

An Innovative Glossy Object Sensor with Optical Technology Discriminates an Array of Glossy Objects

- Employs OMRON's unique FAO (Free Angle Optics) technology which enables delicate sensing of object glossiness without influence from colors and patterns.
- Easily senses minute objects within a sensing spot that is 2 mm in diameter (short-range models).
- Two types of Fiber Unit (10-mm short-range and 20-mm long-range models) can be used for wide range of applications.
- Incorporates a mutual interference preventive function, enabling operation of multiple closely mounted models without mutual interference.
- Incorporates an easy-to-use teaching function.



Ordering Information


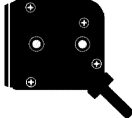
■ Amplifier Units

Model	E3X-NL11
Appearance	
Light source	Red LED ($\lambda = 680 \text{ nm}$)
Power supply voltage	12 to 24 VDC $\pm 10\%$, ripple (p-p) 10% max.
Current consumption	100 mA max.
Response time	1 ms
Control output	30-VDC NPN open collector output, load current: 100 mA, residual voltage: 1 V max.
Timer function (see note 1)	OFF-delay timer (fixed to 40 ms)
Remote teaching input	Pink and blue (0 V) wires are short-circuited when remote input is ON. (0 V short-circuit current: 1 mA max.) Pink and blue (0 V) wires are not short-circuited when remote input is OFF. (Open or 9 V min.; max. input voltage: 24 V)
Answer-back output	30-VDC NPN open collector output, load current: 100 mA, residual voltage: 1 V max.
Output	Light ON and Dark ON switch selectable

- Note:**
1. It is possible to disable the OFF-delay timer function by using the switch setting.
 2. Before using the product under conditions not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment, and other systems, machines, and equipment that may have a serious influence on lives and property if used improperly, consult your OMRON representative. Make sure that the ratings and performance characteristics of the product are good enough for the systems, machines, and equipment, and be sure to provide the systems, machines, and equipment with double safety mechanisms.

■ Fiber Unit

Reflective Sensors

Characteristics	Short-range small spot		Long-range	
Model	E32-S15-1	E32-S15-2	E32-S15L-1	E32-S15L-2
Appearance				
Standard object	Glossy plastic and light paper			
Fiber length	50 cm (No cutting possible)	100 cm (No cutting possible)	50 cm (No cutting possible)	100 cm (No cutting possible)
Sensing distance	10±3 mm		20±7 mm	
Min. sensing object	0.5-mm		2-mm	

Specifications

■ Ratings/Characteristics


Amplifier Unit

Model	E3X-NL11
Indicator	Orange LED: Lit during output operation Green LED: Lit with stable operation
Circuit protection	Reverse polarity, Output short-circuit
Ambient illumination	Sunlight: 10,000 lx max.; Incandescent lamp: 3,000 lx max.
Ambient temperature	Operating: -25°C to 55°C (with no icing) Storage: -40°C to 70°C (with no icing)
Ambient humidity	Operating: 35% to 85% (with no condensation)
Insulation resistance	20 MΩ min. (at 500 VDC)
Dielectric strength	1,000 VAC, 50/60 Hz for 1 min
Vibration resistance	10 to 55 Hz, 1.5-mm double amplitude or 300 m/s ² (approx. 30G) for 2 hrs each in X, Y, and Z directions
Shock resistance	500 m/s ² (approx. 50G) for 3 times each in X, Y, and Z directions
Enclosure rating	IEC IP50 (with protective cover in place)
Material	Case: PBT; Cover: Polycarbonate
Connection method	2-m cord-drawing method V _{cc} : Brown 0 V: Blue Control output: Black Remote teaching input: Pink, purple Answer-back output: Orange
Weight (with 2-m cord)	Approx. 200 g

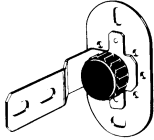
Fiber Unit Reflective Sensors

Characteristics	Short-range small spot	Long-range small spot
Model	E32-S15-1/E32-S15-2	E32-S15L-1/E32-S15L-2
Sensing object angle	Glossiness determination is possible with $\pm 4^\circ$ inclination from the mounting hole (at a sensing distance of 10 mm).	Glossiness determination is possible with $\pm 7^\circ$ inclination from the mounting hole (at a sensing distance of 20 mm).
Spot diameter	Approx. 2 mm (at a sensing distance of 10 mm)	Approx. 15 mm (at a sensing distance of 20 mm)
Ambient temperature	Operating: -25°C to 55°C (with no icing)	
Ambient humidity	Operating: 35% to 85% (with no condensation)	
Permissible bending radius	4 mm min.	
Material	Sensor case: heat-resistant ABS plastic Sensor window: transparent glass (short-range models), acrylic (long-range models) Fiber cladding: urethane	
Enclosure rating	IEC IP50	
Weight	Approx. 40 g max.	Approx. 60 g max.

Accessories

Name	Protective Cover
Model	E39-G9
Appearance	
Applicable Amplifier	E3X-NL11

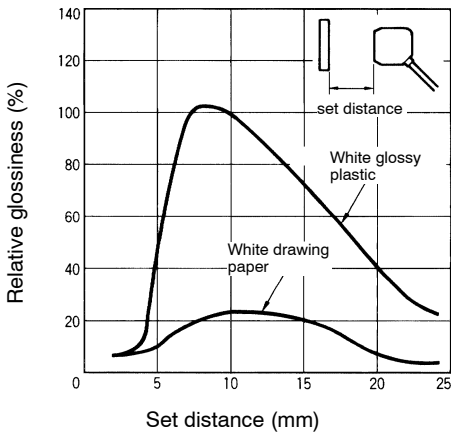
Note: One protection cover is provided with each amplifier.

Name	Rotating fiber unit mounting bracket (sold separately)
Model	E39-L109
Appearance	
Application	Rotates to an angle of 0° or 45° enables sensing of double-reflective objects including transparent films on glossy objects, such as metal or glass plates. Refer to page 8 Technical Guide for details
Applicable fiber	E32-S15-□

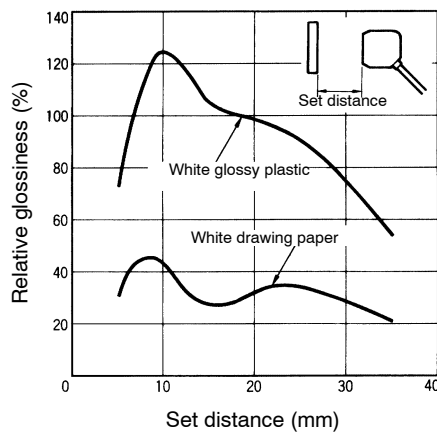
Engineering Data

■ Glossiness vs. Operating Range (Typical)

E3X-NL11 with E32-S15-□

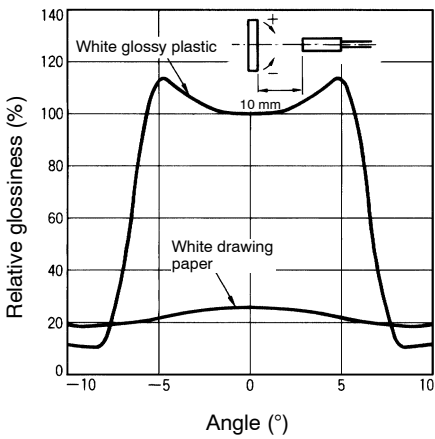


E3X-NL11 with E32-S15L-□

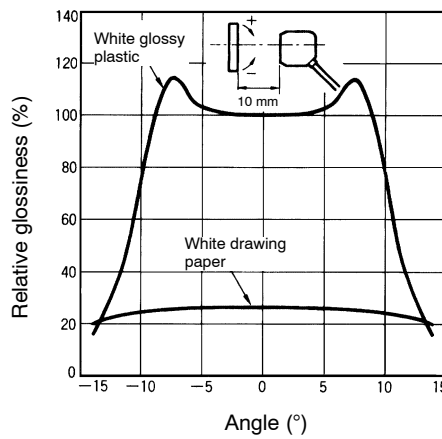


■ Glossiness vs. Angle (Typical)

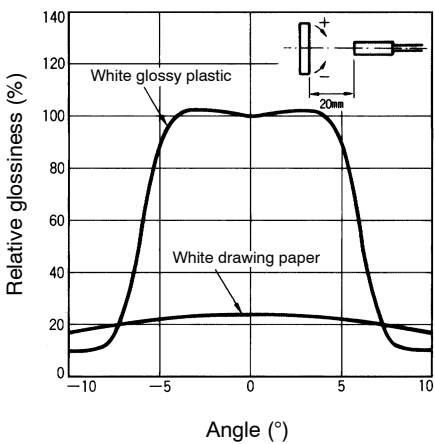
E3X-NL11 with E32-S15-□ (X direction)



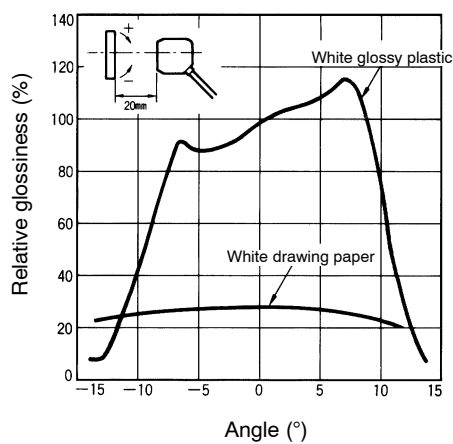
E3X-NL11 with E32-S15-□ (Y direction)



E3X-NL11 with E32-S15L-□ (X direction)

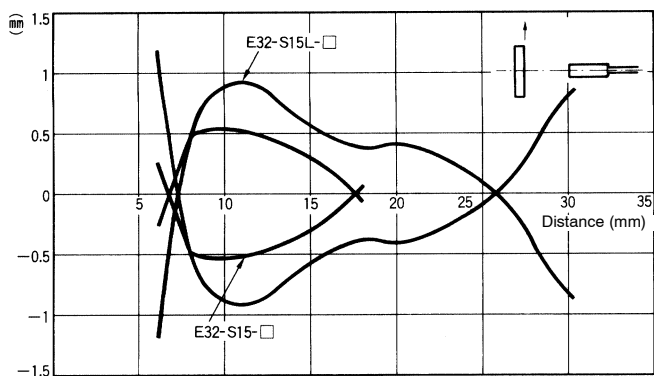


E3X-NL11 with E32-S15L-□ (Y direction)



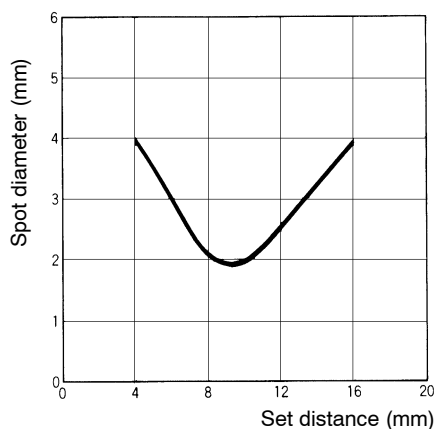
■ Operating Range (Typical)

E3X-NL11 with E32-S15-□/-S15L-□
(Sensing Object: White Glossy Plastic)

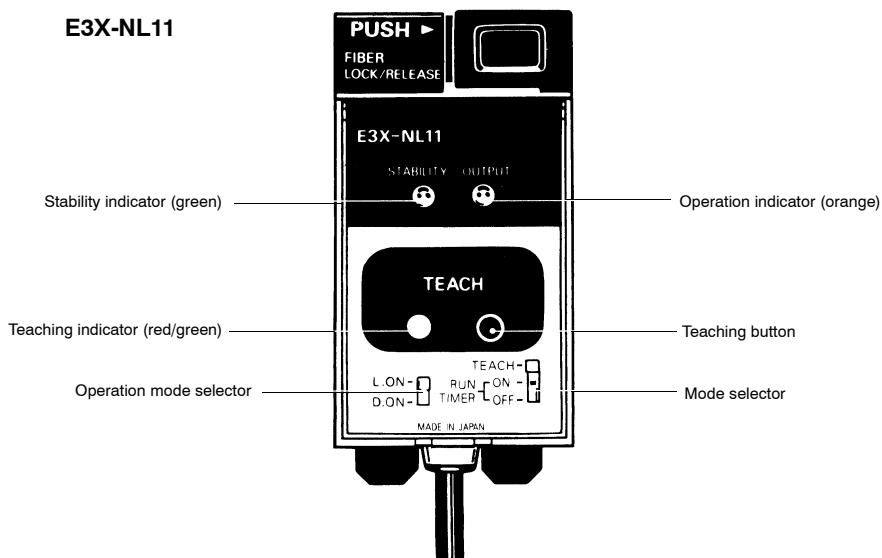


■ Spot Diameter

E3X-NL11 with E32-S15-□



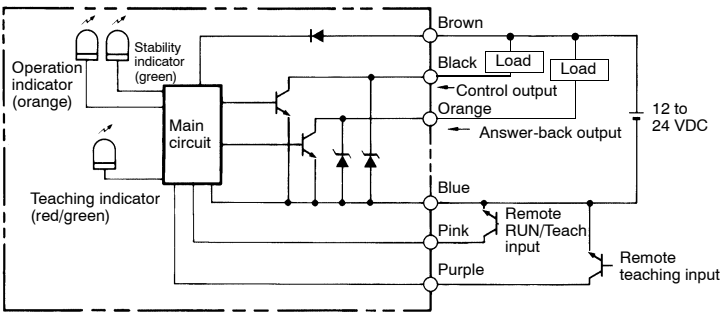
Nomenclature



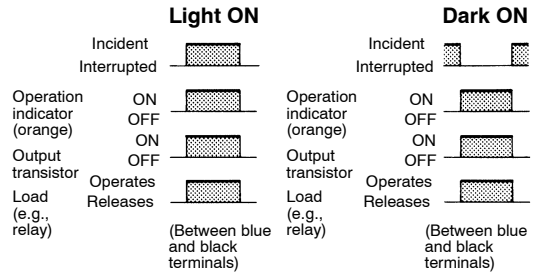
Operation

Output Circuits

E3X-NL11



Timing Chart



Two-point Teaching and One-point Teaching

Refer to the following information to select the most suitable sensitivity setting method for the application.

Sensitivity setting method	Two-point teaching	One-point teaching
Difference	Two-point teaching can be performed for the sensing of most sensing objects. In this teaching method, the fuzzy teaching function will automatically set the algorithmic value to the most suitable value for the sensing object and the operating level will be set midway between the two teaching points.	One-point teaching should be performed for the sensing of different objects on a single background object or a single type of objects on a variety of glossy background objects. The operating level will be set 15% above or below the teaching point, depending on the glossiness of the first sensing object. One-point teaching disables the fuzzy teaching function.

Selection of Teaching Point(s)

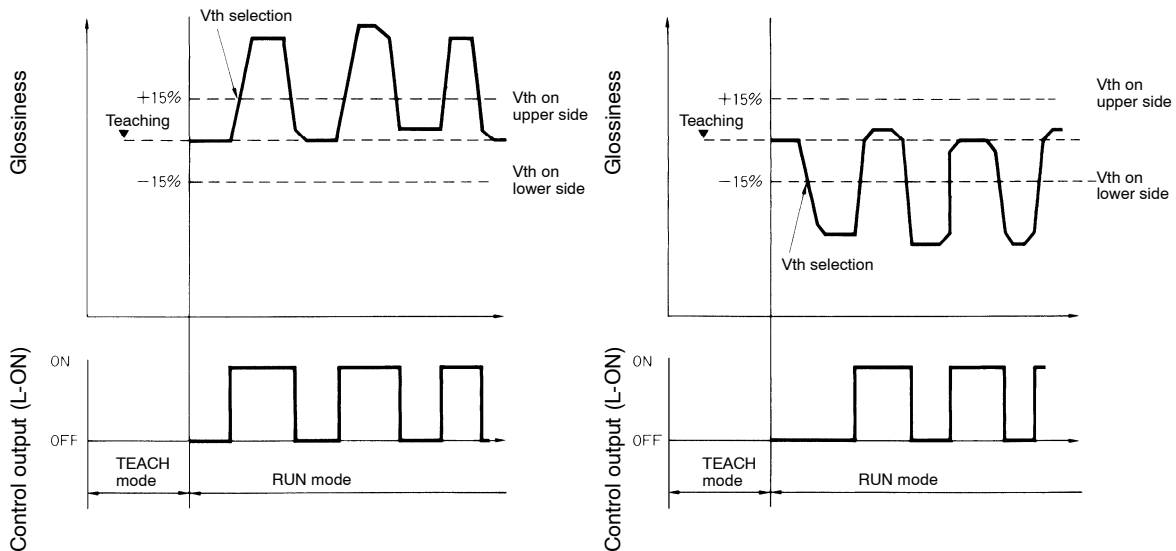
Two-point Teaching

If the E3X-NL is used to sense sensing objects that are only a little different in glossiness from the background object and the sensing objects have color patterns, the difference in glossiness among the inks on the sensing objects may influence the sensing operation of the E3X-NL. Therefore perform two-point teaching with the E3X-NL at a place where the E3X-NL can sense the sensing objects smoothly while considering the characteristics of glossiness versus distance of the E3X-NL if the sensing position of each of the sensing objects is different from each other.

One-point Teaching

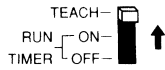
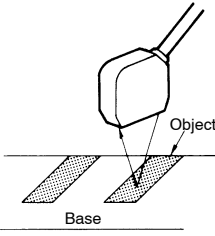
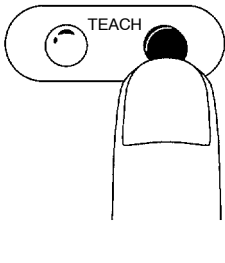
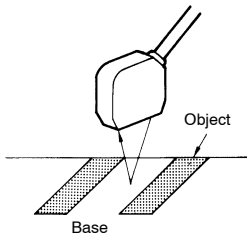
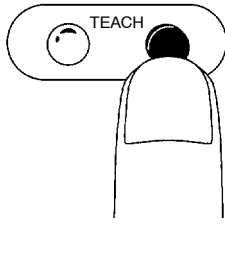
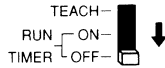
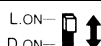
If the E3X-NL is used to sense sensing objects different from each other in glossiness on a single background object, perform one-point teaching with the E3X-NL using the background object. If the E3X-NL is used to sense identical sensing objects on a variety of glossy background objects, perform one-point teaching with the E3X-NL using one of the sensing objects.

Operation Level Setting and Control Output for One-point Teaching

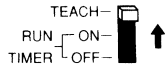
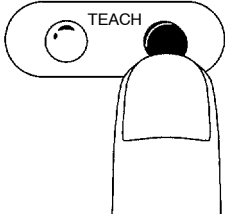
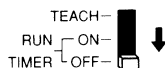



■ Sensitivity Setting

Two-point Teaching

Procedure	Operation	E3X-NT
1	Locate the sensor head within the sensing distance.	---
2	Set the mode selector to TEACH.	
3	<p>Press the teaching button once with a sensing object located under the sensor as shown in the following illustration.</p>  <p>The teaching indicator (red) is lit. The built-in buzzer beeps once.</p>	
4	<p>Press the teaching button once again without a sensing object located under the sensor as shown in the following illustration.</p>  <p>If teaching is OK: The teaching indicator (red) turns green. The built-in buzzer beeps once. If teaching is NG: The teaching indicator (red) starts flashing. The built-in buzzer beeps 3 times. Change the position of the object and the sensing distance that have been set and repeat from the beginning.</p>	
5	<p>Set the mode selector to RUN to complete the sensitivity setting.</p> <p>This will complete the setting of E3X-NL's sensitivity. The teaching indicator (green) is OFF.</p>	
6	Select the logical output required with the operation mode selector.	

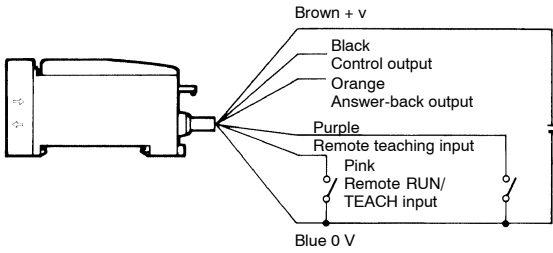
One-point Teaching

Procedure	Operation	E3X-NT
1	Set the mode selector to TEACH.	
2	<p>Press the teaching button with one of the sensing objects or the background object located under the sensor for sensing.</p> <p>The teaching indicator (red) is lit. The built-in buzzer beeps once.</p>	
3	<p>Set the mode selector to RUN.</p> <p>One-point teaching will be complete when the first object passes the sensing spot. The teaching indicator (red) turns green.</p>	
4	Select the logical output required with the operation mode selector.	

Remote Teaching Function

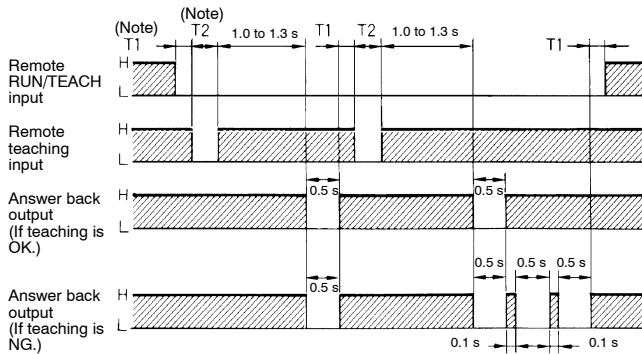
In remote teaching, the remote RUN/TEACH input signal is used for teaching instead of the mode selector and the remote teaching input signal is used instead of the teaching button.

1. Set the mode selector to RUN.
2. The following signal conditions must be given as remote teaching input conditions.

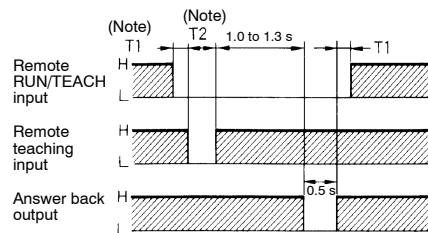


1. If there is a teaching error after performing remote two-point teaching with the E3X-NL, try performing remote two-point teaching again. If the remote RUN/TEACH input is set from L to H after the teaching error, the thresholds set with the E3X-NL will not be refreshed.
2. If remote teaching is not performed, cut the pink and purple wires at the base each or connect the pink and purple wires to the +V terminal and cut the orange wire at the base or connect the orange wire to the GND terminal.
3. After the remote teaching input setting is finished, the E3X-NL will be ready to sense objects in approximately one second.

Remote Two-point Teaching



Remote One-point Teaching



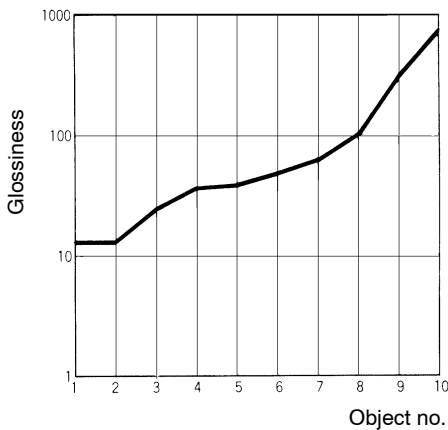
Note: T1 must be 20 milliseconds minimum and T2 must be 500 milliseconds minimum at the time of remote teaching.

Technical Guide

Glossiness

When a sensing object is illuminated, the light reflected by the sensing object includes regular reflective light and diffused reflective light. The glossiness of the sensing object increases in proportion to the amount of the regular reflective light. Japanese Industrial Standards (JIS) specify that the surface of a glass plate with a reflection factor of 1.567 has a glossiness value of 100.

Glossiness of Typical Objects sensed by E3X-NL11 with E32-S15-□

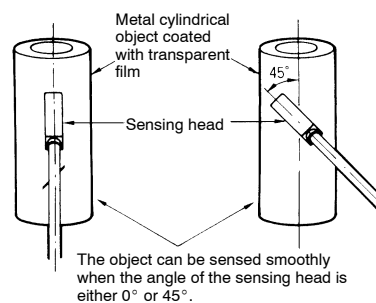


1. White drawing paper
2. Brown corrugated board
3. Gummed paper tape
4. White glossy paper (used to pack OMRON's sensors)
5. Blue label paper
6. Transparent label on blue sheet
7. Glossy plastic
8. Transparent glass (t = 1 mm)
9. Golden printing ink
10. Metal mirror (SUS mirror surface)

Sensing of Transparent Objects with Rotating Fiber Unit Mounting Bracket

There are transparent films and transparent plastic objects that change the direction of polarized light when it passes through the transparent films and transparent plastic objects. When the E3X-NL senses these transparent films and transparent plastic objects on glossy background objects, such as glossy paper or metals, the E3X-NL will not sense these objects smoothly if the angle of the sensor head is improper. The most suitable angle of the sensor head varies with the transparent object. The angle of the sensor head can be, however, 0° or 45° for the smooth sensing of such transparent objects due to the characteristic of polarized light. There is no need for the angle to be midway between 0° and 45°. The E39-L109, which is sold separately, is a mounting bracket that rotates to angles of 0° or 45° and enables the E3X-NL to sense such transparent objects smoothly with its sensing head set at 0° or 45° without changing the sensing position.

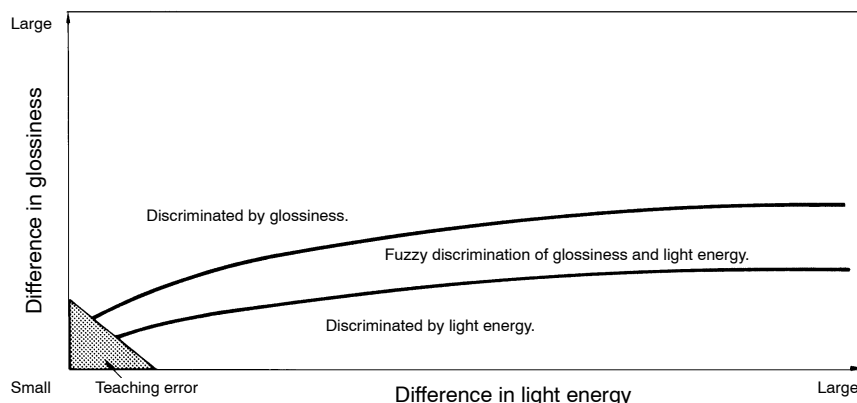
Example: Metal Cylindrical Object Coated with Transparent Film



Fuzzy Teaching Function

The E3X-NL in two-point teaching operation will perform fuzzy computation using the difference in glossiness and the difference in light energy between the two teaching points to determine the thresholds setting with the E3X-NL. As shown in the following table, if there is only a small difference in glossiness but there is a large difference in light energy between the two teaching points, the thresholds set with the E3X-NL will be determined by the light energy values.

Difference in glossiness between two teaching points	Difference in light energy between two teaching points	Discriminating method
Large	Large	Discriminated by glossiness.
Large	Small	Discriminated by glossiness.
Small	Large	Discriminated by light energy.
Small	Small	Discriminated by glossiness. A teaching error will result if the difference in glossiness and that in light energy are less than the sensing levels of the E3X-NL.



Countermeasures against Teaching Errors Resulted with Transparent Labels on Sheets

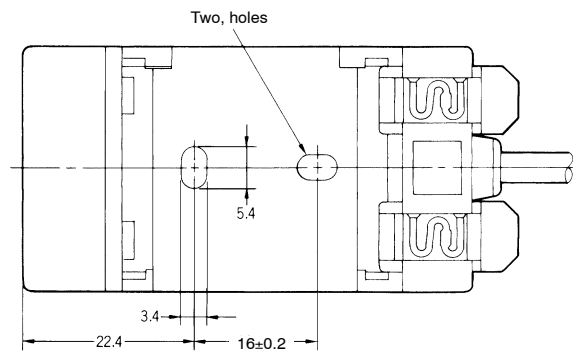
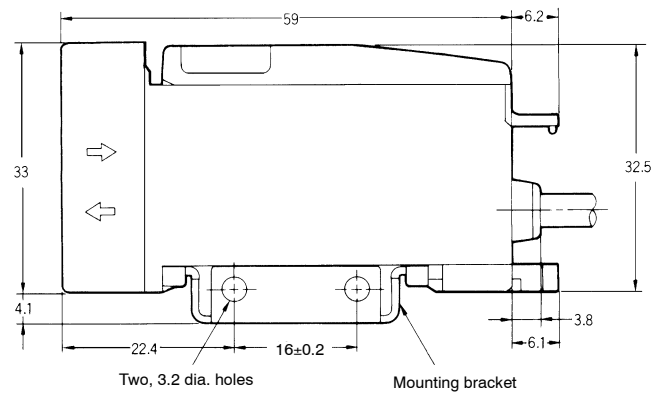
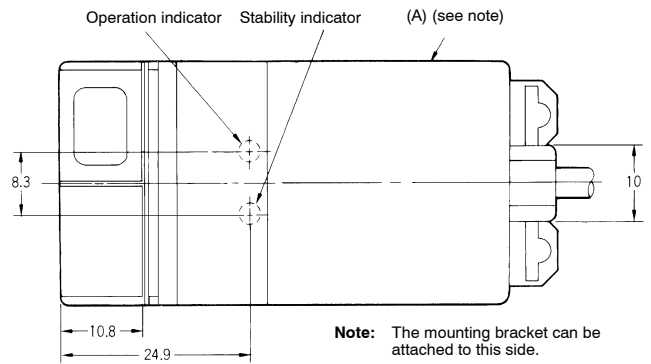
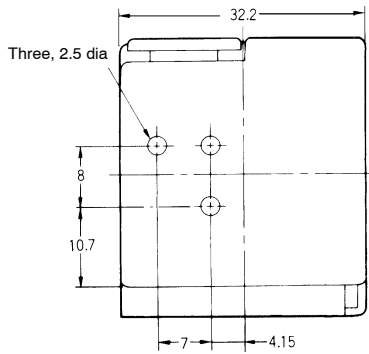
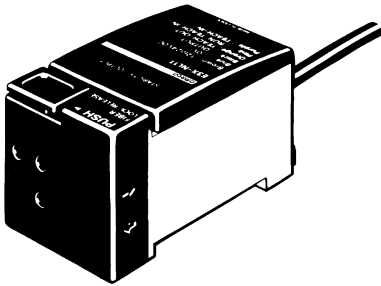
The material of the sheets must not be too glossy.

Dimensions

Note: All units are in millimeters unless otherwise indicated.

■ Amplifier Units

E3X-NL11

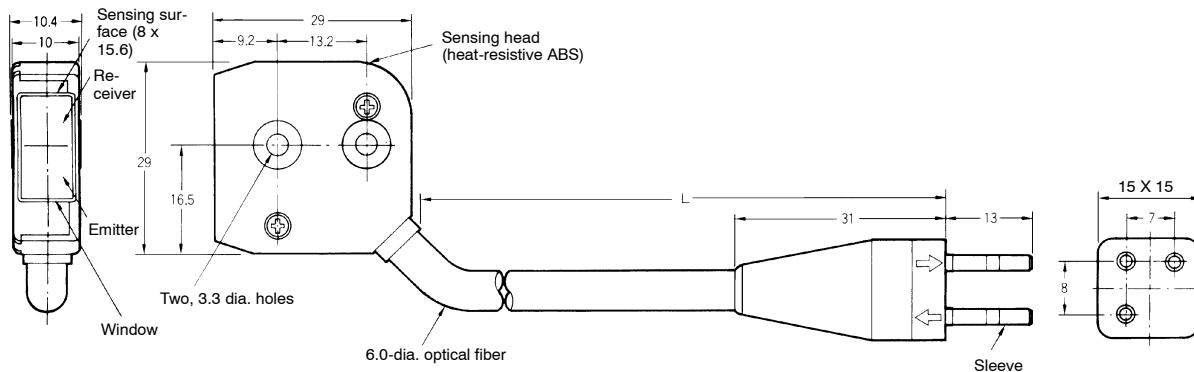


Cord: Polyvinyl chloride-covered cord
 4-mm dia. (0.08 dia x 40), 6 cores
 Standard length: 2 m

Weight: Approx. 200 g

■ Fiber Units

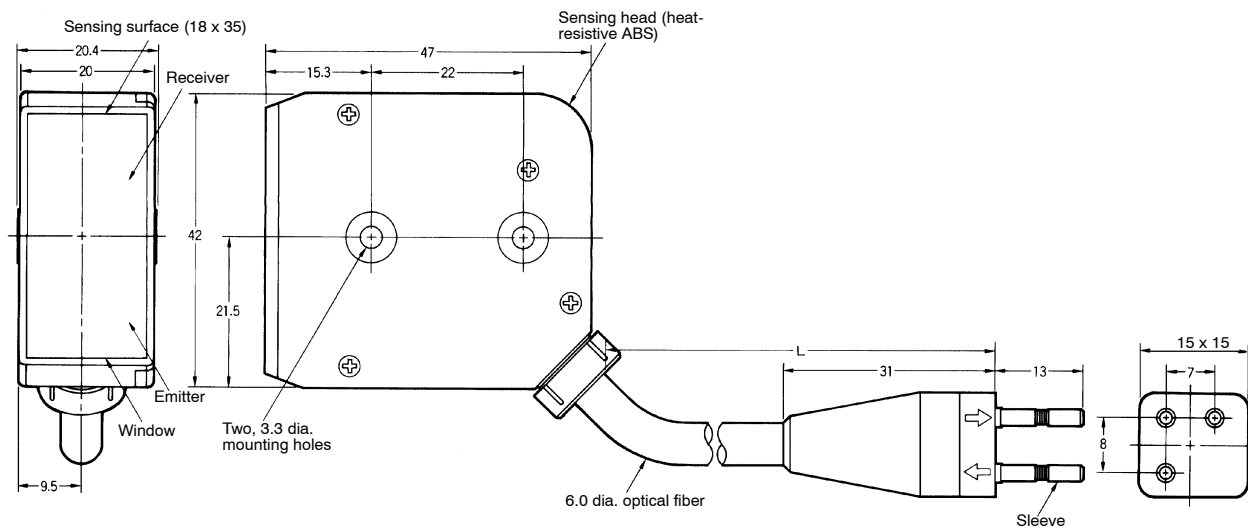
E32-S15-□ Short-range Small Spot Type



Fiber Length (L)

Model	Standard length (L)
E32-S15-1	500
E32-S15-2	1,000

E32-S15L-□ Long-range Type

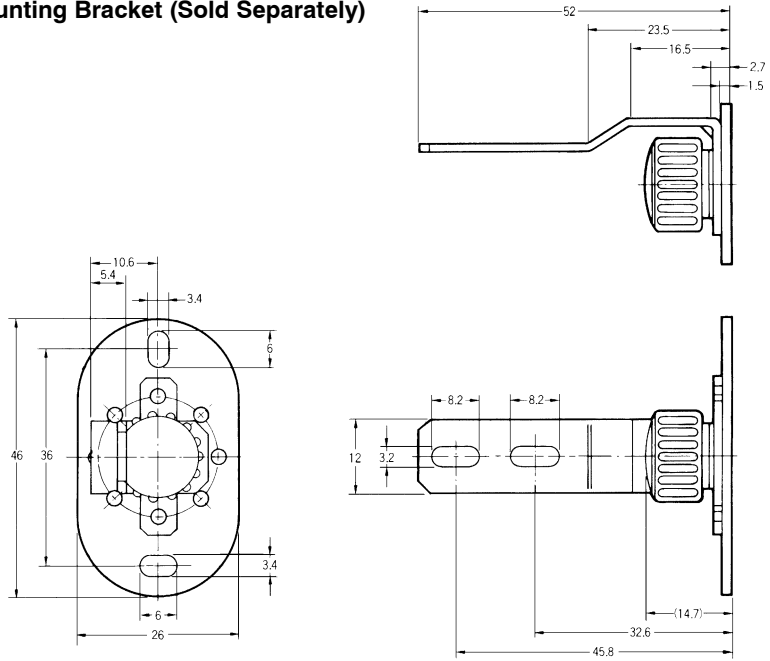


Fiber Length (L)

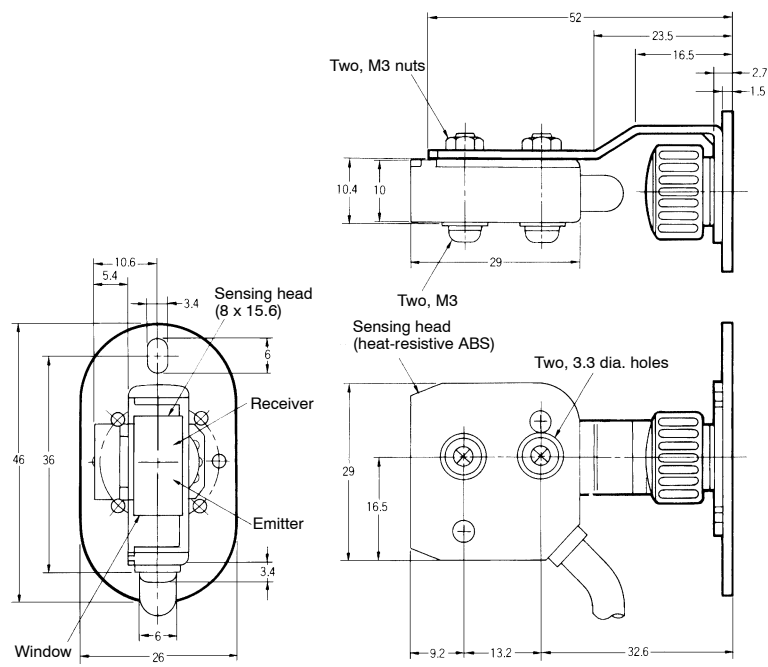
Model	Standard length (L)
E32-S15L-1	500
E32-S15L-2	1,000

■ Accessories

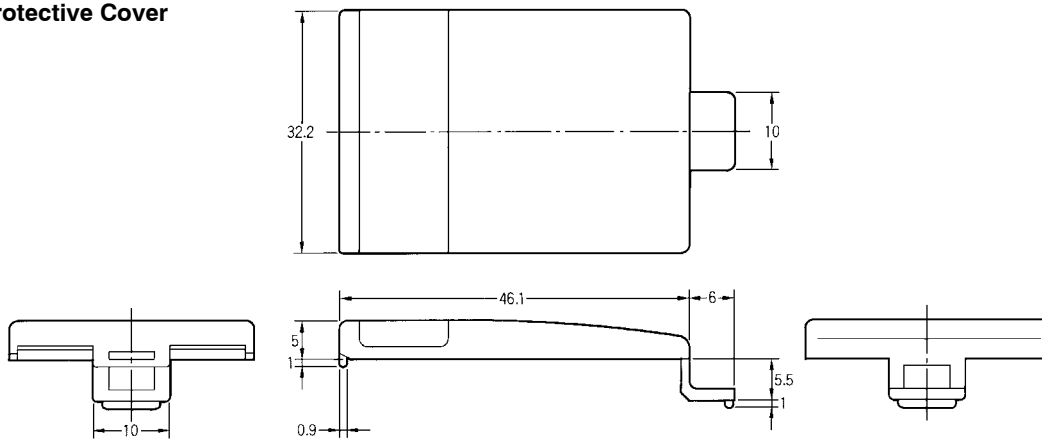
E39-L109 Rotating Fiber Unit Mounting Bracket (Sold Separately)



With Sensor Attached



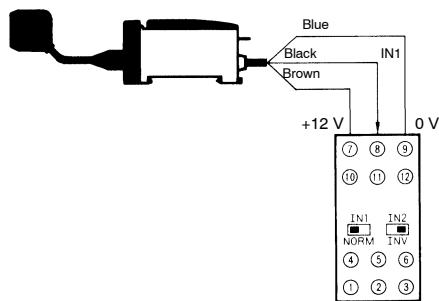
E39-G9 Protective Cover



Installation

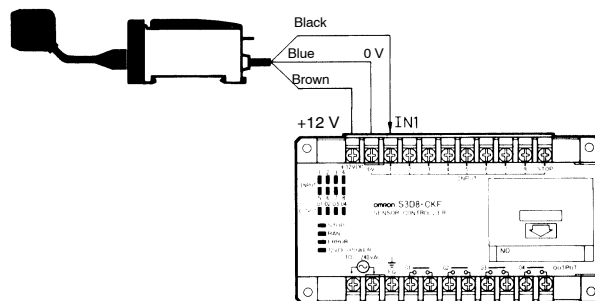
■ Connection

Connection with S3D2 Sensor Controller



Note: A maximum of two E3X-NL11 Sensors can be connected.

Connection with S3D8 Sensor Controller



Note: 1. The E3X-NL11 will switch to reverse operation by pressing the L Key.
2. A maximum of eight E3X-NL11 Sensors can be connected.

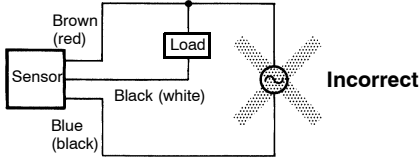
Power supply voltage	Output	Functions	Model
100 to 240 VAC	Relay	AND, OR	S3D2-AK
		AND, OR, and timer	S3D2-CK
		Flip-flop	S3D2-BK
	Transistor	AND, OR, and timer	S3D2-CC
	24 VDC	Relay	2 inputs, 2 outputs,
2 inputs, 2 outputs, and timer			S3D2-EK
		AND, OR	S3D2-AKD
		AND, OR, and timer	S3D2-CKD

Precautions

⚠ WARNING

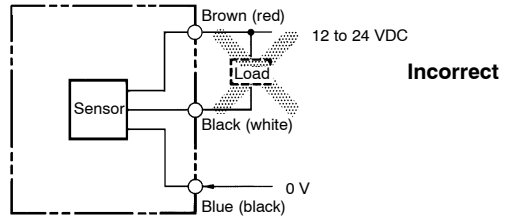
Power Supply

Do not impose an excessive voltage on the E3X-NL, otherwise it may explode or burn. Do not impose 100 to 220 VAC on any E3X-NL DC model, otherwise it may explode or burn.



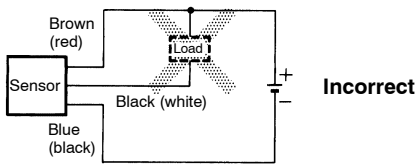
Connection with No Load

Make sure to connect a proper load to the E3X-NL in operation, otherwise it may explode or burn.



Load Short-circuit

Do not short-circuit the load connected to the E3X-NL, otherwise the E3X-NL may explode or burn.



⚠ Caution

Fiber Unit

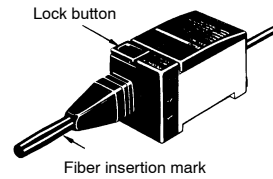
Tightening Force

The Fiber Unit must be tightened to a maximum torque of 0.3 N•m (3 kgf•cm).

Fiber Connection and Disconnection

The E3X-NL amplifier has a push lock. Connect or disconnect the fibers to or from the E3X-NL amplifier using the following procedures:

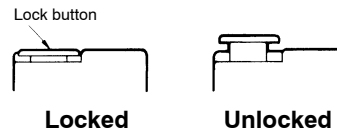
1. Connection



After inserting the fiber into the Amplifier, push the lock button until a click sound is heard so that the fiber is securely connected.

2. Disconnection

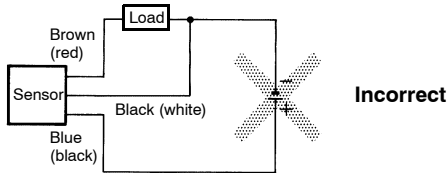
Be sure to press the push lock again to unlock before pulling out the fiber, otherwise the fiber may be deteriorated.



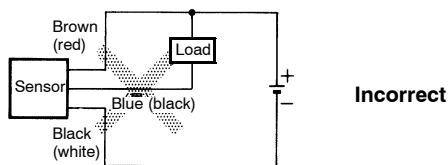
Wiring

Be sure to wire the E3X-NL and load correctly, otherwise it may explode or burn.

Ex. Wrong Polarity



Ex. Wrong Wiring



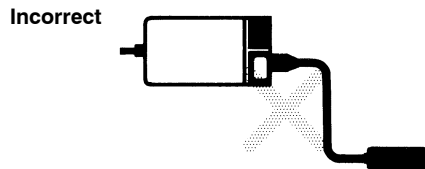
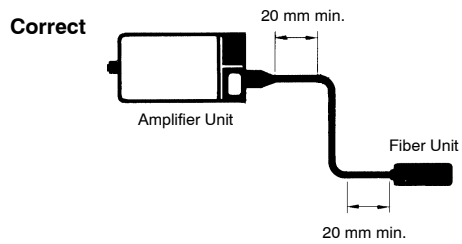
3. The fiber must be locked or released in a temperature range of -10° to 40°C.

Cabling the Fiber Unit

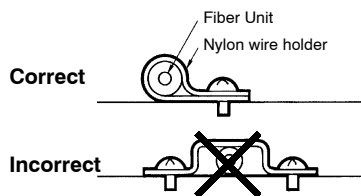
Do not pull or press the Fiber Units.

Do not bend the Fiber Units beyond the permissible bending radius.

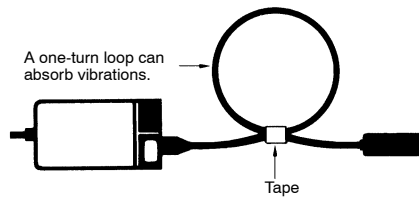
Do not bend the edge of the Fiber Units.



Do not apply excess force on the Fiber Units.



The Fiber Head could be broken by excessive vibration. To prevent this, the following is effective:



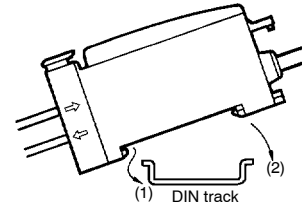
Amplifier Units

Mounting

Mounting

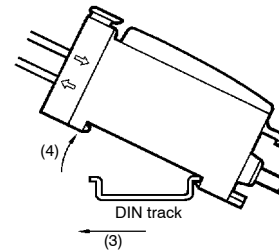
1. Mount the front part on the mounting bracket (sold together) or a DIN track.
2. Press the back part onto the mounting bracket or the DIN track.

Note: Do not mount the back part onto the mounting bracket or the DIN track first and then mount the front part on the mounting bracket or the DIN track, or the mounting strength of the Amplifier Unit may decrease.

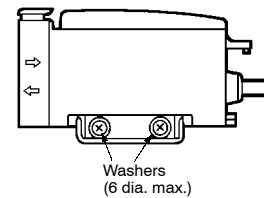


Dismounting

By pressing the Amplifier Unit in direction (3) and lifting the fiber insertion part in direction (4) as shown in the following, the amplifier can be dismounted with ease.



In the case of side mounting, attach the mounting bracket on the amplifier first, and secure the amplifier with M3 screws and washers. The diameter of the washers should be 6 mm max.



Installation

Power Reset Time

The E3X-NL is ready to sense objects from 100 ms after the E3X-NL is turned ON, until when no devices connected the E3X-NL can be used. Be sure to turn ON the E3X-NL first if power is supplied to the E3X-NL and the load independently.

When the E3X-NL is turned ON or OFF, the operation indicator will be lit for an instant but no control output will be turned ON.

Power OFF

The E3X-NL may output a single pulse when the control power supply is turned OFF. If the E3X-NL is connected to a timer or counter to which power is supplied from an independent power supply, the E3X-NL will be more likely to output a single pulse when the control power supply is turned OFF. Therefore, supply power to the timer or counter from the same power supply for the E3X-NL.

Types of Power Supplies

No full-wave or half-wave rectified power supplies can be connected to the E3X-NL.

Power Supplies

Be sure to ground the FG (frame ground) and G (ground) terminals if a switching regulator is connected to the E3X-NL, otherwise the E3X-NL may malfunction due to the switching noise of the switching regulator.

Wiring

Cord

The cord can be extended up to 100 m provided that the thickness of the cord is 0.3 mm² maximum.

Repeated Bending

The cable must not be bent repeatedly.

High-tension Lines

The power supply lines of the Photoelectric Sensor must not be wired alongside power lines or high-tension lines in the same conduit, otherwise the Photoelectric Sensor may become damaged or malfunction due to induction noise that may be generated from the power lines or high-tension lines.

Cord Tractive Force

Do not pull cords with the tractive forces exceeding 50 N.

Ratings

Minimum Sensing Object

Typical examples of the smallest sensing object, characteristic data, and level difference sensing data in this datasheet may not apply to all E3X-NL models because these examples were obtained from models in a lot. Use the typical examples as reference only.

Maintenance and Inspection

Not Operating

Check the following if the E3X-NL does not operate

1. The E3X-NL is properly wired as specified in this data sheet.
2. No mounting screws are loosened.
3. The optical axis and sensitivity are properly adjusted.
4. The sensing object size and the moving speed of the sensing objects are within the specified ranges.
5. No dust is found on the surface of the emitter or receiver lens.
6. The receiver is not affected by intensive external light, such as direct or reflected sunlight.
7. Users must not attempt to disassemble or repair the E3X-NL.

Lens Case

The basic material of the lens case is plastic. Use a dry cloth to clean the lens case carefully so that the lens case will not be damaged. Do not use organic solvent, such as paint thinner, to clean the lens case.

Others

EEPROM Error

If a teaching error has occurred at the time of teaching (including the completion of compensating the initial operation level at the time of teaching with no sensing object) due to a power failure or electrostatic noise, repeat the teaching operation using the buttons of the E3X-NL. The buzzer will go off, the red and green teaching indicators start flashing simultaneously, and the operation and stability indicators start flashing if a teaching error has occurred, in which case no data is written to the EEPROM correctly.

The red and green teaching indicators will start flashing simultaneously and the stability indicator will start flashing if a memory error has occurred.

Operating Environment

Do not install the E3X-NL in the following places. Doing so may cause the E3X-NL to malfunction.

1. Places with excessive dust
2. Places with corrosive gas
3. Places with vibration or shock affecting the E3X-NL
4. Places with water, oil, or chemical sprayed on the E3X-NL

Water Resistivity

Do not use the E3X-NL underwater, outdoors, or in the rain.

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.

To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. E248-E1-2 In the interest of product improvement, specifications are subject to change without notice.

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