

Color Mark Sensor with Teach Function

E3M-V

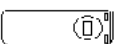
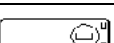
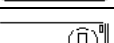
High-speed Registration Mark Detection

- Fast 50 μ s 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



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 $\pm$ 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

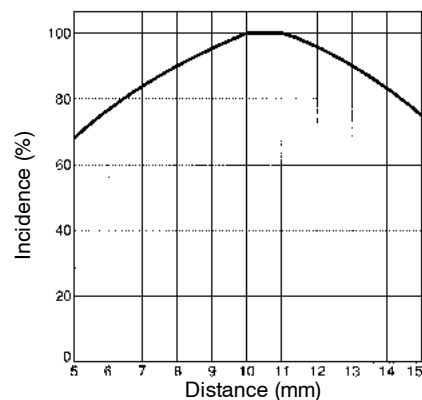
Part number	E3M-VG11	E3M-VG21	E3M-VG16	E3M-VG26
Method of detection	Diffuse type			
Supply voltage	10 to 30 VDC, 10% ripple max. (p-p)			
Current consumption	100 mA max.			
Sensing distance	10 ± 3 mm			
Spot size (W x H) and orientation	1 x 4 mm 	4 x 1 mm 	1 x 4 mm 	4 x 1 mm 
Light source (wavelength)	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/s ² for 2 hrs each in X, Y, and Z axes With bracket attached: 0.75-mm double amplitude or 100 m/s ²			
Shock resistance	500 m/s ² 3 times each in X, Y, and Z axes. With bracket attached: 300 m/s ²			
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

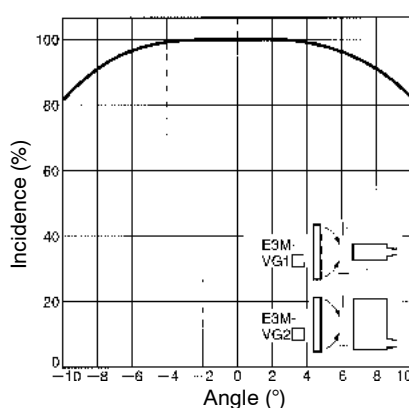
SENSING DISTANCE VS. INCIDENT CHARACTERISTICS (TYPICAL)

E3M-VG1□



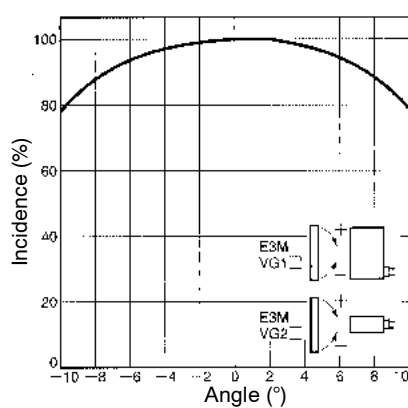
ANGLE VS. INCIDENT CHARACTERISTICS (X DIRECTION)

E3M-VG1□/VG2□



ANGLE VS. INCIDENT CHARACTERISTICS (Y DIRECTION)

E3M-VG1□/VG2□



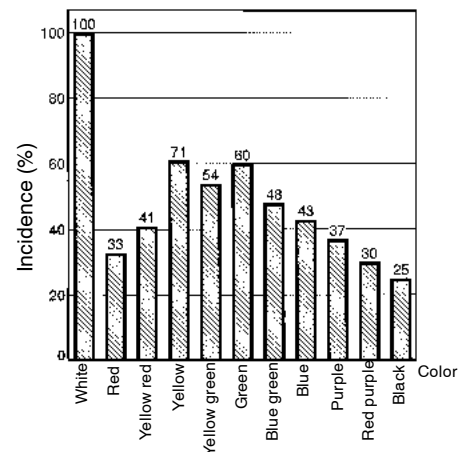
COLOR SENSING BACKGROUND VS. COLOR MARK

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

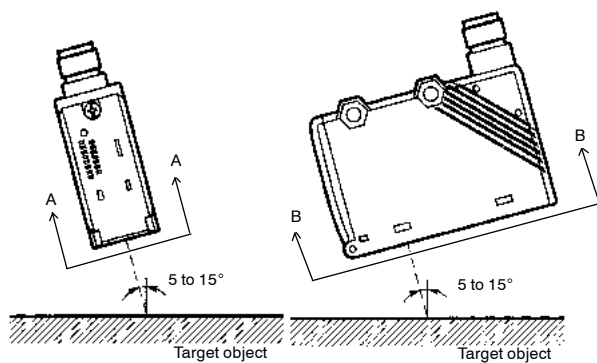
DIFFERENCES IN INCIDENT BY COLOR



■ INSTALLATION

Glossy Target Objects

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



E3M-VG1 □



View AA

E3M-VG2 □



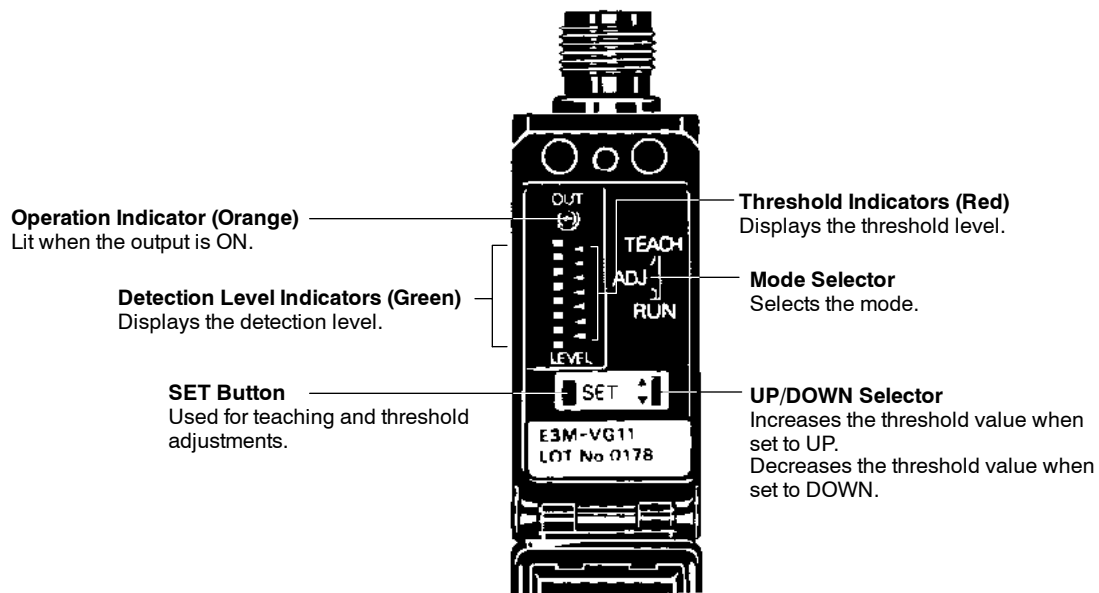
View BB

■ 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

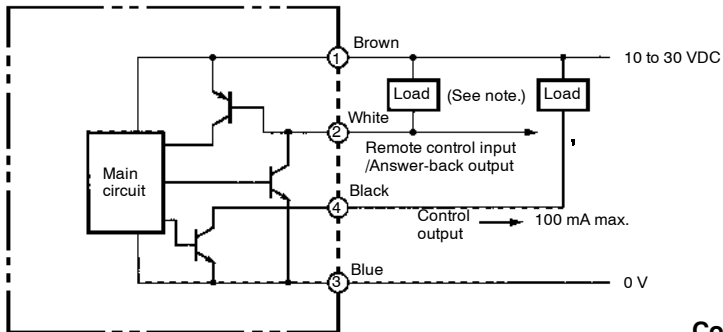
■ E3M-V SENSOR



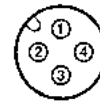
Operation

■ OUTPUT CIRCUITS

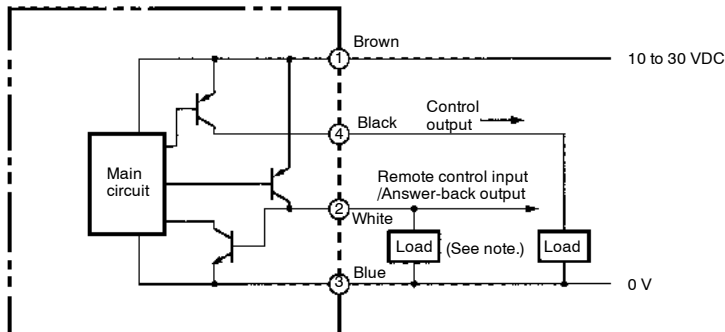
NPN (E3M-VG11, E3M-VG21)



Connector Pin Arrangement



PNP (E3M-VG16, E3M-VG26)



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)

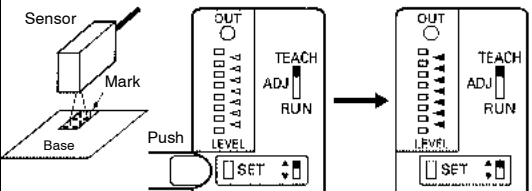
Refer to the following for ideal teaching.

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.

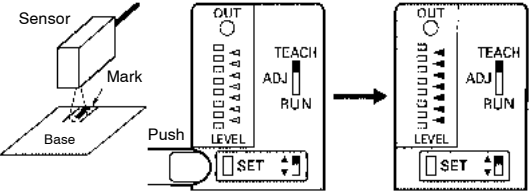
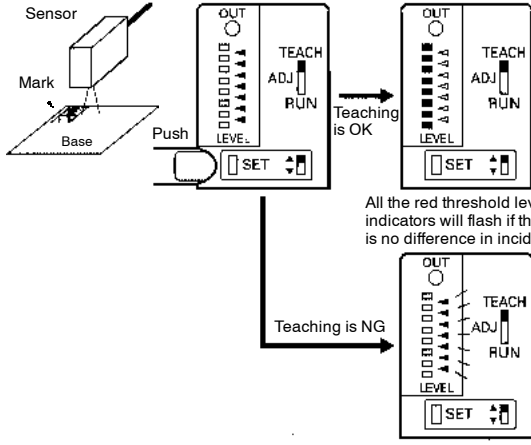
Refer to the following for each teaching method. Remote one- or two-point teaching is possible. Refer to *Remote Control Function*.

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. Teaching is OK Teaching is NG 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.

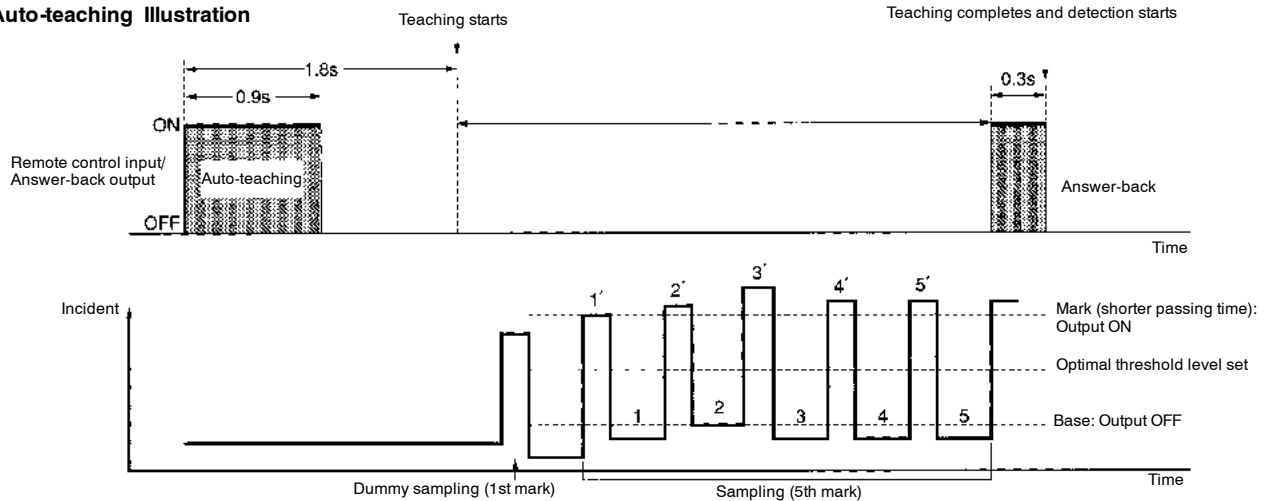
ADJUSTMENT STEPS

Auto-teaching

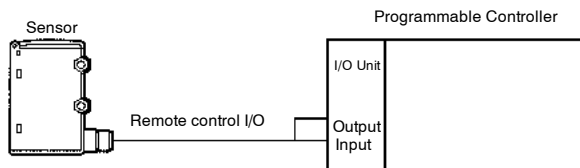
1. Check that the mode selector is set to either RUN or ADJUST.
2. Input a 0.9-s pulse signal into the remote control I/O terminal. (See Note.)
3. Auto-teaching starts when the mark is moved. When the mark passes six times, auto-teaching completes.
 - If teaching is successful, answer-back output from 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.

The threshold level increases.

The threshold level decreases.

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

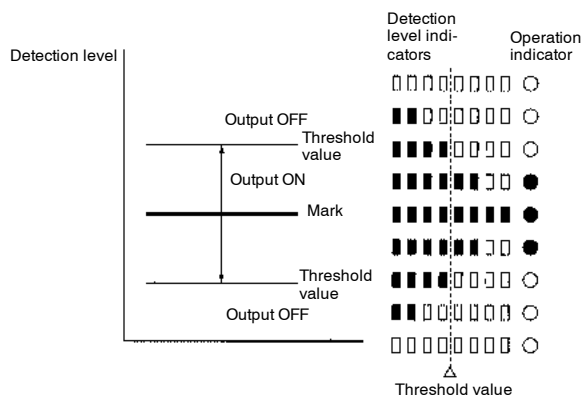
3 After setting the level, set the mode selector to RUN.

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.

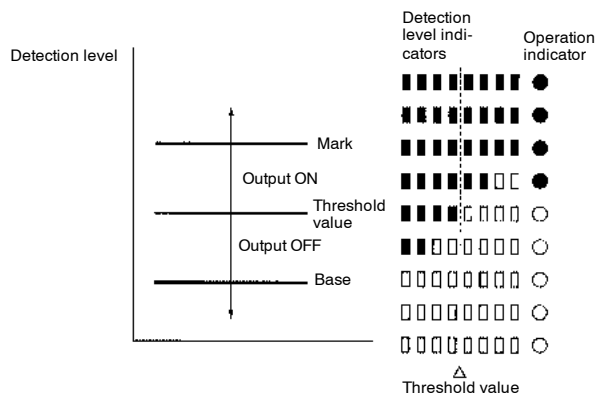
One-point Teaching

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.

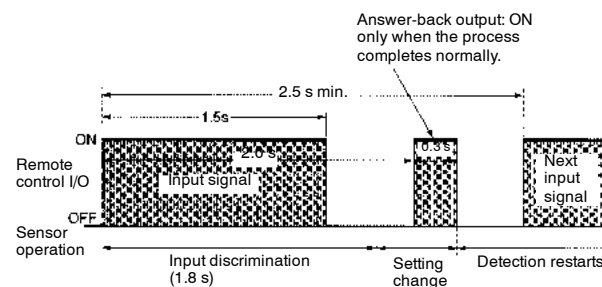


Remote Control Function (Bank Selection, Mark Registration, and Threshold Adjustments)

Under Run Mode or Adjust Mode

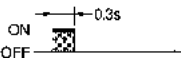
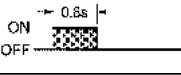
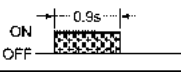
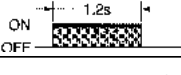
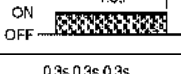
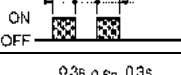
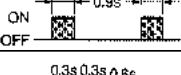
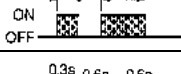
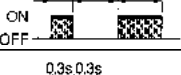
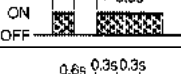
The input of any of the signals listed in the following table into the remote control I/O terminal allows remote control of the E3M-V. When the signal is accepted, answer-back output will be turned ON for 0.3 s. Only in the case of one-point teaching, however, can the signal be manually input, provided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

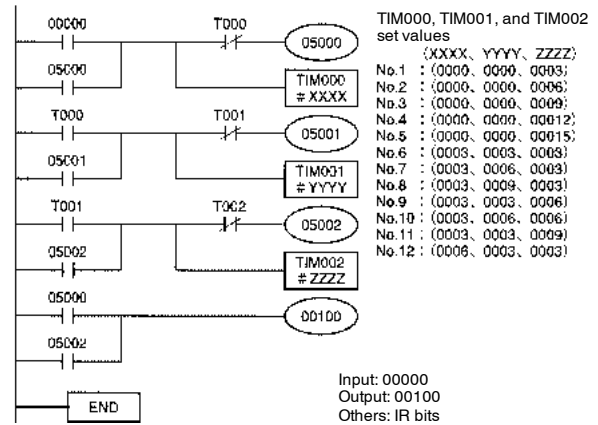
Control Signals

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

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

Ladder Program Example

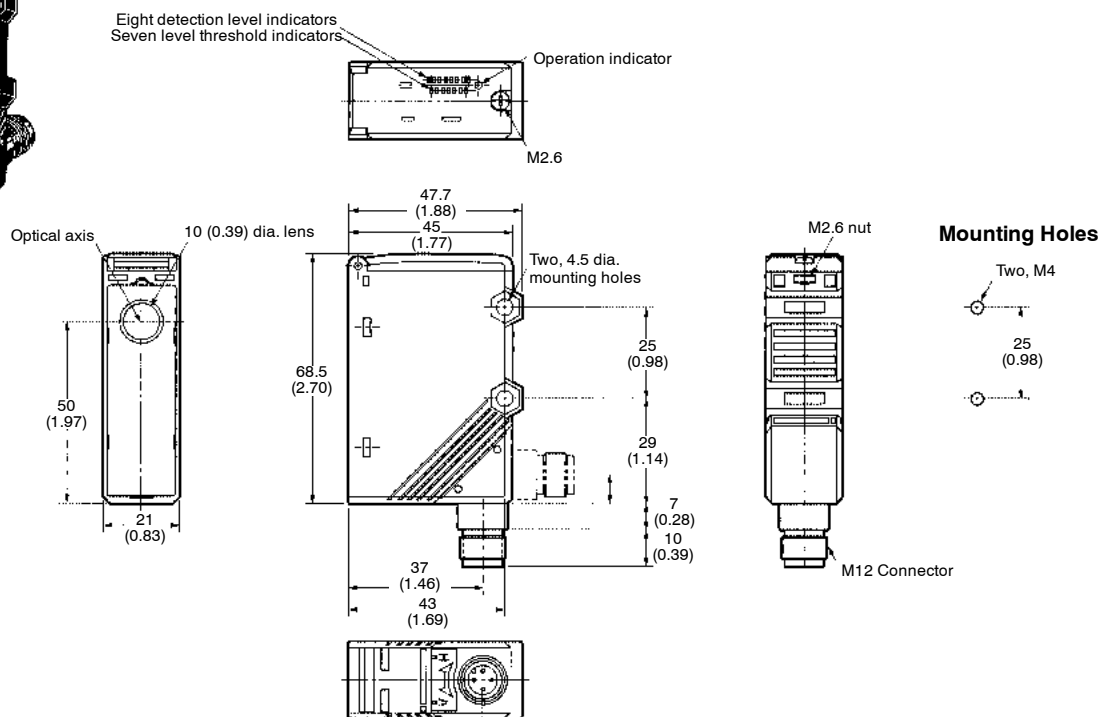
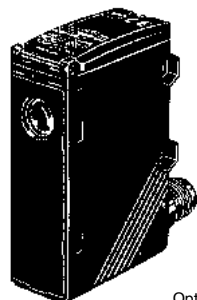
Control signals are input by a ladder program as shown below.



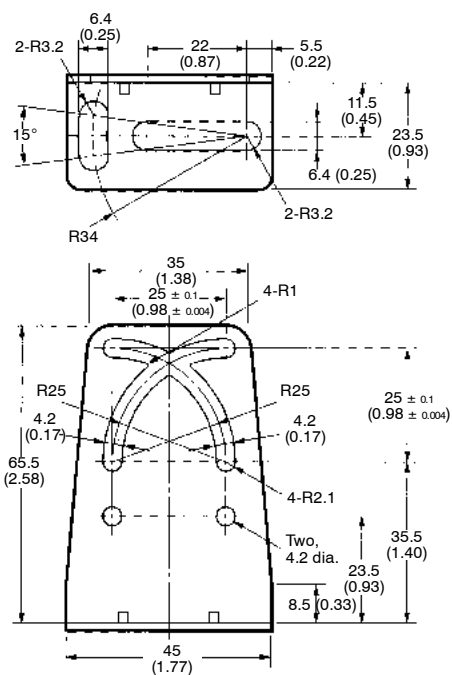
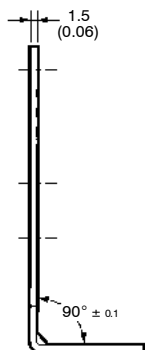
Dimensions

Unit: mm (inch)

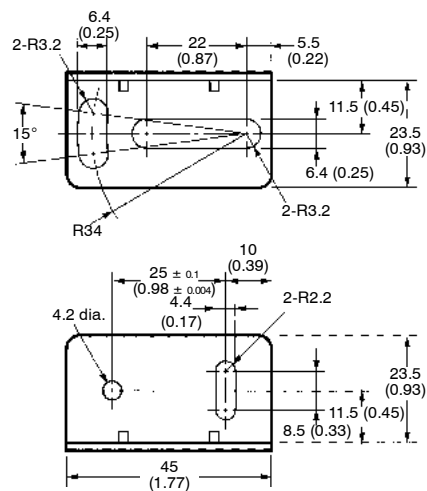
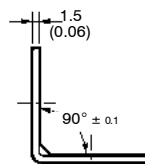
■ COLOR MARK SENSORS



E39-L131



Material: Stainless steel (SUS304)



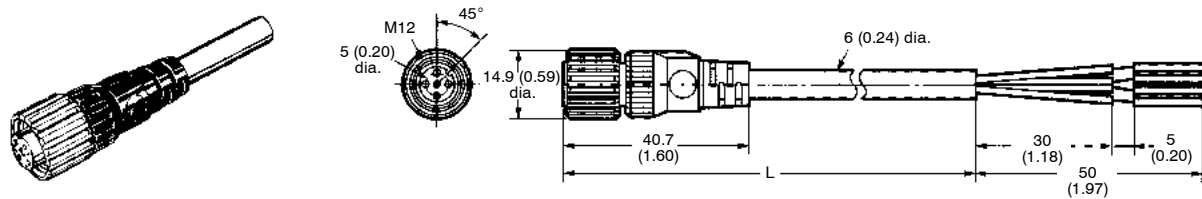
Material: Stainless steel (SUS304)

■ SENSOR CABLES

Single-end Connector (Straight Model)

Y96E43SD2 (2 m)

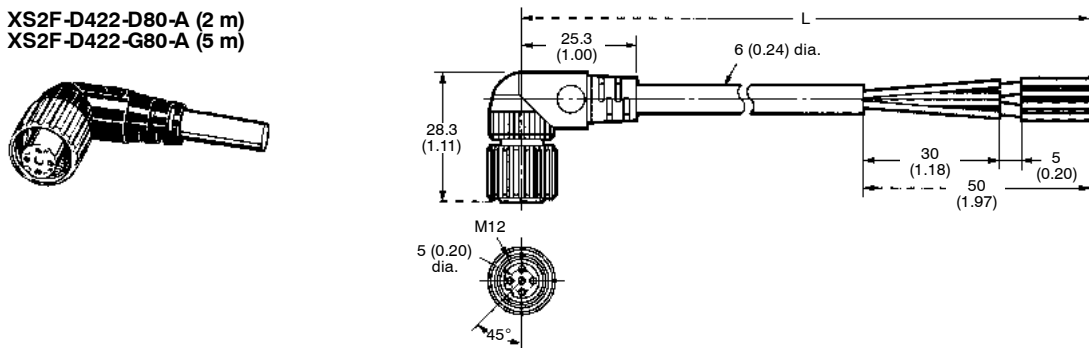
Y96E43SD5 (5 m)



Single-end Connector (L-shaped Model)

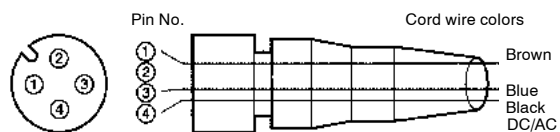
XS2F-D422-D80-A (2 m)

XS2F-D422-G80-A (5 m)



Installation

■ SENSOR CABLE



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 mm² 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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