OMRON ®

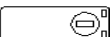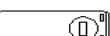## Color Mark Sensor with Teach Function — **E3M-V**

High-speed Registration Mark Detection

- ■ Fast 50 μs response

- ■ Pushbutton programming for quick setup

- ■ Remote control setup for on-the-fly adjustments

- ■ Green LED detects yellow-on-white and other difficult color combinations

- ■ Stable operation even on shiny surfaces
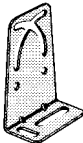
- ■ IP67 watertight construction

CE

ISO 9001 and 14001 Approved
OMRON Corporation, Ayabe Factory,
Sensing Components and Systems

Ordering Information

■ SENSOR

Shape	Sensing distance	Light source	Output	Spot size (W x H) and orientation		Part number (Quick-disconnect)	Part number (Pre-leaded)
	10 ±3 mm	Green LED (525 nm)	NPN	1 x 4 mm		**E3M-VG11**	**E3M-VG17**
				4 x 1 mm		**E3M-VG21**	**E3M-VG27**
			PNP	1 x 4 mm		**E3M-VG16**	**E3M-VG12**
				4 x 1 mm		**E3M-VG26**	**E3M-VG22**

■ MOUNTING BRACKETS

Order mounting brackets separately. These are not included with the sensor.

Shape	Part number
	E39-L131
	E39-L132

■ CONNECTING CABLES

Shape	Type	Conductors	Length	Part number
	Straight	4-wire	2 meter (6.56 ft)	**Y96E43SD2**
			5 meter (16.40 ft)	**Y96E43SD5**
	L-shaped		2 meter (6.56 ft)	**XS2F-D422-D80-A**
			5 meter (16.40 ft)	**XS2F-D422-G80-A**

Specifications

■ RATINGS/CHARACTERISTICS

Part number		E3M-VG11	E3M-VG21	E3M-VG16	E3M-VG26
Method of detection		Diffuse type			
Supply voltage		10 to 30 VDC, 10% ripple max. (p–p)			
Current consumption		100 mA max.			
Sensing distance		10 ± 3 mm			
Spot size (W x H) and orientation		1 x 4 mm	4 x 1 mm	1 x 4 mm	4 x 1 mm
Light source (wavelength)		Green LED, 525 nm			
Output		NPN open collector		PNP open collector	
		Residual voltage: 1.2 V max.		Residual voltage: 2 V max.	
		100 mA load, 30 VDC max.			
		Light-ON/Dark-ON switch selectable			
		Short-circuit protected			
Response time		ON: 50 μs max. OFF: 70 μs max.			
Remote control input (See Note.)		ON: Short-circuited to 0 or 1.5 V max., leakage current of 1 mA max. OFF: Open or V_{CC} –1.5 V to V_{CC}, leakage current of 0.1 mA max.		ON: V_{CC} –1.5 V to V_{CC}, leakage current of 3 mA max. OFF: Open or 1.5 V max., leakage current of 0.1 mA max.	
Remote control output (See Note.)		30 VDC max., 100 mA max.			
		NPN open collector, residual voltage: 1.2 V max.		PNP open collector, residual voltage: 2 V max.	
Bank selection		Two banks selectable. Available for remote control only.			
Circuit protection		Protection from reversed polarity connection and load short-circuit			
Ambient light immunity		Incandescent lamp: 3,000 ℓx max. Sunlight: 10,000 ℓx max.			
Ambient temperature	Operating	–20°C to 55°C (–4°F to 131°F) with no icing			
	Storage	–30°C to 70°C (–22°F to 158°F) with no icing			
Ambient humidity	Operating	35% to 85% RH with no condensation			
	Storage	35% to 95% RH with no condensation			
Insulation resistance		20 MΩ min. (at 500 VDC)			
Dielectric strength		1,000 VAC, 50/60Hz, 1 min.			
Vibration resistance		10 to 55 Hz, 1-mm double amplitude or 150 m/s² for 2 hrs each in X, Y, and Z axes With bracket attached: 0.75-mm double amplitude or 100 m/s²			
Shock resistance		500 m/s² 3 times each in X, Y, and Z axes. With bracket attached: 300 m/s²			
Enclosure rating		IP67 IEC60529 (with cover properly closed)			
Connection method		Quick-disconnect M12			
Weight		Approx. 100 g (with carton)			
Material		Case: Polybutylene terephthalate Lens: Acrylic (PMMA)			
Included		Instruction manual			

Note: Remote control input and answer-back output share the same signal line.
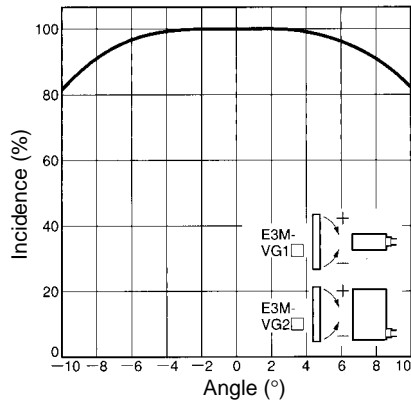
Engineering Data

■ SENSING DISTANCE VS. INCIDENT CHARACTERISTICS (TYPICAL)
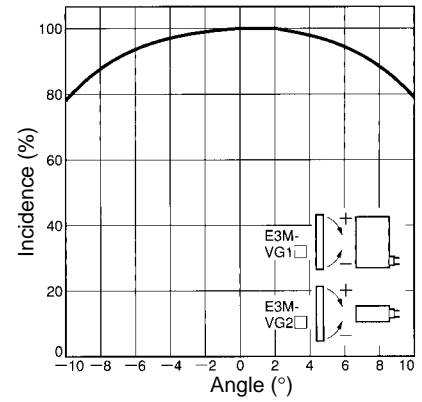
E3M-VG1□
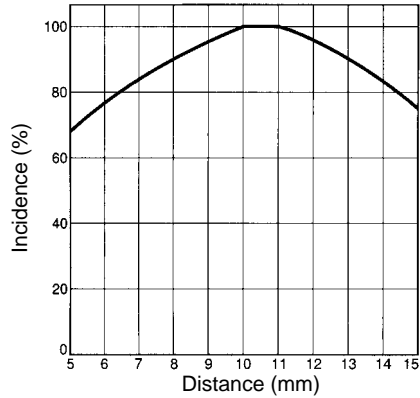
■ ANGLE VS. INCIDENT CHARACTERISTICS (X DIRECTION)

E3M-VG1□/VG2□

■ ANGLE VS. INCIDENT CHARACTERISTICS (Y DIRECTION)
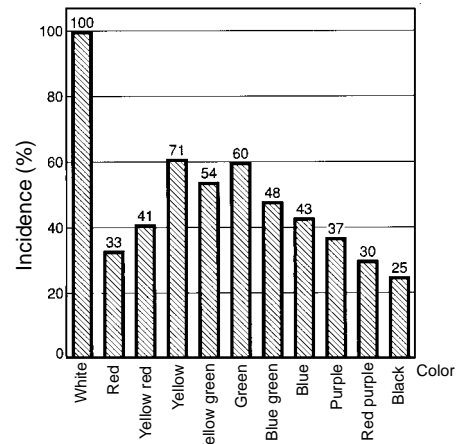
E3M-VG1□/VG2□

■ COLOR SENSING BACKGROUND VS. COLOR MARK

E3M-VG□□

	White	Red	Yellow red	Yellow	Yellow green	Green	Blue green	Blue	Purple	Red purple	Black
White		○	○	○	○	○	○	○	○	○	○
Red	○		○	○	○	○	○	○	○	X	△
Yellow red	○	○		○	○	○	○	○	X	○	○
Yellow	○	○	○		○	○	○	○	○	○	○
Green yellow	○	○	○	○		○	○	○	○	○	○
Green	○	○	○	○	○		○	○	○	○	○
Blue green	○	○	○	○	○	○		△	○	○	○
Blue	○	○	○	○	○	○	△		△	○	○
Purple	○	○	X	○	○	○	○	△		○	○
Red purple	○	X	○	○	○	○	○	○	○		X
Black	○	△	○	○	○	○	○	○	○	X	

○: Detectable   △: Detectable but unstable   X: Not detectable

■ DIFFERENCES IN INCIDENT BY COLOR

White 100, Red 33, Yellow red 41, Yellow 71, Yellow green 54, Green 60, Blue green 48, Blue 43, Purple 37, Red purple 30, Black 25
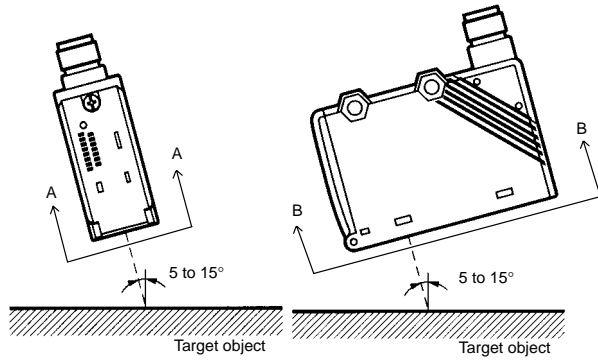
■ INSTALLATION

Glossy Target Objects

Incline the Sensor for glossy objects to reduce mirror reflection for stable sensing operation.

5 to 15°

Target object

5 to 15°

Target object

E3M-VG1□

E3M-VG2□

View AA

View BB

■ STANDARD TARGET OBJECT (COLOR VS. MUNSELL)

11 standard colors	Munsell color notation
White	N9.5
Red	4R, 4.5/12.0
Yellow red	4YR, 6.0/11.5
Yellow	5Y, 8.5/11.0
Yellow green	3GY, 6.5/10.0
Green	3G, 6.5/9.0
Blue green	5BG, 4.5/10.0
Blue	3PB, 5.0/10.0
Purple	7P, 5.0/10.0
Red purple	6RP, 4.5/12.5
Black	N2.0

Nomenclature

■ **E3M-V SENSOR**

Operation Indicator (Orange)
Lit when the output is ON.

Detection Level Indicators (Green)
Displays the detection level.

SET Button
Used for teaching and threshold adjustments.

Threshold Indicators (Red)
Displays the threshold level.

Mode Selector
Selects the mode.

UP/DOWN Selector
Increases the threshold value when set to UP.
Decreases the threshold value when set to DOWN.

OUT

TEACH
ADJ
RUN

LEVEL

SET

E3M-VG11
LOT No 0178

Operation

■ **OUTPUT CIRCUITS**

NPN (E3M-VG11, E3M-VG21)

Main circuit

① Brown — 10 to 30 VDC

Load (See note.) Load

② White
Remote control input /Answer-back output

④ Black
Control output → 100 mA max.

③ Blue — 0 V
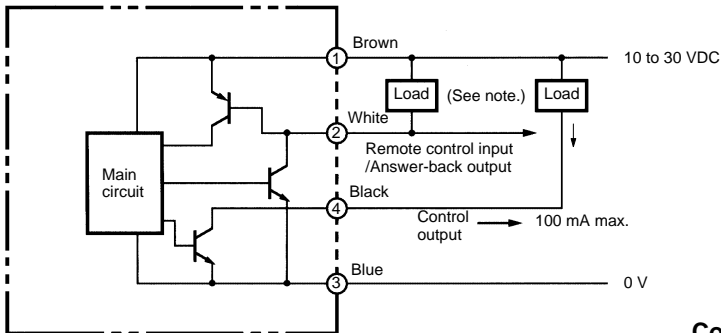
Connector Pin Arrangement

①
② ④
③

PNP (E3M-VG16, E3M-VG26)

Main circuit

① Brown — 10 to 30 VDC

④ Black
Control output →

Remote control input /Answer-back output

② White

Load (See note.) Load

③ Blue — 0 V
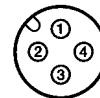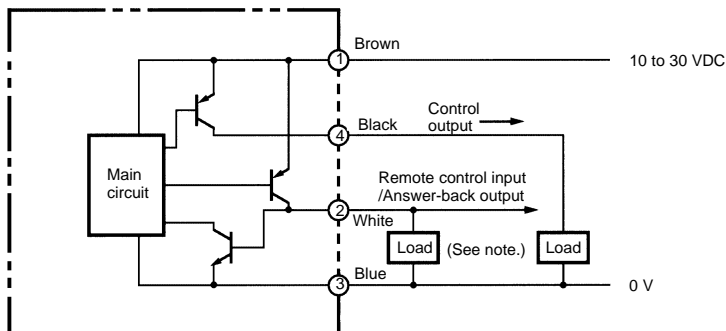
Note: Remote control input and answer-back output share the same line. Be sure to connect the load as shown above if the remote control function is used.

■ OPERATING PROCEDURE

Adjustment Steps

1. Install, wire, and turn ON the E3M-V.
2. Perform teaching (mark registration). Refer to *Mark Registration (Teaching)*.
3. Make fine adjustments of the threshold level if necessary. Refer to *Threshold Level Adjustments*.
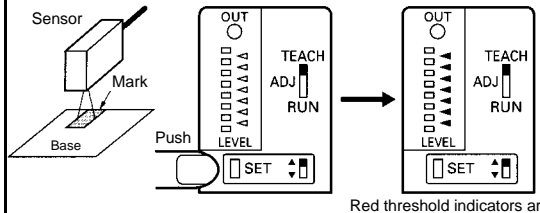4. Check that the mode selector is set to RUN.

Mark Registration (Teaching)

Refer to the following for ideal teaching.

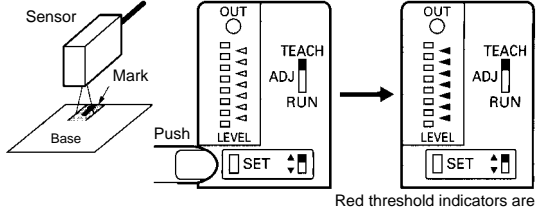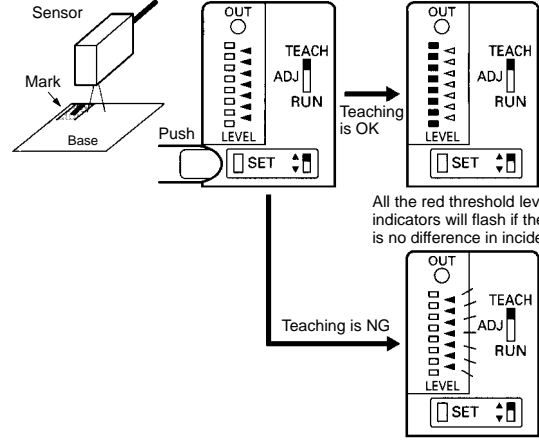| Application		
The base has a color pattern. The mark and base are clearly different in color.	The base has no color pattern. The mark and base are slightly different in color.	The base has no color pattern. Remote teaching with no positioning is desired.
↓	↓	↓
One-point teaching	Two-points teaching	Auto-teaching
The default level is set and the output is ON when the mark is detected.	The threshold level is set between the color of the mark and base. The output is ON when the mark is detected.	The threshold level is set between color of the mark and base. The output is ON when the mark (i.e., the color with shorter passing time) is detected.

Refer to the following for each teaching method. Remote one- or two-point teaching is possible. Refer to *Remote Control Function*.

One-point Teaching

1	Set the mode selector to TEACH.
2	Locate the mark to the sensing position and press the SET button. Then all the red threshold indicators are ON. Red threshold indicators are ON.
3	Set the mode selector to RUN. The output will be ON whenever the set mark is detected.

Note: By teaching on the base, reversed output as shown above (base: ON, mark: OFF) can be obtained.

Two-point Teaching

1	Set the mode selector to TEACH.
2	Locate the mark to the sensing position and press the SET button. All the red threshold indicators will turn ON. Red threshold indicators are ON.
3	If teaching is successful, move the mark and press the SET button at the base. • If teaching is successful, all the green detection level indicators are ON. • If teaching is unsuccessful, all the red threshold level indicators flash. Green detection level indicators are ON. All the red threshold level indicators will flash if there is no difference in incident.
4	If teaching is successful, set the mode selector to RUN to complete the teaching operation. If teaching is unsuccessful, restart from the above step 2.

Note: Follow the above steps so that the output will be turned ON whenever the mark is detected. By taking the opposite steps, the output will be turned OFF whenever the mark is detected and turned ON whenever the base is detected.

■ ADJUSTMENT STEPS

Auto-teaching

1. Check that the mode selector is set to either RUN or ADJUST.
2. Input a 0.9-s pulse signal into the remote control I/O terminal. (See Note.)
3. Auto-teaching starts when the mark is moved. When the mark passes six times, auto-teaching completes.
- If teaching is successful, answer-back output from the remote control I/O terminal will turn ON for 0.3 s.
- If teaching is unsuccessful, no answer-back signal will be output. Readjust using two-point teaching.
  (Teaching will be unsuccessful if there is no difference in incident between the mark and base.)
4. If the answer-back signal is ON, the whole teaching operation will be completed. The output will be turned ON whenever the mark (i.e., the color with shorter passing time) is detected.

Note: Make sure that the input tolerance of each pulse is within ±0.1 s.

Auto-teaching Illustration
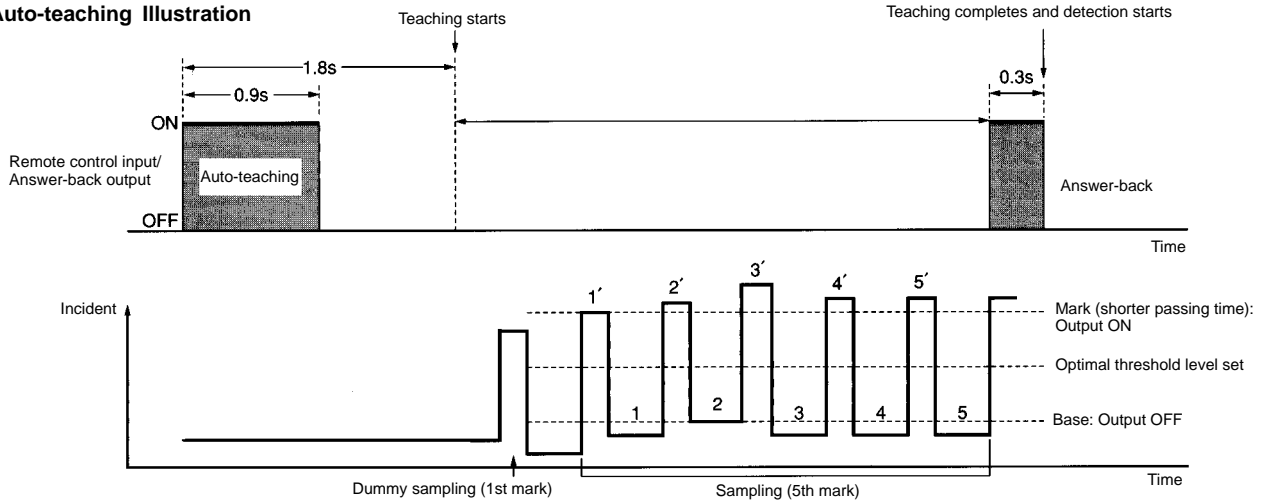
Example of Connection to Programmable Controller
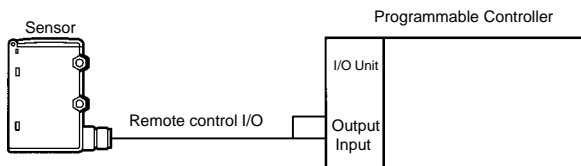
Note: Be sure to connect the E3M-V to the Programmable Controller as shown above.

Precautions when Using Automatic Teaching

Incorrect discrimination may be caused by automatic teaching in the following cases. Use one-point or two-point teaching in such cases.

- Color patterns exist in the base.
- Sensing objects change their positions.
- Sensing objects have protrusions or surface level differences.

Threshold Level Adjustments

It is possible to make fine adjustments of the threshold level after teaching. Such fine adjustments can be made remotely as well. Refer to *Remote Control Function*.

1	Set the mode selector to ADJUST.
2	Select the upper or lower threshold setting with the threshold selector. Whenever the SET button is pressed, the threshold level will move. Two indicators will be lit together when the threshold level is an even level.

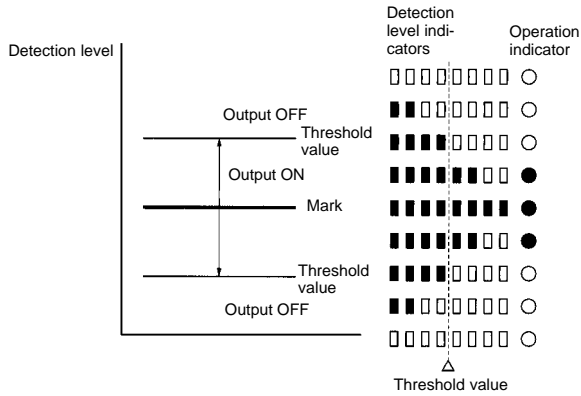| Threshold indicators												
Threshold level	1	2	3	4	5	6	7	8	9	10	11	12	13

3	After setting the level, set the mode selector to RUN.

Detection Level Indicator

The control output of the E3M-V will be turned ON if the detection level exceeds the threshold level. The indication of the detection level varies with the teaching method.

One-point Teaching

The upper and lower threshold values are set on the basis of the mark and the detection level indicators indicate the degree of color conformity to the mark's color.

Two-point or Auto-teaching

A single threshold value is set between the mark (registered first) and the base (registered next). The detection level indicators indicate the tolerance between the mark and base.
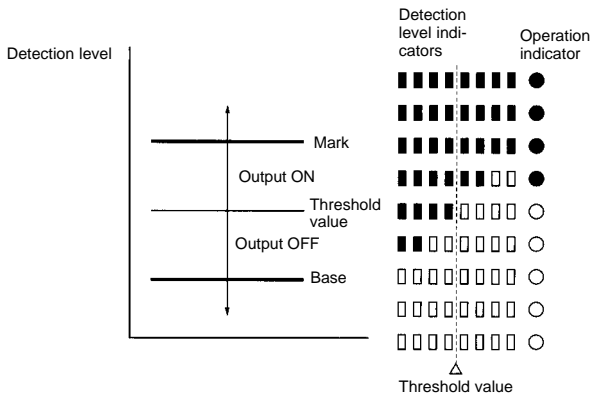
Remote Control Function (Bank Selection, Mark Registration, and Threshold Adjustments)

Under Run Mode or Adjust Mode

The input of any of the signals listed in the following table into the remote control I/O terminal allows remote control of the E3M-V. When the signal is accepted, answer-back output will be turned ON for 0.3 s. Only in the case of one-point teaching, however, can the signal be manually input, provided that the input is ON for 1.5 s or more.

Timing Chart
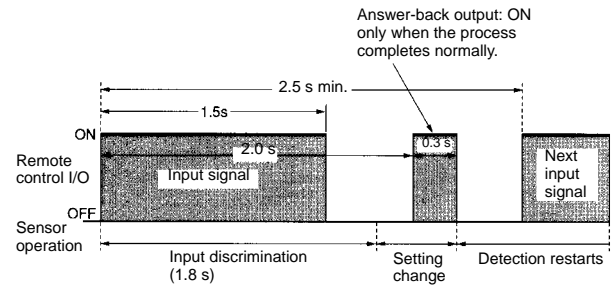
Note: If signals are sent continuously, make sure that there is an interval of 2.5 s between signal inputs as shown above.

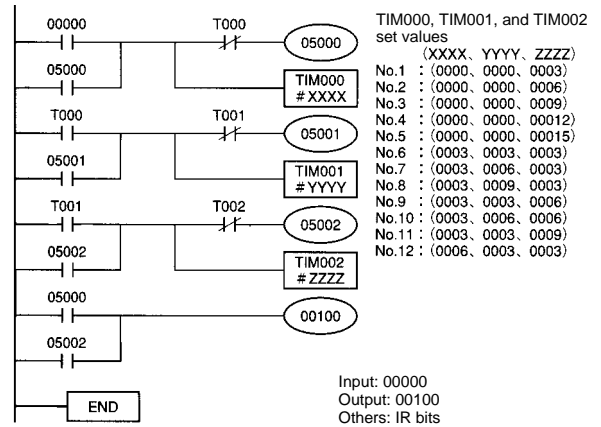## Control Signals

No.	Control signal	Function
1	ON — 0.3s / OFF	Bank 1 is selected (operation indicator OFF in TEACH mode)
2	ON — 0.6s / OFF	Bank 2 is selected (operation indicator ON in TEACH mode)
3	ON — 0.9s / OFF	Auto-teaching
4	ON — 1.2s / OFF	Two-point teaching (1st and 2nd)
5	ON — 1.5s / OFF	One-point teaching (or input for 1.5 s min.)
6	0.3s 0.3s 0.3s	Threshold level 1 is selected.
7	0.3s 0.6s 0.3s	Threshold level 3 is selected.
8	0.3s 0.9s 0.3s	Threshold level 5 is selected.
9	0.3s 0.3s 0.6s	Threshold level 7 is selected.
10	0.3s 0.6s 0.6s	Threshold level 9 is selected.
11	0.3s 0.3s 0.9s	Threshold level 11 is selected.
12	0.6s 0.3s 0.3s	Threshold level 13 is selected.

Note: The input error of each signal pulse must be within ±0.1 s.
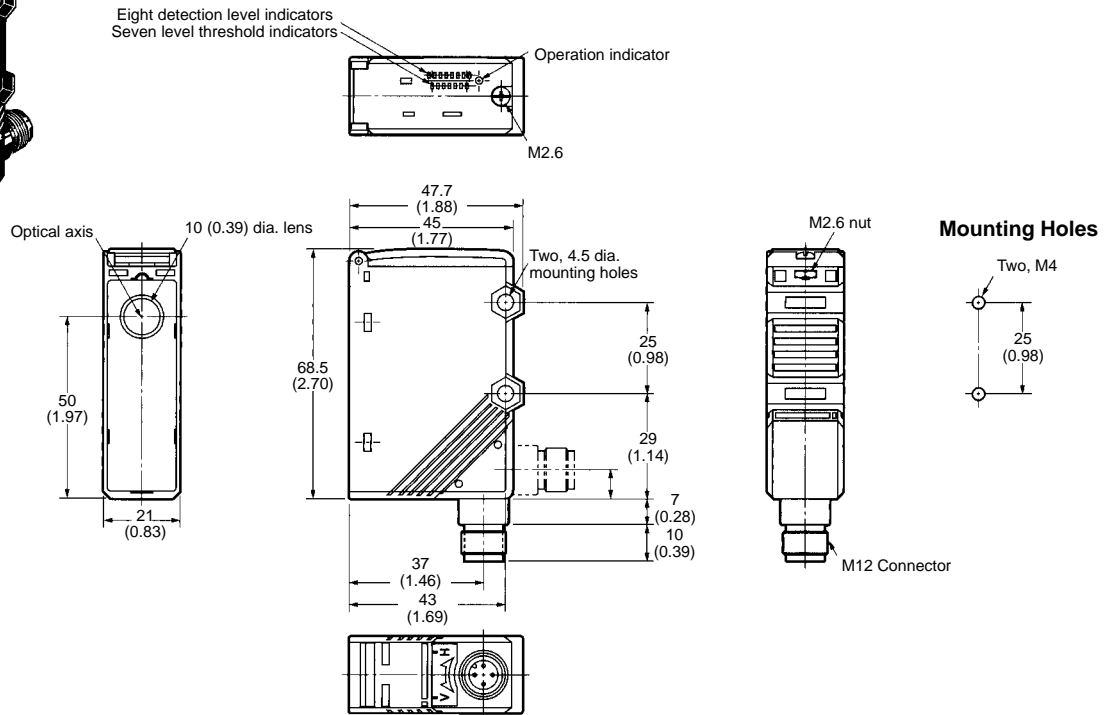
Ladder Program Example

Control signals are input by a ladder program as shown below.

TIM000, TIM001, and TIM002 set values
(XXXX、YYYY、ZZZZ)
No.1 : (0000、0000、0003)
No.2 : (0000、0000、0006)
No.3 : (0000、0000、0009)
No.4 : (0000、0000、00012)
No.5 : (0000、0000、00015)
No.6 : (0003、0003、0003)
No.7 : (0003、0006、0003)
No.8 : (0003、0009、0003)
No.9 : (0003、0003、0006)
No.10 : (0003、0006、0006)
No.11 : (0003、0003、0009)
No.12 : (0006、0003、0003)

Input: 00000
Output: 00100
Others: IR bits

Dimensions ———————————————————————————————

Unit: mm (inch)

■ COLOR MARK SENSORS

Eight detection level indicators
Seven level threshold indicators

Operation indicator

M2.6

Optical axis

10 (0.39) dia. lens

47.7
(1.88)

45
(1.77)

Two, 4.5 dia.
mounting holes

50
(1.97)

68.5
(2.70)

25
(0.98)

29
(1.14)

7
(0.28)

10
(0.39)

21
(0.83)

37
(1.46)

43
(1.69)

M2.6 nut

M12 Connector

Mounting Holes

Two, M4

25
(0.98)
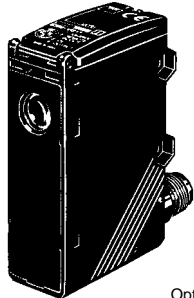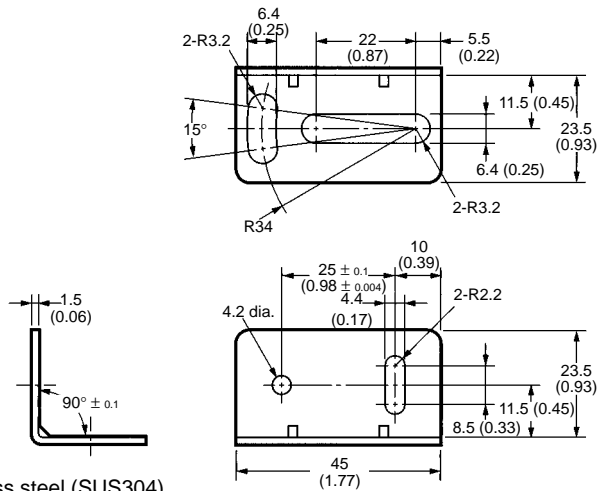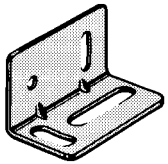
■ MOUNTING BRACKETS

E39-L131
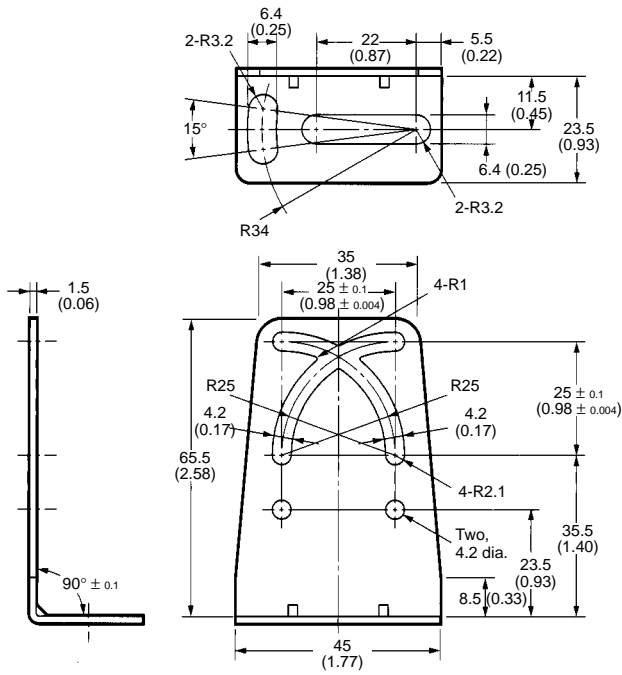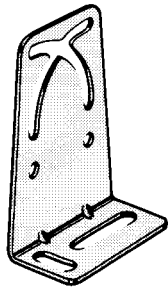
Material: Stainless steel (SUS304)

E39-L132
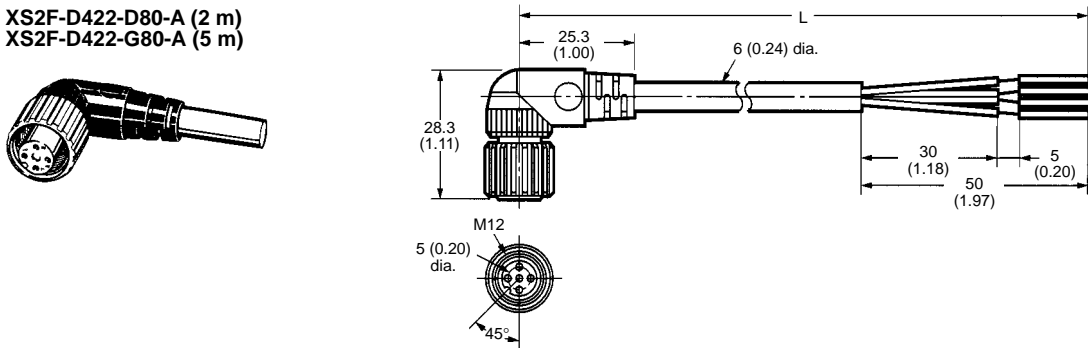
Material: Stainless steel (SUS304)

■ SENSOR CABLES

Single-end Connector (Straight Model)
Y96E43SD2 (2 m)
Y96E43SD5 (5 m)

M12
45°
5 (0.20) dia.
14.9 (0.59) dia.
6 (0.24) dia.
40.7 (1.60)
L
30 (1.18)
50 (1.97)
5 (0.20)
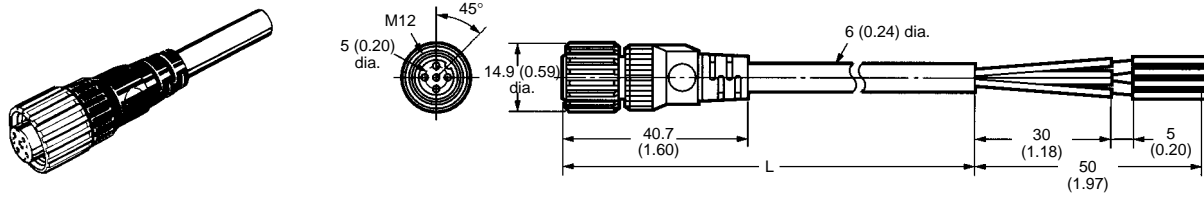
Single-end Connector (L-shaped Model)
XS2F-D422-D80-A (2 m)
XS2F-D422-G80-A (5 m)

L
25.3 (1.00)
6 (0.24) dia.
28.3 (1.11)
30 (1.18)
50 (1.97)
5 (0.20)
M12
5 (0.20) dia.
45°

Installation ———————————————————————————————

■ SENSOR CABLE

Pin No.
Cord wire colors
① Brown
②
③ Blue
④ Black
DC/AC
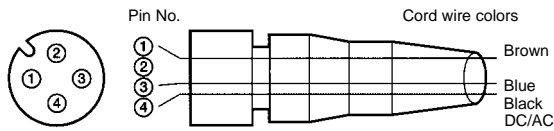
Classification	Wire color	Connector pin No.	Use
DC	Brown	1	(+V)
	White	2	Remote control
	Blue	3	(0V)
	Black	4	Output

Precautions ────────────

■ SAFETY

Observe the following precautions to ensure safety.

- Do not use the Sensor in locations subject to flammable or explosive gases.
- Do not use the Sensor in water or conductive solution.
- Do not disassemble, repair, or modify the Sensor.
- Use the Sensor under proper power supply specifications such as the use of AC or DC power supply.
- Do not apply any voltage or current exceeding the rated level.
- Be careful with the power supply polarities and wire correctly.
- Connect the loads correctly.
- Do not short-circuit both ends of loads.

■ INSTALLATION AND USE

Power Reset Time

Since the E3M-V is ready to detect objects from 100 ms max. after the E3M-V is turned ON, operate the remaining devices 100 ms after the Sensor is turned ON. If power is supplied to the E3M-V and the load independently, be sure to turn on the E3M-V first.

Power OFF

The E3M-V may output a single pulse when the control power supply is turned OFF. If the E3M-V is connected to a timer or counter to which power is supplied from an independent power supply, the E3M-V will be more likely to output a single pulse when the control power supply is turned OFF. For this reason, supply power to the timer or counter from the same power supply for the E3M-V.

Power Supply Type

Supply voltage ripple must not exceed rated percentage.

Power Supply Connection

Be sure to ground the FG (frame ground) and G (ground) terminals if a switching regulator is connected to the E3M-V to avoid malfunction due to the switching noise of the switching regulator.

■ WIRING

Cable

- The cable can be extended up to 100 m provided that the thickness of the cable is 0.3 mm^2 minimum.
- The cable must not be bent repeatedly.
- Do not pull cables with pulling forces exceeding 50N (11.24 lb).

High-tension Lines

To avoid damage and malfunctioning due to induction noise, wire sensor power lines in a separate conduit from any power lines or high tension lines.

■ MOUNTING

Screw Tightening

Make sure that the casing is tightened to a maximum torque of 1.2 N • m.

Mounting Direction

When Sensors are mounted to face each other, make sure to adjust the optical axes to avoid mutual interference.

■ EEPROM WRITE ERROR

An EEPROM error may result if power supply to the Sensor fails or the Sensor is influenced by static noise, and the threshold level indicators will flash. Perform the teaching and threshold level setting of the E3M-V again.

■ M12 METAL CONNECTOR

- Turn off the E3M-V before connecting or disconnecting the metal connector.
- Make sure to hold the connector cover when connecting or disconnecting the metal connector.
- Tighten the metal connector securely by hand. To avoid damage, do not use any tool, such as pliers.
- If the metal connector is not tightened securely, it may be disconnected by vibration, and the proper degree of protection of the E3M-V may not be maintained.

NOTE: DIMENSIONS SHOWN ARE IN MILLIMETERS. To convert millimeters to inches divide by 25.4.

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