number, press the SET key. While the number is highlighted, press the up and down arrow keys to change it.



Next, adjust the image you want to measure.

1. Press the SEL key to move the cursor to the "F" position in the upper function menu. Press the up and down arrow keys to change the "F" to "T." Now the image from "CAM1" will be displayed as a through image on the monitor.

   Note: When the image is difficult to see, change the image setting between "BRT" and "DRK." After changing from the "Freeze" to the "Through" image display, press the left key once and then press the up key once. The "Dark" image setting can be selected.



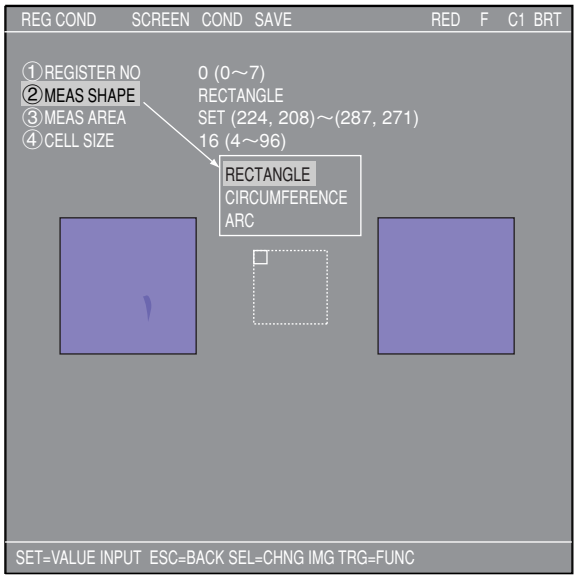
2. Adjust the focus and aperture of the camera lens to obtain a clear image of the object.
   ⇨ See pages 5-3.

3. After the measurement object image is clearly visible, change the image mode back to "F" (Freeze) using the up and down arrow keys.
   By switching the image display mode from "T" to "F," the image will be captured by the IV-C35M controller.

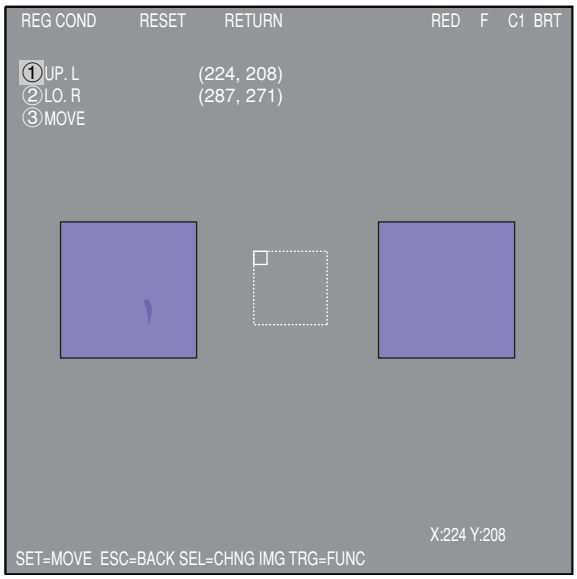
   Note: Whenever you want to register a reference image, the image display mode should be changed to "F."

4. Press the SEL key and move the cursor from the upper function menu to the "REG COND" screen.

② **MEAS SHAPE**
Move the cursor to this line and press the SET key. A popup menu will appear.
Move the cursor to "RECTANGLE," "CIRCUMFERENCE," or "ARC," and press the SET key. In this example, select "RECTANGLE."



③ **MEAS AREA**
Move the cursor to this line and press the SET key. The "SET" line will be highlighted. Press the SET key again and the "RECTANGLE" setting screen will appear.
Adjust the size of the rectangle by setting "①UP.L" and "②LO.R" (upper left and lower right corners) in order to establish the reference image area.



UP.L	The upper left corner of the rectangle can be moved up, down, left, and right.
LO.R	The lower right corner of the rectangle can be moved up, down, left, and right.
MOVE	The rectangle can be moved up, down, left, and right. Select "③MOVE" and press the SET key to display a cross hair cursor on the screen. Now, move the rectangle by pressing the up, down, left, and right arrow keys. When it is in position, press the SET key to confirm it.

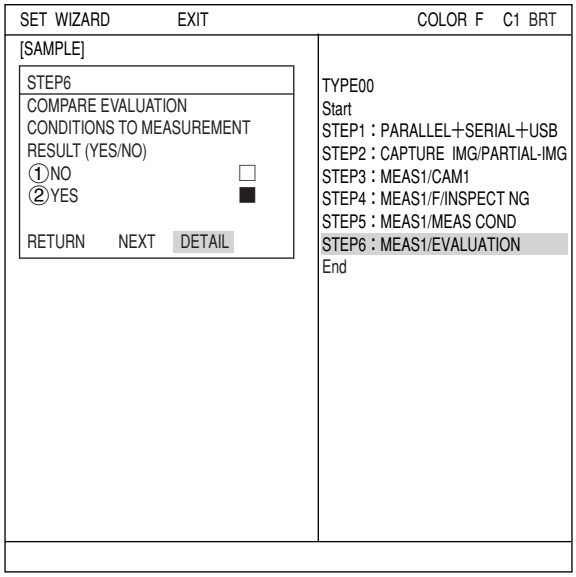
Press the ESC key to return to the previous screen, and then select cell size.

④ **CELL SIZE**
In this setting example, do not set cell size, and press the ESC key.

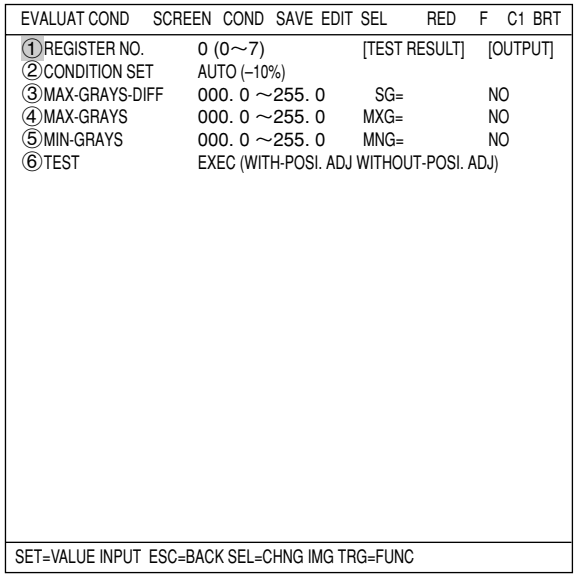
After returning to the previous screen, select "NEXT" and press the SET key to go to next screen.

(12) Select whether or not to set the evaluation conditions for measured results.
Select "②YES" and press the SET key.

The "DETAIL" item will appear on the lower part of the screen. Move the cursor to "DETAIL" and press the SET key.



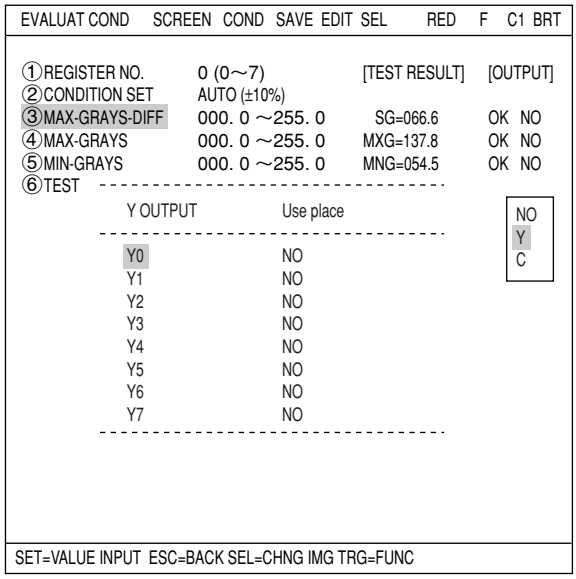
The "EVALUAT COND" screen will appear. Select "①REGISTER NO." using the up and down arrow keys. Change the number to "0" using the up and down arrow keys. Then press the SET key.



Select "②CONDITION SET" and "③MAX-GRAYS-DIFF" using the up and down arrow keys, and enter upper and lower limit values. Use the left and right arrow keys to change between each digit and use up and down arrow keys to change values of each digit.

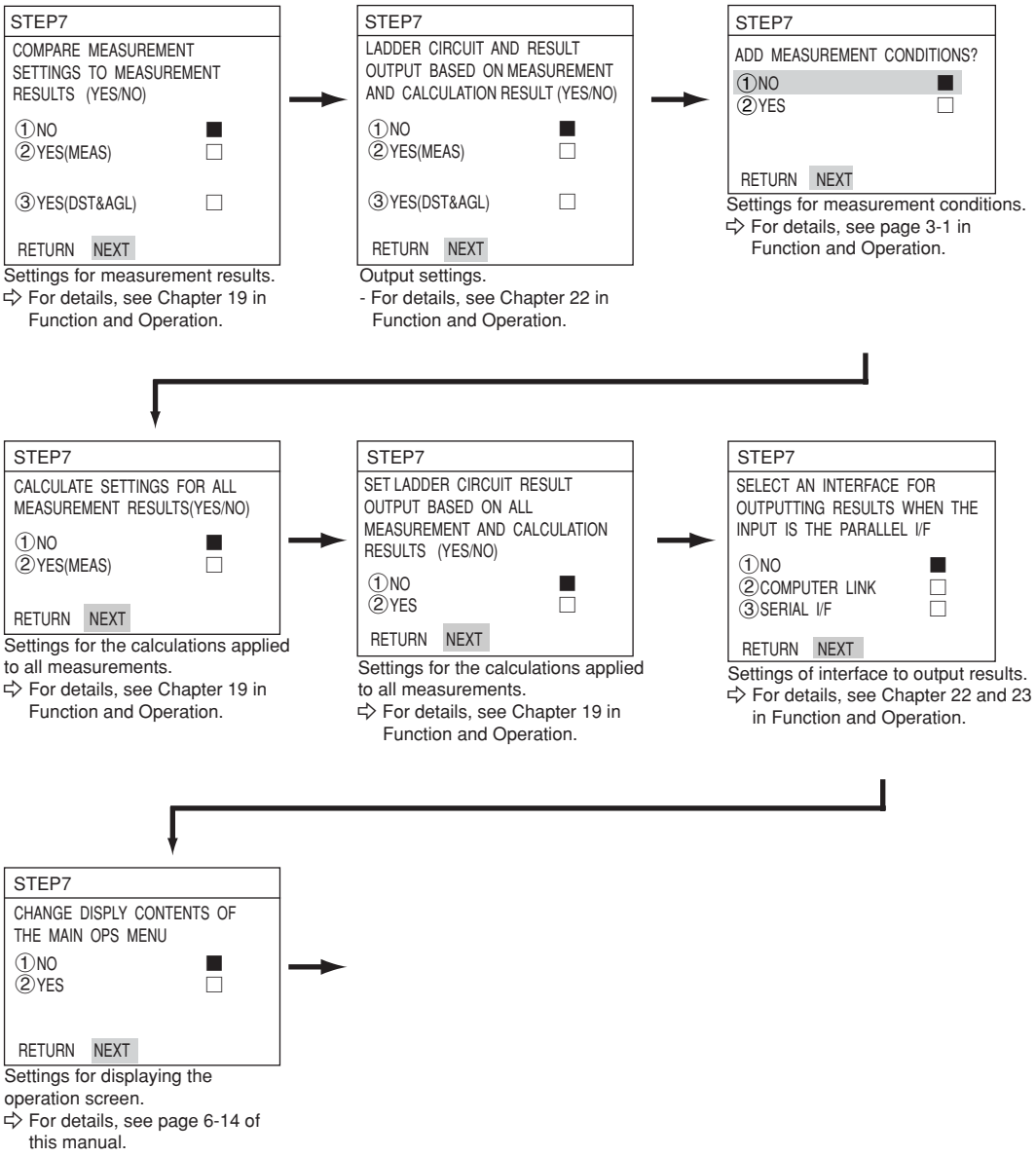
For example, when selecting "③MAX-GRAYS-DIFF," press the SET key and then move the cursor to the "OUTPUT" column using the left and right arrow keys. Now, press the SET key, a popup menu appears. From this popup menu, select output destination from "NO," "Y," and "C."
* "Y" is for terminal block. "C" is for auxiliary relay.
Move the cursor to "Y" and press the SET key. Then select the Y0 and press the SET key. Now the evaluation results will be output to the Y0 terminal.

⇨ For details about the evaluation conditions, see page 3-28 in Function and Operation.



After the settings are complete, press the ESC key to return to the "SET WIZARD" screen.

= In this example, the settings on the STEP 7 (COMPARE MEASUREMENT SETTINGS) to STEP 7 (MAIN OPS MENU) are not changed. Select "NEXT" on each of these screens to go to the next screen.



Settings for measurement results.
⇨ For details, see Chapter 19 in Function and Operation.

Output settings.
- For details, see Chapter 22 in Function and Operation.

Settings for measurement conditions.
⇨ For details, see page 3-1 in Function and Operation.

Settings for the calculations applied to all measurements.
⇨ For details, see Chapter 19 in Function and Operation.

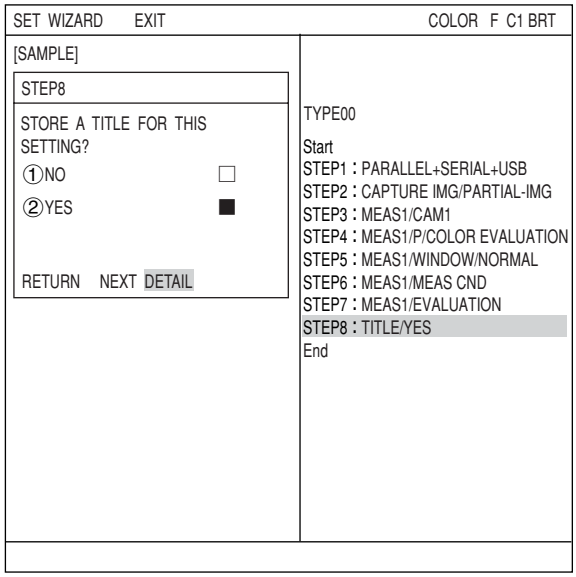
Settings for the calculations applied to all measurements.
⇨ For details, see Chapter 19 in Function and Operation.

Settings of interface to output results.
⇨ For details, see Chapter 22 and 23 in Function and Operation.

Settings for displaying the operation screen.
⇨ For details, see page 6-14 of this manual.

7

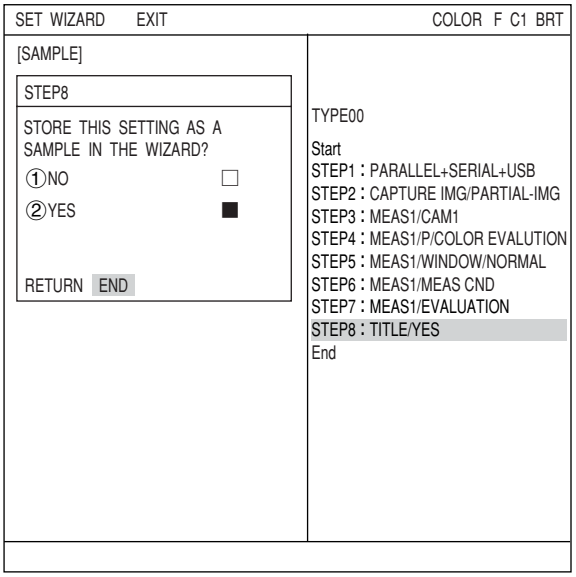
(13) STORE A TITLE FOR THIS SETTING?
After making this series of settings, select "②YES" to save the settings as a group. By selecting "② YES," "DETAIL" will appear in the lower menu. Select "DETAIL" and press the SET key.



The "STR OBJ TITLE" screen will appear. Enter a name using the up, down, left, and right arrow keys. Then, select "END" and press the SET key.
The monitor will return to the "SET WIZARD" screen. Select "NEXT" and press the SET key to go to the next screen.
* In this example, "AREA" is entered as the title.

(14) STORE THIS SETTING AS A SAMPLE IN THE WIZARD?
Select "①NO" or "②YES" and then "END." Finally, press the SET key.

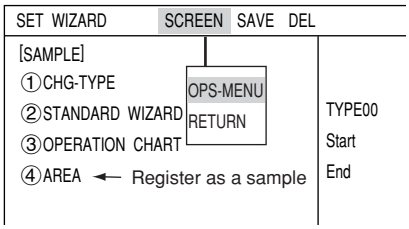
If you selected "②YES" to store the settings, move the cursor to "END" and press the SET key. The wizard will shut down.



(15) The sample is registered with the title you assigned to on the "SET WIZARD" screen.

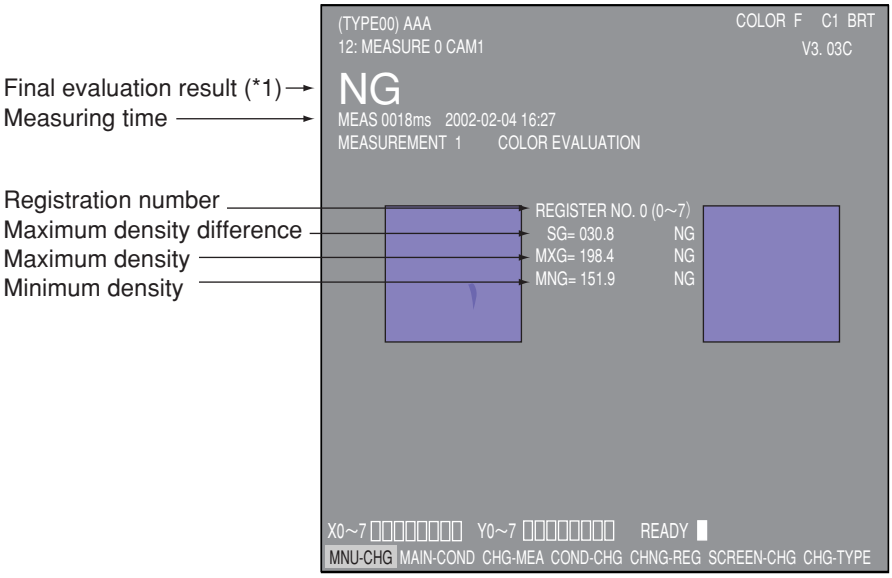
Note 1: If no title was assigned, the sample settings are simply listed as "Sample *"

Note 2: A maximum of eight sample settings can be assigned.



(16) The monitor will return to display the operation screen.
To return to the operation screen, press the ESC key twice, or move the cursor to "SCREEN" in the upper menu area using TRG/BRT key and select "OPS-MENU" from the popup menu.

(17) Execute a measurement.
While the operation screen is displayed, press the TRG/BRT key. The measurement results will be displayed on the screen.



*1 The final evaluation result will be displayed as "OK" in the upper left corner of the screen when all of the items have been evaluated acceptable.
If there is a single unacceptable item, "NG" will be displayed.

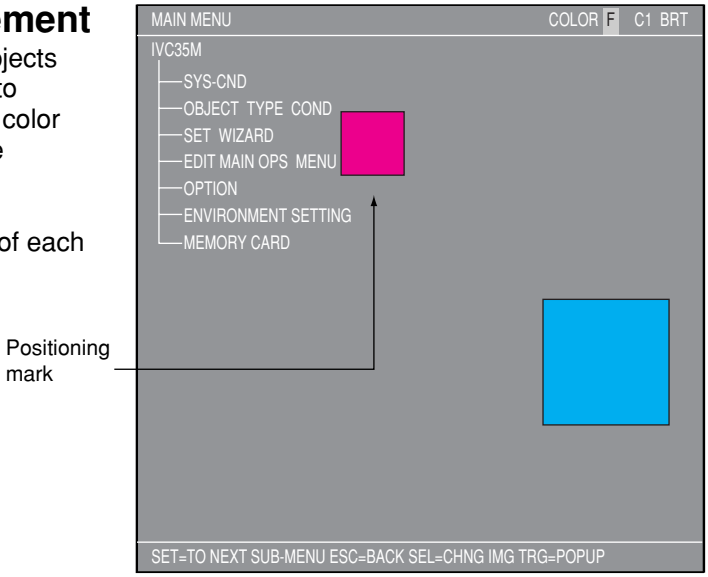
*2 When the final evaluation result is OK, Y0 is turned ON, and a filled box ■ is displayed. (When the result is NG, an empty box □ is displayed.)

7-3 Positional deviation measurement

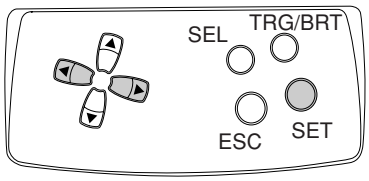
This function selects specified color from objects with multiple colors, and converts this area to binary. Then, the controller measures area, color degree of match, average hue, and average saturation.

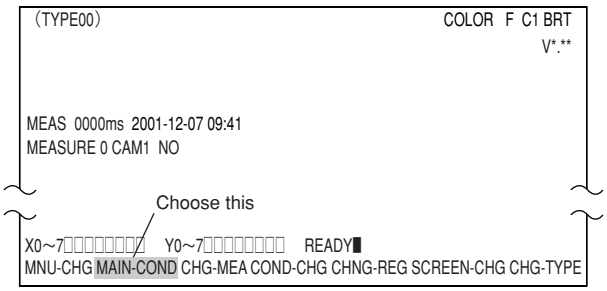
Use the remote keypad for this operation.

⇨ See page 6-6 for detail of the operation of each key on the remote keypad.

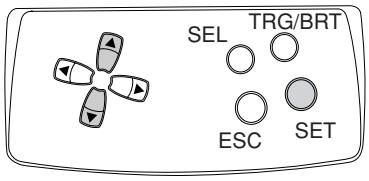


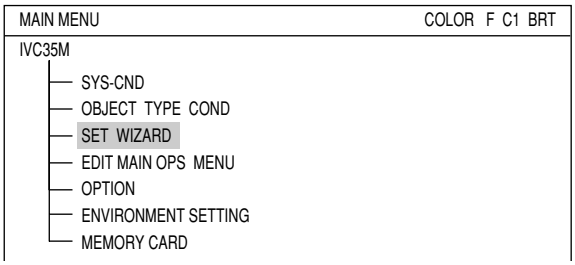
(1) Move the cursor to "MAIN COND" using the left and right arrow keys and press the SET key.



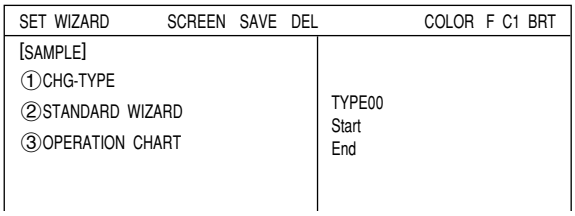


(2) The "MAIN MENU" will appear. Move the cursor to the "SET WIZARD" item using the up and down arrow keys, and press the SET key.

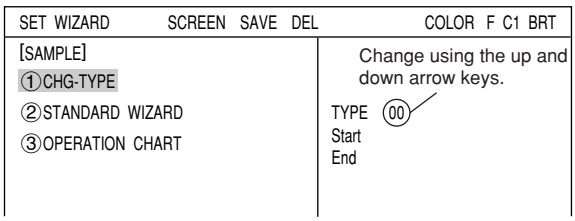




(3) The "SET WIZARD" screen will appear.



(4) Enter an object type number. Move the cursor to "①CHG-TYPE," using the up and down arrow keys, and press the SET key. "①CHG-TYPE" will be highlighted. Next, press the up and down arrow keys and the "TYPE00" display on the right will change. Each time you press the up key, the type number will increase by one, from 00 to 31 and then back to 00. Each time you press the down key, the type number will decrease by one, first from 00 to 31 and then from 31 down to 00. Holding down either of these keys advances the number rapidly. Finally, press the ESC key to confirm the selected number.



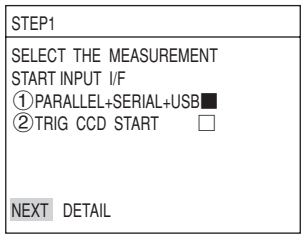
(5) Move the cursor to "②STANDARD WIZARD" and press the SET key. The set wizard will start.

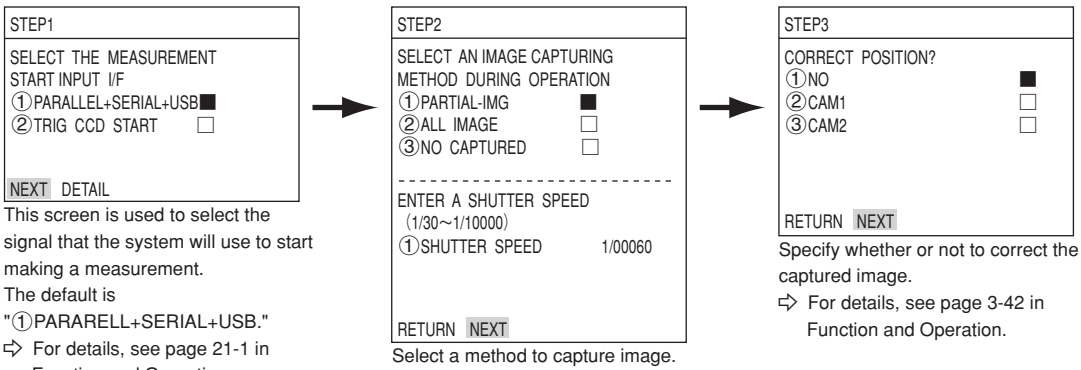
= In this example, the settings on the screens from the STEP1 to STEP 3 (CORRECT POSITION) are not changed. Select "NEXT" on each of these screens to go to the next screen. =

How to go to next step while leaving the current step in the Set Wizard unchanged.

(1) Press the up or down arrow key several times to move the cursor to the "NEXT" item.

(2) Press the SET key.



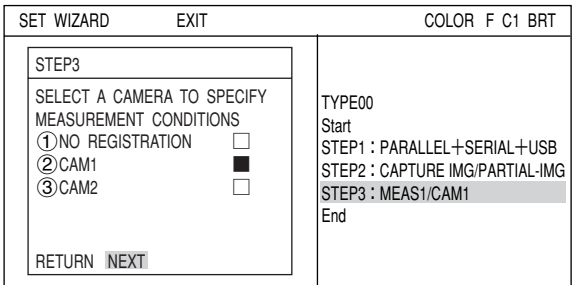


This screen is used to select the signal that the system will use to start making a measurement.
The default is "①PARARELL+SERIAL+USB."
⇨ For details, see page 21-1 in Function and Operation.
CCD trigger
⇨ For details, see page G-2.

Select a method to capture image.
The default is "①PARTIAL-IMG."

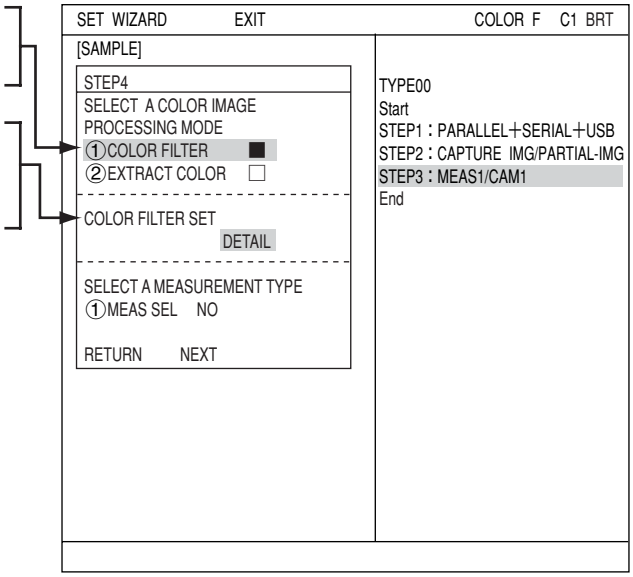
Specify whether or not to correct the captured image.
⇨ For details, see page 3-42 in Function and Operation.

(6) Select a camera in order to specify measurement conditions
Move the cursor to "②CAM1" or "③CAM2" using the up and down arrow keys, and press the SET key.
Note: If you select "NO REGISTRATION", you cannot set the measurement conditions.

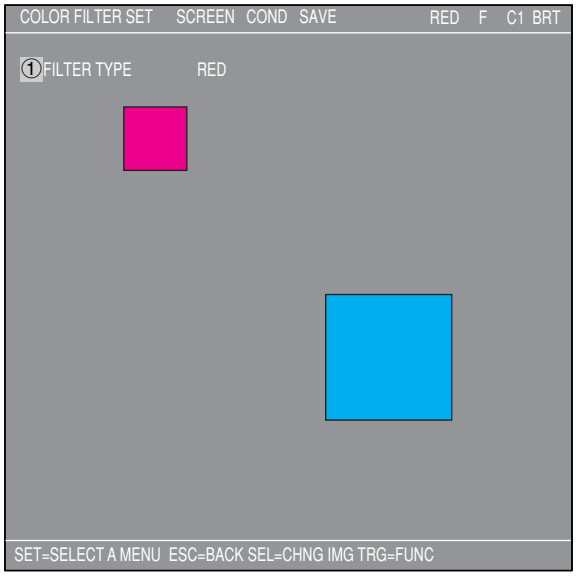


(7) Select an image-processing method
Move the cursor to "①COLOR FILTER" and press the SET key.

Next move the cursor to "COLOR FILTER SET" using the up and down arrow keys and press the SET key. Select "DETAIL" to enter the "COLOR FILTER SET" screen.



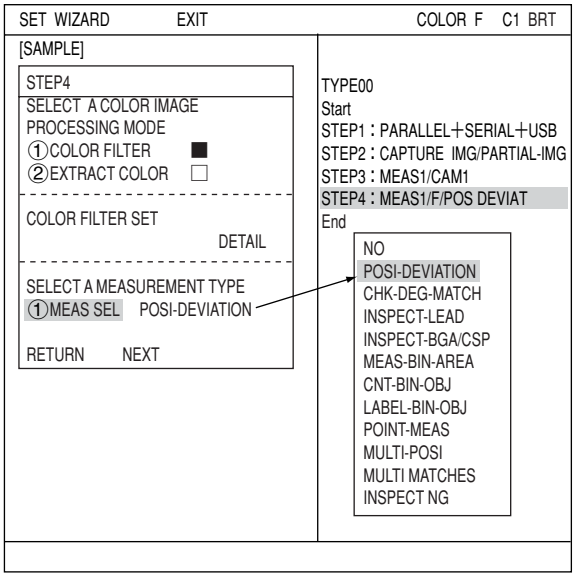
(8) On the "①FILTER TYPE" item, select a filter from the popup menu.



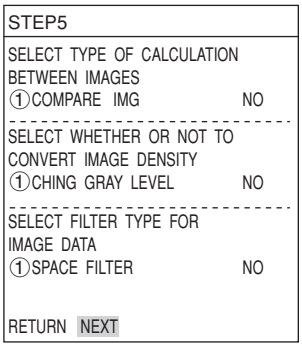
RED	Displays red areas more brightly.
GREEN	Displays green areas more brightly.
BLUE	Displays blue areas more brightly.
BRIGHT LEV	Displays areas that are within the specified brightness range (within the specified upper and lower limits) more brightly.
ANY	Specify the optimum color filter parameters to use, based on the original image conditions.

After the settings are complete, press the ESC key to return to the "SET WIZARD" screen.

(9) Move the cursor to the "①MEAS SEL" line using the up and down arrow keys, and press the SET key. Select "POSI-DEVIATION" from the popup menu. Then, select "NEXT" to move to the next screen.

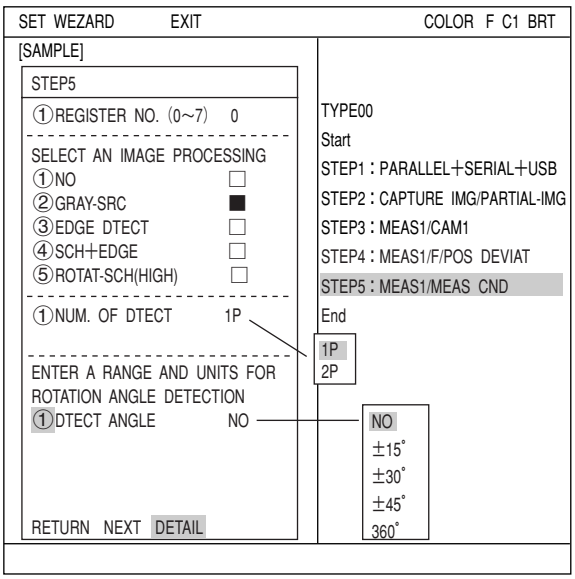


= In this example, the settings on the screens are not changed. Select "NEXT" on each of these screens to go to the next screen. =



Select whether or not to process the captured image.
Calculation between images ⇨ See page 3-30 in Function and Operation
Density conversion ⇨ See page 3-33 in Function and Operation
Space filter ⇨ See page 3-34 in Function and Operation

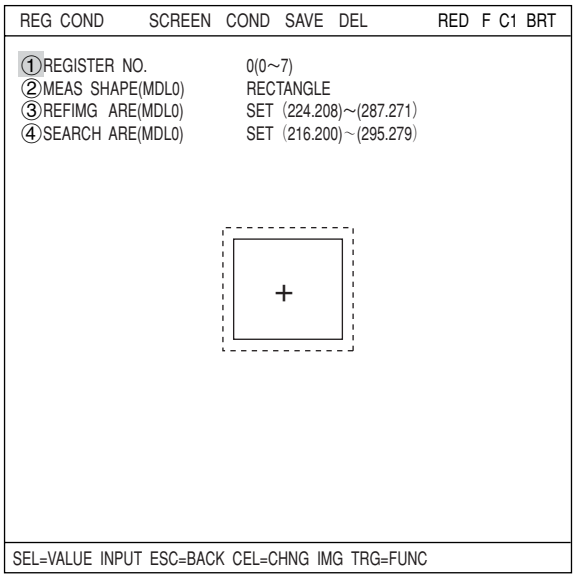
(10) Select a registration number
Move the cursor to "①REGISTER NO. (0 ~ 7)" and press the SET key. While this item is highlighted, press the up and down arrow keys and press the SET key when the number you want appears.
* In this example, select "0."
Next, move the cursor to "②GRAY-SRC" on the "SELECT AN IMAGE PROCESSING" line and press the SET key.
Move the cursor to "①NUM. OF DTECT" and press the SET key. Select the "1P" on the popup menu and press the SET key.
Move the cursor to "①DTECT ANGL" on the "ENTER A RANGE AND UNITS FOR ROTATION ANGLE DETECTION" line and select an angle ("NO," "±15˚," "±30˚," "±45˚" or "360˚") on the pop up menu. When an angle other than "NO" is selected, "10" is displayed for the "②UNIT."
In this example, select "NO."
The "DETAIL" item will appear in the lower menu.
Move the cursor to "DETAIL" and press the SET key.
Now "REG COND" screen will appear.



(11) Setting the registration conditions

① **REGISTER NO.**

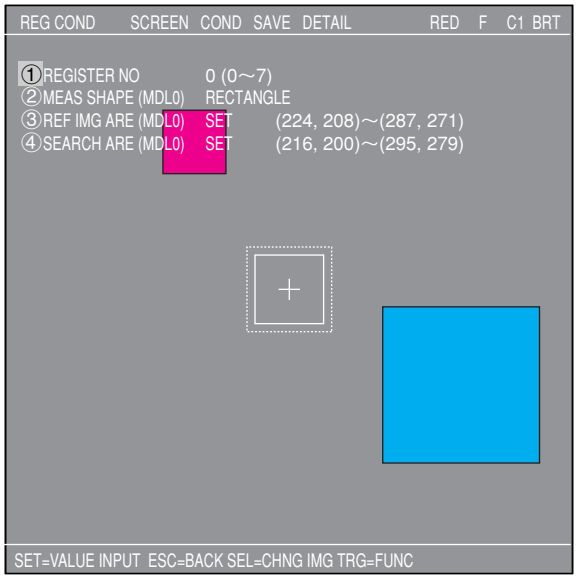
The previously specified register number is displayed. To change the register number, press the SET key. While the number is highlighted, press the up and down arrow keys to change it.



Next, adjust the image you want to measure.

1. Press the SEL key to move the cursor to the "F" position in the upper function menu. Press the up and down arrow keys to change the "F" to "T." Now the image from "CAM1" will be displayed as a through image on the monitor.

   Note: When the image is difficult to see, change the image setting between "BRT" and "DRK." After changing from the "Freeze" to the "Through" image display, press the left key once and then press the up key once. The "Dark" image setting can be selected.



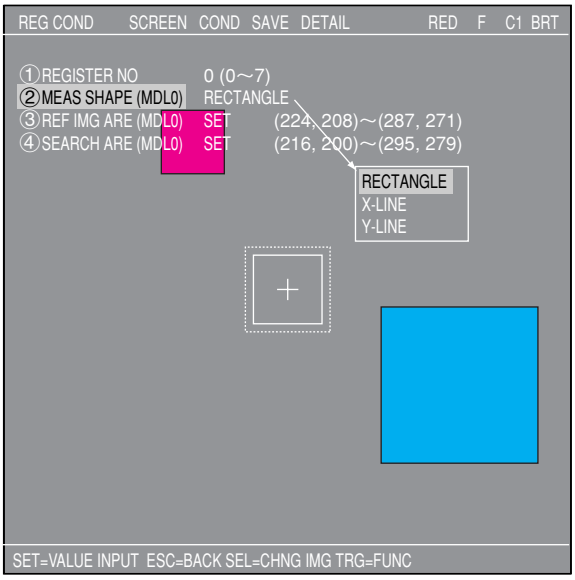
2. Adjust the focus and aperture of the camera lens to obtain a clear image of the object.
   ⇨ See pages 5-3.

3. After the measurement object image is clearly visible, change the image mode back to "F" (Freeze) using the up and down arrow keys.
   By switching the image display mode from "T" to "F," the image will be captured by the IV-C35M controller.

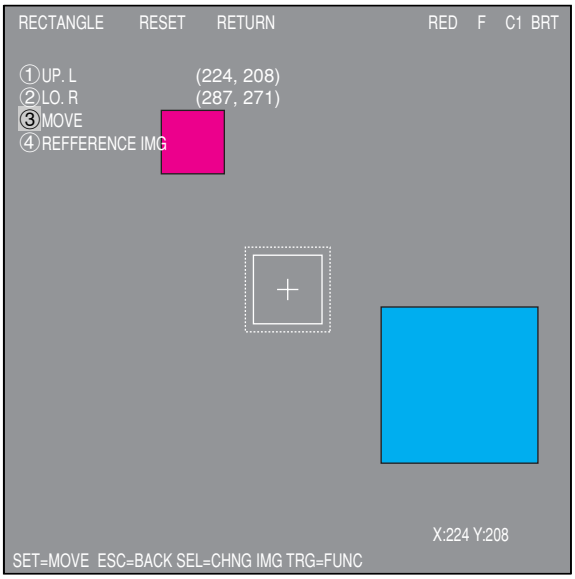
   Note: Whenever you want to register a reference image, the image display mode should be changed to "F."

4. Press the SEL key and move the cursor from the upper function menu to the "REG COND" screen.

② **MEAS SHAPE (MDL0)**
Move the cursor to this line and press the SET key. A popup menu will appear.
Move the cursor to "RECTANGLE", "X- LINE" or "Y- LINE" and press the SET key. In this example, select "RECTANGLE."
⇨ For details, see page 3-15 in Function and Operation.



③ **REFIMG ARE (MDL0)**
Move the cursor to this line and press the SET key. The "SET" line will be highlighted. Press the SET key again and the "RECTANGLE" setting screen will appear.
Adjust the size of the rectangle by setting "①UP.L" and "②LO.R" (upper left and lower right corners) in order to establish the reference image area.



UP.L	The upper left corner of the rectangle can be moved up, down, left, and right.
LO.R	The lower right corner of the rectangle can be moved up, down, left, and right.
MOVE	The rectangle can be moved up, down, left, and right. Select "③MOVE" and press the SET key to display a cross hair cursor on the screen. Now, move the rectangle by pressing the up, down, left, and right arrow keys. When it is in position, press the SET key to confirm it.

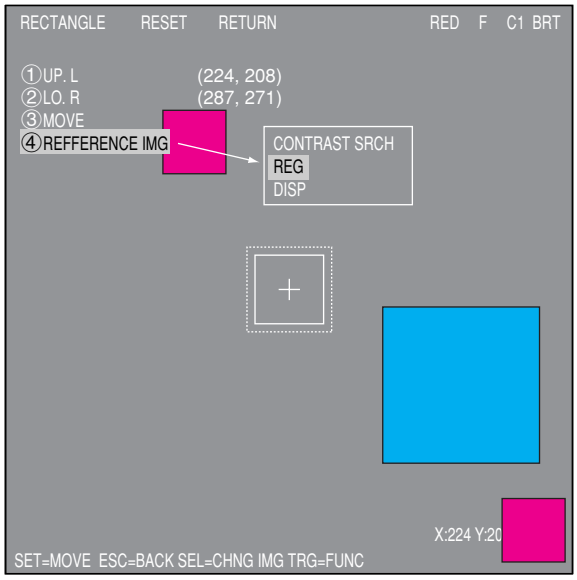
After the position of the rectangle is correct, press the SET key.

Register a reference image

Move the cursor to "④REFERENCE IMG" using the up and down arrow keys. Then, select "REG" from the popup menu. The reference image that you registered is shown in the lower right corner of the screen.

After the setting is complete, press the ESC key to return to the "REG COND" screen.

Note: If a reference image is not registered, you cannot make measurements.



④ **SEARCH ARE (MDL0)**

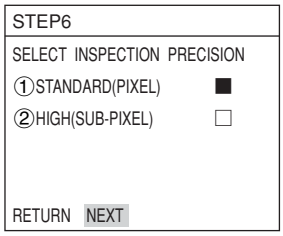
Move the cursor to this line and press the SET key. "SET" will be highlighted. Press the SET key again and the "RECTANGLE" screen will appear.

Use the same procedures as you used for "③REFIMG ARE(MDL0)" to adjust the size and position of the rectangle defining the search area.

After the setting is complete, press the ESC key twice and return to the "SET WIZARD" screen.

Move the cursor to "NEXT" and press the SET key.

= In this example, the settings on the screens are not changed. Select "NEXT" on each of these screens to go to the next screen. =



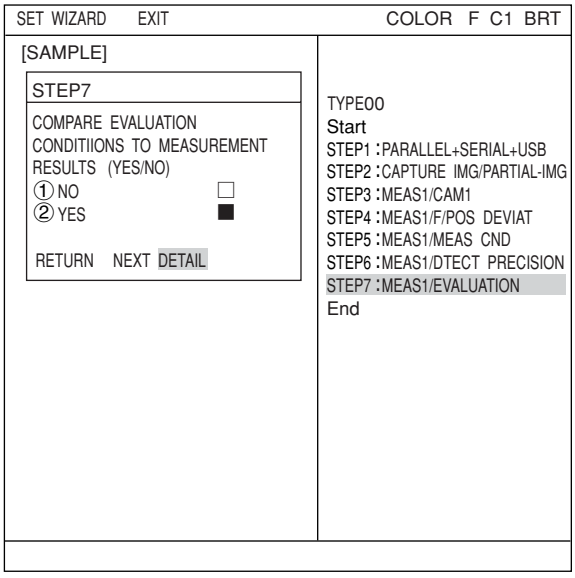
Setting the detection precision.

⇨ For details, see page 3-20 in Function and Operation.

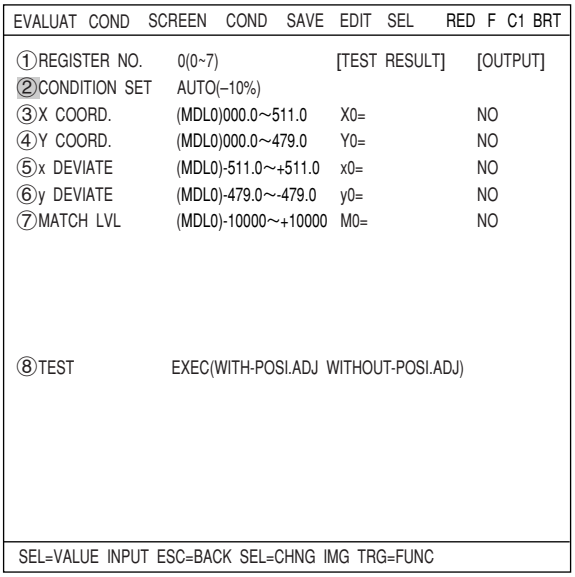
(12) Select whether or not to set the evaluation conditions for measured results.

Select "②YES" and press the SET key.

The "DETAIL" item will appear on the lower part of the screen. Move the cursor to "DETAIL" and press the SET key.

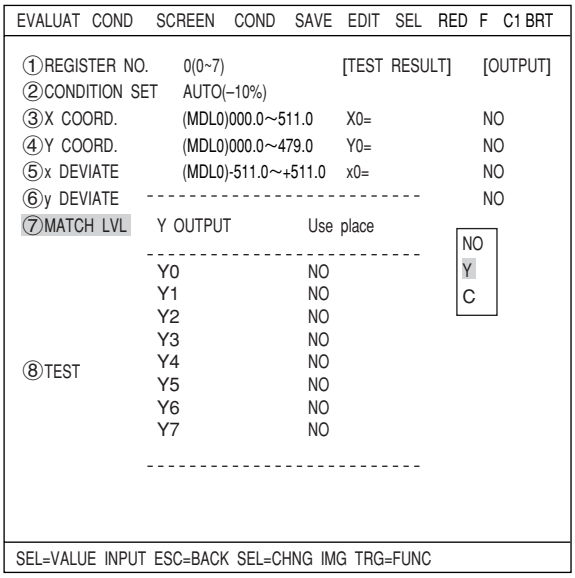


The "EVALUAT COND" screen will appear. Select "①REGISTER NO." using the up and down arrow keys. Change the number to "0" using the up and down arrow keys. Then press the SET key.



Select "②CONDITION SET," "⑤x DEVIATE," and "⑥y DEVIATE" using the up and down arrow keys, and enter upper and lower limit values. Use the left and right arrow keys to change between each digit and use up and down arrow keys to change values of each digit.

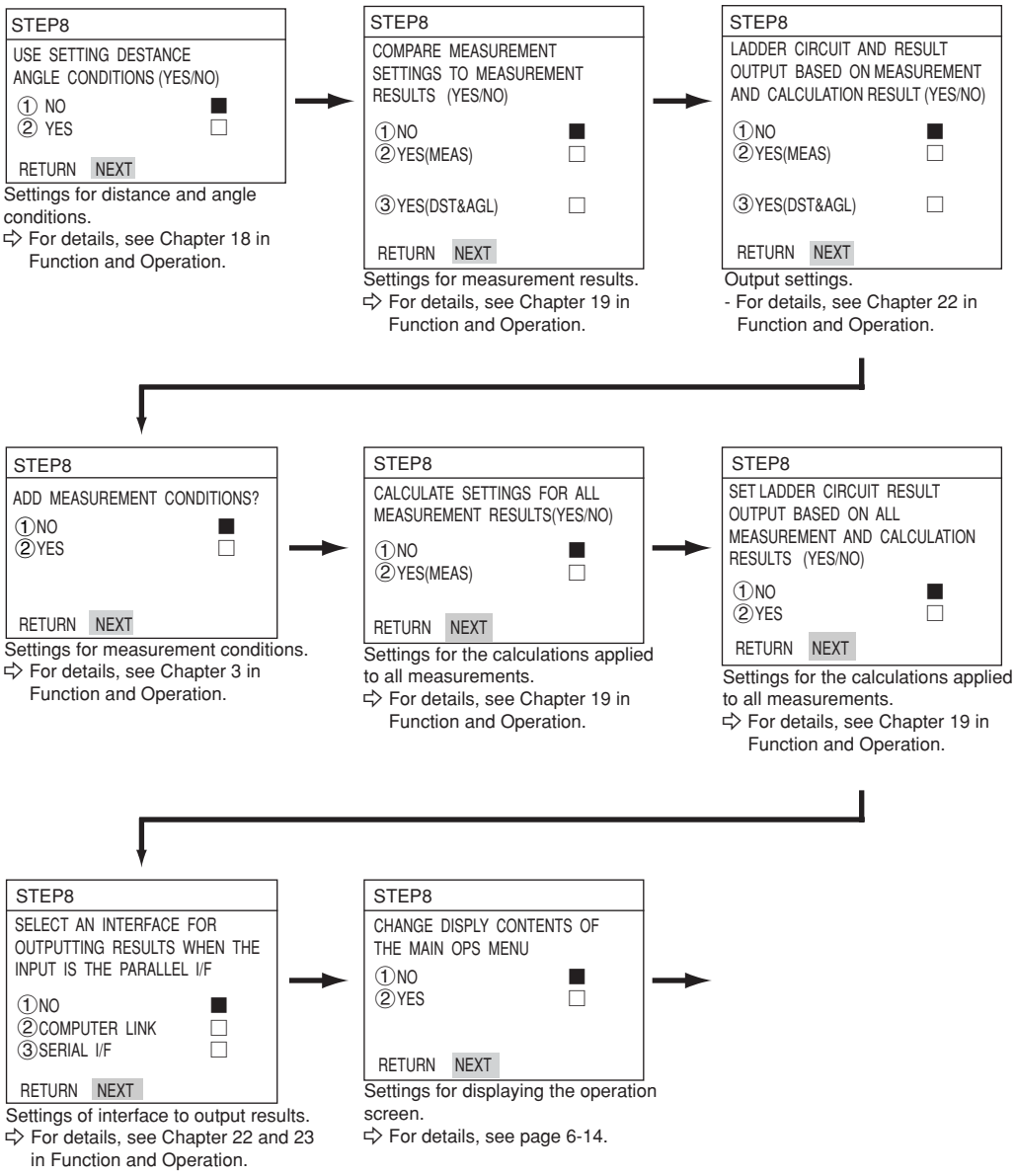
For example, when selecting "⑤x DEVIATE" or "⑥y DEVIATE," press the SET key and then move the cursor to the "OUTPUT" column using the left and right arrow keys. Now, press the SET key, a popup menu appears. From this popup menu, select output destination from "NO," "Y," and "C."
Move the cursor to "Y" and press the SET key. Then select the Y0 and press the SET key. Now the evaluation results will be output to the Y0 terminal.
* In this example, select output Y0 for "⑤x DEVIAT" and output Y1 for "⑥y DEVIAT."



⇨ For details about the evaluation conditions, see page 3-28 in Function and Operation.

After the settings are complete, press the ESC key to return to the "SET WIZARD" screen.

= In this example, the settings on the STEP8 (DST&AGL COND SET) to STEP8 (MAIN OPS MENU) are not changed. Select "NEXT" on each of these screens to go to the next screen. =

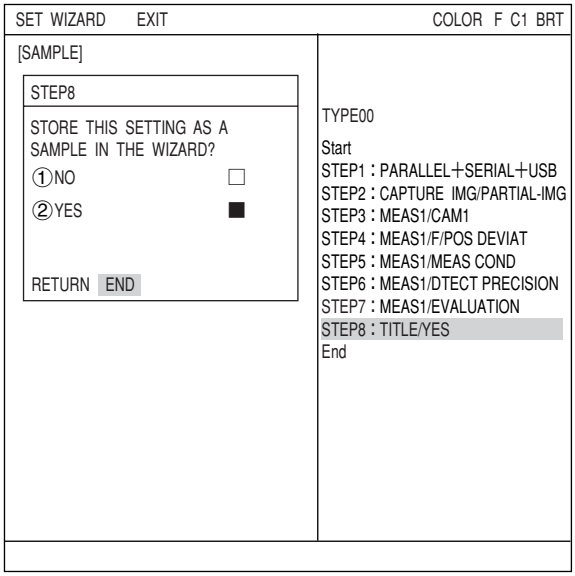


(13) STORE A TITLE FOR THIS SETTING?
After making this series of settings, select "②YES" to save the settings as a group. By selecting "② YES," "DETAIL" will appear in the lower menu. Select "DETAIL" and press the SET key.

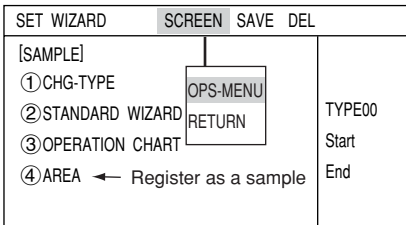
The "STR OBJ TITLE" screen will appear. Enter a name using the up, down, left, and right arrow keys. Then, select "END" and press the SET key.
* In this example, "AREA" is entered as the title.
The monitor will return to the "SET WIZARD" screen. Select "NEXT" and press the SET key to go to the next screen.

(14) STORE THIS SETTING AS A SAMPLE IN THE WIZARD?
Select "①NO" or "②YES" and then "END." Finally, press the SET key.

If you selected "②YES" to store the settings, move the cursor to "END" and press the SET key. The wizard will shut down.

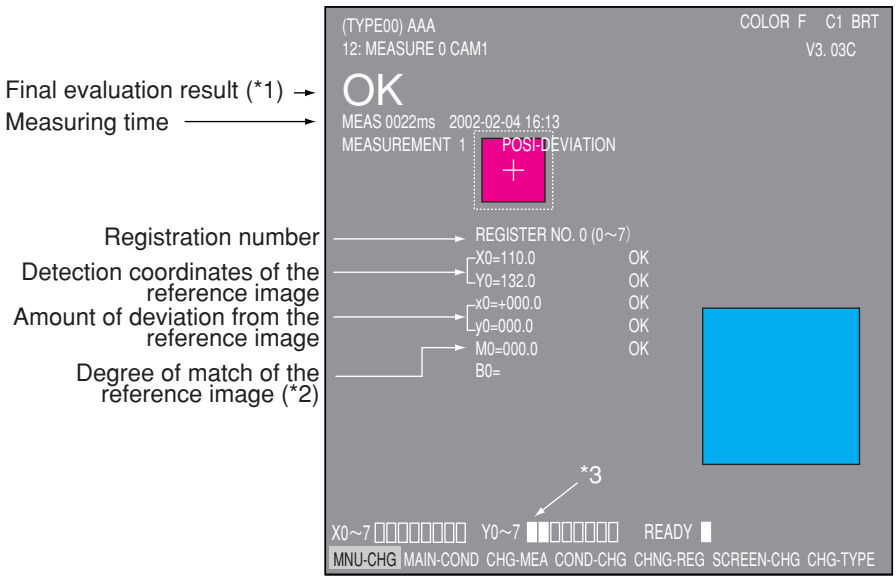


(15) The sample is registered with the title you assigned to on the "SET WIZARD" screen.
Note 1: If no title was assigned, the sample settings are simply listed as "Sample *"
Note 2: A maximum of eight sample settings can be assigned.



(16) The monitor will return to display the operation screen.
To return to the operation screen, press the ESC key twice, or move the cursor to "SCREEN" in the upper menu area using TRG/BRT key. Then, select "OPS-MENU" from the popup menu.

(17) Execute a measurement.
While the operation screen is displayed, press the TRG/BRT key. The measurement results will be displayed on the screen.



*1 The final evaluation result will be displayed as "OK" in the upper left corner of the screen when all of the items have been evaluated acceptable.
If there is a single unacceptable item, "NG" will be displayed.

*2 "M0 +09735" means that the degree of match (percentage of pixels that match) between pixels in the stored image and the measured image is 97.35%.
[The acceptance and rejection criteria based on the degree of match]
In order to evaluate acceptability based on the degree of match, first an image of a good specimen is stored for reference. Then, an image of defective specimen is compared for degree of match. Finally an image of another good specimen is compared. These comparisons establish the degree of match to be used for setting the limits used for working comparisons.
For example, the degree of match for a non-defective object is 90% or more and that for a defective object is 70% or less, then the threshold value for degree of match can be set to approx. 85%. This allows the evaluation acceptability to be made.

*3 When the final evaluation result is OK, Y0 is turned ON, and a filled box ■ is displayed. (When the result is NG, an empty box □ is displayed.)

Chapter 8: Specifications

8-1 Controller (IV-C35M)

Item		Specifications
Image sampling system		16,770,000 colors, 256 level gray scale, binary conversion, edge detection
Number of pixels		512 (horizontal) x 480 (vertical), approximately 240,000 pixels.
Image memory		One screen for displaying captured images. One monochrome screen for displaying camera information and messages
No.of assignable object type		32 object types
Maximum number of reference images stored / number of whole screens stored		600 / 8 screens
image scan time	IV-C30C5	33.3 ms
	IV-S30C3/C4	16.7 ms [full mode] 8.3 ms [half mode]
Gray search time		9 ms (When the search area is 256×256 pixels, the model size is 64×64 pixels, and the contraction function is set to 3.)
Gray search, edge detection precision		Pixel, sub-pixel
Image processing		Color filter (R, G, B, brightness, custom)
		Color extraction (hue, saturation, brightness)
		Gray
Color image pre-processing	Hue correction	Adjust hue level
	Brightness correction	Adjust brightness level
Gray image pre-processing	Shading correction	Dividing, subtracting, and filtering
	Comparative calculation between images	Subtracting, absolute value of difference (between camera 1 and reference image, between camera 2 and reference image, between camera 1 and camera 2)
	Gray level changes	Magnification by "n" processing, γ (+/-) correction, histogram widening, mid-range emphasis
	Space filter	Smoothing (center/average), edge emphasis, edge extraction, horizontal edge, vertical edge
Binary threshold value		Fixed and threshold value corrections (variation difference/variation rate)
Binary noise elimination		Expansion to contraction, contraction to expansion, area filter
Binary image mask		Specified window (rectangle, circle, oval), any binary image mask
Positional correction method		X/Y correction, rotation correction

Item		Specifications
Measurement program	Color evaluation	Area, hue (average), saturation (average), color degree of match [Maximum 8 windows]
	Color unevenness inspection	Number of objects [Maximum 128 windows] Total area, hue (max./min.), number of faults of hue, saturation (max./min.), and number of faults of saturation. [Maximum 4 windows]
	Color position measurement	XY coordinate, XY deviation amount, color degree of match (1-point search, 2-point search, 1-point edge, 2-point edge, 1-point search and 1-point edge) [Maximum 8 windows x 2 models]
	Fault inspection	Density (max./min.), density difference (max.) [Maximum 8 windows]
	Positional deviation measurement	XY coordinate, deviation amount in X and Y axes, degree of match (1-point search, 2-point search, 1-point edge, 2-point edge, 1-point search and 1-point edge) Angle: ±15 , ±30 , ±45 , 360 (1-point search, 1-point search + 1-point edge) [Maximum 8 windows x 2 models]
	Degree of match inspection	Degree of match, XY coordinate, density (1-point search, 2-point search) [Maximum 16 windows x 2 models]
	Area measurement by binary conversion	Area [Maximum 16 windows]
	Object counting by binary conversion	Quantity (maximum 3,000 items per window), total area [Maximum 4 windows]
	Object identification by binary conversion	Quantity (maximum 128 per window), total area, area of each object identified, gravity center, main axis angle, fillet diameter, peripheral length, center point [Maximum 4 windows]
	Point measurement	Number in binary image (maximum 256 points), average density [Maximum 128 points]
	Lead inspection	Number of leads, distance between leads (max., min.), lead width (max., min.), lead length (max., min.) [Maximum 16 windows]
	BGA/CSP inspection	Number of labels, total area, area of each label, XY pitch (max., min.) XY fillet diameter (max., min.), [Maximum 4 windows]
	Multiple positional measurement	Number of objects (max. 128), degree of match, XY coordinate (1-point search, 1-point edge) [Maximum 4 windows]
	Multiple degree of match inspection	Number of objects (max. 128), degree of match, XY coordinate (1-point search) [Maximum 4 windows]
Number of measurement programs		Maximum 6 per object type (measurement 0 - camera 1, measurement 0 - camera 2, measurements 1 to 4) Note: Measurement 0 is only used for positional deviation measurement.
Window shape		Rectangle, circle, oval (when using color evaluation, color unevenness inspection, area measurement by binary conversion, object counting by binary conversion, object identification by binary measurement), circumference (when using fault inspection), and arc (when using fault inspection).
Distance and angle measurement		Measure distance (between two points, X coordinate, Y coordinate), measure angle (3 points, 2 points against horizontal line, 2 points against vertical line), auxiliary point (center, circle center, gravity center, line over 2 points, crossing point of two straight lines)
Arithmetic operation		Four basic operations (+, -, X, /), root, absolute value, TAN, ATAN, maximum, minimum, average , total.
NG image memory function		Maximum 128 images (8 images for all images) Possible extension when using a memory card (compact flash memory)
Memory card slot		One slot (compatible card : up to 192 MB)
Calendar/timer		Year, month, day, hour, minute
Other functions		Display measuring time, light level monitor function, crosshair cursor display, change display language between Japanese and English, Run screen lock function, setting menu display "yes/no", change image display (through/freeze), change image brightness (bright/dark)
Micro PC section	Input relays	Parallel input: 8 points (X0 to X7)
	Output relays	Parallel output: 8 points (Y0 to Y7) General-purpose serial interface, computer link: 16 points (Y0 to Y15)
	Auxiliary relays	128 points (C000 to C127), special area 18 points (C110 to C127)
	Timers	8 points (TM0 to TM7), timer setting range: 0.01 to 9.99 seconds (countdown timer)
	Counters	8 points (CN0 to CN7), counter setting range: 000 to 999 (counts down)

Item			Specifications
External interface	Parallel interface		Input: 8 points, Output: 9 points, 12/24 VDC
	General-purpose serial interface		RS232C/RS422 (2.4 to 115.2 kbps)
	Computer link		Built-in compatibility with certain SHARP, OMRON, Mitsubishi and Yokogawa models
	USB		USB device node (Compatible with USB1.1)
Image output			1 channel, Equivalent to NTSC system, 2:1 interlace
Number of cameras			Maximum of 2
Connecting camera			IV-C30C5, IV-S30C3, IV-S30C4
Make settings			Using the IV-S30RK1 remote keypad and/or the IV-S30SP parameter setting support software
Measurement start input		Internal trigger	CCD trigger (using the CCD camera)
		External trigger	Trigger input (parallel I/F), general-purpose serial I/F, keypad trigger (for manual measuring)
Terminal block	Inputs	Number of points	8 points: External trigger; 1 point (X0), Object type change; 5 points (X1 to X5), external input; 2 points (X6, X7)
		Common terminal	1 point: + or - common
	outputs	Number of points	9 points: 1 READY , 8 user settable logical outputs (Y0 to Y7)
		Common terminal	1 point: + or - common
	Power supply	Power supply terminal	2 points: +24 VDC, 0 V
Power supply voltage			24 VDC (±10%)
Power consumption			12 W
Storage ambient temperature			-20 to 70°C
Operation ambient temperature			0 to 45°C
Operation ambient humidity			35 to 85% RH (non-condensing)
Operation atmosphere			No corrosive gases or dust
Vibration resistance			JIS C 0911 or equivalent - Amplitude 0.15 mm (10 to 57 Hz), 9.8 m/s^2 (57 to 150 Hz) Number of sweeps: 10 (1 octave/min.), 3 directions (X, Y, Z)
Shock resistance			JIS C 0912 or equivalent : 147 m/s^2 (three times each in X, Y, and Z directions)
Noise immunity			1000 Vp-p 1μs width impulse (by noise simulator) when applied to the primary side (100 VAC) of an external DC power supply
Outside dimensions			130 (W) x 100 (D) x 42 (H) mm (except protruding portions)
Weight			Approx. 600 g

8-2 Camera specifications

[1] Camera (IV-C30C5/S30C3/S30C4)

Item		Specifications		
		Color, IV-C30C5	**High speed, IV-S30C3**	**Micro and high-speed, IV-S30C4**
Optical system	Lens mount method	C mount	C mount	Custom ϕ17 mm mount
Picture taking element	Method	Interline transmission method, 1-CCD color	Interline transmission method, monochrome CCD	
	Reading system	Full pixel type, partial image scanning is available		
	Reading	33.3 ms *	16.7 ms [full mode], 8.3m [half mode]*	
	Size	1/3 inch		
	No. of effective pixels	512 (horizontal) × 480 (vertical)		
	Pixel shape	Square		
Shutter	Shutter speed (s)	Settable between 1/30 and 1/10,000 for each object type		
	Method	Random shutter		
Connector		Round, 12-pin female connector		
Connection to controller		Using custom camera cables (IV-S30KC3 : 3m, IV-S30KC5 : 5m)		
Operation ambient temperature		0 to 45°C		
Operation ambient humidity		35 to 85% RH (non-condensing)		
Operation atmosphere		No corrosive gases or dust		
Outside dimensions (mm)	Camera body	30 (W) x 32 (H) x 40 (D)	30 (W) x 32 (H) x 40 (D)	30 (W) x 32 (H) x 44.7 (D)
	Head	---	---	ϕ 17 x 35.6 mm
	Head cable	---	---	1m
Weight		50 g (not including the lens)	50 g (not including the lens)	140 g (The head weighs approximately 13 g)
Accessories		- 1 camera angle bracket - 2 securing screws - 1 Instruction Manual	- 1 camera angle bracket - 2 securing screws - 1 Instruction Manual	- 1 camera angle bracket - 1 camera head bracket - 3 securing screws - 1 Instruction Manual

* Variable with partial-image capturing

[2] Camera lens (IV-S20L16)

Item	Specifications
Focal distance	16 mm
Maximum f-stop	1.6
Aperture range	1.6 to 16, Close
Focal range	50 mm to ∞
Filter installation dia.	M 25.5, P = 0.75, U1
Mount system	C mount
Compatible cameras	IV-C30C5, IV-S30C1/C3, IV-S20C1 (camera for the IV-S20)

[3] Camera cable (IV-S30KC3/KC5)

Item	Specifications
Overall length	3m (IV-S30KC3), 5m (IV-S30KC5)
Cable sheath	Polyvinyl chloride
Video connectors	Main housing: Round, 12-pin male connector
	Camera: Round, 12-pin male connector
Minimum bending radius	40 mm (75 mm when bending)

8-3 Support tools

[1] LCD monitors (IV-10MT/10MTV/10MTK)

Item name	IV-10MT	IV-10MTV	IV-10MTK
Display device	10.4-inch, TFT liquid crystal module		
Display size	211.2 (horizontal) x 158.4 (vertical) mm		
No. of pixels	640 (horizontal) x 480 (vertical) dots		
Display colors	Approx. 260,000 colors (RGB 6-bit)		
Contrast control	3 steps		
Backlight	Cold-cathode tube (service life 25,000 hours *)		
White brightness	400 cd/m^2		
Angle of visibility	Up/down: 40/60 degrees, left/right: 65 degrees		
Image input connector	RCA connector (1 channel)		
Input signal method	NTSC system		
Input signal level	VBS 1.0 V (p-p)/75 ohms		
Power supply	90 to 110 VAC, 50/60 Hz (when the supplied AC adapter is used)		
Power consumption	28 W (when the supplied AC adapter is used)		
Storage temperature	-20 to 60 degrees		
Operating temperature	0 to 45 degrees		
Operating humidity	35 to 85% RH (no condensation)		
Atmosphere	No corrosive gases		
Vibration resistance	Compliance with JIS C0911 Vibration and acceleration: 0.15 mm (10 to 58 Hz), 9.8 m/s^2 (58 to 150 Hz) Vibration frequency: 10 to 150 to 10 Hz (1 oct/min) 2 hours in each of X, Y and Z directions (15 sweeps)		
Shock resistance	Compliance with JIS C0912 147 m/s^2 (3 times in each of X, Y and Z directions)		
Noise immunity	1000 Vp-p 1 micro second impulse (by noise simulator) (when applied to the primary side (100 VAC) of the supplied AC adapter)		
Withstand voltage	1000 VAC, 1 min. (between AC adapter plug and chassis)		
Insulation resistance	500 VDC, over 10 M ohms (between AC adapter plug and chassis)		
Dimensions (mm)	282.6 (W) x 196.6 (H) x 46.9 (D)	300 (W) x 231.7 (H) x 49.5 (D)	
Panel cut size (mm)	-	286.6 $^{+0.5}_{-0}$ x 218.3 $^{+0.5}_{-0}$ (not including bracket)	
Weight (approx.)	1.8 kg	2.4 kg	2.5 kg
Accessories	One AC adapter, one instruction manual	One AC adapter, one instruction manual, 4 brackets	One AC adapter, one instruction manual, 4 brackets, one cable

* The product life above means a time until the monitor luminous level drops to 50% of the initial value or start flickering while it has been used under the ambient temperature 25±5˚C, selecting the light level as the "standard."

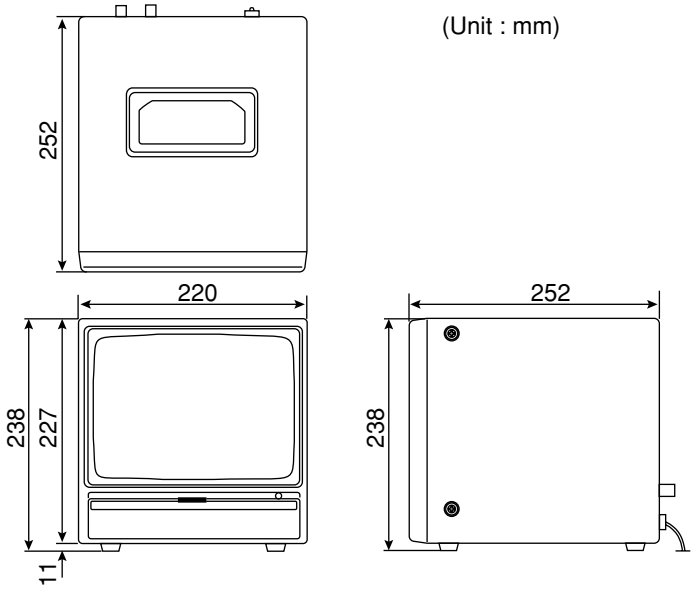
[2] Monochrome monitor (IV-09MT: When using IV-S30C3/C4)

Item		Specifications
Power input voltage		90 to 110VAC, 50/60Hz
Input capacity		25 VA
Signal voltage		1.0Vp-p/75 ohms
Screen display resolution		900 scanning lines (center), 600 scanning lines (edges)
Scan method		EIA 525 lines (2:1 interlaced)
Scan frequency		Horizontal : 15.75 kHz, vertical : 48 to 62 Hz
Image size		8% under scan
Linearity		Horizontal : 10% or less, vertical : max. 10%
Image input connector		BNC
Image input impedance		75 ohms/ High-Z
Video output connector		BNC
Adjustments	Front	Brightness, contrast, vertical position, horizontal position
	Back	Focus, vertical width, horizontal linearity, sub-brightness (only used by our service staff)
Storage ambient temperature		-20 to 60°C
Operation ambient temperature		0 to 45°C
Operation ambient humidity		35 to 85 %RH (non-considering)
Atmosphere		No corrosive gases
Vibration resistance		JIS C 0911 or equivalent - Amplitude 0.15mm, (10 to 57Hz), 9.8m/s^2 (57 to 150Hz), No. of sweeps : 10 (1 octave/min.) 3 directions (X, Y, Z)
Shock resistance		JIS C 0912 or equivalent, 147m/s^2 (3 times each in X,Y, and Z directions)
Weight		Approx. 6 kg
Dimensions (mm)		220 (W) × 238 (H) × 257 (D) (not including protrusion)
Dielectric resistance		1000 VAC, 1 minute (between AC plug and chassis)
Insulation resistance		DC 500VDC, 10M ohms or more (between AC plug and chassis)
Accessories		One instruction manual

Note: Even when using an IV-C30C5 color camera, it displays as a monochrome image.

■ **External dimension drawings**

(Unit : mm)



[3] LED lighting equipment (IV-60LD: When using IV-S30C3/C4)

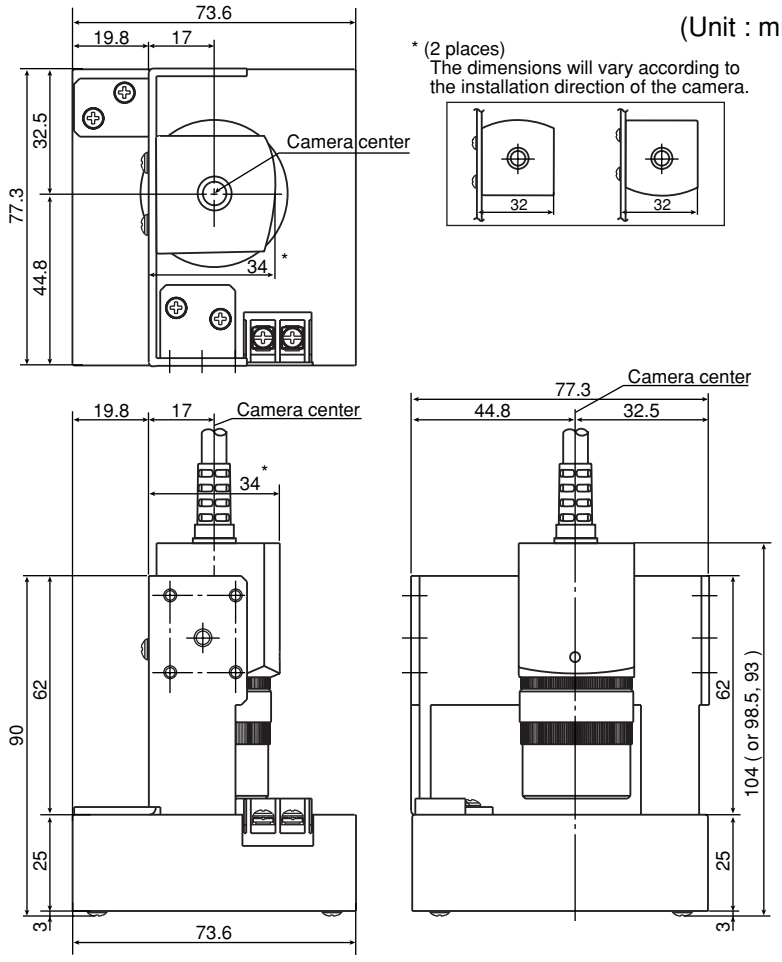
Item	Specifications
LEDs used	36 pcs of 5mm diameter - High brightness LEDs
Standard lighting range	Approx. 50 mm x 50 mm (workpiece distance at 150mm)
Input voltage	24 VDC ±10% , 2P terminal
Current consumption	Approx. 2 W
Lighting level adjustment	Semi-fixed volume
Operation ambient temperature	0 to 45°C
Storage ambient temperature	-10 to 60°C
Operation ambient humidity	35 to 90%RH (non-condensing)
Operation atmosphere	No corrosive gases or dust
Vibration resistance	JIS C 0911 or equivalent - Amplitude 2 mm (10 to 61 Hz), 147 m/s² (61 to 150Hz), No. of sweeps : 10 (1 octave/min.), 3 directions (X,Y,Z)
Shock resistance	JIS C 0912 or equivalent, 147 m/s² (each 3 times in X, Y, and Z directions)
Outside dimensions (mm)	76.9 x 73.6 x 25.0 (except camera angle bracket)
Weight	Approx. 230g (IV-60LD body : Approx. 140g + Camera angle bracket : Approx. 90 g)
Accessories	One camera angle bracket, 6 installation screws (M3 x 6mm), one instruction manual

8

■ **External dimension drawings**

Shown below are an IV-S30C3 camera with an IV-S20L16 camera lens installed.

(Unit : mm)



Glossary

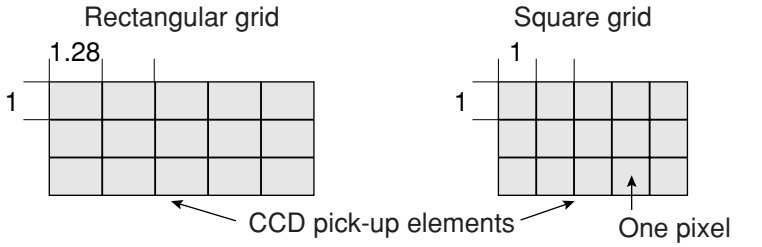
[A]

■ **Area filter**

A function used to eliminate an island if its area is smaller that the specified size after each of the objects in an image have been identified.

■ **Arrangement of the square pixels**

This refers to CCD elements whose pixels are square and arranged at the same vertical and horizontal interval.
If this type of CCD element is used, length corrections do not need to be calculated and the precision and processing time do not deteriorate.



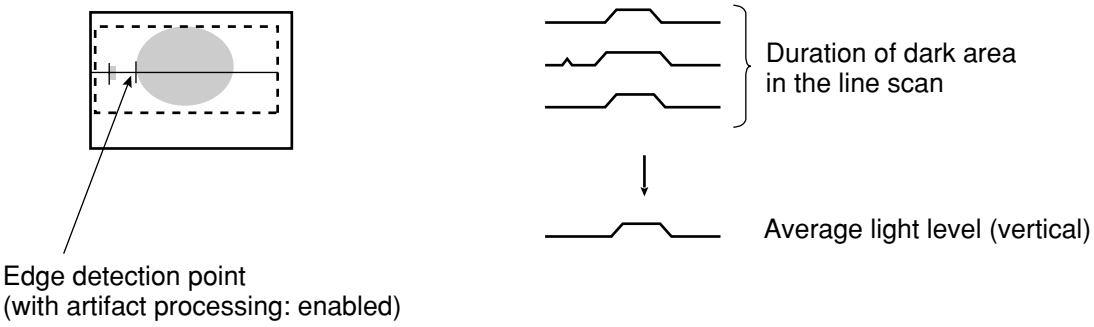
The aspect ratio is 1: 1.

■ **Artifact processing**

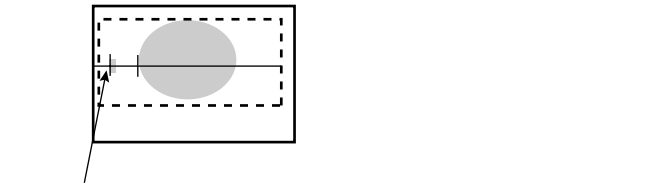
Artifact processing is a method of processing that eliminates the false detection of the edge of the target object when an artifact is in the line being scanned. This process can be used during edge detection. The real edge of the target object is detected by computing the average duration of the dark area.

[Example of detection]

- An example of light to dark averaging (DTCT MODE: BRT - DRK) while scanning horizontally (SEARCH DIR.: HORIZ -), with artifact processing (enabled) .



When artifact processing is disabled in the above example, the edge detection point changes.



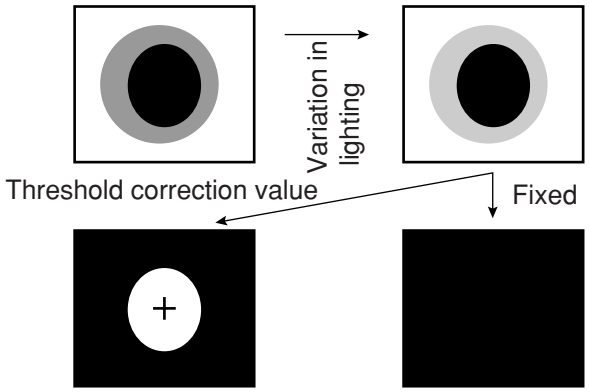
[B]

■ **Binary image**

Pixels in images are converted to one of two values, "1" when the pixel is lighter than the specified threshold value (level), and "0" when it is darker than the specified threshold value (level).

■ **Binary processing (fixed/threshold value correction)**

By setting THESHLD. ADJ (threshold adjustment function), the IV-C35M can cope with variations in lighting.



Note: In order to use the THRESHOLD (threshold adjustment function), the monitor brightness functions must be selected to measure variations in lighting. If you don't select the monitor brightness function, a BINARY CORR.: LIGHT LVL NOT SET (correcting binary value: monitor illumination not selected) error will occur.

Fails to convert the image due to a variation in lighting

■ **Boundary processing**

⇨ See "Setting window boundaries (enable/disable)."

■ **Brightness level**

Indicates color brightness level.

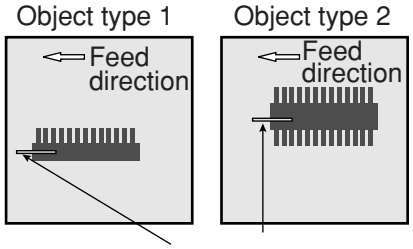
[C]

■ **CCD (charge capture device)**

A charge capture device (CCD) converts light into electric signals. It consists of a photoelectric converter to convert light and store it as an electric charge signal, a scanner to read the stored electric charges, and an output section to transmit the signals as a stream of data.

■ **CCD trigger**

The CCD trigger allows sampling a part of the CCD camera image at high speed. When the sampled image changes, the camera starts the shutter operation to capture a new image. With this built-in shutter operation, an external sensor, such as a photo sensor, is not needed to trigger the shutter. A window can be created to trigger the shutter operation. The window can be set for each item on the production line so that adjustments to the position of an external sensor are no longer needed. This feature reduces the down time needed to change object types on production lines.



Window for triggering the shutter operation

■ **Center of gravity**

The "center of gravity" is the geographical center of the image. It is determined by treating the binary image to be measured as an object that has mass.

■ **C mount**

A system for mounting lenses on a camera body. The flange back (the distance from the reference level for mounting a lens to the focal plane surface) is defined as 17.526 mm.

■ Color extraction

The color extraction function extracts a color in a certain area from the original image, and registers it as a reference color. The controller converts areas of color that are within the upper and lower limit ranges of hue, saturation, and brightness of the reference color to binary images, as well as colors outside of these ranges.
Then, the controller measures these binary images with conventional measurement procedures.

■ Color filter

Color filter is to filter red, green, blue, brightness, or optionally, the captured image, and display the filtered color as bright gray.
Then, the controller measures these gray images with conventional measurement

Filter types

R (red) filter	Displays red areas more brightly.
G (green) filter	Displays green areas more brightly.
B (blue) filter	Displays blue areas more brightly.
Brightness filter	Displays areas that are within the specified brightness range (within the specified upper and lower limits) more brightly.
Custom filter	Specify the optimum color filter parameters to use, based on the original image conditions.

The color filter function can be used with positional deviation measurement, degree of match inspection, lead inspection, BGA/CSP inspection, area measurement by binary conversion, object counting by binary conversion, object identification by binary conversion, point measurement, multiple position measurement, multiple degree of match inspection, and fault inspection.

■ Computer link

Programmable controllers (PC) are equipped with communication protocols. The "computer link" is used to transfer data between the PC and an external computer, or the like, using this communication protocol. The IV-C35M supports the computer link protocols used by Sharp, Omron, Mitsubishi, and Yokogawa PCs. Therefore, the PC does not need a custom communication program in order to create a computer link with the IV-C35M.

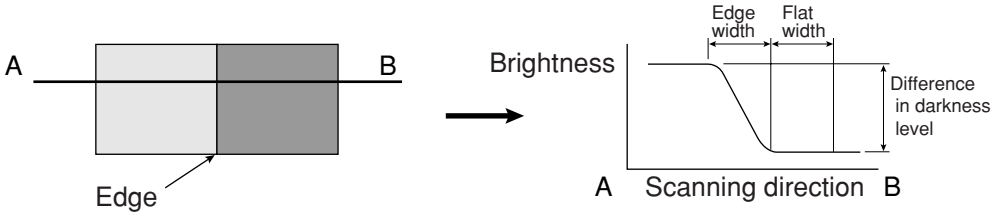
■ Contraction

⇨ See "Expansion and contraction to eliminate binary noise in the image."

[E]

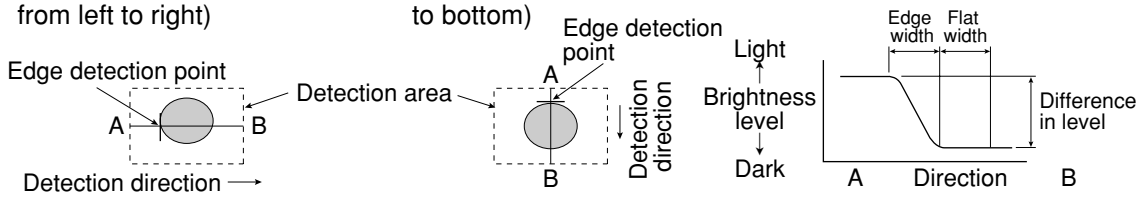
■ Edge detection

The "edge" refers to the boundaries between the brighter (white) and darker (black) parts in an image. The "edge detection" function is used to detect this boundary by processing the image.

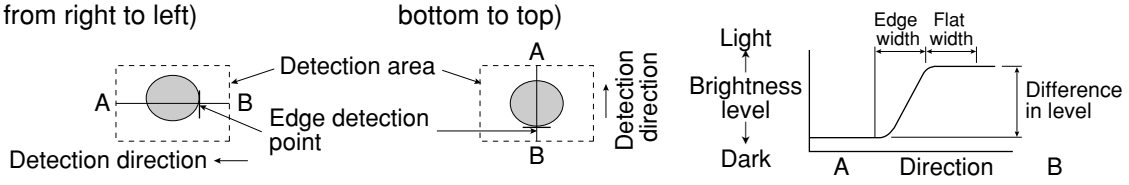


[An example of detecting a point using the edge detection function and user specified criteria]

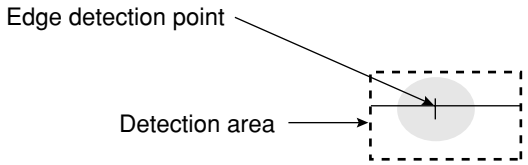
- Horizontal transition point from light to dark (moving from left to right)
- Vertical transition point from light to dark (moving from top to bottom)



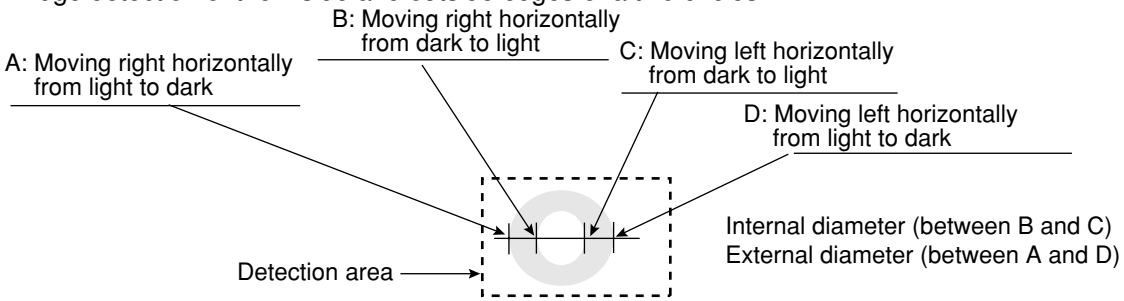
- Horizontal transition point from light to dark (moving from right to left)
- Vertical transition point from light to dark (moving from bottom to top)



- Center (dark), horizontal (left and right)



- Edge detection of the inside and outside edges of a two circles



G

■ Edge emphasis

⇨ See "Space filter."

■ Edge extraction

⇨ See "Space filter."

■ Expansion

⇨ See "Expansion and contraction to eliminate binary noise in the image."

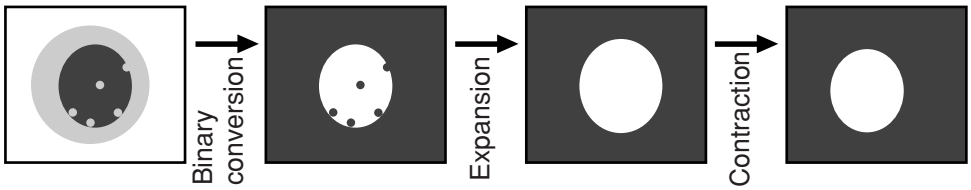
■ Expansion and contraction to eliminate binary noise in the image

When an image is converted to black and white, a number of unwanted dots may appear in the image. These noises can be eliminated during the preliminary processing. Dot control processing of binary values is used to eliminate this problem, as described below.

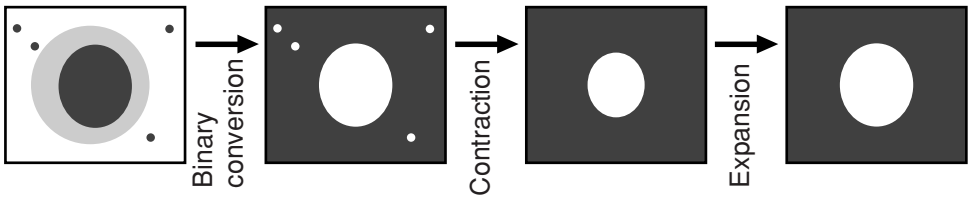
① Expansion
If a white area contains a single, isolated black point, the system will interrupt the black point to white.

② Contraction
If a black area contains a single, isolated white point, the system will convert the white point to black.

-① Expansion ➡ contraction
Delete e isolated black points by expansion and then restore the original image size by contraction.

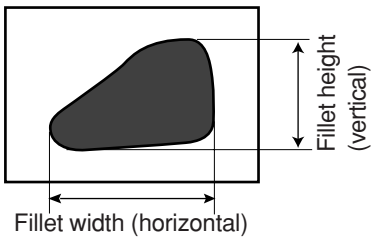


② Contraction ➡ expansion
Delete isolated white points by contraction and then restore the original image size by expansion.



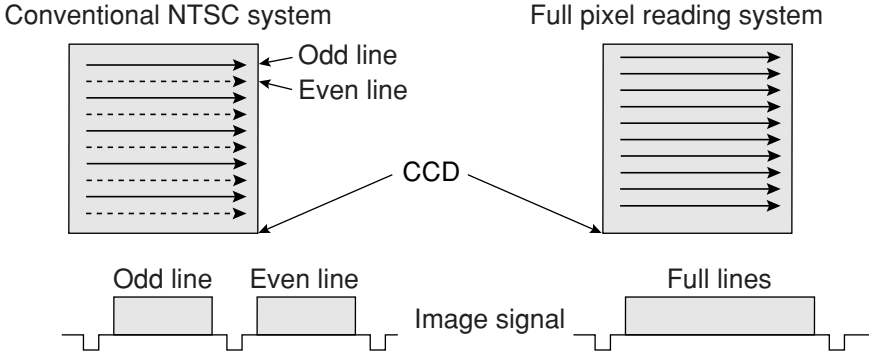
[F]

■ **Fillet width (shading width)**
Size of a hollow rectangle which closely matches to the target object in a binary image (white part). Horizontal direction: Length of a side parallel to the X axis. Vertical direction: Length of a side parallel to the Y axis.



■ **Flat width**
⇨ See "Edge detection."

■ **Full pixel reading (progressive scan)**
A system which reads all of pixels of image information from the CCD element one after another is referred to as "full pixel reading system." This system provides the same high resolution for moving objects as it does for static objects.
On the other hand, conventional CCDs using the NTSC scanning technique must read an object two times. First the odd lines are read and then the even lines. Therefore, NTSC system produces blurry images of moving objects. In order to solve this problem, the NTSC system can read only the odd lines. The disadvantage is that only half the resolution is available.



G

[G]

■ **Gray scale check using the normalization correlation method**

Even when the IV-C35M is looking at the same object as the object used for the reference image, the new target image and the previously stored reference image may not match completely, due to variations in the illumination conditions and the ambient light.
In order to check the resemblance between the two sets of image data, the normalization correlation method can be used.
In order to check whether or not the levels match using the normalization correlation method, the system slides the reference image one pixel at a time in the measurement objective range (measurement window), and calculates correlation value between the reference image and the target image. The position where the maximum correlation value can be obtained is treated as the position where the target image might exist, and the IV-C35M calculates resemblance level at this position.
The normalization correlation method also can be applied to binary images. However, gray scale images (images with shades of light) contain large volumes of information, compared with binary images (images with 256 levels of gray have 256 times the volume of information than in binary images). Therefore, gray-scale images offer more precision and more reliable results.
However, the larger the information volume, the larger the number of calculations that must be made for correlation values. This means that high speed processing hardware and software are required to use the normalization correlation method on the gray scale images.

■ **Gray scale processing (gray image processing)**

This is a process used to handle the unmodified captured image data, obtained from the CCD camera. In other words, the image data is not converted to binary values.

- This process produces more precise results than binary image processing (one pixel = one bit) by using 8 bits (one pixel = 256 gray levels) to represent each pixel in a gray scale image.
  [Advantage] Theoretically, better precision and reliability can be offered because the image more information about the brightness of each pixel in the image.
  [Disadvantage] More processing time is required because this approach must handle a large amount of data.

G

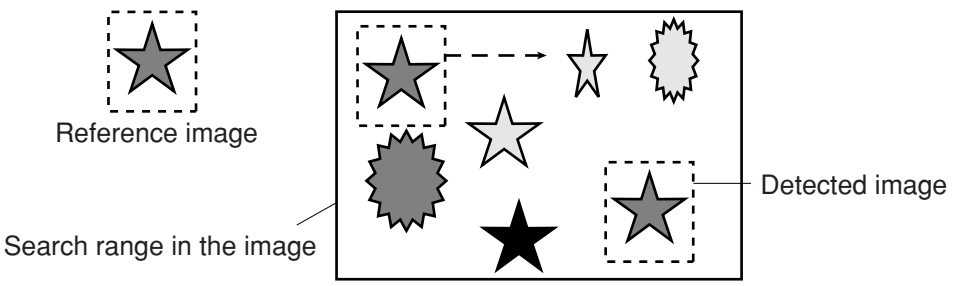
■ **Gray scale search (corrected gray scale search)**

The "gray scale search" function is a system for detecting a point where the input image and the reference image match, after calculating the matching levels in the input image and the reference image.

[Procedures]

① Store the reference image as a gray scale image with 256 levels of gray.
② Capture the workpiece image to be measured.
③ Move the captured image of the object so that the upper left corner of the captured image is right on top of the upper left edge of the reference image. Calculates the level of matching between the two images, based on the stored gray scale image data.
④ Slide the reference image over one pixel width and then measure the level of matching at that position.
⑤ Repeat step ④ above for the whole workpiece image until a good match is found.

(Output)	**(Application)**
Maximum matching level value	Shape inspection
The center coordinates where the highest level of matching is obtained	Positional deviation measurement



[H]

■ **Halogen lamp**

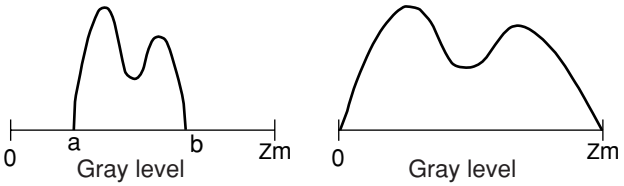
Light source with halogen gas in the bulb. When a halogen lamp is lit, the halogen gas and vaporized tungsten combine. When the filament is heated, these combined particles reattach to the tungsten, in stead of being deposited on the glass bulb, so that the original brightness of the lamp is maintained throughout its life span.

■ **High frequency lighting**

If a fluorescent lamp is powered by commercial electricity, it will flicker at 50 Hz or 60 Hz. Since the CCD scans images at 60 Hz, the brightness of the image may fluctuate due to the flickering of the fluorescent lamp.
By increasing frequency used to power the fluorescent lamp (employing a high frequency light), this type interference is eliminated and a stable image can be obtained.

■ **Histogram widening**

This is a method to widen the histogram for an image in which the histogram only occupies part of the available scale, thus improving the contrast. For example, in figure 1, the gray level values are concentrated in the [a, b] part of the range, and the [0, a] and [b, Zm] parts of the range are not used (the histogram is not expanded to use all of the gray scale values). This image has low contrast, since the image does not use the full dynamic range efficiently. Expand the histogram to cover the entire range of gray scale values, as shown in figure 2. The contrast will be improved.



① Low contrast image ② Good contrast image

■ **Hue**

Color tone, or the property by which the sense of vision can distinguish between objects such as red, blue, or green.

[I]

■ **Illumination monitor alarm density setting**

The "illumination (light level) monitor" is a function which automatically monitors the environmental lighting conditions when measuring objects.
If the illuminance exceeds the alarm density setting, the IV-C35M will display an alarm message.

■ **Interline transfer system**

The interline transfer system is a system for transferring electrical charges from the CCD receiving elements to the readout matrix.
The frame transfer system is a system for transferring electrical charge which uses the photo sensitive area to read out the charges. This system is subject to smearing noise since the area is used for both receiving and transferring the image.

■ **Island**

An "island" is a separate area which is created after labeling (object identification) process of the binary image.

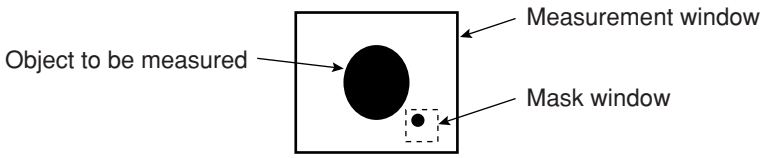
[M]

Main axis angle

The acute angle between the longitudinal and horizontal axes of a shape in the image after the measurement object is converted to binary. This angle cannot be measured for nearly circular or square-shaped objects.

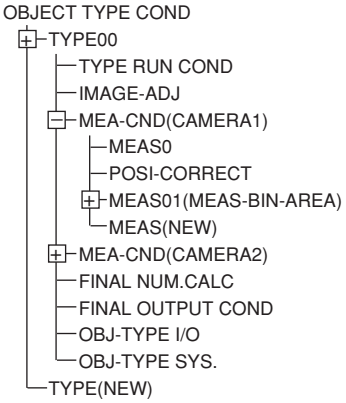
Mask window

The image being examined may contain an area that does not need to be processed. To eliminate such an area, a mask window is used.



Menu tree

The tree structure menu lets you find the setting parameter you need easily. Using the short cut function, you can move directly to a desired menu.



Mid gray level emphasis

Emphasize the mid gray level. This improves contrast while remaining the background image. Input image density (G) becomes output image density with the following formulas.

Input image density	Output image density
0 to 127	$(G\ 127)^2 x127$
128 to 255	$((G\sqrt{-128})\ 127x127)+127$

[N]

■ **Normalization correlation**

To determine whether the levels between the reference image and the input image match, the IV-C35M uses an information processing method called "normalization correlation." This is a method used to calculate relationship between two groups of data.

- Factors determining the correlation value If the densities of the two images have the same tendency (positive correlation), the two images are said to resemble each other. If the densities of the two images have opposite tendencies (negative correlation), the two images are said not to resemble each other. Therefore, areas of the reference image and the input image which resemble each other (the areas of both images are brighter, or darker) are positive, and areas which do not (the areas of one is brighter and the other is darker) are negative.
- Correlation formula = $\{ A \circledR \sqrt{B \times C} \} \times 10000$

  $A = N\Sigma(I \times T) - (\Sigma I) \times (\Sigma T)$: Correlation between input image and reference image

  $B = N\Sigma(I \times I) - (\Sigma I) \times (\Sigma I)$: Correlation between input images

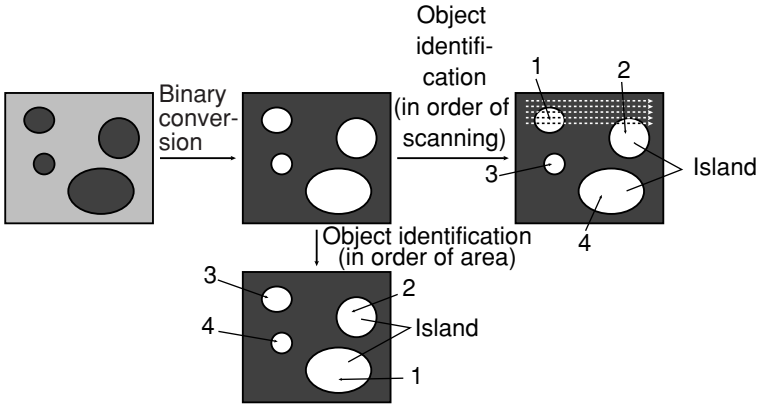
  $C = N\Sigma(T \times T) - (\Sigma T) \times (\Sigma T)$: Correlation between reference images

  (N: Area of reference image, T: Density of reference image, I: Density of input image)

[O]

■ **Object identification and numbering function (labeling)**

Object identification and numbering (labeling) is a process for locating separate object and assigning serial numbers (labels) one at a time in a binary image. By this process, multiple objects in the same binary image can be handled separately or as a group.



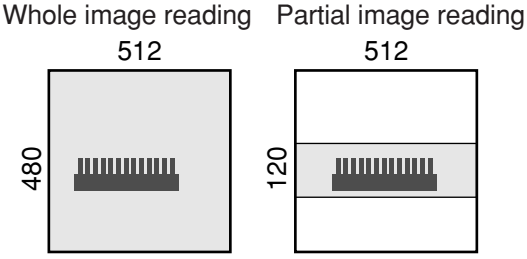
[P]

■ **Partial CCD reading**

The "partial CCD reading" technique reads only that part of the CCD which contains the object needed for image processing. This can shorten the data transfer time from the CCD camera to the image memory.

To read the entire CCD image (480 horizontal lines) takes approximately 33 ms. With the partial reading technique (e. g.: 120 horizontal lines) can take only 25 % of the time to read the entire image.

The IV-C35M can automatically determine the width of the partial image window. You can change back and forth between reading the whole image and a partial image.



■ **Pixel**
On the CCD, the electrically charged elements are in close proximity, arranged in a matrix (480 lines in vertical direction, 512 rows in horizontal direction). One element is equivalent to one pixel.

■ **Progressive scan**
⇨ See "Full pixel reading."

[R]

■ **Random shutter function**
This function allows the CCD camera shutter operation to be triggered when even an object to be measured reaches a specified position in the camera's field of view.
In order to make a partial reading of the CCD image at high speed, the IV-C35M is equipped with the detection function described above with the works just like a proximity sensor to trigger the CCD. A proximity sensor can also be connected to the system.

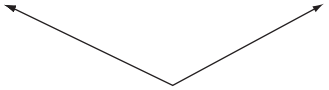
■ **Resolution**
The CCD in the IV-C35M contains 512 pixels horizontally and 480 pixels vertically. If it takes a full picture, the resolution will be X/512 and Y/480.

[S]

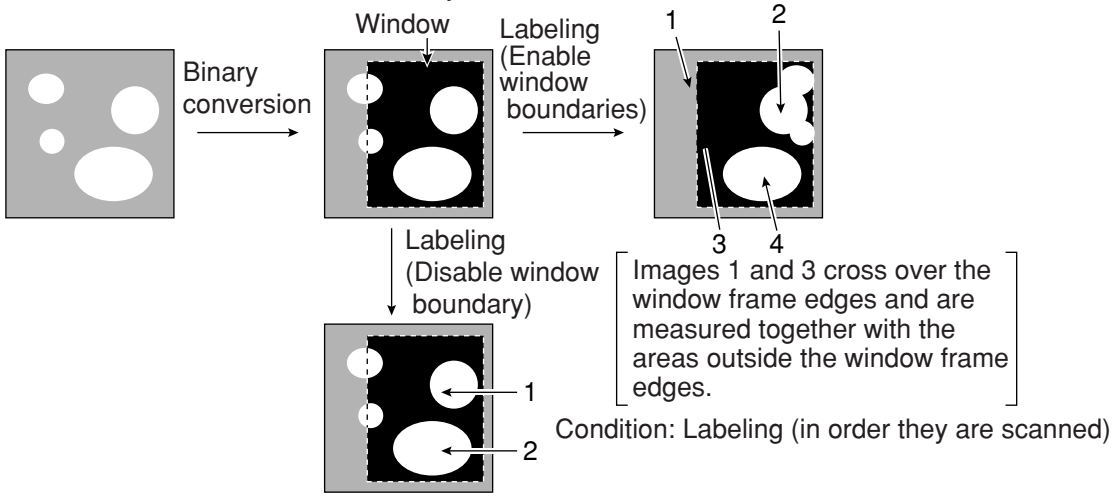
■ **Saturation (chroma)**
Indicates color vividness level.

■ **Search area**
A portion of the target image to be compared with the reference image, using the gray scale search function.

■ **Search pixel**
The relationship between detection precision and search speed, and also between pixel contraction (reduce the number of pixels in the image that must be searched) and search speed, is shown below:
- DETECTION PRECISION: High speed ⬅ [STANDARD-HIGH] ➡ Low speed
- PIXEL CONTRACTION: High speed ⬅ [3 - 2 - 1] ➡ Low speed

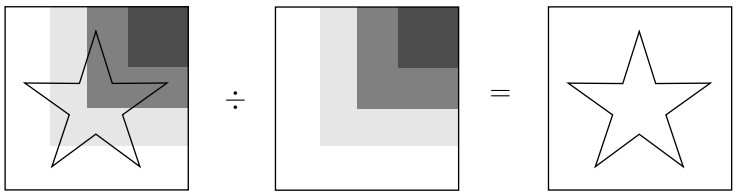


■ **Setting window boundaries (enable/disable)**
This function enables and disables the labeling (object identification) of binary images located that cross over the window frame boundary.



■ Shading correction

The process used to remove uneven gray areas (light level) from an image is called a shading correction. The figures below illustrate the principle of the shading correction. The new image has the areas of uneven brightness subtracted from it to produce a corrected image.



New image　　Uneven areas of brightness　　Corrected image

■ Smoothing

⇨ See "Space filter."

■ Space filter

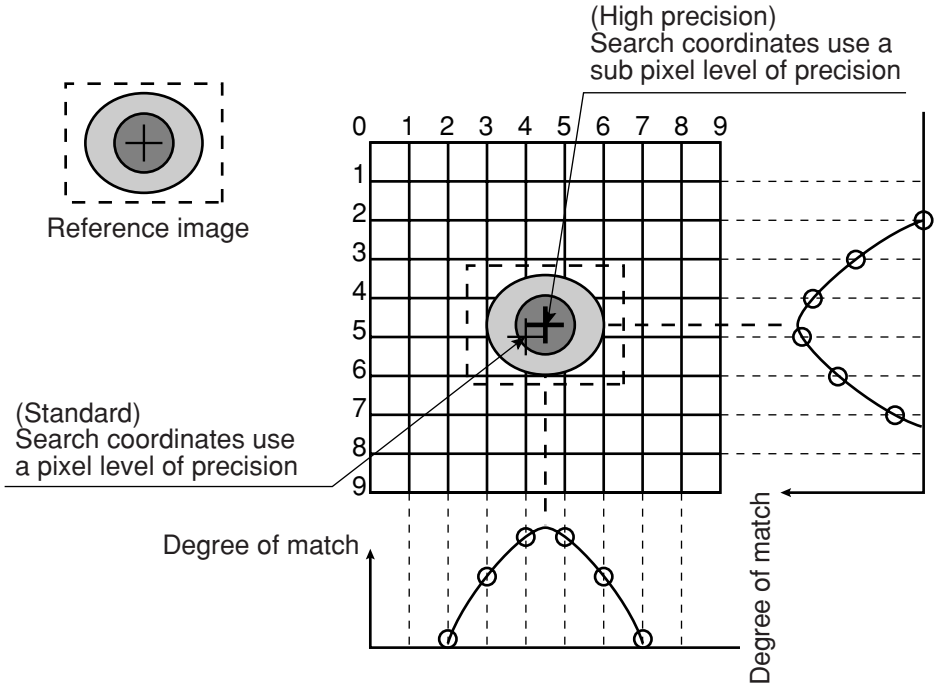
Space filter includes various image manipulation processes that create more readable images by removing noise and distortion in the image data. And, by extracting or emphasizing certain image features, it is easier to evaluate or identify target objects by converting the images into standard patterns. In the IV-C35M, you can select a "smoothing (average, center)," "edge emphasis," "edge extraction," "horizontal edge," and "vertical edge."

Item	Contents	
Smoothing (center)	- Specify the median pixel gray level from the surrounding 3 x 3 area. - Since noise elements are difficult to select, they will not affect the output.	- Display smooth images with decreased noise. - Used to eliminated surface flaws and unevenness in the reflected light caused by protrusions or dents. - This type of smoothing (averaging) is faster than the median smoothing.
Smoothing (average)	- Specify the average pixel gray level from the surrounding 3 x 3 area. - Since noise elements are included in the average, the noise will affect the output.	
Edge emphasis	- Display images with sharp boundaries between brighter and darker areas. - Used to stabilize and create a binary outline around unclear objects.	
Edge extraction	- Display images after extracting and clarifying the boundaries between the brighter and darker areas.	- Used to measure objects with low contrast.
Horizontal edge	- Horizontal edge extraction: Display only the horizontal boundaries of an object.	
Vertical edge	- Vertical edge extraction: Display only the vertical boundaries of an object.	

G

■ Sub pixel, pixel

Refers to the pixel precision level to be used with the gray scale search function.
-A "pixel" is one picture element (DTECT PRECISION: STANDARD (detection precision: standard) in case of the IV-C35M). "Sub pixel" refers to a unit smaller than a single pixel (DTECT PRECISION: HIGH (detection precision: high) for 1/10 pixel in case of the IV-C35M).



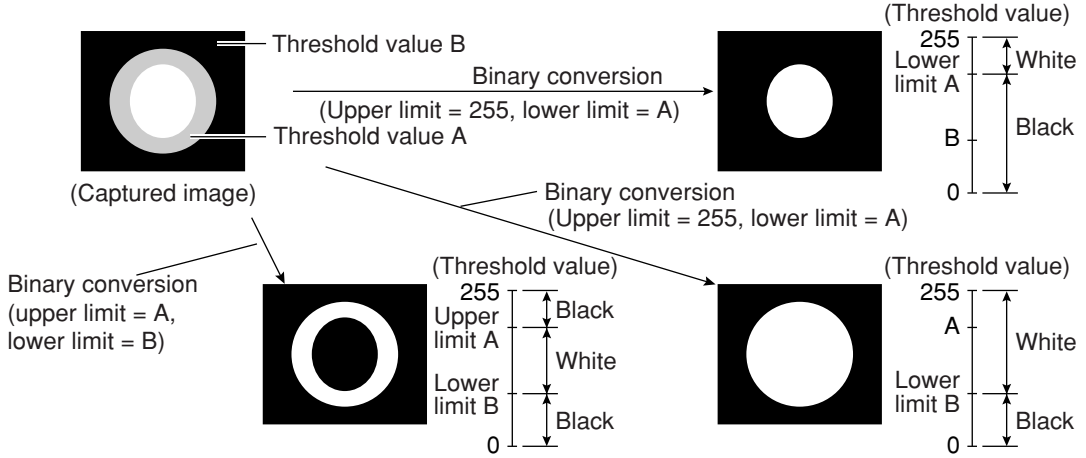
[T]

■ Threshold value

The criteria used for binary conversion of a gray scale image. If an area of the image is lighter than this threshold value, it is converted to 1. If an area of the image is darker than the threshold value, it is converted to 0.

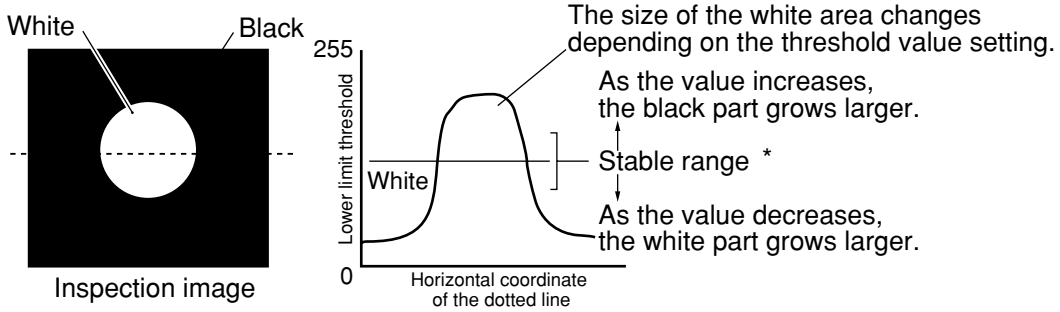
■ Threshold value setting

The IV-S30 treats the "areas darker than the lower limit value" or "brighter than the upper limit value" as "black." It treats that the areas between the upper limit value and lower limit value as "white." However, if the white-black reverse function is enabled, conversion to white/black will be reversed. Normally, if you want to use only one threshold value for binary conversion, set the upper limit value to "255." Then you only need to adjust the lower limit value to a threshold value that works for our application.



(Example for adjustment)

An example of adjustment is shown below, using a white object on a black background. When the dotted line in the window is converted to a binary image, if the lower limit is set higher, the black part in the binary image will become larger. If the lower limit is set lower, the white part will become larger. Increase and decrease the lower limit value, find the value at which the white part in the binary image starts growing and the value at which the black part starts growing. Then set the lower limit at the value halfway between these points. This will ensure reliable operation.



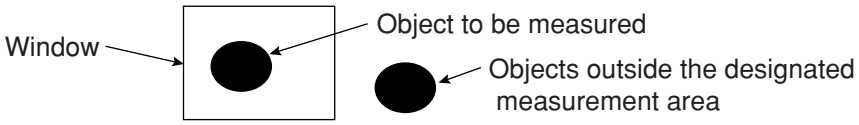
Changing the lower limit threshold value

[* If the stable range in the lower limit threshold value is less than 20, (actual measurement) measurement errors may occur.]

[W]

■ Window

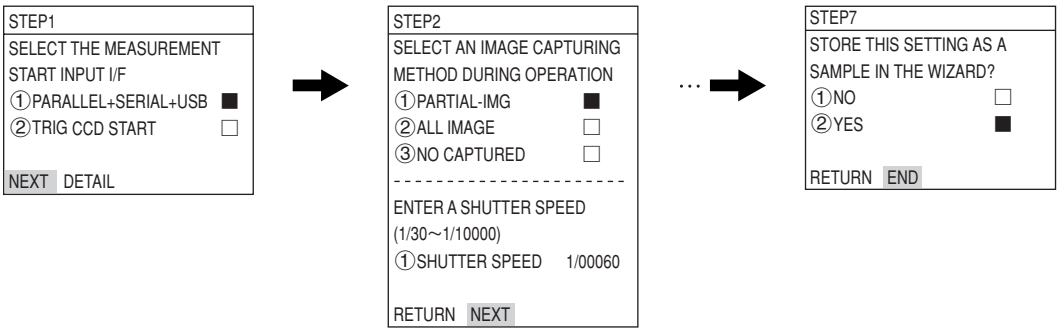
The IV-S30 captures images using CCDs, which are the light sensitive elements in the camera. The IV-S30 may capture more than one target image to be measured for image processing, and it may capture images not required for measurement. In these cases, a window is used to pick out just the desired target for measurement. The area inside the window will contain the object to be measured and the areas outside the window will be ignored.



■ Wizard

The "Wizard" is a program that helps users make settings for measurement operations easily and without making mistakes. The controller asks you a series of questions at each step and you simply answer these to complete the settings.

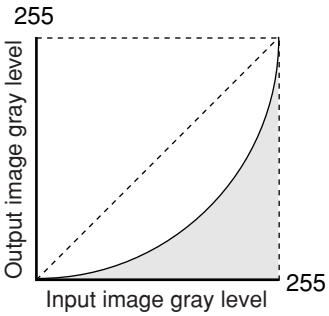
The wizard is convenient for making settings when beginners and inexperienced operators are operating the machine. However, operators who are familiar with the operation may save a lot of time by using other setting methods.



[γ]

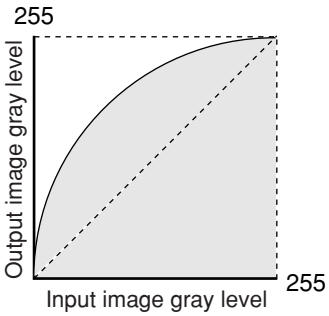
■ γ negative correction

Used when the mid gray level is too high.



■ γ positive correction

Used when the mid gray level is too low.



Appendix

Appendix 1: Commercially available peripheral devices

Described below for your reference are peripheral devices needed to build a system around the IV-C35M. (Items handled by SHARP are listed on the next page.)

(1) Lighting equipment

Supplier	Address	Phone
Moritex Corporation	3-1-14, Jingumae, Shibuya Ku, Tokyo, 150-0001	03-3401-9711
Nippoin-PI	1-17-1, Toranomon, Minato Ku, Tokyo, 105-000	03-3504-3321
Dentsu Sangyo Co., Ltd	6-1, 3 Chome, Kamifukuoka, Kamifukuoka City, Saitama, 356-0004	0492-64-1391
Hayashi Watch-Works Co., Ltd., Special Item Department	1-28-3, Kita Otshuka, Toshima Ku, Tokyo, 170-000	03-3918-5237

(2) Lens (mirror barrel)

Supplier	Address	Phone
Moritex Corporation	3-1-14, Jingumae, Shibuya Ku, Tokyo, 150-0001	03-3401-9711
Seiwa Optical Mfg. Co., Ltd.	12-17, 4 Chome, Yayoi Cho, Nakano Ku, Tokyo, 164-0013	03-3383-6301
Asahi Precision Co., Ltd., Optical machine Department	1-21, 1 Chome, Shirako, Wako City, Saitama 351-0101	048-466-8801
CBC Co., Ltd.	2-15-13, Tsukishima, Chuo ku, Tokyo,104-0052	03-3536-4766
Tamuron Co., Ltd., Special Item Sales Department	1385, Hasunuma, Ohmiya City, Saitama, 330-0015	048-684-9129
Canon Sales Co., Ltd., Optical Lens Sales Department	2-13-29, Minato Minami, Minato Ku, Tokyo, 108-0072	03-3740-3388

(3) Optical filter

Supplier	Address	Phone
Sakai Glass Engineering Co., Ltd., Optic Department	2-3-6, Sengoku, Koto Ku, Tokyo ,135-0015	03-3647-6031

A

■ **Table of standard items related to the IV-C35M handled by SHARP**

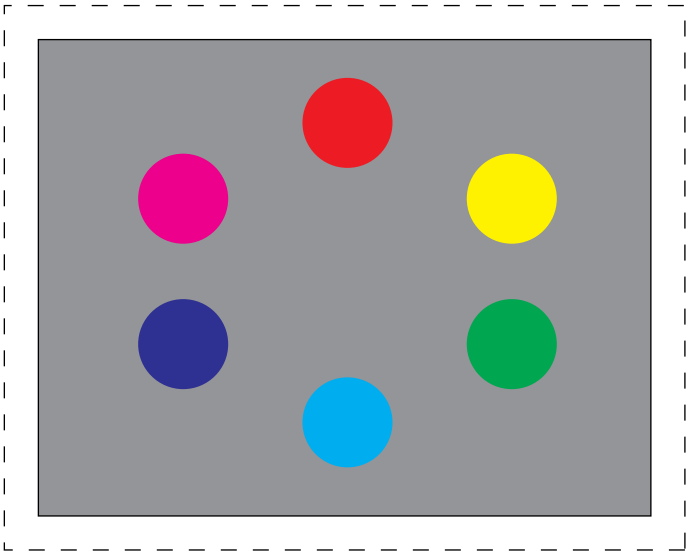
SHARP's article Nbr.	Moritex's article Nr.	Item name	Specifications	
IV-1A0101	ML-0614	CCTV lens	C mount	f = 6 mm
IV-1A0102	ML-0813	CCTV lens	C mount	f = 8 mm
IV-1A0103	ML-1214	CCTV lens	C mount	f = 12 mm
IV-1A0104	ML-2514	CCTV lens	C mount	f = 25 mm
IV-1A0105	ML-3514	CCTV lens	C mount	f = 35 mm
IV-1A0106	ML-5018	CCTV lens	C mount	f = 50 mm
IV-1A0107	ML-7527	CCTV lens	C mount	f = 75 mm
IV-1A0201	ML-EXR	Close up ring	A set of 7 intermediate rings	
IV-1A0301	MML1-65D	Telecentric lens	C mount	1x
IV-1A0302	MML2-65D	Telecentric lens	C mount	2x
IV-1A1101	ML17-07516	CCTV lens	ϕ 17 mmmount	f = 7.5 mm
IV-1A1102	ML17-1520	CCTV lens	ϕ 17 mm mount	f = 15 mm
IV-1A1103	ML17-2431	CCTV lens	ϕ 17 mm mount	f = 24 mm
IV-1A1301	ML1-65D-CM1	Telecentric lens	ϕ 17 mm mount	1x
IV-1A1302	ML2-65D-CM1	Telecentric lens	ϕ 17 mm mount	2x
IV-2A0101	MHF-H50LR	Halogen light source	50 W	
IV-2A0102	MHF-D100LR	Halogen light source	100 W	
IV-2A0103	MHF-150L	Halogen light source	150 W	
IV-2A0201	LM-50	Halogen lamp	12 V, 50 W	
IV-2A0202	LM-100	Halogen lamp	12 V, 100 W	
IV-2A0203	LM-150	Halogen lamp	12 V, 150 W (high luminous)	
IV-2A0204	LM-150C	Halogen lamp	12 V, 150 W (long life)	
IV-2A0301	MRG31-1500S	Ring light guide	ϕ 31 x 1500 mm	
IV-2A0302	MRG48-1500S	Ring light guide	ϕ 48 x 1500 mm	
IV-2A0401	MSG4-1100S	Straight light guide	ϕ 4 mm, 1100 mm	
IV-2A0701	MPP60-1500S	Surface illuminating light guide	60 x 60 mm, 1500 mm	
IV-2A0901	KA-03	Crystal adapter	Needed when the IV-2A0701 is used with an IV-2A0102	

The items listed above are all Moritex products.

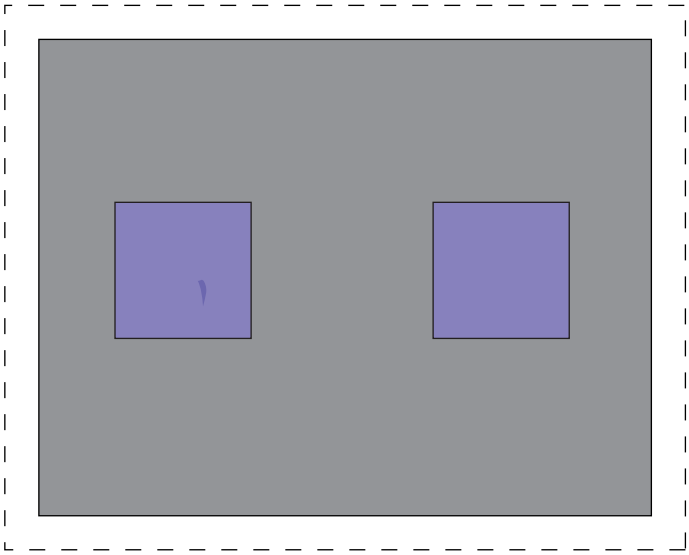
Appendix 2: Working samples

Cut out the following working samples and try to measure them.

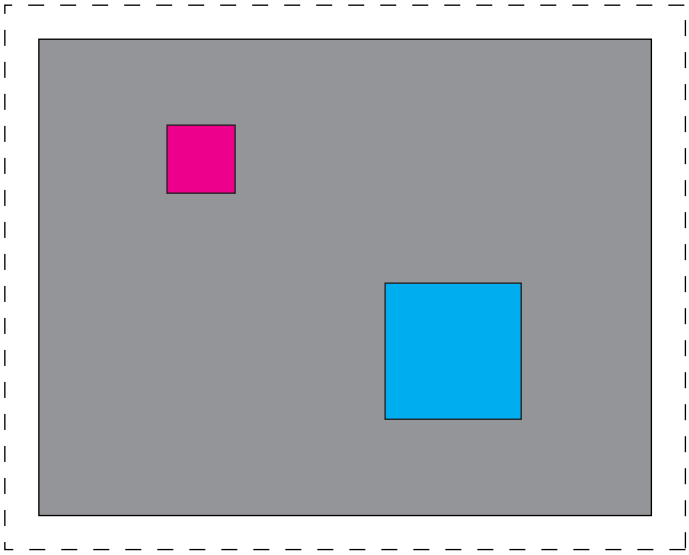
Working sample for color evaluation (color extraction)



Working sample for fault inspection (color filter)



Working sample for positional deviation measurement



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