

## LED Displacement Sensor

## Z4W-V

### Low-cost Displacement Sensor with 10-micron Resolution with Red LED

- Measurement point: 25 mm;  
measurement range:  $\pm 4$  mm.
- Easy adjustment, range/stable light indicators.
- Easy-to-use built-in Amp.
- High-speed response: 5 ms.
- Visible beam spot.
- Enclosure rating: IP66.

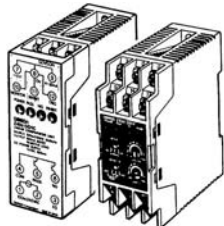
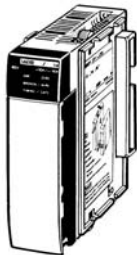


### Ordering Information

| Sensing distance | Resolution | Model    |
|------------------|------------|----------|
| 25 $\pm$ 4 mm    | 10 $\mu$ m | Z4W-V25R |

### ■ Selecting a Controller

The following controllers can be used with the analog output of the Z4W-V25R. Select one that suits your application.

| Unit            | Z4W-DD1C                                                                           | S3A-D□K-□                                                                                   | K3TX                                                                                              | K3TS                                                                                                                                                                                                                                      | CQM1                                                                                                                                                                                                           |
|-----------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 |  |           |                |                                                                                                                                                       |                                                                                                                            |
| <b>Name</b>     | Linear Sensor Controller                                                           | Linear Sensor Controller                                                                    | Intelligent Signal Processor                                                                      | Intelligent Signal Processor                                                                                                                                                                                                              | Linear Sensor Interface Unit                                                                                                                                                                                   |
| <b>Model</b>    | Z4W-DD1C                                                                           | S3A-DAK                                                                                     | K3TX-AD□-□□                                                                                       | K3TS-SD□□□-□□                                                                                                                                                                                                                             | CQM1-LSE01/02                                                                                                                                                                                                  |
| <b>Features</b> | Ideal for dimensional checks with Displacement Sensors (tolerance: $\pm 0.1$ mm).  | Accurate setting possible via gauged dials. Provides both open-collector and relay outputs. | High accurate ( $\pm 0.1\%$ ) panel meter. Five discrimination levels. Available with BCD output. | High-speed sampling of 1.04 ms. Dual inputs with arithmetic functions. Forced zero function and other versatile functions incorporated. A sensor power supply with a capacity of 80 mA at 12 VDC incorporated. Five-level discrimination. | High-speed sampling of 1 ms (03 ms for timing input) without CQM1 programs. A forced-zero function lets you easily change reference points for different workpieces. Monitor output available with CQM1-LSE02. |

# Specifications

## ■ Ratings

|                             |                                                                                                                                                                            |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measurement range           | ±4 mm                                                                                                                                                                      |
| Measurement point           | 25±1 mm                                                                                                                                                                    |
| Light source                | Red LED                                                                                                                                                                    |
| Spot diameter               | 2-mm dia. (at measurement point)                                                                                                                                           |
| Resolution                  | 10 microns (see Note. 1)                                                                                                                                                   |
| Linearity                   | ±3% FS (See Note. 2)                                                                                                                                                       |
| Response time               | 5 ms (In case of white alumina ceramic. Linearity change according to object.)                                                                                             |
| Temperature characteristics | ±0.3% FS/°C                                                                                                                                                                |
| Warming up time             | 3 min (within 1% of stable value)                                                                                                                                          |
| Indicators                  | Stability:    Stable range:    Lit green<br>Operating range: Not lit<br>Dark:                Lit red<br>Range:       In range:            Green<br>Out of range:       Red |
| Outputs                     | Analog output:    4 to 20 mA/±4 mm<br>Load impedance: 300Ω max.<br>DARK output:    NPN open collector<br>50 mA max., 30 VDC<br>Residual voltage: 1 V max.                  |
| External light              | 3,000 In (incandescent light)                                                                                                                                              |

## ■ Characteristics

|                      |                                                                                                          |
|----------------------|----------------------------------------------------------------------------------------------------------|
| Power supply voltage | 12 to 24 VDC±10%: ripple (p-p) 10% max.                                                                  |
| Current consumption  | 80 mA max.                                                                                               |
| Vibration resistance | Destruction: 10 to 55 Hz (1.5-mm double amplitude) for 2 sweeps of 15 min each in X, Y, and Z directions |
| Shock resistance     | Destruction: 500 m/s <sup>2</sup> for 3 times each in X, Y, and Z directions                             |
| Ambient temperature  | Operating: -10° to 55°C (with no icing)                                                                  |
| Ambient humidity     | 35% to 85% (with no icing)                                                                               |
| Degree of protection | IP66                                                                                                     |
| Weight               | 150 g (with 5-m cable); 50 g (without cable)                                                             |
| Attachments          | Mounting bracket, mounting screws, resistor (250Ω, 0.5 W)                                                |

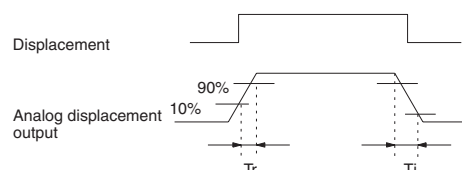
### Note: 1. Resolution

The resolution is the peak-to-peak displacement conversion value of the analog output.  
(Conditions: white alumina ceramic at the measurement point)



### 2. Response Time

The delays are the 10% to 90% rising and falling times of the analog output in response to a sudden change in the displacement.

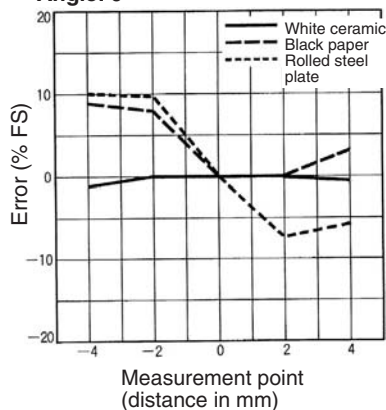
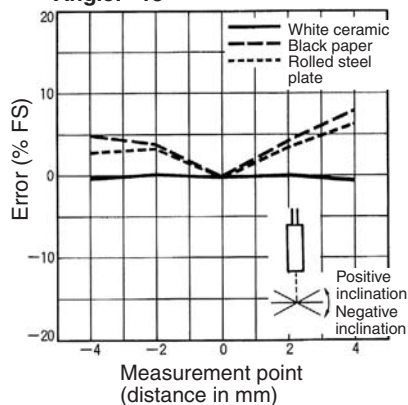
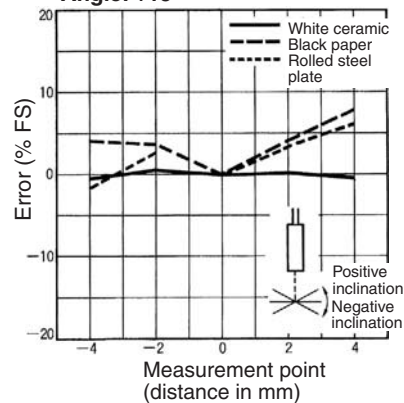
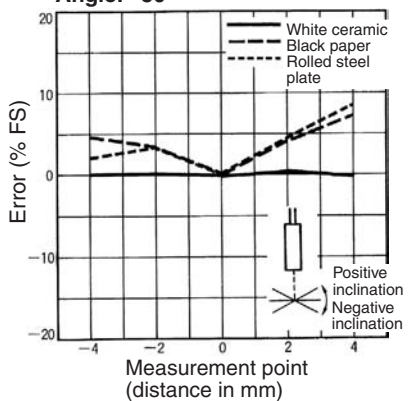
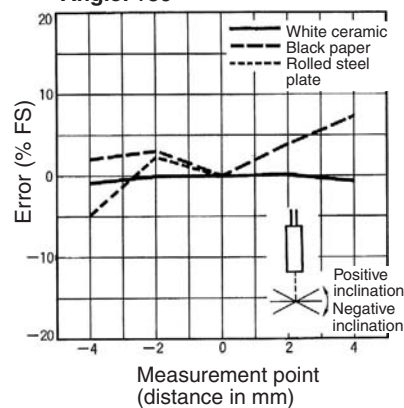
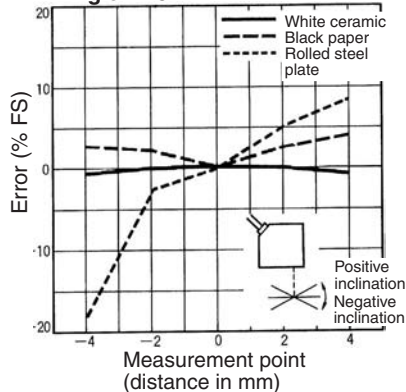
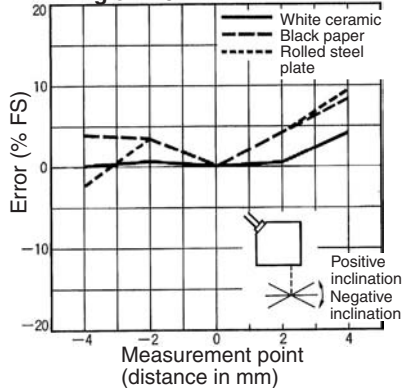
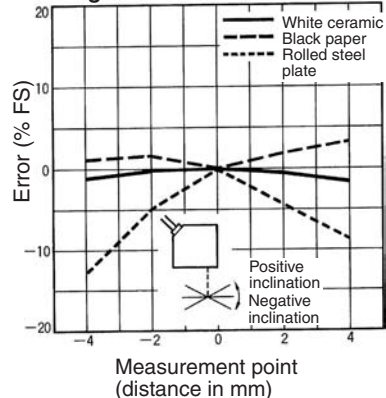
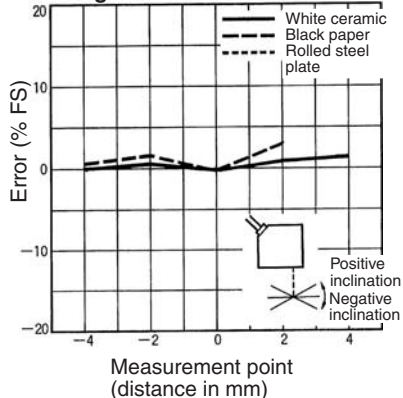


# Engineering Data

## ■ Linearity Characteristics vs. Objects

Linearity characteristic curves are obtained by detecting an object at different positions within the measurement range and plotting the analog output error resulting from each operation.

The LED Displacement Sensor cannot detect an object accurately if the reflection ratio of the object is extremely small (a black object) or extremely large (an object with a glossy surface).

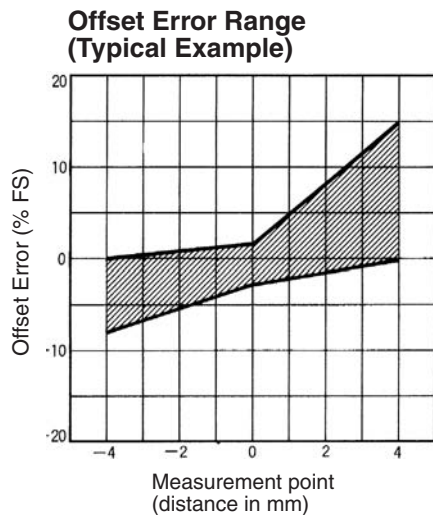
**Inclined Object (Typical Example)****Angle: 0°****Angle: -15°****Angle: +15°****Angle: -30°****Angle: +30°****Obliquely Positioned Object (Typical Example)****Angle: -15°****Angle: +15°****Angle: -30°****Angle: +30°**

**Note:** The LED Displacement Sensor cannot detect an object accurately if the object is positioned at an angle oblique to the sensor position. If the oblique angle is large, detection is not possible because of insufficient reflection of light. This must be taken into consideration when installing the sensor.

## ■ Sensing Various Objects

### Offset Error vs. Object Material

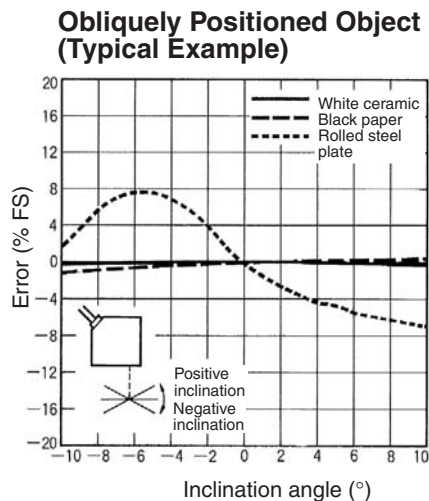
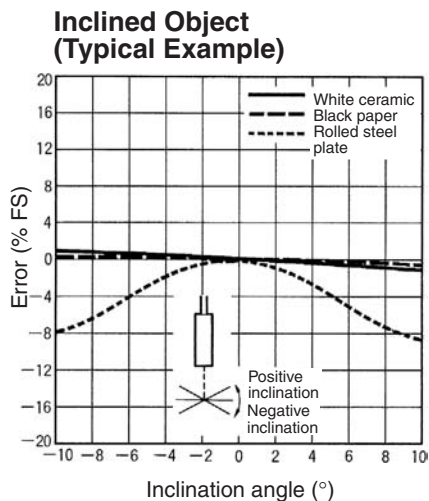
When detecting a variety of objects successively, refer to the offset error graph below. The graph illustrates the change in sensor output characteristics when black paper is compared to white paper. To reduce the offset error value, install the Sensor so that objects are detected at or as close as possible to the measurement point.



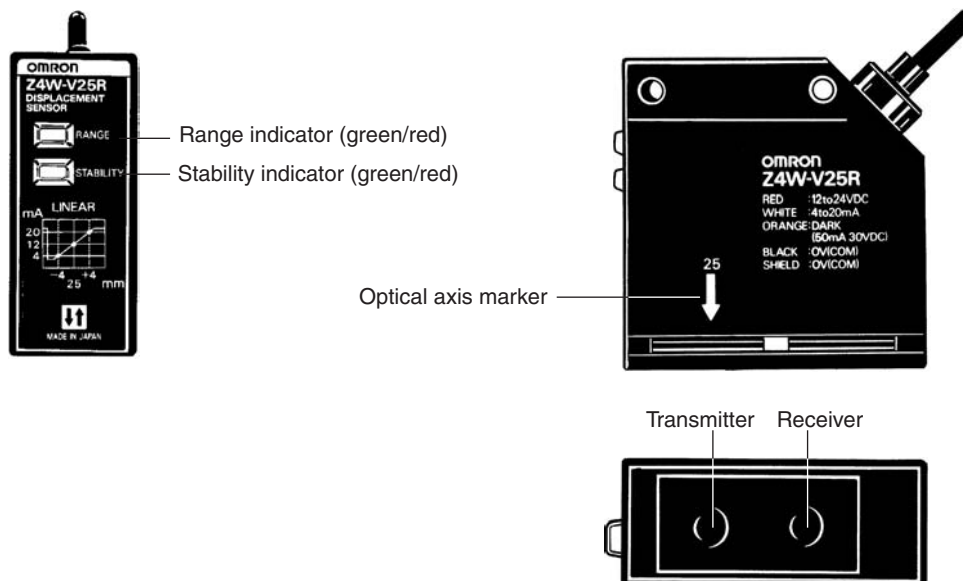
### ■ Angle Characteristics

The angle characteristics were obtained by detecting an object with different angles of inclination at the measurement point and plotting the analog output error resulting from each operation.

The LED Displacement Sensor is designed to detect the front of an object facing the sensor. Error occurs when the object is positioned at an oblique angle to the sensor.

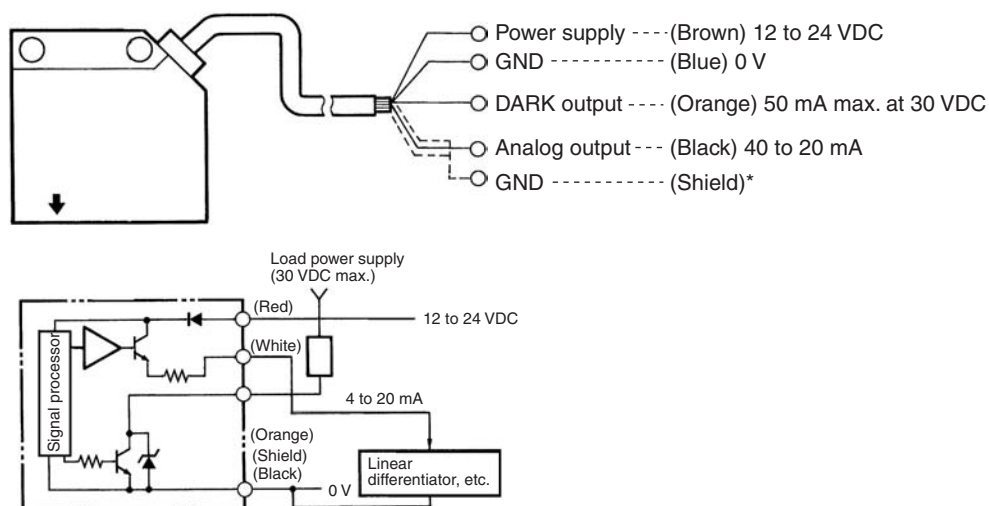


## Nomenclature



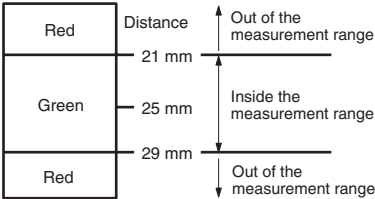
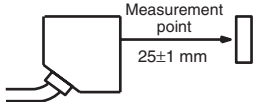
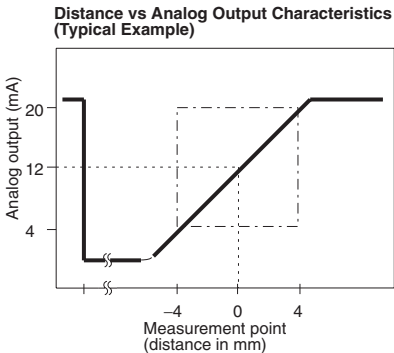
## Operation

### ■ Connections/Output Circuits



**Note:** \*The two ground terminals (black and shield) are internally connected. However, the black ground must be used with the red terminal for the power supply and the shield ground must be used with the white terminal for the analog output.

## ■ Functions

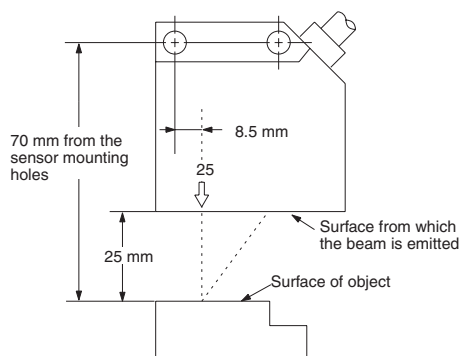
| Classification             | Functions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Remarks                                                                                                                                                                                                  |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Range indicator</b>     | <p>The green indicator is lit when the object is within the measurement range. The red indicator is lit when the object is not within the measurement range.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | When the intensity of the light input is insufficient (DARK output is ON and the red stability indicator is lit), the range indicator all remain OFF even if the object is within the measurement range. |
| <b>Stability indicator</b> | <p>These indicators indicate the intensity of the light input. The object in the measurement range is detected when the green indicator is lit or OFF.</p> <p>The red indicator is lit when there is no object in the measurement range or the intensity of light input is insufficient.</p> <p>If this green indicator is lit when there is an object in the measurement range, the light source control circuit and light input sensitivity control circuit of the Sensor operate.</p> <p>Even if the green indicator is OFF, the Sensor works as long as the internal light source control circuit and the light input sensitivity circuit are within the operating range. In this case the red indicator is also OFF.</p> <p>When the Sensor is active for a long duration, the green indicator may turn OFF. This does not mean that the Sensor has malfunctioned.</p> | ---                                                                                                                                                                                                      |
| <b>DARK output</b>         | <p>The orange indicator (DARK output) is ON when there is no object in the measurement range or when the input light intensity is insufficient. The red stability indicator is also lit when DARK output is ON.</p> <p>The Sensor has an open collector output of 50 mA at 30 VDC max.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ---                                                                                                                                                                                                      |
| <b>Analog output</b>       | <p>An analog signal is output from the output line (white) according to the sensing distance.</p> <p>Output: 4 to 20 mA/21 to 29 mm (<math>\pm 4</math> mm)</p> <p>Load impedance: 300 <math>\Omega</math> max. The output range lies between 20.5 and 26 mA when DARK output is ON.</p>                                                                                                                                                                                                                                                                                                                                                                                                              | ---                                                                                                                                                                                                      |

## ■ Operations

### Basic Operation of the Z4W-V25R

#### Mounting

Install the Sensor so that the optical axis of the Sensor and the surface of the object meet at right angles (i.e., the panel that incorporates the light source is parallel with the object). For accurate results, it is recommended that the sensing distance is set to the measurement point (25 mm).



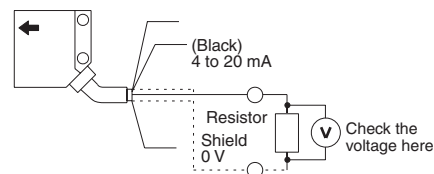
**Note:** Do not tighten the mounting screws for the moment as the optical axis must be adjusted.

#### Wiring

Connect the Sensor to the controlling device using a sensor cable. Do not switch power ON during wiring. Refer to the instructions on the Sensor and the connection diagram (page 5) before connecting the sensor to the controlling device.

#### Conversion to Voltage Output Model (1 to 5 V)

The Z4W-V25R has a current output of 4 to 20 mA. With the resistor provided (250  $\Omega$ ), a voltage output of 1 to 5 V can be obtained. Refer to the figure below for connection.

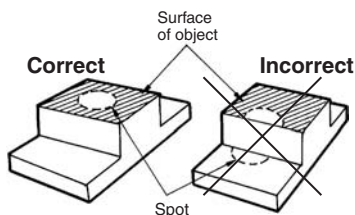


Although a resistor is included, any resistor may be used provided the resistance is 300  $\Omega$  or less.



### Axis Adjustment

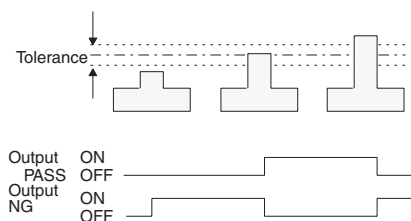
When the Sensor power is switched ON, the red transmitter indicator is lit. Move the Sensor so that the red beam (see the figure below) focuses on the object. The entire light beam should be focused on the object or an error will result.



After the optical axis has been adjusted, tighten the mounting screws firmly.

### Connecting a Z4W-DD1C Linear Sensor Controller

To discriminate among objects according to size, use the Z4W-V25R LED Displacement Sensor with a Z4W-DD1C Linear Sensor Controller.



The following equipment is required:

- Z4W-V25R LED Displacement Sensor
- Z4W-DD1C Linear Sensor Controller
- Synchronization Sensor (E3X Fiber Photoelectric Sensor or E3C-VM Miniature Head Photoelectric Sensor is recommended)
- An object of standard dimensions
- An object of threshold dimensions
- Tools

### Mounting

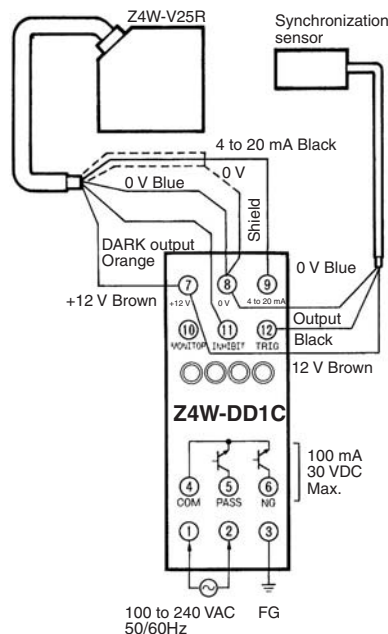
Mount as described on page 6.

When installing a Synchronization Sensor, refer to the instruction manual and read the precautions for the model. It is important to install the Synchronization Sensor so that the LED Displacement Sensor can detect the object at the measurement position. Do not tighten the mounting screws for the moment since the optical axis must be adjusted.

The Z4W-DD1C Linear Sensor Controller can be mounted on a wall and secured with screws, or mounted to DIN rail.

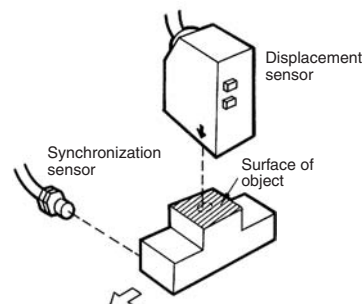
### Wiring

Make sure that the Linear Sensor Controller, the LED Displacement Sensor, and the Synchronization Sensor are wired correctly before turning on the Linear Sensor Controller power (power is supplied to the LED Displacement Sensor and the Linear Sensor Controller by the Linear Sensor Controller). To avoid trouble, leave the output terminals (No. 4, 5, 6) of the Linear Sensor Controller open for the moment.



### Axis Adjustment

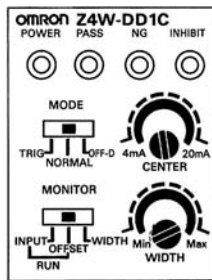
After adjusting the optical axis of the LED Displacement Sensor, adjust the optical axis of the Synchronization Sensor so that the LED Displacement Sensor detects the object at the measurement position in synchronous operation. Since the Linear Sensor Controller operates synchronously on receiving each output signal of the Synchronization Sensor, set the position of the Synchronization Sensor so that the front edge of the object is detected by the Synchronization Sensor.



After the optical axis has been adjusted, tighten the mounting screws and secure the Synchronization Sensor firmly. Some Synchronization Sensor models incorporate a sensitivity controller. For the adjustment of such models, refer to the instruction manual for the Synchronization Sensor.

## Adjustment and Operation of the Linear Sensor Controller

Control panel of the Linear Sensor Controller



The control panel consists of two switches (MODE and MONITOR), two adjusters (CENTER and WIDTH) and four indicators (POWER, PASS, NG, INHIBIT) for monitoring.

By adjusting the settings of the Linear Sensor Controller and compensating for the position of the LED Displacement Sensor, the size of the object of standard dimensions is registered with the Linear Sensor Controller. With the object of standard dimensions, operate the LED Displacement Sensor as follows:

1. Set the MODE switch to NORMAL.
2. Turn the WIDTH adjuster counterclockwise to the MIN position.
3. Turn the CENTER adjuster clockwise or counterclockwise and set the adjuster to the position where the PASS indicator is lit. If the PASS indicator is lit for a wide range of positions, set the adjuster in the middle of the range. If the PASS indicator does not light with the CENTER adjuster in any position, turn the WIDTH adjuster clockwise slightly.

An object of threshold dimensions or a multimeter can be used to determine the tolerance (use the object where possible).

### Determining Settings Using an Object

1. Prepare an object of threshold dimensions (an object with the allowable upper threshold dimensions or with the allowable lower threshold dimensions) to be detected by the LED Displacement Sensor.
2. Set the MODE switch to NORMAL.
3. Turn the WIDTH adjuster counterclockwise to the MIN position. The NG indicator will light.
4. Turn the WIDTH adjuster clockwise slowly to the position where the NG indicator turns OFF. The PASS indicator will light.

### Determining Settings Using a Multimeter

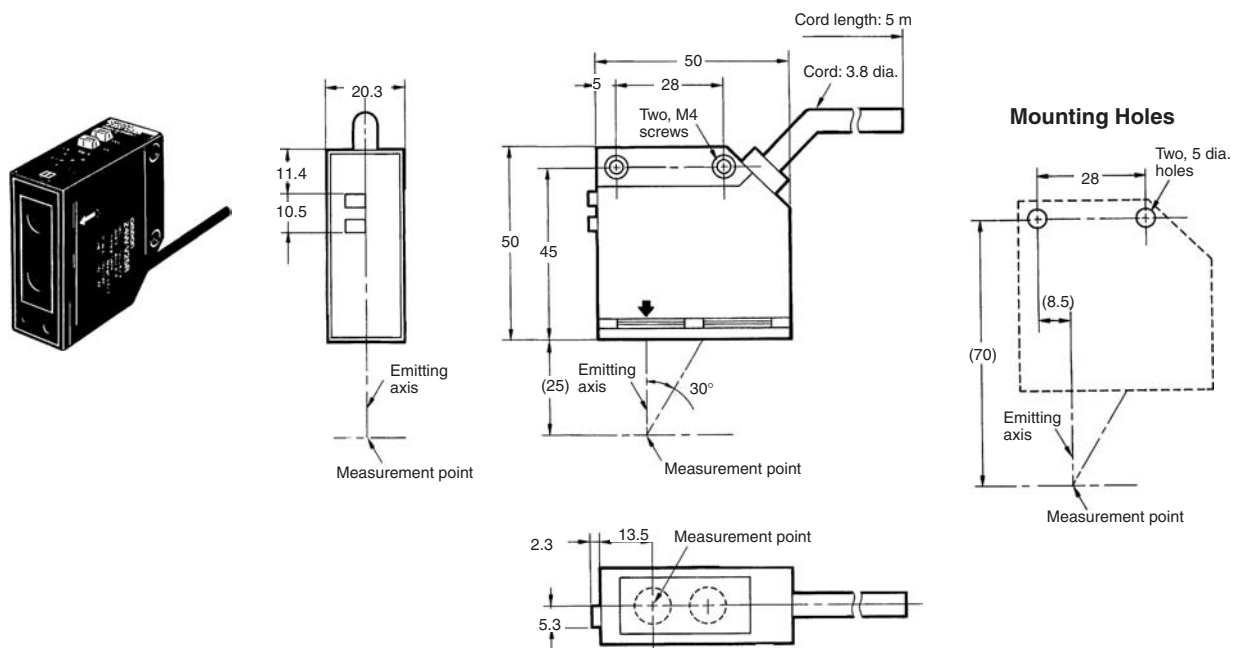
Determine the absolute tolerance,  $A$  (in mm), and obtain the voltage  $V_x$  (V) as follows (example for tolerance of  $\pm 0.5$  mm):

1. Set the MONITOR switch to WIDTH.
2. Check the voltage of monitor terminals 10 (positive voltage output) and 8 (negative voltage output) of the Linear Sensor Controller with the multimeter in the 10-VDC or 5-VDC range.
3. Turn the WIDTH adjuster clockwise or counterclockwise to the position where the voltage reaches  $V_x$  (obtained from the above formula).

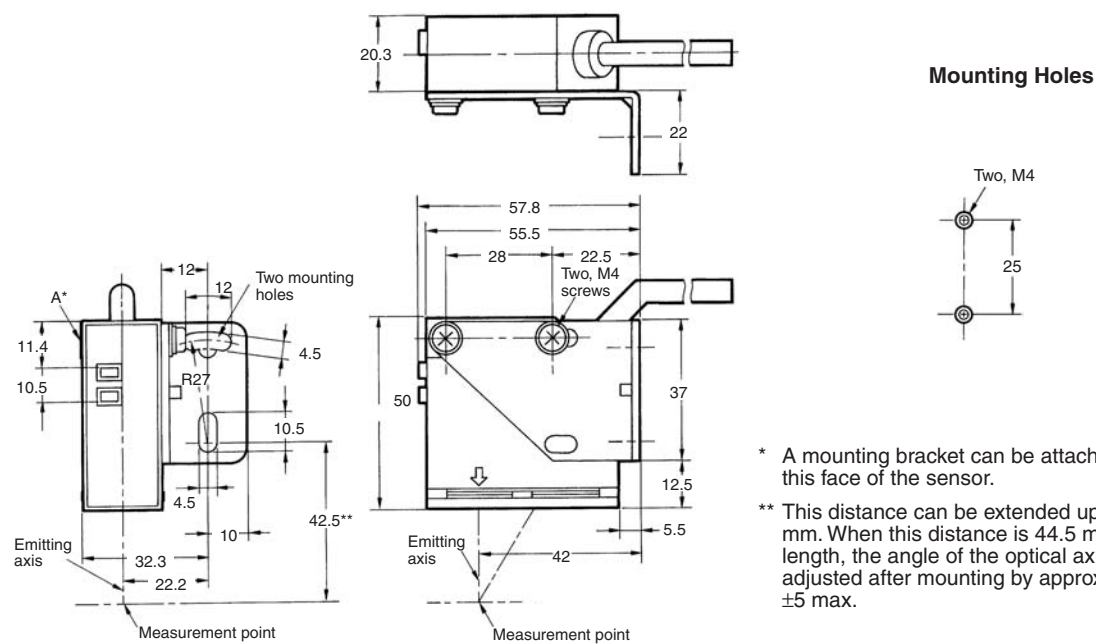
Set the MODE switch to TRIG as follows:

1. Set the MODE switch to TRIG.
2. Set the MONITOR switch to INPUT or OFFSET (RUN).
3. Turn off the power and wire the output terminals (No. 4, 5, and 6).



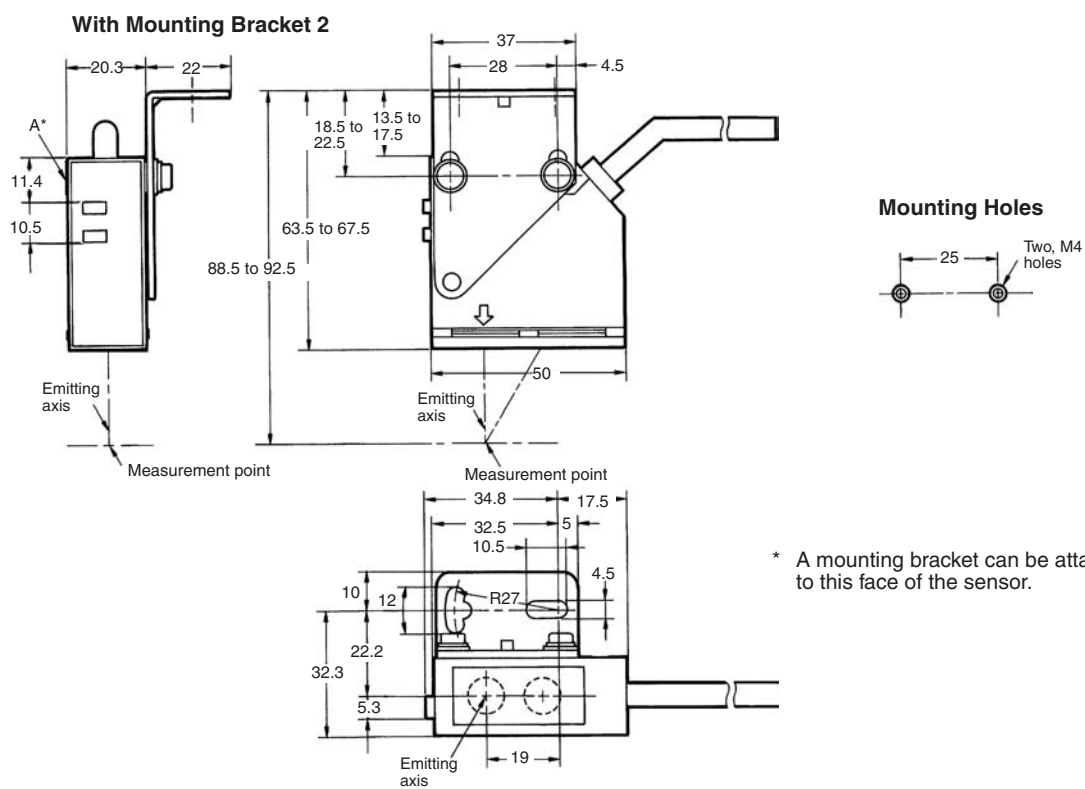


### With Mounting Bracket 1



\* A mounting bracket can be attached to this face of the sensor.

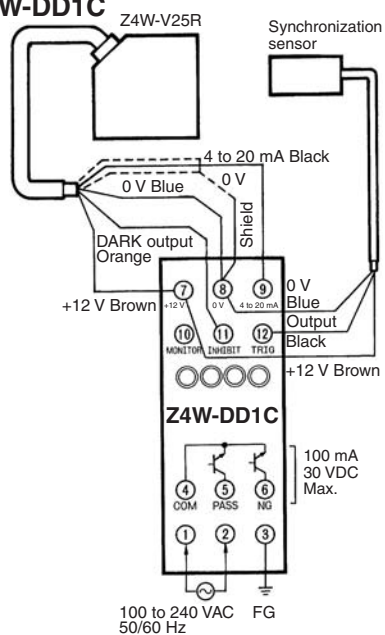
**\*\* This distance can be extended up to 44.5 mm. When this distance is 44.5 mm in length, the angle of the optical axis can be adjusted after mounting by approximately  $\pm 5$  max.**



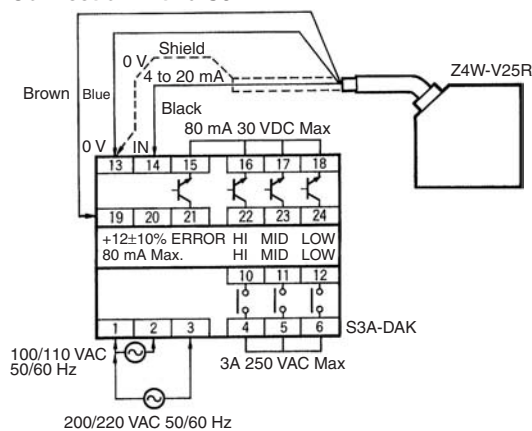
# Installation

## ■ Controller Connections

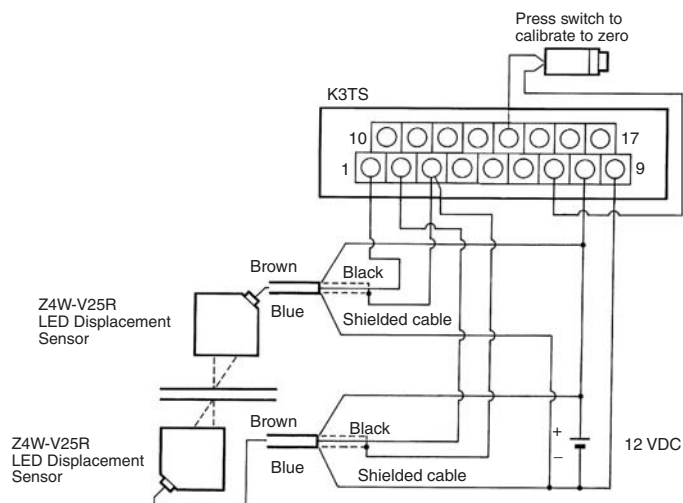
### Z4W-DD1C



### Connection with a S3A-DAK



### Connection with a K3TX



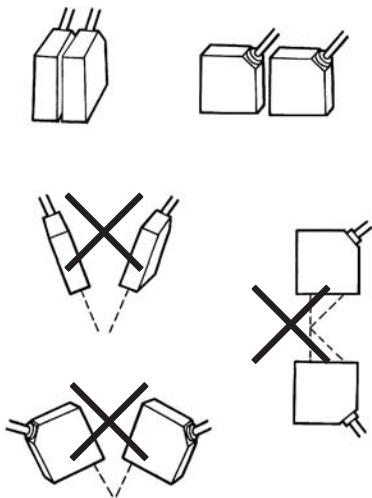
## Precautions

Install the Sensor in a clean environment keep the filter (on the front of the Sensor) free from oil and dust. If affected by oil or dust, clean the Sensor as follows:

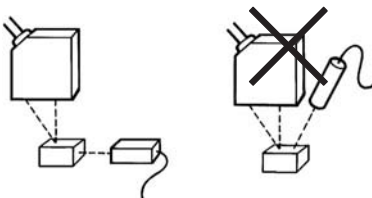
1. Use a blower brush (used to clean camera lenses) to blow large dust particles from the surface. Do not blow the dust away with your mouth.
2. Use a soft cloth (for lenses) with a little alcohol to remove the remaining dust.  
Do not use a scrubbing action when cleaning as a scratch on the filter could result in the Sensor malfunctioning.

### Interference

Z4W-V25R LED Displacement Sensors can be installed within close proximity to each other and operate independently without interference (refer to the figures below). However, if they are installed at an oblique angle to each other, interference may result.



When using the LED Displacement Sensor in combination with another type of Sensor (such as a Photoelectric Sensor), the sensor beams should be as close to perpendicular as possible.



### Environment

Refrain from using the LED Displacement Sensor in a strong electromagnetic field or in an environment where the operation of the Sensor is subject to the reflection of intensive light (such as a laser beam or an electric arc welding machine).

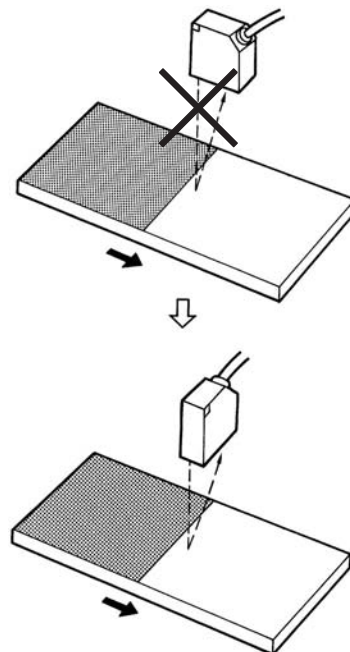
The LED Displacement Sensor cannot accurately detect a mirror-like object, a transparent object, one with an extremely small reflection ratio, an object smaller than the diameter of the Sensor's sensing spot, or an inclined object.

### Wiring

The power supply cable for the Z4W-V25R should not be wired with high-voltage lines or power lines in order to avoid interference, damage, or malfunction.

### Others

The Sensor cannot detect an object accurately if the surface of the object consists of different materials placed next to each other (refer to the figures below). In such case install the Sensor so that the boundaries of the materials and the Sensor are parallel.



**ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.**

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

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

## OMRON Corporation

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## Application Considerations

### SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the product.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

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