SHARP

Version 1.0
Produced in Jan. 2002

Compact image sensor camera

IV-S30 Series

Controller: IV-S31MX/S32MX/S33MX

User's Manual (Introduction and Hardware)

Remote keypad: IV-S30RK1

Controller:
IV-S31MX/32MXS33MX

Standard camera: IV-S30C1
High-speed camera: IV-S30C3

Micro camera: IV-S30C2
Micro, high-speed camera: IV-S30C4

Thank you for purchasing the SHARP IV-S30 compact image sensor camera (IV-S31MX/S32MX/S33MX controller).
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-S30 (IV-S31MX/S32MX/S33MX) manuals as follows. Read them in conjunction with this manual.

IV-S30 (IV-S31MX/S32MX/S33MX)
- User's Manual (Introduction and Hardware: **This manual**)
- User's Manual (Function and Operation)
- Instruction Manual

Manual type	Major subjects	How to use
IV-S30 (IV-S31MX/S32MX/S33MX) User's Manual (Introduction and Hardware)	- Outline of the IV-S30 (features and functions) - Description of the hardware - Startup method - General performance specifications. - Example of operation and instruction	- Become acquainted with the IV-S30 - Learn how to install the IV-S30 and wire it up - When mastering the outline of operation
IV-S30 (IV-S31MX/S32MX/S33MX) 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 rinstruction 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 IV-S31MX/S32MX/S33MX 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-S30 compact image sensor camera). Otherwise a breakdown or damage to other equipment may occur due to a problem with the IV-S30.

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 IV-S32MX/S33MX controller contains a lithium battery. Do not expose the IV-S32MX /S33MX 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-S30. If you don't, electric shocks, malfunctions or breakdowns may occur.

Table of contents

Chapter 1: Outline

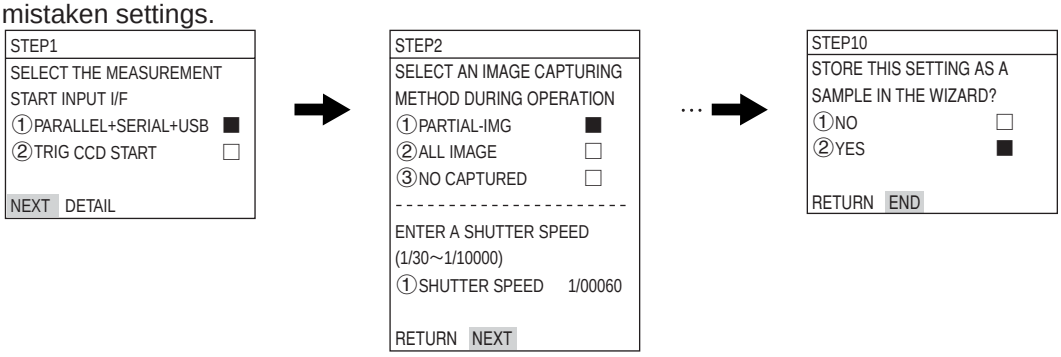
This compact image sensor camera system, the IV-S30, dramatically reduces overall processing time, thanks to a camera with double and quadruple speeds (using the IV-S33MX controller), SHARP's partial-image capture function, and a high-speed gray search function. It will not only contribute to high-speed, high-efficiency inspection and measurement processes, but it will also help you keep your prices competitive.

1-1 Features

■ Easy operation menu

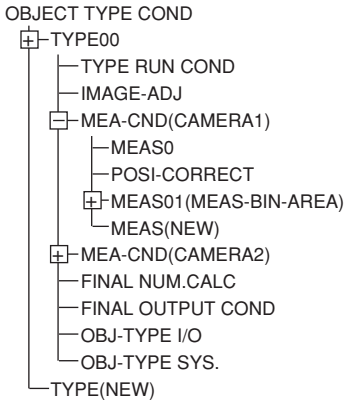
(1) Setting wizard

The IV-S31MX/S32MX/S33MX 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.



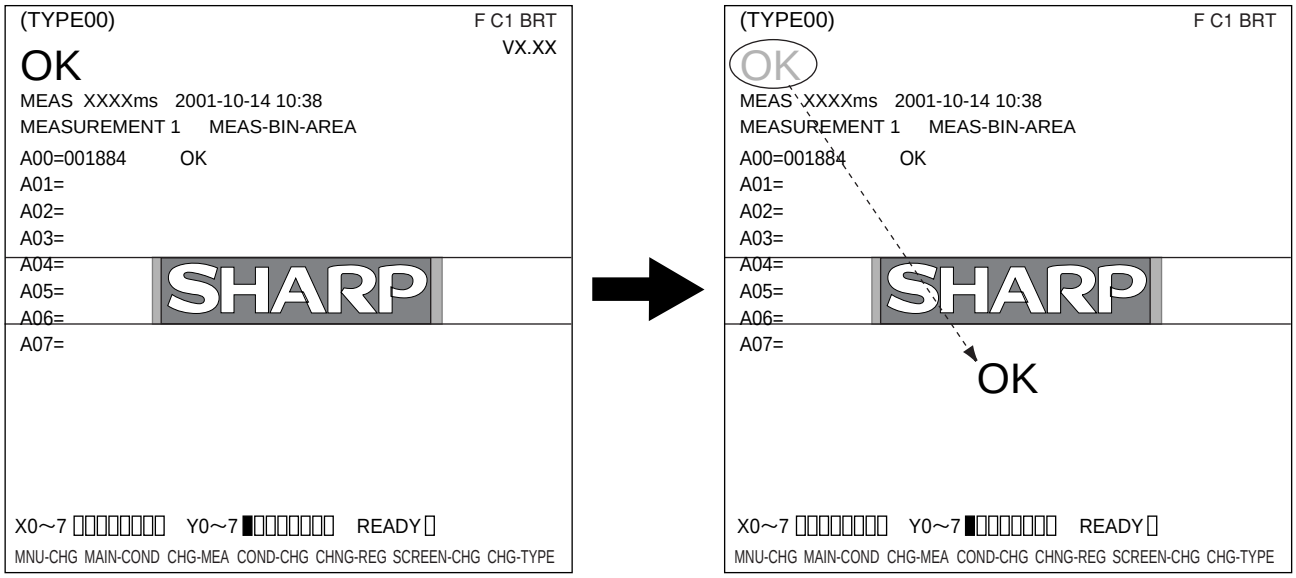
(2) Tree menu

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.



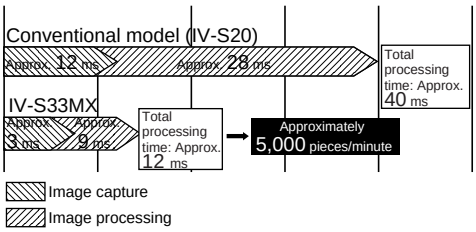
■ Operation screen editing function

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



■ It is now possible to inspect every item in a production run, thanks to high-speed processing

High-speed camera offers double and quadruple speeds. SHARP's unique partial-image capture function and high-speed gray search function provide higher overall speed. This system can inspect approximately 5,000 * pieces per minute (using the IV-S33MX controller). Such high speed makes it possible to inspect all the chips or parts in a production lot.



* The total processing times above are true when the measurement conditions are: a 64 x 64 model; a 160 x 160 search, contraction is set to 3; the shutter speed is 1 ms; and a partial image that is 33% of the total image area is specified.

■ Customize to your own specification

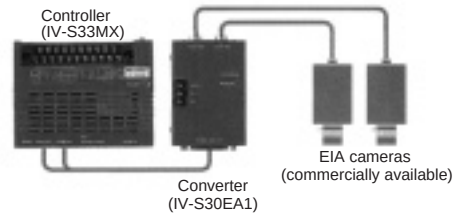
An IV-S30LB1 image processing library and IV-S30SP parameter setting support software are both available. Using these tools, the menu screen can be modified to suit your specialized needs to create your own unique image processing system.

■ The camera diameter is only 17 mm, so it can be installed in a very limited space.

The IV-S30C2 camera is capable of capturing images at 4 times the speed of the standard camera, progressive scanning, and it uses a square grid. It is as small as your thumb. It can be installed in virtually any tiny space in even the smallest machines.

■ Conventional EIA (data) cameras can be used with the controller

The IV-S33MX controller can connect two EIA specification cameras using a converter. Just by replacing the controller in the image processing section, you can achieve high-speed processing at decreased cost.



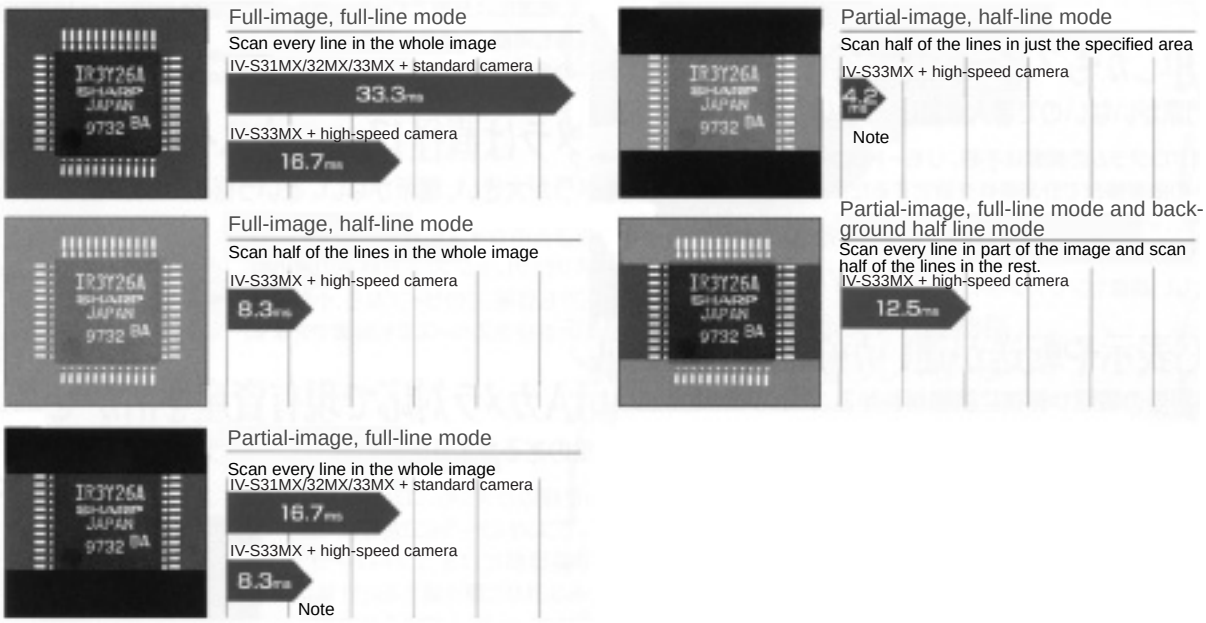
■ Simple and speedy setting makes for easy setups

No need to create a measuring program. You just set the measuring conditions using the remote keypad. In addition, the IV-S30 can automatically set the binary conversion threshold value and evaluation conditions by just pressing the SET key.

■ NG displays and data are transferred quickly, for truly useful NG handling

The IV-S32MX/S33MX can check an NG image and a part's NG history while measuring. Using the USB communication bus, NG images can be transferred to a personal computer in less than 7 seconds. The causes of NG products can be fed back to the design section, leading to quick improvements in the quality of your products.

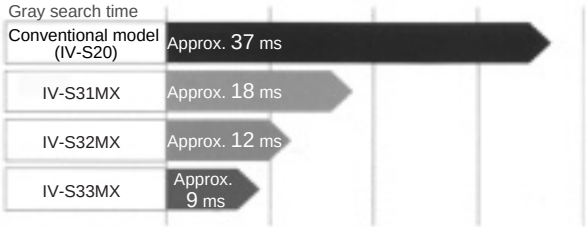
- **High-speed processing now possible using a high-speed camera and a partial-image capture function**
  The IV-S30 (with the IV-S33MX controller) can use double and quad-speed cameras that employ progressive type CCDs. Using SHARP's unique, partial-image capture function, the IV-S30 offers very high-speed image capturing. By selecting the best of five image capturing modes to match your inspection and measurement conditions, this system helps reduce the processing time even further.



  * The partial-image modes are available when scanning 240 out of 480 vertical lines.
  * Standard camera: IV-S30C1/C2, High-speed camera: IV-S30C3/C4
  * Full-line mode: Scan odd and even lines. Half-line mode: Scan only the odd lines.

  Note: The scan time will vary with the position of the partial image to scan. (In the cases given above, there is a maximum of 0.4 ms of difference.)

- **Our high-precision gray search is also high speed**
  We normalize images to a 256 grayscale standard, and perform a high-precision gray search by detecting features in sub-pixel units.
  The IV-S30 can shorten this process using 9 ms high-speed processing * (IV-S33MX)

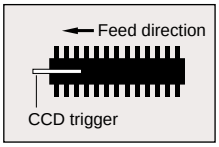


  * When the search area is 256 x 256 pixels, the model is 64 x 64 pixels, and contraction is to set 3.

- **Shorten the cycle time by connecting two cameras**
  The IV-S33MX can be simultaneously connected to two IV-S30C3/C4 high-speed cameras or two IV-S30C1/C2 standard cameras. 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 high-speed camera and a standard camera is not possible.

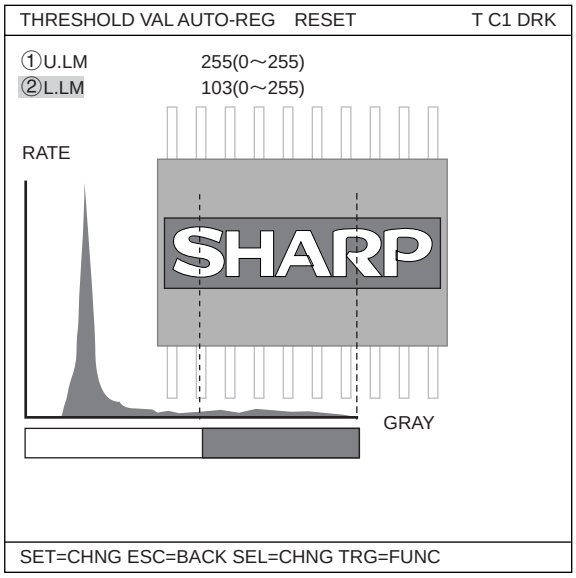
- **CCD trigger function does not need an external sensor**
  After a trigger window is setup, the IV-S30 does not need an external sensor if it is scanning moving objects. To set up a trigger, you can select from binary image conversion, average density, and gray search techniques. The gray search mode 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.

- **Easily and automatically set threshold value and judgement criteria**
  Using the SET key, the IV-S33MX can automatically set the threshold values (binary conversion, density difference, and edge width), that used to be set by entering numbers manually. To determine the upper and lower limits of the OK and NG criteria, you only need to measure an OK workpiece. Therefore, you no longer need to rely on skill, or experience to make accurate measurements at high speed.

- **Histogram display of threshold values**
  In previous versions, the threshold values have only been displayed as numeric values. This model adds a graphic display so that you can view the threshold values as an image.



- **Automatic search reference images**
  The controller automatically searches for the maximum contrast area within the measurement area, and detects it virtually instantly. Mistake-free work can now be performed quickly.
  - This can be used for mis-collation checks of printed matters.

- **Simple measurements of position, detection of the same workpiece and counting quantities**
  By using the degree of match inspection functions for multiple workpieces and position measurement for multiple workpieces, the controller can detect up to 128 workpieces in one image that meet or exceed a specified degree of match with the reference image. The controller can count quantities and measure the positions of workpieces that have complicated structures of light levels and are difficult to convert to binary images.

- **Effective when checking for angular deviation, very good as a robotic eye**
  The controller can detect objects turned through a full 360˚ of orientation. It can inspect printing at great angles off the main axis, and can be used in robotic inspection machines.

- **Integrated measuring programs allow the controller to be used for inspection and measurement immediately**
  Simple operations on the remote keypad let you select the desired measuring program to suit your application. Since there is no need to develop measuring programs, this unit is easy set up and you can start measuring products the same day you receive it.
  - Various measuring programs

  Positional deviation measurement, degree of match inspection, distance and angle measurement, lead inspection, area measurement by binary conversion, counting by binary conversion, label measurement by binary conversion, point measurement, BGA/CSP inspection*, multiple position measurement, and multiple degree of match inspection.

  * IV-S32MX/S33MX only.

- **You can cut your camera costs by using your current camera (IV-S33MX)**
  Two, commercially available EIA cameras can be connected using an IV-S30EA1 special converter. This means that you can use your current EIA cameras the same as before, and just replace your image processing section with the IV-S33MX. Installation and adjustment of lighting, camera, and lenses is easy and can cut your costs.

- **Displays and transfers NG images while measurements are being made (IV-S32MX/S33MX)**
  The IV-S32MX/S33MX can check an NG image history (up to 128 images) while measuring, or simultaneously display a measured image and an NG image by splitting the screen. While measuring, the controller can send NG images over the USB bus (12 Mbps) to a personal computer at high speed (approximately 7 seconds per image). Since you can collect and analyze NG images in real time, the NG rate can be decreased by finding the cause and making corrections immediately.

- **Integrated micro PC function**
  The IV-S30 has a micro PC function that allows it to determine unknown values by calculating the inspected and measured results and then output signals to lamps and plungers. You can construct a complete, simple inspection process with a single controller.

1-2 Controller

[1] Software version of the controllers

This manual describes the controllers (IV-S31MX/S32MX/S33MX) and their respective software versions 3.03C below.

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[2] Differences between types of controllers

The controller models (IV-S31MX/S32MX/S33MX) have the following specifications.

Item		IV-S31MX	IV-S32MX	IV-S33MX	IV-S30J	IV-S31M	IV-S20
Number of object types handled		16	32	32	16	16	16
Maximum number of reference images/ total number of images		300/3	600/8	600/8	200/2	300/3	200/3
Measurement program	Positional deviation measurement	○	○	○	○	○	○
	Degree of match inspection	○	○	○	○	○	○
	Area measurement by binary conversion	○	○	○	○	○	○
	Object counting by binary conversion	○	○	○	○	○	○
	Object identification (labeling) by binary conversion	○	○	○	○	○	○
	Point measurements	○	○	○	○	○	○
	Lead inspection	○	○	○	○	○	○
	BGA/CSP inspection	–	○	○	–	–	–
	Multiple position meansurement	○	○	○	○	○	–
	Distance and angle measurement	○	○	○	○	○	–
Communication method		RS232C/ RS422/USB	RS232C/ RS422/USB	RS232C/ RS422/USB	RS232C/ RS422	RS232C/ RS422/USB	RS232C/ RS422
Menu		Setting window Menu tree	Setting window Menu tree	Setting window Menu tree	Setting window Menu tree	Simplified menu Standard menu	Standard menu
Customize operation screen		○	○	○	○	–	–
Connecting camera	Standard camera (IV-S30C1)	○	○	○	○	○	–
	Micro camera (IV-S30C2)	○	○	○	○	○	–
	High-speed camera (IV-S30C3)	–	–	○	–	–	–
	Micro, high-speed camera (IV-S30C4)	–	–	○	–	–	–
	EIA camera (commercially available)	–	–	○	–	–	–
Split display of two camera images on the left and right sides of the screen		–	–	○	–	–	–
Number of NG images that can be stored (Maximum 128 images)		–	○	○	–	–	–
Calendar/timer		–	○	○	–	–	–
Size (WxDxH)		130x100x42	130x100x42	130x100x42	130x92x30	130x100x42	130x92x30
Polygonal window		32	32	32	32	Octagonal (binary mask only)	–
CCD trigger		Binary/average density/ Gray search/ edge detection	Binary/average density/ Gray search/ edge detection	Binary/average density/ Gray search/ edge detection	Binary/average density/ Gray search/ edge detection	Binary/average density/ Gray search	Binary/average density
Gray search time*		18 ms	12 ms	9 ms	15 ms	18 ms	37 ms
Input terminal block	Object type be changed	X1 to 4	X1 to 5	X1 to 5	X1 to 4	X1 to 4	X0,X1 to 4
	External input	X5 to 7	X6, X7	X6, X7	X5 to 6	X5 to 7	X5 to 6
Power consumption		7 W	7 W	8 W	7 W	7 W	250 mA

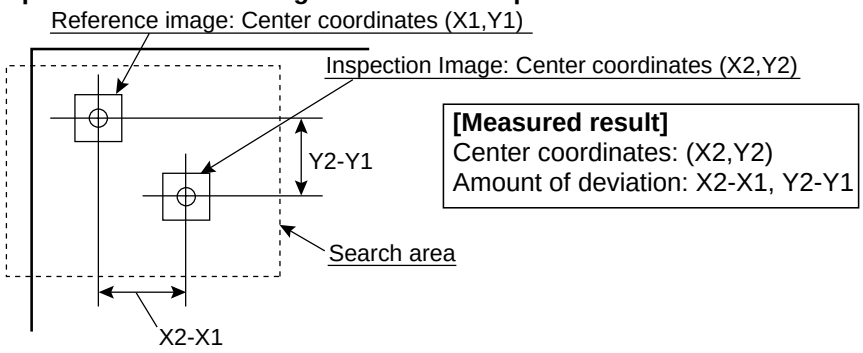
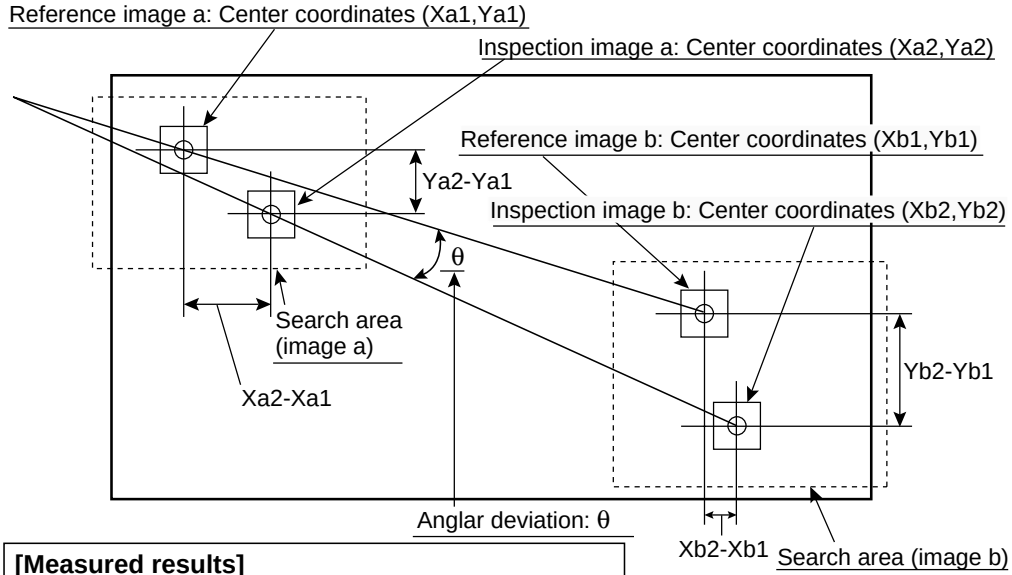
("○": Compatible/available, "-": Not compatible/unavailable)

* The gray search times given above are true when the search area is 256 x 256 pixels, the model is 64 x 64 pixels, and the contraction value is set to 3.
For other specifications, see pages 9-1 to 9-3 in "Chapter 9: Specifications."

1-3 Measurement program

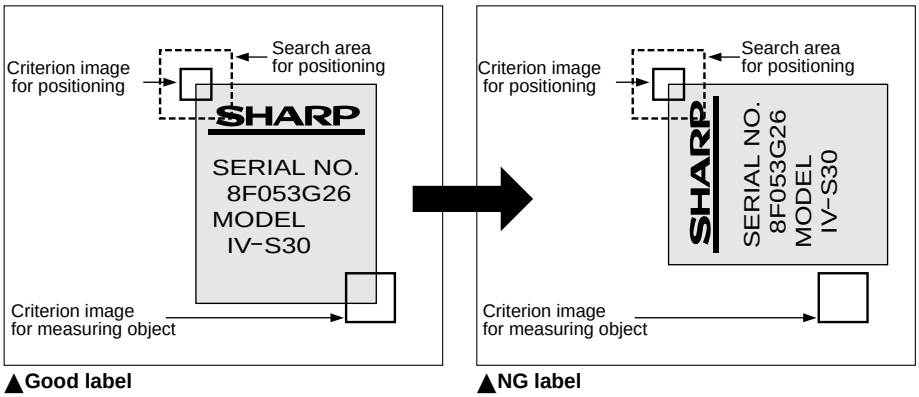
The IV-S30 integrates the following eight measurement programs: Positional deviation,degree of match inspection, lead inspection, BGA/CSP inspection (IV-S32MX/S33MX), area measurement by binary conversion, object counting by binary conversion, object identification (labeling) measurements by binary conversion, multiple position measurement, multiple degree of match inspection, point measurements and distance and angle measurement. You can select operating condition parameters to suit your application of the IV-S30.
A description of each screen area is shown below.

[1] Positional deviation measurement

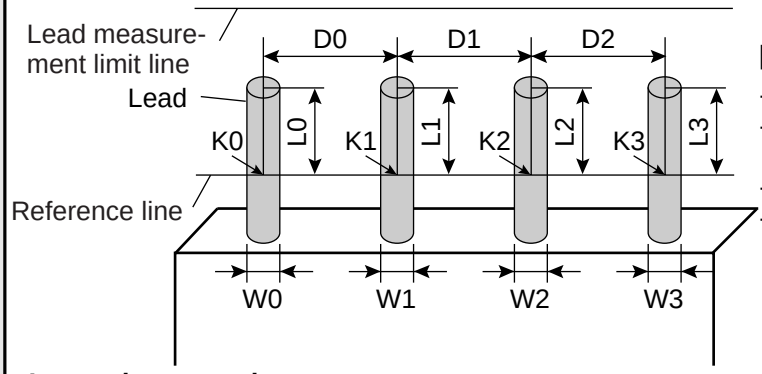
Purpose	The gray scale search function and edge detection function* make possible measuring positional deviation as well as the absolute position. - It is also possible to detect the position of sub-pixel units with great accuracy. - A rotation angle of 360° can be detected. (When a one point gray search 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**  **[Measured result]** Center coordinates: (X2,Y2) Amount of deviation: X2-X1, Y2-Y1 **(2) 2 point search: Determining positional deviation in X and Y directions as well as rotational deviation**  **[Measured results]** - Center coordinates of image a: (Xa2,Ya2) - Amount of deviation of image a: Xa2-Xa1, Ya2-Ya1 - Center coordinates of image b: (Xb2,Yb2) - Amount of deviation of image b: Xb2-Xb1, Yb2-Yb1 - Deviation angle: θ * 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

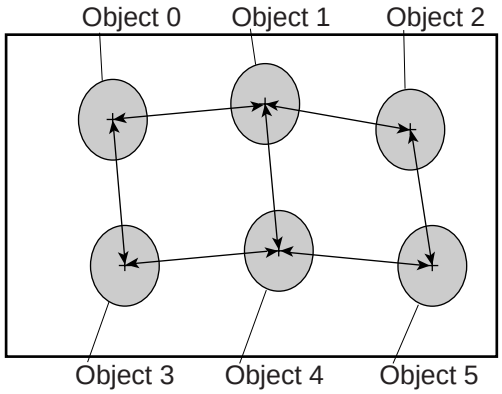
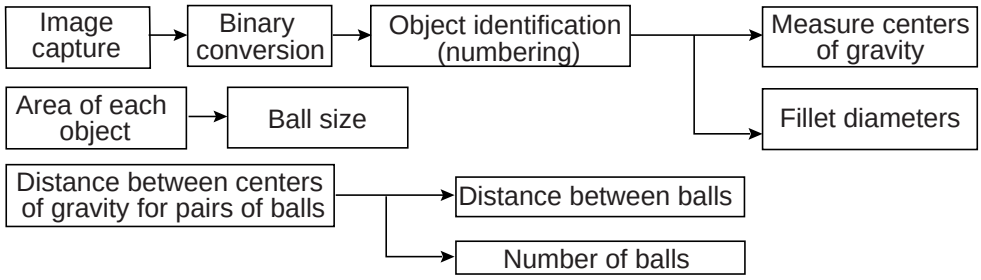
[2] Degree of match inspection

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.) A matching level comparison using binary images is also possible.
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 **[Measured 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-S30 can determine that the label position is NG.

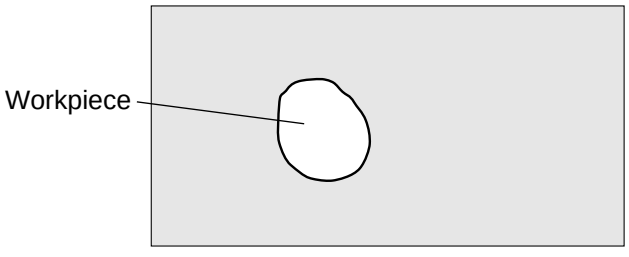
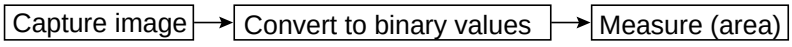
[3] Lead inspection

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. ④ Calculate the lead widths (W0 to W3) centering the measurement points.

[4] BGA/CSP inspection (IV-S32MX/S33MX)

Purpose	Measure the center of gravity, area of each object, number of objects, and fillet diameter using the object identification function after binary conversion.
Application	Inspecting BGA/CSP solder balls.
Example	**[Measurement of 6 balls]**  **[Measured 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** 

[5] Area measurement by binary conversion

Purpose	Detect the existence/absence and size of a workpiece when the workpiece is one point or "measurement position is fixed." - Convert the specified pixel area to binary values and measure the size of the white area.
Application	Check for the existence of bearings inserted by a bearing insert machine, prevent contamination of different parts in automobile production lines, determine the type of waterproof caps, check for the existence/absence of bottle labels, inspect the cuircuit traces on PWBs, check for the presence of grease, check for existence of frozen foods.
Example	 **[Measured result]** - Workpiece area **- Inspection procedure** 

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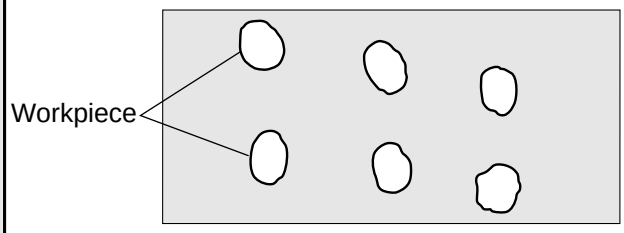
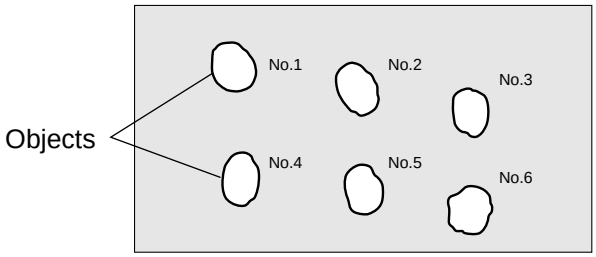
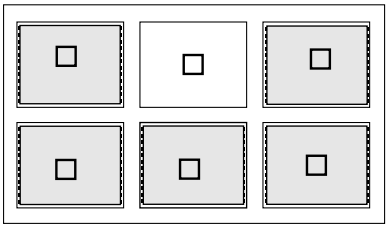
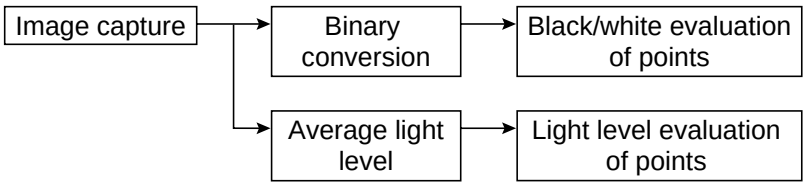
[6] Object counting by binary conversion

Purpose	Checks the number of objects (max. 3000 pcs.) when there is more than one object in an image arranged arbitrary. - When the specified pixel field has been converted to a binary image, the white areas are measured or identified as separate objects and counted.
Application	Counting pieces of food or parts
Example	 **[Measured result]** - Number of workpieces/total area size **- Inspection procedure** Capture image → Convert to binary values → Measure (quantity, total area size)

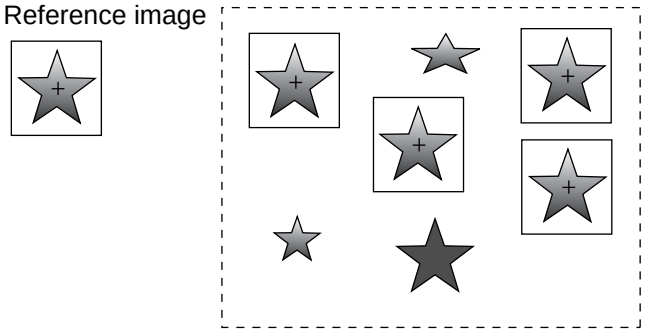
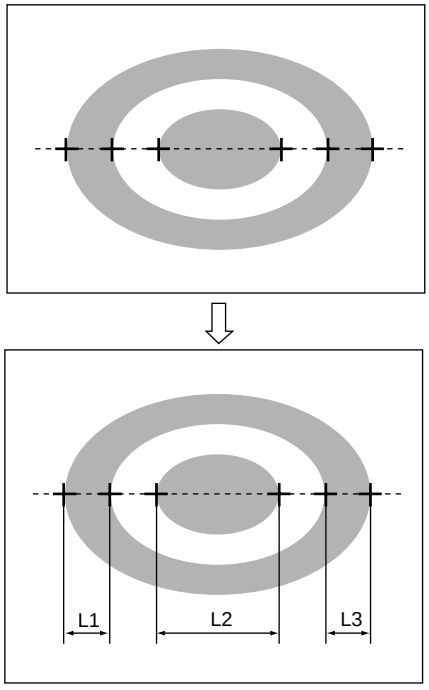
[7] Object identification (labeling) by binary conversion

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]**  **[Measured 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 → Convert to binary values → Object identification (numbering) → Measurement (area, gravity center, main axis angle, fillet diameter, circumference, and center point)

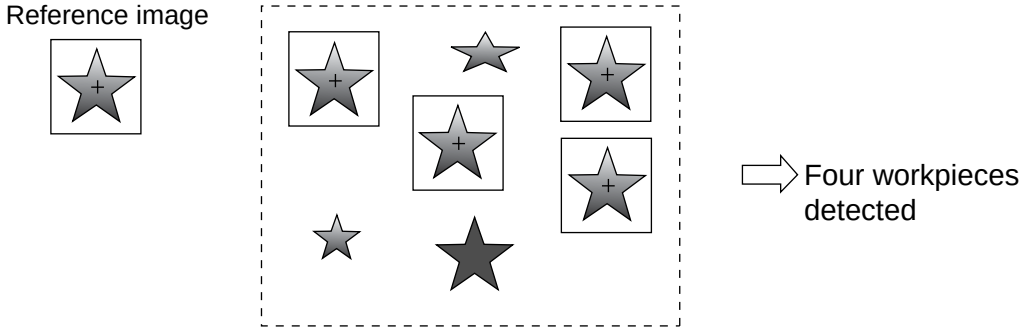
[8] Point measurements

Purpose	The presence or absence of target objects is examined. - A simple black or white evaluation is made in the specified pixel area of binary images. - The light level in the specified pixel area is averaged, and a decision is made whether or not it is within the specified lightness range in gray scale images.
Applications	Checking the presence or absence of packed parts, inspecting the working condition of LEDs or fluorescent character display tubes, and sorting household electric appliances.
Example	**[Inspection at 6 points]**  Number of points (max.) : 128 points at average light levels 256 points in binary images Point size: 2 m x 2n pixels (m, n = 1 to 16) **- Inspection procedures** 

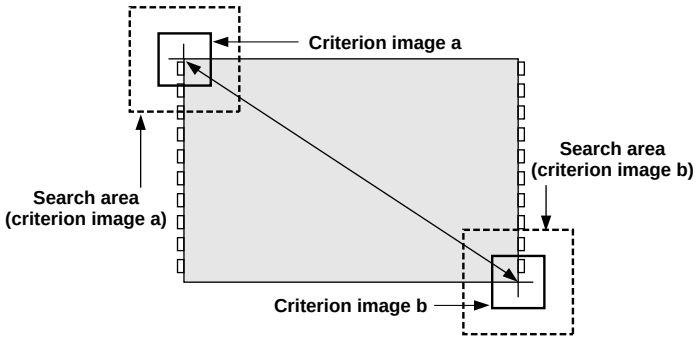
[9] Multiple position measurement

Purpose	The IV-S30 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	Measure the position of workpieces with a complicated light level that cannot be converted into binary images.
Example	● **Gray search** Reference image  **[Measured results]** - Number of images detected - Coordinates and degree of match detected for each image ● **Edge detection**  **[Measured 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.

[10] Multiple degree of match inspection

Purpose	Using the gray search function, the IV-S30 can detect up to 128 workpieces whose captured image exceeds the required degree of match with the reference image.
Application	Inspect (or count) workpieces that have complicated light levels and cannot be converted into binary images
Example	Reference image  **[Measured results]** - Number of images detected - Degree of match, density (average/absolute difference), and detected coordinates

[11] Distance and angle measurement

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, 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-S30.

(1) Installation

- Each device in the IV-S30 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-S30 (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) 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-S31MX/S32MX/S33MX assumes that an abnormal operation has occurred and may try to reset the system.

(5) Data saving

- The data set by using the remote keypad is temporarily stored in the memory (RAM) of the IV-S30. 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-S30 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-S30.

(6) Storing the devices

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

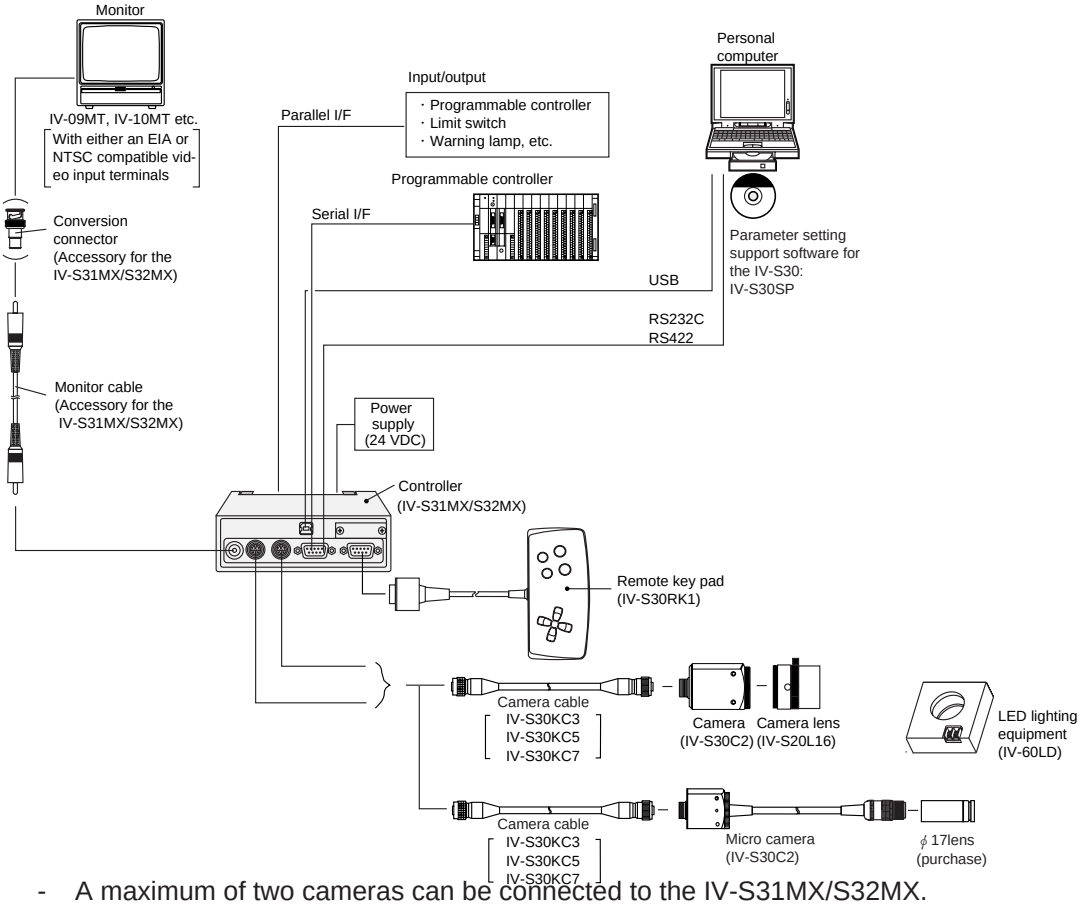
(7) Maintenance

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

[1] When the IV-S31MX/S32MX is used as the controller



- A maximum of two cameras can be connected to the IV-S31MX/S32MX.
- An IV-S20C1 camera (for the IV-S20) also can be connected using a camera conversion cable (IV-S30HC).

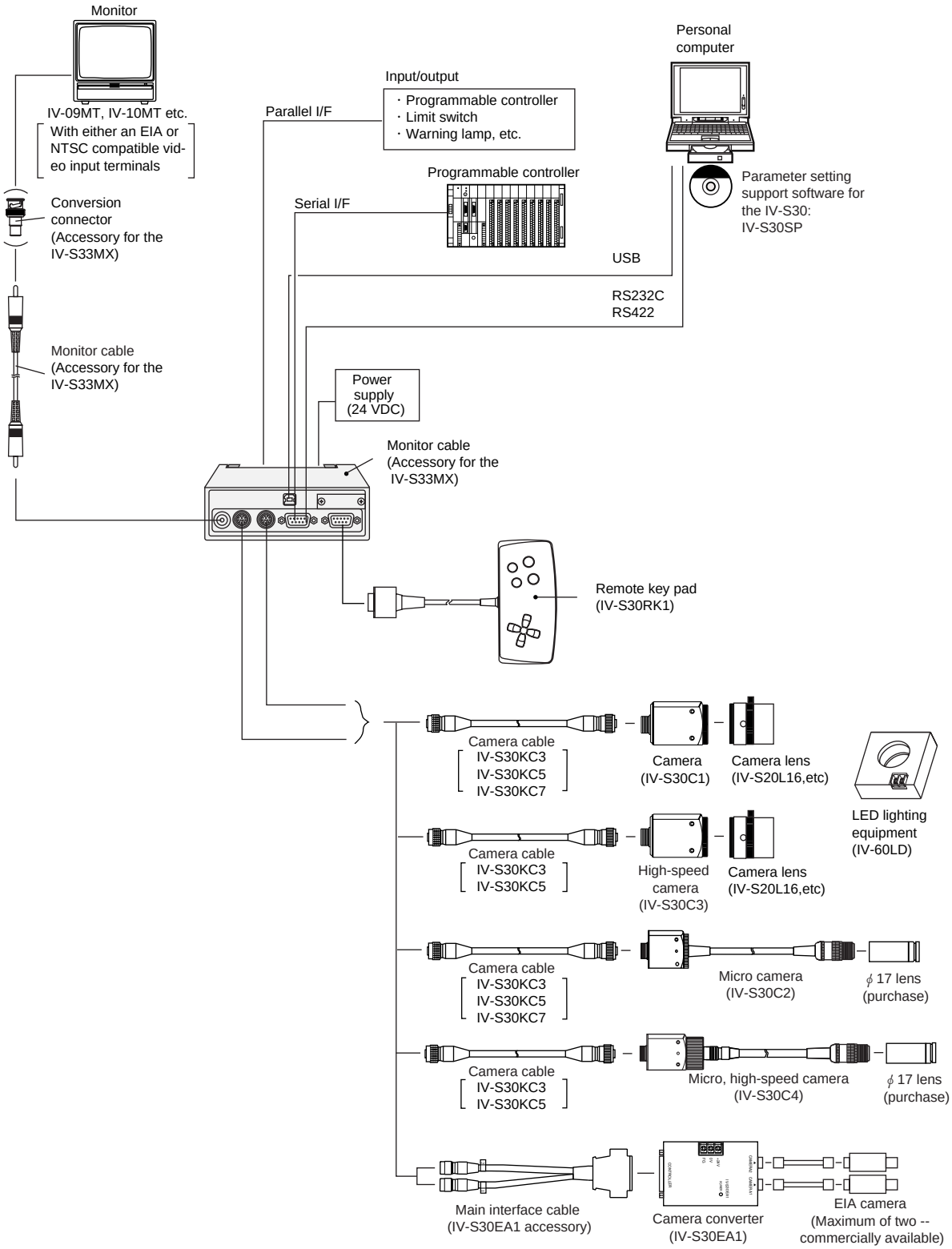
■ Product lines

Item name		Model name	Specification or details
Camera	Standard	IV-S30C1	Camera main housing (without lens or camera cable)
	Micro	IV-S30C2	Camera main housing (without lens or camera cable)
Camera cable		IV-S30KC3	Cable for IV-S30C1/C2 camera, 3 m
		IV-S30KC5	Cable for IV-S30C1/C2 camera, 5 m
		IV-S30KC7	Cable for IV-S30C1/C2 camera, 7 m
Camera lens		IV-S20L16	C mount lens with a 16 mm focal length
Remote keypad		IV-S30RK1	Keys for remote entry
Parameter setting support software		IV-S30SP	Runs on Windows95/98/NT4.0
Image processing library		IV-S30LB1	Runs on Windows95/98/NT4.0
Monochrome monitor		IV-09MT	Monochrome 9 inch monitor
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
LED lighting equipment		IV-60LD	Integrated light source and controller in one housing

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

3

[2] When the IV-S33MX controller is used



- A maximum of two cameras of the same type can be connected to the IV-S33MX.
- Mixed use of different camera types (IV-S30C1/C2, IV-S30C3/C4, and EIA cameras) is not supported.
- The IV-S30KC7 camera cable cannot be used with the IV-S30C3/C4 high-speed camera.
- The IV-S20C1 camera for the IV-S20 can also be connected using a camera conversion cable (IV-S30HC).

■ Product configuration

Item name		Model name	Specification or details
Camera	Standard	IV-S30C1	Camera main housing (without lens or camera cable)
	Micro	IV-S30C2	Camera main housing (without lens or camera cable)
	High-speed	IV-S30C3	Camera main housing (without lens or camera cable)
	Micro, high-speed camera	IV-S30C4	Camera main housing (without lens or camera cable)
Camera converter		IV-S30EA1	Connect up to two EIA cameras (commercially available)
Camera cable		IV-S30KC3	Cable for IV-S30C1/C2/C3/C4 camera, 3 m
		IV-S30KC5	Cable for IV-S30C1/C2/C3/C4 camera, 5 m
		IV-S30KC7	Cable for IV-S30C1/C2 camera, 7 m
Camera lens		IV-S20L16	C mount lens with a 16 mm focal length
Remote keypad		IV-S30RK1	Keys for remote entry
Parameter setting support software		IV-S30SP	Runs on Windows95/98/NT4.0
Image processing library		IV-S30LB1	Runs on Windows95/98/NT4.0
Monochrome monitor		IV-09MT	Monochrome 9 inch monitor
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
LED lighting equipment		IV-60LD	Integrated light source and controller in one housing

- 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, such as measurement using a photo sensor, measurement using CCD trigger, and measurement triggered by a command from a personal computer.

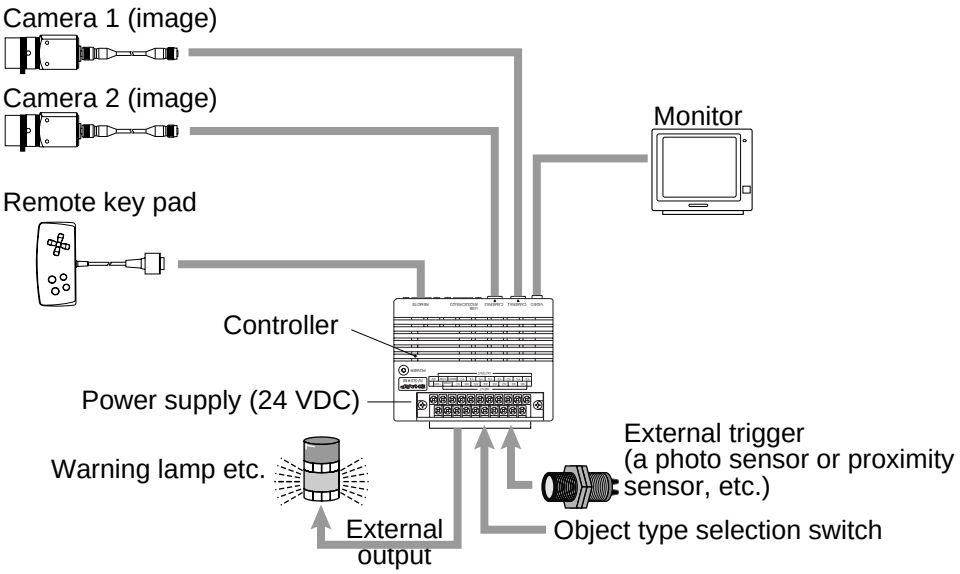
⇨ See "Setting the Input/Output Conditions" in the IV-S31MX/S32MX/S33MX User's Manual (Function and Operation).

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

(1) When IV-S30 is used in a stand-alone mode

- **Purpose/application**

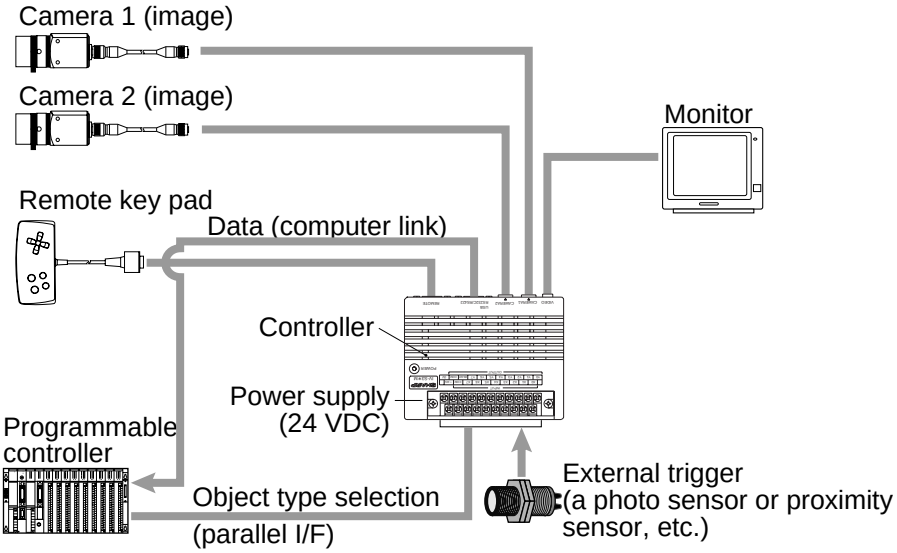
  Measurement is started by an external trigger (a photo sensor or proximity sensor), and the measurement result is output externally (warning lamp). The object type number is selected by an external switch.



(2) When a programmable controller is connected

- **Purpose/application**

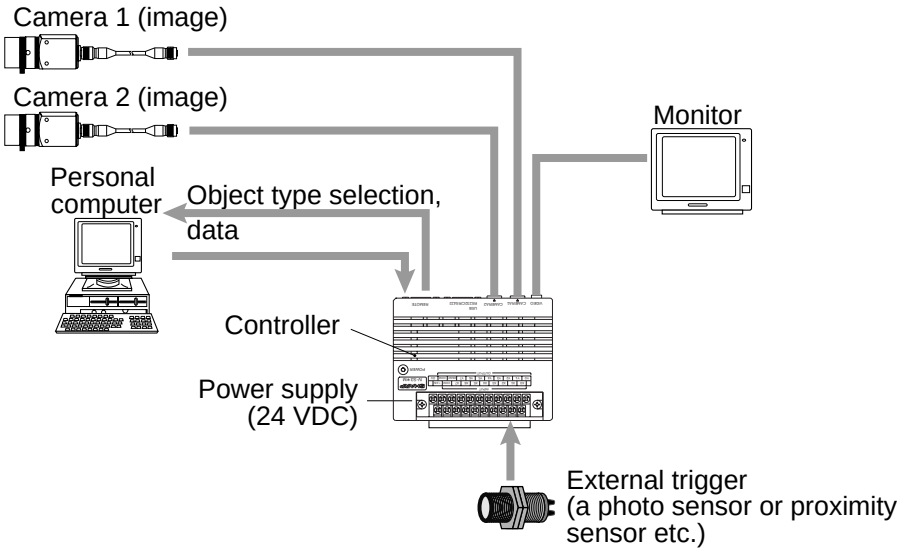
  Measurement is started by an external trigger (a photo sensor or proximity sensor), and the measurement data is output to a programmable controller. The object type number is selected by the programmable controller.



(3) When a personal computer is connected

- **Purpose/application**

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



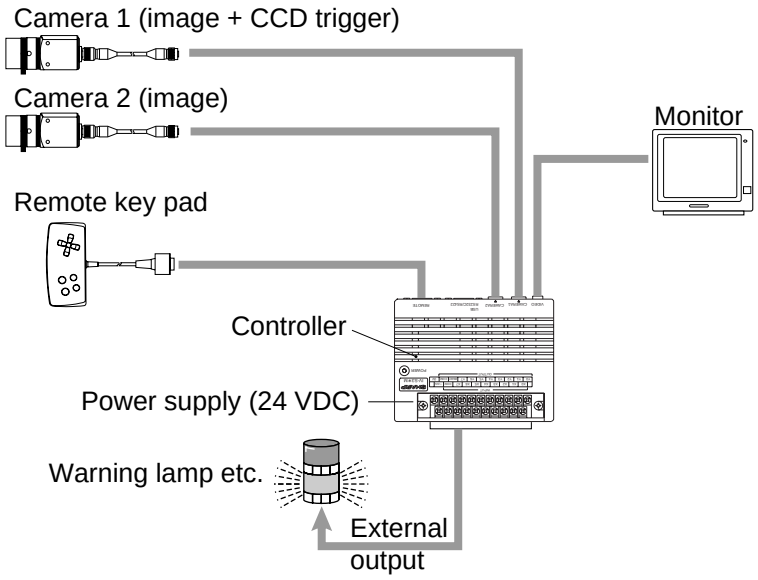
[2] System configuration example for measurement triggered by the internal CCD sensor trigger

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

(1) When IV-S30 is used in a stand-alone mode

- **Purpose/application**

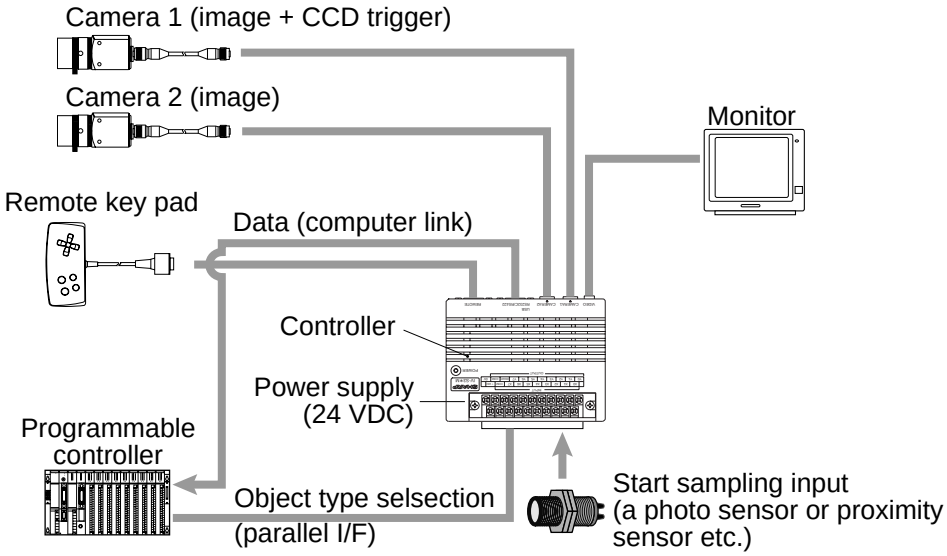
  Measurement is started by a CCD trigger, and the measurement result is output externally (warning lamp etc.). In this case, sampling operation is automatically started.



(2) When a programmable controller is connected

- **Purpose/application**

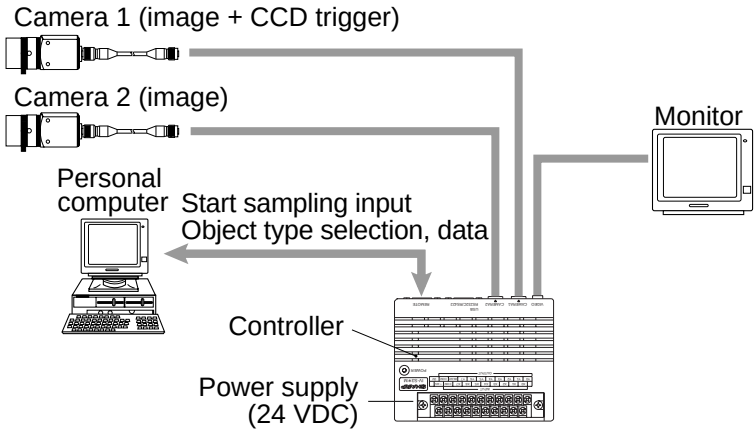
  Measurement is started by a CCD trigger (sampling start input: a photo sensor etc.), and the measurement data is output to a programmable controller. The object type number is selected by the programmable controller.



(3) When a personal computer is connected

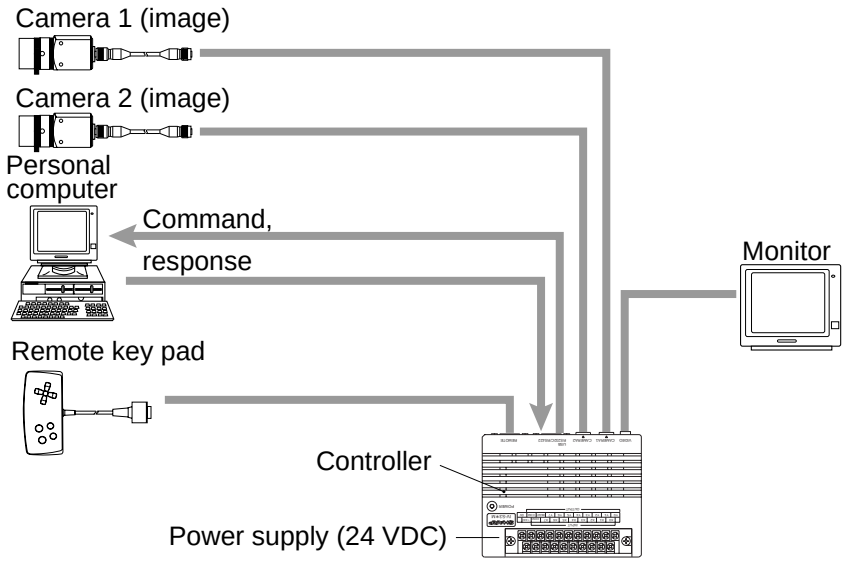
- **Purpose/application**

  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.



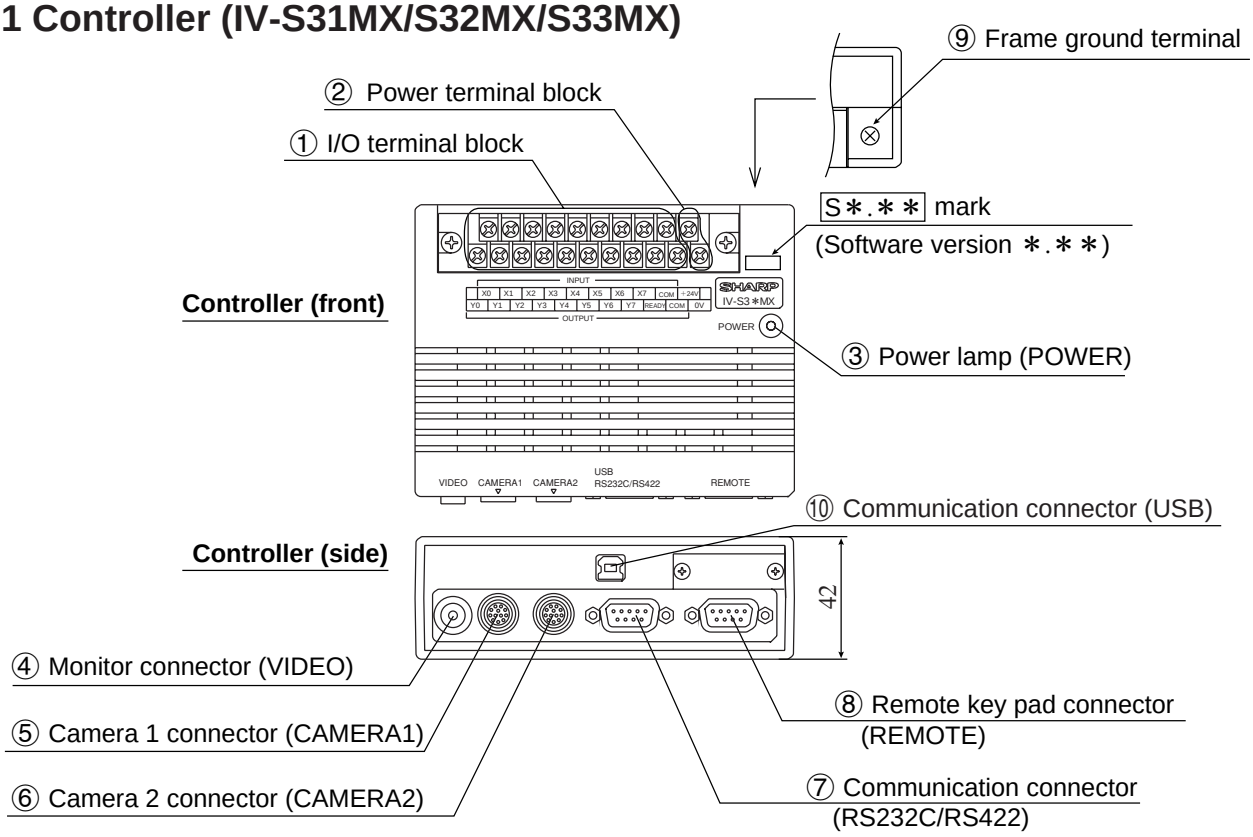
■ **Table of combinations of controllers, camera cables, and cameras.**

Controller+Camera			Compatible cable
IV-S31MX IV-S32MX IV-S33MX	+	IV-S30C1 IV-S30C2	IV-S30KC3 IV-S30KC5 IV-S30KC7
IV-S33MX	+	IV-S30C3 IV-S30C4	IV-S30KC3 IV-S30KC5
IV-S33MX+Camera converter (IV-S30EA1) +Commercially available EIA camera			Main interface cable (IV-S30EA1 accessory)

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-S30 system. See section in Chapter 5 "Connection and Installation Methods" for details about the housing brackets, camera angle bracket and conversion connector.

4-1 Controller (IV-S31MX/S32MX/S33MX)

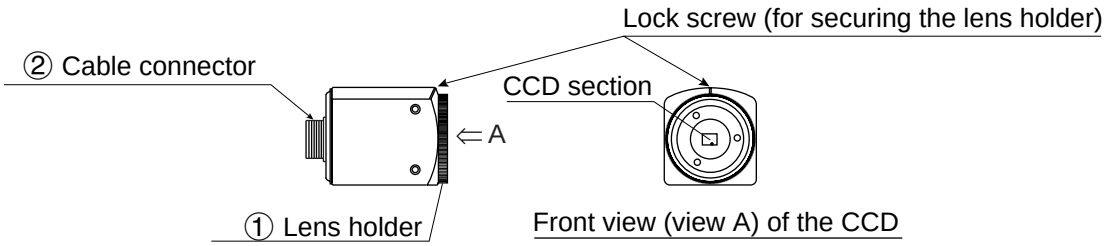


	Name	Function
①	I/O terminal block [INPUT: X0 to X7, C (+) OUTPUT: Y0 to Y7, READY, COM]	This block has 8 input terminals and 9 output terminals. - External devices are connected to these terminals for input and output (parallel I/F). ⇨ See page 5-16.
②	Power terminal block (+24V, 0V)	Commercially available constant-voltage power supply (24 V DC ± 10%, 500 mA or more) is connected here. ⇨ See page 5-15.
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 jack.
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. ⇨ See page 5-19.
⑧	Remote key pad connector (REMOTE)	The remote key pad connector is used to make selections from the menues 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. ⇨See page 5-15.
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.

4-2 Camera

[1] Camera

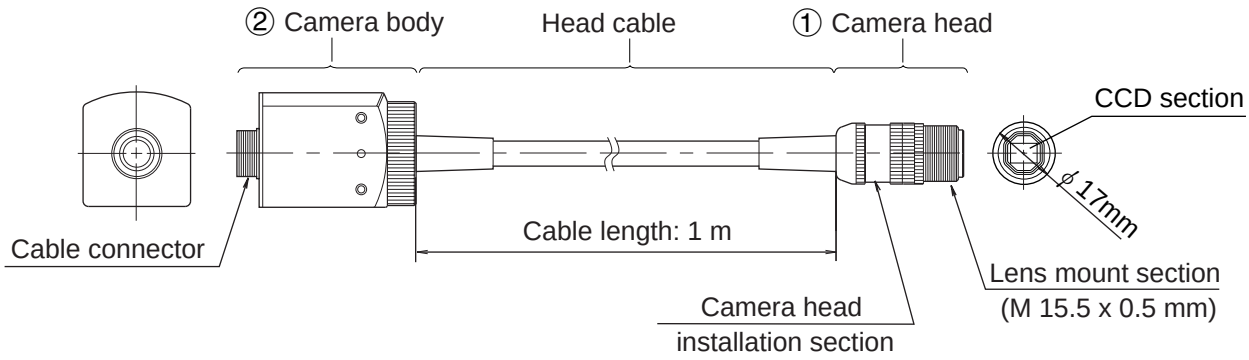
(1) Standard camera (IV-S30C1)



	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/KC7).

- To connect a standard camera (IV-S30C1), use the IV-S31MX/S32MX/S33MX controller and camera cable (IV-S30KC3/KC5/KC7) shown above.

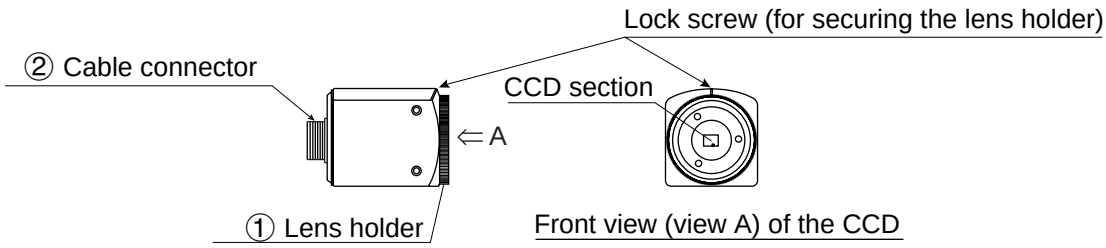
(2) Micro camera (IV-S30C2)



	Name	Function
①	Camera head	Install a (commercially available) lens. - The maximum external diameter of the camera head is ϕ17 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/KC7).

- To connect a micro camera (IV-S30C2), use the IV-S31MX/S32MX/S33MX controller and camera cable (IV-S30KC3/KC5/KC7) shown above.

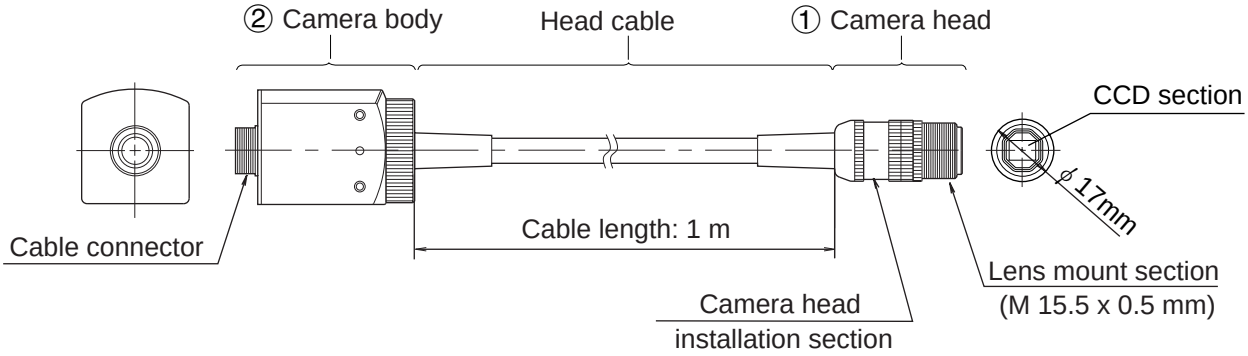
(3) High-speed camera (IV-S30C3)



	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). Note: This cable cannot be used to connect the IV-S30KC7.

- To connect a high-speed camera (IV-S30C3), use the IV-S33MX controller and camera cable (IV-S30KC3/KC5) shown above.
  Note: Do not connect a high-speed camera (IV-S30C3) to the IV-S31MX/S32MX controller.

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



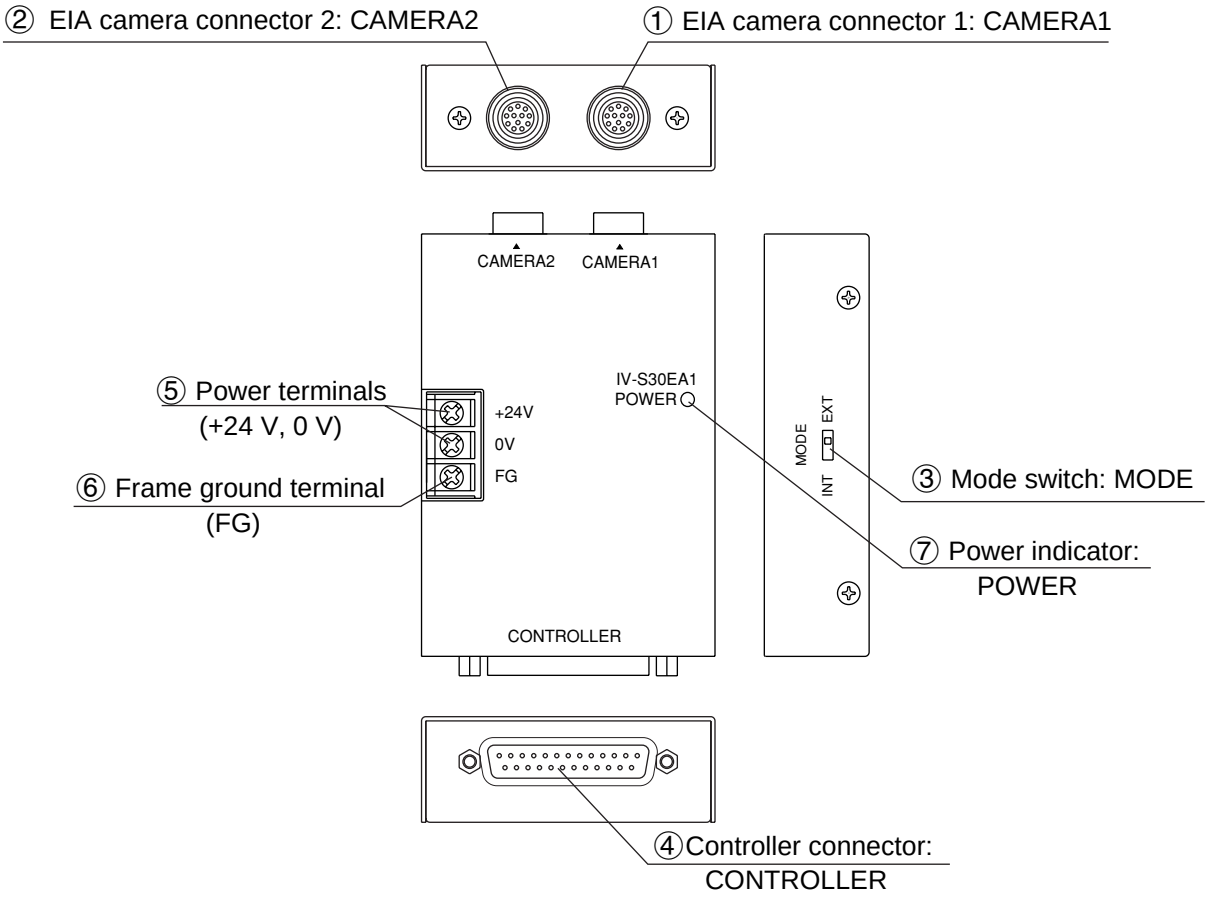
	Name	Function
①	Camera head	Install a (commercially available) lens - The maximum external diameter of the camera head is ø17 mm, and the one for lens mount is M 15.5 x 0.5 mm.
②	Camera body	Connect to the camera connector of the camera cable (IV-S30KC3/KC5) Note: This cable cannot be used to connect the IV-S30KC7.

- To connect micro, high-speed camera (IV-S30C4), use the IV-S33MX controller and camera cable (IV-S30KC3/KC5) shown above.
  Note: Do not connect micro, high-speed camera (IV-S30C4) to the IV-S31MX/S32MX controller.

[2] Connects to commercially available EIA cameras

(1) Camera converter (IV-S30EA1)

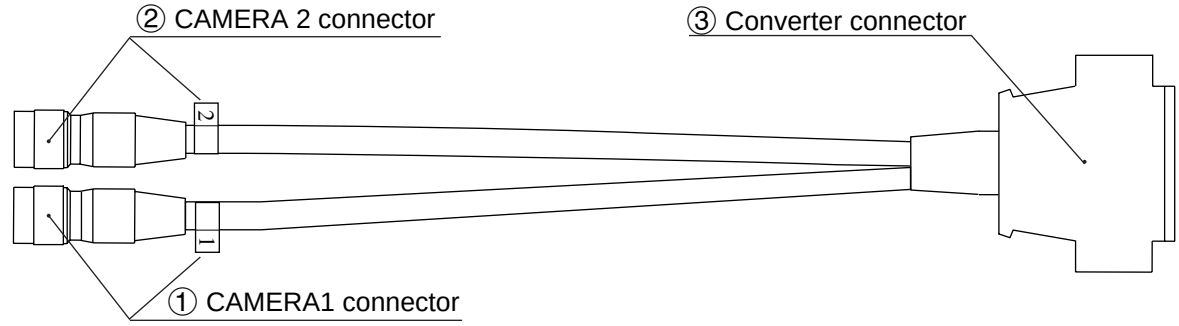
Use the IV-30EA1 camera converter when you want to use a commercially available EIA camera with the IV-S33MX controller.



	Name	Function
①	EIA camera connector 1: CAMERA1	Connect an EIA camera (commercially available). Any camera connected to CAMERA1 will be camera 1, and any camera connected to CAMERA2 will be camera 2. Note: Do not connect SHARP's special IV-S30C1/C2/C3/C4 camera.
②	EIA camera connector 2: CAMERA2	
③	Mode switch: MODE	Select the camera synchronization mode from EXT and INT. Use a thin pointed object such as a ballpoint pen. - EXT = Lets you use an EIA camera with an externally synchronized mode (a synchronizing signal is sent from the IV-S33MX to the EIA camera). - INT = Lets you use an EIA camera with an internally synchronized mode.
④	Controller connector: CONTROLLER	Connect to the main housing cable (supplied with the IV-S30EA1, see the next page) to the IV-S33MX controller.
⑤	Power terminals (+24 V, 0 V)	Connect to any commercially available constant voltage DC power supply (24 VDC±10%, 500 mA or more)
⑥	Frame ground terminal (FG)	This terminal is commoned with the enclosure. When the EIA camera is connected to the controller using a shielded cable, the EIA camera housing will be electrically connected to this terminal.
⑦	Power indicator: POWER	When power is supplied to the IV-S30EA1, this lamp will light green.

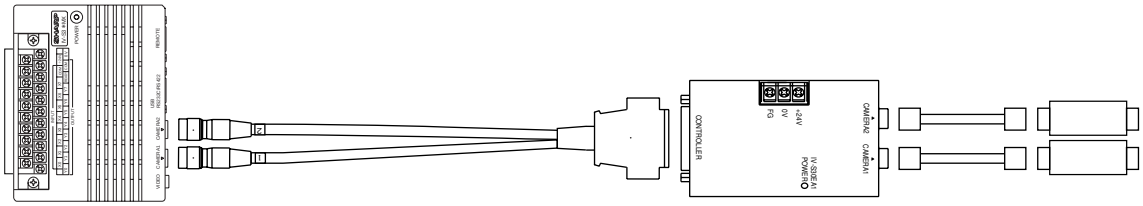
- To connect the IV-S30EA1 camera converter to the IV-S33MX controller, use the cable supplied with the IV-S33MX (see the next page).
  Note: The IV-S30EA1 camera converter cannot be connected to the IV-S31MX/S32MX controller.

(2) Cable to connect the camera converter to the controller (supplied with the IV-S30EA1)



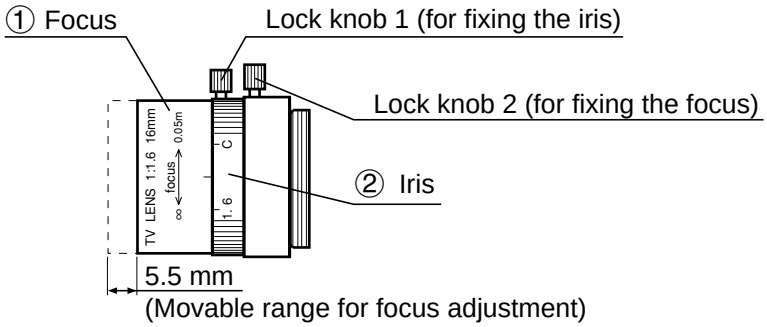
	Name	Function
①	Camera 1 connector	Connect to the CAMERA 1 and CAMERA 2 connectors on the IV-S33MX controller.
②	Camera 2 connector	
③	Converter connection connector	Connect to the controller side connector on the IV-S30EA1.

(3) Connection example using an EIA camera



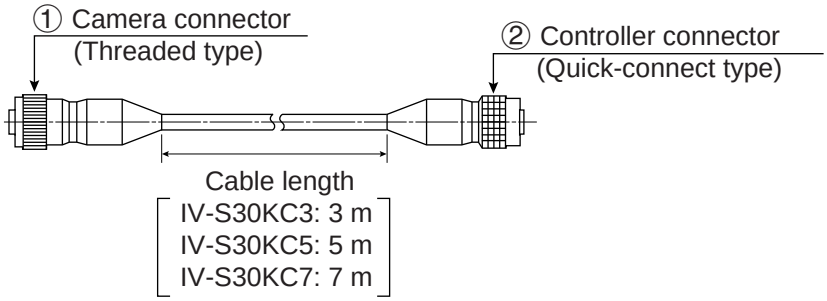
Controller IV-S31MX/S32MX/S33MX | Main interface cable | Camera converter IV-S30EA1 | Commercially available EIA cameras

[3] Camera lens (IV-S20L16)



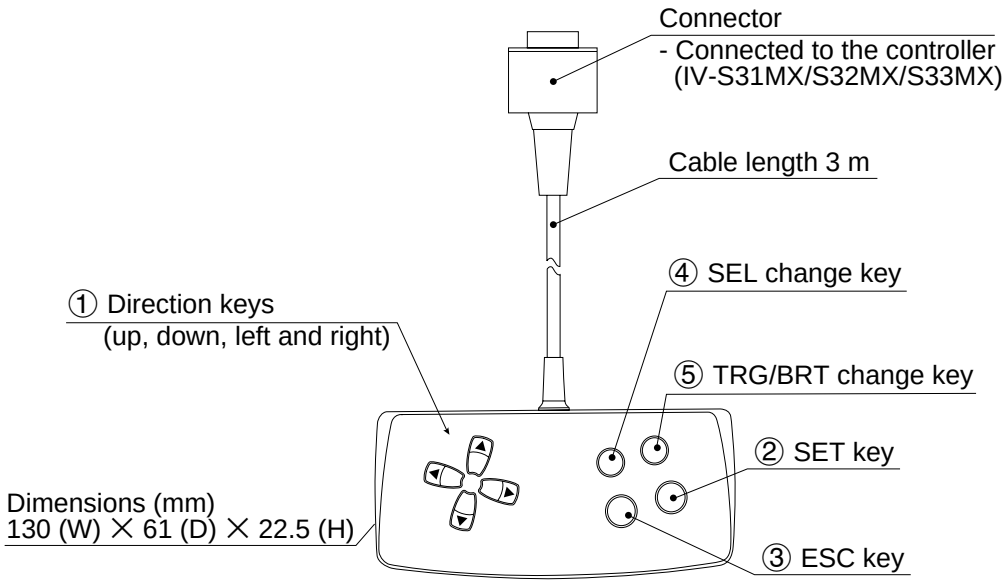
	Name	Function
①	Focus	To focus an image -The focall enght (distance from an object) is 50 mm to infinity (from the front of lens).
②	Iris	To adjust the image brightness. -The iris a perture can be set from 1.6mm to closed.

[4] Camera cable (IV-S30KC3/KC5/KC7)



	Name	Function
①	Camera connector	Connect to a connector of camera cable (IV-S30C1/C2/C3/C4). Note: The IV-S30KC7 cannot be connected to the IV-S30C3/C4.
②	Controller connector	Connect to camera 1 connector or camera 2 connector of the controller (IV-S31MX/S32MX/S33MX).

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

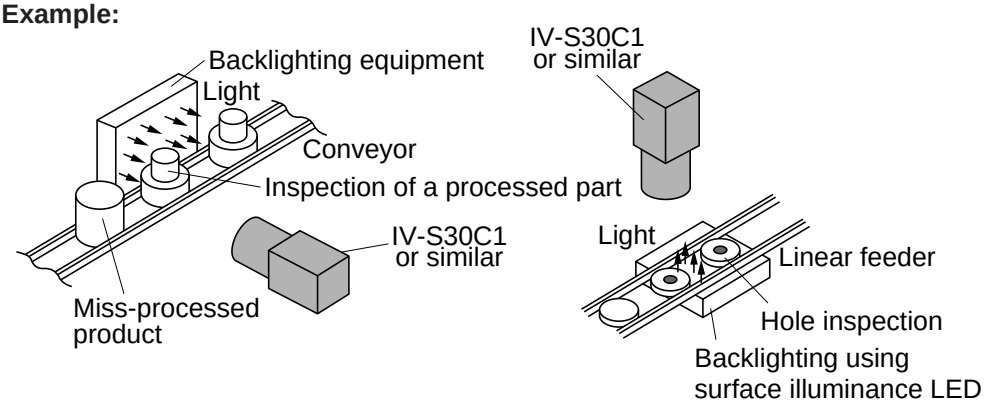
Lighting for the workpieces is an important factor in image processing. The lighting conditions affect the measurement results. Select the proper lighting equipment.

- 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-S30 measure the object with it's shadow. Since the shadow picture will be converted to binary values, reliable measurements can be executed.

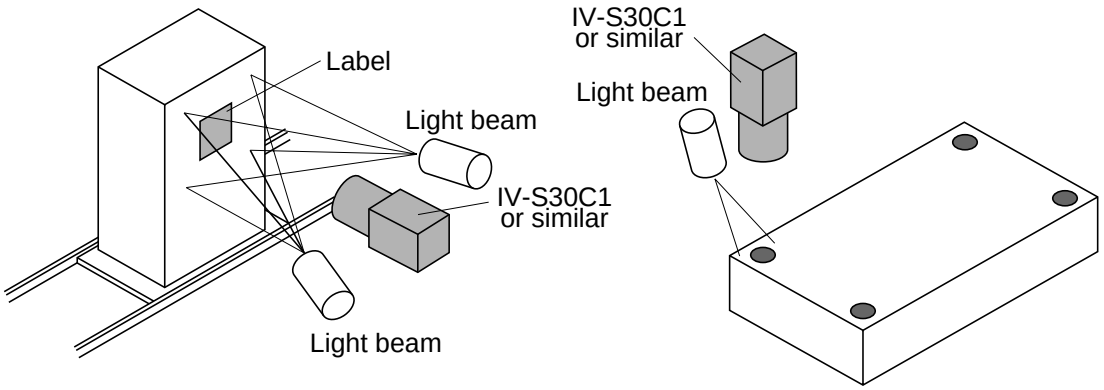
Example:



(2) Reflective lighting

A light shone on the front of an object with angle will be reflected, and the IV-S30 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:

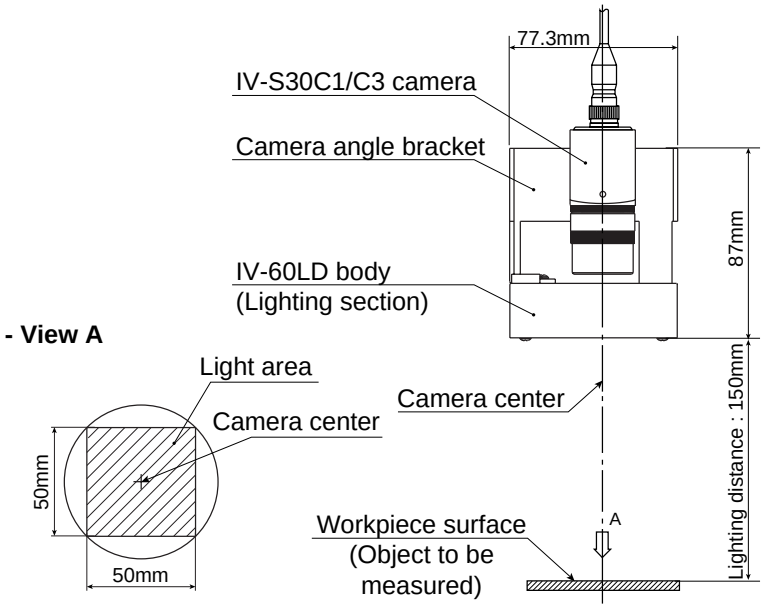


Label detection

Measurement of the center coordinates of a hole

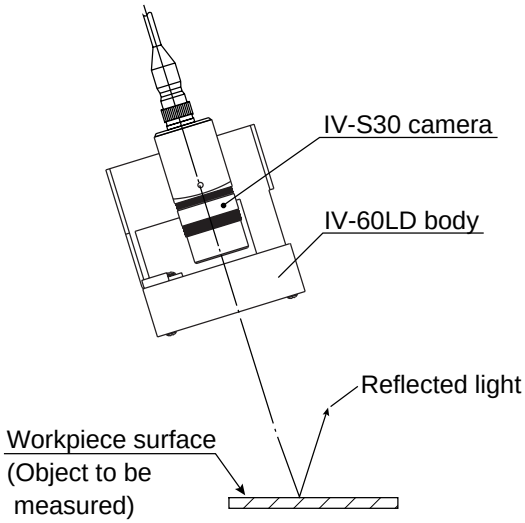
When using the IV-60LD

This paragraph describes how to use Sharp IV-60LD LED lighting equipment. For details about the installation and wiring of the IV-60LD, see the instruction manual.
The distance between the IV-60LD and an object (distance at which to install lighting equipment) should be approximately 150 mm, and the lit area is approximately 50 mm x 50 mm.
If the lighting distance is reduced approximately 60 mm, the lighting may be uneven.



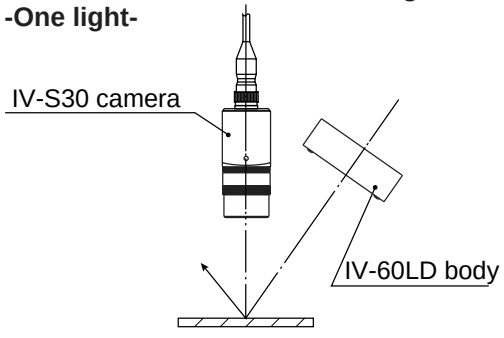
When the light is projected from above the object and if reflection off the object influences the image processing, try the following countermeasures.

1) Tilt the camera center axis (within a range that does not affect the image processing) to move away from the light reflected from the object.

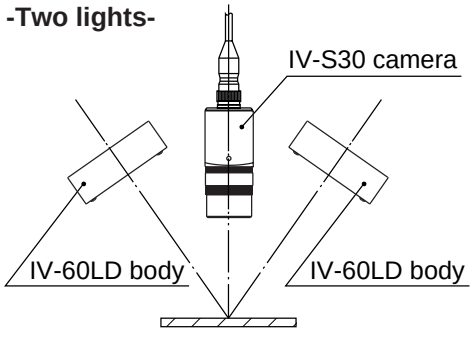


2) Separate the camera from the lighting equipment. Install the IV-60LD lighting equipment so that it will shines from an angle that prevents creation of the reflection.

-One light-



-Two lights-

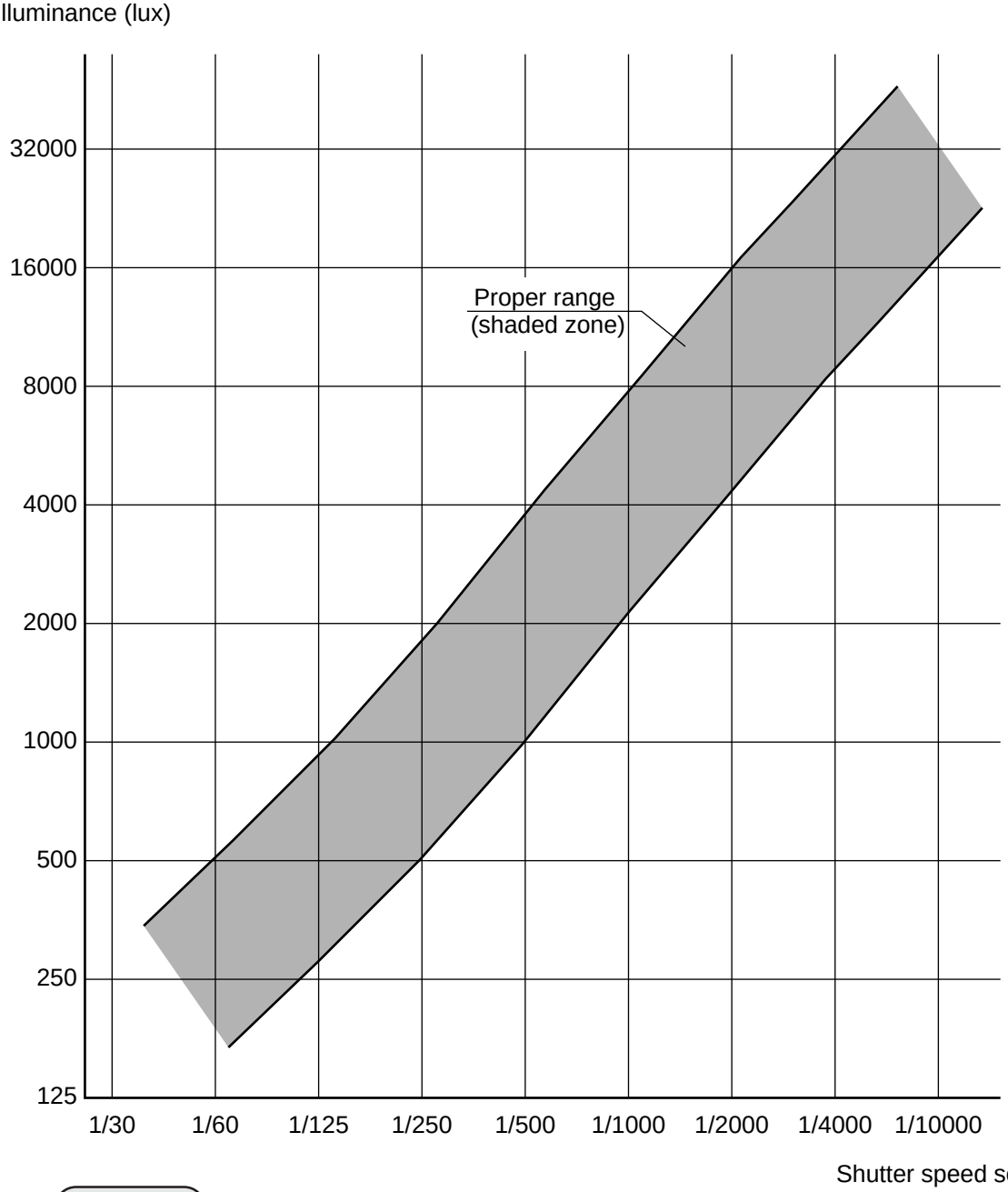


[2] Illuminance and shutter speed

The illuminance provided by the lighting equipment and the shutter speed must be set within the proper range.

- The following graph shows the relation between illuminance and shutter speed for the IV-S20L16 camera lens (focal length 16 mm) with an aperture setting of f = 1.6.
  Determine the proper amount of illuminance and the correct shutter speed, by referring to this graph. Adjust the aperture as necessary.
- To measure a moving object, or to increase the image processing speed, set the shutter speed to 1/1000 sec. or 1/2000 sec. or faster. However, an extremely high shutter speed will require intense lighting, thereby increasing the cost.

Relation between illuminance and shutter speed [IV-S20L16 camera lens (focal length 16 mm) with an aperture setting of f = 1.6]



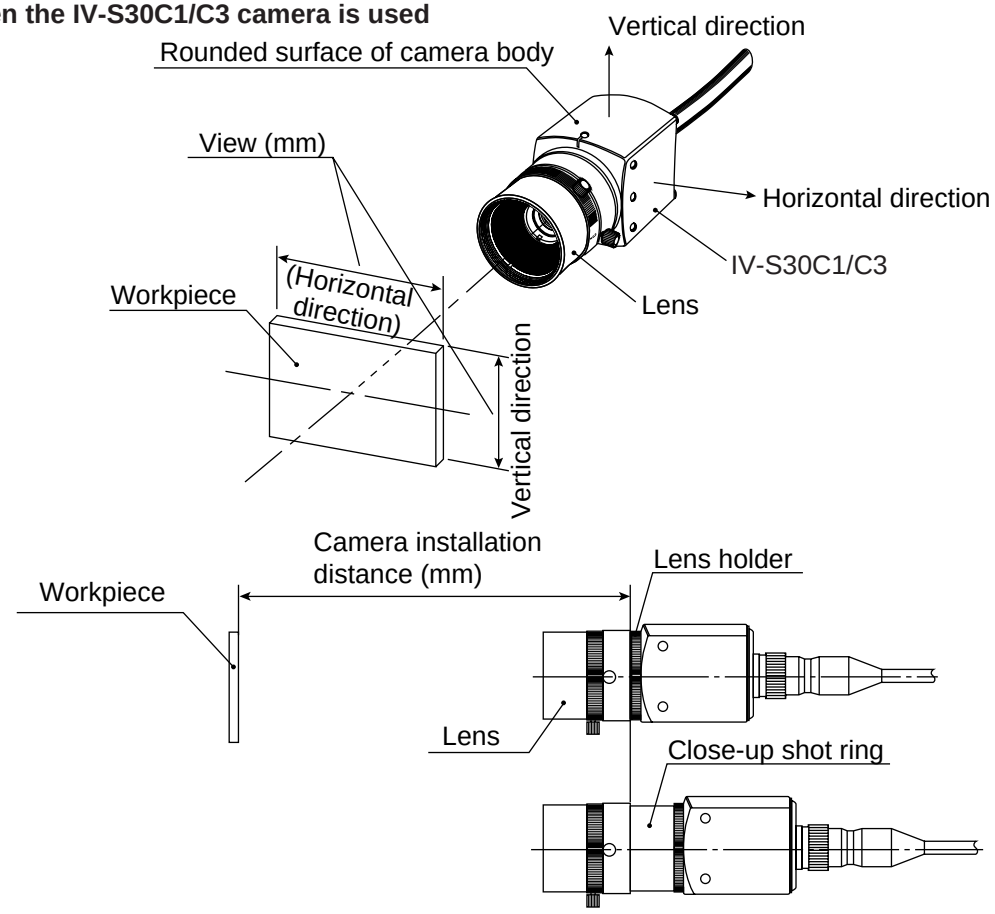
Note

- The standard relationship between illuminance and shutter speed is given above for reference. When actually installing the equipment, make sure the proper combination is used for the actual system.

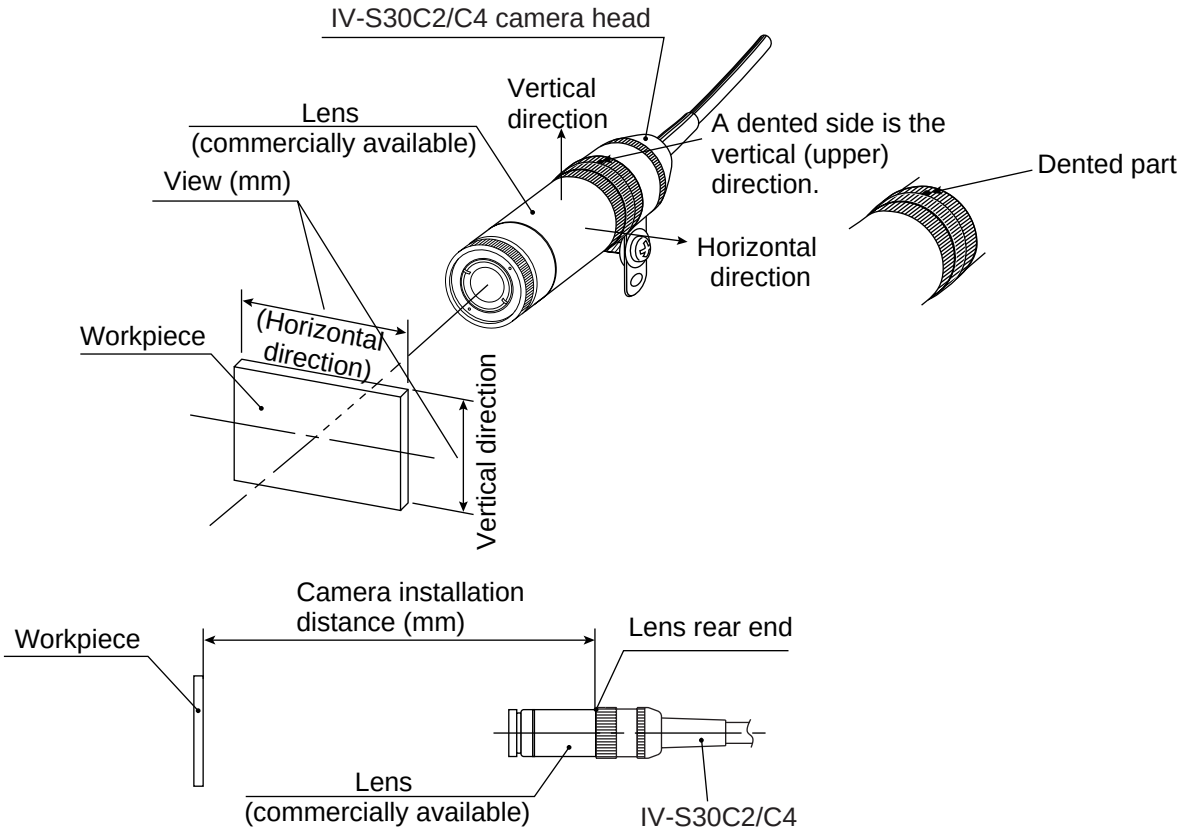
[3] Optimum lens and resolution

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-S30C1/C3 camera is used



• When the IV-S30C2/C4 camera is used



There is a relationships as shown on page 5-7 to page 5-9, 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-S30C1/C3 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 5-7.

Camera installation distance (mm)	Lens focal length f=16mm			
	View (mm)		Focal length (mm)	Resolution (mm)
	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 mm.

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

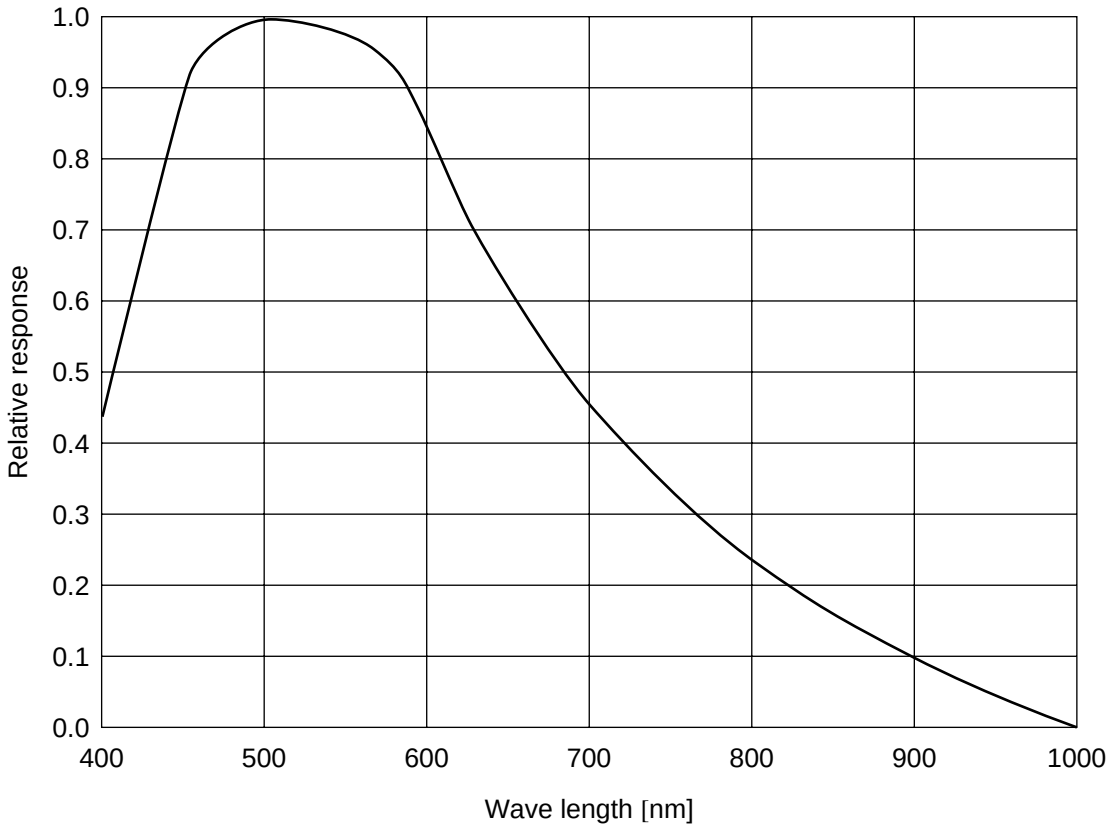
⇨ See "G-9" for the diefinition of resolution.

Notes

- The values shown in the tables on page 5-7 to 5-9 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-S30C1/C3 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-S30C2/C4 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.

The spectral sensitivity characteristics of the CCD element used in the CCD camera are listed below.

- Spectral sensitivity characteristics of the CCD element



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

• When the IV-S30C1/C3 camera is used

Camera installation distance (mm)	Lens focal length f=4.2mm				Lens focal length f=8mm				Lens focal length f=16mm				Lens focal length f=25mm			
	View (mm)		Focal length	Resolution	View (mm)		Focal length	Resolution	View (mm)		Focal length	Resolution	View (mm)		Focal length	Resolution
	Vertical	Hori-zontal	(mm)	(mm)	Vertical	Hori-zontal	(mm)	(mm)	Vertical	Hori-zontal	(mm)	(mm)	Vertical	Hori-zontal	(mm)	(mm)
55	39.7	42.4	4.9	82.8	14.2	15.2	10.0	29.6	–	–	–	–	–	–	–	–
60	44.0	46.9	4.8	91.6	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	52.4	55.9	4.7	109.2	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	60.9	65.0	4.7	126.9	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	69.3	74.0	4.6	144.5	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	77.8	83.0	4.6	162.1	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	94.7	101.0	4.5	197.3	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	111.6	119.1	4.5	232.6	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	128.5	137.1	4.4	267.8	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	145.5	155.2	4.4	303.1	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	162.4	173.2	4.4	338.3	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	204.7	218.3	4.3	426.4	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	246.9	263.4	4.3	514.5	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	289.2	308.5	4.3	602.6	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	331.5	353.6	4.3	690.7	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	373.8	398.7	4.3	778.8	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	416.1	443.9	4.3	866.9	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	500.7	534.1	4.3	1043.1	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	585.2	624.3	4.2	1219.3	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	669.8	714.5	4.2	1395.5	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	754.4	804.7	4.2	1571.7	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	838.9	894.9	4.2	1747.9	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	923.5	985.1	4.2	1924.1	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	1008.1	1075.4	4.2	2100.3	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	1092.7	1165.6	4.2	2276.5	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	1177.2	1255.8	4.2	2452.7	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	1261.8	1346.0	4.2	2628.9	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	1346.4	1436.2	4.2	2805.1	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	1430.9	1526.4	4.2	2981.3	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	1515.5	1616.6	4.2	3157.5	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	1600.1	1706.9	4.2	3333.7	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	1684.7	1797.1	4.2	3509.9	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	2107.5	2248.1	4.2	4390.9	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	2530.4	2699.2	4.2	5271.9	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	2953.2	3150.3	4.2	6152.9	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	3376.1	3601.4	4.2	7033.9	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	3798.9	4052.4	4.2	7914.9	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	4221.8	4503.5	4.2	8795.9	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	4644.7	4954.6	4.2	9676.9	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	5067.5	5405.6	4.2	10557.9	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	5490.4	5856.7	4.2	11438.9	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	5913.2	6307.8	4.2	12319.9	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	6336.1	6758.9	4.2	13200.9	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	Horizontal	(mm)	(mm)	Vertical	Horizontal	(mm)	(mm)	Vertical	Horizontal	(mm)	(mm)
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-S30C2/C4 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 (mm)	Workpiece size (Hmm)	Workpiece size (Hmm)	Focal length (mm)	Resolution (mm)	Workpiece size (Hmm)	Workpiece size (Hmm)	Focal length (mm)	Resolution (mm)
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

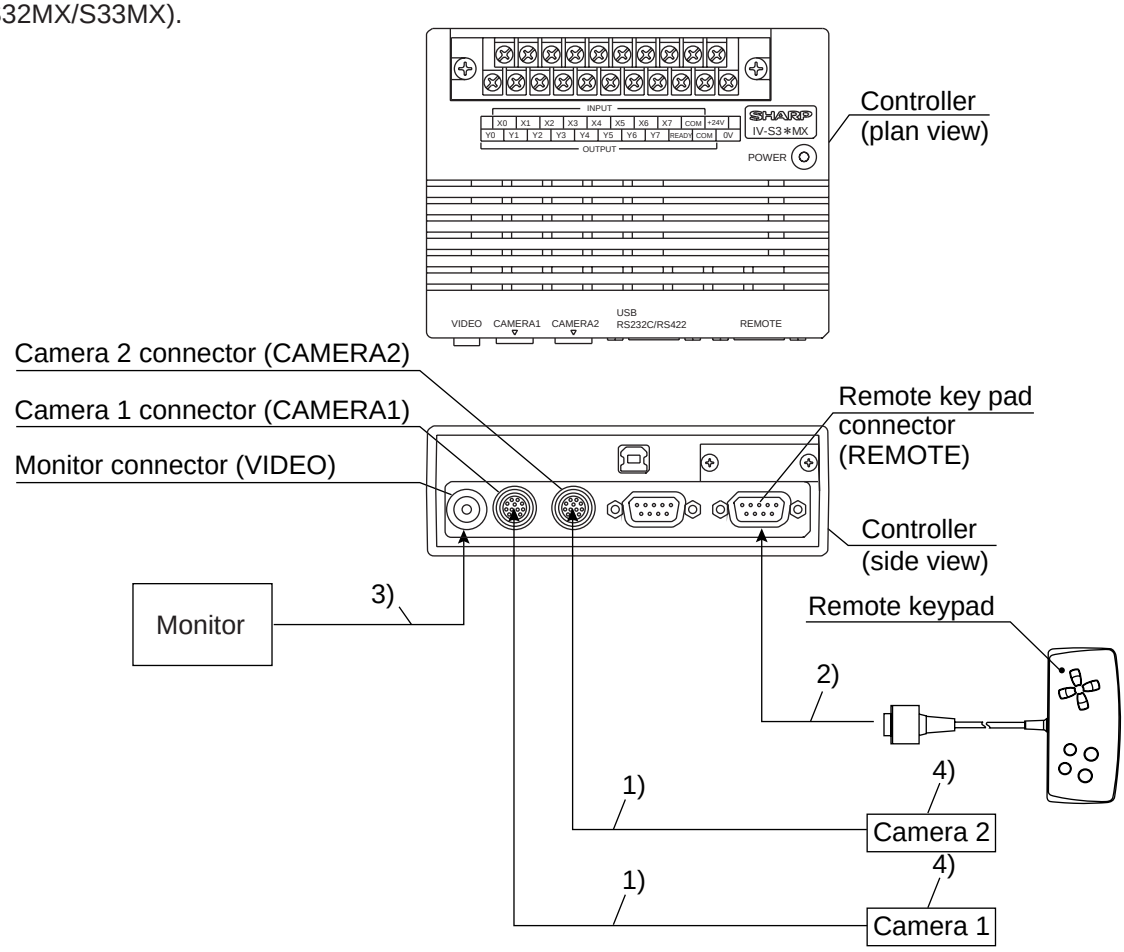
(Vertical size x Horizontal size x Diagonal size) mm

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-S31MX/S32MX/S33MX controller

[1] Connecting equipment to the controller

Connect the cameras (up to 2 cameras), remote keypad, and monitor to the controller (IV-S31MX/S32MX/S33MX).



1) Connect the camera cable (IV-S30KC3/S30KC5/S30KC7) connector or a connector of the main interface cable supplied with the IV-S30EA1 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.
The main interface cable supplied with the IV-S30EA1 can be connected to the IV-S33MX only.

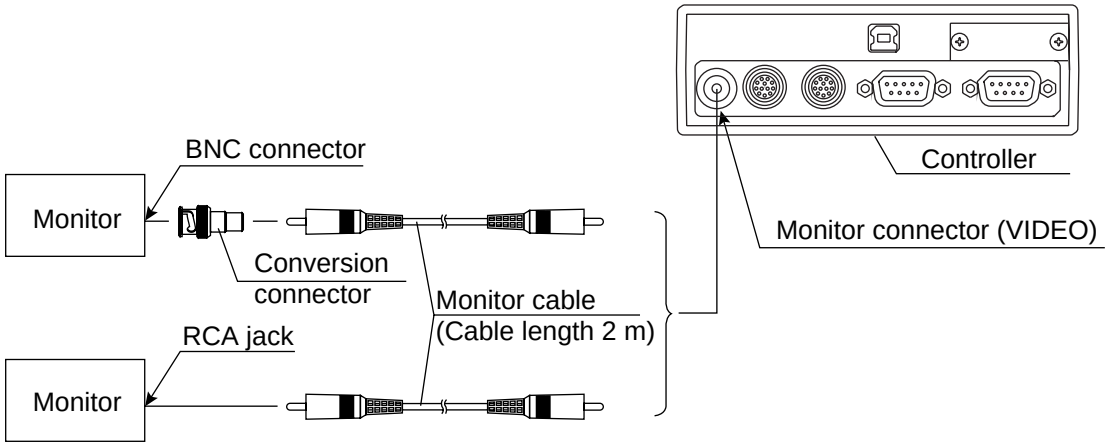
- Push the convex side of the connector into the concave side of the mating connector. When the connector is all the way on, it clicks.
- To disconnect the connector, hold the plug of the connector, and pull it straight out.
- A camera connected to the camera 1 connector (CAMERA1) is treated as camera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

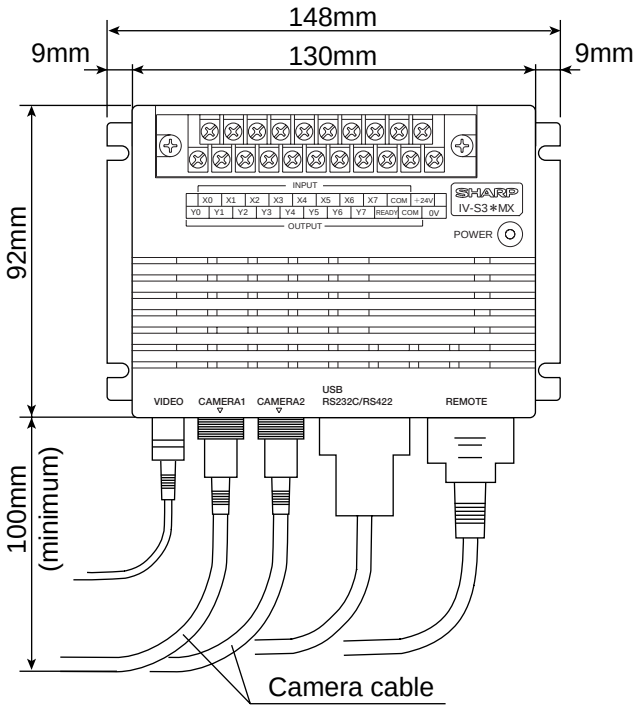


- If you need a monitor cable longer than 2 m, you can purchase a one at a video store.

4) For details about connecting and installing cameras, see page 5-23 and after in this manual.

■ Leave enough space around the controller (IV-S31MX/S32MX/S33MX)

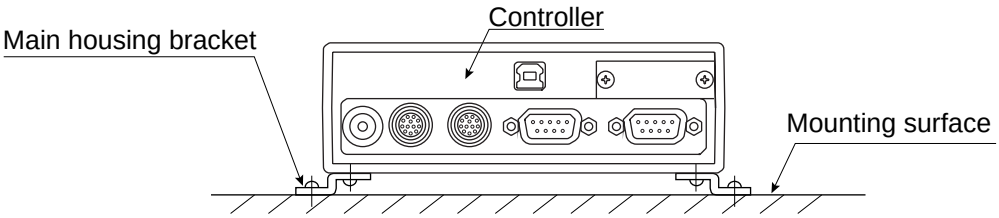
In order to connect camera cables, the remote key pad cable, monitor cable and D-sub connector to the controller, the following space (min.) is required.



- 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.

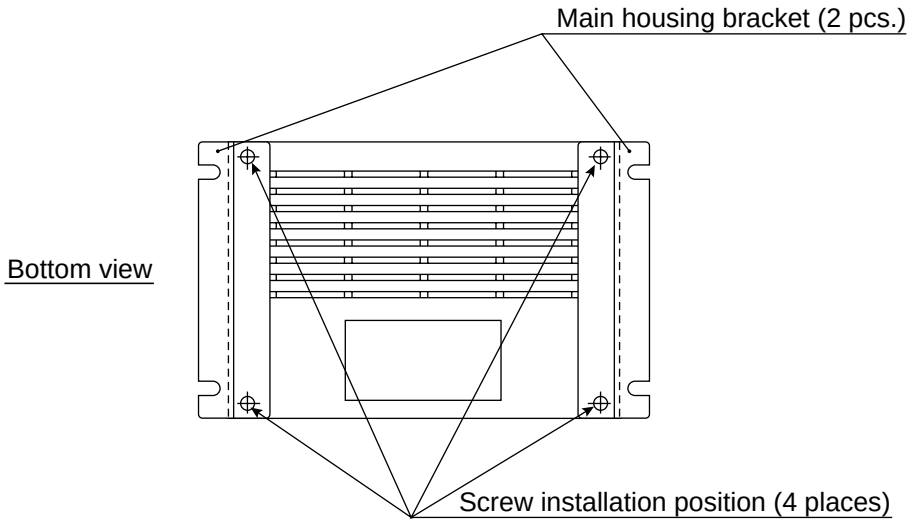
[2] Installation

To install the IV-S31MX/S32MX/S33MX controller, secure the bottom of the housing on the mounting surface with the two main housing brackets (supplied with the controller.)

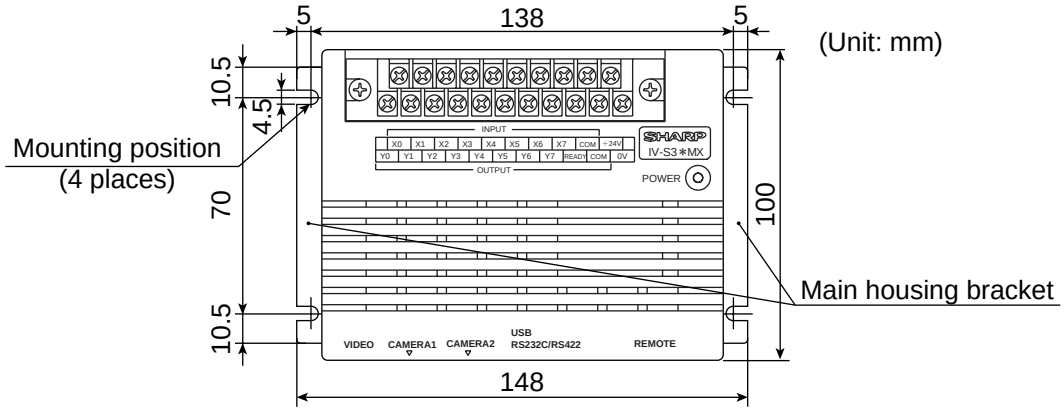


■ Mounting procedure

1. Attach the two main housing brackets on the bottom of the controller.
   Four screws (M 3 x 6) are supplied to attach the brackets.



2. Secure the controller on the mounting surface using the main housing brackets.

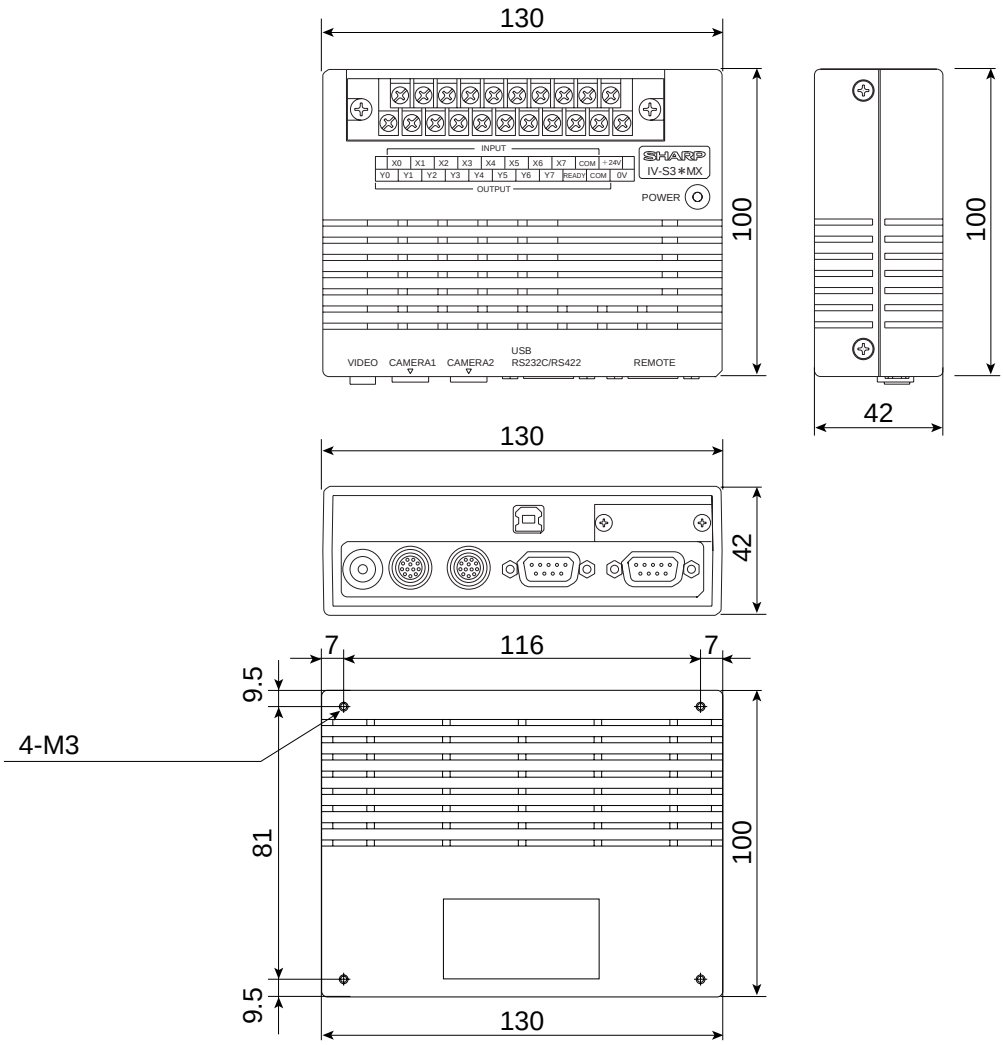


⇨ The external dimensions of the main housing brackets and the controller are shown on the following page.

5

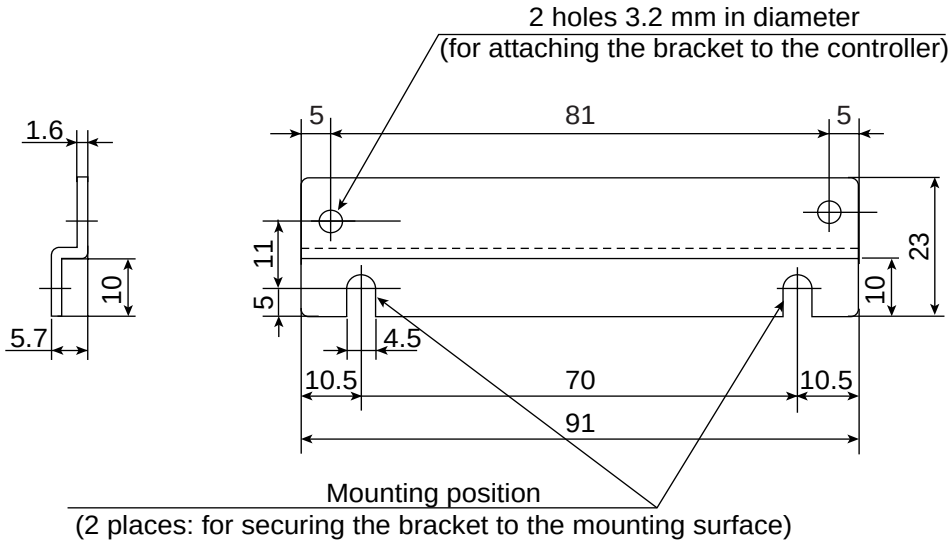
- External dimensions of the controller (IV-S31MX/S32MX/S33MX)

(Unit: mm)



- External dimensions of main housing bracket

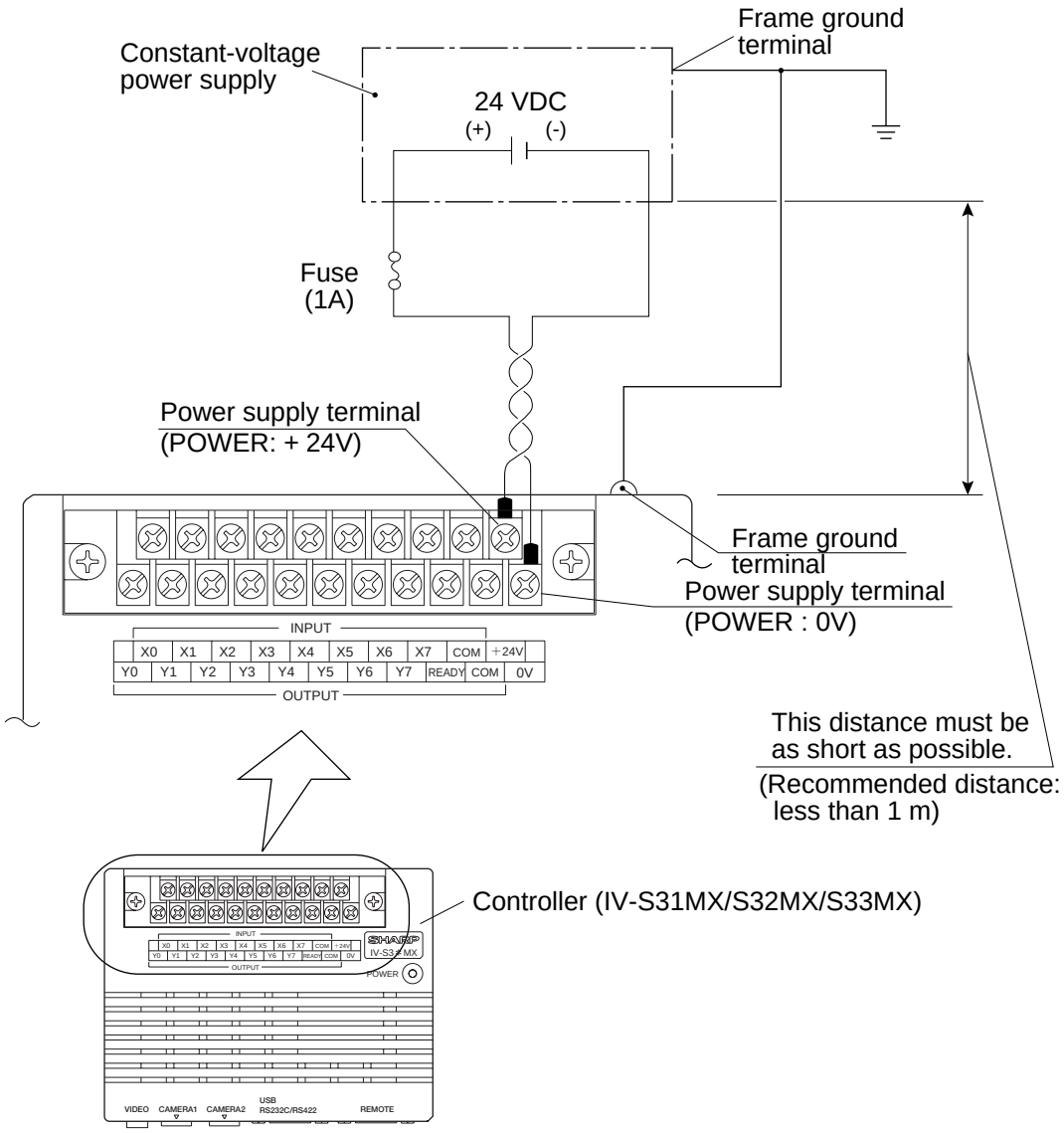
(Unit: mm)



[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-S31MX/S32MX/S33MX). Use a 24 VDC ±10%, 500 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

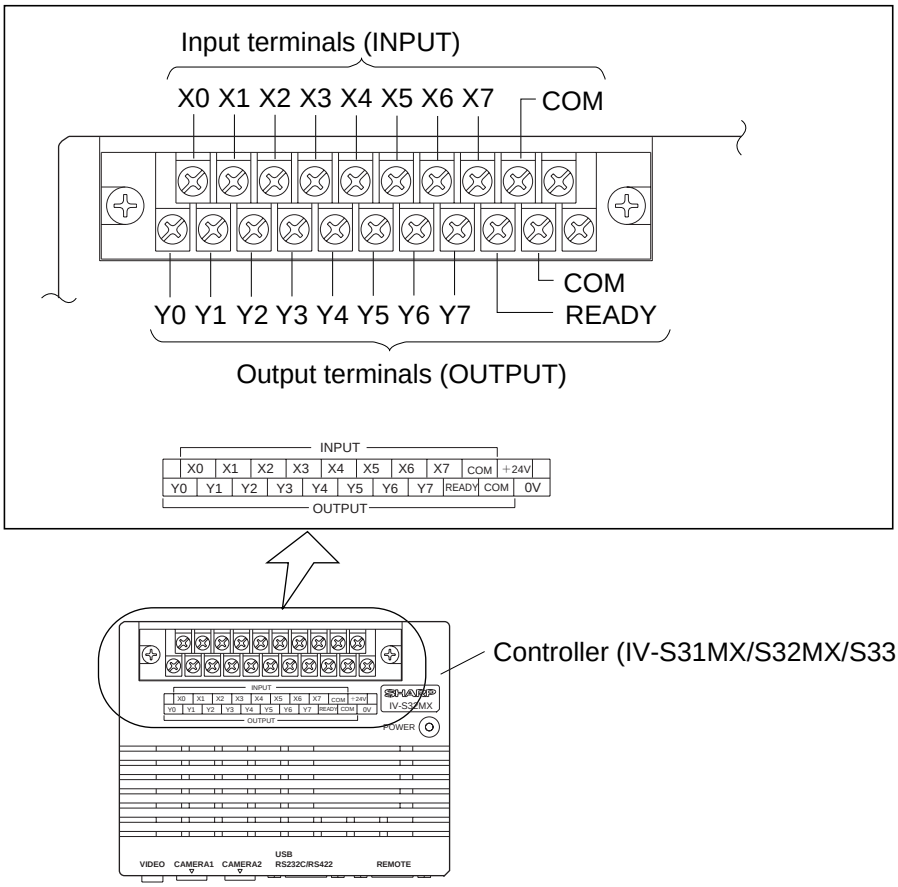
To improve the noise resistance of the constant-voltage power supply connected to the controller (IV-S31MX/S32MX/S33MX), observe the following precautions.

- 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-S31MX/S32MX/S33MX).
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]



Controller (IV-S31MX/S32MX/S33MX)

Terminal block	Interrupt processing input (1 terminal)	External trigger (X0)
	Input (7 terminals)	-IV-S32MX/S33MX Object type change (X1 to 5): 5 terminals External input (X6 and 7): 2 terminals -IV-S31MX Object type change (X1 to 4): 4 terminals External input (X5 to 7): 3 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

(1) Input terminals (INPUT) X0 to X7

Input terminal	Input/output condition setting *1	Input details
X0	Measurement start input I/F = CCD trigger CCD sampling start = General-purpose serial interface signal or auto detect (edge + level)	External input
	Measurement start input I/F = Parallel + General-purpose serial interface signal + USB	Measurement start input
	Measurement start input I/F = CCD trigger CCD sampling start = Parallel	
X1 to 5	Measurement start input I/F = CCD trigger CCD sampling start = General-purpose serial interface signal or auto detect (edge + level)	External input
	Measurement start input I/F = Parallel + General-purpose serial + USB	Object type numbers *2 IV-S32MX/S33MX: 0 to 31 IV-S31MX: 0 to 15 - X5 is used for external input on the IV-S31MX
	Measurement start input I/F = CCD trigger CCD sampling start = Parallel	
X6	Parallel input X6 is used for external input, a register reference image signal, or to correct a total area judgement.	
X7	Parallel input X7 is used for external input, a change in the output camera signal, measurements with each camera, and for overlapping images.	

*1: For details about the settings on the [I/O CONDITIONS] menu, see "Setting the Input/Output Conditions" in the IV-S30 (IV-S31MX/S32MX/S33MX) User's Manual (Function and Operation).
*2: Object type numbers and X1 to X5 have the following relationships.

• IV-S32MX/S33MX

Object type	X5	X4	X3	X2	X1
00	OFF	OFF	OFF	OFF	OFF
01	OFF	OFF	OFF	OFF	ON
02	OFF	OFF	OFF	ON	OFF
03	OFF	OFF	OFF	ON	ON
04	OFF	OFF	ON	OFF	OFF
05	OFF	OFF	ON	OFF	ON
06	OFF	OFF	ON	ON	OFF
07	OFF	OFF	ON	ON	ON
08	OFF	ON	OFF	OFF	OFF
09	OFF	ON	OFF	OFF	ON
10	OFF	ON	OFF	ON	OFF
11	OFF	ON	OFF	ON	ON
12	OFF	ON	ON	OFF	OFF
13	OFF	ON	ON	OFF	ON
14	OFF	ON	ON	ON	OFF
15	OFF	ON	ON	ON	ON

Object type	X5	X4	X3	X2	X1
16	ON	OFF	OFF	OFF	OFF
17	ON	OFF	OFF	OFF	ON
18	ON	OFF	OFF	ON	OFF
19	ON	OFF	OFF	ON	ON
20	ON	OFF	ON	OFF	OFF
21	ON	OFF	ON	OFF	ON
22	ON	OFF	ON	ON	OFF
23	ON	OFF	ON	ON	ON
24	ON	ON	OFF	OFF	OFF
25	ON	ON	OFF	OFF	ON
26	ON	ON	OFF	ON	OFF
27	ON	ON	OFF	ON	ON
28	ON	ON	ON	OFF	OFF
29	ON	ON	ON	OFF	ON
30	ON	ON	ON	ON	OFF
31	ON	ON	ON	ON	ON

• IV-S31MX

Object type	X4	X3	X2	X1
0	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	ON
2	OFF	OFF	ON	OFF
3	OFF	OFF	ON	ON
4	OFF	ON	OFF	OFF
5	OFF	ON	OFF	ON
6	OFF	ON	ON	OFF
7	OFF	ON	ON	ON

Object type	X4	X3	X2	X1
8	ON	OFF	OFF	OFF
9	ON	OFF	OFF	ON
10	ON	OFF	ON	OFF
11	ON	OFF	ON	ON
12	ON	ON	OFF	OFF
13	ON	ON	OFF	ON
14	ON	ON	ON	OFF
15	ON	ON	ON	ON

(2) Output terminals (OUTPUT) Y0 to Y7 and READY

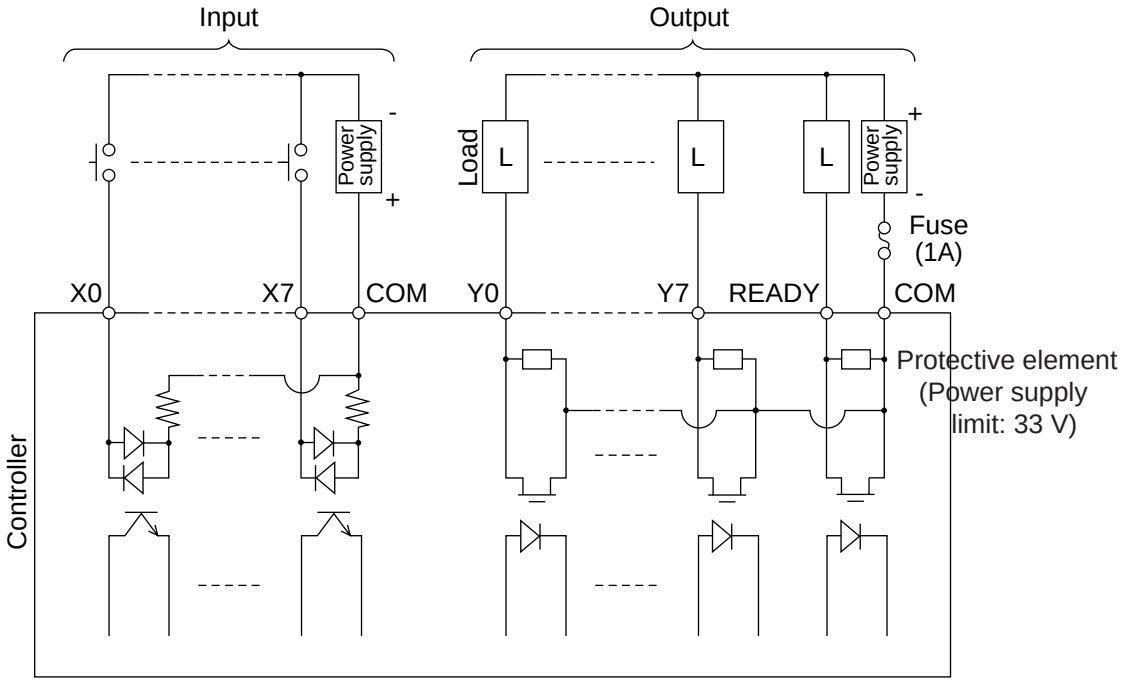
Y0 to Y7	Result of logical calculation output - Specify in the "FINAL-OUTPUT COND" on the [OBJECT TYPE COND] menu.
READY	These signals will turn ON when the measurement start input is enabled. - For information about the timing chart and other details, see "Setting the Input/Output Conditions" in the IV-S31MX/S32MX/S33MX User's Manual (Function and Operation).

(3) 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.

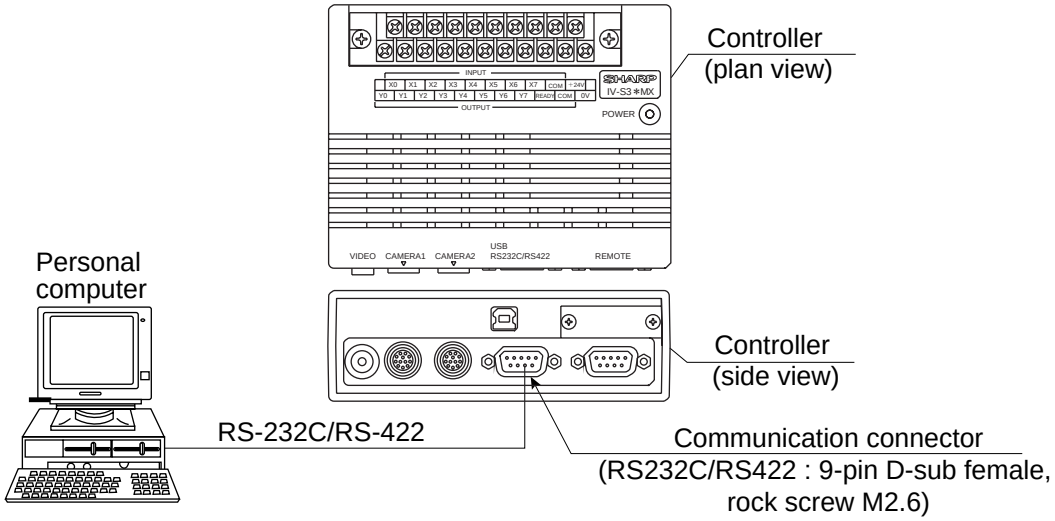
Item		Rating
Input	Rated input voltage	12/24 VDC
	Input voltage range	10.5 to 26.4 VDC
	Input voltage level	ON: 10.5 V or less OFF: 3 V or more
	Input current level	ON: 3 mA or less OFF: 0.9 mA or more
	Input impedance	3.3 k ohm
Output	Rated output voltage	12/24 VDC
	Load voltage range	10.5 to 27 VDC
	Rated max. output current	100 mA DC
	Output type	Photo MOS open drain
	ON resistance	30 ohms or less
	Isolation method	Photo MOS isolation
Response time		3 ms or less (OFF to ON, ON to OFF)

(4) Wiring to the controller (IV-S31MX/S32MX/S33MX)



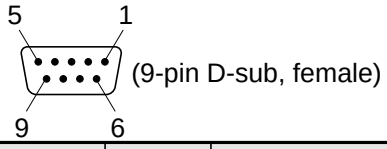
[5] Connection for communications with personal computer (general purpose serial I/F)

Connect a personal computer to the communication connector (RS232C/RS422) on the controller (IV-S31MX/S32MX/S33MX).
A 9-pin D-sub, male connector is included with the controller.



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

- 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	—
Connector case		FG	Frame ground	—

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 controller
(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)

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

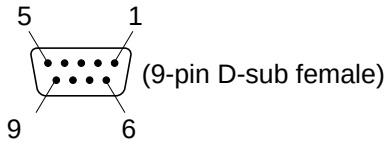
Communication speed (kbps)	Cable length
9.6, 19.2	15 m or less
38.4, 57.6, 115.2	2 to 3 m

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

(2) When communicating through the RS-422

Specify the 4-wire or 2-wire RS-422 system on the [COMM.SET] menu.

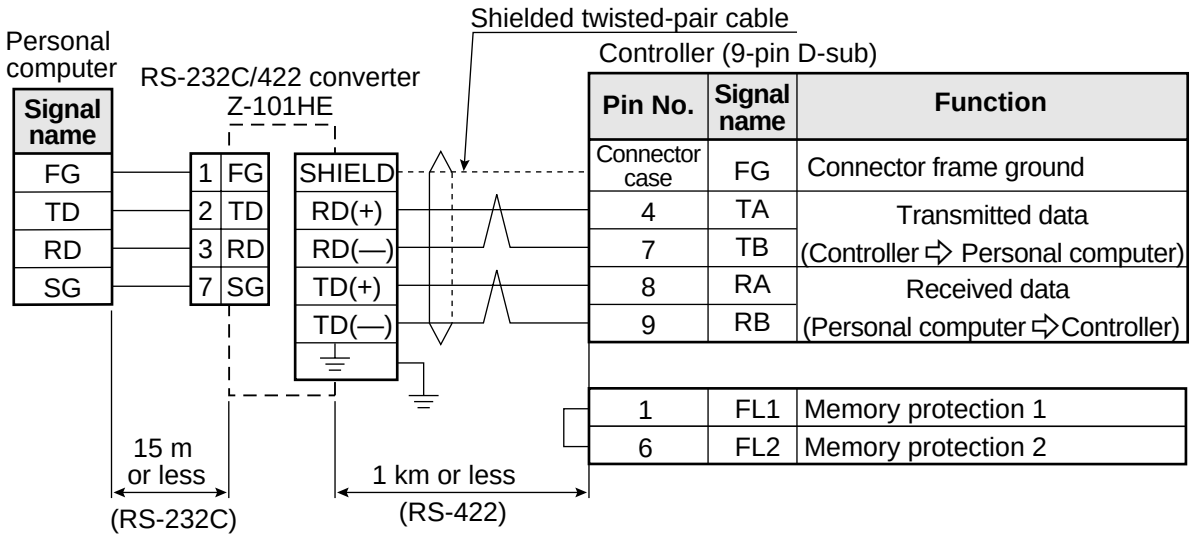
- The controller pin arrangement of the communication connector (for RS-422C)



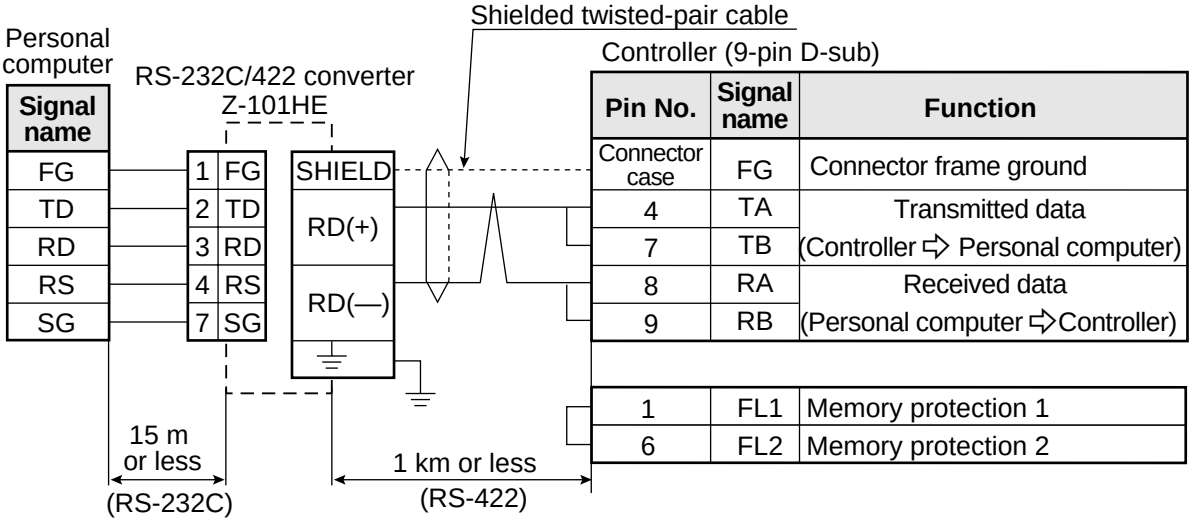
Communication standard	Pin No.	Signal name	Details	Direction
RS-422	4	TA	Transmitted data (Controller ⇨ Personal computer)	Output
	7	TB		
	8	RA	Received data (Personal computer ⇨ Controller)	Input
	9	RB		
Connector case		FG	Frame ground	–

5

• 4-wire system

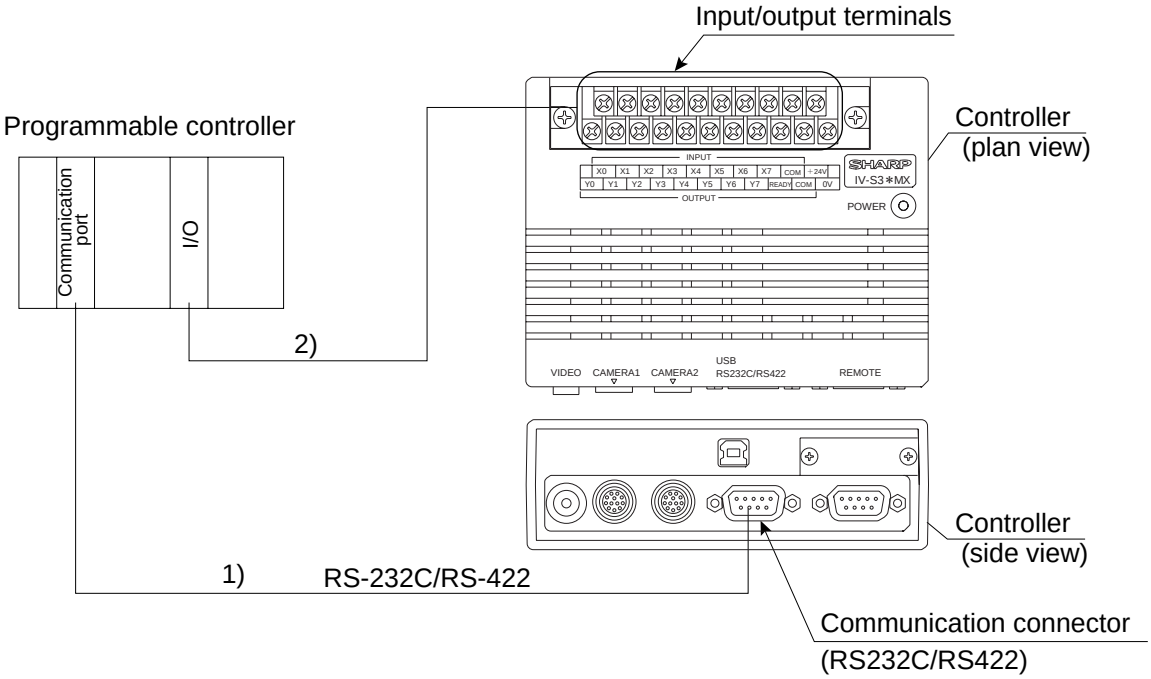


• 2-wire system



[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-S31MX/S32MX/S33MX).



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 "Computer Link" in the IV-S31MX/S32MX/S33MX User's Manual (Function and Operation).

(The pin arrangement of the communication connector on the controller is shown on page 5-19 to 5-20.)

- In the case of RS-232C, the maximum communication cable length depends on the communication speed.

Communication speed	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) Connect the input/output terminals of the programmable controller to the input/output terminals on the controller.

⇨ See page 5-16: item [4] "Connecting to the input/output terminals (parallel I/F)" for details about wiring procedure.

5-3 Installing and connecting the IV-S30C1/C2/C3/C4 camera

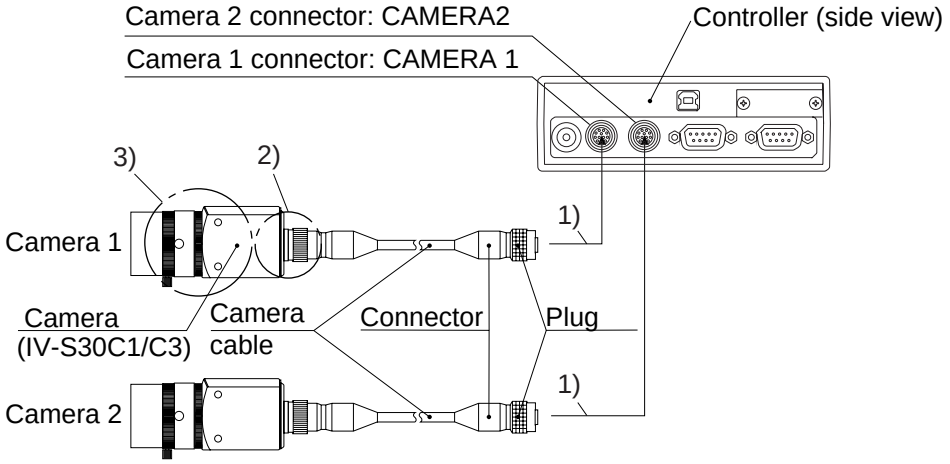
[1] Installing and connecting the IV-S30C1/C3 standard and high-speed cameras

(1) Connections

Up to two IV-S30C1 standard cameras or IV-S30C3 high-speed cameras can be connected to the following controllers using camera cables.

Camera	Controller to connect	Cables to be used
IV-S30C1	IV-S31MX, IV-S32MX, IV-S33MX	IV-S30KC3 (3 m), IV-S30KC5 (5 m), IV-S30KC7 (7 m),
IV-S30C3	IV-S33MX	IV-S30KC3 (3 m), IV-S30KC5 (5 m)

Note 1: Do not connect the IV-S30C3 to the IV-S31MX/S32MX. The IV-S30C3 cannot be used with the IV-S30KC7.



1) Connect the camera cable(s) to the CAMERA 1 and CAMERA 2 connectors on the controller.

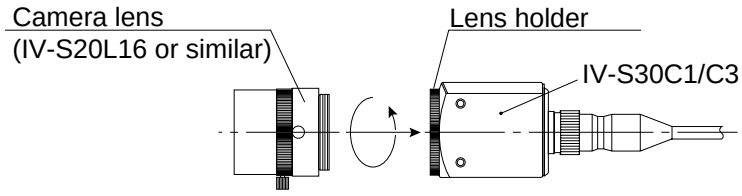
- To connect them, match the keyed portion of the connectors and press in. When they are firmly connected, you will hear a click.
- To unplug a connector, hold the plug housing and pull it straight out.
- Any camera plugged into the CAMERA 1 connector will be system camera 1 and any camera plugged into the CAMERA 2 connector will be system camera 2 in the IV-S30 system.

Note 2: Make sure to turn OFF the power before connecting or disconnecting the cameras.

Note 3: 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-S30C1/C3, 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-S30C1/C3 until it is secure.



Remarks

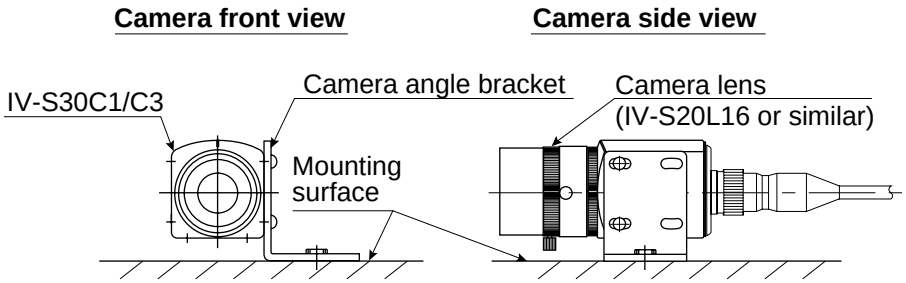
- You cannot use different types of cameras at the same time with the same controller (standard, high-speed and EIA cameras cannot be mixed). When an IV-S30C1 or IV-S30C3 is connected to the controller, the other cameras that can be connected to the controller are as follows:

Camera	Compatible second cameras
IV-S30C1	IV-S30C2 (Micro camera)
IV-S30C3	IV-S30C4 (Micro, high-speed camera)

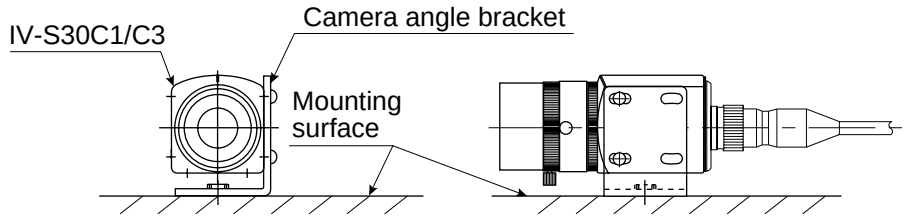
(2) Installing the camera body

Attach the camera (IV-S30C1/C3) on the mounting surface with the camera angle bracket (supplied with the camera).

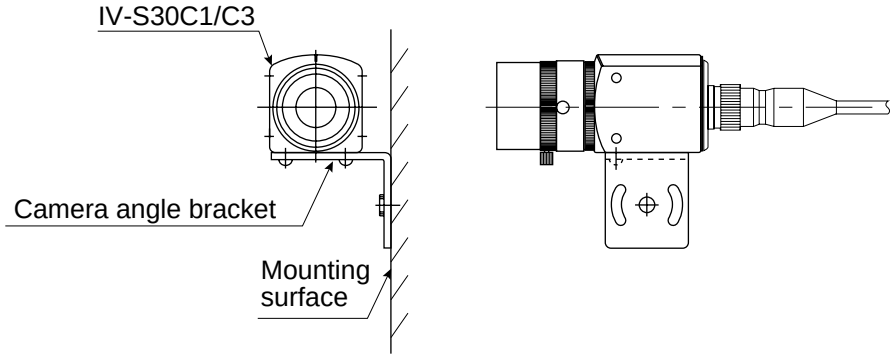
- Installation example 1



- Installation example 2



- Installation example 3



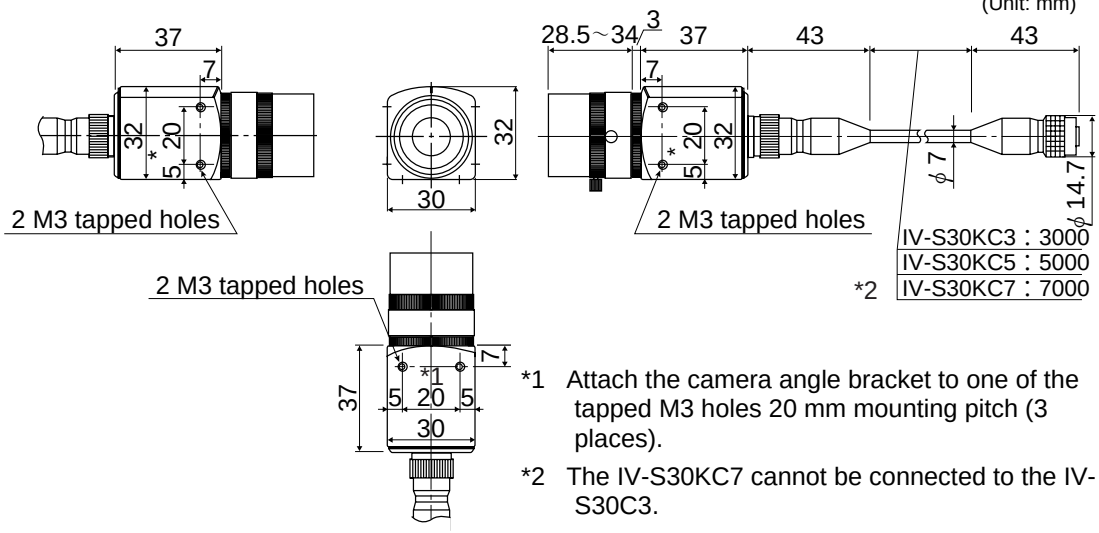
■ **Installation procedure**

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-S30C1/C3 camera body are shown on the following page.

- External dimensions when the IV-S20L16 camera lens and IV-S30KC3/KC5/KC7 camera cable are connected to the IV-S30C1/C3.

(Unit: mm)

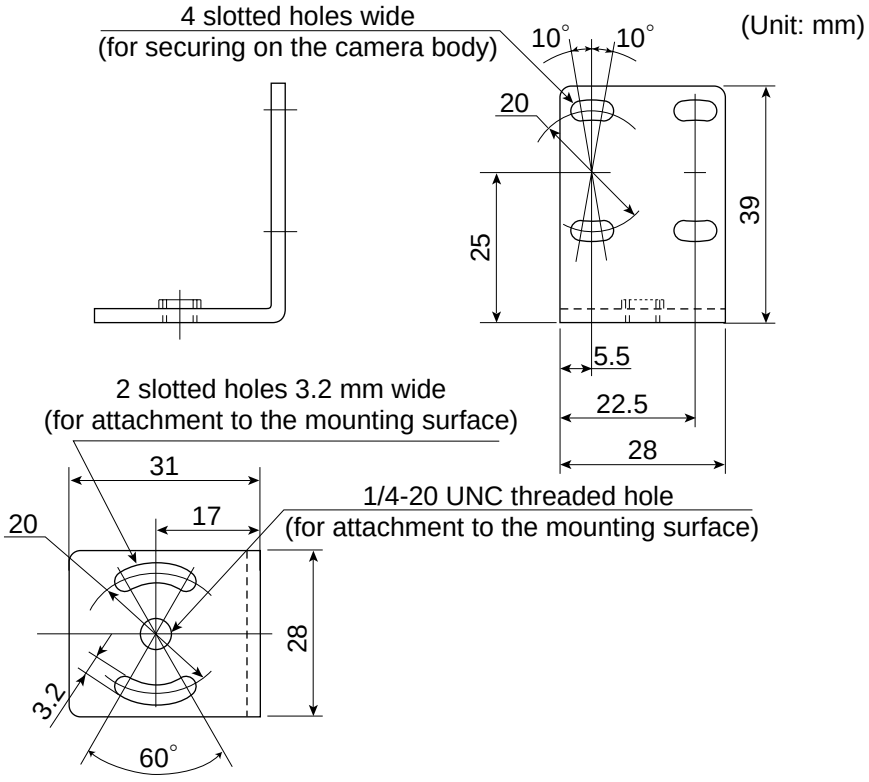


*1 Attach the camera angle bracket to one of the tapped M3 holes 20 mm mounting pitch (3 places).

*2 The IV-S30KC7 cannot be connected to the IV-S30C3.

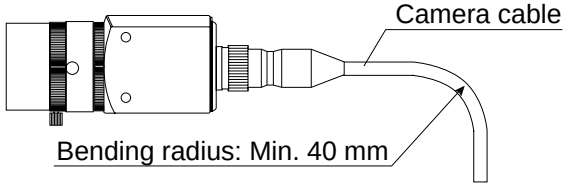
5

- External dimensions of camera angle bracket



Note

- When the camera cable (IV-S30KC3/KC5/KC7) 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.



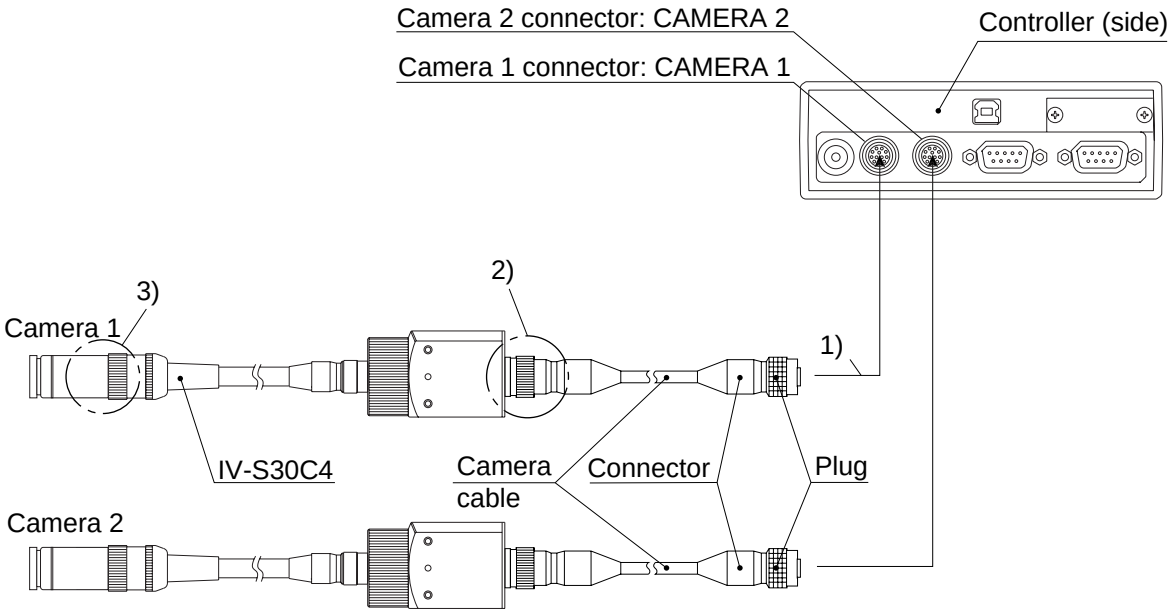
[2] Installing and connecting the IV-S30C2/C4 micro cameras or micro, high-speed cameras

(1) Connections

Up to two IV-S30C2 micro cameras or IV-S30C4 micro, high-speed cameras can be connected to the following controllers using camera cables.

Camera	Controller to connect	Cables to be used
IV-S30C2	IV-S31MX, IV-S32MX, IV-S33MX	IV-S30KC3 (3 m), IV-S30KC5 (5 m), IV-S30KC7 (7 m),
IV-S30C4	IV-S33MX	IV-S30KC3 (3 m), IV-S30KC5 (5 m)

Note 1: Do not connect the micro, high-speed cameras (IV-S30C4) to the controllers (IV-S31MX/S32MX). The micro, high-speed cameras (IV-S30C4) cannot be used with camera cables (IV-S30KC7).



(Some parts of the external appearance of the IV-S30C2 are different from the IV-S30C4.)

1) Connect the 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-S30 system.

Note 2: Make sure to turn OFF the power before connecting or disconnecting the cameras.

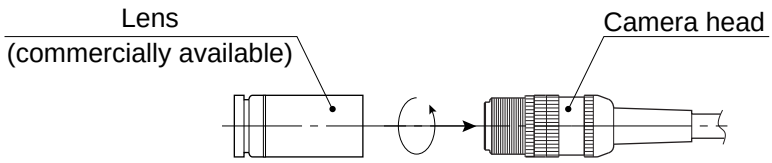
Note 3: If there is only one camera, make sure to connect it as system camera 1.

Remarks

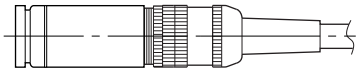
- You cannot use different types of cameras at the same time with the same controller (standard, high-speed and EIA cameras cannot be mixed). When an IV-S30C2 or IV-S30C4 is connected to the controller, the other cameras that can be connected to the controller are as follows:

Camera	Compatible second cameras
IV-S30C2	IV-S30C1 (standard camera)
IV-S30C4	IV-S30C3 (high-speed camera)

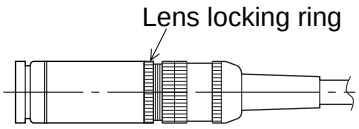
2) Plug the camera connector on the camera cable (camera conversion cable) into the cable connector on the IV-S30C2/C4 camera and screw it down to secure the connection.
3) Screw a commercially available lens into the camera head of the IV-S30C2/C4.



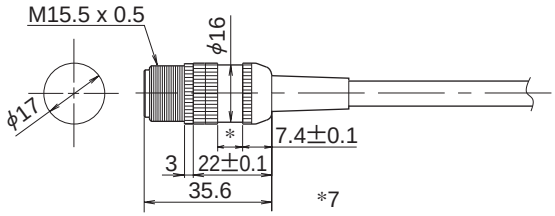
Step1. Screw the lens in until the camera image is focused.



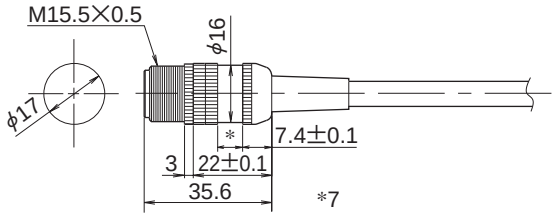
Step2. Secure the lens using the lens locking ring on the camera head



• External dimensions of the IV-S30C2 camera head (Unit: mm)

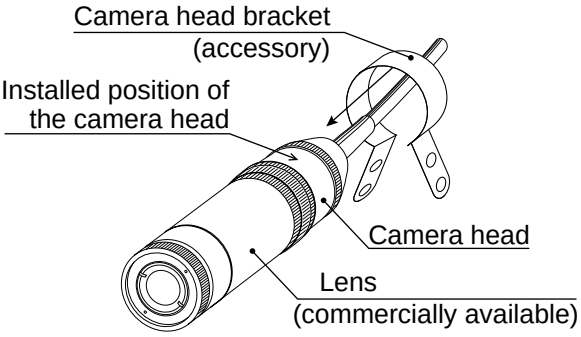


• External dimensions of the IV-S30C4 camera head

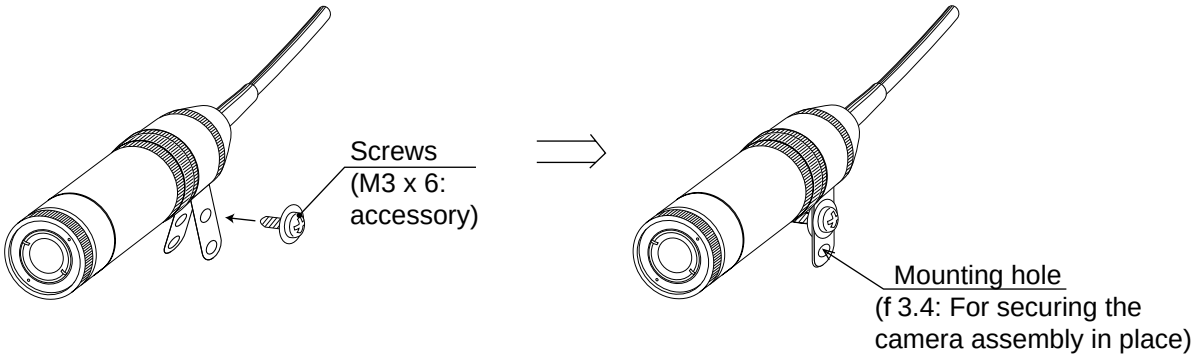


(2) Installation of the camera head

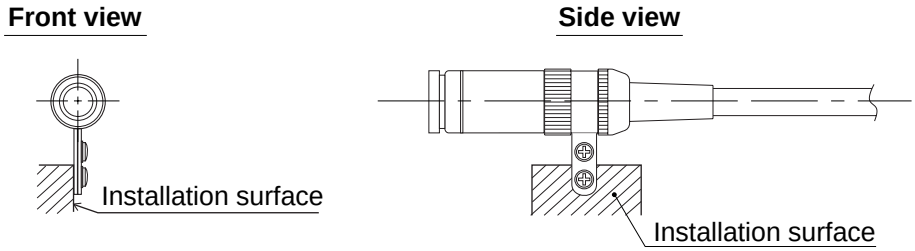
1. Put the camera head through the bracket (supplied with the IV-S30C2/C4) from the cable side and slide the camera head into position.



2. Secure the camera head bracket using the M3x6 screws that come with the IV-S30C2/C4.



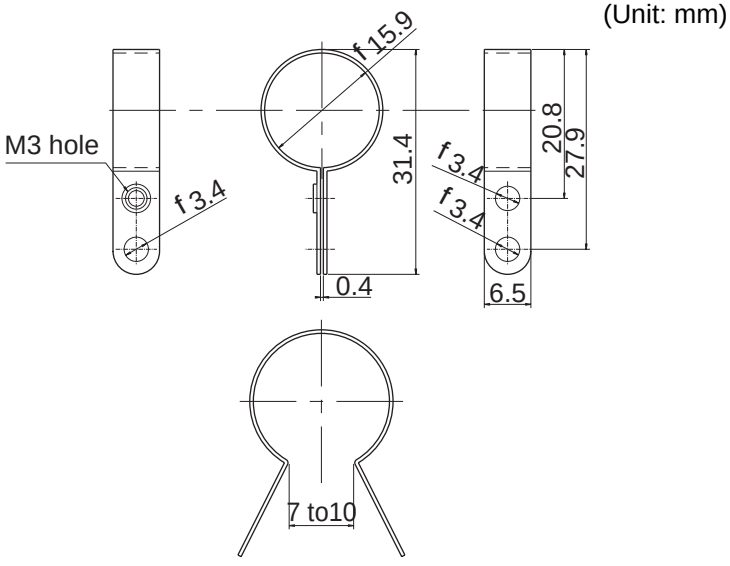
3. Secure the camera head assembly in place using the mounting hole (ø3.4) on the camera head bracket.



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)

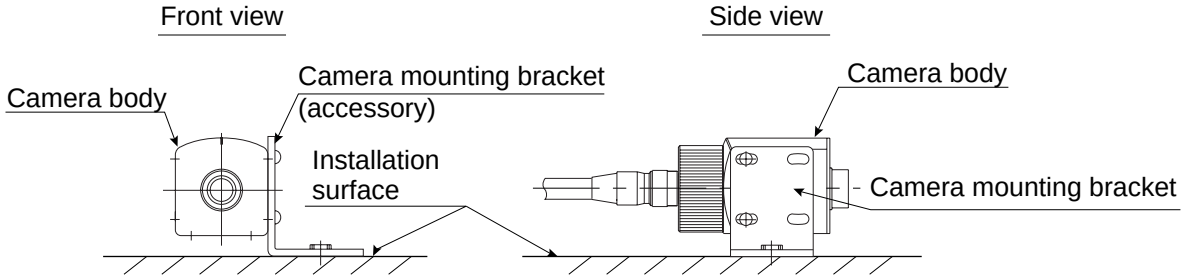


(Shape before installation)

(3) Installation of the camera body

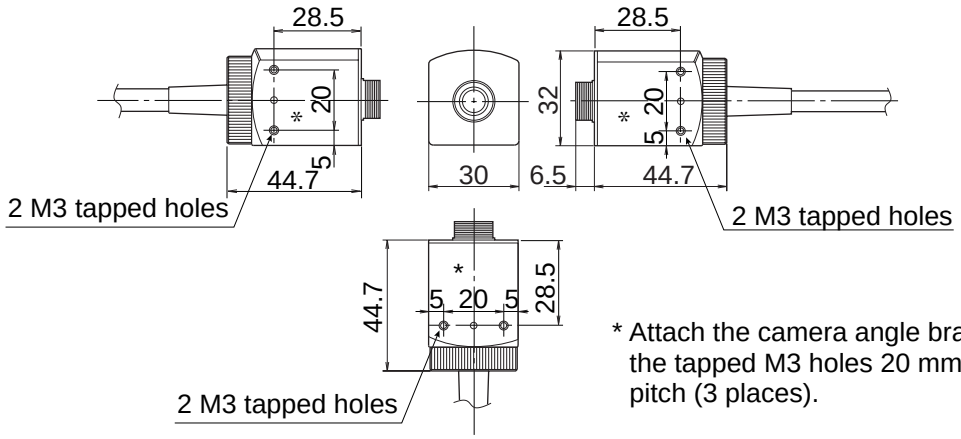
1. Attach the camera mounting bracket (comes with the IV-S30C2/C4) to the three M3 tapped holes (spacing: 20 mm) on the camera body using the M3x6 installation screws that come with the IV-S30C2/C4.
2. Secure the camera mounting bracket on the installation surface using a 3.2mm long, 20 mm difference screw or a 1/4-20 UNC screw hole.

[Installation example]



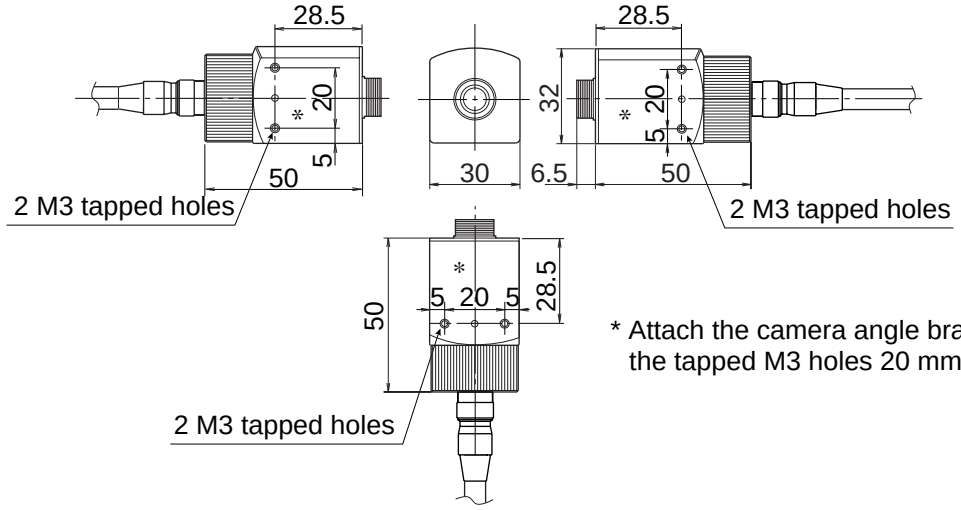
- External dimensions of the IV-S30C2 camera body

(Unit: mm)



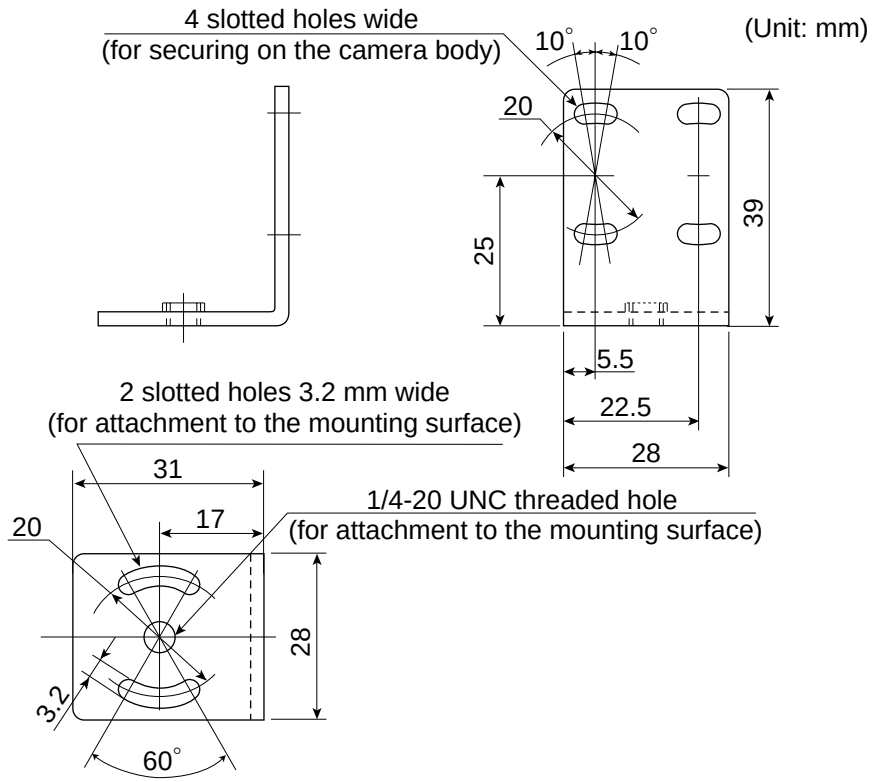
* Attach the camera angle bracket to one of the tapped M3 holes 20 mm mounting pitch (3 places).

- External dimensions of the IV-S30C4 camera body



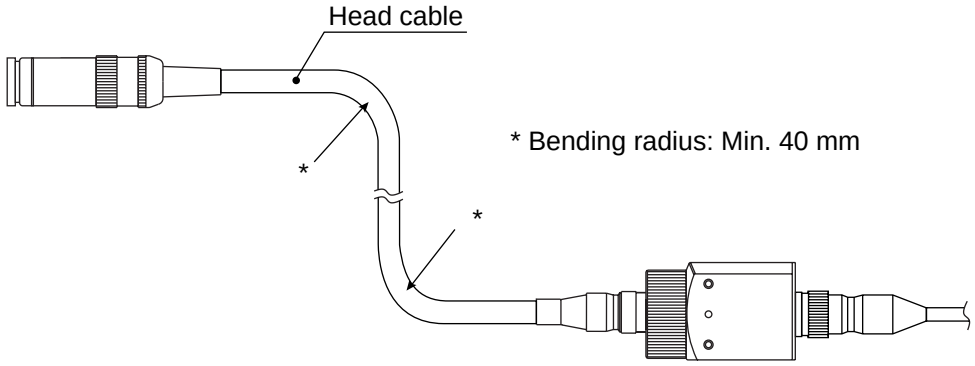
* Attach the camera angle bracket to one of the tapped M3 holes 20 mm mounting

- External dimensions of camera angle bracket



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.

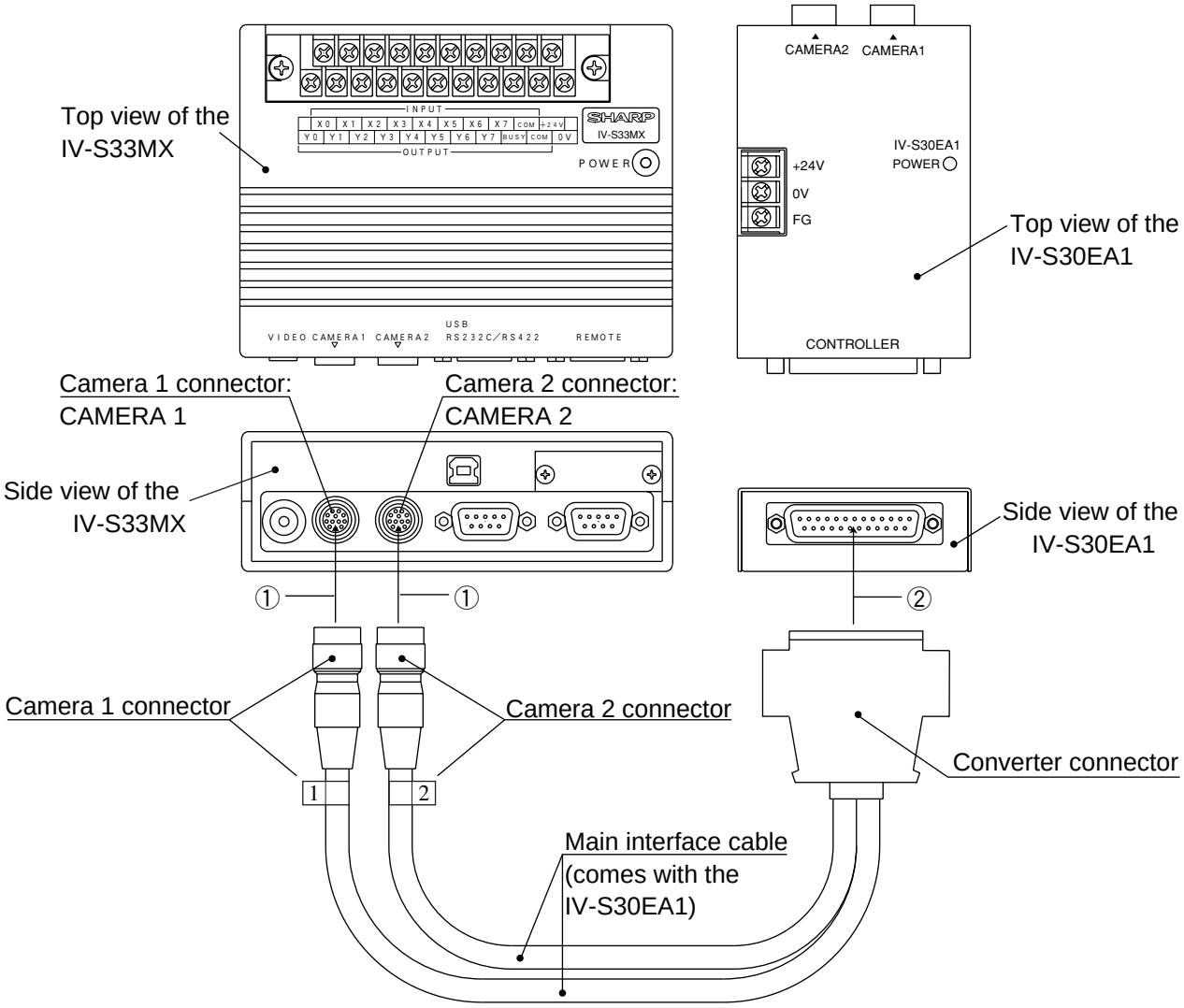


5-4 Installing, connecting, and wiring the IV-S30EA1 camera converter

[1] Connection to the IV-S33MX controller

Connect the IV-S30EA1 camera converter to the IV-S33MX controller using the main interface cable that comes with the camera converter.

Note: Do not connect the IV-S30EA1 to IV-S31MX/S32MX controllers.



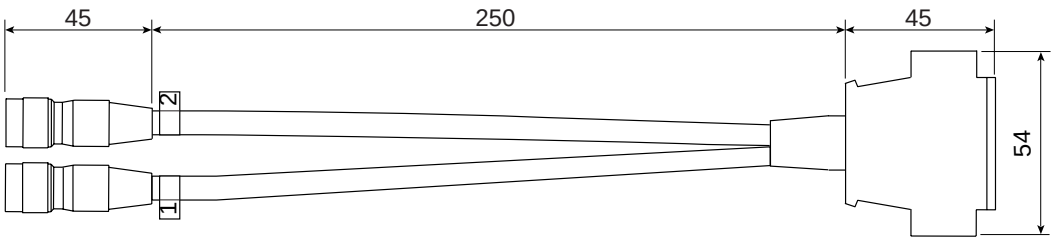
① Connect the camera 1 and 2 connectors on the main interface cable to the CAMERA 1 and CAMERA 2 connectors on the IV-S33MX. Make sure the connector numbers match.

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

- 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-S30 system.

② Connect the converter connector on the main interface cable to the controller connector on the IV-S30EA1.

• External dimensions of the main interface cable. (Unit: mm)



[2] Connection to an EIA camera

This section describes how to connect a commercially available camera that conforms to the EIA standards to the IV-S30EA1.

(1) Cameras that can be connected

The specifications of the EIA cameras that can be connected to the IV-S30EA1 and the cameras we recommend are as follows:

• Specifications

Item	Specifications
Number of scan lines	525
Scan method	2:1 interlace
Frequency	Horizontal 15.734 kHz, vertical 59.94 Hz
Image output	1.0 Vp-p (with a 75 ohm load)
Power supply	+12 VDC ±10%
Current consumption	300 mA maximum

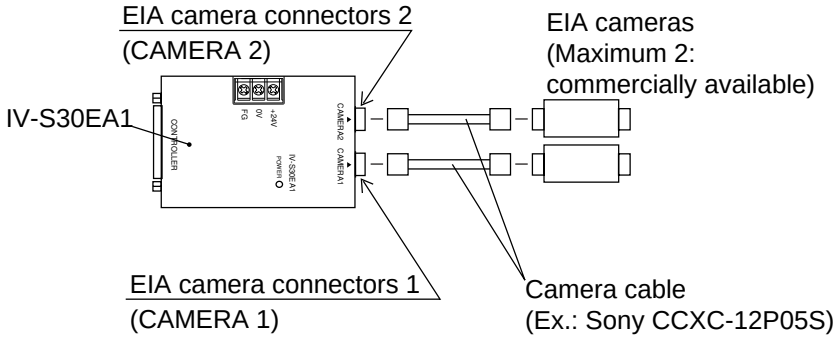
• Recommended cameras

Model	Manufacturer
XC-75	Sony
CS8320B	Tokyo Electronics Industries

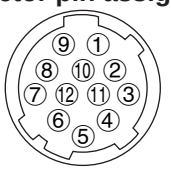
5

(2) Connecting between the IV-S30EA1 and an EIA camera

Connect the IV-S30EA1 to an EIA camera using the EIA camera cable.
Check the signals (pin assignment) against the figures below.



• EIA camera connector pin assignments for connectors 1 and 2 on the IV-S30EA1



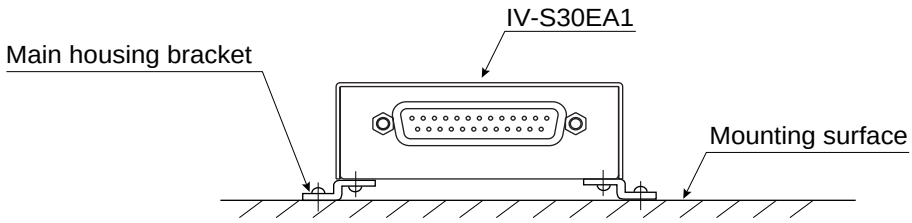
12-pin round connector (female): Made by Hirose Electric

Pin No.	Signal name	Signal type (input/output)	
		INT (internally synchronized mode)	EXT (externally synchronized mode)
1	GND	-	-
2	+12 V		
3	Image GND		
4	Image signal	Input	Input
5	HD GND	-	-
6	HD	Input	Output
7	VD	Input	Output
8	TRIG GND	-	-
9	TRG signal	High impedance state	Output
10	GND	-	-
11	-	Not connected	Not connected
12	VD GND	-	-

- When only one EIA camera is used, make sure to connect it to connector 1 (CAMERA1).

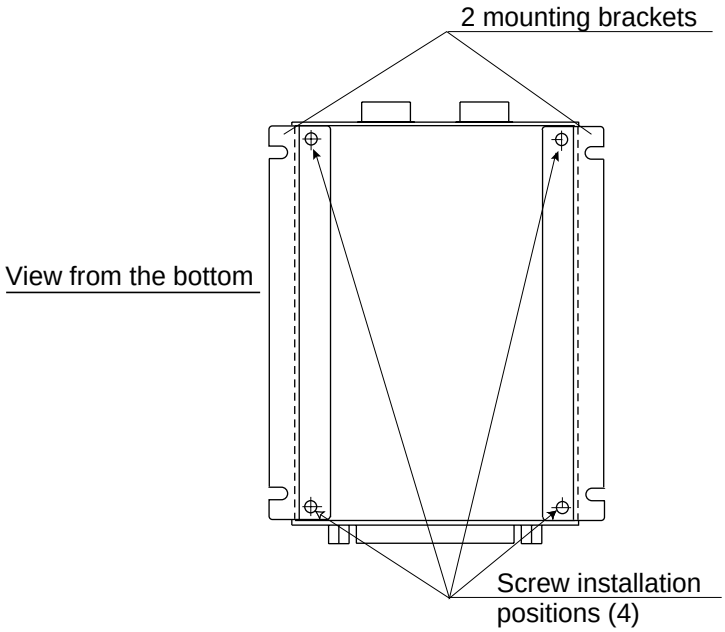
[3] Installing the camera converter (IV-S30EA1)

The bottom of the IV-S30EA1 camera converter should be installed by securing it on another surface with the two main housing brackets that come with the IV-S30EA1.

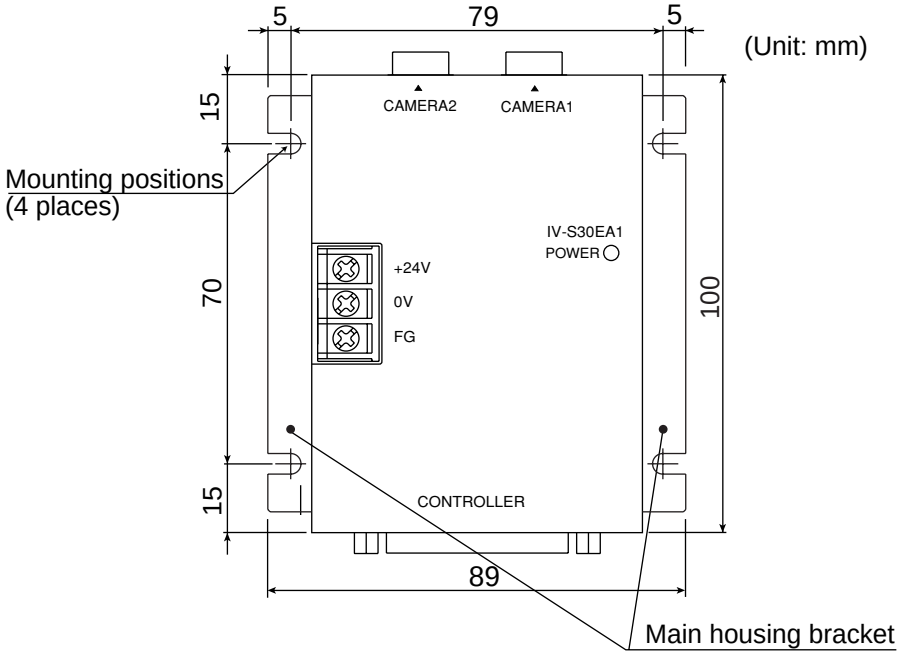


(1) Installation procedures

1. Install the two main housing brackets on the bottom of the IV-S30EA1. Use the 4 screws (M3 x 6) that come with the IV-S30EA1.



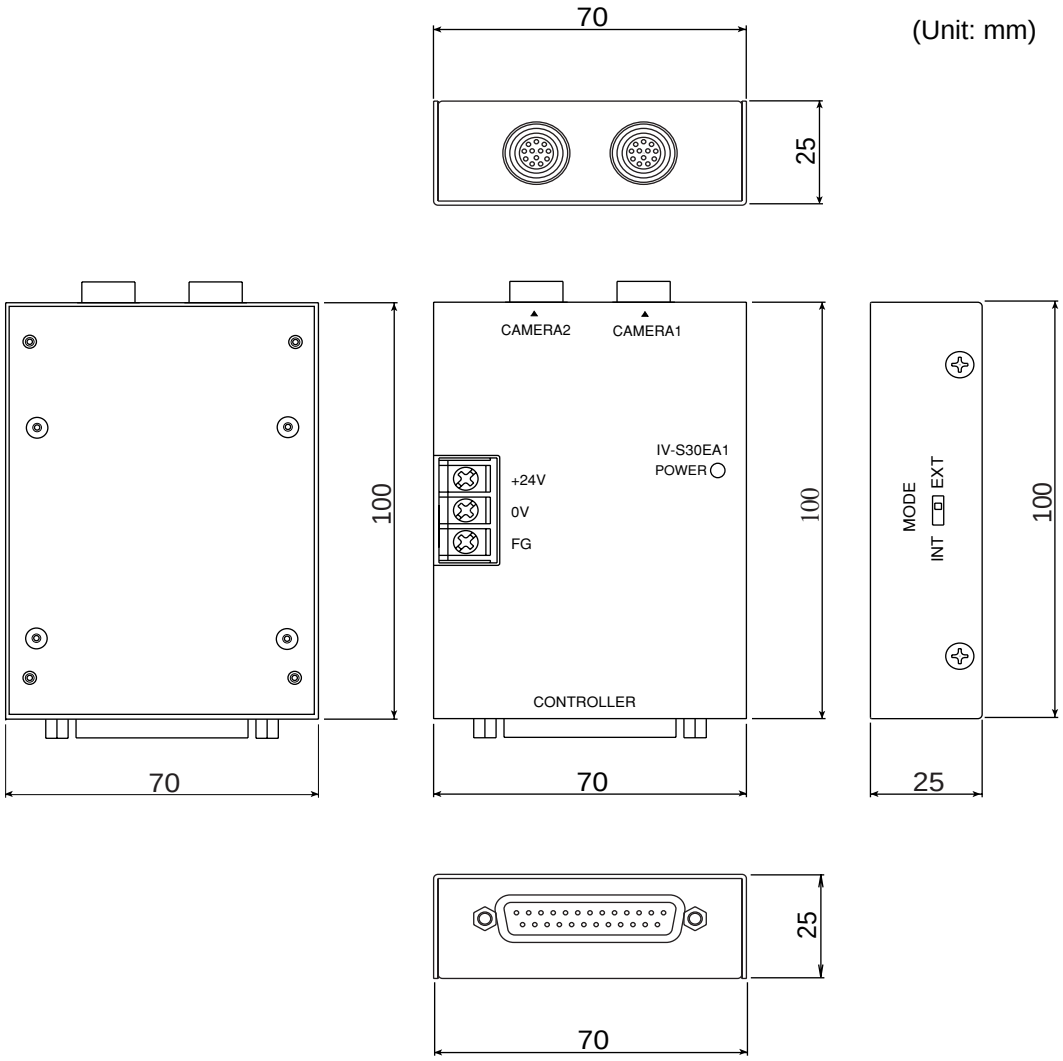
2. Secure the unit on the mounting surface using the main mounting brackets.



The external dimensions of the IV-S30EA1 and main housing brackets are shown on the next page.

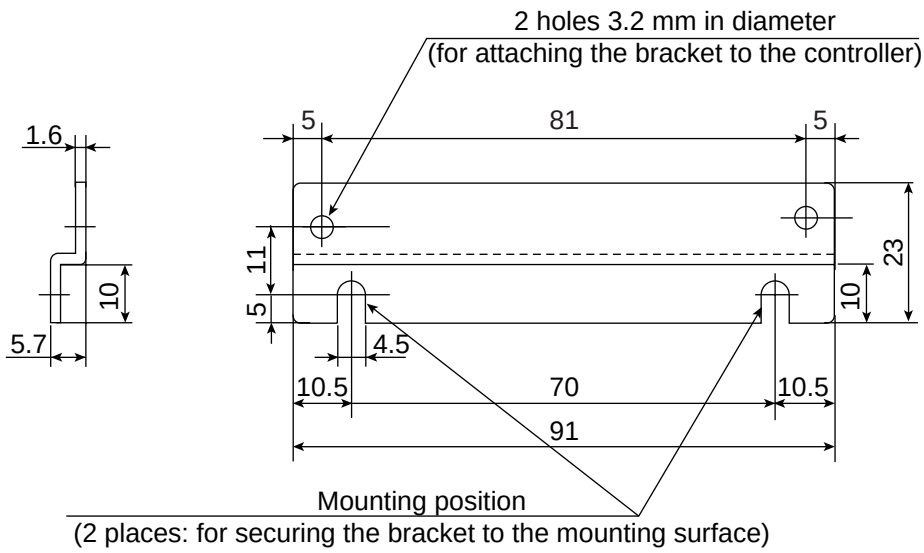
- External dimensions of the IV-S30EA1

(Unit: mm)

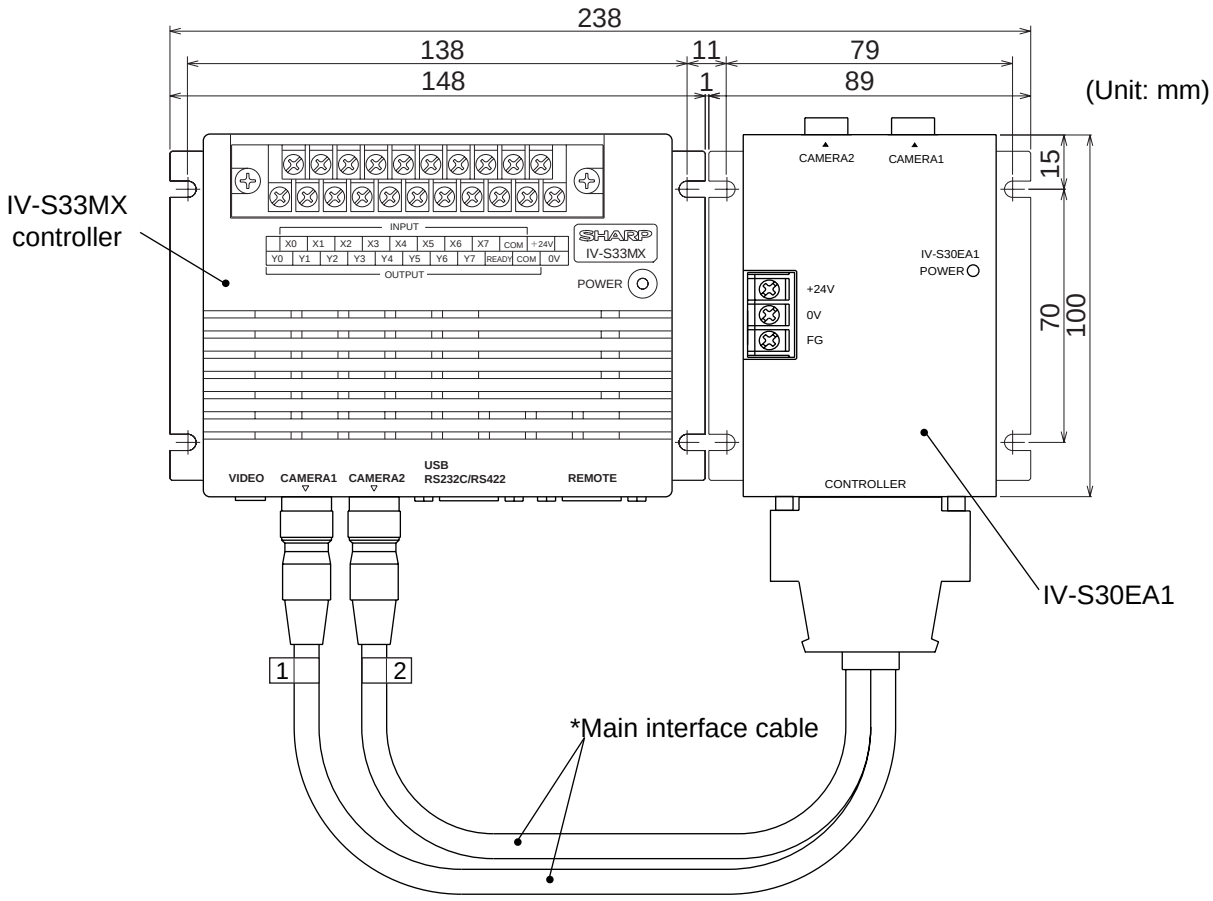


- External dimensions of main housing angle bracket

(Unit: mm)



(2) Installation example



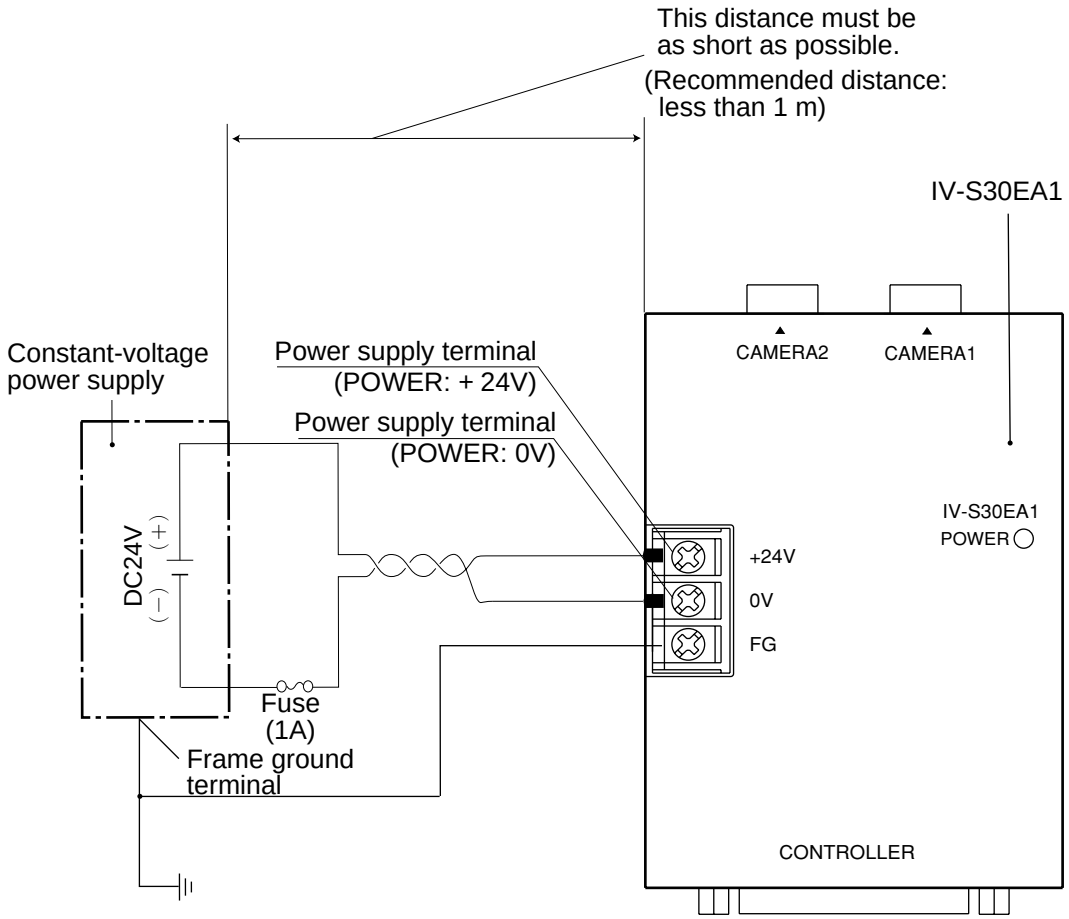
* The main interface cable should not be bent to a radius smaller than 40 mm.
(External dimensions of the main interface cable ⇨ See page 5-30.)

[4] Wiring of the camera converter (IV-S30EA1)

■ Connecting a power supply

Connect a commercially available constant-voltage power supply to the power terminals (POWER: +24 V, 0 V) on the IV-S30EA1 camera converter. Use a 24 VDC ±10%, 500 mA or more constant-voltage power supply.

- Use an individual and dedicated power supply to supply power to the IV-S30EA1. 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 IV-S30EA1 camera converter, 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 IV-S30EA1 camera converter 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.

Chapter 6: Setting and Operating Outlines

6-1 Setting and operating procedures

This paragraph describes the rough operation sequence of the IV-S30.

① System design **(Ref. chapter)**

Plan your hardware environment to suit your use of the IV-S30.

- Measurement program (positional deviation measurement, degree of match inspection, etc.) ---------- 1-3 Measurement programs
- Number of cameras, externally connected devices, system components ---------- 3-1 Basic system configuration
- Input/output (start measurement input, result output, object type change, etc.) ---------- 3-2 System configuration examples
- Lighting equipment, illumination, shutter speed, lens, etc. ---------- 5-1 Installation conditions

② Installation/assembly

Install the hardware you will be using.

- Connection of cameras and monitor to the controller
- Installation of the controller and camera body
- Connection of a power supply, input/output terminals and external devices

---------- 5-2 to 5-4 Connection and installation and wiring methods

③ Turning ON the power supply (controller and monitor)

Supply power to each device.

④ Environment settings

Set IV-S30 parameters according to the actual hardware environment.

- Setting the Input / Output conditions ---------- User's Manual (Function and Operation) Chapter 17
- Communication ---------- User's Manual (Function and Operation) Chapter 18
- Computer link ---------- User's Manual (Function and Operation) Chapter 19
- Gain / offset adjustment ---------- User's Manual (Function and Operation) page 2-15

⑤ Enter measuring programs

- **Entered using the wizard**
- **Entered using the menu tree**

Chapter 7: Setting Examples Using the Setting Wizard
Chapter 8: Setting Examples Using the Menu Tree
6-4 Operation chart

⑥ Editing Operation screen 6-7 Editing operation screen

⑦ Other settings

- **Initialization**
- **Self Diagnosis**

6-8 Option

⑧ Operation

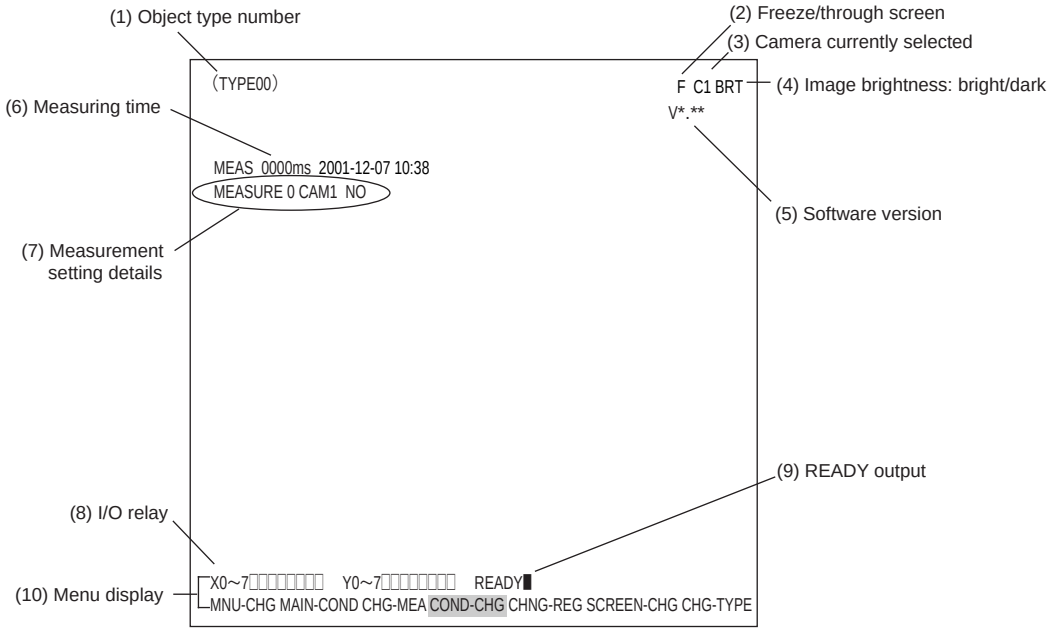
⑨ Test/inspection

⑩ Maintenance

User's Manual (Function and Operation) Chapter 20

6-2 Description of the operation screen

When the IV-S30 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 15 for the IV-S31MX and from 0 to 31 for the IV-S32MX/S32MX.)

(2) 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.

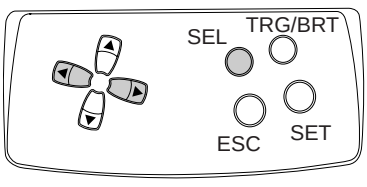
(3) Indicates which camera is currently selected
C1: Camera 1 (the camera connected to the "CAMERA1" connector)
C2: Camera 2 (the camera connected to the "CAMERA2" connector)

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

Screen display	Description
Bright	Display the captured image without changing its brightness.
Dark	Display the captured image at 1/2 the actual brightness

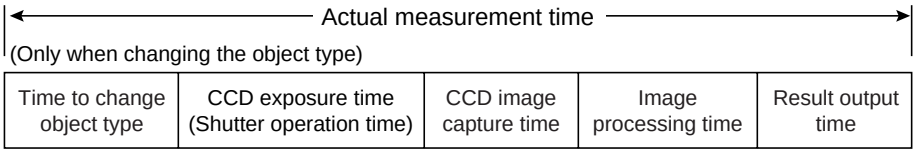
How to select the brightness level

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.



(5) Displays the software version.

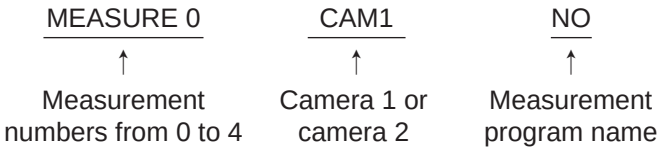
(6) Displays the measurement time currently assigned.



- 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).

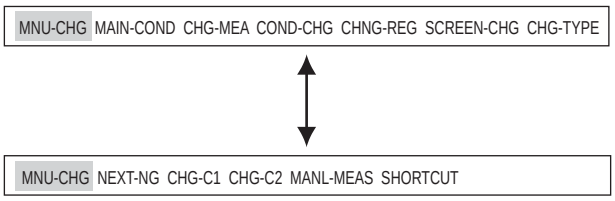
(7) Display setting details of each measurement.



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

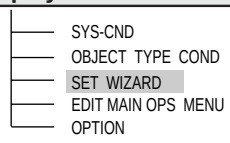
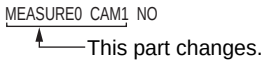
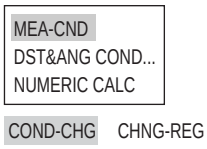
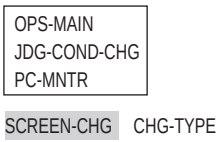
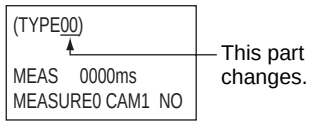
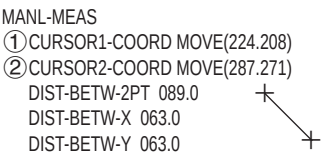
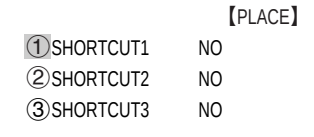
(9) Displays the status of the ready output: OFF [□], ON [■].

(10) 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.

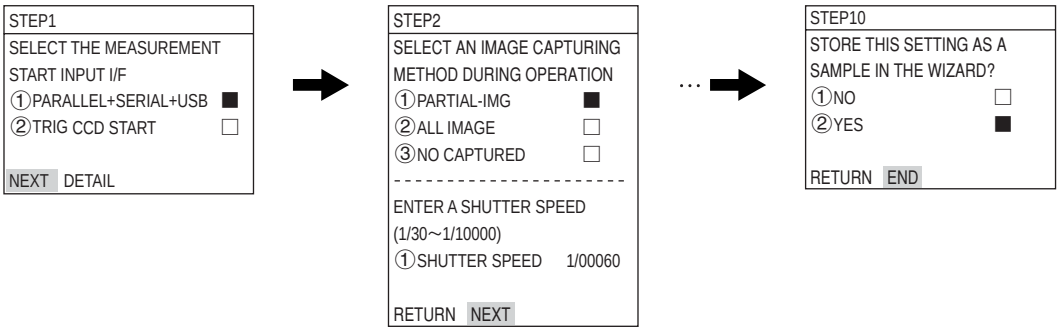
■ Details of each item on the menu bar

Item on the menu bar	Description	Display detail on the screen
MAIN-COND (main conditions)	Displays the MAIN screen.	
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)	
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 pages 8-3 and 8-8 in this manual and Chapter 3: Function and Operation. For details about the distance and angle conditions, see page 14-2 in Function and Operation. For details about the numeric value calculation conditions, see page 15-7 in Function and Operation.	
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-ING-DISP" can be selected. Press the SET key and the monitor will change to the NG image display screen.* ⇨ See page 1-22 in Function and Operation.	
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."	
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 (operatiion conditions), this screen cannot be displayed.	
SHORTCUT	Displays a short cut screen.	

* Only the IV-S32MX/S33MX can display and use this function

6-3 Wizard

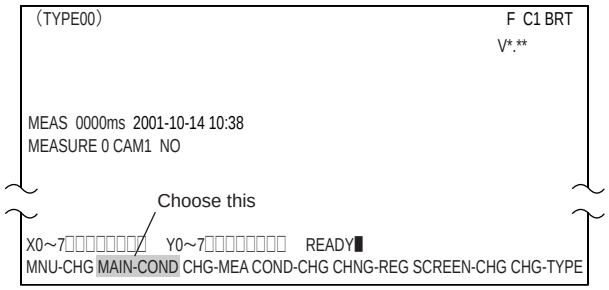
The "Wizard" is a program that helps users make settings for measurement operations easily and without making mistakes. The controller asks you a series of questions at each step and you simply answer these to complete the settings.
The wizard is convenient for making settings when beginners and inexperienced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



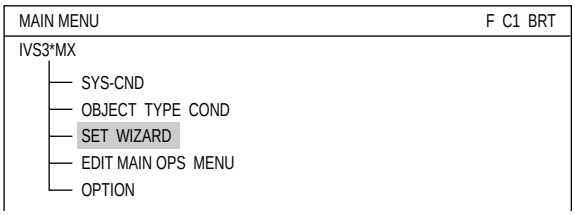
[1] How to start the standard wizard

■ Basic operation

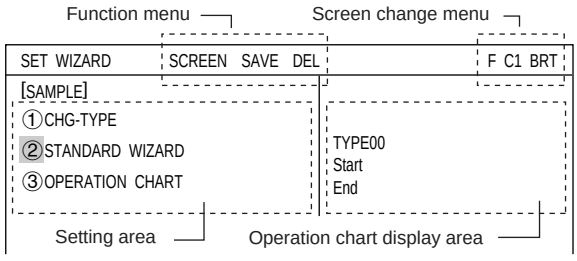
1. Move the cursor to the "MAIN-COND" item on the lower menu using the left and right arrow keys, and press the SET key.



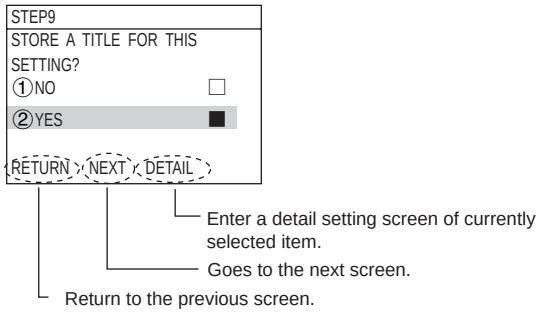
2. The "MAIN MENU" will appear.
Move the cursor to the "SET WIZARD" item using the up and down keys and press the SET key.



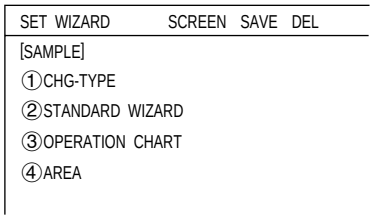
3. Move the cursor to the "②STANDARD WIZARD" and press the SET key. The SET WIZARD program will start.



4. Answer the questions at each step, from STEP1 to the final step (the step which displays the "End" item")



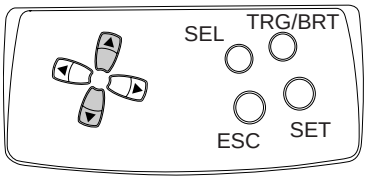
5. After storing the sample in the final step, the sample name will appear on the ④ line as shown on the figure right.



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

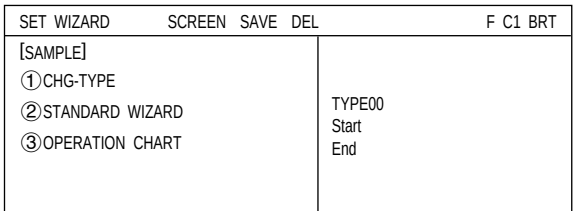
1. Up/down/left/right keys

When the "Set Wizard" program screen appears, the cursor is on the "①OBJECT CHANGE" 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.

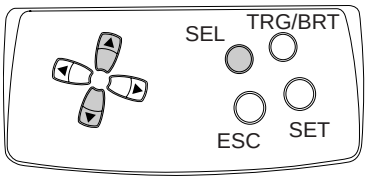


2. SEL key

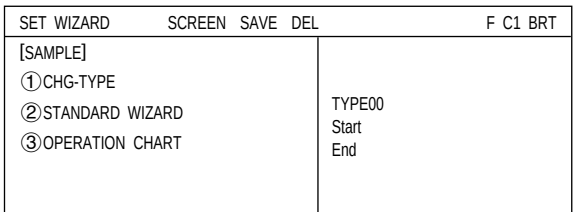
Move the cursor to the "②STANDARD WIZARD" line. Then press the SEL key. The cursor will jump to "F" (freeze) in the upper menu area. Press the up and down key to change between "F" (freeze) and "T" (through) display of images.



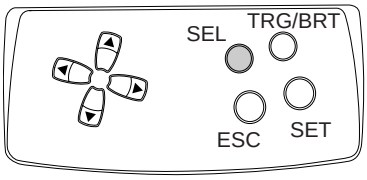
"F" (freeze): Static image (Capture an image with the camera and display it on the monitor.
"T" (through): Dynamic images (display the sequence of images coming from the camera on a real time basis. As the object moves, the display of the object will also move.)



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

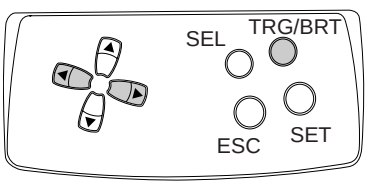


Press the SEL key again and the cursor will jump back to "②STANDARD WIZARD."

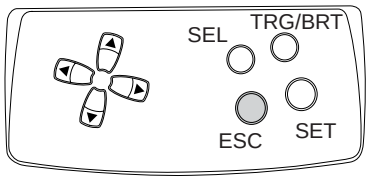


3. TRG/BRT key

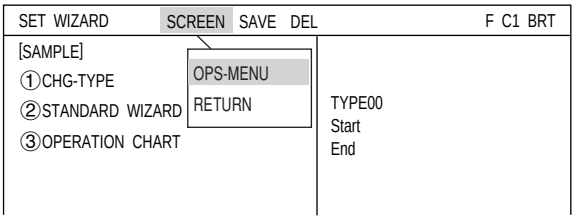
Move the cursor to the "②STANDARD WIZARD" line using the up and down arrow keys. Then press the TRG/BRT key. The cursor will jump to "SCREEN" in the upper menu area. Press the left and right arrow keys to move the cursor between the "SAVE" and "DEL (delete)" items.
Press the TRG/BRT key again to bring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



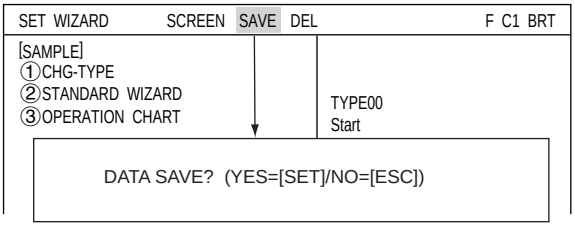
4. ESC key
Press the ESC key to return to the previous screen.



- **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.

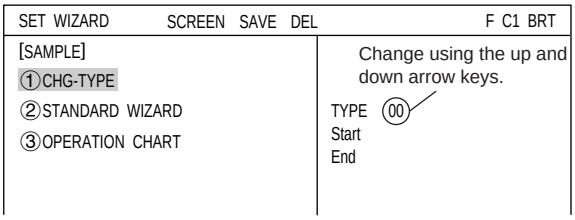


- **SAVE**
  Move the cursor to the "SAVE" and press the SET key. The Save Settings screen will appear. Press the SET key and select "YES," the current setting data will be stored in flash memory. If you press the ESC key and select "NO," the controller will close the screen without saving the current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



- **DEL**
  Deletes the sample selected.

- **①CHG-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 6-8).



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

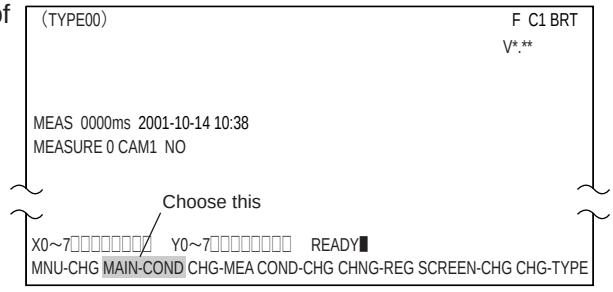
This section describes how to use the operation chart. The operation chart shows the measurement decisions that were made and saved as a chart. You can easily see the major flow of the measurement process and you can determine the execution timing for processes other than image processing (such as numeric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

TYPE00

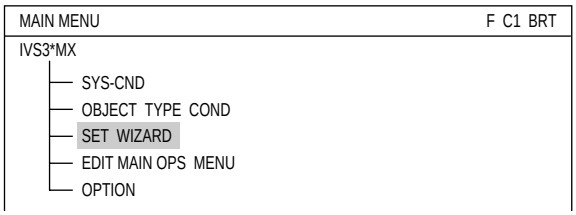
Start
STEP1 : PARALLEL+SERIAL+USB
STEP2 : CAPTURE IMG/PARTIAL-IMG
STEP3 : MEAS1/CAM1
STEP4 : MEAS1/BIN-AREA
STEP5 : MEAS1/WINDOW/MASK,1
STEP6 : MEAS1/MEAS CND
STEP7 : MEAS1/EVALUATION
STEP8 : MEAS1/CLAC
STEP9 : MEAS1/OUT
STEP10 : FINAL NUMERIC CALC
STEP11 : FINAL OUTPUT COND
STEP12 : OUT/SERIAL OUTPUT
STEP13 : OPS MENU COND
STEP14 : TITLE/YES
End

[1] Method for displaying the operation chart

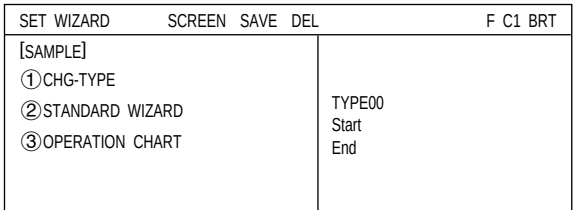
1. Move the cursor to "MAIN-COND" at the bottom of the Operation screen and press the SET key.



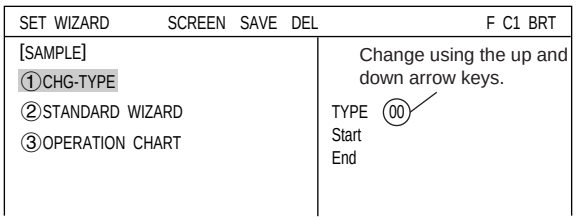
2. The "MAIN MENU" will appear.
   Move the cursor to "SET WIZARD" using the up and down arrow keys, and press the SET key.



3. The "SET WIZARD" screen will appear.



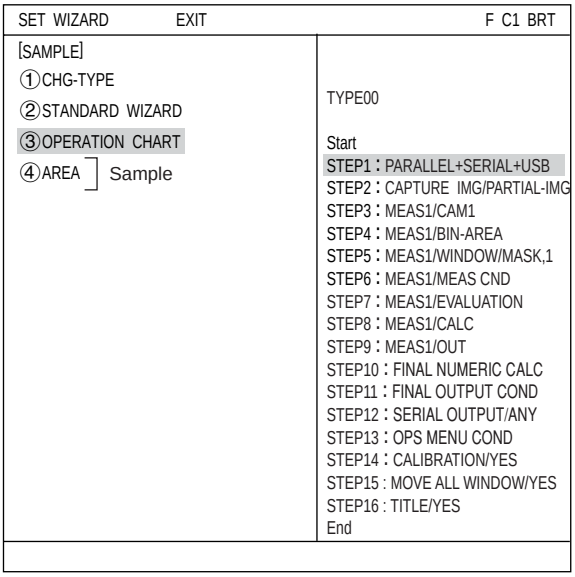
4. Change the object type number on the operation chart to the desired object type number.
   Select "①CHG-TYPE" and press the SET key. Then press the up and down arrow keys to change the object type number.
   After selecting a number, press the ESC key.



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.

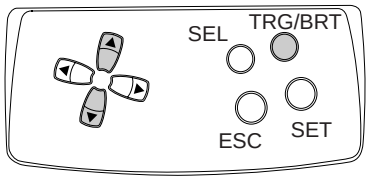
   Reference: To use a sample operation chart, move the cursor to the sample number desired and press the SET key. (Ex.: ④)

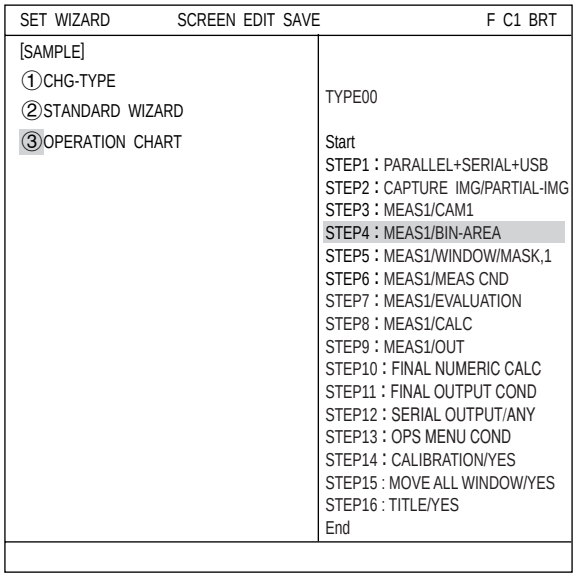
   Note: If no measurement conditions are set, the screen will not display any operation chart when you select "③OPERATION CHART."



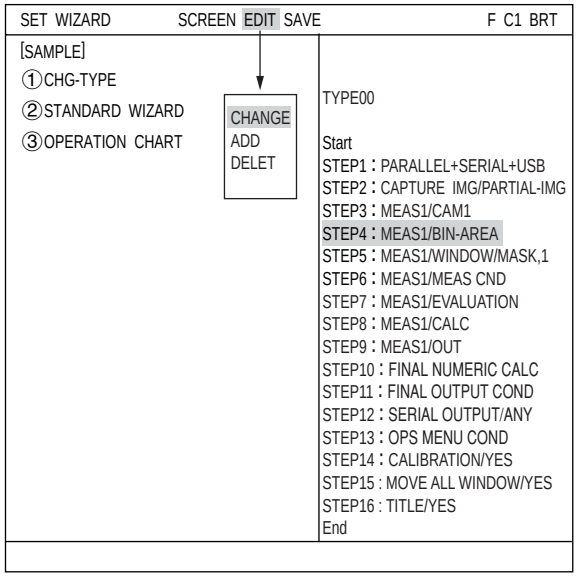
[2] How to edit an operation chart

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.

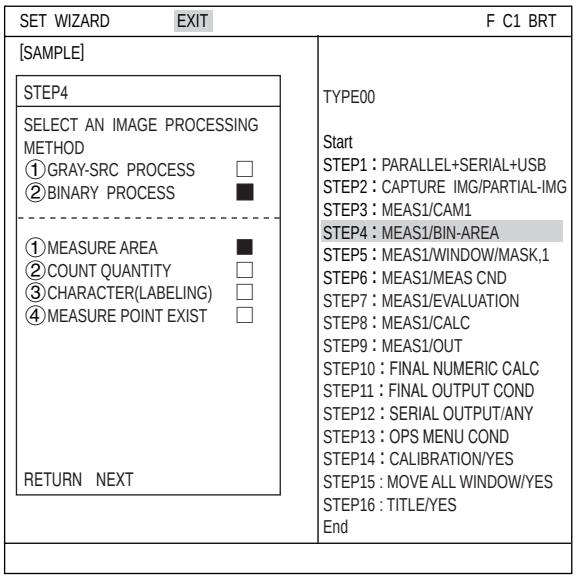




2. A pop up menu will appear and you can chose "CHANGE," "ADD," or "DELET" from it.
   Or, while the cursor is in the "③OPERATION CHART," move the cursor to any desired step number and press the SET key. You can then edit that step. (You cannot delete a step using this access method.)



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.)

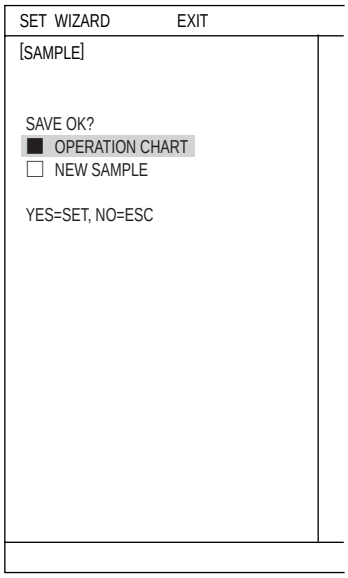


6

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.

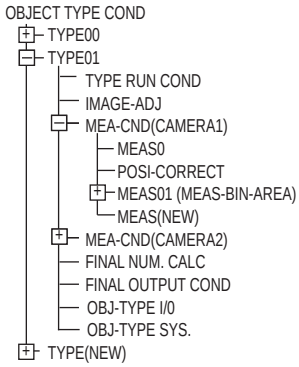
   - The changes will be written into the current operation chart.
   - Save as new sample (The original operation chart will not be changed.)

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

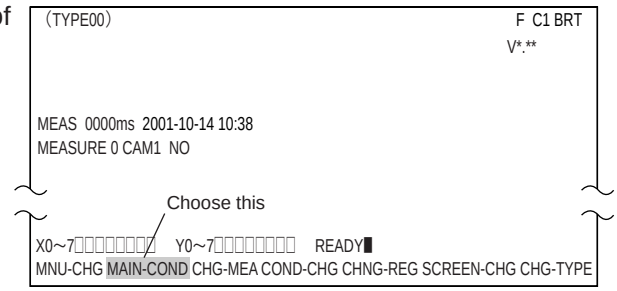


6-5 Menu tree

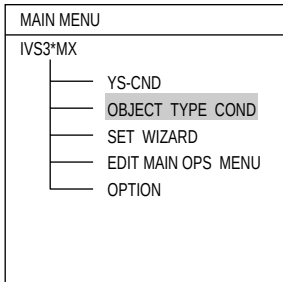
This section describes each of the settings using the menu tree.



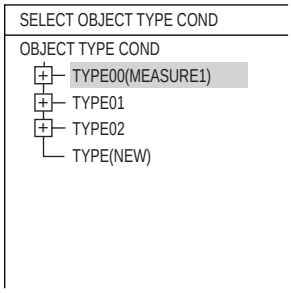
1. Move the cursor to "MAIN-COND" at the bottom of the Operation screen and press the SET key.



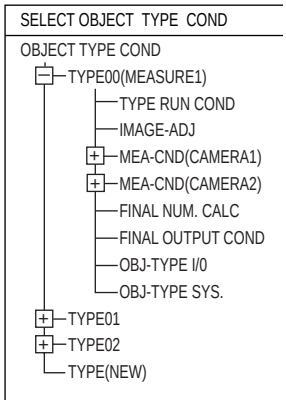
2. The "MAIN MENU" will appear.
   Move the cursor to "OBJECT TYPE COND" using the up and down arrow keys, and press the SET key.



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.)

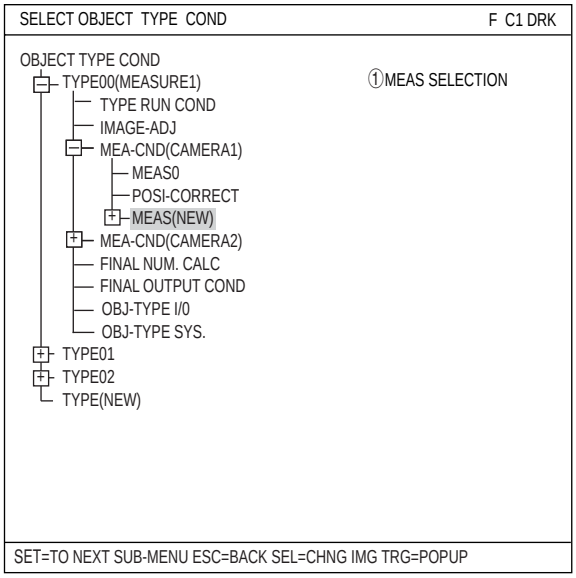


4. Move the cursor to the object type number you want to change using the up and down keys. Press the right arrow key and the sub menu will be displayed. A plus sign "⊞" means that there are other sub-menus below the marked menu. A minus sign "⊟" means that the sub menus are already displayed. By pressing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



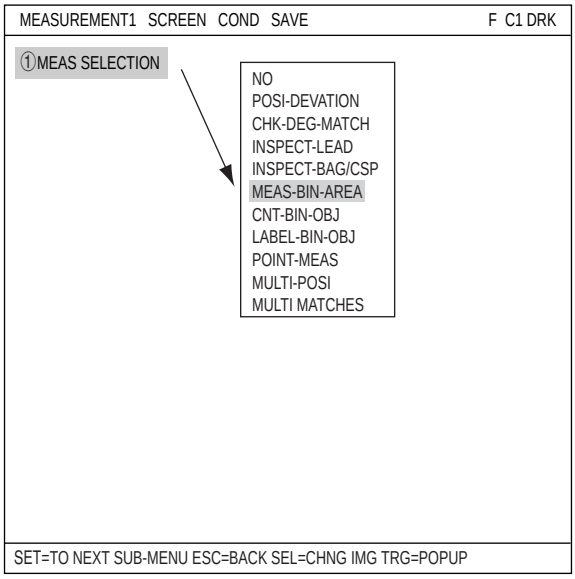
5. Move the cursor to the item on the menu that you want to set using the up and down arrow keys. Press the SET key to begin setting this item.

   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.



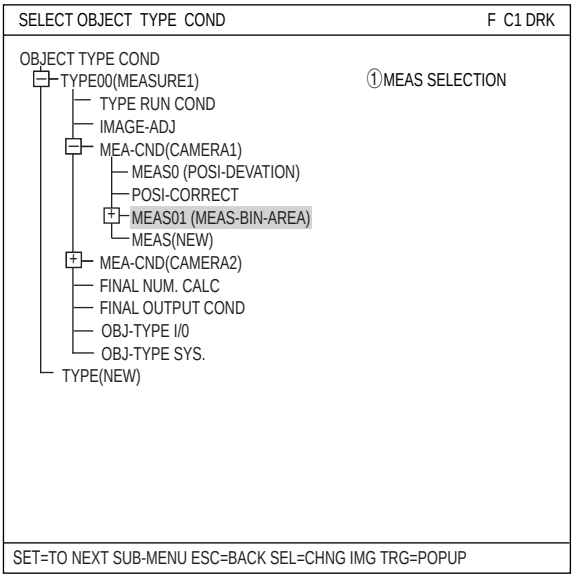
6

6. Press the SET key on "①MEAS SELECTION" on the measurement setting screen and then select "MEAS-BIN-AREA" on the pop up menu. Finally, press the SET key.



7. After making your selection, press the ESC key to return the cursor to the menu tree. Item "MEAS01 (MEAS-BIN-AREA)" will be given a "⊞" sign on the menu tree.

8. Move the cursor to "MEAS01 (MEAS-BIN-AREA)" 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.: When you want to change the image-processing method from gray search to binary processing.

	Set wizard operation chart	Menu tree
Gray processing	SET WIZARD EXIT F C1 BRT [SAMPLE] STEP4 SELECT AN IMAGE PROCESSING METHOD ①GRAY-SRC PROCESS ■ ②BINARY PROCESS □ ①MEAS POSI-DEVIAT ■ ②MEAS MULTI-POSI □ ③DETECT DEG-MAGCH LE □ ④MEAS MULTI-MATCHES □ ⑤INSPECT LEADS □ ⑥MEASURE POINT DENSI □ RETURN NEXT TYPE00 Start STEP1 : PARALLEL+SERIAL+USB STEP2 : CAPTURE IMG/PARTIAL-IMG STEP3 : MEAS1/CAM1 STEP4 : MEAS1/POS DEVIAT STEP5 : MEAS1/MEAS CND STEP6 : MEAS1/DTECT PRECISION STEP7 : MEAS1/EVALUATION STEP8 : MEAS1/CALC STEP9 : MEAS1/OUT STEP10 : FINAL NUMERIC CALC STEP11 : FINAL OUTPUT COND STEP12 : SERIAL OUTPUT/ANY STEP13 : OPS MENU COND STEP14 : CALIBRATION/YES STEP15 : MOVE ALL WINDOW/YES STEP16 : TITLE/YES End	SELECT OBJECT TYPE COND F C1 DRK OBJECT TYPE COND TYPE00(AREA) TYPE RUN COND IMAGE-ADJ MEA-CND(CAMERA1) MEAS0 POSI-CORRECT MEAS01 (POSI-DEVIATION) IMG PRE-PROC MEAS CND REG-COND(S) REG-COND(E) EVALUATION COND DISTANCE&ANGLE COND NUM-CALC OUT-COND MEAS(NEW) MEA-CND(CAMERA2) FINAL NUM. CALC ①DTECT PRECISION ②REGISTER NO. ③MODE ④DTECT ANGL ⑤MDL 0 ⑥MDL 1 SET=TO NEXT SUB-MENU ESC=BACK SEL=CHNG IMG TRG=POPUP
Binary processing	SET WIZARD EXIT F C1 BRT [SAMPLE] STEP4 SELECT AN IMAGE PROCESSING METHOD ①GRAY-SRC PROCESS □ ②BINARY PROCESS ■ ①MEASURE AREA ■ ②COUNT QUANTITY □ ③CHARACTER(LABELING) □ ④MEASURE POINT EXIST □ ⑤INSPECT BGA/CSP □ TYPE00 Start STEP1 : PARALLEL+SERIAL+USB STEP2 : CAPTURE IMG/PARTIAL-IMG STEP3 : MEAS1/CAM1 STEP4 : MEAS1/BIN-AREA STEP5 : MEAS1/WINDOW/MASK,1 STEP6 : MEAS1/MEAS CND STEP7 : MEAS1/EVALUATION STEP8 : MEAS1/CALC STEP9 : MEAS1/OUT STEP10 : FINAL NUMERIC CALC STEP11 : FINAL OUTPUT COND STEP12 : SERIAL OUTPUT/ANY STEP13 : OPS MENU COND STEP14 : CALIBRATION/YES STEP15 : MOVE ALL WINDOW/YES STEP16 : TITLE/YES End	SELECT OBJECT TYPE COND F C1 DRK OBJECT TYPE COND TYPE00(AREA) TYPE RUN COND IMAGE-ADJ MEA-CND(CAMERA1) MEAS0 POSI-CORRECT MEAS01(MEAS-BIN-AREA) IMG PRE-PROC MEAS CND REG-COND EVALUATION COND DISTANCE&ANGLE COND NUM-CALC OUT-COND MEAS(NEW) MEA-CND(CAMERA2) FINAL NUM. CALC ①WINDOW ②REGISTER NO. ③REGISTER EXIST ④MASK BINARY IMG ⑤BIN IMG MASK ⑥BINARY AREA SET=TO NEXT SUB-MENU ESC=BACK SEL=CHNG IMG TRG=POPUP

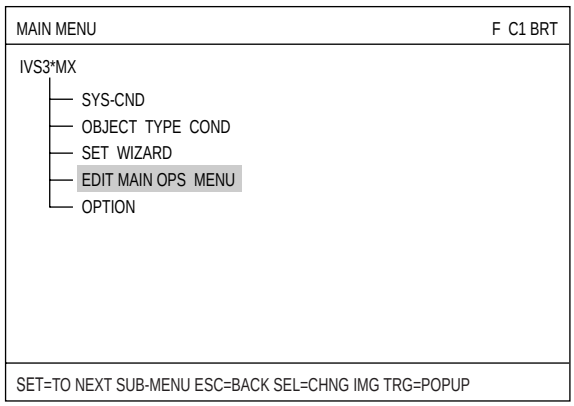
If you change the gray search to area measurement by binary processing using the set wizard program, the corresponding item on the menu tree will also change.

6-7 Editing operation screen

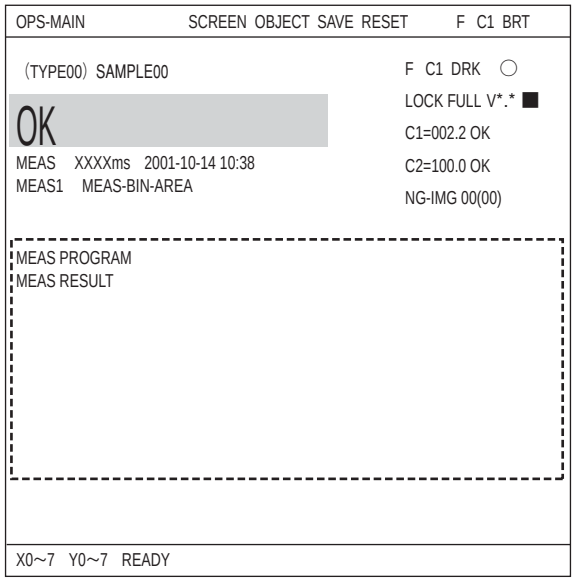
In this controller, the operation screen display can be changed. You can move, enlarge, reduce, or hide any block of text.

(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.



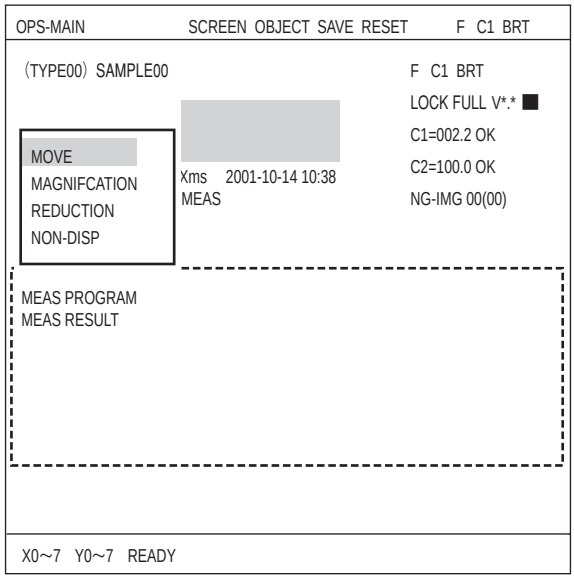
(3) Now the operation screen will appear. Select a block of text you want to edit using the up, down, left, and right arrow keys, and press the SET key. A pop up menu will appear and you can select from move, enlarge, reduce, and hide. (In this example, the block of text "OK" is selected.)



- **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.

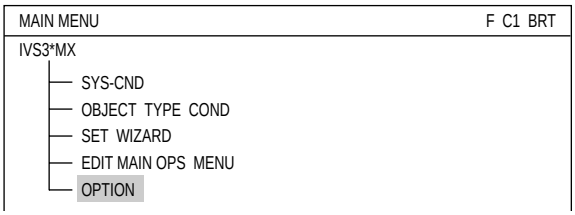


6-8 Option

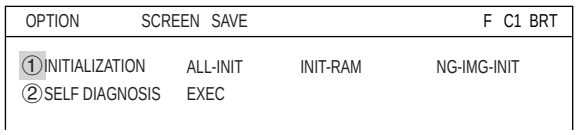
With the IV-S30, you can initialize the measurement settings, and run a self-diagnosis from the option menu.

Setting method

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



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

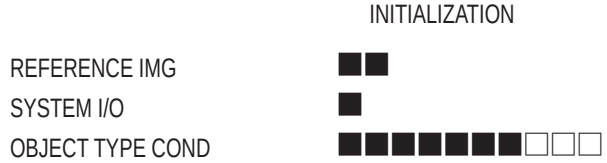


① INITIALIZATION

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.

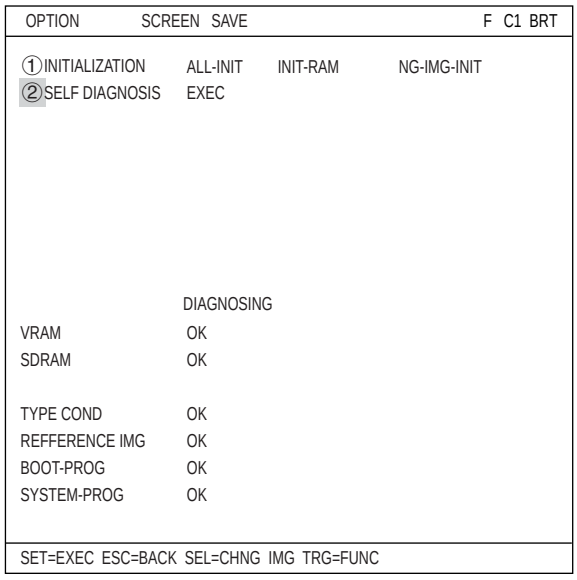


After the initialization is complete, the word "INITIALIZING" will change to "COMPLETE INIT." Press the ESC key to return to "MAIN MENU."

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."

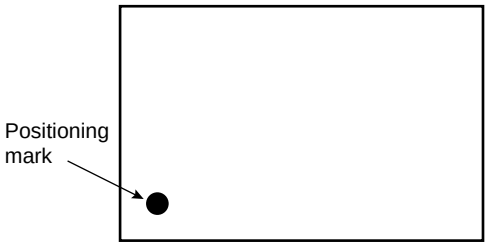


Chapter 7: Setting Examples Using the Setting Wizard

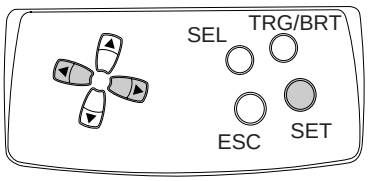
7-1 Position deviation measurement

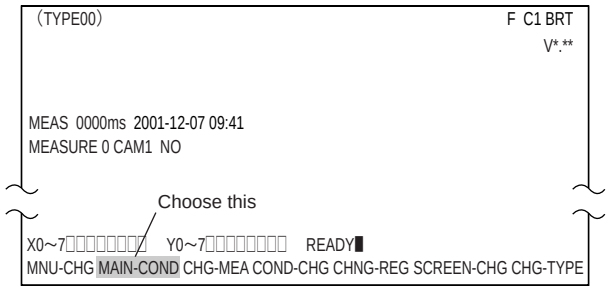
This paragraph describes an example of how to set the measurement positional deviation amount for the positioning mark shown on the right.
Use the remote keypad for this operation.

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

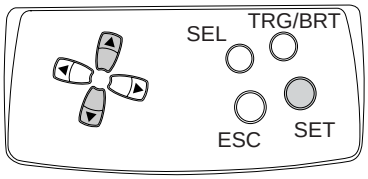


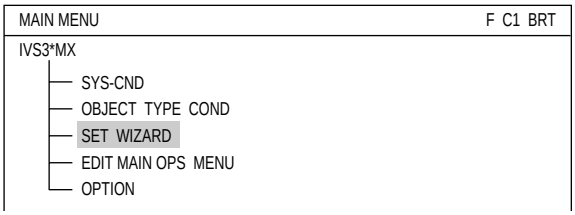
(1) Move the cursor to "MAIN COND" using the left and right arrow keys and press the SET key.



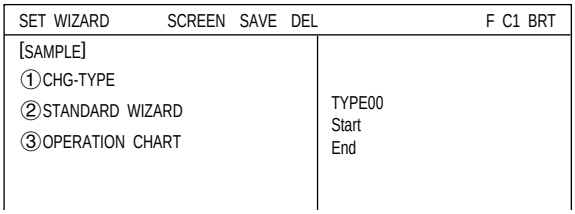


(2) The "MAIN MENU" will appear.
Move the cursor to the "SET WIZARD" item using the up and down arrow keys, and press the SET key.

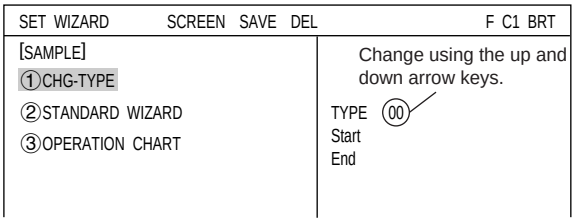




(3) The "SET WIZARD" screen will appear.



(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.



Note: If you are using the IV-S31MX, the range of numbers is from 00 to 15.

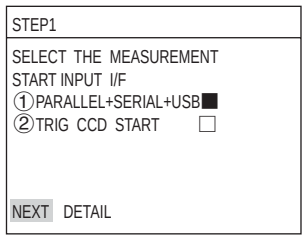
(5) Move the cursor to "②STANDARD WIZARD" and press the SET key. The set wizard will start.

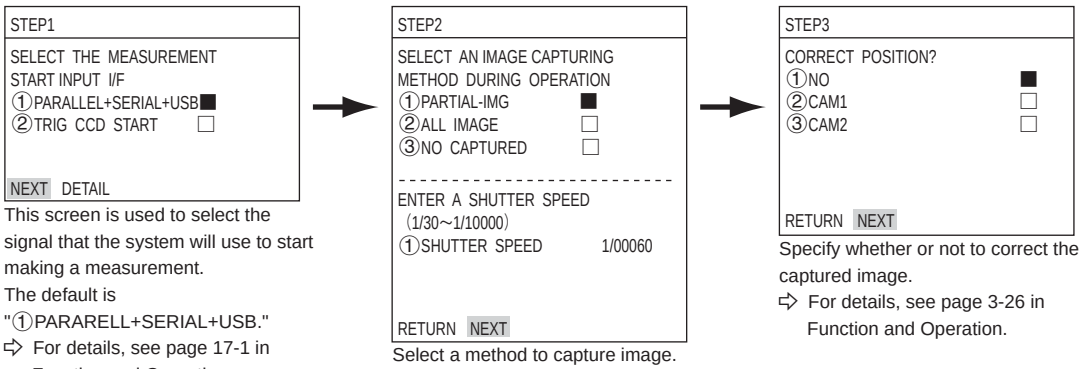
= In this example, the settings on the screens from the STEP1 to STEP 3 (CORRECT POSITION) are not changed. Select NEXT on each of these screens to go to the next screen. =

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.



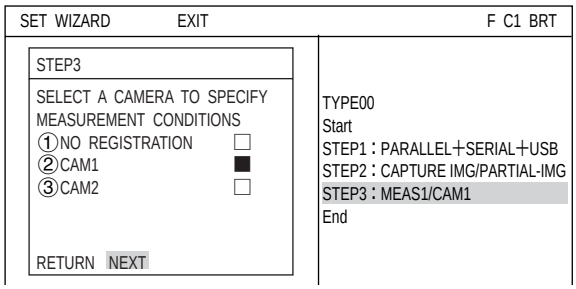


This screen is used to select the signal that the system will use to start making a measurement.
The default is "①PARARELL+SERIAL+USB."
⇨ For details, see page 17-1 in Function and Operation.
CCD trigger
⇨ For details, see page G-2.

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

Specify whether or not to correct the captured image.
⇨ For details, see page 3-26 in Function and Operation.

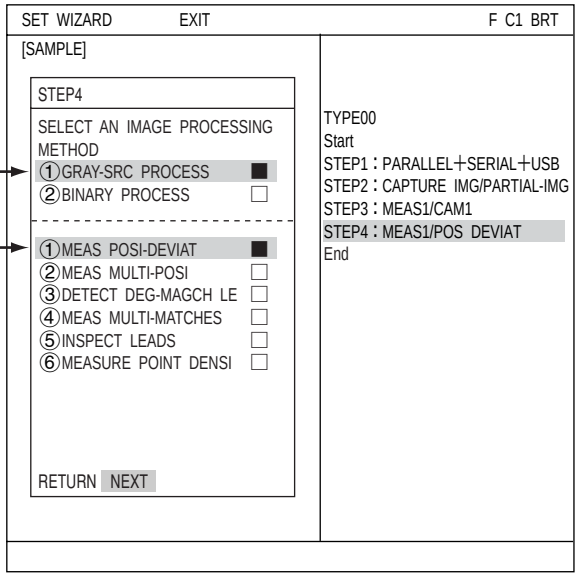
(6) Select a camera in order to specify measurement conditions
Move the cursor to "②CAM1" or "③CAM2" using the up and down arrow keys, and press the SET key.
Note: If you select "NO REGISTRATION", you cannot set the measurement conditions.



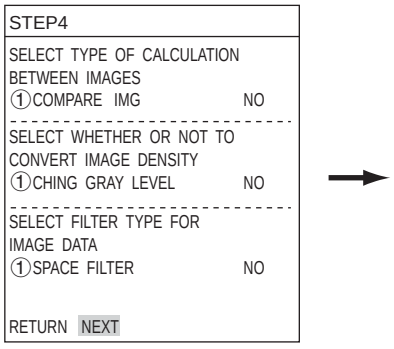
(7) Select an image-processing method

Move the cursor to "①GRAY-SRC PROCESS" and press the SET key.

Next move the cursor to "①MEAS POSI-DEVIAT" using the up and down arrow keys and press the SET key.
Press "NEXT" and go 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. =



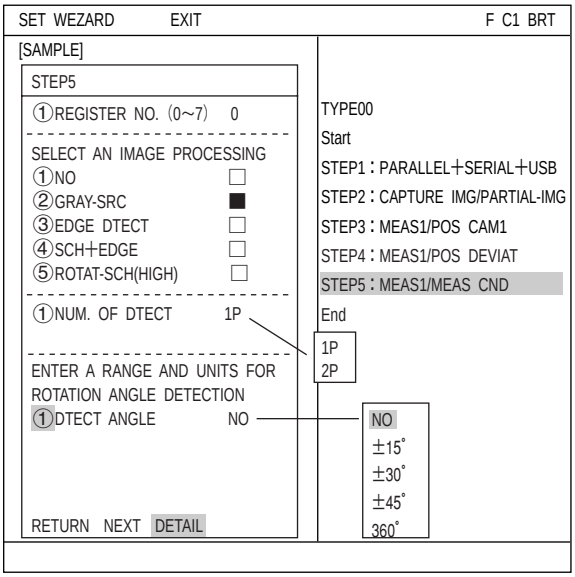
Select whether or not to process the captured image.
Calculation between images ⇨ See page 3-18 in Function and Operation
Density conversion ⇨ See page 3-20 in Function and Operation
Space filter ⇨ See page 3-21 in Function and Operation

(8) 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 "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."

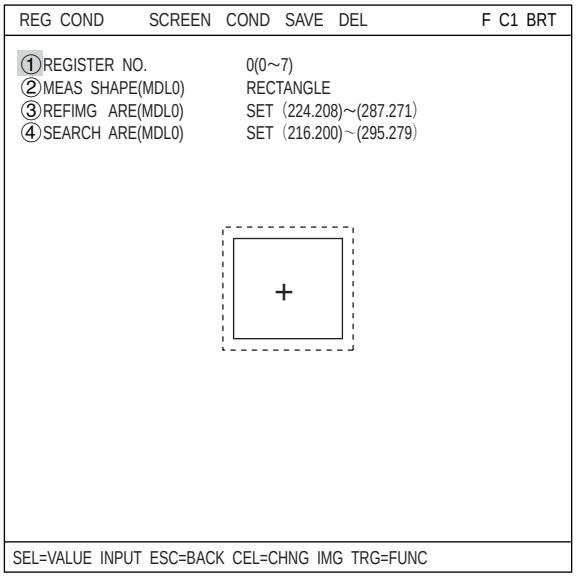
The "DETAIL" item will appear in the lower menu. Move the cursor to "DETAIL" and press the SET key.

Now "REG COND" screen will appear.

■ Setting the registration conditions

① REGISTER NUMBER

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.

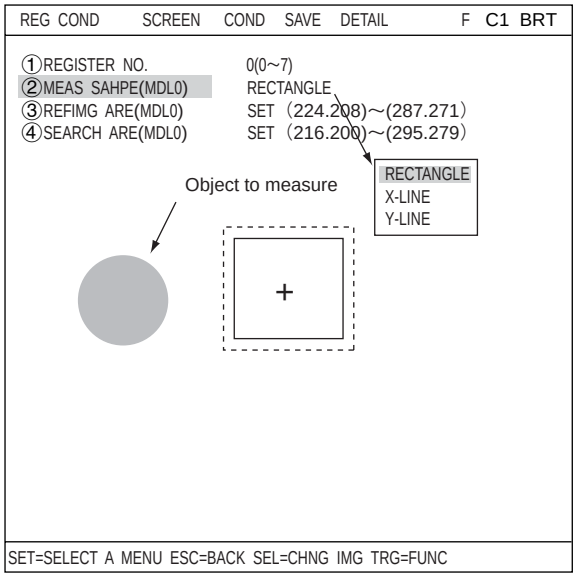


Next, adjust the image you want to measure.

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 4-2 and 4-3.
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-S30 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.

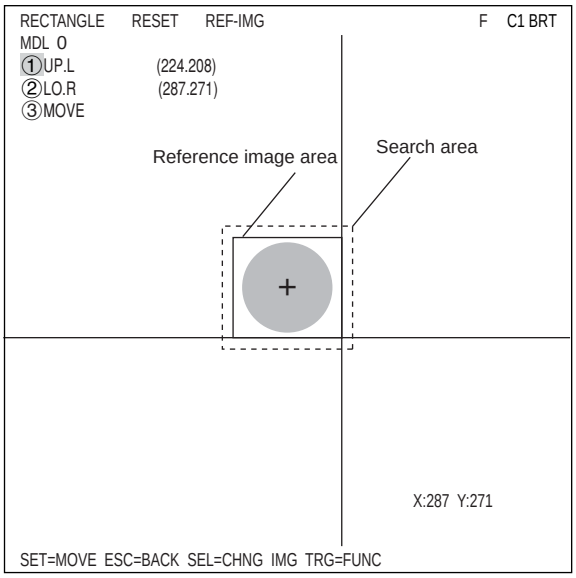
② MEAS SHAPE (MDL0)

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 3-4 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.



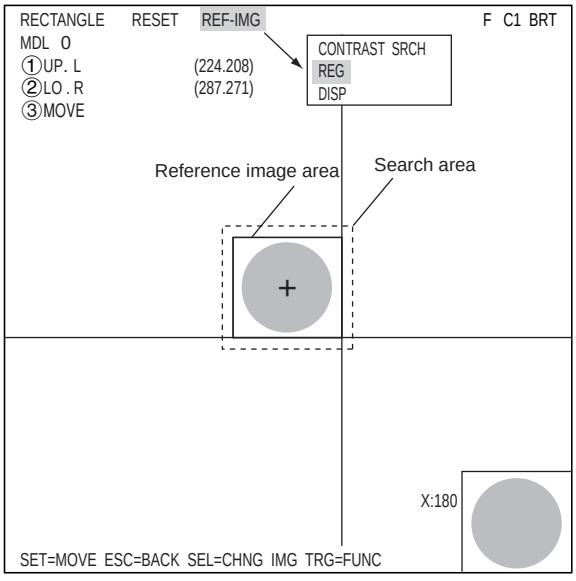
UP.L	The upper left corner of the rectangle can be moved up, down, left, and right.
LO.R	The lower right corner of the rectangle can be moved up, down, left, and right.
MOVE	The rectangle can be moved up, down, left, and right. Press the TRG/BRT key and select "MOVE." Press the SET key to display a cross 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 TRG/BRT key and move the cursor back to "①UP.L" or "②LO.R." After the position of the rectangle is correct, press the SET key.

Register a reference image

Press the TRG/BRT key and move the cursor to "REF-IMG" using the left and right 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.

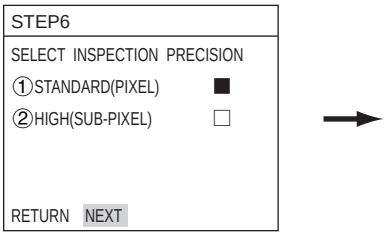
After the setting is complete, press the ESC key to return to the "REG COND" screen.
Note: If a reference image is not registered, you cannot make measurements.



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 and return to the "SET WIZARD" screen. Move the cursor to "NEXT" and press the SET key.

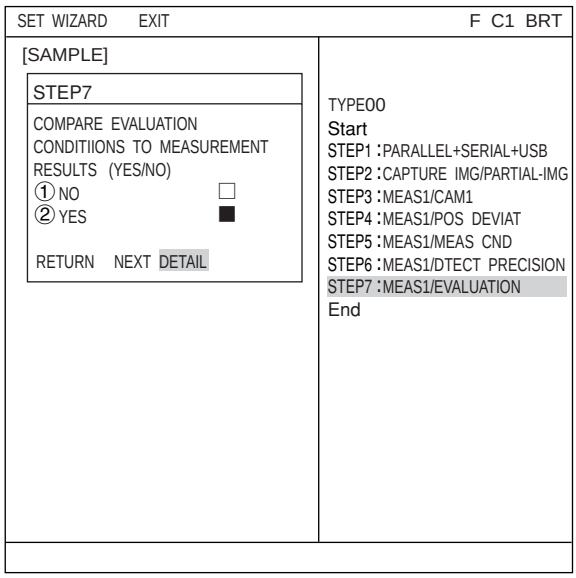
= In this example, the settings on the screens are not changed. Select "NEXT" on each of these screens to go to the next screen. =



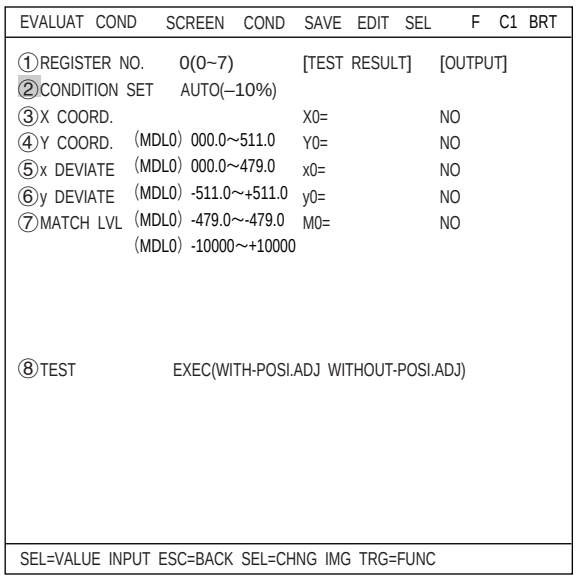
Setting the detection precision.
⇨ For details, see page 3-8 in Function and Operation.

(9) 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.

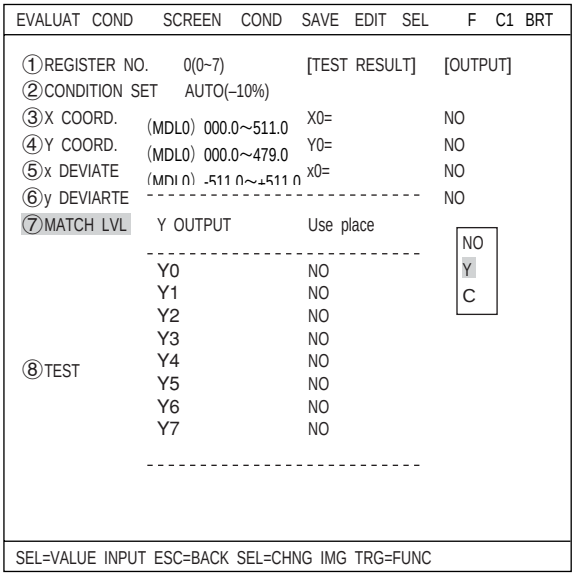


The "EVALUAT COND" screen will appear. Select "①REGISTER NO." using the up and down arrow keys. Change the number to "0" using the up and down arrow keys. Then press the SET key.



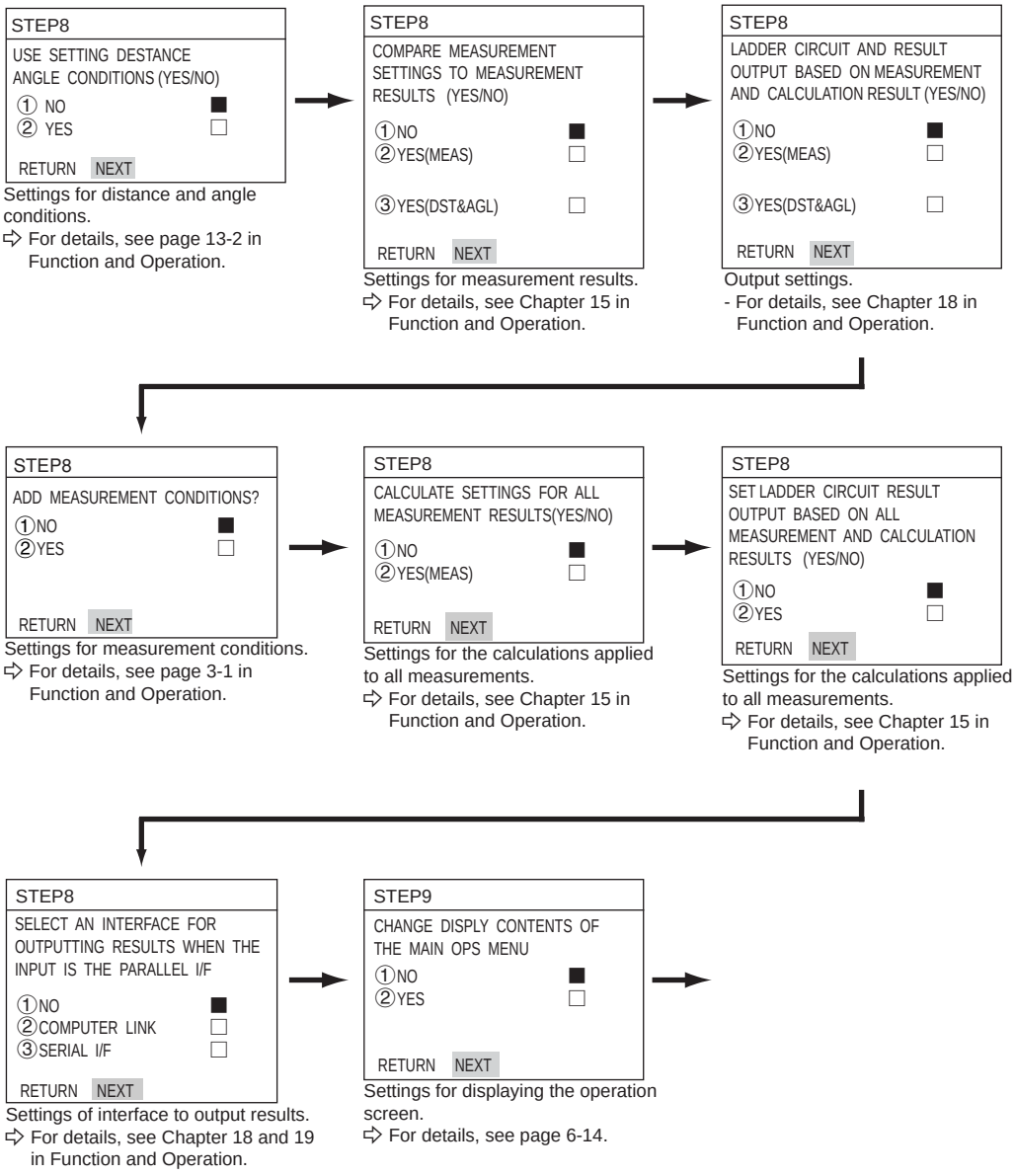
Select "⑦MATCH LVL (MDL0)" using the up and down arrow keys and set the upper and lower limit values.

Select a digit using the left and right arrow keys. Select a number using the up and down 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."
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 3-18 in Function and Operation.

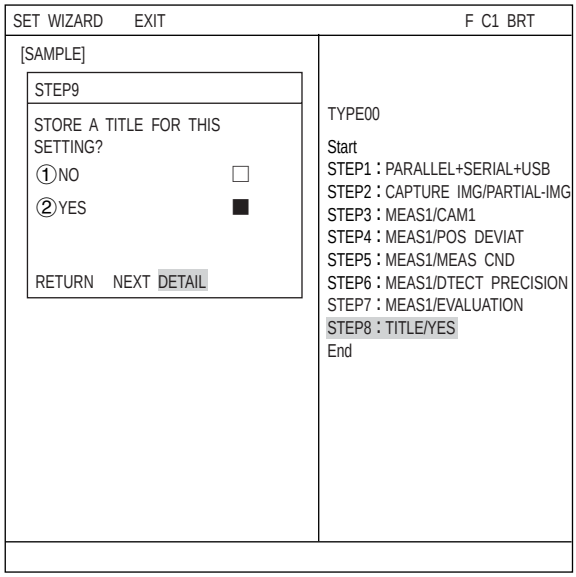


After the settings are complete, press the ESC key to return to the "SET WIZARD" screen.

= In this example, the settings on the STEP8 to STEP9 (MAIN OPS MENU) are not changed. Select "NEXT" on each of these screens to go to the next screen. =



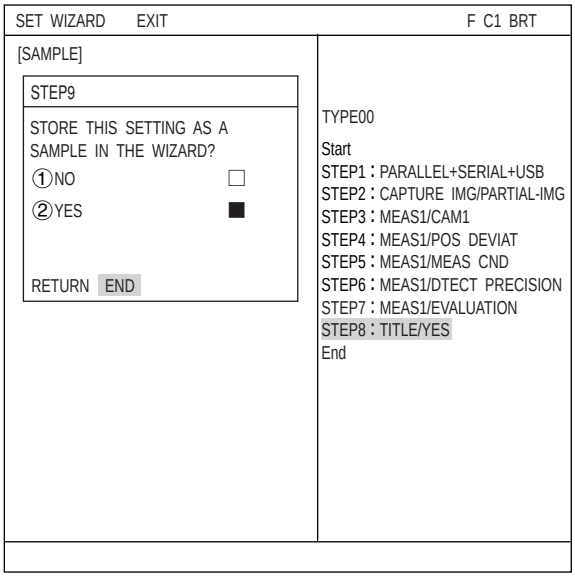
(10) STORE A TITLE FOR THIS SETTING?
After making this series of settings, select "②YES" to save the settings as a group. By selecting "② YES," "DETAIL" will appear in the lower menu. Select "DETAIL" and press the SET key.



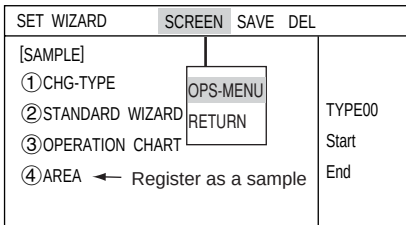
The "STR OBJ TITLE" screen will appear. Enter a name using the up, down, left, and right arrow keys. Then, select "END" and press the SET key. The monitor will return to the "SET WIZARD" screen. Select "NEXT" and press the SET key to go to the next screen.

(11) 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.

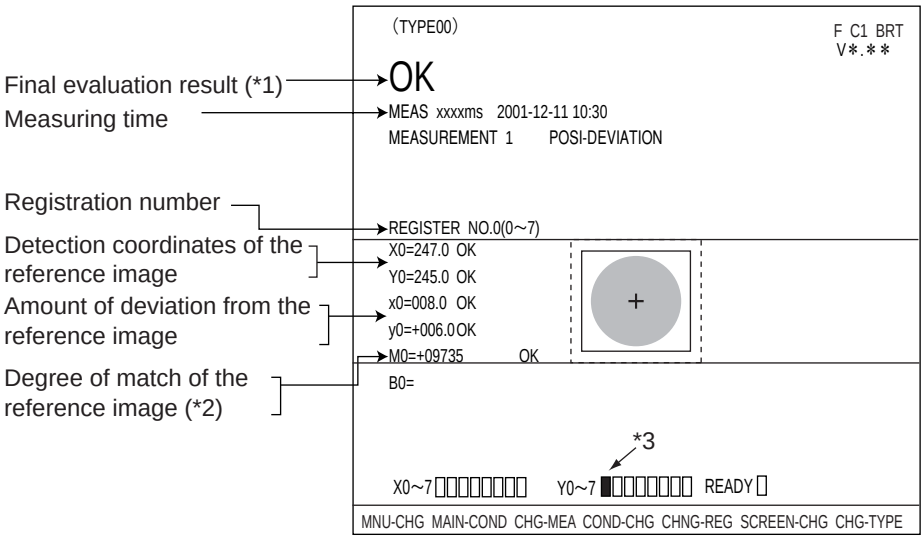


(12) The sample is registered with the title you assigned to on the "SET WIZARD" screen.
Note 1: If no title was assigned, the sample settings are simply listed as "Sample *"
Note 2: A maximum of eight sample settings can be assigned.



(13) 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 and select "OPS-MENU" from the popup menu.

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



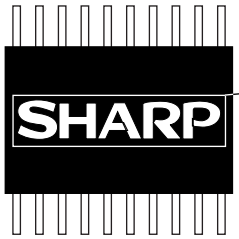
*1 The final evaluation result will be displayed as "OK" in the upper left corner of the screen when all of the items have been evaluated acceptable.
If there is a single unacceptable item, "NG" will be displayed.

*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.)

7-2 Area measurement by binary conversion

This section describes the setting procedures for the binary area measurement of the object below. The area will be measured by counting the number of pixels after binarization.

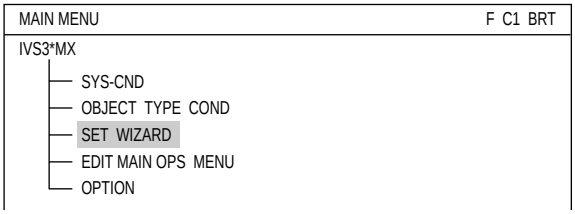


Object to be measured
(Measure the white area in the "SHARP" logo.)

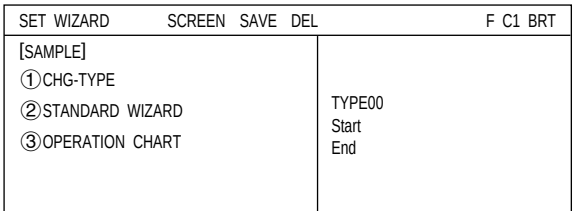
This section descrives only the minimum required settings.
Use the remote keypad for the operation.
⇨ See page 6-6 for detail of the operation of each key on the remote keypad.

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

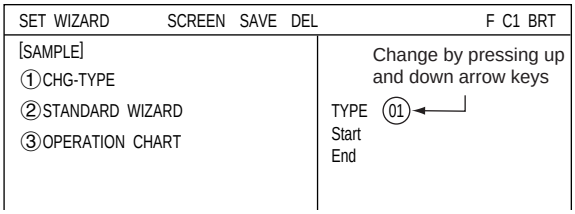
(2) The "MAIN MENU" will appear.
Move the cursor to the "SET WIZARD" item using the up and down arrow keys, and press the SET key.



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

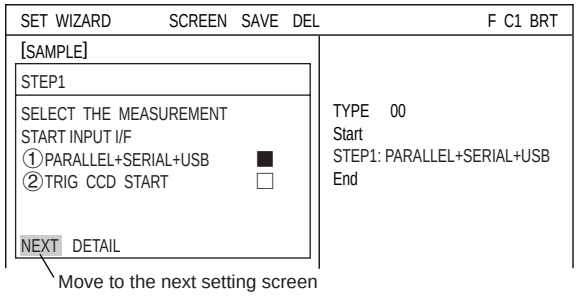


(4) Enter an object type number.
Move the cursor to "①CHG-TYPE,"using the up and down arrow keys, and press the SET key. "①CHG-TYPE" will be highlighted. Next, press the up and down arrow keys and the "TYPE00" display on the right will change. Each time you press the up key, the type number will increase 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.

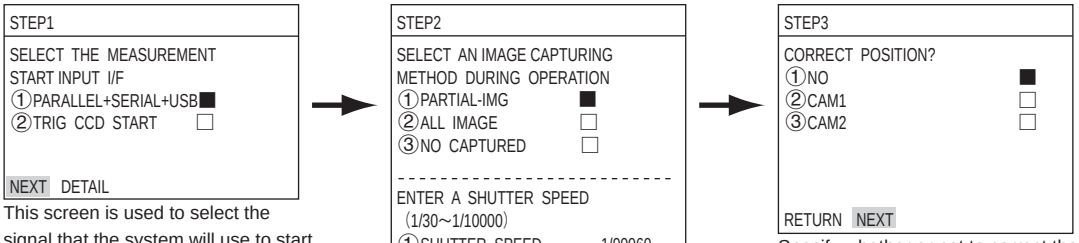


Note: If you are using the IV-S31MX, the range of numbers is from 00 to 15.

(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. =

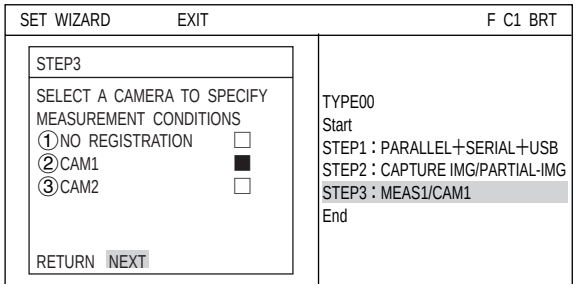


This screen is used to select the signal that the system will use to start making a measurement.
The default is "①PARARELL+SERIAL+USB."
⇨ For details, see page 17-1 in Function and Operation.
CCD trigger
⇨ For details, see page G-2.

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

Specify whether or not to correct the captured image.
⇨ For details, see page 3-26 in Function and Operation.

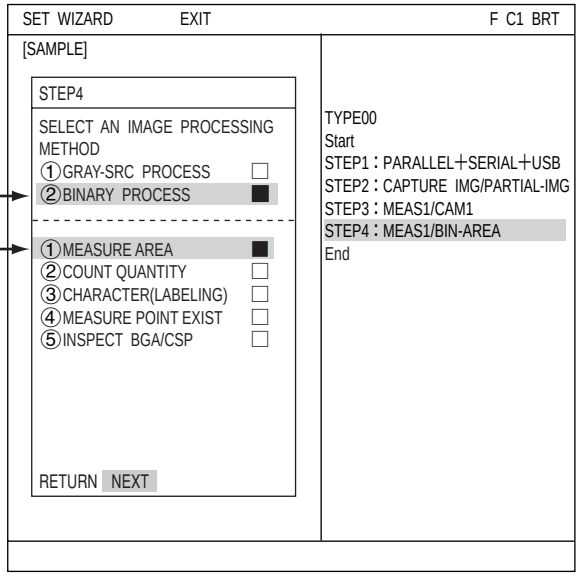
(6) Select a camera in order to specify measurement conditions.
Move the cursor to "②CAM1" or "③CAM2" using the up and down arrow keys, and press the SET key.
Note: If you select "NO REGISTRATION" you cannot set the measurement conditions.



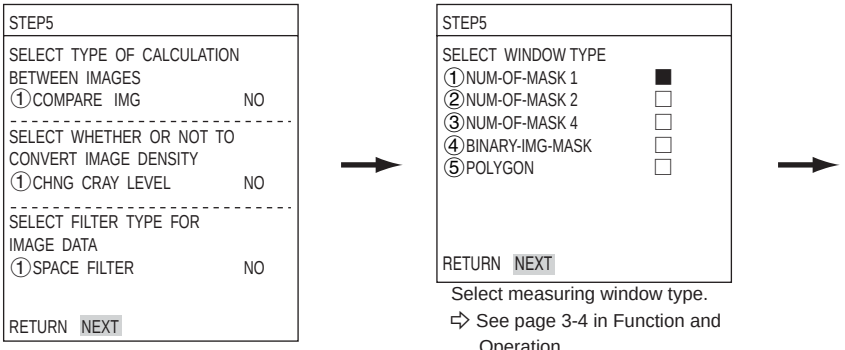
(7) Select an image-processing method
Move the cursor to "②BINARY PROCESS" and press the SET key.

Next move the cursor to "①MEASURE AREA" using the up and down arrow keys and press the SET key.

Press "NEXT" and go to the next screen.



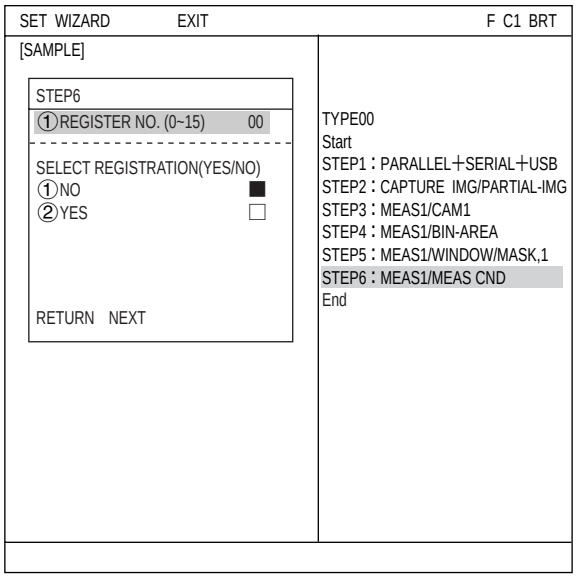
= In this example, the settings on the screens are not changed. Select "NEXT" on each of these screens to go to the next screen. =



Detailed settings of the compare images.
⇨ See page 3-18 in Function and Operation

Select measuring window type.
⇨ See page 3-4 in Function and Operation

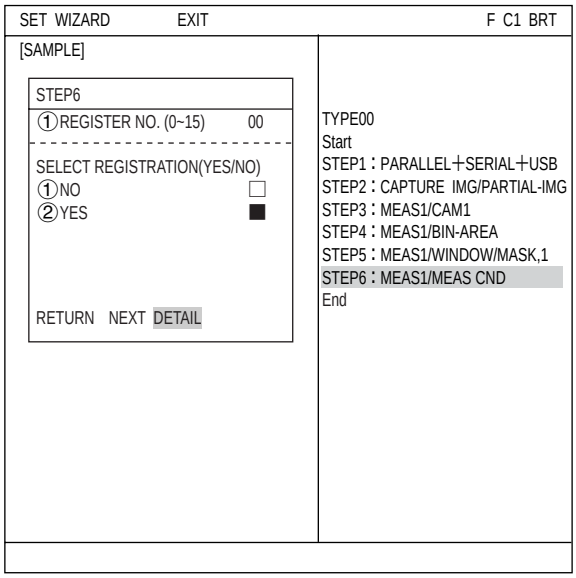
(8) Select a registration number
Move the cursor to "①REGISTER NO. (0 ~ 15)" and press the SET key. While this item is highlighted, press the up and down arrow keys and press the SET key twice when the number you want appears.



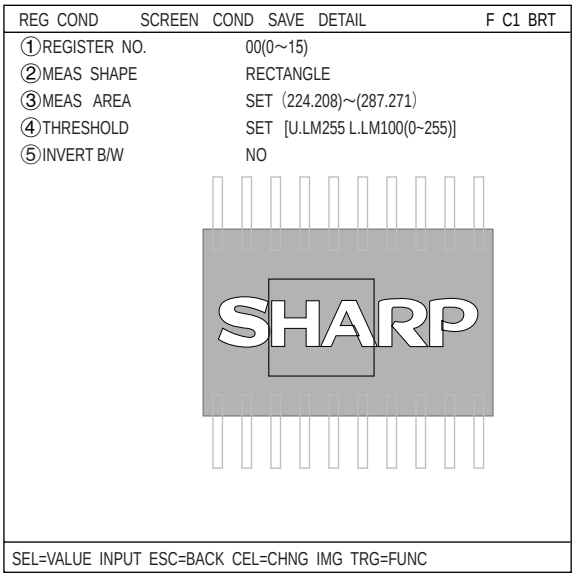
Next, move the cursor to "②YES" on the "SELECT REGISTRATION (YES/NO)" line and press the SET key.

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

Now the "REG COND" menu will appear.



■ Setting the registration conditions



- **Adjust the image**
  On the "REG COND" menu, adjust the image to be measured.

  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 "DRK" 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 4-2 and 4-3.

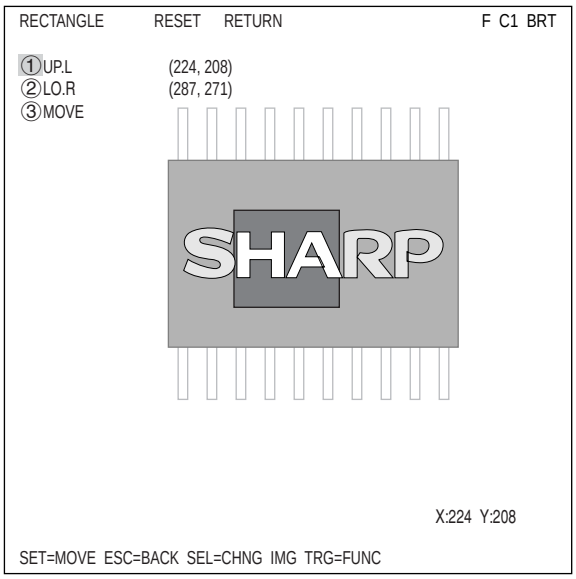
  3. After the measurement object image is clearly visible, change the image mode back to "F" (Freeze) using the up and down arrow keys.

     Note: Whenever you want to set threshold value, the image display mode should be changed to "F."

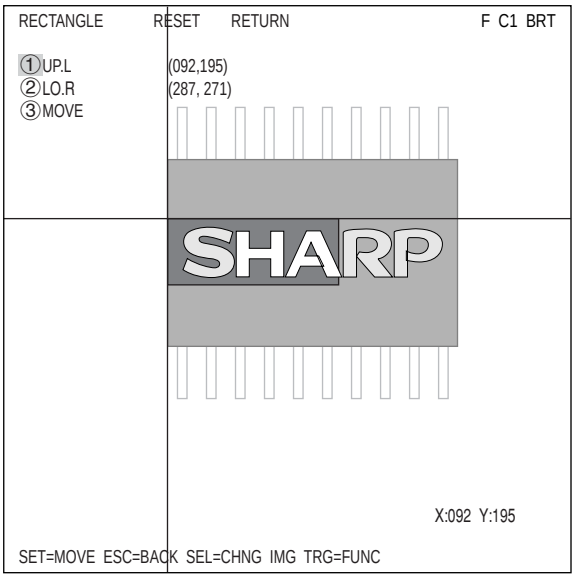
  4. Press the SEL key and move the cursor from the upper function menu to the "REG COND" screen.

- **Specify the measurement area**
  Move the cursor to "③MEAS AREA" and press the SET key. "SET" will be highlighted.

  Press the SET key again and the "RECTANGLE" screen will appear.

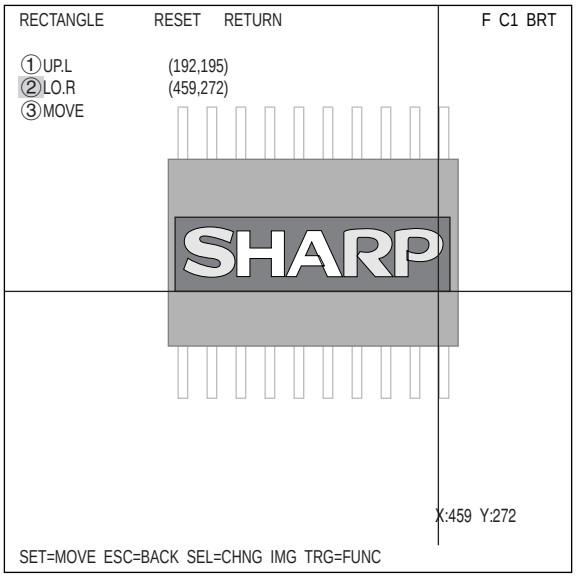


Move the cursor to "①UP.L" and press the SET key. The X and Y coordinates of the rectangle are displayed on the screen. Identify the coordinates of the upper left corner of the measurement area using the up, down, left, and right arrow keys.
After the coordinates of the upper left corner are correct, press the SET key.
Note: If you press the ESC key, the setting will be canceled.



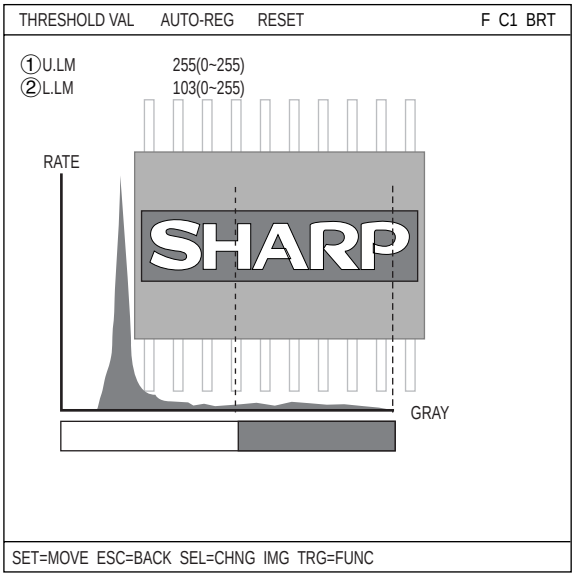
Next, move the cursor to the "②LO.R" line and press the SET key. Then set the coordinates of the lower right corner of the measurement area, the same as done for the upper left corner.

After the setting is complete, press the ESC key and the monitor will return to the "MEAS COND" screen.
If "③MEAS AREA" setting is highlighted, press the ESC key again to remove the highlighting.



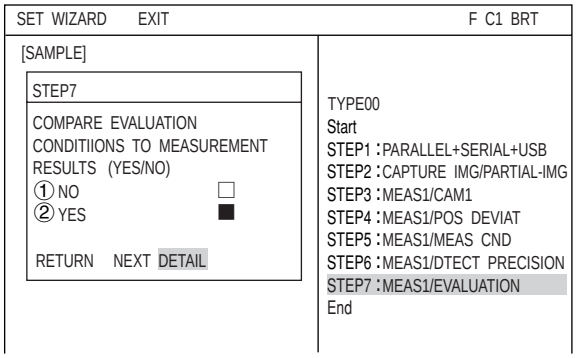
- **Setting the threshold value**
  Move the cursor to "④THRESHOLD" and press the SET key. The "SET" will be highlighted, press the SET key again. The "THRESHOLD (graphic)" screen will appear.
  Move the cursor to "①U.LM" or "②L.LM" and press the SET key. The number will be highlighted. Next, press the up and down arrow keys. The bar on the graph will move left and right and you can adjust the upper and lower limit values.

- **Auto setting**
  On the "THRESHOLD VAL (graphic)" screen, press the TRG/BRT key to move the cursor to the upper function menu. Move the cursor to "AUTO-REG" and press the SET key. A popup menu will appear. The controller will set the threshold to the optimum values automatically when you select the "L LIMIT ONLY" or " U&L LIMITS."



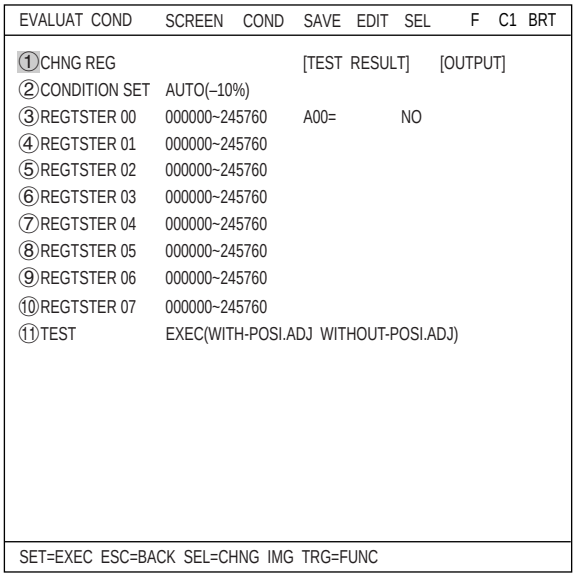
After the settings are complete, press the ESC key twice to return to the "SET WIZARD" screen. Select "NEXT" to go to the next screen.

(9) Select whether or not to set the evaluation conditions for measured results.
Select "②YES" using the up and down arrow keys 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 "③REGISTER 00" using the up and down arrow keys and press the SET key twice. The cursor will move to the leftmost digit of the lower limit value.
Select a digit using the left and right arrow keys. Set the value of the digit using the up and down arrow keys.
After the value is correct, press the SET key.

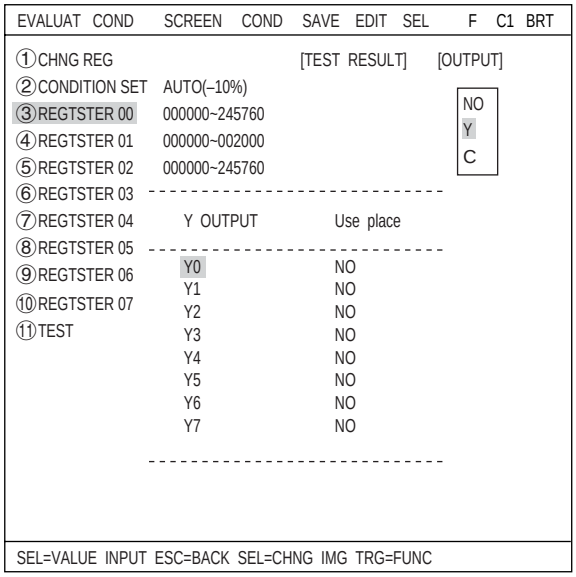


7

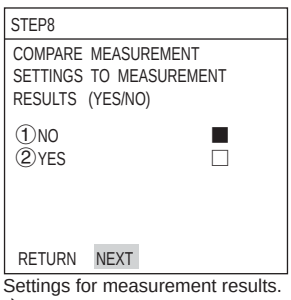
Press the left and right keys to move the cursor to "OUTPUT." Now press the SET key. A popup menu will appear and you can choose "NO," "Y," or "C."
Move the cursor to "Y" and press the SET key. Then select the Y0 and press the SET key. Now the evaluation results will be output to the Y0 terminal.

⇨ For details about the evaluation conditions, see page 3-16 in Function and Operation.

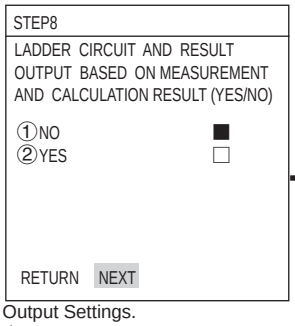
After the settings are complete, press the ESC key to return to the "SET WIZARD" screen. Move the cursor to the "NEXT" using the left and right arrow keys, and press the SET key.



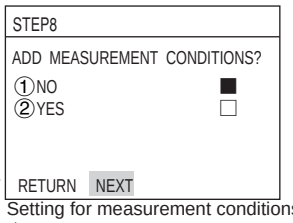
= In this example, the settings on the STEP8 to STEP9 (MAIN OP MENU) are not changed. Select the "NEXT" on each of these screens to go to the next screen. =



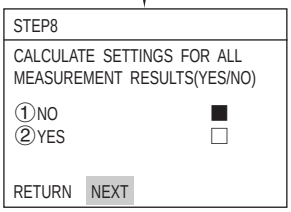
Settings for measurement results.
⇨ For details, see Chapter 15 in Function and Operation.



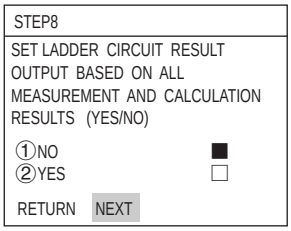
Output Settings.
⇨ For details, see Chapter 18 in Function and Operation.



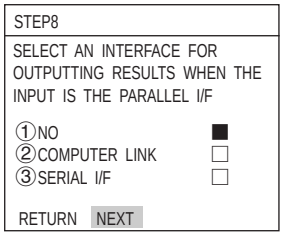
Setting for measurement conditions.
⇨ For details, see page 3-1 in Function and Operation.



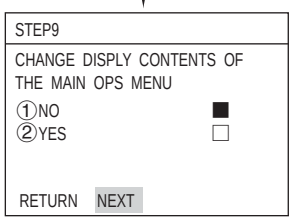
Settings for the calculations applied to all measurements.
⇨ For details, see Chapter 15 in Function and Operation.



Settings of outputting the calculation results all the measurements.
⇨ For details, see Chapter 15 in Function and Operation.

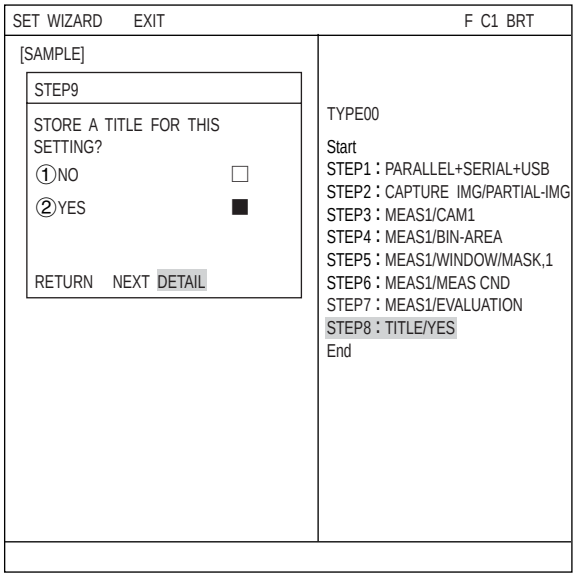


Settings of interface to output results.
⇨ For details, see Chapter 18 and 19 in Function and Operation.



Arrange the operation screen.
⇨ For details, see page 6-14 in Function and Operation.

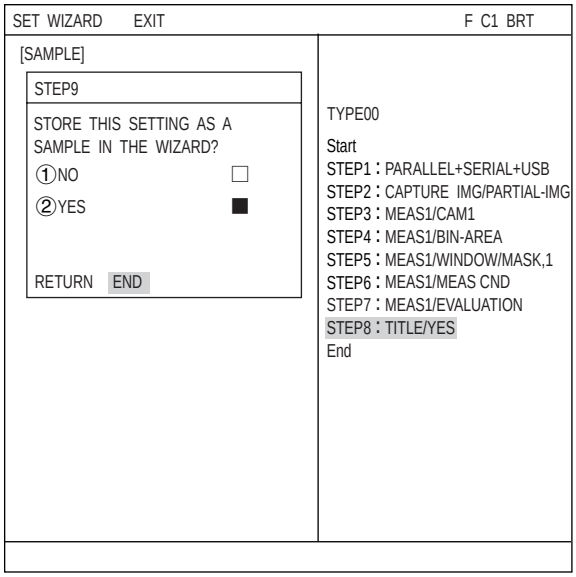
(10) STORE A TITLE FOR THIS SETTING?
After making this series of settings, select "②YES" to save the settings as a group. By selecting "② YES," "DETAIL" will appear in the lower menu. Select "DETAIL" and press the SET key.



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.

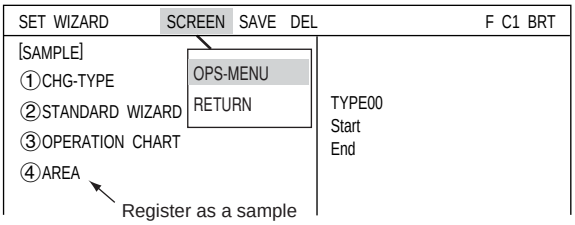
(11) STORE THIS SETTING AS A SAMPLE IN THE WIZARD?
Select "①NO" or "②YES" and then "END." Finally, press the SET key.

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



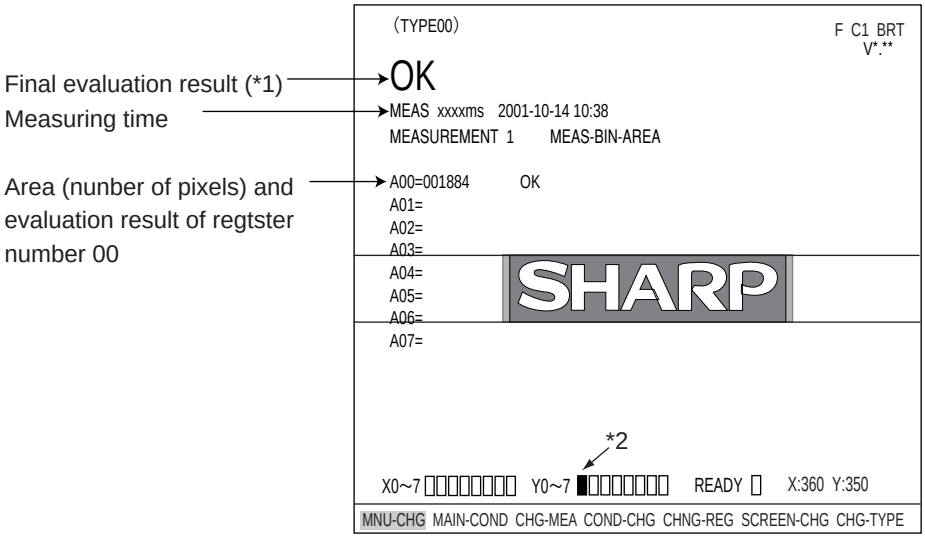
(12) The sample settings are shown with the title you assigned to them on the "SET WIZARD" screen.

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.



(13) 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 and select "OPS-MENU" from the popup menu.

(14) Execute a measurement.
The operation screen will appear.
Press the TRG/BRT key, the area within the specified measurement area will be displayed as a number of pixels.



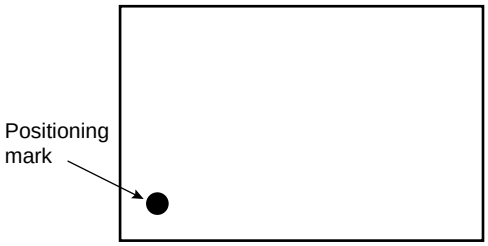
*1 The final evaluation result will be displayed as "OK" in the upper left corner of the screen when all of the items have been evaluated acceptable.
If there is a single unacceptable item, "NG" will be displayed.
When the "MEAS BIN AREA" is selected, only area is evaluated. When the area is within the range specifired in the step (7) (upper and lowe limits), the result wil be OK.

*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.)

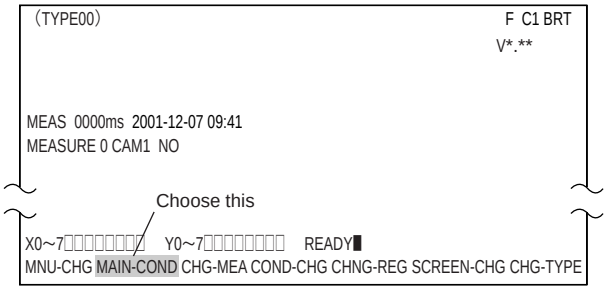
Chapter 8: Setting Examples Using the Menu Tree

8-1 Position deviation measurement

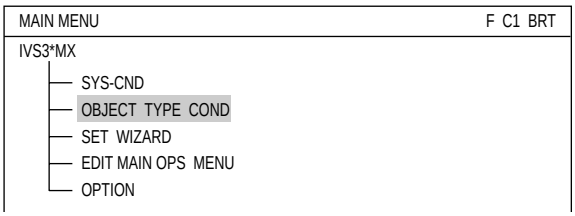
This paragraph describes an example of how to set the measurement positional deviation amount for the positioning mark shown on the right.



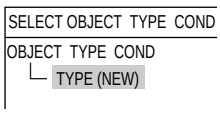
(1) Move the cursor to "MAIN COND" using the left and right arrow keys and press the SET key.



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

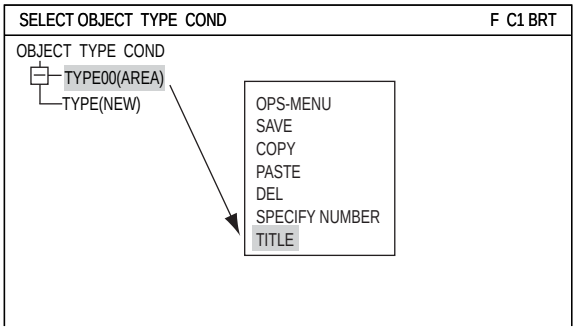


(3) The "SELECT OBJECT TYPE COND" screen will appear.
When the cursor is on "TYPE(NEW)," press the SET key. "TYPE00" will be created.

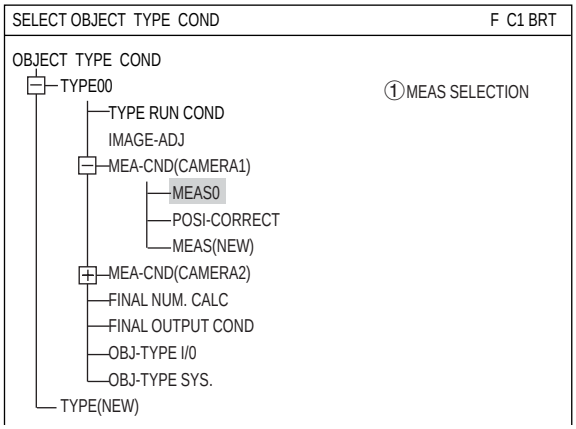


(4) Enter a title for the object type.
Move the cursor to "TYPE00" and press the TRG/BRT key. A popup menu will appear. Move the cursor to "TITLE" on the popup menu and the "STR OBJ TITLE" screen will appear.
⇨ See page 7-9

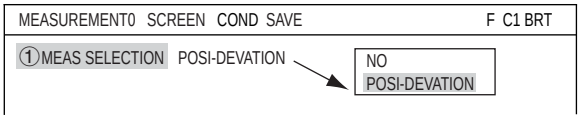
Enter a name and press "END." The name will be added next to the "TYPE00" term.



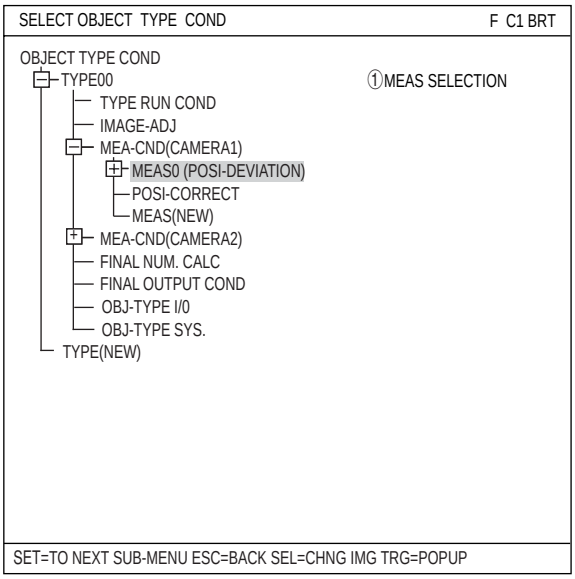
(5) While the cursor is on "TYPE00," press the right arrow key (or the SET key). A sub menu will be displayed. On the sub menu, select "MEA-CND (CAMERA1)" and then "MEAS0."



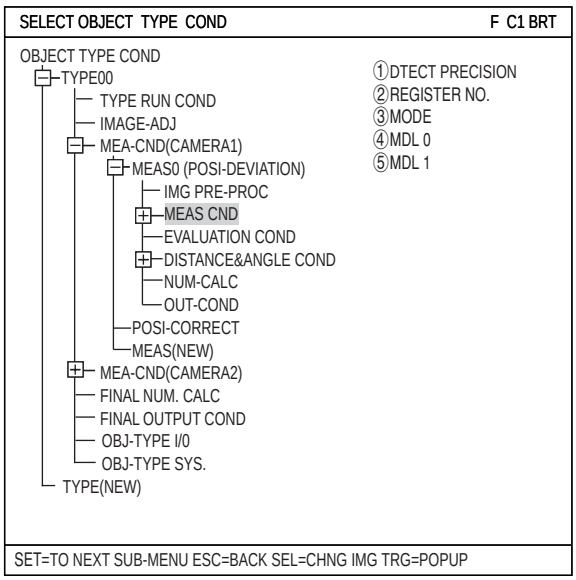
(6) When "MEAS0" is selected, press the SET key. The "MEAS0" screen will appear. Press the SET key, and a popup menu will appear. Select "POSI-DEVIATION" using the up and down arrow keys, and press the SET key.



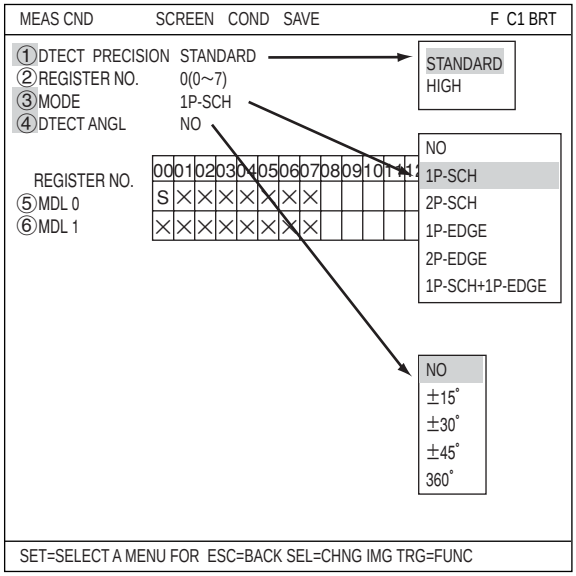
(7) Press the ESC key to return to the menu tree display. Now "MEAS0" will change to "MEAS0(POSI-DEVIATION)."



(8) Select "MEAS0(POSI-DEVIATION)" and then "MEAS CND." Then, press the SET key, the "MEAS CND" screen will appear.



(9) Setting the "MEAS CND" (measurement conditions)



① **DETECT PRECISION**
Select "STANDARD" from the popup menu.
⇨ For details, see page 3-10 in Function and Operation.

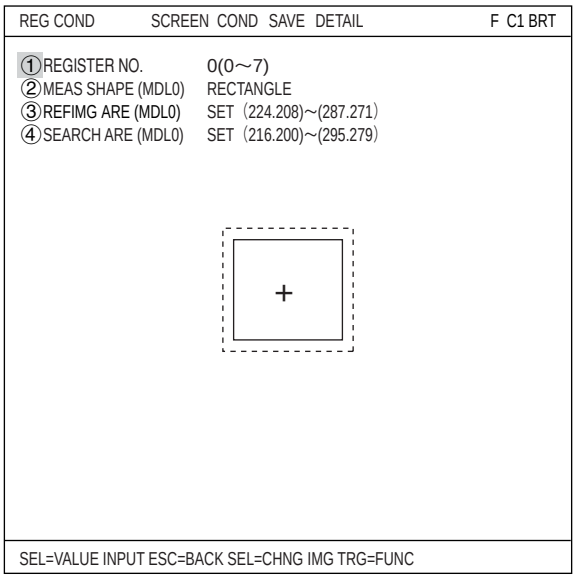
② **REGISTER NO.**
Press the SET key and then press the up and down arrow keys to change the register number.

③ **MODE**
Select "1P-SCH" from the popup menu.

④ **DTECT ANGL**
Select "NO" on the popup menu.

⑤ **MDL 0**
An "S" will be put in the column of the registered number. Move the cursor to the "⑤MDL 0" line and press the SET key twice. The "REG COND" screen will appear.

(10) Setting the "REG COND" (registration conditions)



① **REGISTER NO.**
The previously specified register number is displayed.
⇨ See page 8-3.(9)②
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 "DRK" 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 4-2 and 4-3.

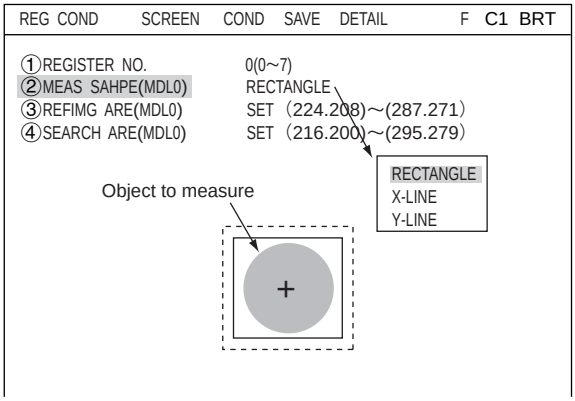
3. After the measurement object image is clearly visible, change the image mode back to "F" (Freeze) using the up and down arrow keys.
   By switching the image display mode from "T" to "F," the image will be captured by the IV-S30 controller.
   Note: Whenever you want to register a reference image, 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)**

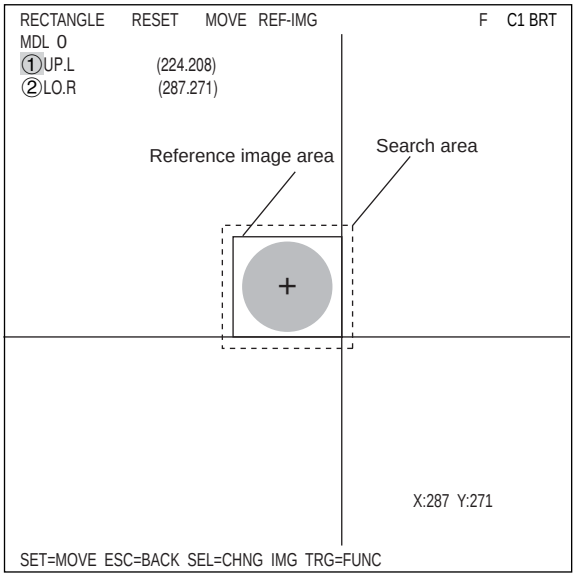
Move the cursor to this line and press the SET key. A popup menu will appear.
Move the cursor to "RECTANGLE", "X- LINE" or "Y- LINE" and press the SET key. In this example, select "RECTANGLE."

⇨ For details, see page 3-4 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. Press the TRG/BRT key and select "MOVE." 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 TRG/BRT key and move the cursor back to "①UP.L" or "②LO.R." After the position of the rectangle is correct, press the SET key.

Register a reference image

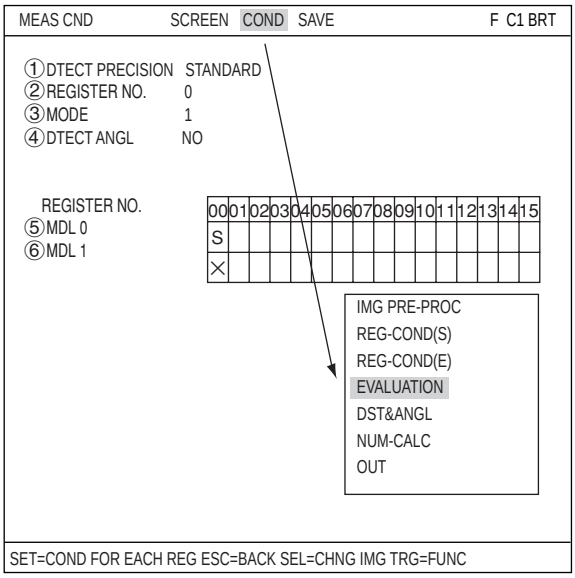
Press the TRG/BRT key and move the cursor to "REF-IMG" using the left and right arrow keys. Then, select "REG" from the popup menu. The reference image that you registered is shown in the lower right corner of the screen.

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 AREA (MDL0)" to adjust the size and position of the rectangle defining the search area.

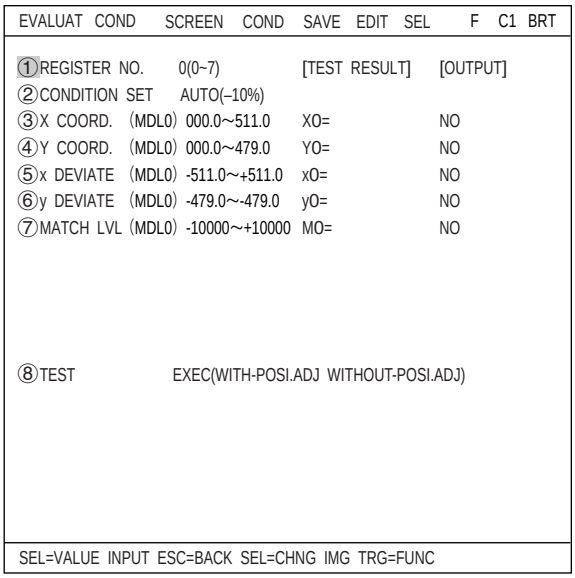
After the setting is complete, press the ESC key and return to the "MEAS CND" screen.

(11) Move the cursor to the upper function key menu by pressing the TRG/BRT key. Then select "COND" using the left and right arrow keys.
A popup menu will appear. Select "EVALUATION" and press the SET key.



(12) The "EVALUAT COND" screen will appear.

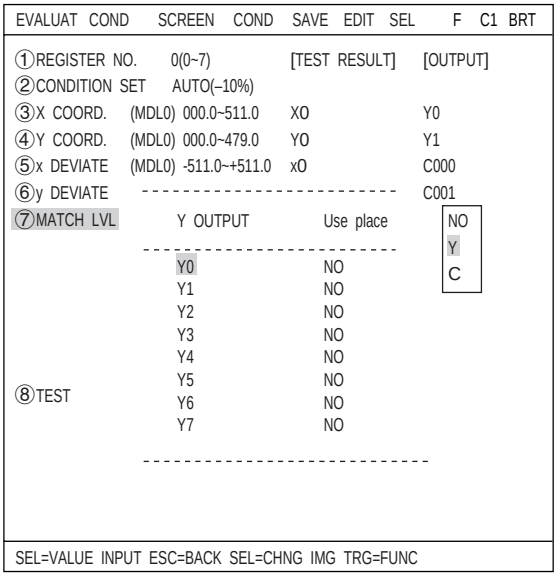
Select "①REGISTER NO." using the up and down arrow keys. Change the number to "0" using the up and down arrow keys. Then press the SET key.



Select "⑦MATCH LVL (MDL0)" using the up and down arrow keys and set the upper and lower limit values.
Select a digit using the left and right arrow keys. Select a number using the up and down arrow keys.

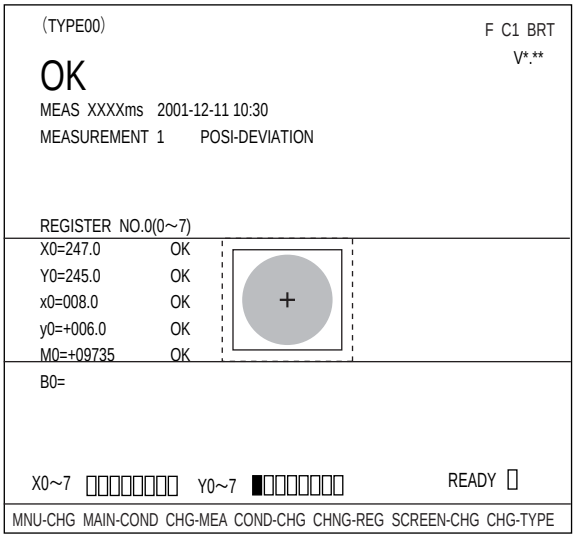
After the value is correct, press the SET key. Then press the left and right keys to move the cursor to "OUTPUT." Now press the SET key. A popup menu will appear and you can choose "NO," "Y," or "C."
Move the cursor to "Y" and press the SET key. Then select the Y0 and press the SET key. Now the evaluation results will be output to the Y0 terminal.
⇨ For details about the evaluation conditions, see page 3-16 in Function and Operation.

After the settings are complete, press the ESC key to return to the "MEAS CND" screen.



(13) The monitor will return to display the operation screen.
To return to the operation screen, press the ESC key three times, or move the cursor to "SCREEN" in the upper menu area and select "OPS-MENU" from the popup menu.

(14) Execute a measurement.
While the operation screen is displayed, press the TRG/BRT key. The measurement results will be displayed on the screen.
⇨ For details about the measurement results, see page 7-10.

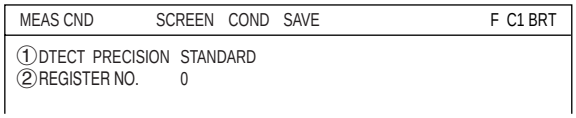


8

• Saving data

- Although the specified data is temporarily stored in RAM memory, it is not stored in the flash memory. So, you must save the data manually using the save operation. If you do not save the data in the flash memory, it will be deleted when the IV-S30 controller is turned OFF.
- You can save data at any time using the "SAVE" item on the [MEAS COND], [TYPE RUN COND],or [SYSTEM COND] menu.

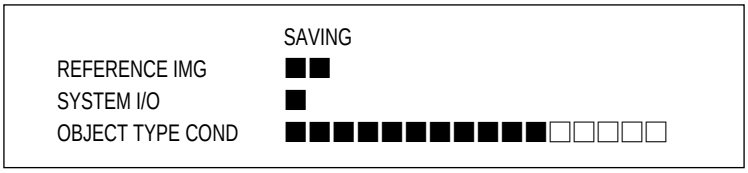
[MEAS COND] menu



1. On each menu screen, pess the "TRG/BRT" key to move the cursor to the upper function key. Then, move the cursor to "SAVE" using the up/down and left/right keys, and press the SET key.
   ⇨ The following message will be displayed on the screen.

   DATA SAVE? (Do you want to save the data?) (YES=[SET]/NO=[ESC])

2. Press the SET key.
   ⇨ The IV-S30 will start saving the data and the progress will be displayed on the bottom of the screen.

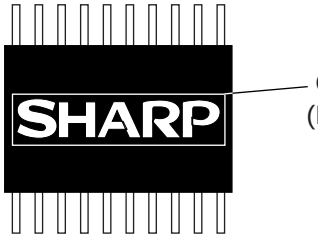


When the data has been saved in the IV-S30 flash memory, the display will change from "SAVING" to "COMPLETE SAVE."

8

8-2 Area measurement by binary conversion

This section describes the setting procedures for the binary area measurement of the object below. The area will be measured by counting the number of pixels after binarization.

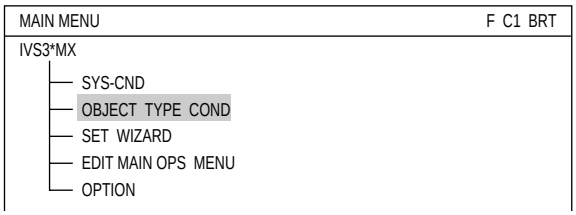


Object to be measured
(Measure the white area in the "SHARP" logo.)

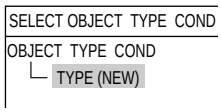
This section descrives only the minimum required settings.

(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 "OBJECT TYPE COND" item using the up and down arrow keys, and press the SET key.

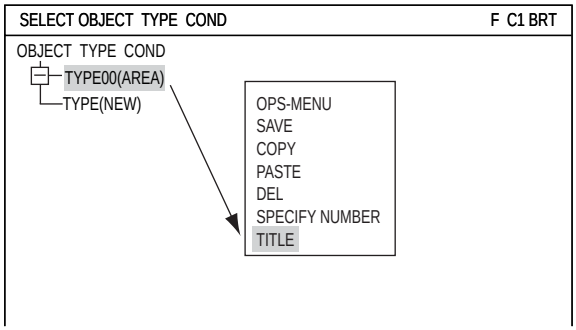


(3) The "SELECT OBJECT TYPE COND" screen will appear.
When the cursor is on "TYPE(NEW)," press the SET key. "TYPE00" will be created.

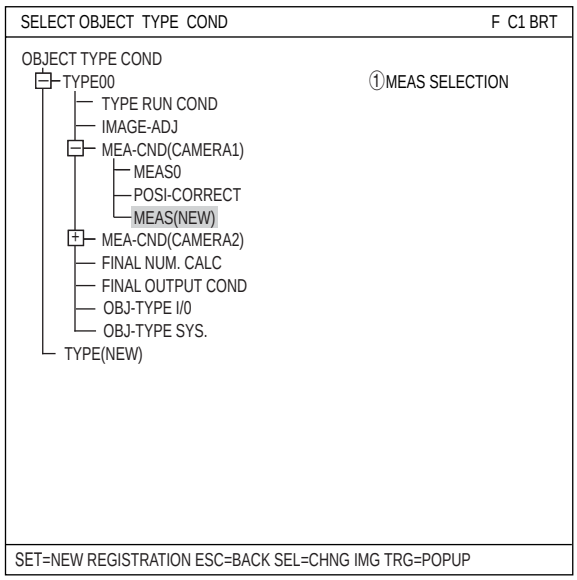


8

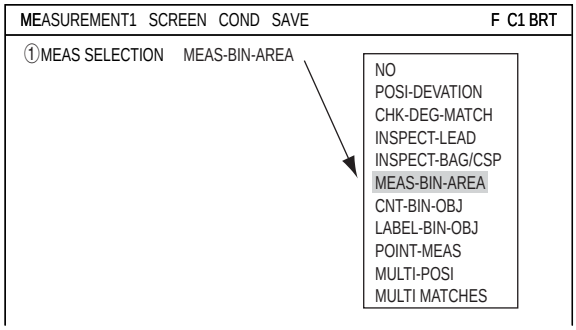
(4) Enter a title for the object type.
Move the cursor to "TYPE00" and press the TRG/BRT key. A popup menu will appear. Move the cursor to "TITLE" on the popup menu and the "STR OBJ TITLE " screen will appear.
⇨ See page 7-9
Enter a name and press "END." The name will be added next to the "TYPE00" term.



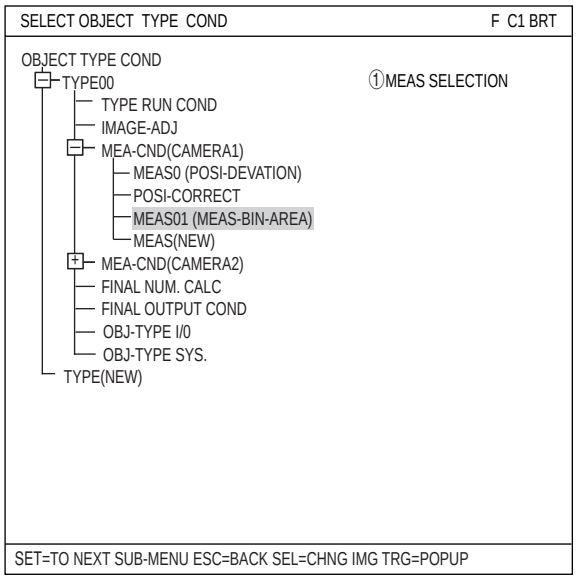
(5) On the menu tree, select "TYPE00," "MEA-CND (CAMERA1)," and then "MEAS(NEW)." Then, press the SET key.
Note: "MEAS0" is used exclusively for positional deviation measurements (position correction). It cannot be used to specify binary processing.



(6) The "MEASUREMENT 1" screen will appear. Press the SET key and a popup menu will appear. Select "MEAS-BIN-AREA" and press the SET key



(7) Press the ESC key to return to the menu tree display.
"MEAS01(MEAS-BIN-AREA)" will be displayed on the menu tree.



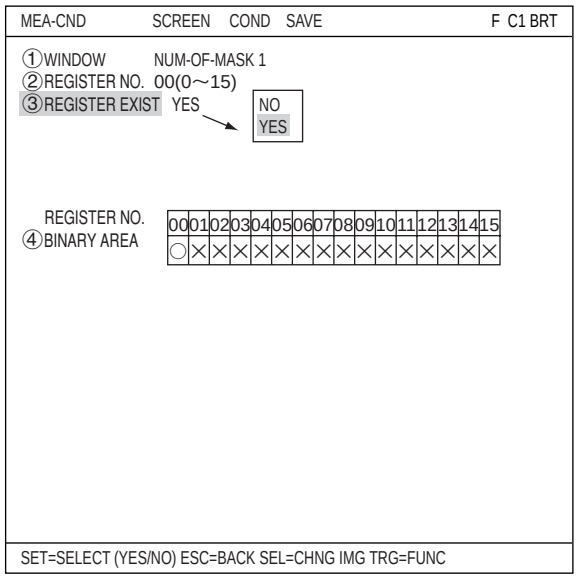
(8) Select "MEAS01(MEAS-BIN-AREA)" and then "MEAS CND." Then, press the SET key, the "MEA-CND" screen will appear.

Setting the "MEA-CND" (measurement conditions)

② **REGISTER NO.**
Press the SET key and then press the up and down arrow keys to change the register number.

③ **REGISTER EXIST**
Select "YES" on the popup menu.

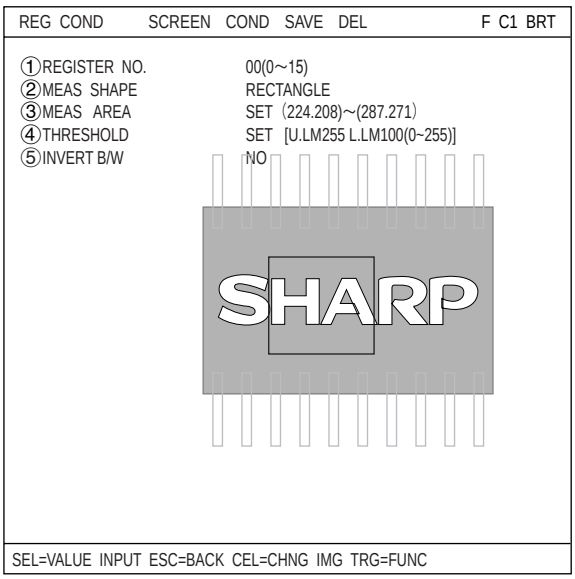
④ **BINARY AREA**
A "[O]" will be displayed under the registered number. Press the SET key and move the cursor to the "[O]" display position. Then press the SET key.



8

(9) Setting the "REG COND" (registration conditions)

- **Adjust the image**
  On the "REG COND" menu, adjust the image to be measured.



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 "DRK" image setting can be selected.

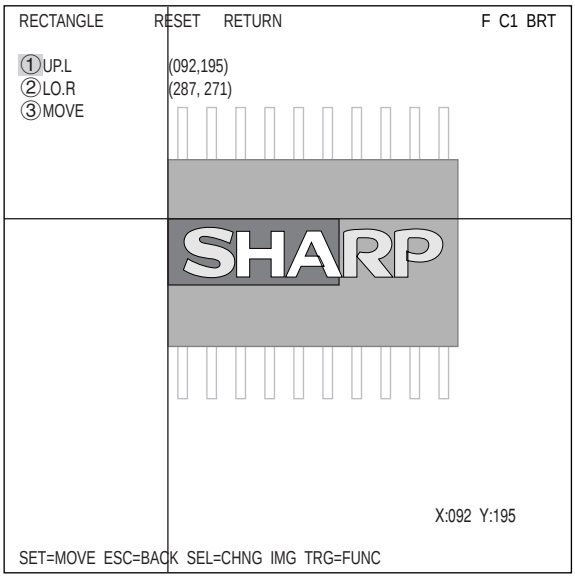
2. Adjust the focus and aperture of the camera lens to obtain a clear image of the object.
   ⇨ See pages 4-2 and 4-3.

3. After the measurement object image is clearly visible, change the image mode back to "F" (Freeze) using the up and down arrow keys.
   Note: Whenever you want to register a reference image, the image display mode should be changed to "F."

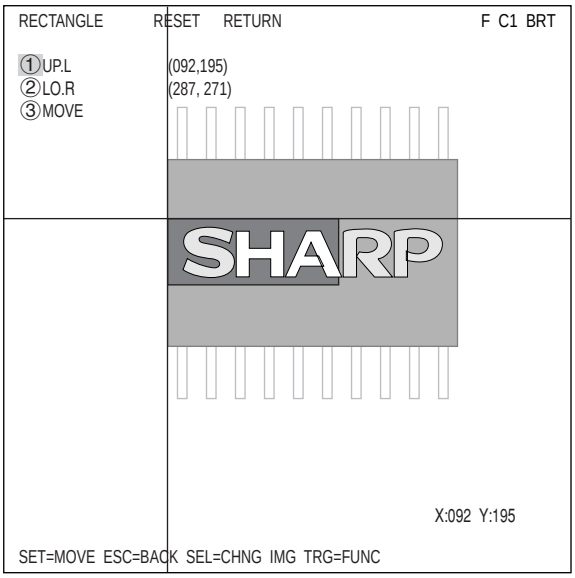
4. Press the SEL key and move the cursor from the upper function menu to the "REG COND" screen.

- **Specify the measurement area**
  Move the cursor to "③MEAS AREA" and press the SET key. "SET" will be highlighted.

  Press the SET key again and the "RECTANGLE" screen will appear.

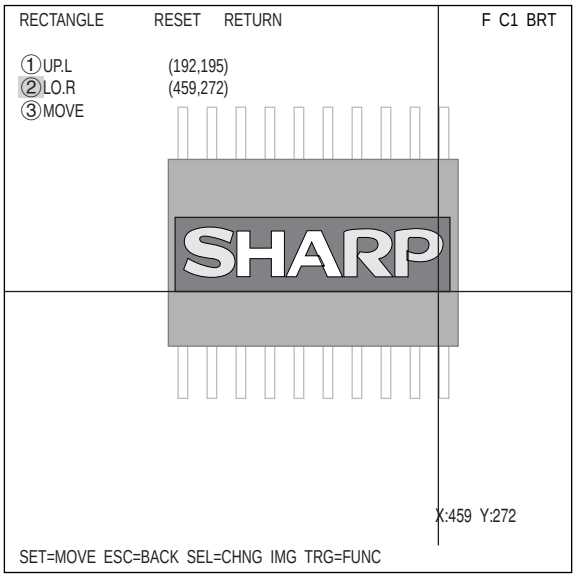


Move the cursor to "①UP.L" and press the SET key. The X and Y coordinates of the rectangle are displayed on the screen. Identify the coordinates of the upper left corner of the measurement area using the up, down, left, and right arrow keys.
After the coordinates of the upper left corner are correct, press the SET key.
Note: If you press the ESC key, the setting will be canceled.



Next, move the cursor to the "②LO.R" line and press the SET key. Then set the coordinates of the lower right corner of the measurement area, the same as done for the upper left corner.

After the setting is complete, press the ESC key and the monitor will return to the "REG COND" screen.
If "③MEAS AREA" setting is highlighted, press the ESC key again to remove the highlighting.



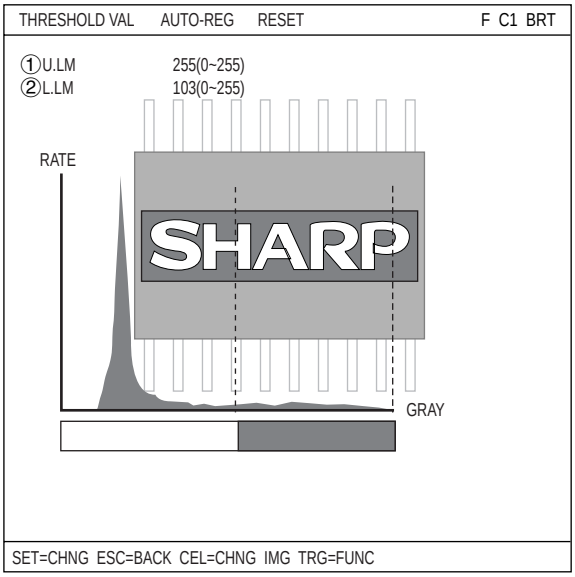
- Setting the threshold value

Move the cursor to "④THRESHOLD" and press the SET key. The "SET" will be highlighted, press the SET key again. The "THRESHOLD (graphic)" screen will appear.

Move the cursor to "①U.LM" or "②L.LM" and press the SET key. The number will be highlighted. Next, press the up and down arrow keys. The bar on the graph will move left and right and you can adjust the upper and lower limit values.

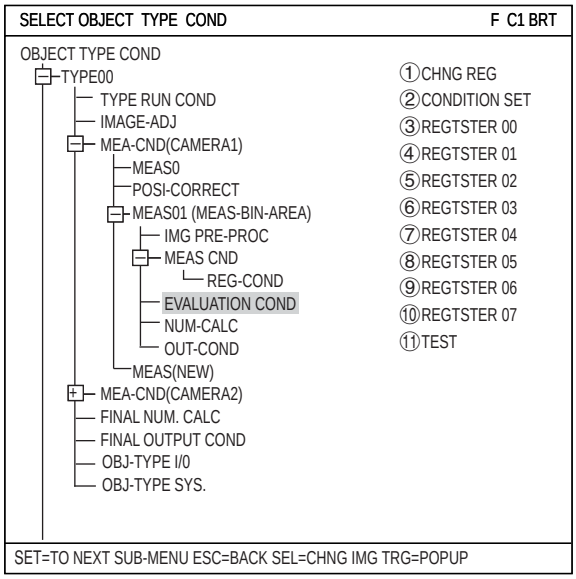
- Auto setting

On the "THRESHOLD VAL" screen, press the TRG/BRT key to move the cursor to the upper function menu. Move the cursor to "AUTO-REG" and press the SET key. A popup menu will appear. The controller will set the threshold to the optimum values automatically when you select the "L LIMIT ONLY" or " U&L LIMITS."

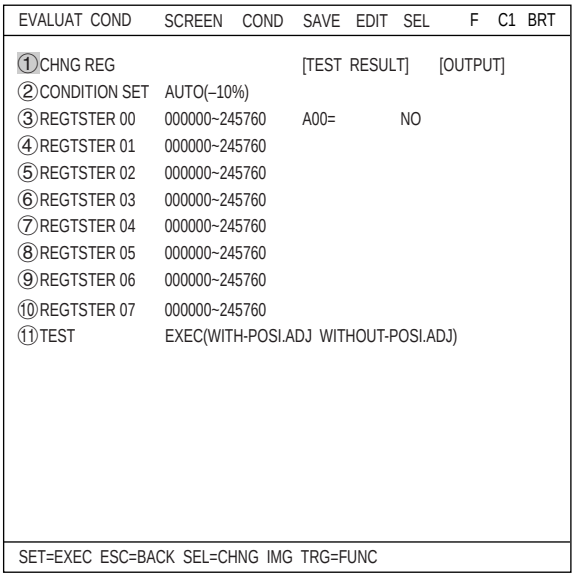


After the settings are complete, press the ESC key twice to return to the "menu tree" screen.

(10) On the menu tree, select "EVALUATION COND" and press the SET key. The "EVALUAT COND" menu will appear.

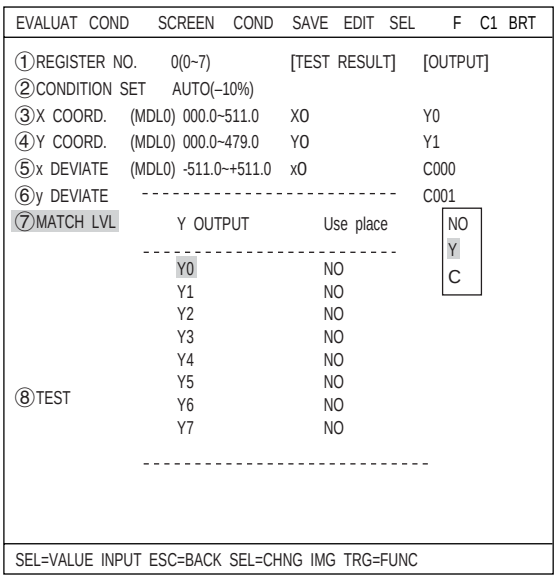


(11) Set items on the "EVALUAT COND" screen.
Select "③REGISTER 00" using the up and down arrow keys and press the SET key twice. The cursor will move to the leftmost digit of the lower limit value. Select a digit using the left and right arrow keys. Set the value of the digit using the up and down arrow keys.
After the value is correct, press the SET key.



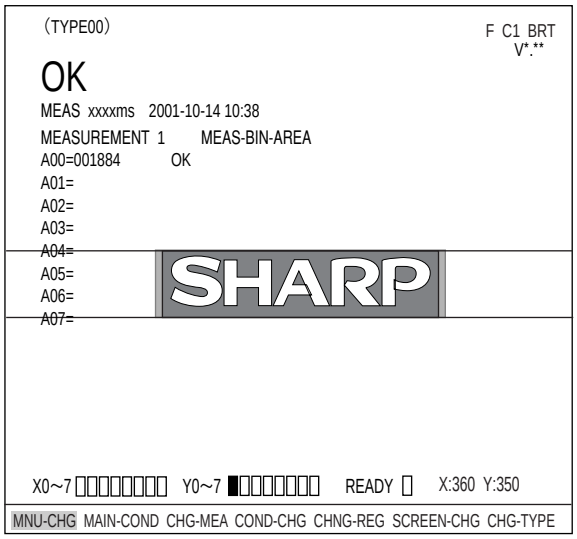
Press the left and right keys to move the cursor to "OUTPUT." Now press the SET key. A popup menu will appear and you can choose "NO," "Y," or "C."
Move the cursor to "Y" and press the SET key. Then select the Y0 and press the SET key. Now the evaluation results will be output to the Y0 terminal.
⇨ For details about the evaluation conditions, see page 3-18 in Function and Operation.

After the settings are complete, press the ESC key to return to the "SELECT OBJECT TYPE COND" screen.



(12) The monitor will return to display the operation screen.
To return to the operation screen, press the ESC key twice.

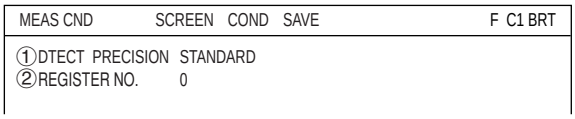
(13) Execute a measurement.
The operation screen will appear.
Press the TRG/BRT key, the area within the specified measurement area will be displayed as a number of pixels.
⇨ For details about the measurement results, see page 7-19.



• Saving data

- Although the specified data is temporarily stored in RAM memory, it is not stored in the flash memory. So, you must save the data manually using the save operation. If you do not save the data in the flash memory, it will be deleted when the IV-S30 controller is turned OFF.
- You can save data at any time using the "SAVE" item on the [MEAS COND], [TYPE RUN COND], or [SYSTEM COND] menu.

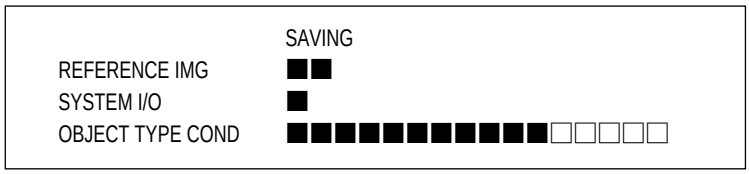
[MEAS COND] menu



1. On each menu screen, move the cursor to "SAVE" using the up/down and left/right keys, and press the SET key.
⇨ The following message will be displayed on the screen.

DATA SAVE? (Do you want to save the data?) (YES=[SET]/NO=[ESC])

2. Press the SET key.
⇨ The IV-S30 will start saving the data and the progress will be displayed on the bottom of the screen.



When the data has been saved in the IV-S30 flash memory, the display will change from "SAVING" to "COMPLETE SAVE."

Chapter 9: Specifications

9-1 Controller (IV-S31MX/S32MX/S33MX)

Item		Specifications		
		IV-S31MX	IV-S32MX	IV-S33MX
Image sampling system		256 level gray scale, binary conversion, edge detection		
Image memory		One screen for displaying captured images. One monochrome screen for displaying camera information and messages		
No.of assignable object type		16 object types	32 object types	
Maximum number of reference images stored / number of whole screens stored		300 / 3 screens	600 / 8 screens	
Image scan time	Standard camera (IV-S30C1/C2)	33.3 ms *2		
	High-speed camera (IV-S30C3/C4)	---		16.7 ms [full mode] 8.3 ms [half mode] *2
	Commercially available EIA camera	---		33.3 ms [full mode] 16.7 ms [half mode]
Gray search time *1		18 ms	12 ms	9 ms
Gray search, edge detection precision		Pixel, sub-pixel		
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		
Measurement program	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) [Maum 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] (IV-S32MX/S33MX only)		
	Multiple position inspection	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]		

*1. The gray search time is true when the search area is 256 x 256 pixels, the model size is 64 x 64 pixels, and the contraction function is set to 3.

*2. Variable, with partial-image capturing.

Specifications

Item		Specifications		
		IV-S31MX	IV-S32MX	IV-S33MX
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 area measurement by binary conversion, object counting by binary conversion, object identification by binary measurement), polygon (3 to 32: when using area measurement by binary conversion, object counting by binary conversion, object identification by binary conversion, and BGA/CSP 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 whole screens)	
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 (C0 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)		
External interface	Parallel interface	Input: 8 points, 12/24 VDC, approx. 7 mA (24VDC) Output: 9 points, 12/24 VDC, max. 100 mA, FET output		
	General-purpose serial interface	RS232C/RS422 (2.4 to 115.2 kbps)		
	Computer link	Built-in compatibility with certain SHARP, OMRON, and Mitsubishi models		
	USB	USB device node, 12 Mbps		
Image output		1 channel, EIA 525 lines, 2:1 interlace		
Number of cameras		Maximum of 2		
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	Interrupt processing input	1 point: External trigger (X0)		
	Inputs	7 points: Object type change (X1 to X4), external input (X5 to X7)	7 points: Object type change (X1 to X5), external input (X6 and X7)	
	Common for input	1 point: + or - common		
	Output	9 points: 1 READY , 8 user settable logical outputs (Y0 to Y7)		
	Common for output	1 point: + or - common		
	Power supply	2 points: +24 VDC, 0 V		
Power supply voltage / power consumption		24 VDC (±10%), 7 W		24 VDC (±10%), 8 W

Item	Specifications		
	IV-S31MX	IV-S32MX	IV-S33MX
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) × 100 (D) × 42 (H) mm (except protruding portions)		
Weight	510 g		
Accessories	- 2 main housing angle bracket - 1 monitor cable - 1 conversion connector - 1 D-sub connector (9-pin D-sub male, M2.6 lock screw: for communication connector of the controller) - 4 securing screws (M3 x 6: for fixing the angle bracket) - 1 instruction manual		

9-2 Camera specifications

[1] Camera (IV-S30C1/C2/C3/C4)

Item		Specifications			
		Standard, IV-S30C1	**Micro, IV-S30C2**	**High speed, IV-S30C3**	**Micro and high speed, IV-S30C4**
Optical system	Lens mount method	C mount	Custom ϕ17 mm mount	C mount	Custom ϕ17 mm mount
Picture taking element	Method	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			
Conncter		Round, 12-pin female connector			
Connection to controller		- Using custom camera cables (IV-S30KC3: 3 m, IV-S30KC5: 5 m, IV-S30KC7: 7 m)		- Using custom camera cables (IV-S30KC3: 3 m, IV-S30KC5: 5 m)	
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) × 32 (H) × 40 (D)	30 (W) × 32 (H) × 50 (D)	30 (W) × 32 (H) × 40 (D)	30 (W) × 32 (H) × 44.7 (D)
	Head	---	ϕ17× 35.6 mm	---	ϕ17× 35.6 mm
	Head cable	---	1m	---	1m
Weight		50 g (not including the lens)	125 g(The head weighs approximately 12 g)	50 g (not including the lens)	140 g(The head weighs approximately 13 g)
Accessories		- 1 camera angle bracket - 2 securing screws	- 1 camera angle bracket - 1 camera head bracket - 3 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 converter (IV-S30EA1)

Item		Function
Camera to be connected	TV system	EIA equivalent camera
	Image input	1 Vp-p (75 ohm load)
	Number of scan lines	525
	Scanning method	2:1 interlace
	Synchronization system	Internal/external Note: External synchronization may not be available with some EIA cameras (The converter is compatible with Sony's S-DNPISHA and the special shutter made by Tokyo Electronic Industries)
	Scanning frequency	Horizontal: 15. 734 KHz, Vertical: 59.94 Hz
	Pulse width	HD: 6.4 ±0.3 μs, VD: 150 to 800 μs
	Power supply	12V ± 10%(300mA / one set or less)
Number of cameras that can be connected		2
Camera connectors		Round, 12-pin female connectors
Main housing connector		D-sub, 25-pin female connectors
Power supply voltage		24 V, 0.5 A (12 W)
Ambient operating temperature		0 to 45° C
Operating humidity		35 to 85% RH (non condensing)
Outside dimensions		70 (W) x 100 (H) x 25 (D) mm
Connection to the controller		Using the supplied main housing cable (250 mm)
Weight		Camera converter: approximately 255 g, main interface cable: approximately 150 g
Accessories		1 main interface cable [Cable length: 250 mm, Connector: D-sub 25 pin male, Hirose round, 12-pin male] 2 main housing mounting brackets 4 securing screws 1 instruction manual

[3] 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-S30C1/C3, IV-S20C1 (camera for the IV-S20)

[4] Camera cable (IV-S30KC3/KC5/KC7)

Item	Specifications
Overall length	3m (IV-S30KC3), 5m (IV-S30KC5), 7m (IV-S30KC7)
Cable sheath	Polyvinyl chrolide
Video connectors	Main housing: Round, 12-pin male connector
	Camera: Round, 12-pin male connector
Minimum bending radius	75 mm

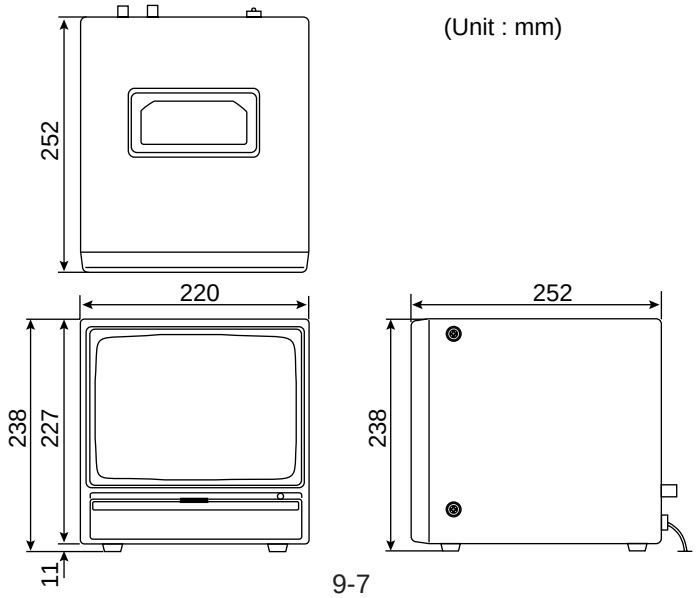
9-3 Support tools

[1] Monochrome monitor (IV-09MT)

Item		Speicfications
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

External dimension drawings

(Unit : mm)



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

	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 100 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 x 218.3 (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 the monitor luminous level drops to 50% of the initial value or start flickering while it has been used under the ambinent temperature 25–5˚C, selecting the light level as the "standard."

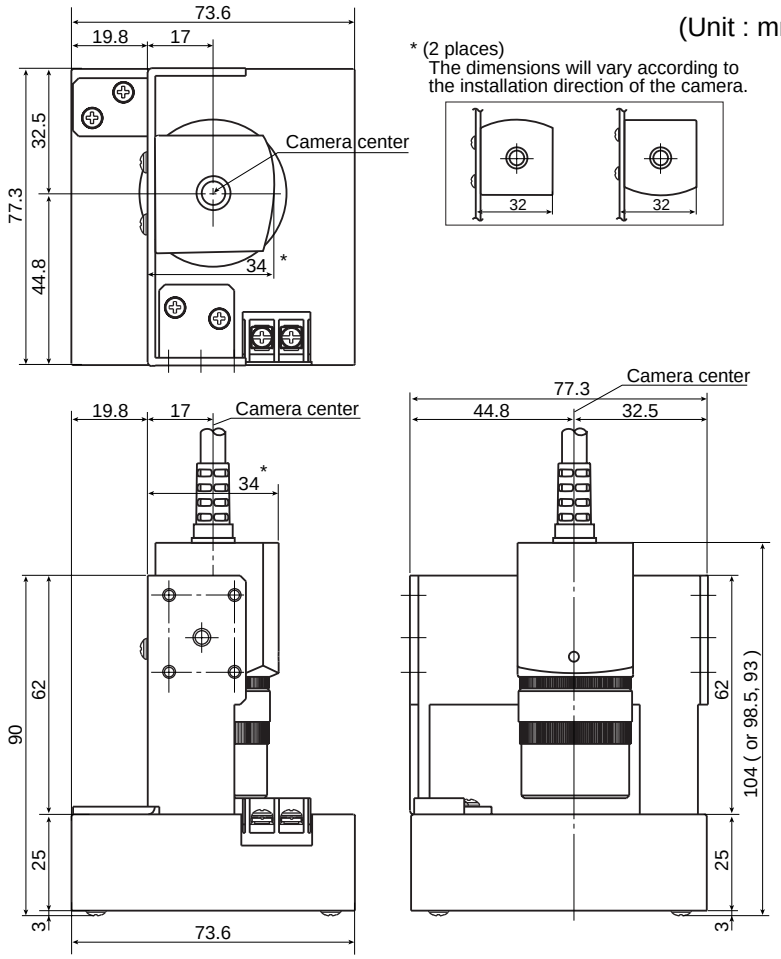
[3] LED lighting equipment (IV-60LD)

Item	Specifications
LEDs used	36 pcs of 5mm diameter - High brightness LEDs
Standard lighting range	Approx. 50mm × 50mm (workpiece distance at 150mm)
Input voltage	24 VDC ±10% , 2P terminal
Current consumption	Approx. 2W
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 2mm (10 to 61 Hz), 147m/s² (61 to 150Hz), No. of sweeps : 10 (1 octave/min.), 3 directions (X,Y,Z)
Shock resistance	JIS C 0912 or equivalent, 147m/s² (each 3 times in X, Y, and Z directions)
Outside dimensions (mm)	76.9 × 73.6 × 25.0 (except camara angle bracket)
Weight	Approx. 230g (IV-60LD body : Approx. 140g + Camera angle bracket : Approx. 90g)
Accessories	One camera angle bracket, 6 installation screws (M3 × 6mm), one instruction manual

■ **External dimension drawings**

Shown below are an IV-S30C1 camera with an IV-S20L16 camera lens installed.

(Unit : mm)



Glossary

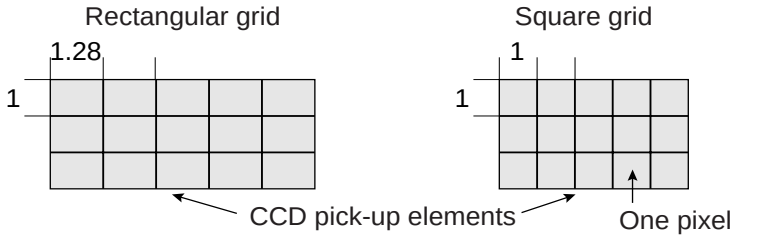
[A]

■ 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.

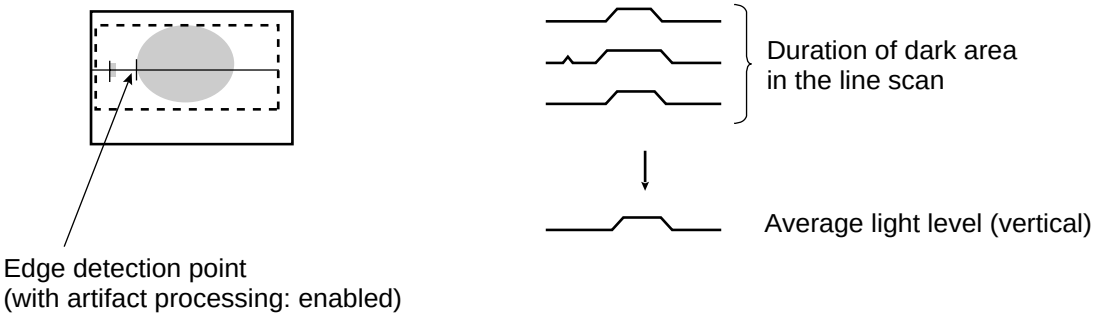


The aspect ratio is 1: 1.

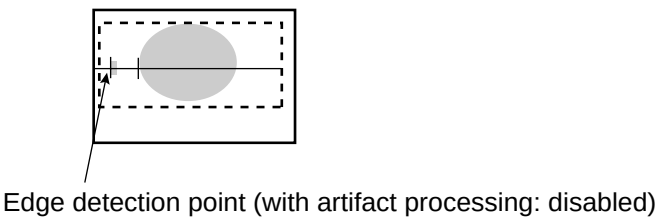
■ Artifact processing

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.



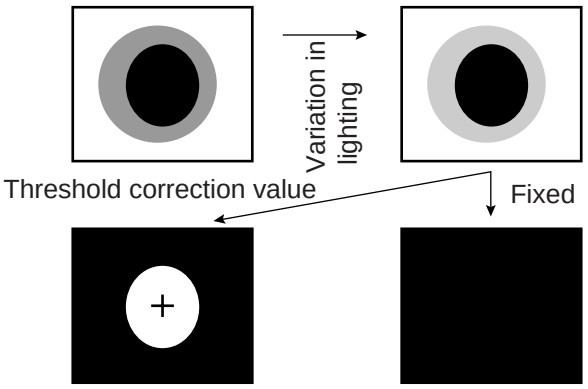
[B]

■ 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-S30 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)."

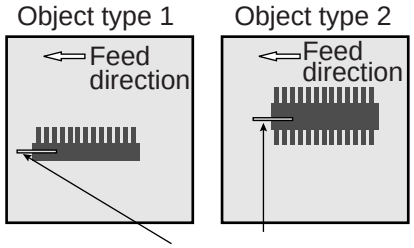
[C]

■ CCD (charge capture device)

A charge capture device (CCD) converts light into electric signals. It consists of a photo-electric 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.

■ 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-S30 supports the computer link protocols used by Sharp, Omron, and Mitsubishi PCs. Therefore, the PC does not need a custom communication program in order to create a computer link with the IV-S30.

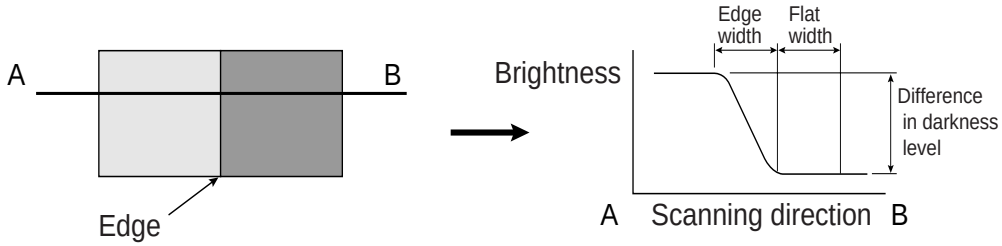
■ Contraction

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

[E]

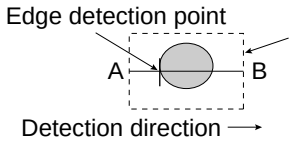
■ Edge detection

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.

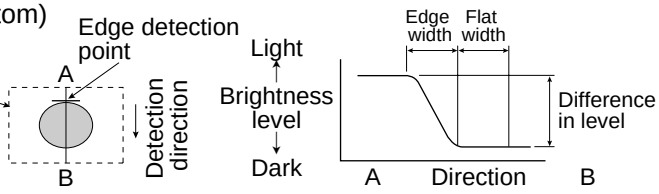


[An example of detecting a point using the edge detection function and user specified criteria]

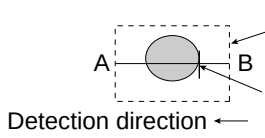
- Horizontal transition point from light to dark (moving from left to right)



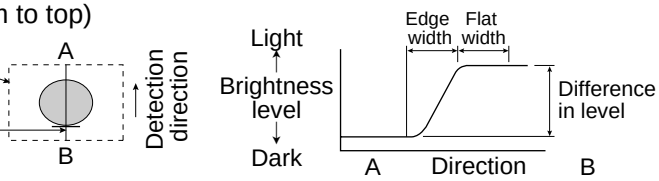
- Vertical transition point from light to dark (moving from top to bottom)



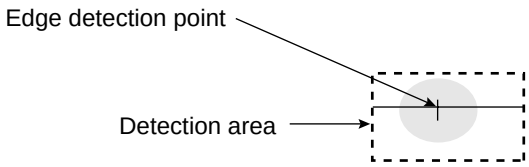
- Horizontal transition point from light to dark (moving from right to left)



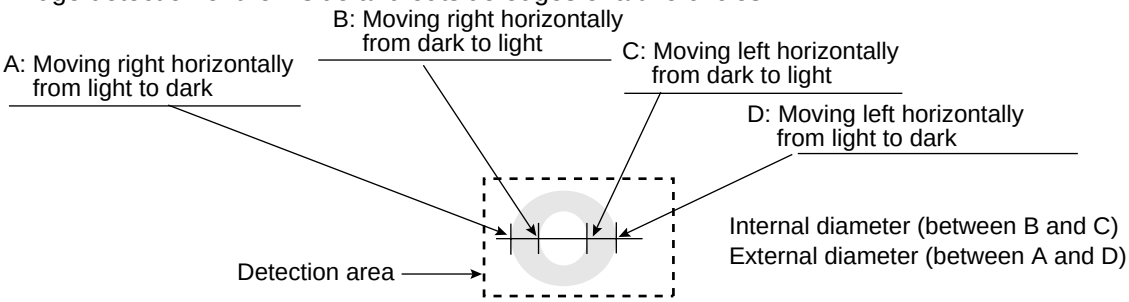
- Vertical transition point from light to dark (moving from bottom to top)



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



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



■ Edge emphasis

⇨ See "Space filter."

■ Edge extraction

⇨ See "Space filter."

■ Expansion

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

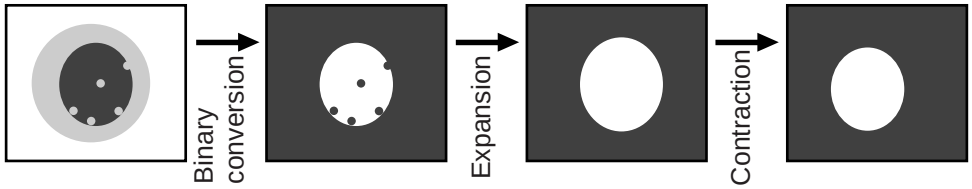
G

■ Expansion and contraction to eliminate binary noise in the image

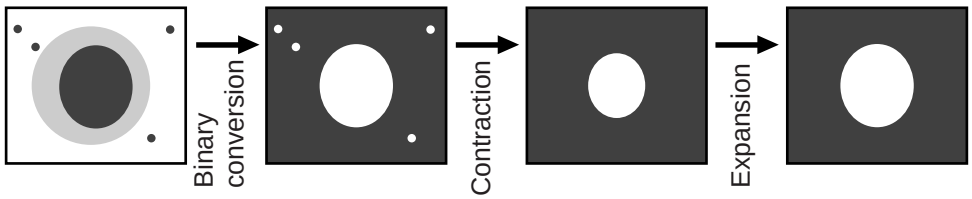
When an image is converted to black and white, a number of unwanted dots may appear in the image. These noises can be eliminated during the preliminary processing. Dot control processing of binary values is used to eliminate this problem, as described below.

- 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 isolated black points by expansion and then restore the original image size by contraction.



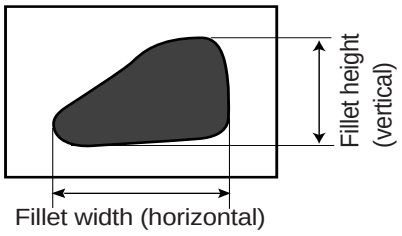
② Contraction ➡ expansion
Delete isolated white points by contraction and then restore the original image size by expansion.



[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.



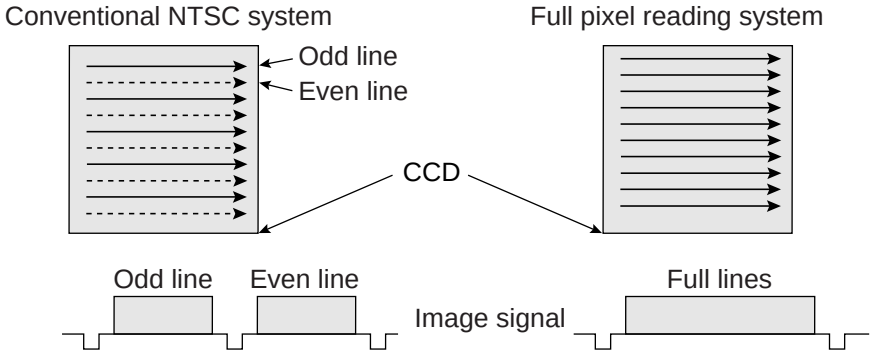
■ Flat width

⇨ 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]

■ Gray scale check using the normalization correlation method

Even when the IV-S30 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-S30 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 contains 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.

■ 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.

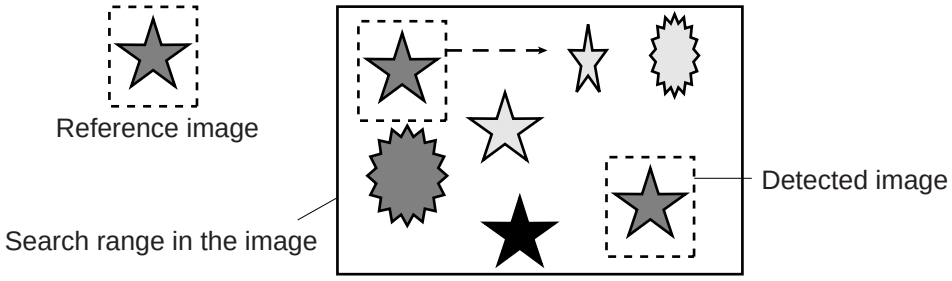
② Capture the workpiece image to be measured.

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.

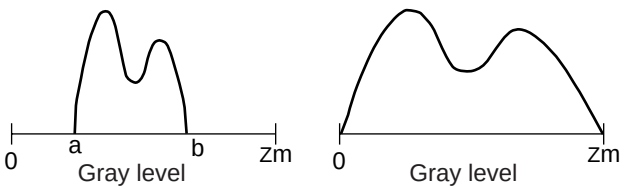
■ High frequency lighting

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 scalel 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

[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-S30 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 read-out 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.

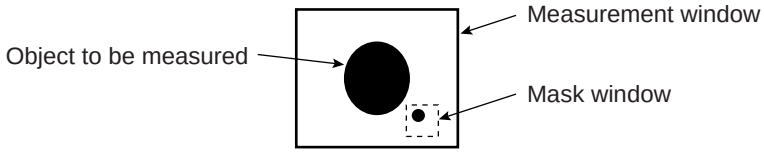
[M]

■ 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.

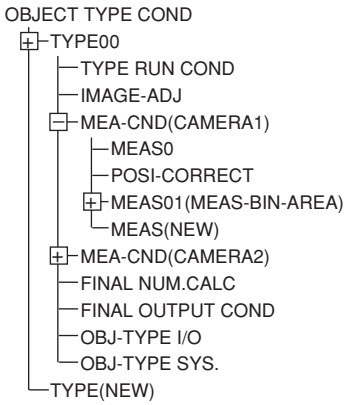
■ Mask window

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.

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

[N]

■ Normalization correlation

To determine whether the levels between the reference image and the input image match, the IV-S30 uses an information processing method called "normalization correlation." This is a method used to calculate relationship between two groups of data.

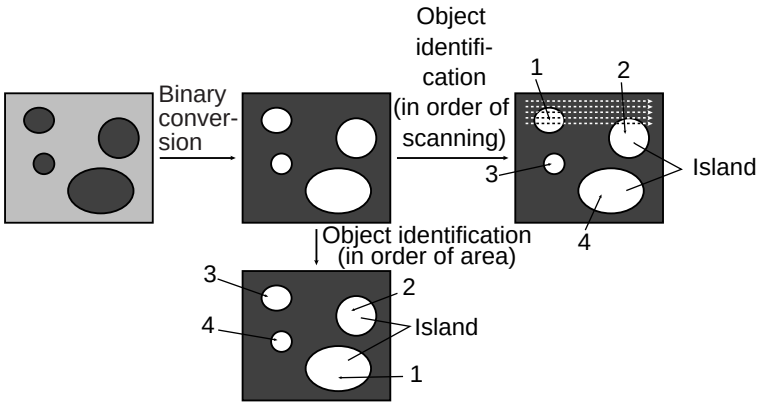
- Factors determining the correlation value
  If the densities of the two images have the same tendency (positive correlation), the two images are said to resemble each other. If the densities of the two images have opposite tendencies (negative correlation), the two images are said not to resemble each 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 = $\{ A , \sqrt{B \times C} \} \times 10000$
  A = NS (I x T) — (SI) x (ST): Correlation between input image and reference image
  B = NS (I x I) — (SI) x (SI): Correlation between input images
  C = NS (T x T) — (ST) x (ST): 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)

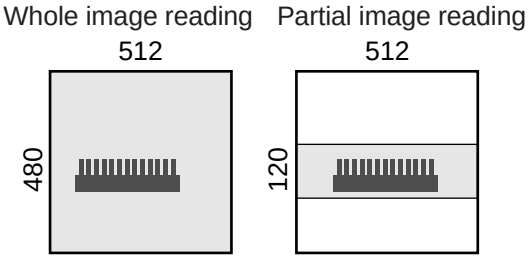
Object identification and numbering (labeling) is a process for locating separate object and assigning serial numbers (labels) one at a time in a binary image. By this process, multiple objects in the same binary image can be handled separately or as a group.



[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-S30 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-S30 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-S30 contains 512 pixels horizontally and 480 pixels vertically. If it takes a full picture, the resolution will be X/512 and Y/480.

[S]

■ Search area

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

■ Search pixel

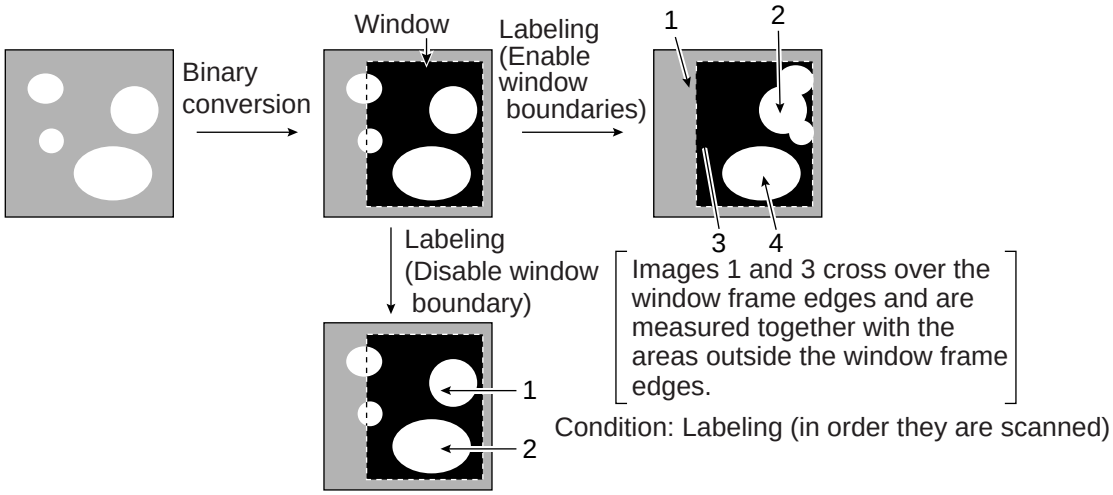
The relationship between detection precision and search speed, and also between pixel contraction (reduce the number of pixels in the image that must be searched) and search speed, is shown below:

- DETECTION PRECISION: High speed ⬅ [STANDARD-HIGH] ➡ Low speed
- PIXEL CONTRACTION: High speed ⬅ [3 - 2 - 1] ➡ Low speed

Search speed

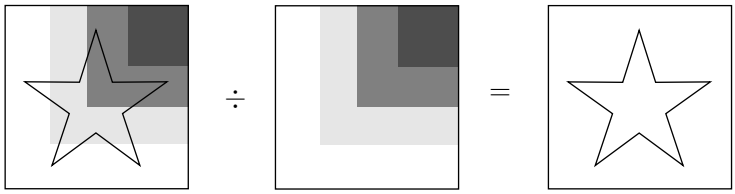
■ Setting window boundaries (enable/disable)

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.



G

■ Smoothing

⇨ See "Space filter"

■ Space filter

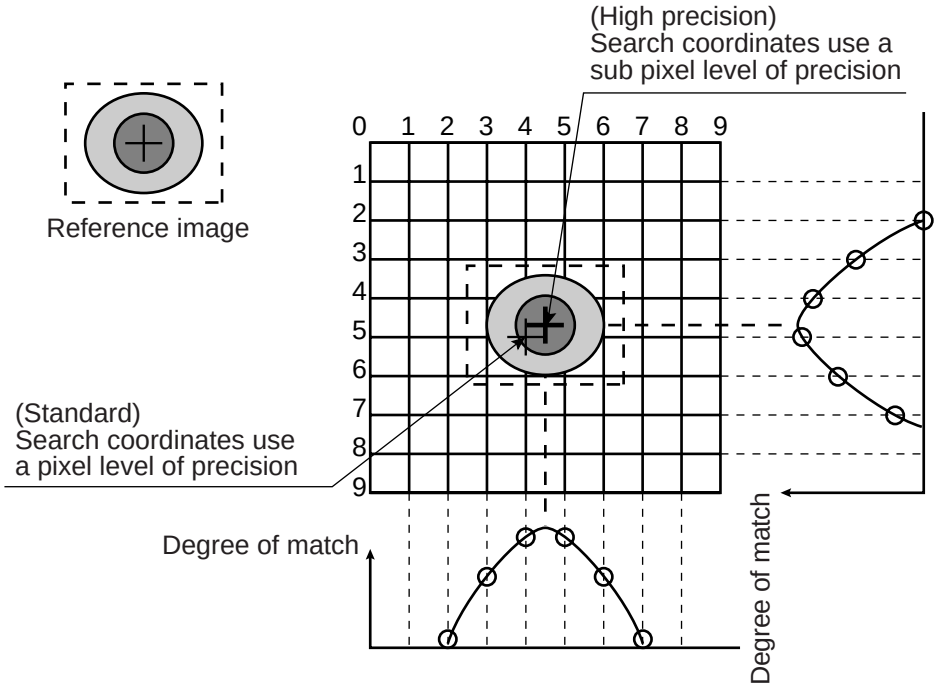
Space filter includes various image manipulation processes that create more readable images by removing noise and distortion in the image data. And, by extracting or emphasizing certain image features, it is easier to evaluate or identify target objects by converting the images into standard patterns.
In the IV-S30, 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.	

■ 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-S30). "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-S30).



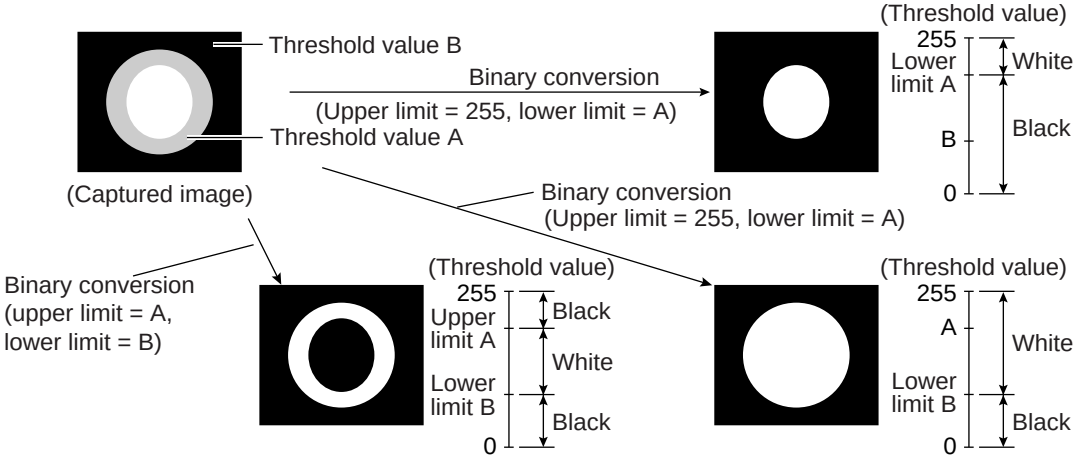
[T]

■ 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.

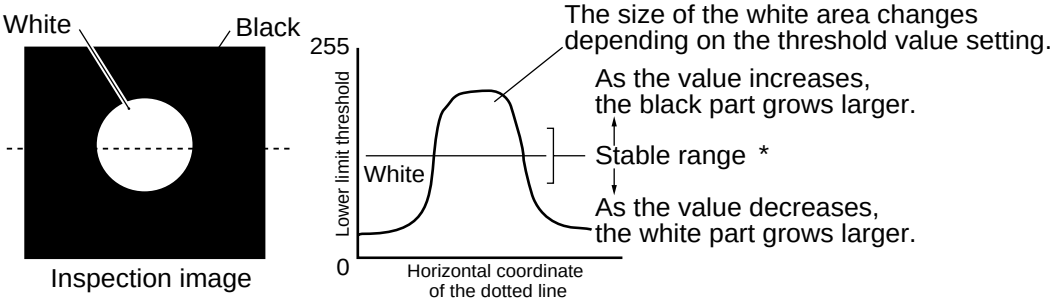
■ Threshold value setting

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.

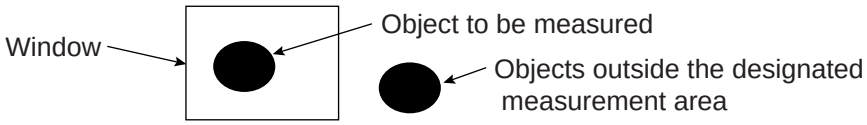


[* If the stable range in the lower limit threshold value is less than 20, (actual measurement) measurement errors may occur.]

[W]

■ Window

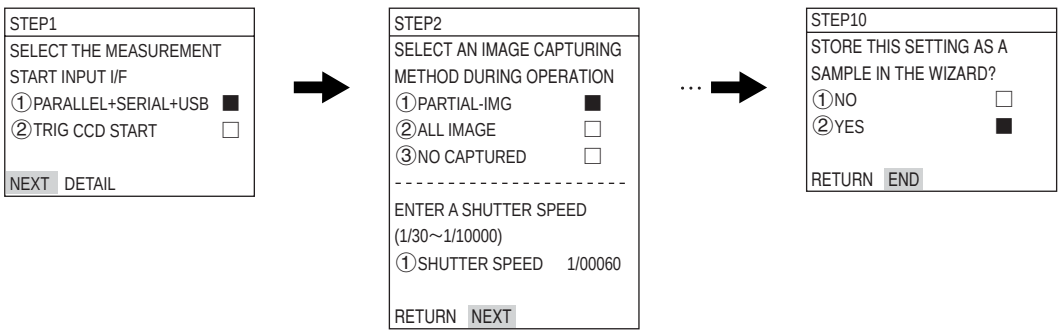
The IV-S30 captures images using CCDs, which are the light sensitive elements in the camera. The IV-S30 may capture more than one target image to be measured for image processing, and it may capture images not required for measurement. In these cases, a window is used to pick out just the desired target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

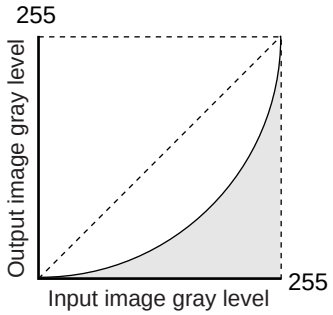
The wizard is convenient for making settings when beginners and inexperienced operators are operating the machine. However, operators who are familiar with the operation may save a lot of time by using other setting methods.



[γ]

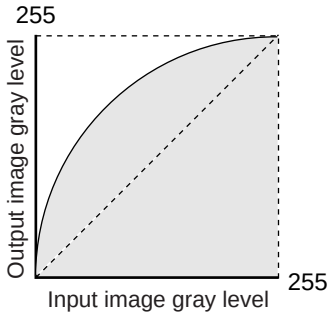
■ γ negative correction

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-S30. (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

App.

■ **Table of standard items related to the IV-S30 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	MIML1-65D	Telecentric lens MY	C mount 1x
IV-1A0302	MIML2-65D	Telecentric lens	C mount 2x
IV-1A1101	ML17-07516	CCTV lens	ϕ17 mm mount f = 7.5 mm
IV-1A1102	ML17-1520	CCTV lens	ϕ17 mm mount f = 15 mm
IV-1A1103	ML17-2431	CCTV lens	ϕ17 mm mount f = 24 mm
IV-1A1301	MML1-65D-CM1	Telecentric lens	ϕ17 mm mount 1x
IV-1A1302	MML2-65D-CM1	Telecentric lens	ϕ17 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.

Alphabetical Index

[T]

[V, W]

[γ]