

Smart Sensors (Inductive Displacement Type) ZX-E Series

High-accuracy Detection of Metal Workpiece Displacement

- Sensor Heads support a wide variety of applications.
- Linearity can be adjusted for non-ferrous metals, such as SUS and aluminum, using the material selection function.
- Simple linearity compensation (teaching).
- Easily perform calculation for two Sensors by using a Calculating Unit.
- Prevent mutual interference for up to five Units by using a Calculating Unit



For the most recent information on models that have been certified for safety standards, refer to your OMRON website.

Ordering Information

■ Sensors

Sensor Heads (Refer to Dimensions on page 11.)

| Shape | Dimensions | Sensing distance | Resolution *1 | Model |
|-----------------------------|------------------|------------------|---------------|----------------|
| Cylindrical | 3 dia. x 18 mm | 0.5 mm | 1 μm | ZX-EDR5T |
| | 5.4 dia. x 18 mm | 1 mm | | ZX-ED01T *2 |
| | 8 dia. x 22 mm | 2 mm | | ZX-ED02T *2 |
| Screw-shaped | M10 x 22 mm | | | ZX-EM02T *2 |
| | M18 x 46.3 mm | 7 mm | | ZX-EM07MT *2 |
| Flat | 30 x 14 x 4.8 mm | 4 mm | | ZX-EV04T *2 *3 |
| Heat-resistant, cylindrical | M12 x 22 mm | 2 mm | ZX-EM02HT *4 | |


*1: For an average count of 4,096.

*2: Models with Protective Spiral Tubes are also available. Add a suffix of “-S” to the above model numbers when ordering. (Example: ZX-ED01T-S)
For detailed dimensions of the Protective Spiral Tube, refer to the information on the E39-F32A on the OMRON website.

*3: Be sure to use ZX-EDA Amplifier Unit version 1,200 or later with the ZX-EV04T.

*4: Be sure to use ZX-EDA Amplifier Unit version 1,300 or later with the ZX-EM02HT.

Amplifier Units (Refer to Dimensions on page 13.)

| Appearance | Power supply | Output type | Model |
|---|--------------|-------------|-------------|
|  | DC | NPN | ZX-EDA11 2M |
| | | PNP | ZX-EDA41 2M |

Note: Compatible connection with the Sensor Head.

Accessories (Order Separately)

Calculating Unit (Refer to Dimensions on page 14.)

| Appearance | Model |
|---|---------|
|  | ZX-CAL2 |

Amplifier Mounting Brackets

A ZX-XBE1 is provided with the Sensor. Order an Amplifier Mounting Bracket separately if required.

(Refer to Dimensions on page 14.)

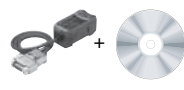
| Appearance | Model | Remarks |
|---|---------|------------------------------|
|  | ZX-XBE1 | Attached to each Sensor Head |
|  | ZX-XBE2 | For DIN track mounting |

Logging Tool for Personal Computers

(Refer to Dimensions on page 15.)

| Appearance | Name | Model |
|--|--|--------------------------|
|  | Communications Interface Unit (RS-232C) | ZX-SF11 |
|  | Smart Monitor (Logging Software + Function Setting Software) | ZX-SW11EV3 (See note 1.) |

Setup Tool for Personal Computer

| Appearance | Name | Model |
|---|---|---------------------------|
|  | Communications Interface Unit (RS-232C) + Smart Monitor Basic*2 (Function Setting Software) | ZX-SFW11EV3 (See note 1.) |

Note 1. The ZX-SFW11EV3 or ZX-SW11EV3 is required to use the Smart Monitor with the ZX-LDA11-N/41-N. Earlier versions cannot be used.


2. The Smart Monitor Basic does not have a logging function. Other than the logging function, the Smart Monitor Basic supports the same functions as the Smart Monitor.

Cables with Connectors on Both Ends (for Extension) (Refer to Dimensions on page 15.)*

| Cable length | Model | Quantity |
|--------------|---------|----------|
| 1 m | ZX-XC1A | 1 |
| 4 m | ZX-XC4A | |
| 8 m | ZX-XC8A | |

* Robot cable models are also available. The model numbers are ZX-XC□R.

Bank Unit

| Appearance | Model |
|--|---------|
|  | ZX-SB11 |

Specifications

■ Sensor Heads

| Model | | ZX-EDR5T | ZX-ED01T | ZX-ED02T/ EM02T | ZX-EM07MT | ZX-EV04T | ZX-EM02HT | |
|--|--------------|---|--------------------|---|---|---------------------------------|---------------|--|
| Measurement range | | 0 to 0.5 mm | 0 to 1 mm | 0 to 2 mm | 0 to 7 mm | 0 to 4 mm | 0 to 2 mm | |
| Sensing object | | Magnetic metals (Measurement ranges and linearities are different for non-magnetic metals. Refer to <i>Engineering Data</i> on page 4.) | | | | | | |
| Standard reference object | | 18×18×3 mm | 30×30×3 mm | 60×60×3 mm | 45×45×3 mm | | | |
| | | Material: ferrous (S50C) | | | | | | |
| Resolution *1 | | 1 μm | | | | | | |
| Linearity *2 | | ±0.5% F.S. | | | | | ±1.0% F.S. *5 | |
| Linear output range | | Same as measurement range. | | | | | | |
| Temperature characteristic *3 (including Amplifier Unit) | | 0.15% F.S./°C | | 0.07% F.S./°C | | 0.1% F.S./°C | | |
| Ambient temperature | Operating *4 | 0 to 50°C (with no icing or condensation) | | -10 to 60°C (with no icing or condensation) | | -10 to 200°C | | |
| | Storage *4 | -20 to 70°C (with no icing or condensation) | | -20 to 70°C (with no icing or condensation) | | (with no icing or condensation) | | |
| Ambient humidity | | Operating and storage: 35% to 85% (with no condensation) | | | | | | |
| Insulation resistance | | 50 MΩ min. (at 500 DC) | | | | | | |
| Dielectric strength | | 1,000 VAC, 50/60 Hz for 1 min between charged parts and case | | | | | | |
| Vibration resistance (destruction) | | 10 to 55 Hz with 1.5-mm double amplitude for 2 h each in X, Y, and Z directions | | | | | | |
| Shock resistance (destruction) | | 500 m/s ² , 3 times each in X, Y, and Z directions | | | | | | |
| Degree of protection (Sensor Head) | | IEC60529, IP65 | | IEC60529, IP67 | | IEC60529, IP60 *6 | | |
| Connection method | | Connector relay (standard cable length: 2 m) | | | | | | |
| Weight (packed state) | | Approx. 120 g | Approx. 140 g | Approx. 160 g | Approx. 130 g | Approx. 160 g | | |
| Materials | Sensor Head | Case | Brass | Stainless steel | Brass | Zinc (nickel-plated) | Brass | |
| | | Sensing surface | Heat-resistant ABS | | | | PEEK | |
| | | Tightening nut | --- | | Brass (nickel-plated) (except ZX-ED02T) | | --- | |
| | | Toothed washer | --- | | Iron (zinc-plated) (except ZX-ED02T) | | --- | |
| Preamplifier | | PES | | | | | | |
| Accessories | | Amplifier Mounting Brackets (ZX-XBE1), Instruction Manual | | | | | | |

- *1:Resolution: The resolution is the deviation ($\pm 3\sigma$) in the linear output when connected to the ZX-EDA Amplifier Unit. The above values indicate the deviations observed 30 minutes after the power is turned ON.
(The resolution is measured with OMRON's standard reference object at 1/2 of the measurement range with the ZX-EDA set for the maximum average count of 4,096 per period.)
The resolution is given at the repeat accuracy for a stationary workpiece, and is not an indication of the distance accuracy. The resolution may be adversely affected under strong electromagnetic fields.
- *2: Linearity: The linearity is given as the error in an ideal straight line displacement output when measuring the standard reference object. The linearity and measurement values vary with the object being measured.
- *3: Temperature characteristic: The temperature characteristic is measured with OMRON's standard reference object at 1/2 of the measurement range.
- *4: The ambient temperature given is only for the sensor head. It is -10 to 60°C for the preamp.
- *5: The value given is for an ambient temperature of 25°C.
- *6: Do not use in moist environments because the case is not waterproof.

■ Amplifier Units

| Model | ZX-EDA11 | ZX-EDA41 |
|--|--|---|
| Measurement period *1 | 150 μ s | |
| Possible average count settings | 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1,024, 2,048, or 4,096 | |
| Linear output *2 | Current output: 4 to 20 mA/F.S., Max. load resistance: 300 Ω Voltage output: ± 4 V (± 5 V, 1 to 5 V *3), Output impedance: 100 Ω | |
| Judgement outputs (3 outputs: HIGH/PASS/LOW) | NPN open-collector outputs, 30 VDC, 50 mA max. Residual voltage: 1.2 V max. | PNP open-collector outputs, 30 VDC, 50 mA max. Residual voltage: 2 V max. |
| Zero reset input, timing input, reset input, judgement output hold input | ON: Short-circuited with 0-V terminal or 1.5 V or less OFF: Open (leakage current: 0.1 mA max.) | ON: Supply voltage short-circuited or supply voltage within 1.5 V OFF: Open (leakage current: 0.1 mA max.) |
| Function | <ul style="list-style-type: none"> <li style="width: 33%;">- Measurement value display <li style="width: 33%;">- Linearity adjustment (materials selection) <li style="width: 33%;">- Display reverse <li style="width: 33%;">- Number of display digit changes <li style="width: 33%;">- Bottom hold, peak-to-peak hold <li style="width: 33%;">- Average hold <li style="width: 33%;">- Initial reset <li style="width: 33%;">- OFF-delay timer <li style="width: 33%;">- Non-measurement setting <li style="width: 33%;">- Automatic teaching <li style="width: 33%;">- Reset input <li style="width: 33%;">- Linear output correction <li style="width: 33%;">- K-(A+B) calculation *4 <li style="width: 33%;">- Sensor disconnection detection <li style="width: 33%;">- Key lock <li style="width: 33%;">- Set value/output value/resolution display <li style="width: 33%;">- Display OFF mode <li style="width: 33%;">- Sample hold <li style="width: 33%;">- Self-peak hold <li style="width: 33%;">- Delay hold <li style="width: 33%;">- Linearity initialization <li style="width: 33%;">- One-shot timer <li style="width: 33%;">- Direct threshold value setting <li style="width: 33%;">- Hysteresis width setting <li style="width: 33%;">- Judgement output hold input <li style="width: 33%;">- (A-B) calculations *4 <li style="width: 33%;">- Mutual interference prevention *4 <li style="width: 33%;">- Zero reset memory <li style="width: 33%;">- Scaling <li style="width: 33%;">- ECO mode <li style="width: 33%;">- Peak hold <li style="width: 33%;">- Self-bottom hold <li style="width: 33%;">- Zero reset <li style="width: 33%;">- ON-delay timer <li style="width: 33%;">- Previous value comparison <li style="width: 33%;">- Position teaching <li style="width: 33%;">- Timing inputs <li style="width: 33%;">- Monitor focus <li style="width: 33%;">- (A+B) calculations *4 <li style="width: 33%;">- Zero reset indicator | |
| Indications | Judgement indicators: High (orange), pass (green), low (yellow), 7-segment main digital display (red), 7-segment sub-digital display (yellow), power ON (green), zero reset (green), enable (green) | |
| Voltage influence (including Sensor) | 0.5% F.S. of linear output value at $\pm 20\%$ of power supply voltage | |
| Power supply voltage | 12 to 24 VDC $\pm 10\%$, Ripple (p-p): 10% max. | |
| Current consumption | 140 mA max. with power supply voltage of 24 VDC (with Sensor connected) | |
| Ambient temperature | Operating and storage: 0 to 50°C (with no icing or condensation) | |
| Ambient humidity | Operating and storage: 35% to 85% (with no condensation) | |
| Insulation resistance | 20 M Ω min. (at 500 DC) | |
| Dielectric strength | 1,000 VAC, 50/60 Hz for 1 min | |
| Vibration resistance (destruction) | 10 to 150 Hz with 0.7-mm double amplitude for 80 min each in X, Y, and Z directions | |
| Shock resistance (destruction) | 300 m/s ² , 3 times each in 6 directions (up, down, left, right, forward, backward) | |
| Connection method | Prewired (standard cable length: 2 m) | |
| Weight (packed state) | Approx. 350 g | |
| Materials | Case: PBT (polybutylene terephthalate), Cover: Polycarbonate | |
| Accessories | Instruction Manual | |

- *1:The response time for the first linear output or judgment output is calculated as follows (with fixed sensitivity): Measurement period \times (Average count setting + 1). The response time for the second and later outputs is the measurement period specified in the table.
- *2: The output can be switched between a current output and voltage output using a switch on the bottom of the Amplifier Unit.
- *3: Setting is possible via the monitor focus function.
- *4: A Calculating Unit (ZX-CAL2) is required.

Engineering Data (Reference Value)

Measurement Distance vs. Linearity (with Linearity Adjusted for Standard Sensing Object)

ZX-EDR5T



ZX-ED01T



ZX-ED02T/ZX-EM02T



ZX-EM07MT



ZX-EV04T



ZX-EM02HT

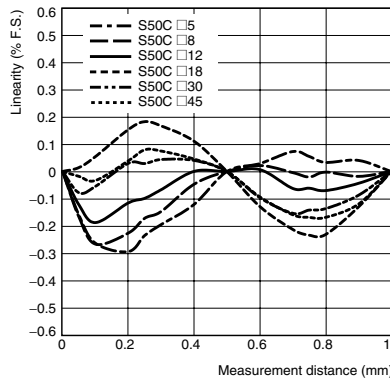


Size of Sensing Object vs. Linearity (with Linearity Adjusted for Each Sensing Object)

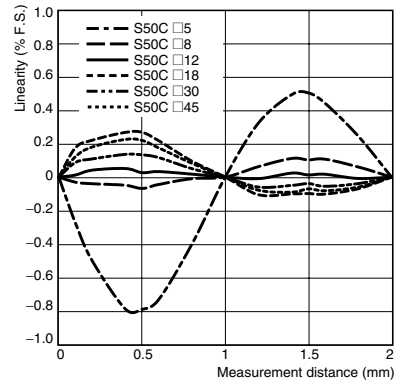
ZX-EDR5T



ZX-ED01T



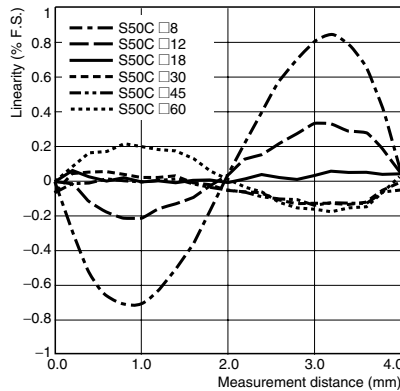
ZX-ED02T/ZX-EM02T



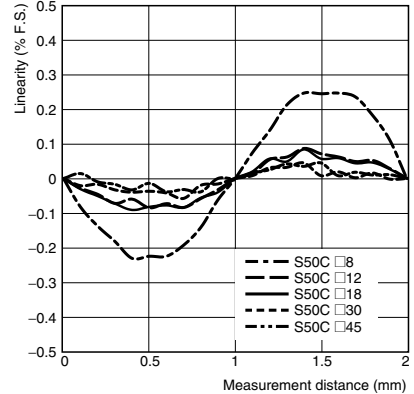
ZX-EM07MT



ZX-EV04T



ZX-EM02HT



Size of Sensing Object vs. Linearity (with Linearity Adjusted for Standard Sensing Object)

ZX-EDR5T



ZX-ED01T



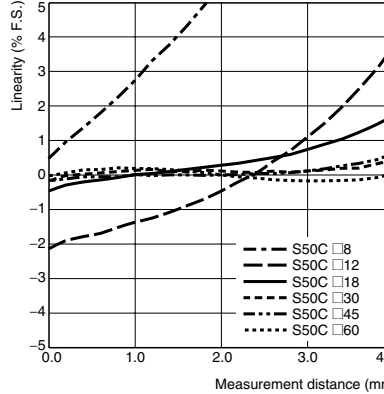
ZX-ED02T/ZX-EM02T



ZX-EM07MT



ZX-EV04T



ZX-EM02HT



Material of Sensing Object vs. Linearity (with Linearity Adjusted for Each Sensing Object)

ZX-EDR5T



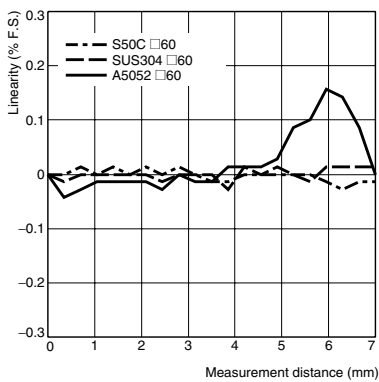
ZX-ED01T



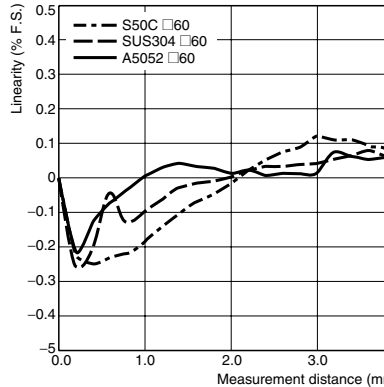
ZX-ED02T/ZX-EM02T



ZX-EM07MT



ZX-EV04T



Material of Sensing Object vs. Linearity (with Linearity Adjusted for Standard Sensing Object and Iron)

ZX-EDR5T



ZX-ED01T



ZX-ED02T/ZX-EM02T



ZX-EM07MT



ZX-EV04T



Temperature Characteristics

ZX-EM02HT

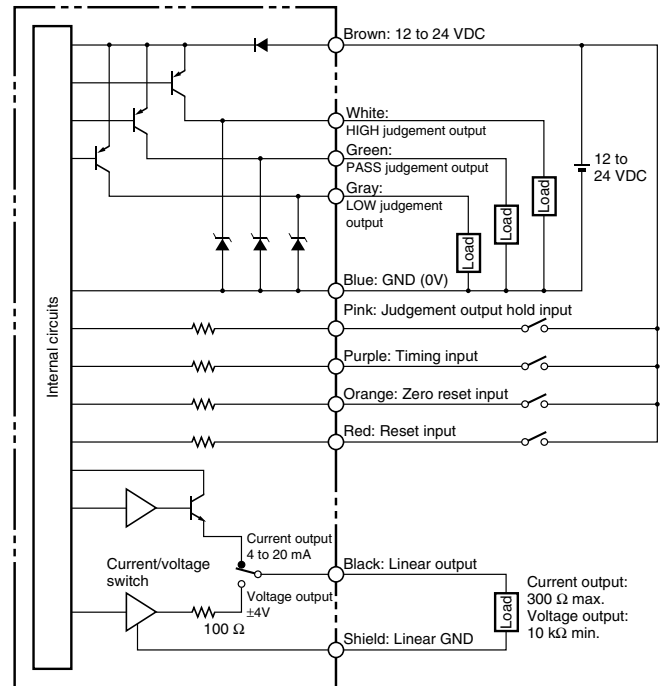


I/O Circuit Diagrams

NPN Amplifier Unit: ZX-EDA11



PNP Amplifier Unit: ZX-EDA41



Connections: Amplifier Unit



- Note 1.** Use a separate stabilized power supply for the Amplifier Unit, particularly when high resolution is required.
- 2.** Wire the Unit correctly. Incorrect wiring may result in damage to the Unit. (Do not allow wiring, particularly the linear output, to come into contact with other lines.)
- 3.** Use the blue (0-V) line for the power supply and use the shield wire (linear output ground) together with the black (linear output) line for linear output. Each of these grounds must be used for the designed purpose. When not using the linear output, connect the linear output ground to the 0-V ground.

Part Names

Sensors

- ZX-EDR5T
- ZX-ED01T
- ZX-ED02T
- ZX-EM02T
- ZX-EM07MT
- ZX-EM02HT



ZX-EV04T



Amplifier Units

- ZX-EDA11
- ZX-EDA41



Calculating Unit

ZX-CAL2



Precautions

For details on information such as the usage precautions, → refer to the “ZX-E Series Smart Sensors Operation Manual” (Cat. No. Z166).

Design Precautions

Conform to the specified ratings and performance. Refer to *Specifications* on page 2 for details.

Objects of certain materials or shapes may not be detectable, or the detection accuracy may not be sufficiently high.

Environment

Do not operate the product in locations subject to flammable or explosive gases.

In order to ensure safe operation and maintenance, do not install the product in the vicinity of high-voltage devices or power equipment.

Wiring

Do not use the product at voltages exceeding the rated values. Doing so may result in damage.

Do not connect the product to an AC power supply or connect the power supply in reverse.

Do not short-circuit the load for open-collector output.

Do not lay the power cable for the product together with or in the same duct as high-voltage lines or power lines. Doing so may result in incorrect operation or damage due to induction.

Do not connect or disconnect connectors while the power is ON. Doing so may result in damage.

Adjustment

Setting

When setting threshold values, ensure that the Amplifier Unit's judgement output hold input line is ON so that there is no judgement output to external devices.

Other Precautions

Do not attempt to disassemble, repair, or modify the product.

Dispose of the product using standard procedures for industrial waste.

These Sensors are not compatible with the ZX-L□□ Smart Sensors (laser type). Do not connect combinations of ZX-E□□ Smart Sensors and ZX-T□□ Smart Sensors.

Correct Use

Design Precautions

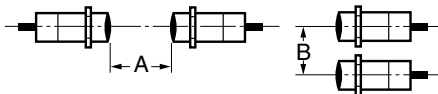
Power Supplies

Allow a warm-up period of approximately 30 minutes after turning ON the power supply.

Mutual Interference

Up to 5 Sensor Heads can be used together by connecting the ZX-CAL2 Calculating Unit between Amplifier Units.

When installing Sensor Heads facing each other or in parallel, separate them by the minimum distances given in the table below.



Mutual Interference

| Model | A | B |
|-----------|--------|-------------|
| ZX-EDR5T | 5 mm | 20 (3.1) mm |
| ZX-ED01T | 10 mm | 50 (5.4) mm |
| ZX-ED02T | 20 mm | 50 (8) mm |
| ZX-EM02T | 20 mm | 50 (10) mm |
| ZX-EM07MT | 100 mm | 150 (30) mm |
| ZX-EV04T | 80 mm | 50 (14) mm |
| ZX-EM02HT | 20 mm | 50 (12) mm |

Note: The figures in parentheses apply when the mutual interference prevention function is used.

Compatibility

Sensors and Amplifier Units are mutually compatible. Sensors can be added or replaced individually.

Influence of High-frequency Electromagnetic Fields

Using the product in the vicinity of devices that generate high-frequency electromagnetic fields, such as ultrasonic cleaning equipment, high-frequency generators, transceivers, mobile phones, and inverters, may result in malfunction.

Influence of Metallic Objects

When installing the product, separate it from metallic objects by the distances shown below.



Influence of Metallic Objects

| Model | d | D |
|----------------|------------|--------|
| ZX-EDR5T | 8 mm | 9 mm |
| ZX-ED01T | 10 mm | |
| ZX-ED02T/EM02T | 12 mm | |
| ZX-EM07MT | 55 mm | 20 mm |
| ZX-EV04T | 16 × 32 mm | 4.8 mm |
| ZX-EM02HT | 18 mm | 9 mm |

Wiring

Wiring Check

After wiring is completed, before turning ON the power, confirm that the power supply is connected correctly, that there are no faulty connections, such as load short-circuits, and that the load current is correct. Incorrect wiring may result in failure.

Cable Extension

Do not extend the cable for the Sensor and the Amplifier Unit to a length exceeding 10 m. Use a ZX-XC□A Extension Cable (sold separately) to extend the Sensor's cable. Extend the Amplifier Unit's cable using a shielded cable of the same type.

Power Supply

When using a commercially available switching regulator, ground the FG (frame ground) terminal.

If the power supply line is subject to surges, connect a surge absorber that meets the conditions of the operating environment.

Calculating Unit

When using a Calculating Unit, connect the linear output ground of the corresponding Amplifier Unit.

Connectors

Do not connect or disconnect connectors while the power is ON.

Be sure hold to connectors by the cover when connecting or disconnecting.

Mounting

Handling

When mounting the Sensor Head, do not apply excessive shock by, for example, using a hammer. Doing so may result in damage or a reduction in the level of water-proofing. Also, there are screw-shaped models that require a toothed washer to allow for a tolerance in the tightening torque for the nut.

When using a heat-resistant model like the ZX-EM02HT, develop designs that account for thermal expansion due to rising sensing object temperature so the sensing object will never touch the sensing surface. Also note that any sudden rise in temperature will shorten the service life of the product.

Tightening Torque

Do not apply excessive torque when tightening the nut. Use a toothed washer if necessary.



| Model | Tightening torque |
|-----------|-------------------|
| ZX-EM02T | 15 N·m |
| ZX-EM07MT | |
| ZX-EM02HT | 59 N·m |

Note: The above figure applies for use with a toothed washer.

Mounting Cylindrical Models:

Tighten set screws with a tightening torque of 0.2 N·m max.



| Model | A |
|----------|-------------|
| ZX-EDR5T | 9 to 18 mm |
| ZX-ED01T | |
| ZX-ED02T | 11 to 22 mm |

Installation Location

Do not install the product in the following locations.

- Locations subject to temperatures outside the specified range
- Locations subject to condensation due to sudden temperature changes
- Locations subject to humidity levels outside range 35% to 85%
- Locations subject to corrosive or flammable gases
- Locations subject to dust, salts, or metallic powder.
- Locations directly subject to vibrations and shocks
- Locations subject to direct sunlight
- Locations subject to splashes of water, oil, or chemicals
- Locations subject to strong electromagnetic or electrical fields

Maintenance and Inspection

- Be sure to turn OFF the power supply before adjusting or removing the Sensor Head.
- Cleaning:
Do not use thinners, benzine, acetone, or kerosene for cleaning.

Dimensions

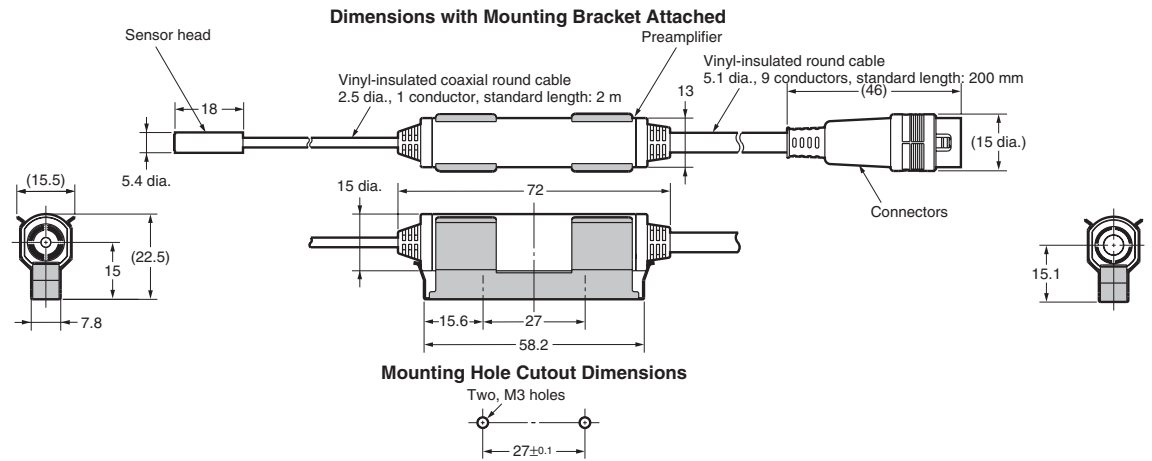
Sensors

Sensor Heads

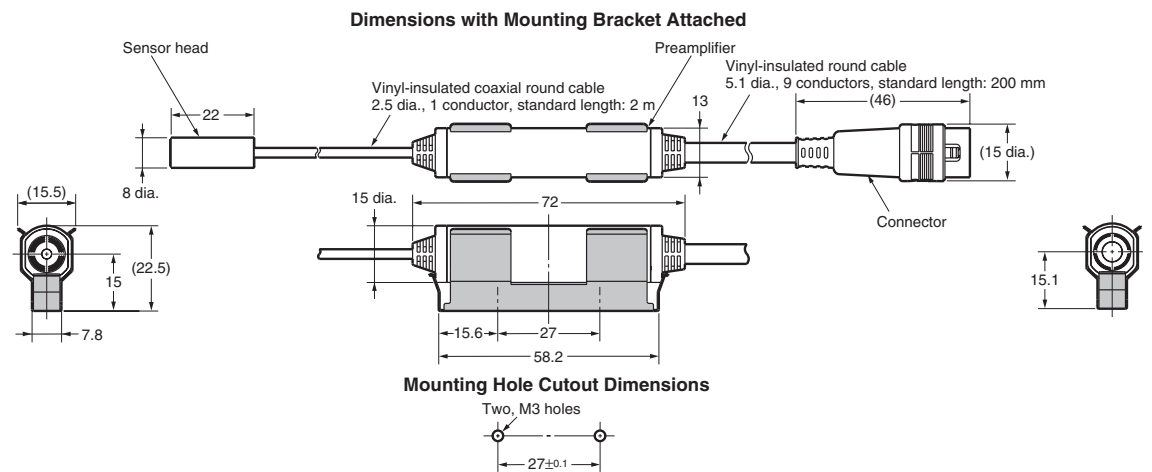
ZX-EDR5T



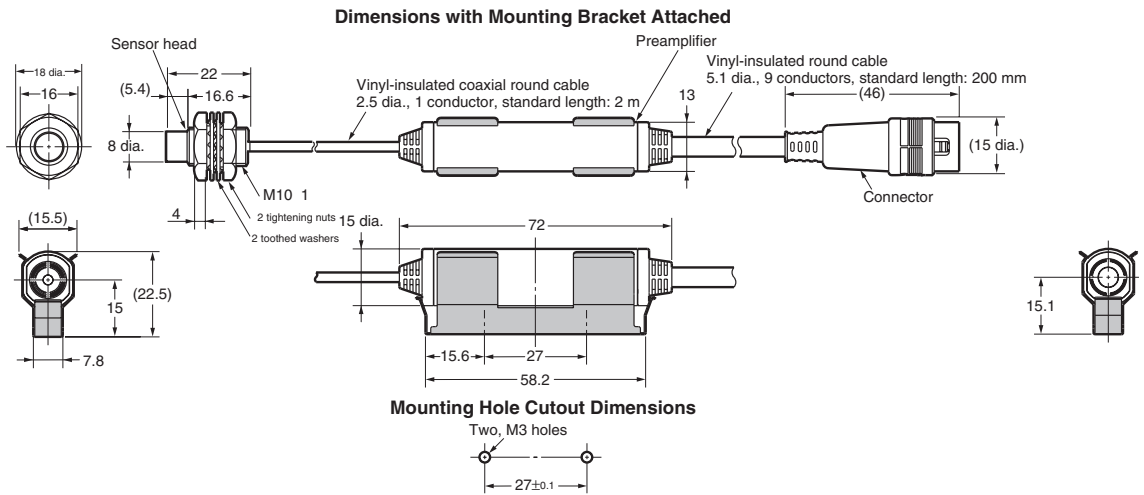
ZX-ED01T



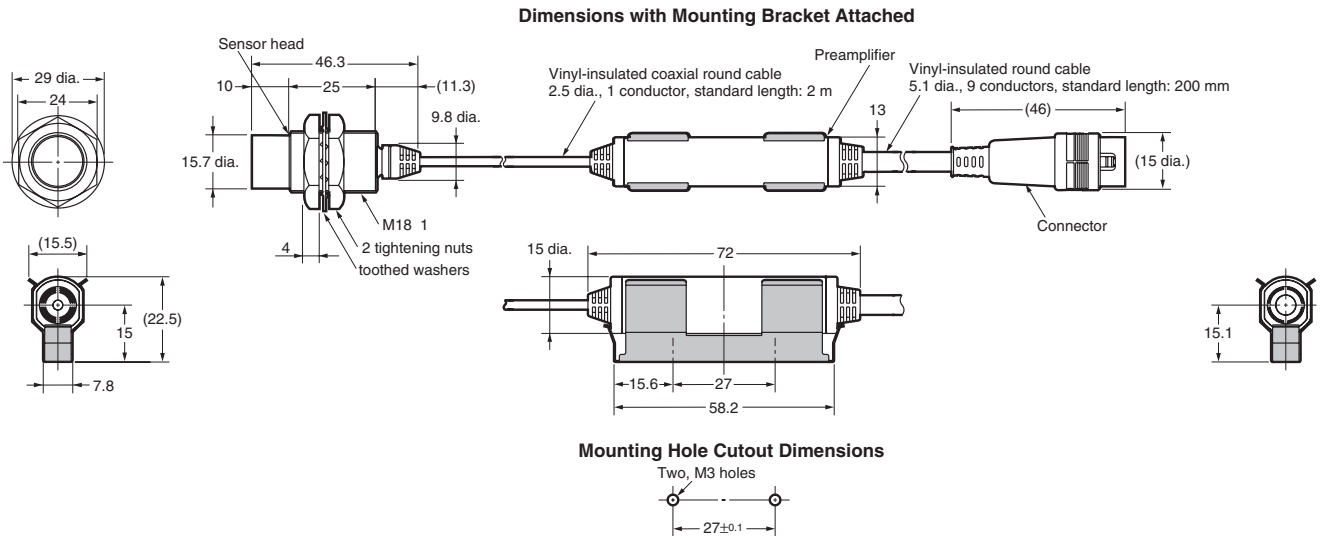
ZX-ED02T



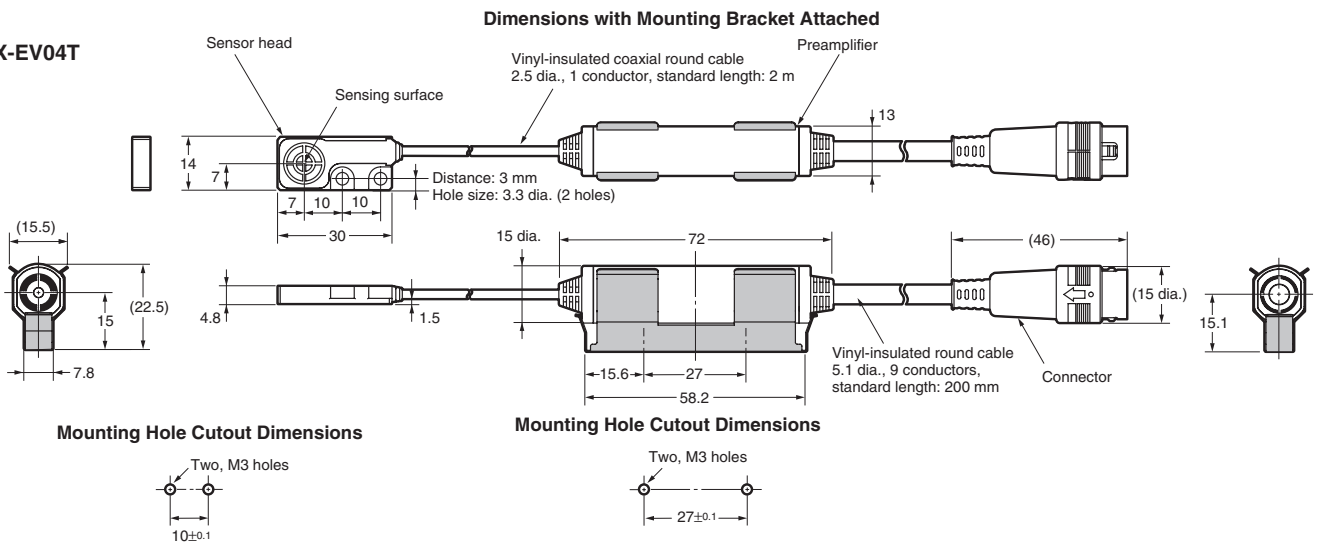
ZX-EM02T



ZX-EM07MT



ZX-EV04T



ZX-EM02HT



Mounting Hole Cutout Dimensions



Dimensions with Mounting Bracket Attached



Amplifier Units

- ZX-EDA11
- ZX-EDA41



Accessories (Sold Separately)

Preamplifier Mounting Bracket

ZX-XBE1



ZX-XBE2



Calculating Unit

ZX-CAL2



ZX-series Communications Interface Unit

ZX-SF11



Cables with Connectors on Both Ends (for Extension)

- ZX-XC1A (1 m)
- ZX-XC4A (4 m)
- ZX-XC8A (8 m)



ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.

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

This document provides information mainly for selecting suitable models. Please read the manual carefully for information that the user must understand and accept before purchase, including information on warranty, limitations of liability, and precautions.

CSM_8_1_0215
E331-E1

In the interest of product improvement, specifications are subject to change without notice.

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