OMRON

Ultrasonic Displacement Sensor

E4PA

Ideal for controlling liquid level.
Long sensing distance and
high-resolution analog output.

- High-precision detection with a wide range of measurements
  Four types of Sensors are available with measurement distances of 0.5 m, 2 m, 4 m, and 6 m. With the 0.5-m type, a measurement resolution of 0.2 mm or better has been achieved.
- The Sensor is ultrasonic, so it is not affected by the color of objects.
- Detection at up to 6 meters makes the E4PA practical for a variety of applications.
- Combine with the K3NX Digital Panel Meter for various control operations.
- A setting plug with a temperature compensation function makes it easy to set the measurement range.
  The measurement range can be set by the Setting Plug, which is included with the Sensor. No special controller is required. The Setting Plug's built-in temperature sensor provides superior temperature characteristics of ±1% FS.

Setting Plug

Ordering Information

Sensors

Measurement range	Model
60 to 500 mm	E4PA-LS50-M1
200 to 2,000 mm	E4PA-LS200-M1
500 to 4,000 mm	E4PA-LS400-M1
800 to 6,000 mm	E4PA-LS600-M1

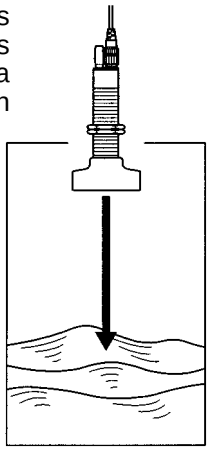
■ Accessories (Order Separately)

Sensor I/O Connectors

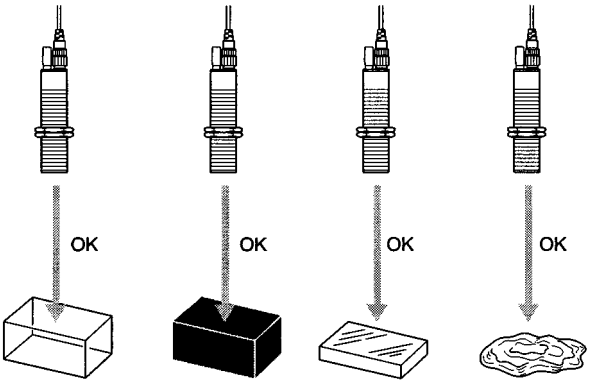
Cable	Shape	Cable length		Model
Standard cable	Straight 	2 m	4 conductors	XS2F-D421-D80-A
		5 m		XS2F-D421-G80-A
	L-shaped 	2 m		XS2F-D422-D80-A
		5 m		XS2F-D422-G80-A

Applications

Detection at up to 6 meters makes the E4PA suitable for applications such as detecting the liquid level in a tank, or the number of windings on large rolls.



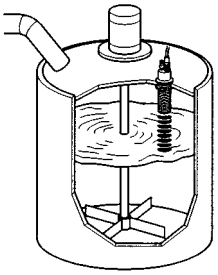
A variety of materials can be measured, including transparent and reflective. Measurements are performed with no contact, so even highly-viscous liquids are no problem.



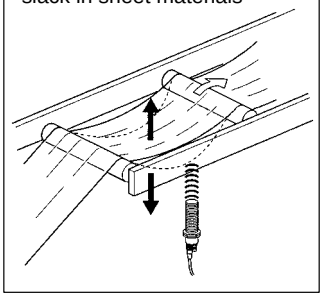
Transparent Black Reflective High viscosity

■ Application Examples

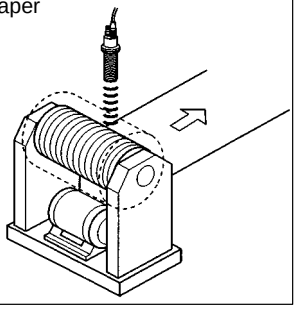
Measuring liquid levels



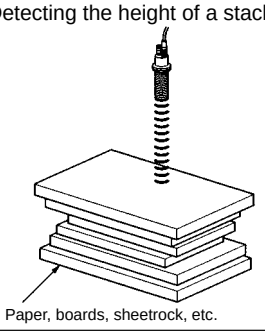
Measuring the amount of slack in sheet materials



Measuring the amount of rolled paper



Detecting the height of a stack



Specifications

■ Ratings/Characteristics

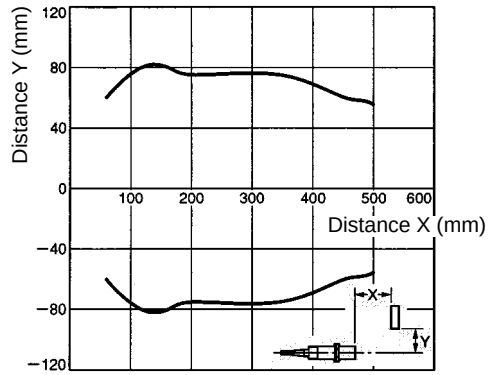
Item	E4PA-LS50-M1	E4PA-LS200-M1	E4PA-LS400-M1	E4PA-LS600-M1
Sensing distance	60 to 500 mm	200 to 2,000 mm	500 to 4,000 mm	800 to 6,000 mm
Standard sensing object	100 x 100 mm flat plate			
Applied frequency	Approx. 380 kHz	Approx. 175 kHz	Approx. 85 kHz	Approx. 65 kHz
Resolution (See note.)	0.172 mm	Measurement range less than 705 mm: 0.172 mm Measurement range 705 mm or greater: Measurement range/4,096 mm		
Linearity	±1% FS			
Repeatability (See note.)	0.1% FS max.			
Response time	35 ms max.	100 ms max.	300 ms max.	500 ms max.
Analog output	Current output: 4 to 20 mA (Allowable load resistance: 0 to 500 Ω) Voltage output: 0 to 10 V (1,000 Ω min.)			
Ultrasonic directional angle	Approx. 5° (3 dB decrease)			
Temperature influence	±1% FS of output value at +23°C in the temperature range of –10 to 55°C			
Voltage influence	0.5% FS max. within rated power supply voltage range			
Ambient temperature	Operating: –10 to 55°C (with no icing) Storage: –40 to 85°C (with no icing)			
Ambient humidity	Operating and storage: 35% to 85% (with no condensation)			
Power supply voltage	10 to 30 VDC; ripple (p-p): 10% max.			
Current consumption	12 V: 170 mA max.; 24 V: 70 mA max. (For current consumption characteristics, refer to *Current Consumption Characteristics* on page 5.)			
Insulation resistance	50 MΩ min. (at 500 VDC) between current-carrying parts and case			
Dielectric strength	1,000 VAC (50/60 Hz) for 1 min between current-carrying parts and case			
Vibration resistance	10 to 55 Hz, 1-mm double amplitude for 2 hours each in X, Y, and Z directions			
Shock resistance	300 m/s^2 three times each in X, Y, and Z directions			
Degree of protection	IEC 60529: IP65			
Connection method	Connector			
Weight (packed)	Approx. 240 g		Approx. 320 g	Approx. 400 g
Materials	Case: Stainless steel (SUS303) Sensing surface: PBT resin, polyurethane, glass epoxy resin			

Note: Values are given one hour after power-up. The outputs may fluctuate due to external disturbances.

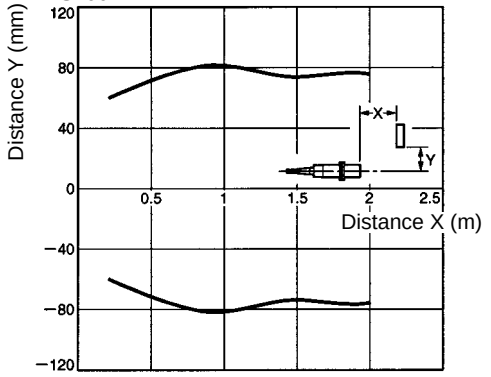
Engineering Data

Sensing Distance (Typical Examples)

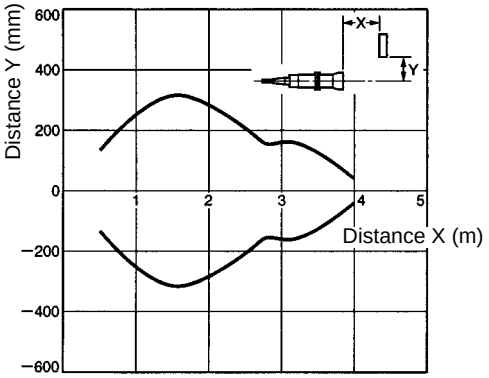
E4PA-LS50-M1



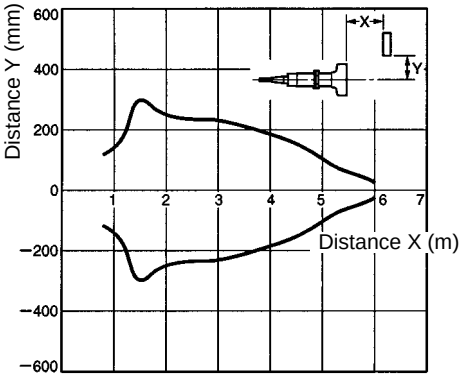
E4PA-LS200-M1



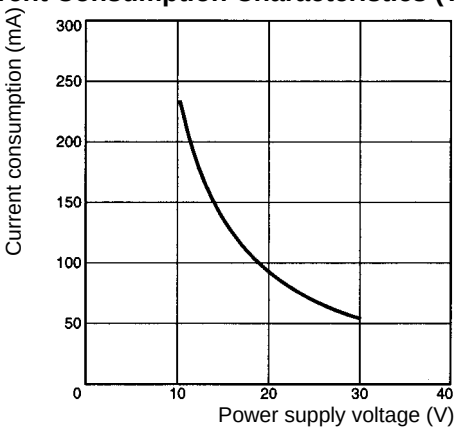
E4PA-LS400-M1



E4PA-LS600-M1



Current Consumption Characteristics (Typical Example)



Terminology

Resolution

The time measurement unit for the Sensor's internal circuits is 1 μs, so the minimum resolution is approx. 0.172 mm at an acoustic velocity of 345 m/s and room temperature of 23°C. If the distance is set to 705 mm or greater, resolution is determined by the number of bits in the internal D/A converter, according to the following equation:

Resolution (mm) = (A2 – A1)/4,096

A1: Nearest point in sensing range
A2: Farthest point in sensing range

Note: The figure 4,096 is the resolution when the number of bits in the internal D/A converter is 12.

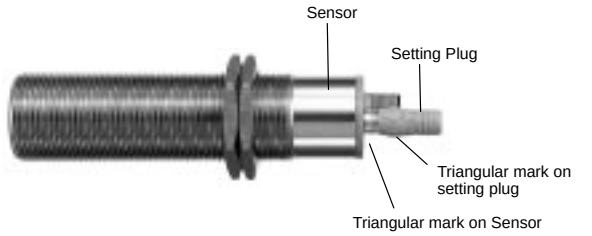
FS (Full Scale)

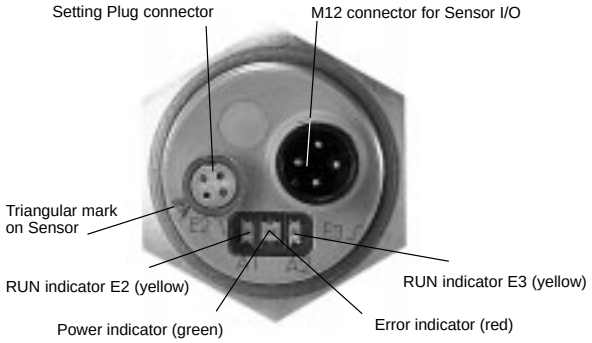
Indicates the rated sensing distance range. The value varies depending on the model.

Linearity

Indicates the ratio of the maximum deviation from an ideal line when the relationship between the distance and linear output under constant conditions is plotted on a graph.

Nomenclature



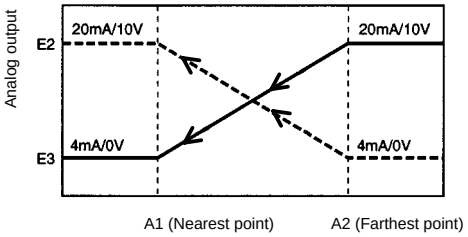


Setting Plug

The E4PA is set up by aligning the triangular marks on the Sensor and the Setting Plug and inserting the Setting Plug into the Sensor.

A1, A2: Sensing region settings
E2, E3: Analog output increase/decrease mode settings
T: Temperature compensation setting

Analog Output Characteristics with Setting Plug at E2/E3 Positions



Note: For information on changing the analog output characteristics, refer to Step 3 under *Setup and Operating Procedure* on page 6.

Output increase mode (E2):
As the distance decreases, the output increases.
Output decrease mode (E3):
As the distance increases, the output decreases.

Indicators

Power (green): Lit when the Setting Plug is completely inserted.

RUN (yellow): Lit when a sensing object comes within the measurement range.

Error (red): Lit when the Setting Plug is not inserted, or flashes when detection does not work (when there is an obstruction generating an alarm).

Mode	Function		Setting Plug position	RUN indicator (yellow)	Power indicator (green)	Error indicator (red)	RUN indicator (yellow)
				A1 (E2)			A2 (E3)
Operation	Normal operation	Temperature compensation	T	Lit/Not lit (See note 1.)	Lit	Not lit	Lit/Not lit (See note 1.)
		Detection that plug is not inserted		Lit/Not lit (See note 1.)	Not lit	Lit	Lit/Not lit (See note 1.)
		Malfunction sensing (When detecting ultrasonic inputs other than self-oscillation waves)		Lit/Not lit (See note 2.)	Not lit	Flashing	Lit/Not lit (See note 2.)
Setting	Sensing distance A1 setting	With sensing object	A1	Flashing	Flashing	Not lit	Not lit
		Without sensing object		Flashing	Not lit	Flashing	Not lit
	Sensing distance A2 setting	With sensing object	A2	Not lit	Flashing	Not lit	Flashing
		Without sensing object		Not lit	Not lit	Flashing	Flashing
	Output characteristics setting	Output increase mode	E2/E3	Flashing	Lit	Not lit	Not lit
		Output decrease mode		Not lit	Lit	Not lit	Flashing
Power turned ON			None	Not lit	Not lit	Lit	Not lit

Note: 1. Lit: The sensing object is within the measurement range.
Not lit: The sensing object is not within the measurement range.
2. Output indicator just prior to occurrence of malfunction.

Operation

■ Setup and Operating Procedure

Follow steps 1 to 4 below to set up the E4PA. The maximum measurement range is set as the default value.

1. Preparation for Setup

1. Remove the Setting Plug.

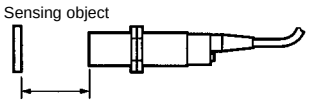
2. Turn ON the power.

Note: Do not insert the Setting Plug yet. It must be inserted within five minutes after the power is turned ON, however, or the setup will not be possible. If that happens, power up again and start over.

3. Proceed to Step 2 (Setting the Measurement Range).

2. Setting Measurement Range

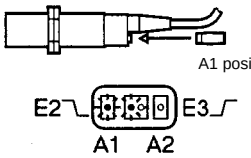
1. Place the sensing object at the nearest point within the measurement range.



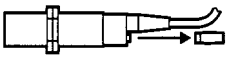
60 mm (for E4PA-LS50-M1)

2. Insert the Setting Plug at the A1 position. (Align the triangular mark on the Sensor with the A1 triangular mark on the Setting Plug.)

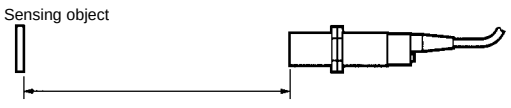
The power indicator (green) and the A1 RUN indicator (yellow) will flash, showing that the near distance has been correctly set.



3. Remove the Setting Plug. (In this state, the setting is confirmed and recorded.)



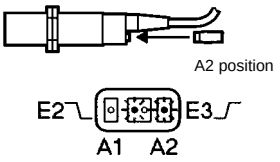
4. Place the sensing object at the farthest point within the measurement range.



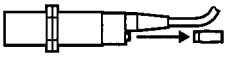
500 mm (for E4PA-LS50-M1)

5. Insert the Setting Plug at the A2 position. (Align the triangular mark on the Sensor with the A2 triangular mark on the Setting Plug.)

The power indicator (green) and the A2 RUN indicator (yellow) will flash, showing that the far distance has been correctly set.



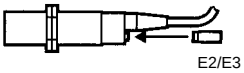
6. Remove the Setting Plug. (In this state, the setting is confirmed and recorded.)



7. Proceed to Step 3 (Setting the Analog Output Characteristics Mode).

3. Setting Analog Output Characteristics Mode

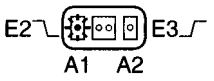
1. Insert the Setting Plug at the E2/E3 position. (Align the triangular mark on the Sensor with the E2/E3 triangular mark on the Setting Plug.)



E2/E3 position

When the A1 RUN indicator (yellow) is flashing

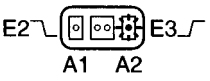
Analog output increase mode: E2
Sets the analog output value to increase (4 → 20 mA/0 → 10 V) as the sensing object approaches the E4PA.



When the Setting Plug is removed and re-inserted at the E2/E3 position, the analog output characteristics mode will be changed.

When the A2 RUN indicator (yellow) is flashing

Analog output decrease mode: E3
Sets the analog output value to decrease (20 → 4 mA/10 → 0 V) as the sensing object approaches the E4PA.



2. After the analog output characteristics have been set, remove the Setting Plug.

3. Proceed to Step 4 (Setting the Temperature Compensation Mode).

4. Setting Temperature Compensation Mode

1. Insert the Setting Plug at the T position. (Align the triangular mark on the Sensor with the T triangular mark on the Setting Plug.)

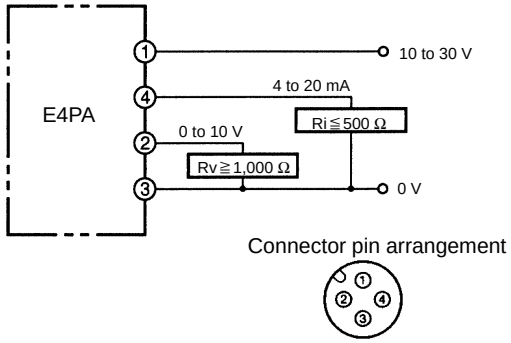
T position

2. Leave the Setting Plug inserted where it is. (This completes the setup.)

Note: 1. To maintain the temperature compensation, leave the Setting Plug inserted during operation. If it is removed, the temperature compensation will be disabled.

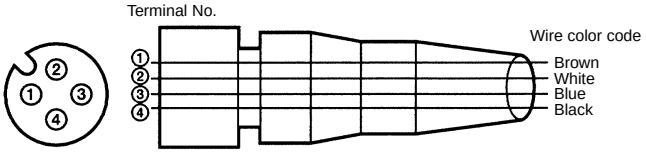
2. If the reflection from the Sensor is extremely weak, or if the sensing object is set outside of the measurement range, the error indicator (red) will flash to show that the measurement range is not accurately set.
3. If it becomes necessary to change the settings for Step 2 (Measurement Range) or Step 3 (Analog Output Characteristics Mode) after Steps 1 through 4 have been completed, the contents of all the previous settings will be remembered so only the items to be changed need to be reset. Go through the steps in order, from 1 to 4, and reset only the items to be changed.

■ Output Circuit



Connector pin arrangement

Sensor I/O Connector



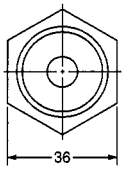
XS2F-D421-D80-A
XS2F-D421-G80-A
XS2F-D422-D80-A
XS2F-D422-G80-A

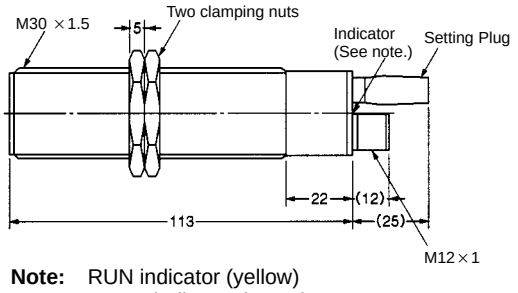
Class	Wire color code	Pin No.	Application
For DC	Brown	1	Power supply (+V)
	White	2	Voltage output
	Blue	3	Power supply (0 V)
	Black	4	Current output

Dimensions

Note: All units are in millimeters unless otherwise indicated.

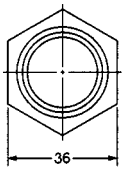
E4PA-LS50-M1

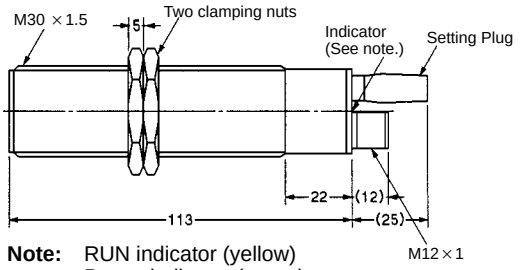




Note: RUN indicator (yellow)
Power indicator (green)
Error indicator (red)

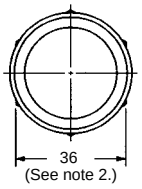
E4PA-LS200-M1

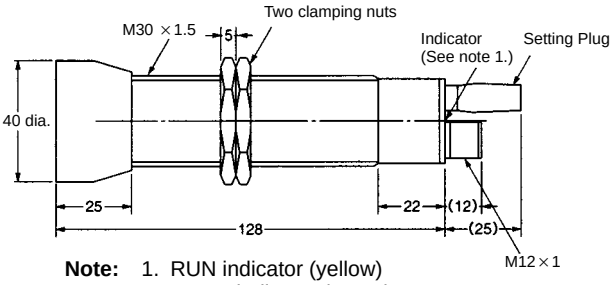




Note: RUN indicator (yellow)
Power indicator (green)
Error indicator (red)

E4PA-LS400-M1

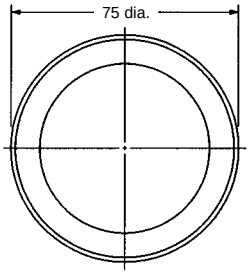


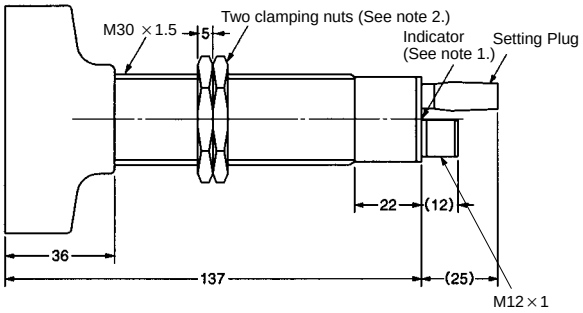


Note: 1. RUN indicator (yellow)
Power indicator (green)
Error indicator (red)

2. This is the dimension between the flat sides of the nuts.

E4PA-LS600-M1





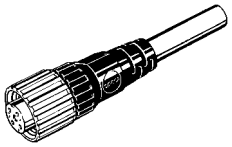
Note: 1. RUN indicator (yellow)
Power indicator (green)
Error indicator (red)

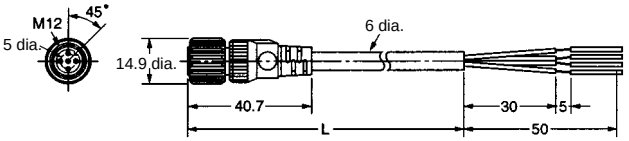
2. The distance between the flat sides of the nuts is 36 mm.

■ Accessories (Order Separately)

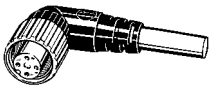
Sensor I/O Connector

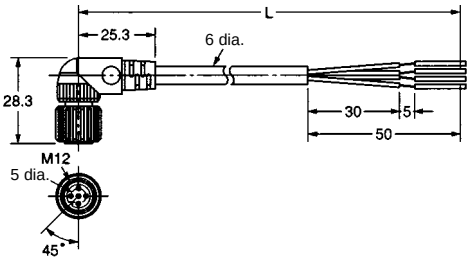
Straight
XS2F-D421-D80-A (L=2 m)
XS2F-D421-G80-A (L=5 m)





L-shaped
XS2F-D422-D80-A (L=2 m)
XS2F-D422-G80-A (L=5 m)

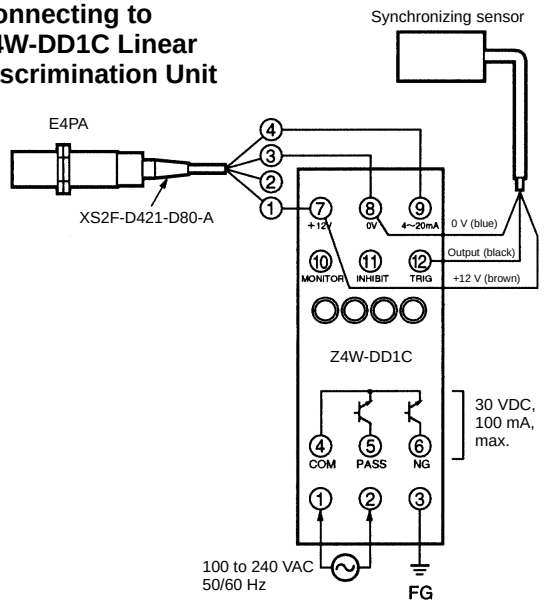




Installation

■ Connection Examples

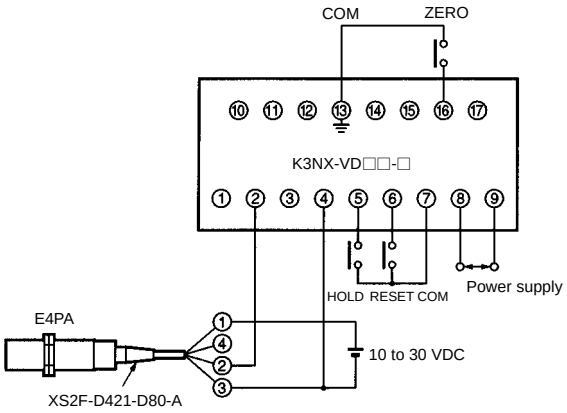
Connecting to Z4W-DD1C Linear Discrimination Unit



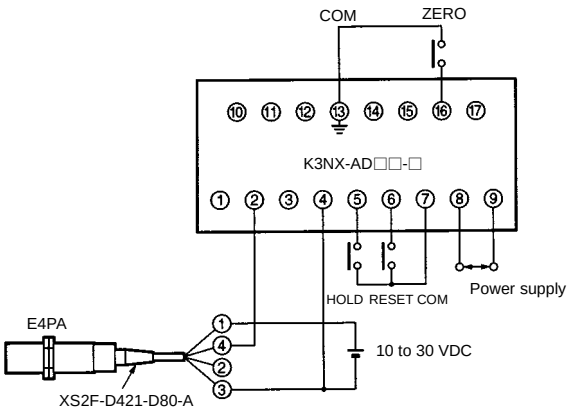
Connecting to a K3NX Process Meter

Provide the E4PA's power from a separate power supply, and not from K3NX terminals 10 and 11.

K3NX-VD□□-□



K3NX-AD□□-□



Precautions

Wiring

Power Supply Voltage

Do not exceed the operating voltage range. Using a higher voltage or using an AC power supply (100 VAC or more) for a DC Sensor can cause explosion or burning

Faulty Wiring

Be careful not to make wiring mistakes such as reversing the power supply polarity. Faulty wiring can cause explosion or burning.

Operating Environment

Do not use the Sensor in an environment where inflammable or explosive gas is present.

■ Correct Use

Design

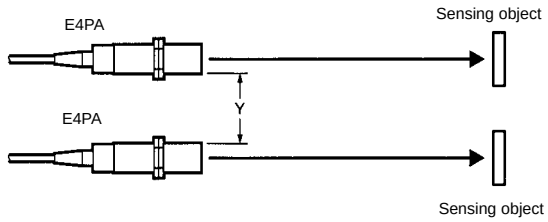
Sensor Ambient Temperature and Humidity

The acoustic velocity generally fluctuates approximately 0.17% with each 1°C of temperature change. For example, if the ambient temperature increases from 20 to 40°C, then the acoustic velocity will increase by 3.5%. Moreover, the acoustic velocity will increase by 2% in dry air in comparison to air with 100% humidity. Test the environmental conditions where the Sensor will actually be used.

Mutual Interference

Separate the Sensors as specified in the following table when using two or more Sensors in close proximity to one another.

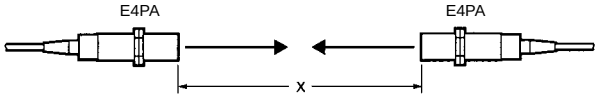
Parallel Arrangement



Note: The values shown in the following table are only examples for reference. The actual values will vary depending on the surface conditions of the sensing object, and on the ultrasonic waves that are reflected. Moreover, if the sensing object is inclined, the Y value in the table will be increased further.

Model	Y (m)
E4PA-LS50-M1	0.3 m min.
E4PA-LS200-M1	1.0 m min.
E4PA-LS400-M1	2.0 m min.
E4PA-LS600-M1	2.5 m min.

Facing Arrangement



Model	X (m)
E4PA-LS50-M1	2.0 m min.
E4PA-LS200-M1	8.0 m min.
E4PA-LS400-M1	16.0 m min.
E4PA-LS600-M1	25.0 m min.

Sensing Object

The sensing object may be solid, liquid, or powder, and the detection capability of the Sensor will vary depending on the surface conditions of the object. If the surface irregularities are no more than 0.2 mm, then the specified sensing distance will apply. Materials such as fine powder, felt, cotton, and other materials that absorb sound should be tested before using the Sensor.

Surface Temperature of Sensing Object

If the surface temperature of the sensing object is over 100°C, there will be very little ultrasonic reflection. Conduct tests before using the Sensor.

Installation

Mounting the Sensor

The Sensor must be mounted using metal nuts, and tightened to a torque of 15 N•m max.

Atmosphere

To ensure reliability and long service life, do not use the Sensor outdoors or in places that exceed the rated temperatures.

Ultrasonic sensors use air as the transmission medium, so if there are local temperature differences there may be malfunctioning due to reflection and refraction at the boundaries, and detection region changes where wind blows. Therefore the Sensor should not be used near equipment such as forced-air ventilators.

Jets from air nozzles include various frequencies, so they can affect the Sensor and should not be used nearby.

Water drops on the Sensor surface shorten the sensing distance.

Wiring Considerations

Cable Length

The cable must be no longer than 10 m.

High-voltage Lines

Do not lay power supply cable for the E4PA together with high-voltage lines or power lines. Placing them together can cause interference, damage, or malfunction.

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. D092-E1-2 **In the interest of product improvement, specifications are subject to change without notice.**

OMRON Corporation
Industrial Automation Company

Industrial Sensors Division
Sensing Devices and Components Division H.Q.
Shiokoji Horikawa, Shimogyo-ku,
Kyoto, 600-8530 Japan
Tel: (81)75-344-7068/Fax: (81)75-344-7107

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