KEYENCE

96M0378

Instruction Manual

Compact Color Vision System

CV-301 Series

Safety Precautions

This instruction manual describes the operation and function of the CV-301. Read this manual carefully to ensure safe use and maximum performance from your CV-301.

Symbols

The following symbols alert you to important messages. Be sure to read these messages carefully.

WARNING Failure to follow instruction may lead to injury. (electric shock, burn, etc.)

CAUTION Failure to follow instructions may lead to product damage.

Note: Provides additional information on proper operation.

General precautions

- At startup and during operation, be sure to monitor the functions and performance of the CV-301.
- We recommend that you take substantial safety measures to avoid any damage in the event a problem occurs.
- Do not open or modify the CV-301 or use it in any way other than described in the specifications.
- When the CV-301 is used in combination with other instruments, functions and performance may be degraded, depending on operating conditions and the surrounding environment.
- Do not use the CV-301 for the purpose of protecting the human body.

Warnings and cautions specific to the CV series

WARNING

Do not use the CV-301 series at a voltage other than 24 VDC. Improper voltage may cause fire, electric shock, or equipment failure.

CAUTION

■ **Usage**

- Be sure to turn off power to the controller and any connected devices before connecting or disconnecting the cables. Otherwise, the camera may be damaged.
- Do not turn off power while setting a parameter. Otherwise, the settings may be partially or completely lost.
- Do not block the ventilation slots on the CV-301 and the peripheral devices. A rise in inner temperature may cause equipment failure.
- Do not disassemble or modify the CV-301. This may cause fire or electric shock.

■ **Use environments and conditions**

To use the CV-301 properly and safely, do not install the CV-301 in locations with the following conditions. Use in an improper environment may cause fire, electric shock, or equipment failure.

- Locations with high humidity, large amounts of dust, or poor ventilation
- Locations where the temperature rises excessively due to direct sunlight, etc.
- Locations where the CV-301 is subjected to vibration or impact
- Locations where water, oil, or chemicals may splash the CV-301
- Isolate the cables as far as possible from high-voltage lines and power lines. Otherwise, generated noises may cause equipment malfunction or failure.
- The CV-301 and peripheral devices are precision machines. Avoid any vibration or impact to these devices.
- To install the CV-301 in a location where static electricity is easily built up, be sure to ground the camera unit.

■ **When abnormal conditions are encountered**

If the following conditions are encountered, immediately turn off the power. Continuing to use the CV-301 under abnormal conditions may cause fire, electric shock, or equipment failure.

Contact your nearest KEYENCE office for repairs.

- When water or foreign matter enters the controller
- When you drop the CV-301 or the housing is damaged.
- When the controller produces smoke or an abnormal smell

Note 1: Maintenance

Do not wipe the CV-301 with a damp cloth or a cloth moistened with benzine, thinner, or alcohol. If there is a large amount of dust or dirt on the CV-301, remove it using a tightly squeezed cloth moistened with a dilute solution of a neutral detergent, and then wipe the unit with a soft, dry cloth.

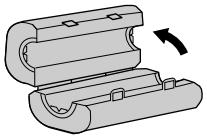
Note 2: Camera

The CV-301 uses a specially-designed camera. A commercially available camera should not be substituted. (However, any commercially available C-mount lens can be used.)

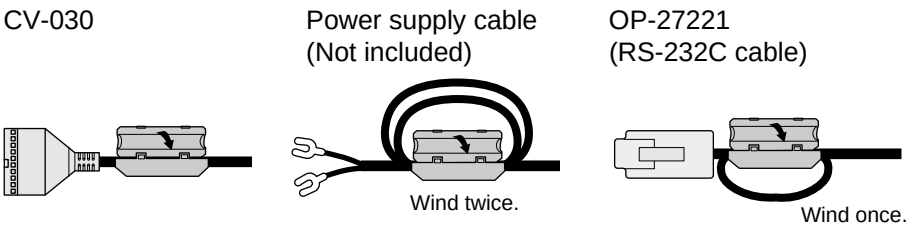
How to use the ferrite core

The ferrite core shown below is packaged with the CV-301 and OP-27221 (RS-232C cable).

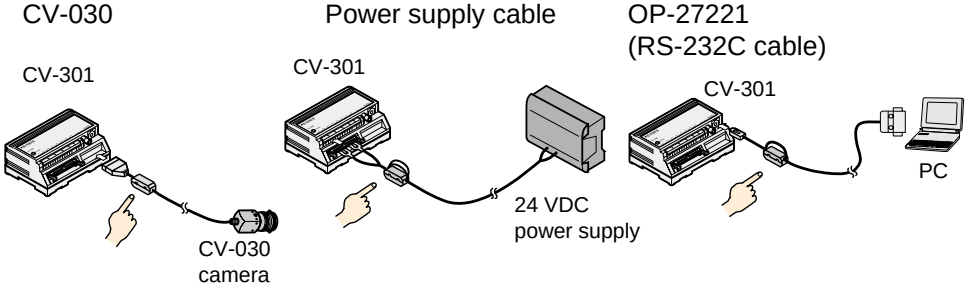
1. Open the ferrite core.



2. Insert the cable into the ferrite core and press firmly to close it completely.



3. Place the ferrite core as close as possible to the CV-301 controller end of the cable.



Note: To conform to CE regulations in Europe, the ferrite core must be attached to the cable.

Warranty

See page 115.

Notice

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- KEYENCE has thoroughly checked and reviewed this manual. Please contact a sales representative if you have any questions or comments regarding this manual or if you find an error.
- KEYENCE assumes no responsibility for any errors or omissions in this manual. No liability is assumed for damages resulting from the use of the information in this manual, item 3 above notwithstanding.
- KEYENCE will replace any incomplete or incorrectly collated manual.

How this manual is organized

Chapter 1 Overview

Describes the check list for the package contents, as well as the features and applications of the CV-301.

Chapter 2 Preparation

Explains how to connect and install the CV-301, how to select lenses, and information about illumination.

Chapter 3 Measurement mode selection by application

Explains the type and operation of the measurement modes and how to select the appropriate mode.

Chapter 4 Setting procedure

Explains how to use the remote control console to set the CV-301. Describes from the basic setting to the advanced setting.

Chapter 5 Operation

Explains how to operate the CV-301.

Chapter 6 RS-232C Interface

Explains how to connect the CV-301 to a personal computer and describes the RS-232C communication to operate the CV-301 using a personal computer.

Chapter 7 I/O terminals

Explains the I/O terminals and connectors, and describes the specifications and timing diagrams.

Chapter 8 Specifications

Describes the specifications and dimensions.

Chapter 9 Appendix

Describes typical troubleshooting procedures and the list of optional parts. An index is also included.

WARRANTIES AND DISCLAIMERS

Contents

Chapter 1

Overview

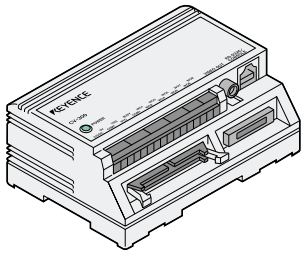
Describes the check list for the package contents, as well as the features and applications of the CV-301.

1.1 Checking the Package Contents

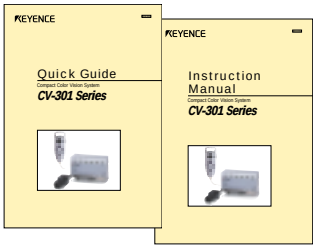
The CV-301/CV-030 package includes the following parts and equipment. Check that all the parts and equipment are included in the package.

■ CV-301

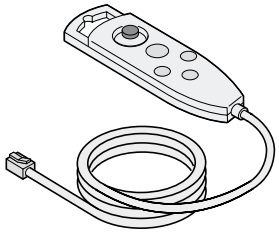
Controller (CV-301): 1



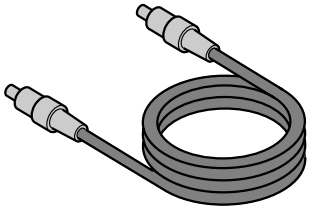
Quick Guide: 1
Instruction Manual (this manual): 1



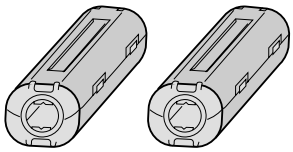
Remote control console: 1



Monitor cable (RCA-RCA): 1

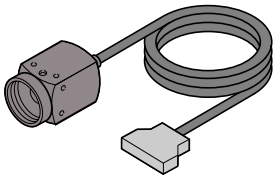


Ferrite cores: 2

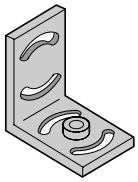


■ CV-030

Camera (CV-030): 1

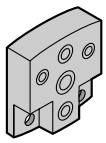


Mounting bracket: 1



* M3 x 6 plastic screw (2) and plastic washer (2) included.

Plastic fitting: 1



* M3 x 6 screw (2) and washer (2) included.

We have thoroughly inspected the package contents before shipment. In the event of defective or broken items, please contact your nearest KEYENCE office listed at the end of this manual.

1.2 Features

This section explains the features and major applications of the CV-301 compact vision system.

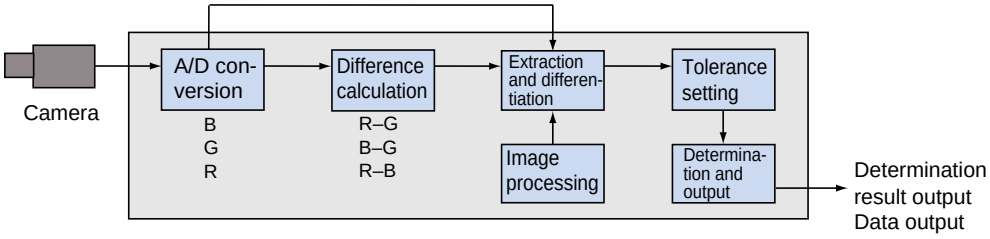
1.2.1 Features

New system has achieved high differentiation ability as well as stability. (Patent-pending)

- **Only the target color can be reliably extracted.**
  The CV-301's color processing enables reliable differentiation between yellow and white, dark blue and black, or gold plating and silver plating. These colors cannot be differentiated using monochromatic or gray processing.

- **No detection error due to the shadow on a target surface.**
  If there is a color difference, the CV-301 can differentiate the target regardless of the variation of illumination distribution, the decrease in light quantity, or the shadow on a target surface caused by differences in individual targets.

■ **Operating principle**



The image input circuit converts the camera's analog signal of the color image into digital signals, R, G, and B. The CV series also calculates the difference between these values (R-G, B-G, and R-B), and uses these 6 parameters to extract the color that matches the one on the screen within the preset tolerance.
The above operation has made high-speed processing and stable extraction of even dark colors possible.

Extraction with a simple click: Setup time is greatly reduced. (Patent pending)

- Just click the color on the screen that you need to extract.
- To specify the color to be extracted, place the cursor on the color and click the mouse button like you would in a Windows application.
- The auto-extraction function and zoom function allow simple sensitivity adjustment.

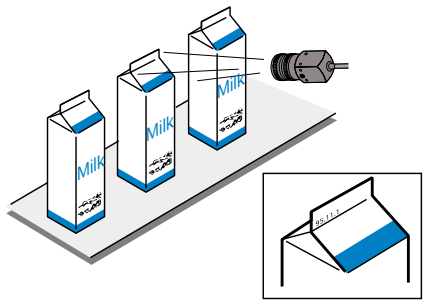
Wide applications from presence/absence detection to positioning

- Presence/absence detection: Area mode
  (position adjustment function provided)
- Positioning: Absolute position detection mode
- Displacement detection: Relative position detection mode

➪ *Refer to page 18 for a description of each mode.*

1.2.2 Application Examples

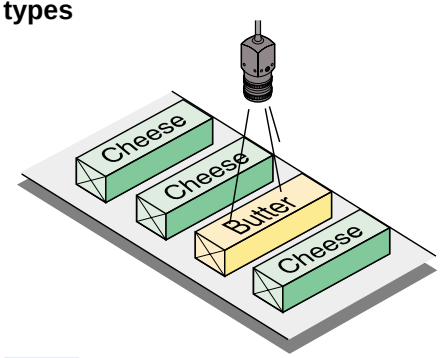
Detecting shelf life printing



Area

Detects the presence/absence of shelf life printing or unclear characters.

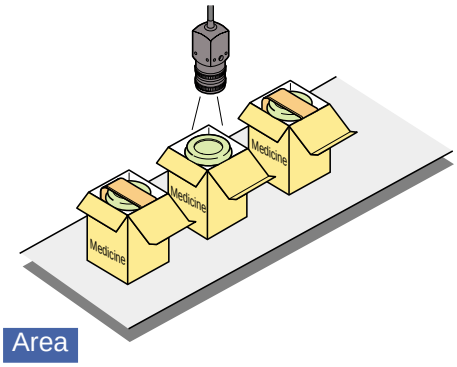
Checking for different package types



Area

Differentiates different package types by the color of the package.

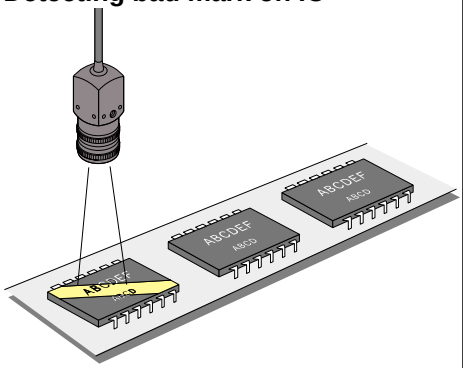
Checking for medication information inserts



Area

Detects a missing information insert by the difference between the color of the paper and the cap.

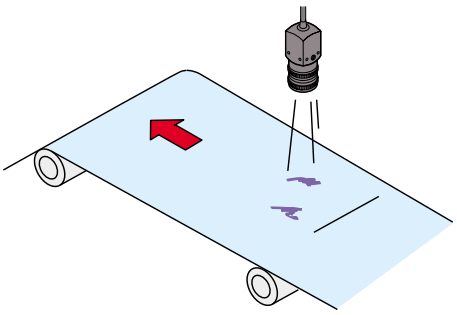
Detecting bad mark on IC



Area

Detects a bad mark on a defective product without being affected by the background characters.

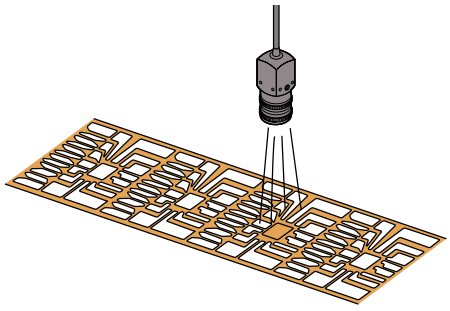
Detecting stain on sheet material



Area

Detects stain on sheet material by the difference in color.

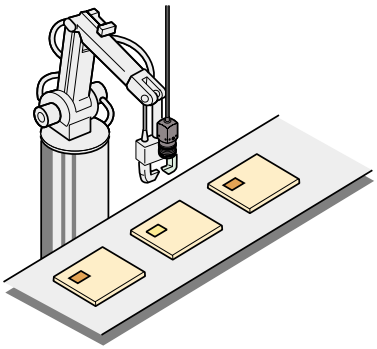
Checking for lack of plating



Area

Differentiates between gold and silver to detect the lack of plating.

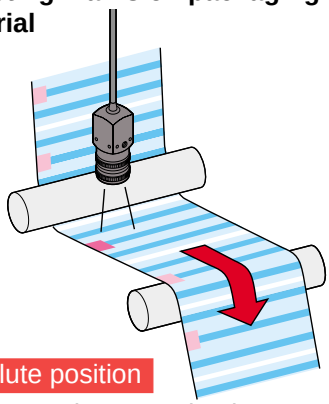
Detecting target for robot handling



Absolute position

Controls robot handling using the position detection data.

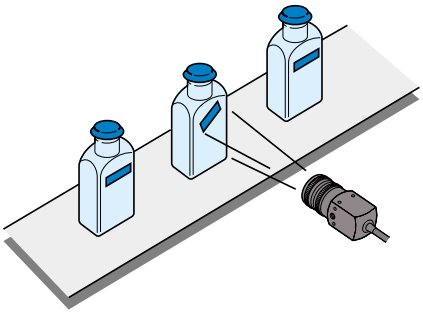
Detecting marks on packaging material



Absolute position

Detects marks on packaging material without being affected by the background print pattern.

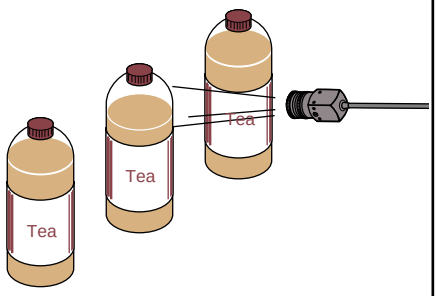
Detecting misaligned labels



Relative position

Detects a displaced label on a bottle in the up/down/right/left direction.

Checking liquid level



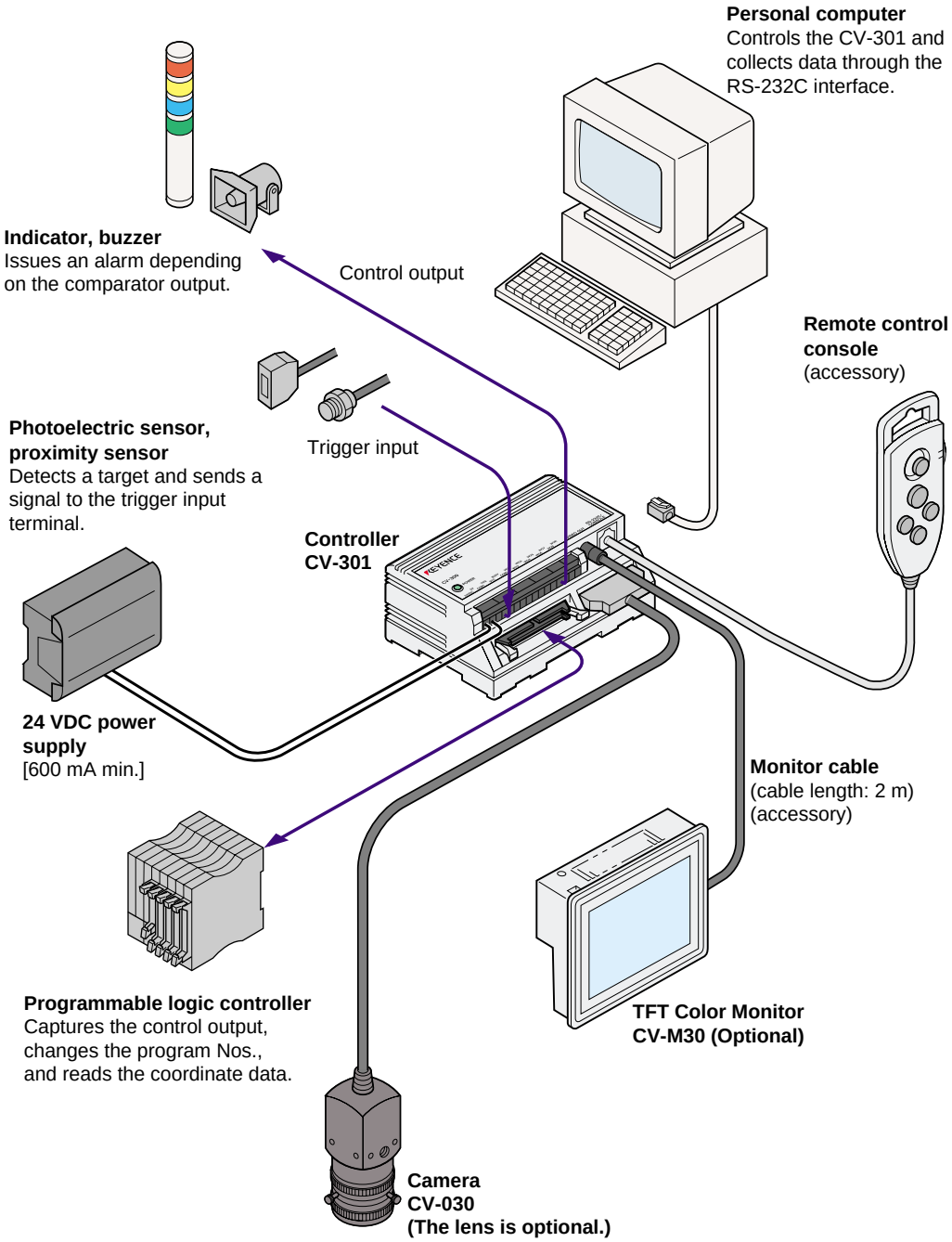
Relative position

Determines the liquid level by the relationship between the position of a bottle cap and a liquid surface.

■ Reference pages for each mode

Mode	Description	Setup procedure
Area	Page 18	Page 19 in Quick Guide, Page 32 in Instruction Manual (this manaul)
Absolute position	Page 20	Page 42 in Instruction Manual (this manaul)
Relative position	Page 20	Page 42 in Instruction Manual (this manaul)

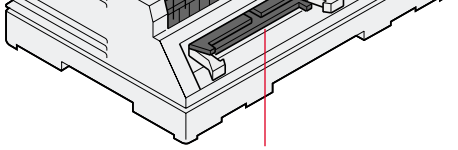
1.2.3 Application in a Complete System



1.3 Part Names and Functions

The following illustration shows the part names and functions of the CV-301 .

■ Controller



Input/output terminal
Used to input/output signals.

Video output terminal (RCA connector)
Connected to a monitor.

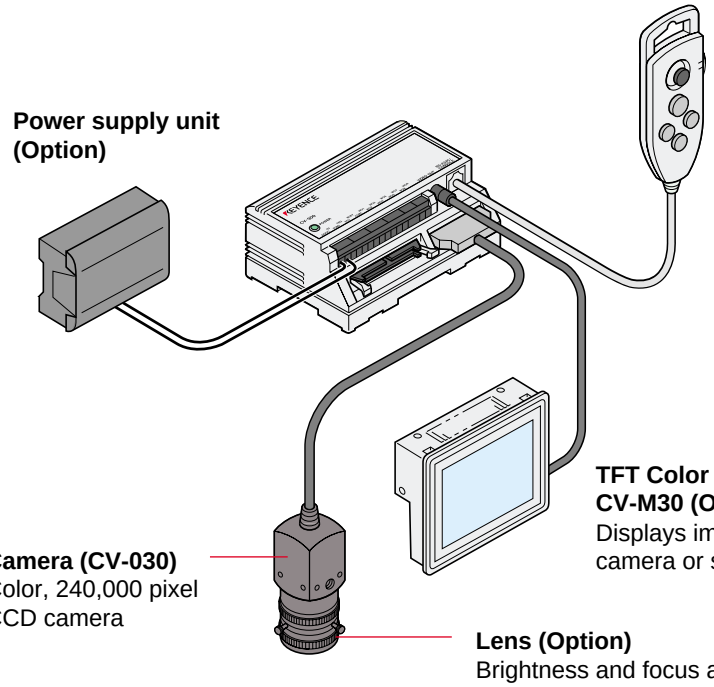
Power input terminal (24 VDC, 0 V)
The input terminal of the 24 VDC (600 mA) power supply

Modular connector
Connected to the remote control console or the RS-232C communication cable.

Power indicator
Illuminates when power is supplied.

Camera connector
Connected to the camera cable.

I/O connector
Used to input/output data.



Remote control console
Selects a target or sets a menu item.

Power supply unit (Option)

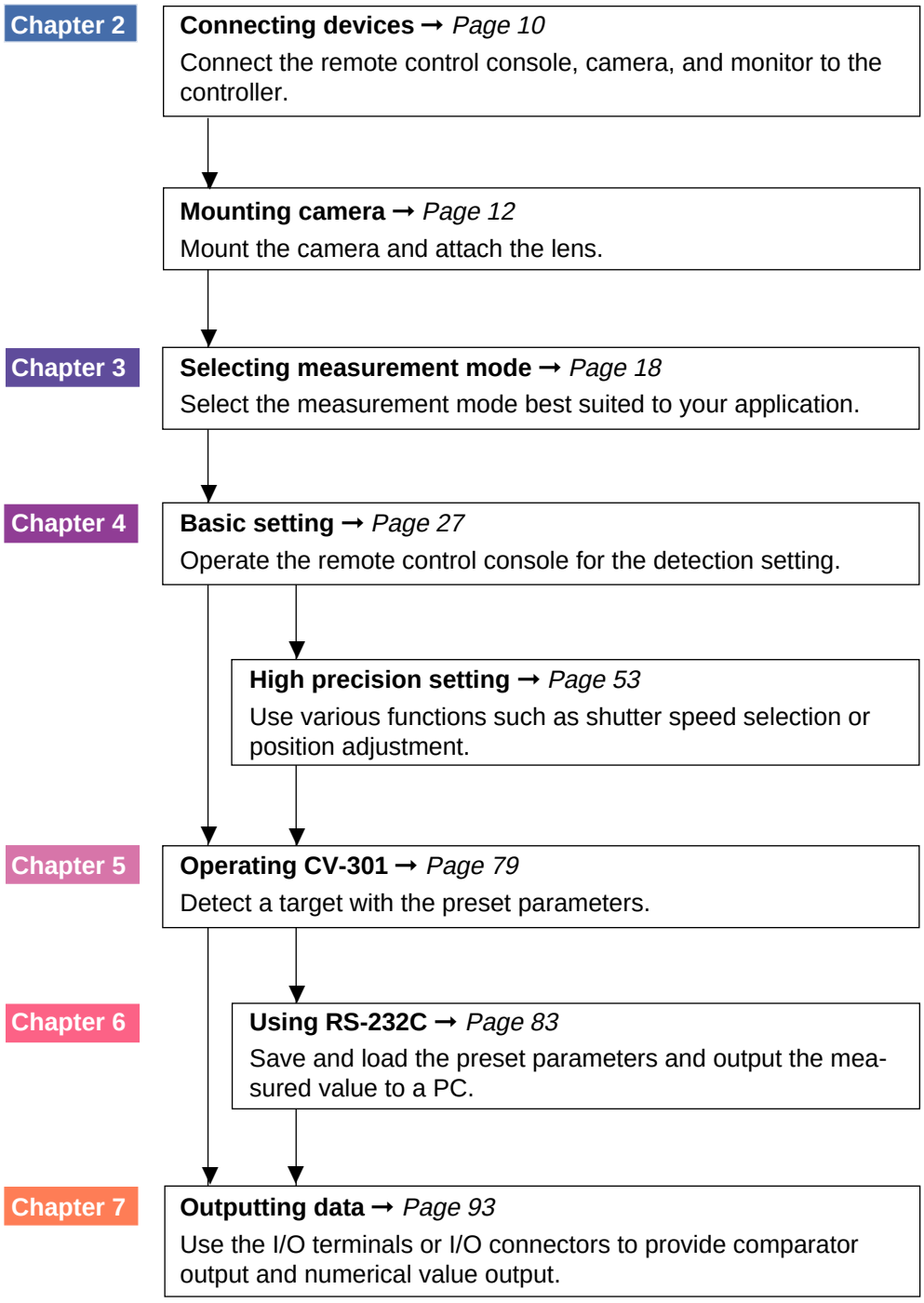
TFT Color Monitor CV-M30 (Option)
Displays images captured with the camera or shows setting menus.

Camera (CV-030)
Color, 240,000 pixel CCD camera

Lens (Option)
Brightness and focus are adjusted using a diaphragm ring and a focus ring.

1.4 Operation Flow

This section describes the general operation flow for detection using the CV-301.



Chapter 2

Preparation

Explains how to connect and install the CV-301, how to select lenses, and provides information about illumination.

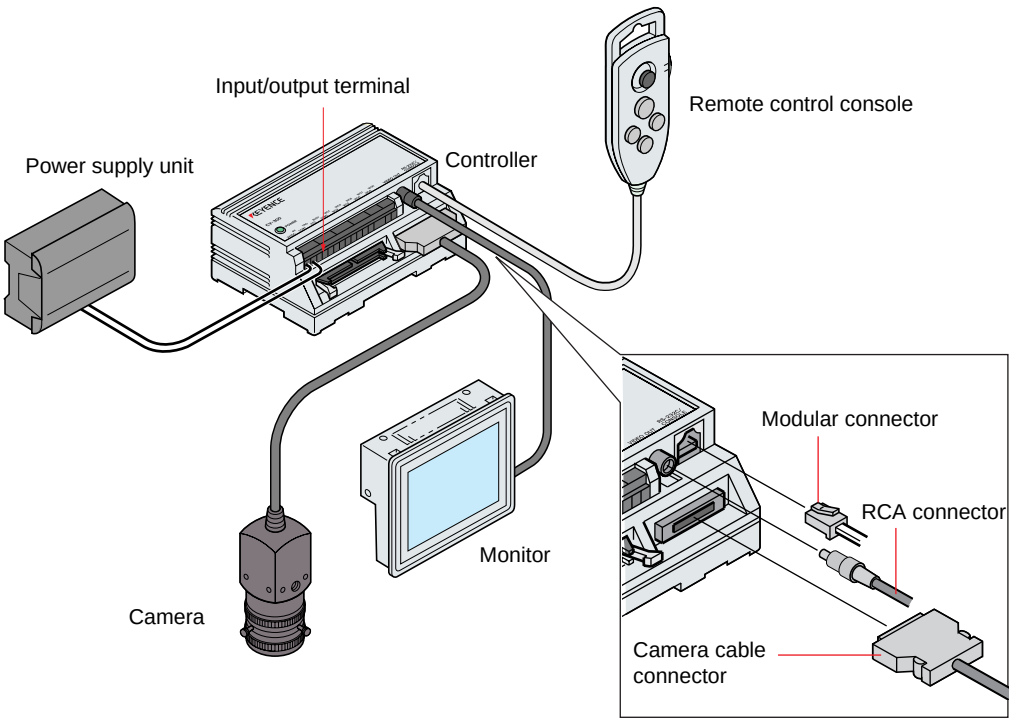
2.1 Connection

This section describes how to connect cables, mount the controller and camera, and select a lens.

2.1.1 Connecting Cables

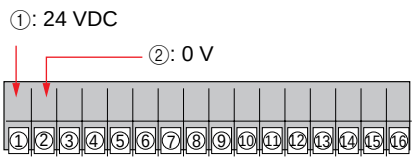
CAUTION

Be sure to turn off the controller before connecting cables. If you connect the cables while the controller is turned on, the camera or peripheral equipment may be damaged.



1. Insert the connector for the camera cable.
2. Insert the modular connector for the remote control console cable.
3. Insert the RCA connector for the monitor cable.
4. Connect the cable for the power supply unit.

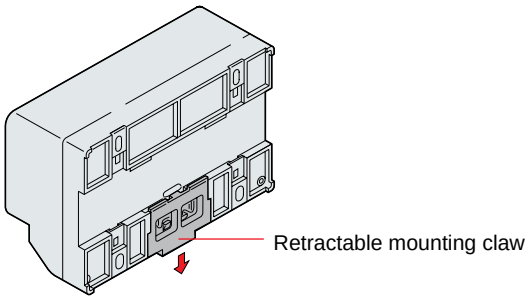
   Connect the controller's input/output terminals number ① and ② with the 24 VDC power supply unit. Do not turn on power until the mounting procedure is completed.



2.1.2 Mounting Controller

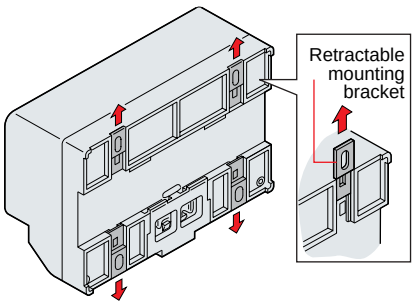
■ DIN rail mounting

The controller is designed to be mounted to the DIN rail. To mount or dismount the controller, move the claw at the bottom of the controller in the direction of the arrow.



■ Screw mounting

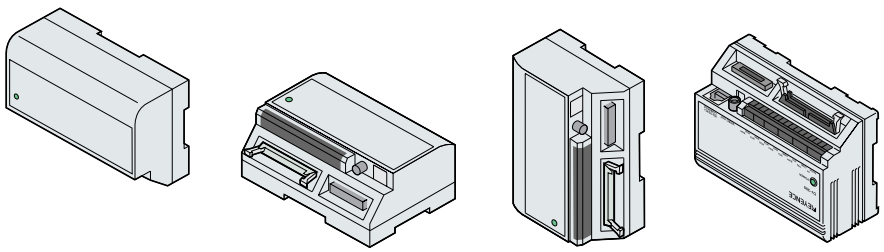
Pull out the four mounting brackets and mount the controller using screws.



■ Mounting position

Mount the controller with the front facing the operator or facing up.

Horizontally with front facing operator:	With front facing up:	Vertically with front facing operator:	With front facing down:
Correct	Correct	Correct	Incorrect



Allow sufficient space for ventilation (approx. 30 mm) around the controller.

CAUTION

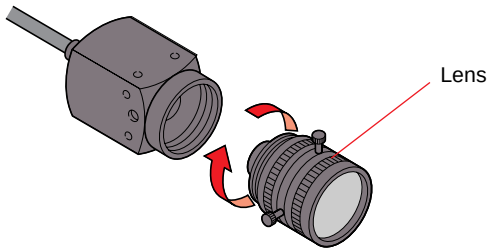
- ***Do not place the controller upside down.***
- ***Do not block the ventilation slots, as this may cause the controller to stop operating.***

2.1.3 Mounting Camera

1. Mount a lens to the camera.

   Select a lens based on the target size and the distance between the lens and the target.

   ➪ *Refer to the next page.*



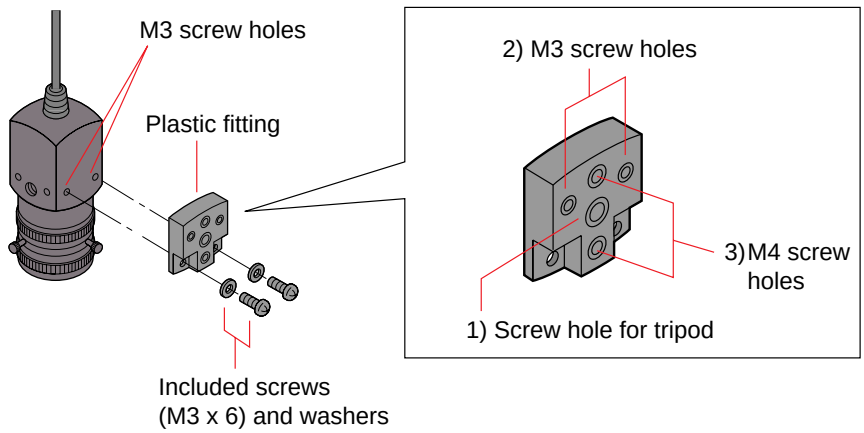
2. Secure the camera.

   The following two methods can be used to secure the camera.

   ● **Using the included plastic fitting**

   The plastic fitting has the following screw holes. Use the appropriate ones to secure the camera.

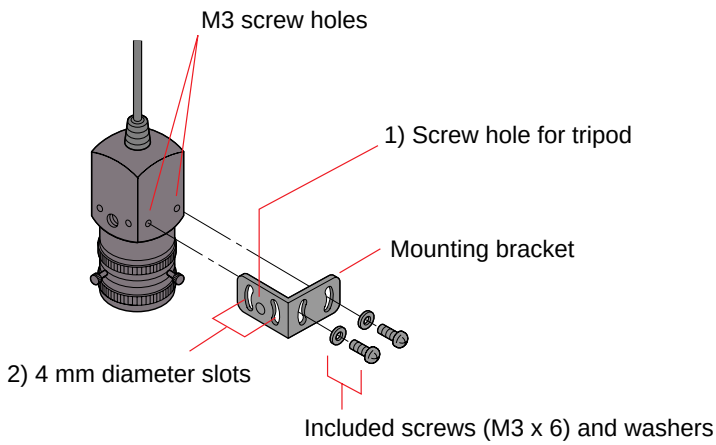
   1) Screw hole for tripod (1/4-20 UNC): 1
   2) M3 screw holes: 2
   3) M4 screw holes: 2



   ● **Using the included mounting bracket**

   The mounting bracket has the following screw hole and slots. Use the appropriate ones to secure the camera.

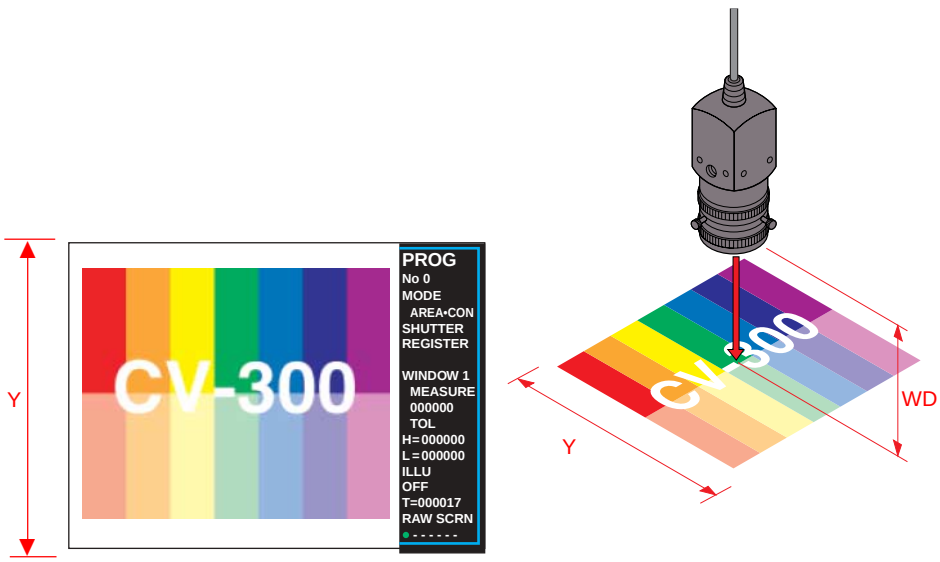
   1) Screw hole for tripod (1/4-20 UNC): 1
   2) 4 mm diameter slots: 2

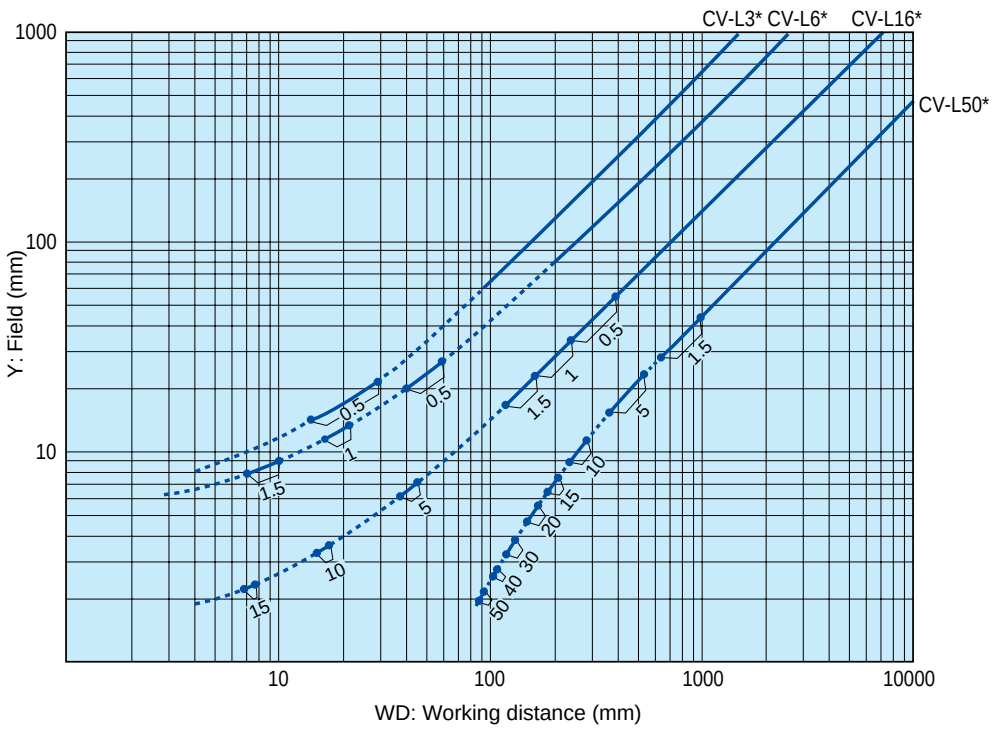


CAUTION ***Be sure to insulate the camera when mounting it. Otherwise, the internal circuit of the camera may become damaged.***

2.1.4 Selecting Lens

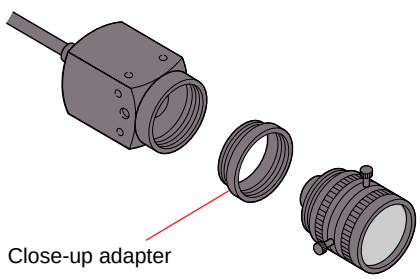
Select the lens based on the target size (Y) and the distance between the lens and the target (working distance). Refer to the following chart to select the best lens for your application.





* Type of lens

The value in the chart (●——●) indicates the thickness of the close-up adapter (option). Insert the close-up adapter between the lens and the camera.



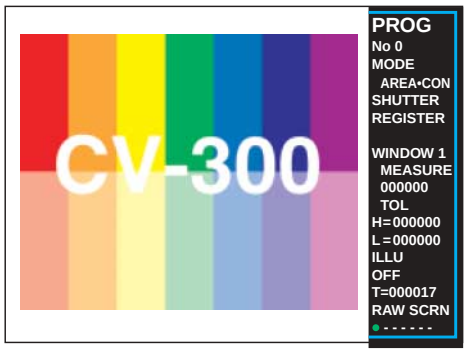
■ How to read the chart

Using a 16 mm lens with a working distance of 500 mm, a field of approximately 70 mm is obtained. Combining a 50 mm lens and a 5 mm close-up adapter provides a field of about 20 mm.

Note 1: The figures in the chart on the previous page are referencce values only. You may need to make some adjustments when setting the actual product.

Note 2: Some types of monitors may not show the frame of the screen.
Although this does not affect the measurement result, if you need to see the screen up to the corners, use an under-scanning type monitor.

Over-scanning type monitor



Under-scanning type monitor

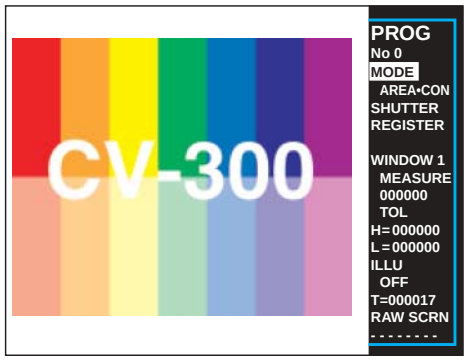
2.1.5 Checking Connection

1. Turn on the power.

   Turn on the connected 24 VDC power supply.

2. Check the monitor.

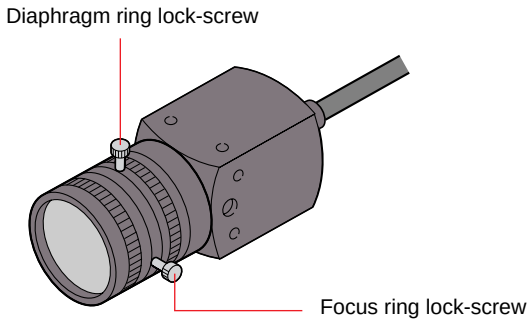
   A raw (unprocessed) screen is displayed.
   * A raw screen is a screen which is seen through the camera.



3. Adjust the diaphragm and focus of the lens.

   1) Turn the diaphragm ring and focus ring to adjust the diaphragm and focus while watching the monitor.

   2) After adjustment is complete, secure the lock-screws to lock the rings.



- **Diaphragm adjustment**
  Adjust the diaphragm so that the screen displays a clear contrast and the target can be easily distinguished from the background.

- **Focus adjustment**
  Adjust the focus until the target contour becomes clear. If the diaphragm is adjusted so that the image is too bright or too dark, proper focus adjustment will not be obtained. Adjust the diaphragm at the same time as the focus.

Notes: Check the following items if nothing appears on the monitor.

- Did you use the 24 VDC (600 mA) power supply? Are the “+24 V” and “0 V” power supply terminals properly connected?
- Are the cables for the camera, remote control console, and monitor properly connected?
- Did you remove the cap from the lens?
- Is the lens diaphragm opened enough?

- Is the monitor turned on?
- Is the video input terminal for the monitor properly connected?

2.2 Illumination

Use illumination for more stable detection.

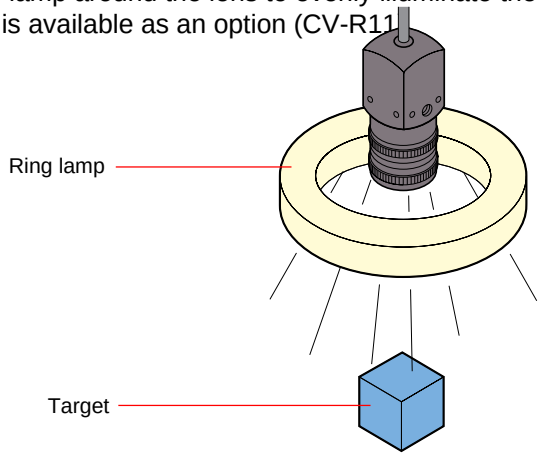
If you install the CV-301 in locations with the following conditions, the detection may not be accurate. Change the location or use the speciallydesigned illumination equipment.

- Locations directly exposed to sunlight
- Locations where the ambient light varies greatly depending on the time of day
- Locations where the illumination level is changed by the movement of a machine or people.

Illumination equipment

■ Ring lamp

Mount the ring lamp around the lens to evenly illuminate the target.
The ring lamp is available as an option (CV-R11).



Other than the ring lamp, the fiber light and other illumination equipment are also available. Order the model that best suits your application.

Note: The illumination lamp has a recommended service life. When the light intensity changes, detection errors may result. Replace the lamp before this problem occurs.

Chapter 3

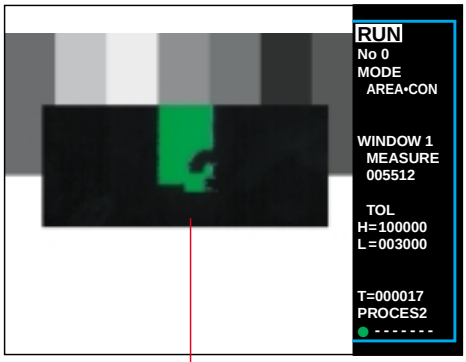
Measurement Mode Selection by Application

Explains the type and operation of the measurement modes and how to select the appropriate mode.

3.1 Measurement Modes and Typical Applications

The CV-301 has 4 measurement modes: [AREA•CON (TRG) “Area continuous (trigger)”], [AREA + POS “Area + Position”], [ABS•POS “Absolute position”], and [REL•POS “Relative position”]. This manual describes how to set the [AREA] mode.

3.1.1 [AREA•CON “Area continuous”] / [AREA•TRG “Area trigger”]



Typical applications: Detection of presence/absence of a target, detection of a missing target, detection of color and shape of a target, and measurement of area

- Measures the area of a target.
- Measures the area of the extracted color in the window or the area of the background.
- Up to eight windows can be drawn at a single setting. The measured data for each window will be output.
- To detect a target continuously, use the [AREA•CON “Area continuous”] mode.
- To detect a target using an external trigger with intervals, use the [AREA•TRG “Area trigger”] mode.

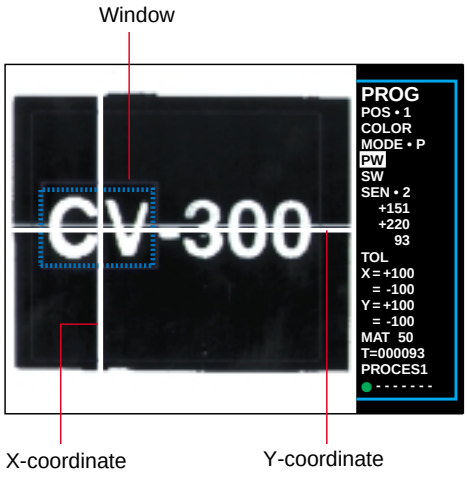
3.1.2 [AREA + POS “Area + Position”]

Typical applications: Detection of presence/absence of a target, detection of a missing target, detection of color and shape of a target, measurement of area, and positioning

- Corrects the position of the window using [POS “Position adjustment”] in the [AREA•TRG] mode.
- The camera can be set to trigger mode only.
- There are two methods of [POS “Position adjustment”]: Pattern search and line sensor.

■ [POS “Position adjustment”]

To correct the window position, select one of the following two methods according to your application.



Pattern search

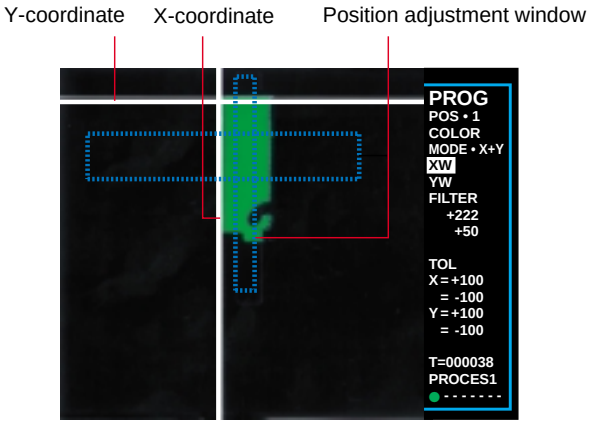
Corrects the window position by using a target with a complicated shape (characters or marks) as a reference.

- Encloses the target in a window and saves an image of it. Next, it searches the images captured during measurement for the saved one (this process is called “search”). Displays the center coordinate value of the most similar image.

➪ *For the setting procedure, refer to page 65.*

Line sensor

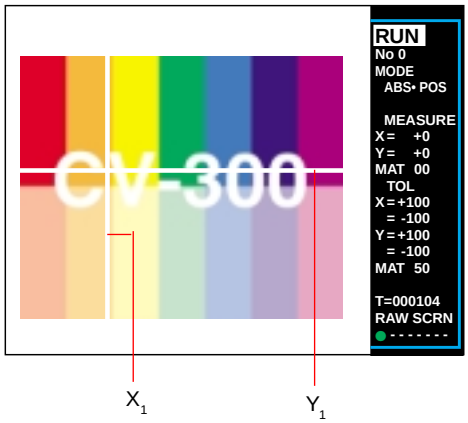
Corrects the window position by using the edge or line mark of a target as a reference.
Correction using the line sensor can be faster than using the pattern search.



- Sets a position adjustment window in the X- and Y- direction. Detects the first edge of the target (color/background selectable) in the window and measures the position.

➪ *For the setting procedure, refer to page 65.*

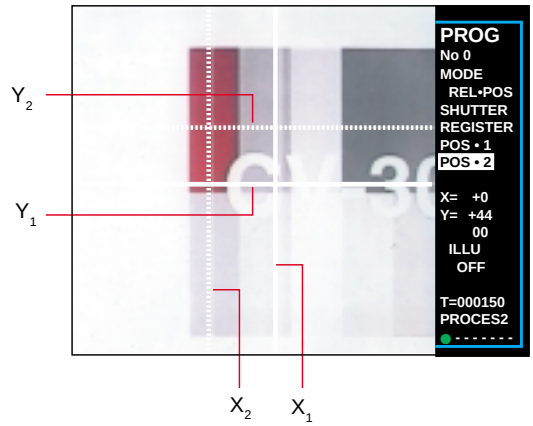
3.1.3 [ABS. POS “Absolute position”]



Typical applications: Positioning and robot handling

- Detects the position of a target.
- Detects the position of a target using [POS “Position adjustment”] and determines the result.
- There are two methods of [POS “Position adjustment”]: Pattern search and line sensor.
  ➪ *Refer to [AREA + POS] section on page 18.*
- Outputs the measurement result and the coordinate value of the target position.
- The camera can be set to trigger mode only.

3.1.4 [REL. POS “Relative position”]



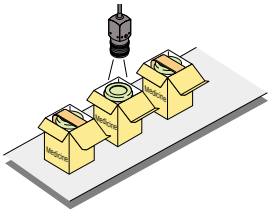
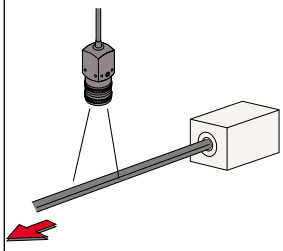
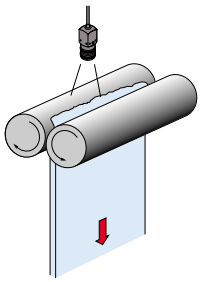
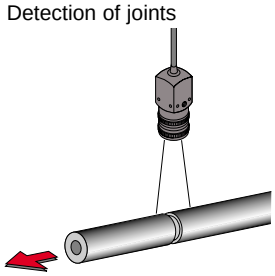
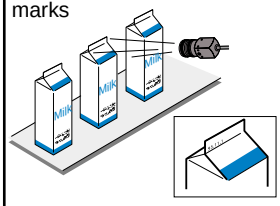
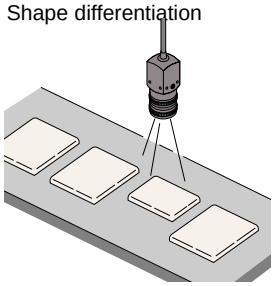
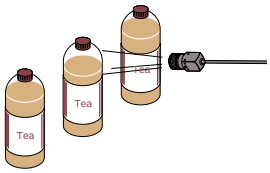
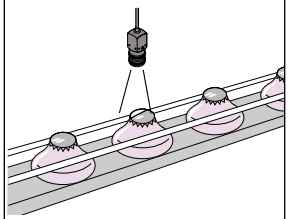
Typical applications: Positioning and detection of target displacement

- Detects the relative position of two targets.
- Detects the position of two targets using [POS. 1 “Position adjustment 1”] and [POS. 2 “Position adjustment 2”], measures the distance between them, and determines the result.
- There are two methods of [POS “Position adjustment”]: Pattern search and line sensor.
  ➪ *Refer to [AREA + POS] section on page 18.*
- Outputs the measurement result and the coordinate value of the distance.
- The camera can be set to trigger mode only.

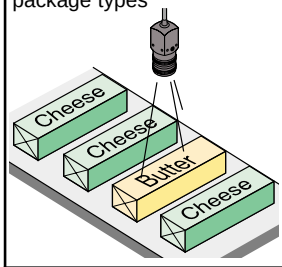
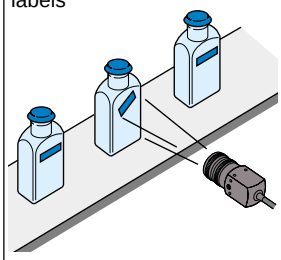
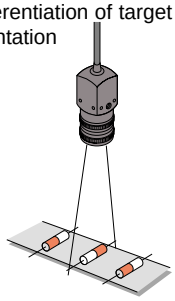
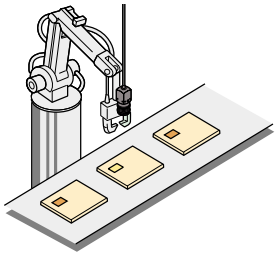
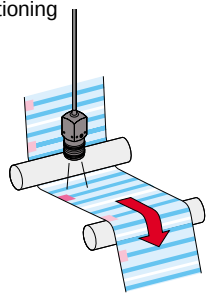
3.2 Selecting measurement mode for application

Refer to the following table to select the measurement mode best suited for your application.

● indicates the best measurement mode.
❍ indicates the applicable measurement mode.

Measurement mode / Inspection item	Area	Area + position	Relative position	Absolute position	Measurement mode / Inspection item	Area	Area + position	Relative position	Absolute position
Checking presence/absence of target 	●	●			Visual inspection 	●	●		
Area measurement 	●	●			Detection of joints 	●	●		
Area measurement, detection of printing or marks 	●	●			Shape differentiation 	●	●		●
Detection of liquid surface 	❍	❍	❍	●	Detection of chipped target 	●	●		

● indicates the best measurement mode.
❍ indicates the applicable measurement mode.

Measurement mode / Inspection item	Area	Area + position	Relative position	Absolute position	Measurement mode / Inspection item	Area	Area + position	Relative position	Absolute position
Checking for different package types 	●	●		❍	Detection of misaligned labels 			❍	●
Differentiation of target orientation 	●	●			Control of robot handling 			●	●
Positioning 			●	●					

Chapter 4

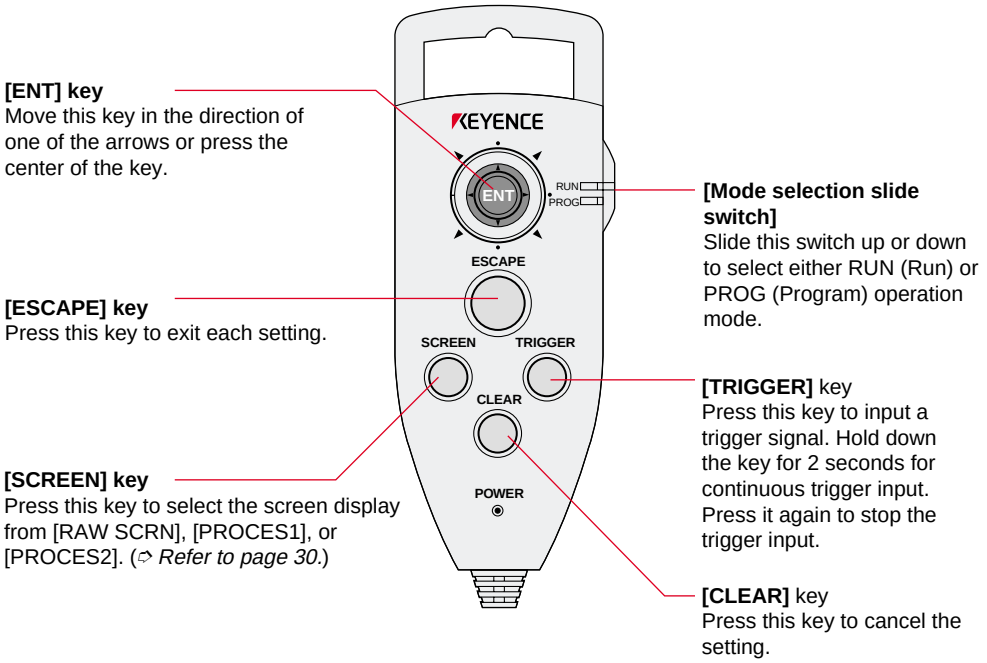
Setting procedure

Explains how to use the remote control console to set the CV-301. Describes from the basic setting to the advanced setting.

4.1 Remote Control Console and Screen Display

The remote control console is used to set the CV controller for detection. The screen display is a display shown on the monitor. Use the remote control console while watching the monitor screen.

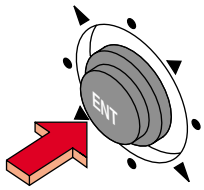
4.1.1 Remote Control Console



How to use the [ENT] key

■ **Press the center of the key**

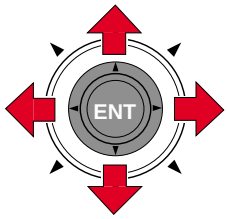
- To select menu item.
- To confirm the numerical set value.



■ **Move the key in the direction of an arrow**

The key can be moved up, down, right, left and diagonally.

- To move through menu items.
- To enter [TOL “tolerance”] value.
- To move the arrow cursor on the monitor.
- To change the size of a window or move a window.

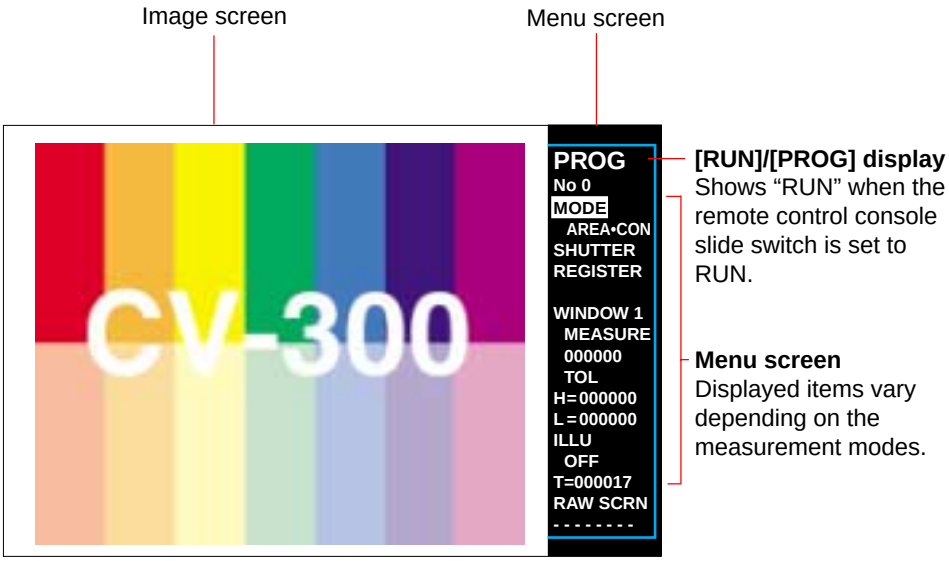


4.1.2 Screen Page Layout

The cursor position is displayed in reverse video.

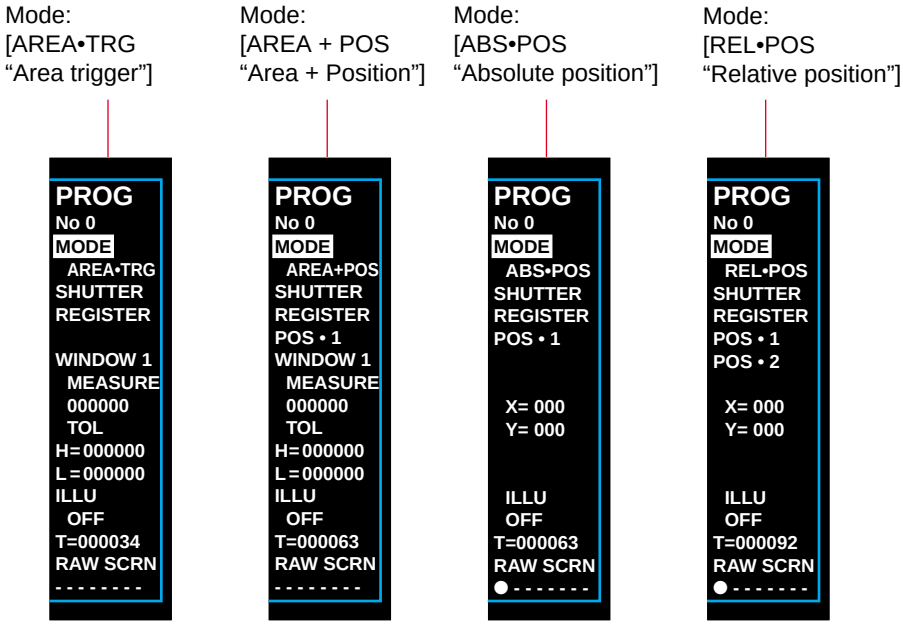
The menu screen has a layered structure. Use the **[ENT]** and **[ESCAPE]** keys to move through the layers.

■ **Initial screen**



Display for each mode

The following menu screens are displayed according to the current measurement mode.



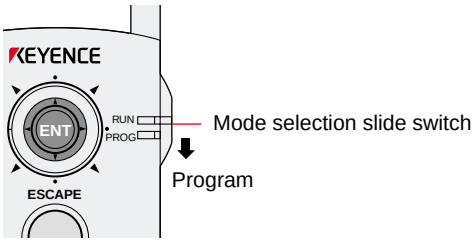
4.2 Preparation and basic setting

4.2.1 Preparation before Setting

Before turning on the power

1. Check the cable connections.
Refer to page 10.

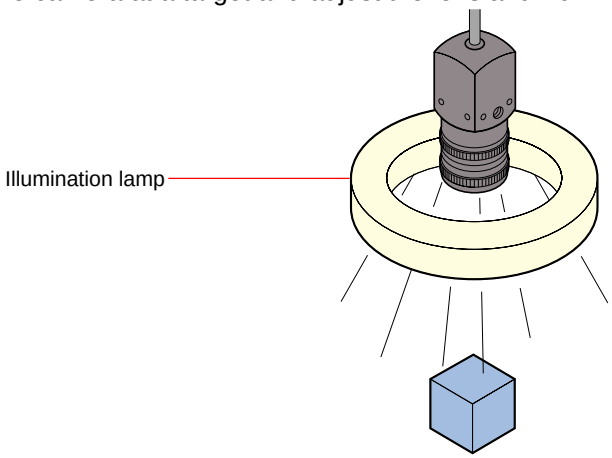
2. Set the remote control console's mode selection slide switch to "Program".



Turning on the power

1. Turn on the power.
An unprocessed screen is projected on the monitor.

2. Aim the camera at a target and adjust the lens and illumination.



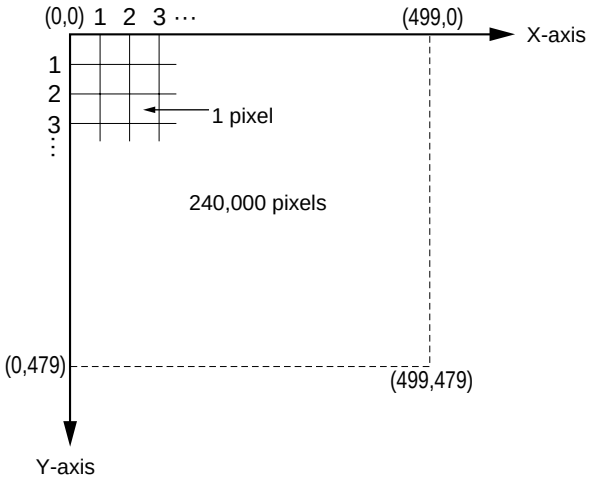
Note: If the color of the target displayed on the monitor is different from that of the actual target, adjust the white balance. (Refer to page 75.)

4.2.2 Basic Setting

This section explains basic information about how to use the vision system and how to use major functions.

Screen coordinates

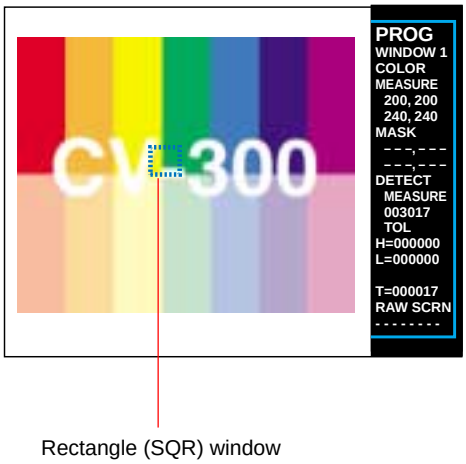
The CV-301's screen defines the upper left point as the reference point and is composed of 240,000 pixels: 500 pixels in the X-axis direction and 480 pixels in Y-axis direction.
The tolerance value and position indication are presented using pixels as the units.



Note: A pixel is a basic unit in image processing. The length and area are presented in pixels.

Drawing window

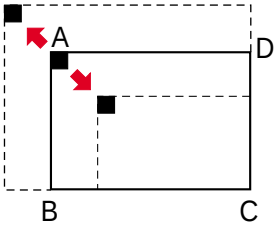
To set a measurement range on the screen, draw a window (frame).
The shape of the window can either be a circle or a rectangle.
The following section explains how to draw the window.



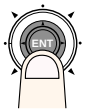
Rectangle (SQR) window

Drawing a rectangle (SQR) window

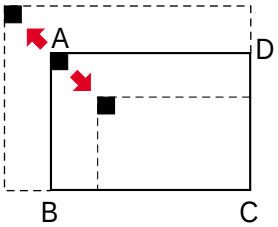
1. Move the ENT key horizontally and vertically to move point A to the desired position.



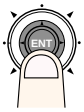
2. Press the ENT key to determine point A.



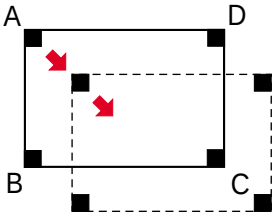
3. Move the ENT key horizontally and vertically to move point C to the desired position.



4. Press the ENT key to determine point C.



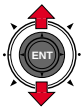
5. Move the ENT key horizontally and vertically to move the entire window. To follow steps 1 through 5 again, press the ENT key.



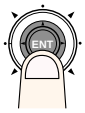
6. After determining the size and position of the window, press the ESCAPE key to exit MEASURE mode.

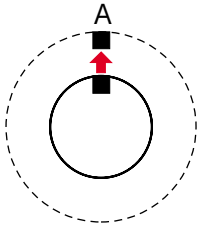
Drawing a circle (CL) window

1. Move the ENT key up or down to change the radius.

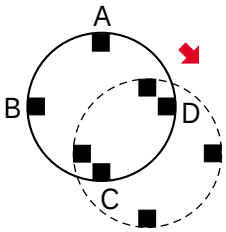


2. Press the ENT key to determine point A.





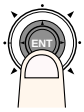
3. Move the ENT key horizontally and vertically to move the entire window.



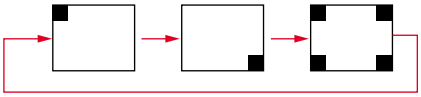
4. To follow steps 1 through 3 again, press the ENT key.

5. After determining the size and position of the window, press the ESCAPE key to exit MEASURE mode.

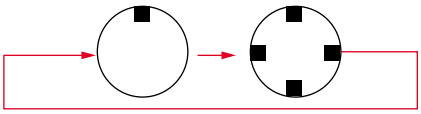
Every time the ENT key is pressed, the window drawing mode changes as shown in the figure on the right.



When drawing a rectangular window



When drawing a circular window



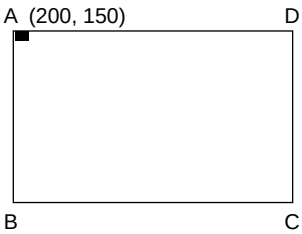
Reference: To change the window shape

Select the window shape before drawing the window. To change the window shape from a rectangle to a circle or from a circle to a rectangle after drawing the window, erase the current window. (➪ *Refer to page 71.*)

Window coordinate value display

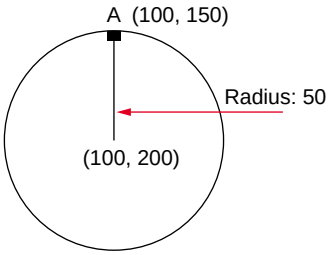
The window coordinate value is displayed using numerical values. Use the value to check or save the specified coordinate values.

Rectangle



Upper line: (X, Y) coordinates of point A
Lower line: (X, Y) coordinates of point C

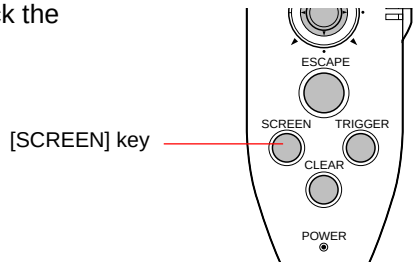
Circle



Upper line: The left value indicates the radius.
The right value is always “000”.
Lower line: (X, Y) coordinates of circle center

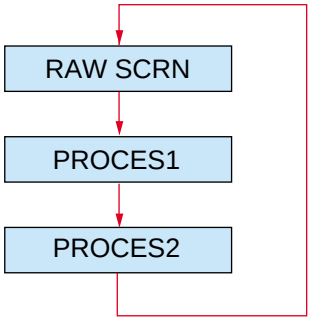
4.2.3 Screen Selection

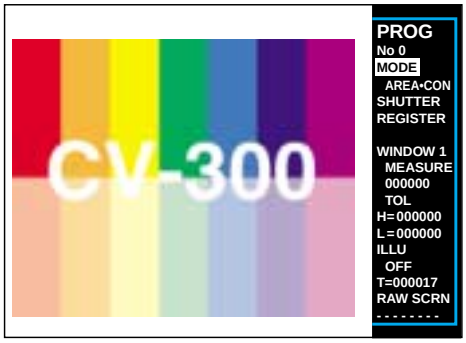
Three types of screens can be selected. Use a screen other than the raw screen to check the settings and operation.



Operation

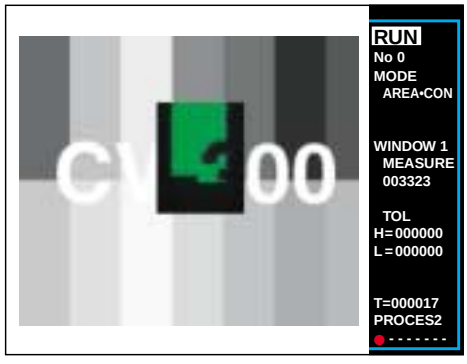
Every time the **[SCREEN]** key is pressed, the screen changes to the next type in the sequence.





RAW SCRN (Unprocessed screen)

PROCES1 (Processed screen 1)



PROCES2 (Processed screen 2)

Note: While the CV is operating, the trigger input is ignored during screen changes. When Trigger mode is selected and the trigger input interval is short, the Processed screen will not be displayed.

Measurement mode		RAW SCRN	PROCES1	PROCES2	
[AREA]		Unprocessed screen	Binary image	Projects the image of Processed screen 1 only in a window. Displays the image outside of the window in black-and-white.	
[ABS • POS "Absolute position"]		Unprocessed screen (Cross cursor)	Binary conversion screen (Cross cursor)	Projects only the extracted color. Displays other colors in black-and-white. (Cross cursor)	
[REL • POS "Relative position"]		Unprocessed screen (Cross cursor)	Binary conversion screen (PW1: Solid cross cursor, PW2: Dot cross cursor)	Projects only the extracted color. Displays other colors in blackand-white. (Cross cursor)	
[AREA + POS "Area + position"]	**Area**	Unprocessed screen (Cross cursor)	Binary conversion screen of Area window (Cross cursor)	Projects the image of Processed screen 1 only in a window. Displays the image outside of the window in black-and-white.	When the CV is set to RUN mode, the [AREA] mode screen automatically appears.
	Position detection (In POS 1 menu)	Unprocessed screen (Cross cursor)	Binary conversion of POS 1 screen (Cross cursor)	Projects only the extracted color in POS 1 screen. Displays other colors in black-andwhite.	

4.3 [AREA] Mode Setting

This section describes the basic setting procedure using the [AREA•CON “Area continuous”] mode. [AREA] is a mode used for the detection of presence/absence of a target, detection of a missing target, detection of color and shape of a target, and measurement of area.

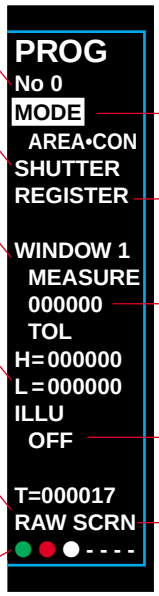
■ **Difference between [AREA•CON] and [AREA•TRG]**

[AREA•CON] is a continuous detection mode. [AREA•TRG] is a trigger detection mode which detects a target when a trigger signal is input. The setting procedures for both modes are the same.

■ **Setting [AREA + POS]**

To set the [AREA + POS] mode, set the [POS “Position adjustment”] setting described on page 45.

4.3.1 [AREA•CON] Mode Menu



Program No.
Up to 16 programs (numbers 0 to 15) can be registered.

SHUTTER
Changes shutter speed.

WINDOW1
Sets a window and selects the color to be extracted.

Tolerance
Sets the tolerance. (Units: pixels)

Processing time
Displays the processing time for each screen. (Units: ms)

Detection result
The color indicator shows the detection result for each window.

● (Green): Within tolerance

● (Red): Out of tolerance

○ (White): No detection

– : Window has not been determined.

MODE
4 measurement modes can be selected.

Screen registration
Store the image for setting.

Measured value
Displays the measured value in a window. (Units: pixels)

Illumination adjustment function ON/OFF display

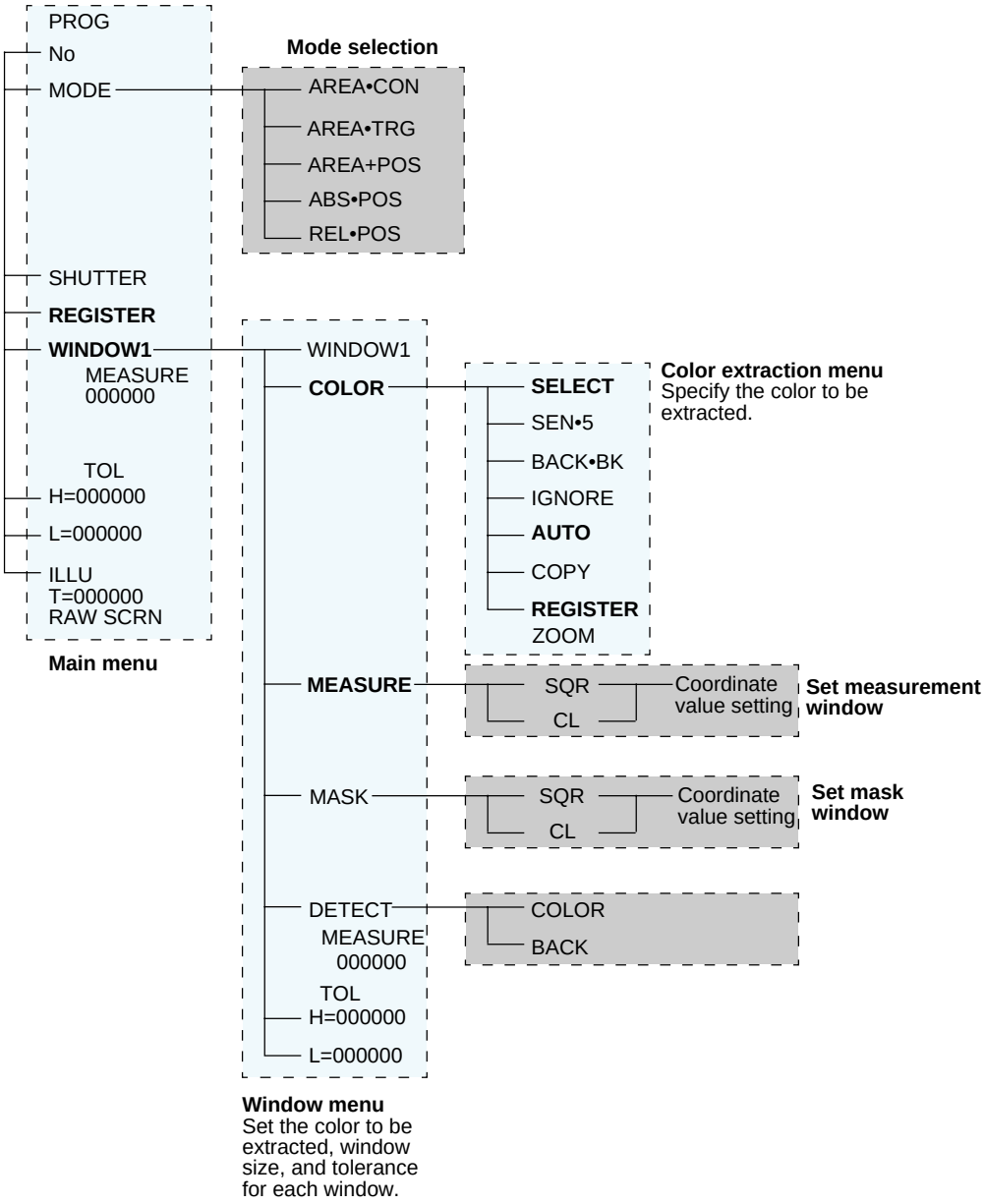
Current display
Shows the current screen mode. (Raw screen, Processed screen 1, Processed screen 2)

Note: This photo shows all indicators lit in order to demonstrate the actual color of the detection result. In actural operation, indicators ○ and ●, or ○ and ● are not lit simultaneously.

4.3.2 Setting Parameters and Procedure

Setting parameters

The following is the layered structure of the parameters for the [AREA•CON] mode setting. The parameters in bold type are described in the basic setting. To set parameters other than those shown in bold type, refer to pages 53 through 71.

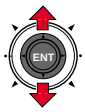


Basic setting

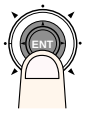
1. Determine the program No.

You can set 16 programs (numbers 0 to 15).

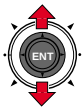
1) Move the ENT key up or down to place the cursor on “No.”.



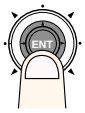
2) Press the ENT key. Now you can change the program number.



3) Move the ENT key up or down to select the number.



4) Press the ENT key to choose the desired selection.

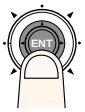


Reference: Program numbers can be changed using the I/O terminals (*Refer to pages 95 and 99.*).

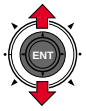
2. Select the measurement mode.

1) Move the ENT key down to place the cursor on “MODE”.

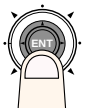
2) Press the ENT key. The cursor moves one line down.



3) Move the ENT key up or down to select “AREA•CON”.



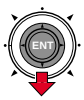
4) Press the ENT key to choose the desired selection. The cursor returns to “MODE”.



3. Register the screen.

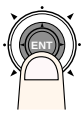
Store the image to be used for the setting in the memory.

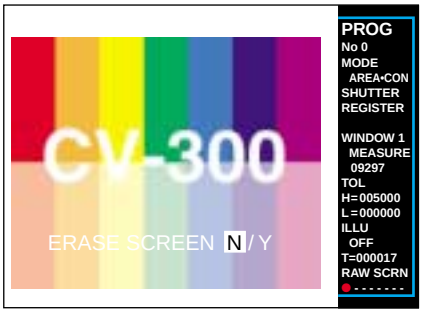
1) Move the ENT key down to place the cursor on “REGISTER”.



2) Press the ENT key.

The message “REGISTER SCREEN N/Y” appears
To cancel the screen registration, press the ENT key while “N” is selected.

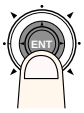




3) Move the ENT key right to select “Y”.

4) Press the ENT key.

The current screen is stored in the memory.



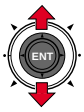
Note: The registered screen is available in any of 16 programs, and remains until you cancel and register new one.

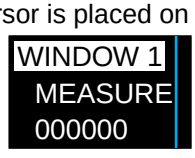
4. Set [COLOR] for [WINDOW1].

Set the color to be extracted.

1) Move the ENT key up or down to place the cursor on “WINDOW1”.

The menu changes. The cursor is placed on “WINDOW1”.

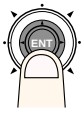




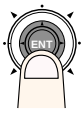
2) Move the ENT key down to place the cursor on “COLOR”.

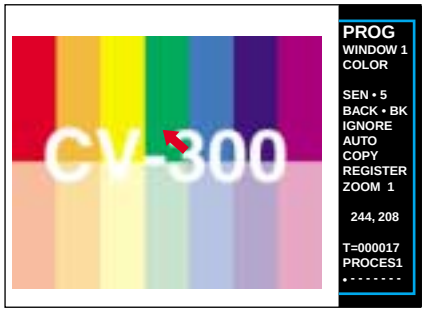
3) Press the ENT key.

The menu changes. The cursor is placed on “SELECT”.



4) Press the ENT key.
The arrow cursor appears on the screen.

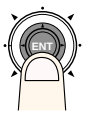




5) Move the ENT key in any direction to move the arrow cursor to the color to be extracted.

6) Press the ENT key.

- The screen changes to Processed Screen 1 and the background becomes black.*
  Only the extracted color is faintly displayed.
  Pressing the ENT key makes the color clearer.



- If there is another area which contains the color to be extracted, place the arrow cursor on the area and press the ENT key.
- Press the CLEAR key to undo the last key operation. The clear key can be used to undo up to 5 previous steps.

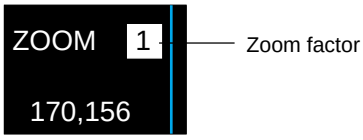
* The background becomes black because “BK” (black) is selected in “BACK” (background) in the menu. (Refer to page 63.)

7) Press the ESCAPE key.

The cursor goes to “SELECT”.

■ To zoom in on the image

The image can be zoomed in during the color extraction.

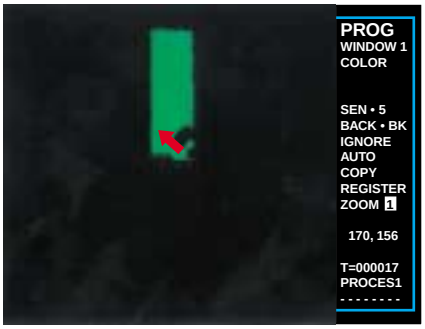


1) Press the TRIGGER key.

   The cursor goes to the number next to “ZOOM”.

2) Every time the ENT key is moved up, the image is zoomed in 2x, 4x, 8x, 16x, and 32x sequentially.

   If the ENT key is moved down, the image is zoomed out.
   Select the desired image size.



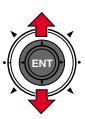
3) Press the TRIGGER key.

   You can continue the “SELECT” operation with the image size of the specified zoom factor.

5. Extract color automatically using the “AUTO” function.

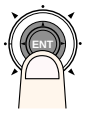
More stable color extraction is ensured regardless of the variation of target color or the change in illumination.
It is recommended that you set “AUTO” after the color extraction.

1) Move the ENT key up or down to select “AUTO”.



2) Press the ENT key repeatedly.

The color selected at “SELECT” is extracted.
Press the CLEAR key to undo the last key operation. The clear key can be used to undo up to 5 previous steps.



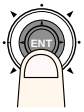
3) Press the ESCAPE key.

The cursor returns to “COLOR”.

■ To cancel the color extraction

You can cancel the color selection and restart the procedure from the beginning.

1) Use the ENT key and ESCAPE key to place the cursor on “SELECT”.



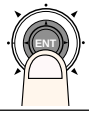
2) Hold down the CLEAR key for 2 seconds.

The message “ERASE COLOR PROGRAM N/Y” appears.

3) Move the ENT key right to select “Y”.

4) Press the ENT key.

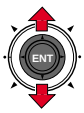
The color selection is canceled.



6. Set “MEASURE”.

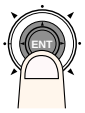
Set the window (range) for measurement.

1) Move the ENT key up or down to place the cursor on “MEASURE”.



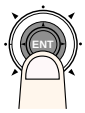
2) Press the ENT key.

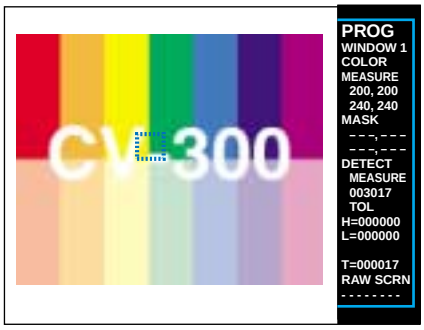
The cursor goes to “SQR”.
Move the ENT key up or down to select the shape of the window from “SQR” (square) or “CL” (circle).



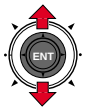
3) Press the ENT key.

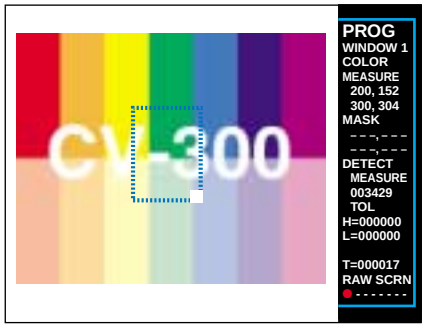
The frame of the window appears.
The figure below shows a rectangular window.



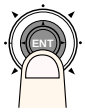


4) Move the ENT key up/down/right/left and enclose the part to be detected.

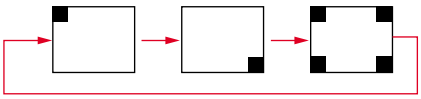




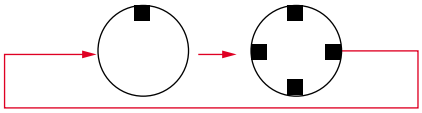
Every time the ENT key is pressed, the window drawing mode changes as follows.



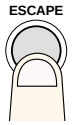
• When drawing a square window



• When drawing a circle window

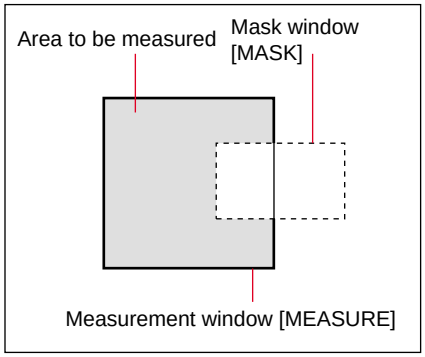


5) After setting the size and position of the window, press the ESCAPE key to exit MEASURE mode.



■ **Mask window**

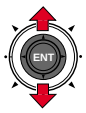
When a mask window ([MASK]) is created in a measurement window, the area inside of the mask window is omitted from the measurement.
Draw a mask window using the same procedure as for a measurement window.

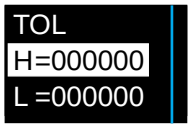


7. Set “TOL” (tolerance).

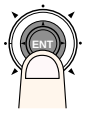
Set the upper limit “H =” and the lower limit “L =” of the tolerance. (Units: pixels)

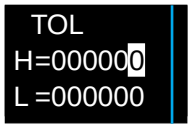
1) First, set the upper limit.
Move the ENT key up or down to place the cursor on “H = 000000” under “TOL”.



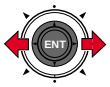


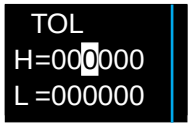
2) Press the ENT key.
“0” on the first digit is shown in reverse video. You can enter a numerical value.



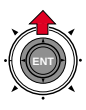


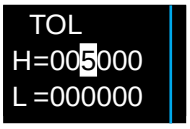
3) Move the ENT key right or left to select the digit to be changed.



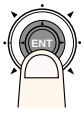


4) Move the ENT key up repeatedly. The numerical value increases starting from 0. When the value goes above 9, the reverse video moves to the next digit. If you move the ENT key down repeatedly, the numerical value decreases to 0.

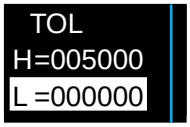




5) Press the ENT key to accept the entered value.



6) Place the cursor on “L = 000000” (Lower limit) and set the value using the same procedure as for the upper limit.



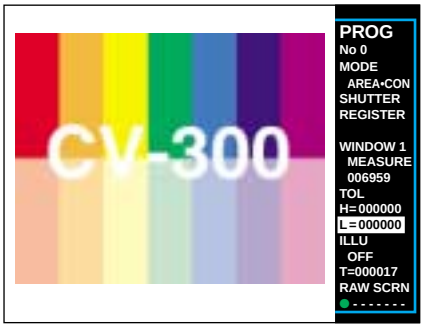
Note: If you do not know what to set the tolerance limit value at, refer to the measured value displayed in the operation check described on the following page. The upper limit cannot be smaller than the lower limit.

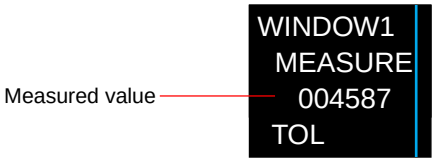
This completes the WINDOW1 settings.
In [AREA] mode, you can set up to 8 windows in a single program number.
To set several windows, select another window number and repeat steps 4 through 7 in the procedure.

Operation check after setting

1. **Press the ESCAPE key to return to the initial menu screen.**

   When the initial menu screen is displayed, trigger signals are input continuously and the measured value is displayed.

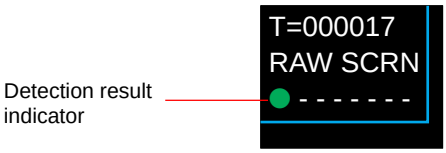




2. **Check the detection result indicator.**

   Green: Acceptable (The measured value is within the tolerance limits.)

   Red: Not acceptable (The measured value is out of the tolerance limits.)



Note 1: When [AREA•TRG] is selected, the measured value is displayed at the time of a trigger input. The detection result indicator is white before the first trigger input is produced.

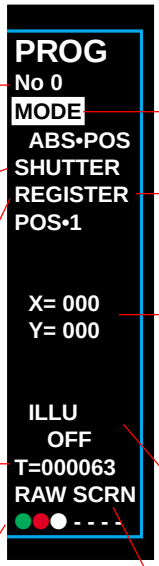
Note 2: When [AREA•CON] is selected, the measured value and the detection result is retained only while the TRIGGER key is pressed.

4.4 [POS “Position detection”] Mode Setting

This section describes the basic setting procedure for position detection mode using [ABS•POS “Absolute position”] mode. Both [ABS•POS] and [REL•POS “Relative position”] modes are set through the same procedure using the “POS“ (Position adjustment) menu.

4.4.1 [ABS•POS] Mode Menu

The following menu is displayed after [ABS•POS] mode is set.



Program No.
Up to 16 programs (numbers 0 to 15) can be registered.

SHUTTER
Changes shutter speed.

POS•1 (Position adjustment 1)
Set parameters for position detection.

Processing time
Displays the processing time for each screen. (Units: ms)

Detection result
The color indicator shows the detection result for each window.

- ● (Green): Within tolerance
- ● (Red): Out of tolerance
- ○ (White): No detection
- – : Window has not been determined.

MODE
4 measurement modes can be selected.

Screen registration
Store the image for setting.

Coordinate value display
Coordinate values of the results of position detection. The values are shown in pixels.

Illumination adjustment function ON/OFF display

Current display
Shows the current screen mode. (Raw screen, Processed screen 1, Processed screen 2)

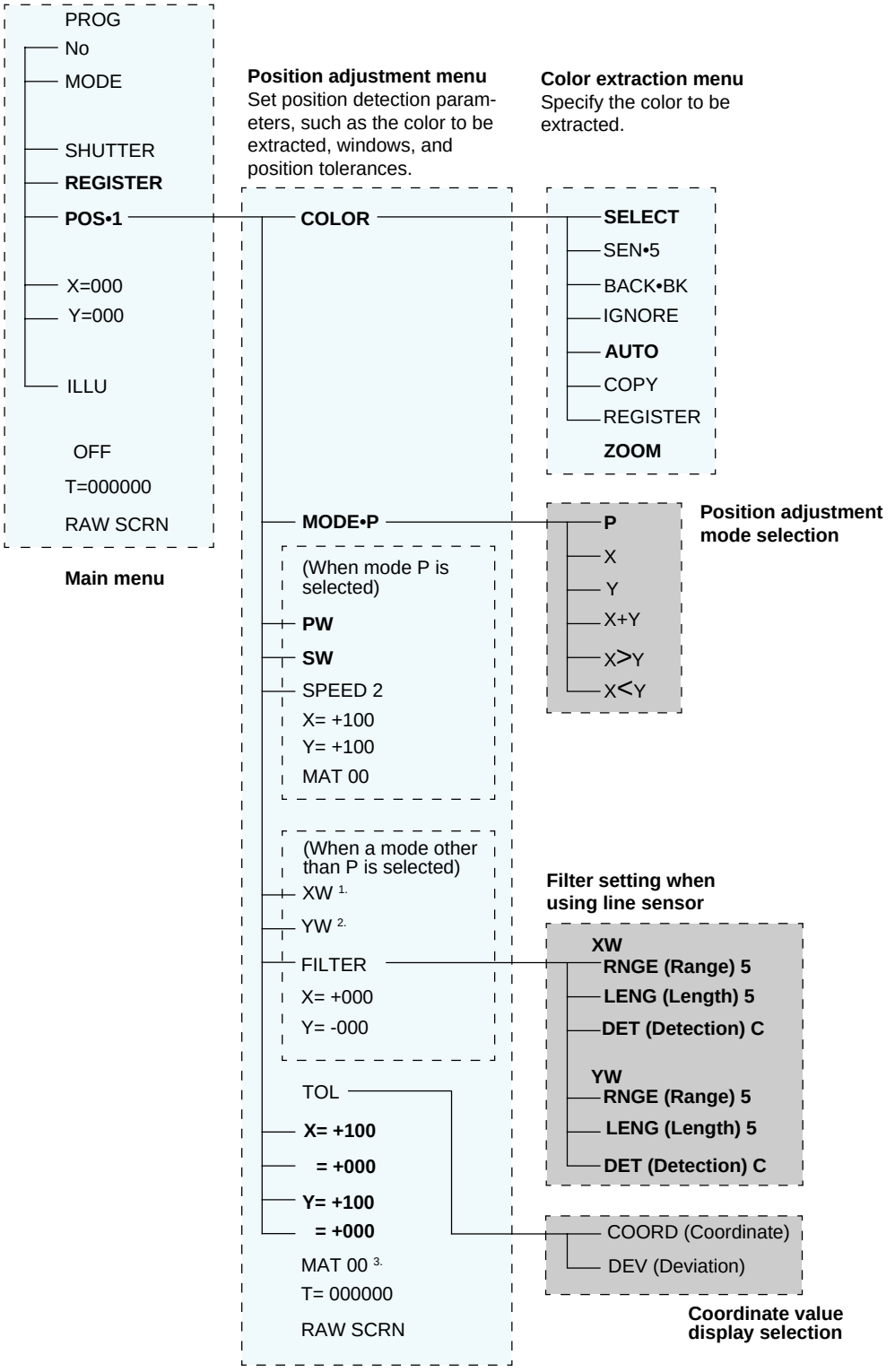
Note: This photo shows all indicators lit in order to demonstrate the actual color of the detection result. In reality, only the left indicator is lit.

4.4.2 Setting Parameters and Procedure

Setting parameters

The following is the layered structure of the parameters for the [ABS•POS] mode setting. The parameters in bold type are described in the basic setting section. For information on the parameters not shown in bold type, refer to page 61.

If you select [REL•POS] mode, you also have to set “POS•2” (Position adjustment 2). Use the same procedure to set both “POS•1” and “POS•2”.



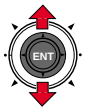
1. Not displayed in Mode Y.
2. Not displayed in Mode X.
3. Displayed in Mode P.

Basic setting

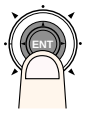
1. Determine the program No.

You can set 16 programs (numbers 0 to 15).

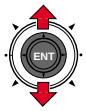
1) Move the ENT key up or down to place the cursor on “No.”.



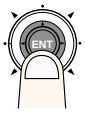
2) Press the ENT key. Now you can change the program number.



3) Move the ENT key up or down to select the number.



4) Press the ENT key to choose the desired selection.

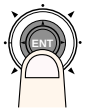


Reference: Program numbers can be changed using the I/O terminals.
➪ *Refer to pages 95 and 99.*

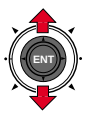
2. Select the measurement mode.

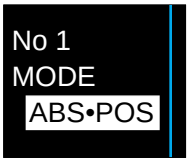
1) Move the ENT key down to place the cursor on “MODE”.

2) Press the ENT key. The cursor moves one line down.

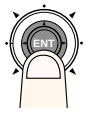


3) Move the ENT key up or down to select [ABS•POS].





4) Press the ENT key to choose the desired selection. The cursor returns to “MODE”.

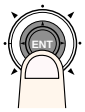


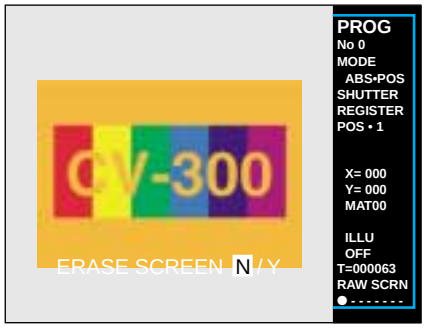
3. Register the screen.

Store the image to be used for the setting in the memory.

1) Move the ENT key down to place the cursor on “REGISTER”.

2) Press the ENT key.
The message “REGISTER SCREEN N/Y” appears
To cancel the screen registration, press the ENT key while “N” is selected.

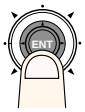




3) Move the ENT key right to select “Y”.

Reference: When you press the TRIGGER key while “Y” is selected, the screen is updated to the latest image.

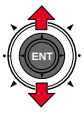
4) Press the ENT key.
The current screen is stored in the memory.



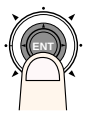
4. Set “COLOR” in the “POS•1” menu.

Set the color to be extracted.

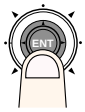
1) Move the ENT key up or down to place the cursor on “POS•1”.
The menu changes. The cursor is placed on “Color”.



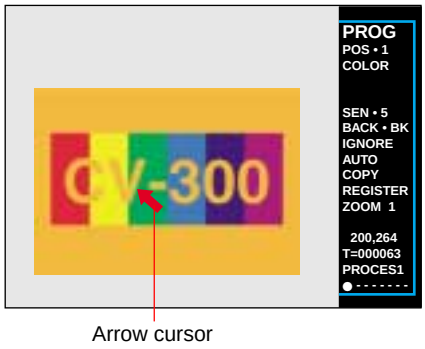
2) Press the ENT key.
The menu changes. The cursor is placed on “SELECT”.



3) Press the ENT key.
The arrow cursor appears on the screen.



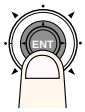
4) Move the ENT key in any direction to move the arrow cursor to the color to be extracted.



5) Press the ENT key.

- The screen changes to Processed Screen 1 and the background becomes black.*
  Only the extracted color is faintly displayed.
  Pressing the ENT key makes the color clearer.
- If there is another area which contains the color to be extracted, place the arrow cursor on the area and press the ENT key.
- Press the CLEAR key to undo the last key operation. The clear key can be used to undo up to 5 previous steps.

* The background becomes black because “BK” (black) is selected in “BACK” (background) in the menu. ⇨ *Refer to page 63 .*

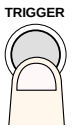


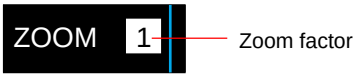
6) Press the ESCAPE key.
The cursor goes to “SELECT”.

■ To zoom in on the image

The image can be zoomed in during the color extraction.

1) Press the TRIGGER key.
The cursor goes to the number next to “ZOOM”.





2) Every time the ENT key is moved up, the image is zoomed in 2x, 4x, 8x, 16x, and 32x sequentially.

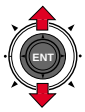
If the ENT key is moved down, the image is zoomed out.
Select the desired image size.

3) Press the TRIGGER key.
You can continue the “SELECT” operation with the image size of the specified zoom factor.

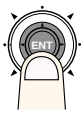
5. Extract color automatically using the “AUTO” function.

More stable color extraction is ensured regardless of the variation of target color or the change in illumination.
It is recommended that you set “AUTO” after the color extraction.

1) Move the ENT key up or down to select “AUTO”.



2) Press the ENT key repeatedly.
The color selected at “SELECT” is extracted.
Press the CLEAR key to undo the last key operation. The clear key can be used to undo up to 7 previous steps.

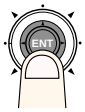


3) Press the ESCAPE key.
The cursor returns to “COLOR”.

■ **To cancel the color extraction**

You can cancel the color selection and restart the procedure from the beginning.

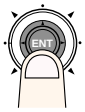
1) Use the ENT key and ESCAPE key to place the cursor on “SELECT”.



2) Hold down the CLEAR key for 2 seconds.
The message “ERASE COLOR PROGRAM N/Y” appears.

3) Move the ENT key right to select “Y”.

4) Press the ENT key.
The color selection is canceled.

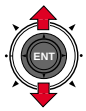


There are two methods for “POS” (Position adjustment) setting: Pattern search and line sensor. This section describes the setting procedure using pattern search.
☞ *Refer to page 19 for details about pattern search and line sensor.*

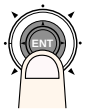
6. Draw “PW” (Pattern window).

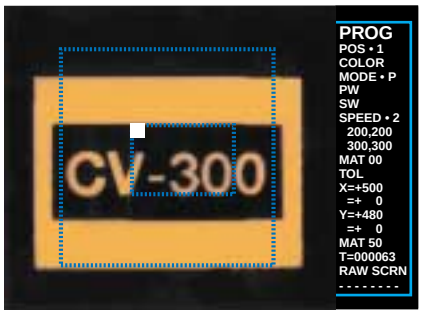
Draw a window (range) around the image pattern using “SELECT” in the “COLOR” menu and save the window’s position on the screen.

1) Move the ENT key up or down to place the cursor on “PW”.

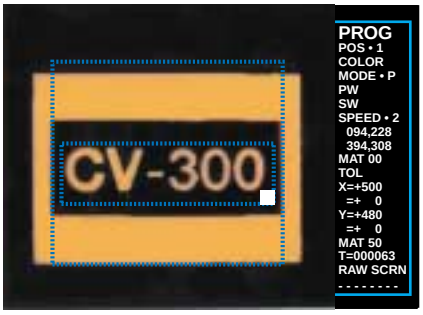


2) Press the ENT key.
The frame of the window appears on the screen.

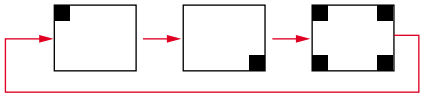




3) Move the ENT key horizontally or vertically to enclose the pattern in the window.



Every time the ENT key is pressed, the window drawing mode changes as shown on the right.



ENT key

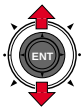
4) After setting the size and position of the window, press the ESCAPE key to exit the “PW” setting.

Note: You cannot draw a pattern window (PW) larger than the search window (SW). If you need to draw a large pattern window, first increase the size of the search window described in step 7 before drawing the pattern window.

7. Draw “SW” (Search window).

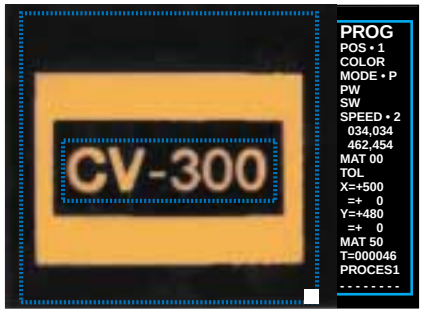
Draw a window (range) in which the pattern saved in the “PW” setting is searched.

1) Move the ENT key up or down to place the cursor on “SW”.

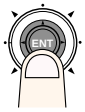


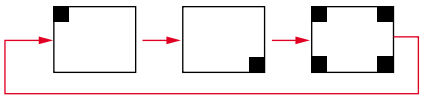
2) Press the ENT key.
The frame of the window appears on the screen.

3) Move the ENT key horizontally or vertically to enclose the desired area in the window.



Every time the ENT key is pressed, the window drawing mode changes as shown on the right.





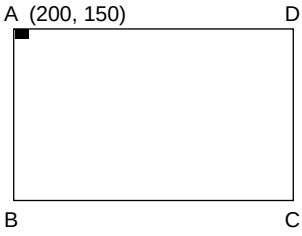
ENT key

4) After setting the size and position of the window, press the ESCAPE key to exit the “SW” setting.

Reference: The search window (SW) is shown with a dotted line. The pattern window (PW) searches the specified pattern within the search window. If a similar pattern is positioned near the specified search pattern, narrow the search window to avoid detection errors.

Narrowing the search window (SW) speeds up detection.

Window coordinate value display
The window coordinate value is displayed using numerical values.
Use the value to check or save the coordinate values.

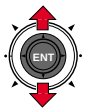


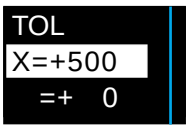
Upper line: (X, Y) coordinates of point A
Lower line: (X, Y) coordinates of point C

8. Set “TOL” (Tolerance) values.

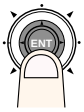
Set the allowable range (upper and lower limits) for the X- and Y-coordinates as the tolerance values. The values are shown in pixels.

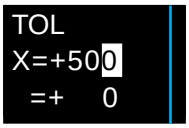
1) Set the upper limit value for the X-coordinate.
Move the ENT key up or down to place the cursor on “H = 000000” under “TOL”.



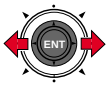


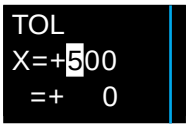
2) Press the ENT key.
“0” on the first digit is shown in reverse video. You can enter a numerical value.





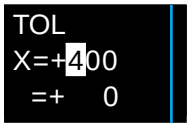
3) Move the ENT key right or left to select the digit to be changed.



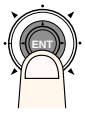


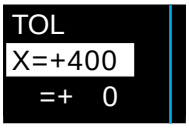
4) Move the ENT key up or down repeatedly.

- Every time the ENT key is moved up, the numerical value of the first digit increases from 0 to 9. When the ENT key is moved up while 9 is displayed, the value of the next digit increases.
- Every time the ENT key is moved down, the numerical value decreases to 500.
- The tolerance value for the X-coordinate can be set between +500 and -500.

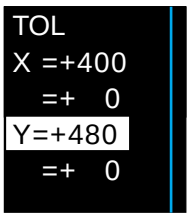


5) Press the ENT key to accept the entered value.





6) Set the lower limit value for the X-coordinate, and the upper and lower limit values of the Y-coordinates using the same procedure as in steps 1) through 5).
The tolerance value of a Y-coordinate can be set between +480 and -480.

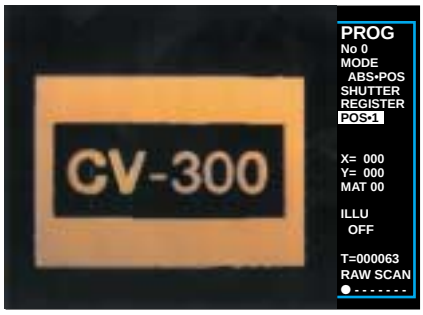


Reference: You cannot set the upper limit value smaller than the lower limit value.

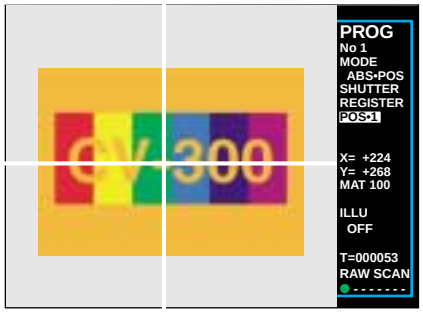
This completes the tolerance setting.

Checking operation

1. Press the ESCAPE key to display the initial menu screen.



2. Press the TRIGGER key.



3. Check the detection result indicator.

- ● (Green): Acceptable (The measured value is within the tolerances.)
- ● (Red): Not acceptable (The measured value is out of the tolerances.)
- ○ (White): No detection (The trigger input is not received.)

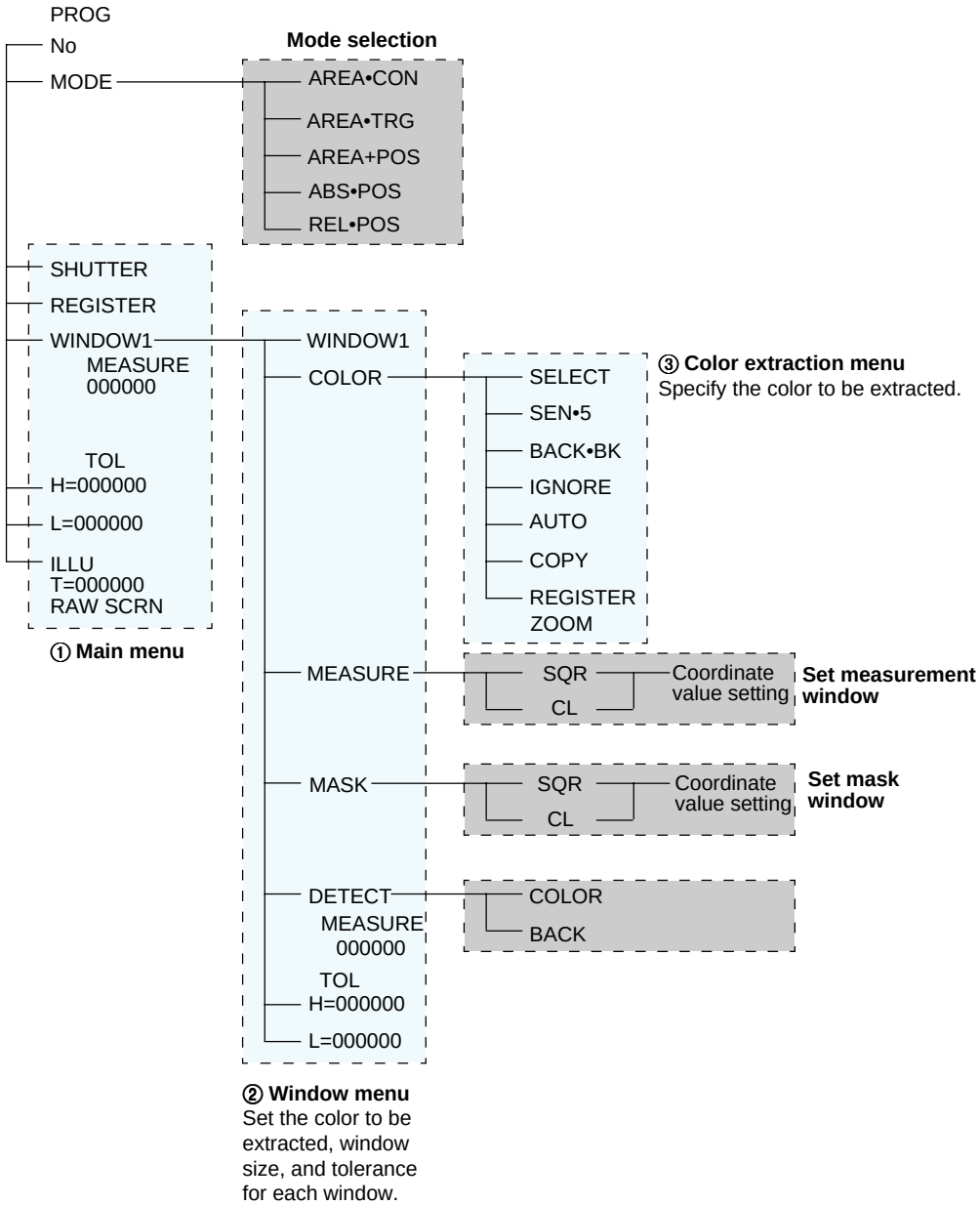
4.5 High Precision Setting

This section describes how to use the functions in the menus used for high precision setting.

4.5.1 Menu Item List

The following is the layered structure of the parameters for the [AREA•CON] and [AREA•TRG] mode settings.

The same setting procedure is used for both the [AREA•CON] and [AREA•TRG] modes. Items 1 to 3 in the structure are explained on the following page.



① Main menu

"*" indicates the initial setting value.

Menu item	Setting	Description	Purpose
SHUTTER	1/60* to 1/10000	Set the shutter speed.	When detecting a fast moving target.
REGISTER	N/Y	Save an image.	Save a target image in the memory.
WINDOW1	To sub menu (Refer to 2 for details.)	Set the color to be extracted and the detection window.	When preparing detection.
MEASURE	——	Measured value display	Check the measured value.
TOL	H=000000 L=000000	Set the upper limit "H" and the lower limit to "L".	Set the allowable range for the detection. (Units: pixels)
ILLU	OFF* ON	Enable/disable the illumination adjustment function.	Enable the function to automatically adjust illumination when the light quantity changes.
T=000000	——	Processing time display	Check the processing time.
RAW SCRN	RAW SCRN*	The actual image captured by the camera.	Check the unprocessed image.
	PROCES 1	Processed image for the detection.	Check the detection condition.
	PROCES 2	Processed image for the detection.	Check the detection condition.

② Window menu

"*" indicates the initial setting value.

Menu item	Setting	Description	Purpose
WINDOW1	1* to 8	Set a window for each color to be extracted.	Set several windows to select several targets.
COLOR	To sub menu (Refer to 3 for details.)	Extract the color of a target.	Extract color for detection or position adjustment.
MEASURE	SQR, CL	Draw a rectangular or circular window on the screen.	Set the range to be measured.
MASK	SQR, CL	Draw a rectangular or circular window on the screen.	Set the range not to be measured.
DETECT	COLOR	Count the no. of pixels in the area of the extracted color.	Check the no. of pixels in the area of the extracted color.
	BACK	Count the no. of pixels in the area outside of the extracted color.	Check the no. of pixels in the area outside of the extracted color.
TOL	H=000000 L=000000	Set the upper limit to "H" and the lower limit to "L".	Set the allowable range to judge whether the measured value is OK or NG. (Units: pixels)

③ Color extraction menu

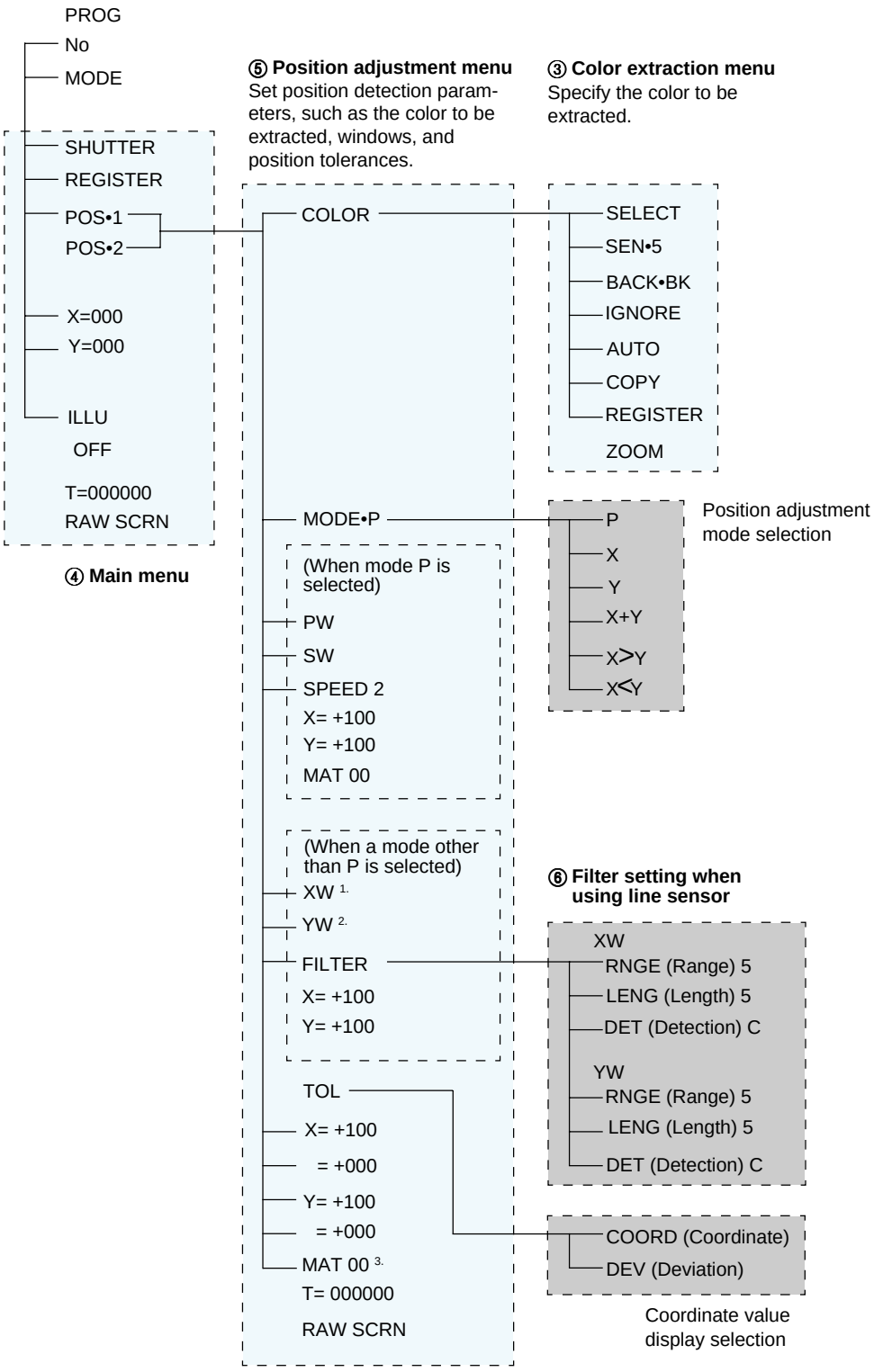
"*" indicates the initial setting value.

Menu item	Setting	Description	Purpose
SELECT		Move the cursor on the screen to select the color to be extracted.	Extract the color to be detected.
(ZOOM)	1* to 32	Zoom in on the image.	Zoom in on the image to select the color. Choose "SELECT" and press the TRIGGER key, and then move the ENT key to select the zoom factor.
SEN•	0 to 20 (5*)	Set the color recognition sensitivity. 0: High sensitivity. 20: Low sensitivity.	Make the detection more accurate or rough.
BACK•	WH	White background	Display a white background in the processed screen 1 or 2.
	BK	Black background	Display a black background in the processed screen 1 or 2.
IGNORE	1 to 20	Specify up to 20 points using the arrow cursor.	Specify the color not to be extracted.
AUTO		Set the color extraction range automatically.	Automatically adjust the extraction range of the color selected using "SELECT".
COPY	W1 to 8, P1, P2	Select another window No.	Copy the other window's color extraction settings.

The following is the layered structure of the parameters for the [REL•POS "Relative position"] mode setting.

- The [ABS•POS] mode setting does not have "POS•2".
- The [AREA+POS] mode setting has "WINDOW1" instead of "POS•2".
- The same setting procedure is used for "WINDOW1" in [AREA+POS] mode and "WINDOW1" in [AREA] mode.

Items ④ to ⑥ in the structure are explained on the following page.



1. Not displayed in Mode Y.
2. Not displayed in Mode X.
3. Displayed in Mode P.

④ Main menu

"*" indicates the initial setting value.

Menu item	Setting	Description	Purpose
SHUTTER	1/60* to 1/10000	Set the shutter speed.	When detecting a fast moving target.
REGISTER	N/Y	Save an image.	To save a target image in the memory.
POS• 1	To sub menu (Refer to 5 for details.)	Set the position of target.	Prepare position adjustment.
X= 000	——	Measured value display	Check the position of an Xcoordinate.
Y= 000	——	Measured value display	Check the position of a Ycoordinate.
ILLU	OFF*, ON	Enable/disable the illumination adjustment function.	Enable the function to automatically adjust illumination when the light quantity changes.
T=000000	——	Processing time display	Check the processing time.
RAW SCRN	RAW SCRN*	The actual image captured by the camera.	Check the unprocessed image.
	PROCES1	Processed image for the detection.	Check the setting.
	PROCES2	Processed image for the detection.	Check the setting.

⑤ Position adjustment menu

"*" indicates the initial setting value.

Menu item	Setting	Description	Purpose
COLOR	To sub menu (Refer to 3 for details.)	Extract the color of a target.	Extract color for detection or position adjustment.
MODE•	P*	Draw a pattern window and a search window.	Adjust position using "pattern search".
	X	Set the range to detect the pattern edge in the X-axis direction.	Detect (adjust) the position of a pattern by using only the pattern edge in the X-axis direction
	Y	Set the range to detect the pattern edge in the Y-axis direction.	Detect (adjust) the position of a pattern by using only the pattern edge in the Y-axis direction
	X+Y	Set the range to detect the pattern edges in both the X- and Y- axis directions.	Detect (adjust) the position of a pattern by using the pattern edges in both the X- and Y- axis directions
	X>Y	Set the range to detect the pattern edges in both the X- and Y- axis directions.	Detect (adjust) the position of a pattern by first using the edge in the X-axis direction and then using the edge in the Y-axis direction.
	X<Y	Set the range to detect the pattern edges in both the X- and Y- axis directions.	Detect (adjust) the position of a pattern by first using the edge in the Y-axis direction and then using the edge in the X-axis direction.
PW (Pattern window) (Only when mode P is selected)		Determine the size and position of a pattern window.	Determine the size and position of a pattern window.
SW (Search window) (Only when mode P is selected)		Determine the range of a search window.	Determine the range of a search window.
SPEED	0 to 5 (2*)	Set the speed of the search. 5: Slow (Accurate search), 0: Fast (Rough search)	Change the speed (accuracy) of the search.
XW (Only when a mode other than P is selected)		Set the range of an edge detection window in the X-axis direction.	Set the range of an edge detection window in the X-axis direction.
YW (Only when a mode other than P is selected)		Set the range of an edge detection window in the Y-axis direction.	Set the range of an edge detection window in the Y-axis direction.
FILTER (Only when a mode other than P is selected)	To sub menu (Refer to 6 for details.)	Set the value of each filter.	Change the filter setting value of line sensor.
TOL (Tolerance)	COORD (Coordinate)		Set the numerical value output to display an absolute coordinate value in pixels.
	DEV (Deviation)		Set the numerical value output to display the deviation amount in comparison to the registered screen.
X= +000	+500 to -500 (+500*), +500 to -500 (-0*)	Set the tolerance on the distance in the X-axis direction.	Set the tolerance of an X-coordinate value.
Y= +000	+480 to -480 (+480*), +480 to -480 (-0*)	Set the tolerance on the distance in the Y-axis direction.	Set the tolerance of a Y-coordinate value.
MAT 000	0 to 100 (50*) (Only when mode P is selected)	Set the tolerance of the matching rate.	Compare the matching rate between the stored pattern and detected pattern.
T= 000000		Processing time display	Check the processing time.
RAW SCRN	RAW SCRN	The actual image captured by the camera.	Check the unprocessed image.
	PROCES1	Processed image for the detection.	Check the setting.
	PROCES2	Processed image for the detection.	Check the setting.

⑥ Filter setting when using line sensor

"*" indicates the initial setting value.

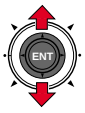
Menu item	Setting	Description	Purpose
XW: RNGE (Range)	1 to 64 (5*)	Set the range of the edge to be recognized.	Set the range of the edge to be recognized in the X-axis direction. (Units: pixels)
LENG (Length)	1 to 64 (5*)	Set the length of the edge to be recognized.	Set the length of the edge to be recognized in the X-axis direction. (Units: pixels)
DET (Detection)	B	——	Detect the first edge of the background in the window in the X-axis direction.
	C*	——	Detect the first edge of the extracted color in the window in the X-axis direction.
YW: RNGE (Range)	1 to 64 (5*)	Set the range of the edge to be recognized.	Set the range of the edge to be recognized in the Y-axis direction. (Units: pixels)
LENG (Length)	1 to 64 (5*)	Set the length of the edge to be recognized.	Set the length of the edge to be recognized in the Y-axis direction. (Units: pixels)
DET (Detection)	B	——	Detect the first edge of the background in the window in the Y-axis direction.
	C*	——	Detect the first edge of the extracted color in the window in the Y-axis direction.

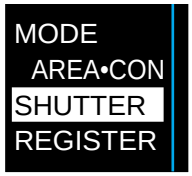
4.5.2 Shutter Speed Adjustment

When the target is moving fast, choose a fast shutter speed to ensure the captured image is clear.
The shutter speed selection is available in each measurement mode. Select the speed best suited for your application.

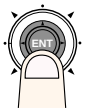
Setting procedure

1. **Move the ENT key up or down to place the cursor on “SHUTTER”.**

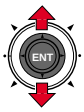




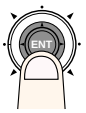
2. **Press the ENT key.**
   The cursor moves to the numerical value line.



3. **Move the ENT key up or down to select a shutter speed from 1/60 to 1/ 10000.**



4. **Press the ENT key to accept the value.**
   The cursor returns to “SHUTTER”.



Note: When selecting a mode other than [AREA•CON] mode, you need to provide a trigger input to see the current video. Press the TRIGGER key on the remote control console or input a trigger signal to the I/O terminal block.

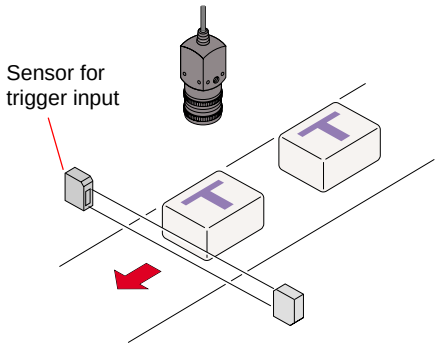
Adjustment

Shutter speed

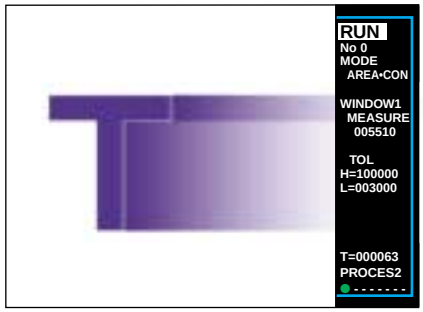
1/60
1/125
1/250
1/500
1/1000
1/2000
1/4000
1/10000

Normal

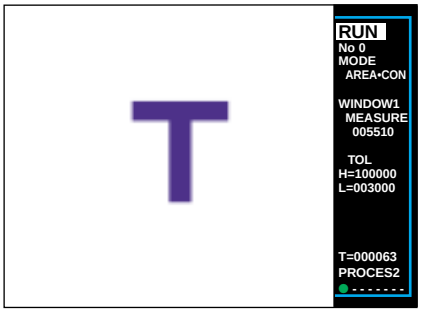
Fast



- **When the shutter speed is too slow, the target image is blurred.**



- **When the shutter speed is fast enough, the target image is clear.**

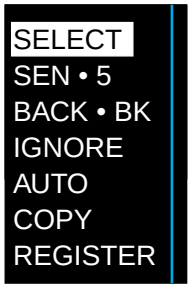


Note: The faster the shutter speed is set, the darker the image on the monitor becomes. Choose a wide lens diaphragm or increase the illumination level.

For illumination, use an inverter lamp or a lamp equipped with a reliable DC power supply.

4.5.3 Advanced “COLOR” Setting

Use the following “COLOR” settings when an accurate search is required or when the current color extraction is not successful.

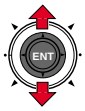


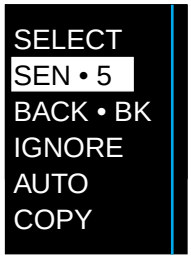
“SEN” (Sensitivity) setting

Setting: 0 to 20 (Initial value: 5)

- Adjust the sensitivity for the color extraction when selecting a color in the “SELECT” menu.
- A smaller value represents high sensitivity for color recognition. The color can be extracted in minute steps in the “SELECT” setting.
- A larger value represents low sensitivity for color recognition. Use larger values to roughly extract the color when the target has a small number of colors.

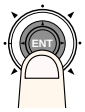
1. Move the ENT key up or down to place the cursor on “SEN”.

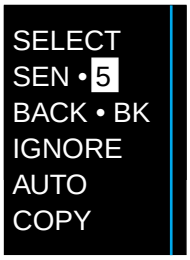




2. 1) Press the ENT key.

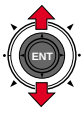
The cursor moves to the numerical value line.



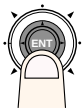


2) Move the ENT key up or down to select the sensitivity value.

When the ENT key is moved up, the value is increased; when the ENT key is moved down, the value is decreased.



3) Press the ENT key to accept the value.



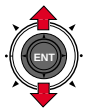
“BACK” (Background) setting

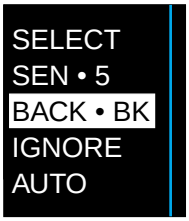
Set the background color of the “PROCES1” screen that appears when you press the SCREEN key.

The color can be set to either “BK” (Black) or “WH” (White). Select a background color that allows the extracted color to be easily seen.

Initial setting: “BK”

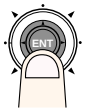
1. Move the ENT key up or down to place the cursor on “BACK”.



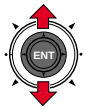


2. 1) Press the ENT key.

The cursor moves to “BK” (or “WH”).

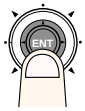


2) Move the ENT key up or down to select “WH” (or “BK”).

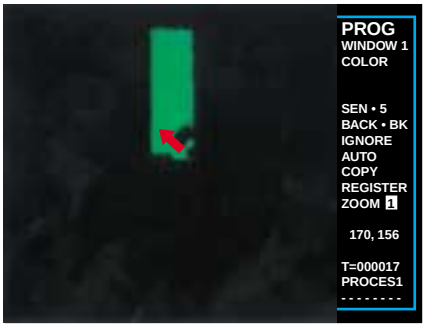


3) Press the ENT key to accept the color.

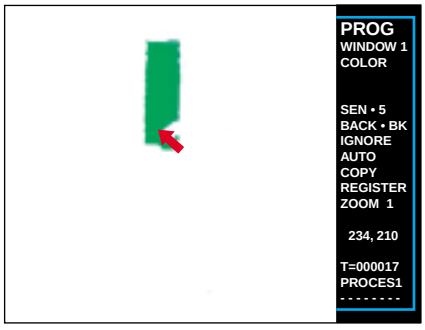
The screens on the right show the difference between black and white backgrounds on the “PROCES1” screen.



When “BK” is selected for the background

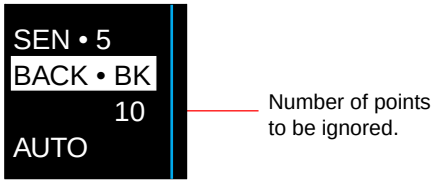


When “WH” is selected for the background



“IGNORE” setting

Setting: 1 to 20
Select the color not to be extracted when you use the “AUTO” function to extend the range of the color extraction.
When you place the cursor on a certain point and press the ENT key, the color at this point will not be extracted. Up to 20 points can be specified.
When you select more than 20 colors, the firstly selected point is erased.



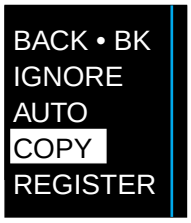
Note: Set “IGNORE” after you select a color in “SELECT” and before you use the “AUTO” function.

“COPY” setting

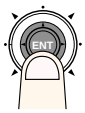
Setting: W1 to W8, P1, P2
“W” represents a window No.
“P” represents a position adjustment No.

The “COLOR” setting of one window No. or position adjustment No. can be copied to another window No. or position adjustment No.

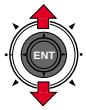
1. Move the ENT key up or down to place the cursor on “COPY”.



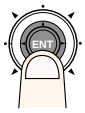
2. 1) Press the ENT key.
The cursor disappears and “W1” appears initially.



2) Move the ENT key up or down to select the original window No. or position adjustment No.



3) Press the ENT key to accept the window No. or position adjustment No.
The window No. or position adjustment No. settings are copied.

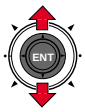


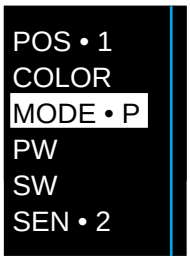
4.5.4 Advanced “Position Adjustment” Setting

To perform accurate position adjustment, you need to set not only the “COLOR” setting but also the position adjustment mode according to the target. This section explains each position adjustment mode and the setting procedure.
Refer to page 18 for details about each mode.

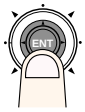
Mode selection

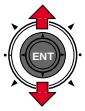
1. Move the ENT key up or down to place the cursor on “MODE”.

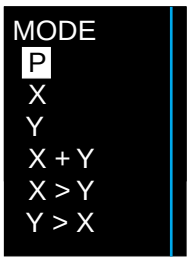




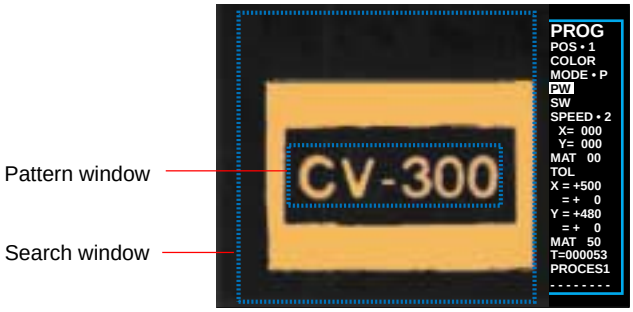
2. Press the ENT key and select a mode from the following selection.



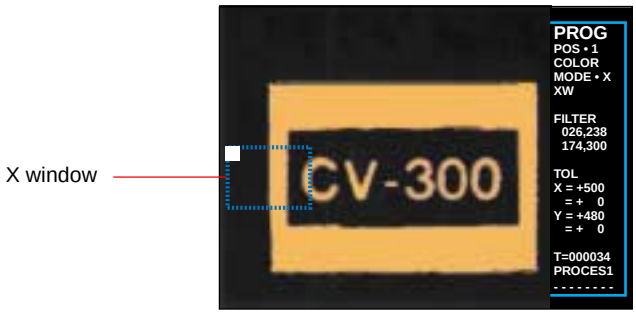




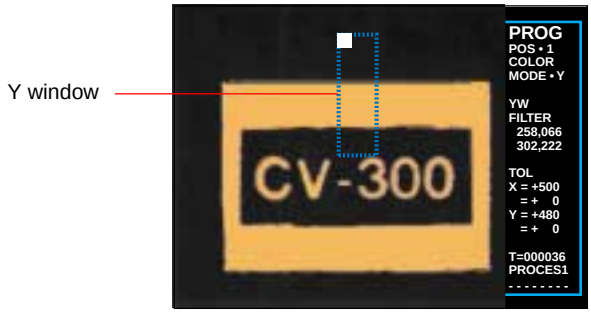
P: Set the image to be saved and the window (range) to be searched.



X: Search only the X-coordinate of the pattern edge in the X window (range).



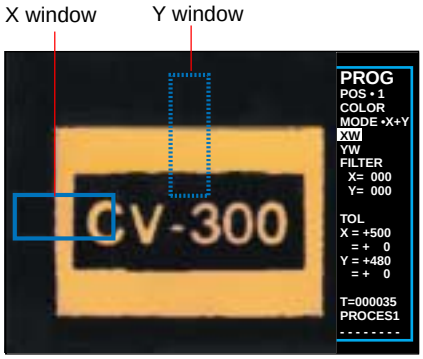
Y: Search only the Y-coordinate of the pattern edge in the Y window (range).



X+Y: Search the X- and Y-coordinates of the pattern edges in the X and Y windows (ranges).

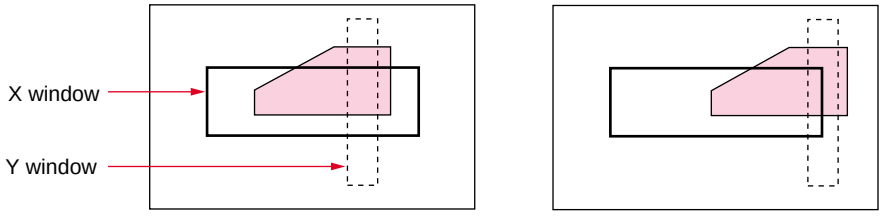
X>Y: Search the X-coordinate of the pattern edge first and then search the Ycoordinate.

X<Y: Search the Y-coordinate of the pattern edge first and then search the Xcoordinate.



Reference: Priority position adjustment

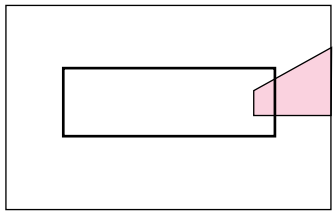
- Example: X priority (X>Y) mode
  When the X priority mode is selected, the X-coordinate of the pattern edge is searched in the X window. The result (the difference between the registered Xcoordinate value and the searched X-coordinate value) is used to shift the position of the Y window, and then the Y-coordinate of the pattern edge is searched.



Registered screen

Y window is shifted.

- When the preferred edge position is extremely different from the registered position and the shifted window disappears from the screen, the NG output is produced regardless of the coordinate value.



Y window is shifted off of the screen.

“SPEED” (Speed) setting

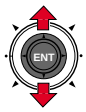
You can set “SPEED” only in “P” mode.

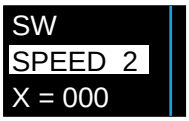
Setting: 0 to 5 (Initial setting: 2)

Use “SPEED” to change the speed (accuracy) of the search.

- A setting of “0” shortens the processing time; a setting of “5” lengthens it.
- If a similar pattern is positioned near the target, set “SPEED” to “5” for a more accurate search.

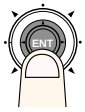
1. Move the ENT key up or down to place the cursor on “SPEED”.



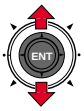


2. 1) Press the ENT key.

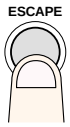
The cursor moves to the numerical value line.



2) Move the ENT key up or down to change the numerical value.



3. Press the ESCAPE key to accept the value and exit the “SPEED” setting.



“XW”/”YW” setting

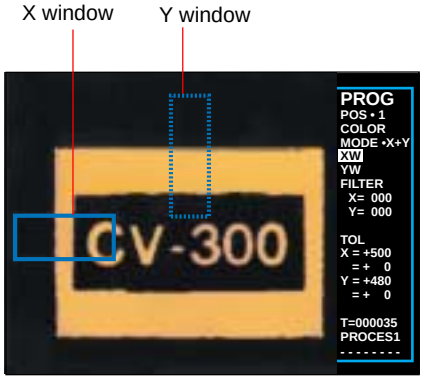
You can set “XW” or “YW” only in a mode other than “P” mode.

- Set a search window (range) to detect the edge of a pattern.

  XW: Set a window in the X-axis direction. The pattern is searched from the left of the screen.

  YW: Set a window in the Y-axis direction. The pattern is searched from the top of the screen.
- On the screen, the X window is drawn with a solid line and the Y window is drawn with a dashed line.
- When “MODE•X” is selected, “YW” is not displayed. When “MODE•Y” is selected, “XW” is not displayed.

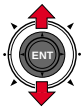
“FILTER” setting



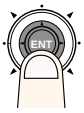
Set the edge detection method in the window drawn in the “XW” and “YW” settings.

RNGE (Range)	: 1 to 64 (Initial setting: 5)	
LENG (Length)	: 1 to 64 (Initial setting: 5)	
DET (Detection)	: C (Color):	The first edge of the extracted color in the window is detected.
	B (Back):	The first edge of the background in the window is detected.

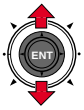
1. Move the ENT key up or down to place the cursor on “FILTER”.



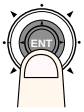
2. 1) Press the ENT key.

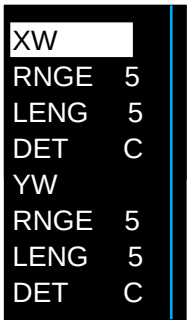


2) Move the ENT key up or down to select the item to be changed.



3) Press the ENT key to accept the item. Move the ENT key up or down to change the value or select “C” or “B”.

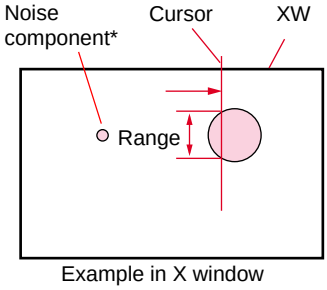




4) Press the ESCAPE key to accept the value and exit the “FILTER” setting.

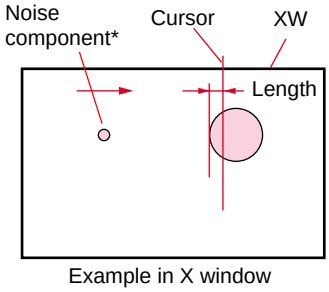
Reference: Filter function

- RNGE (Range)
  Recognize the edge when the detected range of the extracted pattern exceeds the set range.



Example in X window

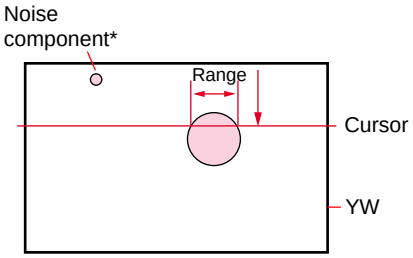
- LENG (Length)
  Recognize the edge when the detected length of the extracted pattern exceeds the set length.



Example in X window

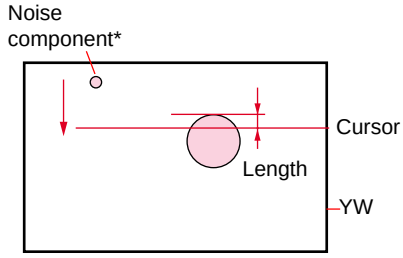
* Small dots such as noise components can be ignored unless the dot size is larger than the set range or length.

- RNGE (Range)



Example in Y window

- LENG (Length)



Example in Y window

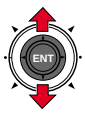
“TOL” (Tolerance) setting

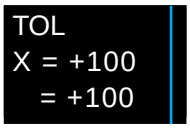
Set the tolerance by using coordinate values or deviation

COORD (Coordinate): Use the absolute coordinate to show the current coordinate and set the tolerance.

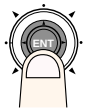
DEV (Deviation): Use the amount of the deviation from the reference value (registered screen) to show the current coordinate and set the tolerance.

1. Move the ENT key up or down to place the cursor on “TOL”.

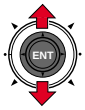




2. 1) Press the ENT key.



2) Move the ENT key up or down to select “COORD” or “DEV”.



3. Press the ESCAPE key to accept the selection and exit the “TOL” setting.

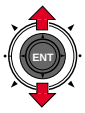
4.5.5 Illumination Adjustment Function

The illumination adjustment function automatically compensates for the brightness of the illumination. Use this function to obtain stable detection even if the light intensity gradually changes over time. The illumination adjustment function can be used in each measurement mode.

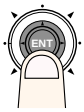
Processing time for illumination adjustment

- **[AREA•CON] mode**
  The response is delayed for several seconds due to the illumination adjustment; however, the whole processing time is the same.
- **[AREA•TRG] mode**
  The processing time becomes approximately 17 ms longer.
- **[AREA+POS], [ABS•POS], and [REL•POS] modes**
  The processing time becomes approximately 17 ms longer.

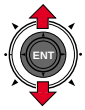
1. 1) Move the ENT key up or down to place the cursor on “ILLU”.



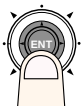
2) Press the ENT key.
The cursor moves to “OFF”.



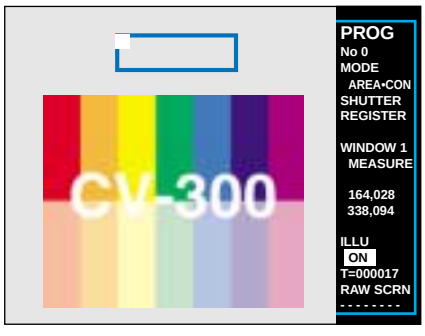
3) Move the ENT key up or down to change “OFF” to “ON”.



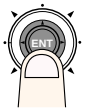
2. 1) Press the ENT key.
A window (frame) appears on the screen.



2) Move the ENT key horizontally or vertically to move the window to a position with moderate brightness. Do not place the window on the target.



3) Press the ENT key to accept the window position and exit the “ILLU” setting.



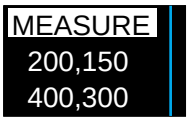
Note: Set the illumination adjustment window to a position with moderate brightness. When the window is set in a position which is too bright or too dark, the illumination adjustment easily becomes saturated by a subtle change in brightness, resulting in unstable detection.

4.5.6 Erasing Settings

You can erase part of the setting.

Erasing window

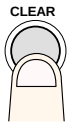
1. **Use the ENT and ESCAPE keys to place the cursor on the item to be erased.**

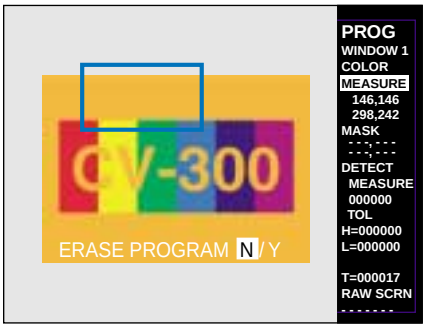


2. **Press the CLEAR key.**

   The message “ERASE PROGRAM N/Y” appears.

   - To cancel erasing the window, select “N” and press the ENT key.
   - To erase the window, select “Y” and press the ENT key.





Items can be erased

Mode	Item	Procedure	Item to be erased
[AREA• CON], [AREA• TRG], [AREA+POS]	Measurement window	Place the cursor on "MEASURE" and press the CLEAR key.	Window
	Mask window	Place the cursor on "MASK" and press the CLEAR key.	Mask window

Erasing color setting (Items set in “SELECT” in the “COLOR” menu)

1. **Use the ENT and ESCAPE keys to place the cursor on “SELECT”, “AUTO”, or “COPY”.**

2. **Press the CLEAR key for 2 seconds.**

   The message “ERASE COLOR PROGRAM N/Y” appears.

   • To cancel erasing the color setting, select “N” and press the ENT key.
   • To erase the color setting, select “Y” and press the ENT key.

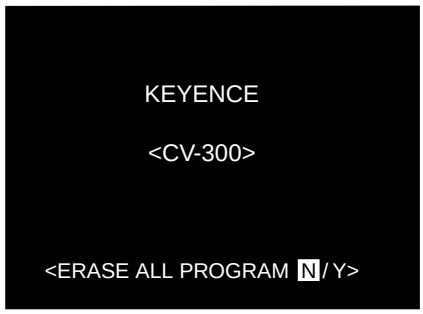
4.6 Initialization

Initialize the CV-301 series when you want to reset all of the settings or when the unit operates abnormally.

Note: After initialization, all settings are cleared to the factory-set values.
If you need to save the settings, save them through the RS-232C or take note of the necessary settings.

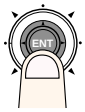
4.6.1 Initialization Procedure

1. **Hold down the remote control console's CLEAR key and turn on the power supply unit.**
   The message "ERASE ALL PROGRAM N/Y" appears on the screen.
   To cancel initialization, press the ENT key while "N" is selected.



2. **Move the ENT key to the right and select "Y".**

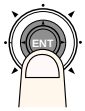
3. **Press the ENT key.**
   The CV-301 series is initialized.

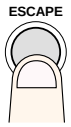


4.6.2 Initialization by Program No.

You can initialize the settings of one of the 16 programs.

1. Use the ENT and ESCAPE keys to place the cursor on “No”.

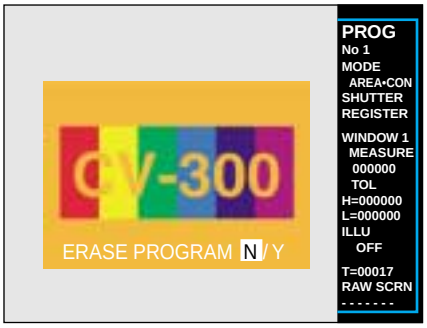




2. Press the CLEAR key for 2 seconds.

The message “ERASE PROGRAM N/Y” appears.

- To cancel erasing the program No., select “N” and press the ENT key.
- To erase the program No., select “Y” and press the ENT key.



4.7 Input/Output Operation in PROGRAM Mode

Even in PROGRAM mode, the CV-301 series accepts a trigger input or provides a busy output so that the measurement result and numerical value are displayed on the screen. The comparator output is not provided. This operation can be used as a test operation for adjustment.

Each input/output operation in the PROGRAM mode is listed in the following table.

Input terminal	TRG	Trigger input for timing signal	Enabled
Input connector	PST	Coordinate value X/Y selection input	Disabled
	RUN/SET	Run/Program selection input	Disabled
	C0 to C3	Program No. input	Disabled
Output terminal	WO1 to WO8	Window comparator output	Disabled
	WOR	Or output of WO1 to WO8	Disabled
	STO	Output strobe signal	Disabled
	BUSY	Busy signal output	Enabled
Output connector	P.POLE	Position data sign output	Disabled
	P0 to P8	Position data output	Disabled
	VIDEO	Video signal output	Enabled
	MONO	Video signal output (black-and-white output)	Enabled

Note: A trigger input is not accepted in PROGRAM mode during the setting procedure such as when drawing a window or extracting a color. A trigger input is not accepted when the remote control console's TRIGGER key cannot be used.

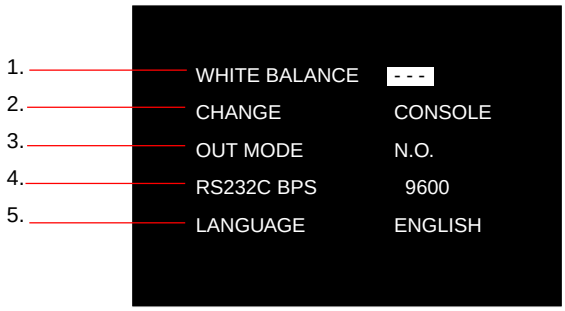
4.8 Changing Environmental Setting

The environmental setting includes the white balance adjustment and external input settings. This section describes each environmental setting and the procedure to change the setting.

4.8.1 Change Environmental Setting

You can set or check the following items in the environmental setting.

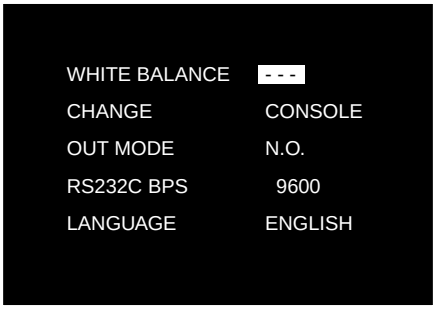
1. Adjust the white balance.
2. Select the option to use the remote control console or I/O connectors to change program No.
3. Change the output form.
4. Change the RS-232C communication speed.
5. Change the display language to Japanese or English.



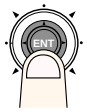
White balance adjustment

It is necessary to adjust the color of a white image to be projected white in the current illumination. This adjustment is called the white balance adjustment. Adjust the white balance whenever you change the target or the illumination.

1. In PROGRAM mode, press the ESCAPE key for 2 seconds. The environmental setting menu appears.



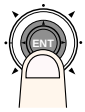
2. Press the ENT key to place the cursor on "—" in the "WHITE BALANCE" menu.

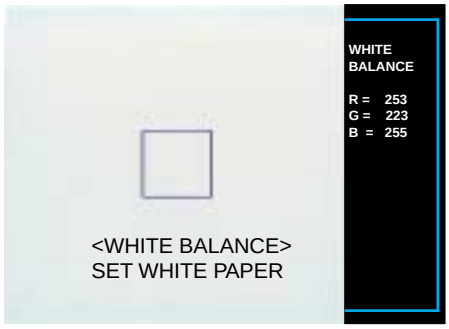


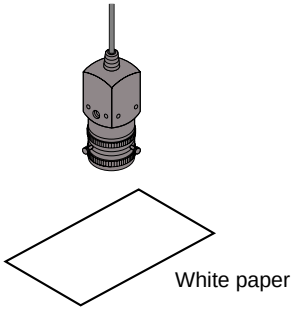
3. Move the ENT key right. "SET" appears at the cursor position.

4. **Press the ENT key.**

   A square frame and the message “<WHITE BALANCE> SET WHITE PAPER” appears at the center of the screen, and a rectangular window appears on the right end of the screen. Place a white paper in front of the camera.

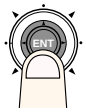


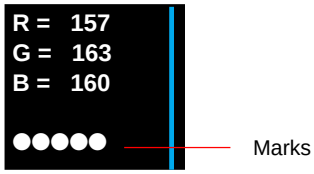




5. **Press the ENT key.**

   “O” marks appear in the menu window. When five marks appear, the white balance adjustment is completed.

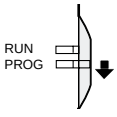




6. **Press the ESCAPE key. The screen returns to the environmental setting menu.**

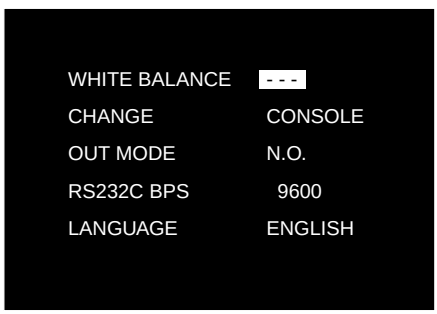
Other settings

1. **Set the remote control console’s slide switch to “PROGRAM”.**



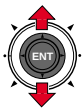
2. **Press the ESCAPE key for 2 seconds. The environmental setting menu appears.**

   The cursor is placed on the “WHITE BALANCE” setting.

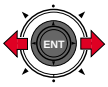


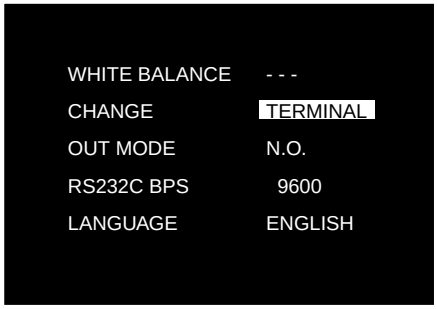
3. **Move the ENT key up or down to place the cursor on the item to be changed.**

   Every time the ENT key is moved, the cursor moves to the next item and displays the item in reverse video.

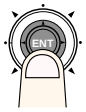


4. **Move the ENT key right or left to select the desired setting.**





5. **Press the ENT key to accept the setting.**



6. **Press the ESCAPE key. The screen returns to the environmental setting menu.**

Description of each item

"*" indicates the initial setting value.

Menu item	Setting	Description	Purpose
① **WHITE-BALANCE**	—*	Disabled	—
	SET	Enabled	Adjust white balance.
② **CHANGE**	CONSOLE*	Use remote control console to change program No.	Use remote control console to select program No.
	TERMINAL	Use I/O connector to change program No.	Use I/O connector to externally select program No. in RUN mode.
③ **OUT MODE**	N.O.*	Normally-open	Provide window comparator output using a normally-open contact (output when detection result is out of tolerances).
	N.C.	Normally-closed	Provide window comparator output using a normally-closed contact (output when detection result is within tolerances).
④ **RS-232C BPS**	9.600*/19,200/ 38,400	Set communication speed.	Change communication speed (no. of bits/sec.).
⑤ **LANGUAGE**	ENGLISH*	Use English language.	Change menu display to English.
	JAPANESE	Use Japanese language.	Change menu display to Japanese.

MEMO