

## Standard Flat Sensors in Many Different Variations

- Only 6 mm thick yet provides a sensing distance of 3 mm (TL-W3MC1).
- Aluminum die-cast models also available.




Be sure to read *Safety Precautions* on page 7.

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



## Ordering Information

Sensors [Refer to *Dimensions* on page 8.]

### DC 2-Wire Models

| Appearance  | Sensing distance |  |  | Model             |                |
|---|------------------|--|--|-------------------|----------------|
|   |                  |  |  | Operation mode    |                |
|   |                  |  |  | NO                | NC             |
| Unshielded<br> | 5 mm             |  |  | TL-W5MD1 2M *1 *2 | TL-W5MD2 2M *2 |

### DC 3-Wire Models

| Appearance  | Sensing distance |  |     | Output configuration | Model               |                   |
|---|------------------|--|-----|----------------------|---------------------|-------------------|
|   |                  |  |     |                      | Operation mode      |                   |
|   |                  |  |     |                      | NO                  | NC                |
| Unshielded<br> | 1.5 mm           |  |     | NPN                  | TL-W1R5MC1 2M *1 *2 | ---               |
|   |                  |  |     | PNP                  | TL-W1R5MB1 2M       | ---               |
|   | 3 mm             |  |     | NPN                  | TL-W3MC1 2M *1 *2   | TL-W3MC2 2M *1 *2 |
|   |                  |  |     | PNP                  | TL-W3MB1 2M *2      | TL-W3MB2 2M *2    |
|   | 5 mm             |  |     | NPN                  | TL-W5MC1 2M *1 *2   | TL-W5MC2 2M       |
|   |                  |  |     | PNP                  | TL-W5MB1 2M         | TL-W5MB2 2M       |
| 20 mm   |                  |  | NPN | TL-W20ME1 2M *1      | TL-W20ME2 2M *1     |                   |
| Shielded<br>   | 5 mm             |  |     | NPN                  | TL-W5E1 2M          | TL-W5E2 2M        |
|   |                  |  |     | PNP                  | TL-W5F1 2M          | TL-W5F2 2M        |

\*1. Models with a different frequency are also available to prevent mutual interference. The model numbers are TL-W□M□□5 (e.g., TL-W5MD15).

\*2. Models are also available with robotics (bend resistant) cables. Add "-R" to the model number. (e.g., TL-W5MC1-R 2M)

## Ratings and Specifications

### DC 2-Wire Models

| Item   | Model            | TL-W5MD□   |
|--|------------------|--|
| Sensing distance                                 |                  | 5 mm ±10%  |
| Set distance                                     |                  | 0 to 4 mm  |
| Differential travel                              |                  | 10% max. of sensing distance   |
| Detectable object                                |                  | Ferrous metal (The sensing distance decreases with non-ferrous metal. Refer to <i>Engineering Data</i> on page 5.) |
| Standard sensing object                          |                  | Iron, 18 × 18 × 1 mm   |
| Response frequency *1                            |                  | 500 Hz   |
| Power supply voltage (operating voltage range)   |                  | 12 to 24 VDC (10 to 30 VDC), ripple (p-p): 10% max.  |
| Leakage current                                  |                  | 0.8 mA max.  |
| Control output                                   | Load current     | 3 to 100 mA  |
|  | Residual voltage | 3.3 V max. (under load current of 100 mA with cable length of 2 m)   |
| Indicators                                       |                  | D1 Models: Operation indicator (red), Setting indicator (green)<br>D2 Models: Operation indicator (red)            |
| Operation mode (with sensing object approaching) |                  | D1 Models: NO Refer to the timing charts under <i>I/O Circuit Diagrams</i> on page 5 for details.<br>D2 Models: NC |
| Protection circuits                              |                  | Load short-circuit protection, Surge suppressor  |
| Ambient temperature range                        |                  | Operating/Storage: -25 to 70°C (with no icing or condensation) *2  |
| Ambient humidity range                           |                  | Operating/Storage: 35% to 95% (with no condensation)   |
| Temperature influence                            |                  | ±10% max. of sensing distance at 23°C in the temperature range of -25 to 70°C                                      |
| Voltage influence                                |                  | ±2.5% max. of sensing distance at rated voltage in the rated voltage ±15% range                                    |
| Insulation resistance                            |                  | 50 MΩ min. (at 500 VDC) between current-carrying parts and case  |
| Dielectric strength                              |                  | 1,000 VAC for 1 min between current-carrying parts and case  |
| Vibration resistance                             |                  | Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions                       |
| Shock resistance                                 |                  | Destruction: 500 m/s <sup>2</sup> 3 times each in X, Y, and Z directions   |
| Degree of protection                             |                  | IEC 60529 IP67, in-house standards: oil-resistant *2   |
| Connection method                                |                  | Pre-wired Models (Standard cable length: 2 m)  |
| Weight (packed state)                            |                  | Approx. 80 g   |
| Materials  | Case             | Heat-resistant ABS   |
|  | Sensing surface  |  |
| Accessories                                      |                  | Instruction manual   |

\*1. The response frequency is an average value.

Measurement conditions are as follows: standard sensing object, a distance of twice the standard sensing object, and a set distance of half the sensing distance.

\*2. For environments that require oil resistance, the upper limit of the ambient operating temperature range is 40°C.

DC 3-Wire Models

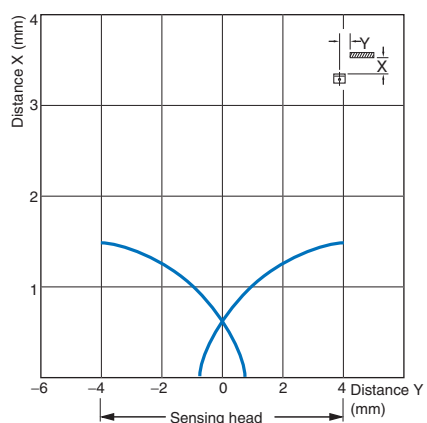
| Item   | Model            | TL-W1R5MC1<br>TL-W1R5MB1  | TL-W3MC□<br>TL-W3MB□                 | TL-W5MC□<br>TL-W5MB□   | TL-W5E1, TL-W5E2<br>TL-W5F1, TL-W5F2  | TL-W20ME1<br>TL-W20ME2  |
|--|------------------|---|--------------------------------------|--|---|---|
| Sensing distance                                 |                  | 1.5 mm ±10%   | 3 mm ±10%                            | 5 mm ±10%  |   | 20 mm ±10%  |
| Set distance                                     |                  | 0 to 1.2 mm   | 0 to 2.4 mm                          | 0 to 4 mm  |   | 0 to 16 mm  |
| Differential travel                              |                  | 10% max. of sensing distance  |                                      |  |   | 1% to 15% of sensing distance   |
| Detectable object                                |                  | Ferrous metal (The sensing distance decreases with non-ferrous metal. Refer to <i>Engineering Data</i> on page 5.)                        |                                      |  |   |   |
| Standard sensing object                          |                  | Iron, 8 × 8 × 1 mm  | Iron, 12 × 12 × 1 mm                 | Iron, 18 × 18 × 1 mm   |   | Iron, 50 × 50 × 1 mm  |
| Response frequency                               |                  | 1 kHz min.  | 600 Hz min.                          | 500 Hz min.  | 300 Hz min.   | 40 Hz min.  |
| Power supply voltage (operating voltage range)   |                  | 12 to 24 VDC (10 to 30 VDC), ripple (p-p): 10% max.   |                                      |  | 12 to 24 VDC (10 to 30 VDC), ripple (p-p): 20% max.                             | 12 to 24 VDC (10 to 30 VDC), ripple (p-p): 10% max.                       |
| Current consumption                              |                  | 15 mA max. at 24 VDC (no-load)  |                                      | 10 mA max. at 24 VDC (no-load)   | 15 mA max. at 24 VDC (no-load)  | 8 mA at 12 VDC, 15 mA at 24 VDC   |
| Control output                                   | Load current     | TL-W1R5MC1:<br>NPN open collector<br>100 mA max. at 30 VDC max.<br>TL-W1R5MC1/-W3MB□:<br>PNP open collector<br>100 mA max. at 30 VDC max. |                                      | TL-W5MC□:<br>NPN open collector<br>50 mA max. at 12 VDC (30 VDC max.)<br>100 mA max. at 24 VDC (30 VDC max.)<br>TL-W5MB□:<br>PNP open collector<br>50 mA max. at 12 VDC (30 VDC max.)<br>100 mA max. at 24 VDC (30 VDC max.) | 200 mA  | 100 mA max. at 12 VDC<br>200 mA max. at 24 VDC                            |
|  | Residual voltage | 1 V max. (under load current of 100 mA with cable length of 2 m)  |                                      | 2 V max. (under load current of 200 mA with cable length of 2 m)   | 1 V max. (under load current of 200 mA with cable length of 2 m)                |   |
| Indicators                                       |                  | Detection indicator (red)   |                                      |  |   |   |
| Operation mode (with sensing object approaching) |                  | NO  | B1/C1 Models: NO<br>B2/C2 Models: NC |  | E1/F1 Models: NO<br>E2/F2 Models: NC  |   |
|  |                  | Refer to the timing charts under <i>I/O Circuit Diagrams</i> on page 6 for details.   |                                      |  |   |   |
| Protection circuits                              |                  | Reverse polarity protection, Surge suppressor   |                                      |  |   |   |
| Ambient temperature range                        |                  | Operating/Storage: -25 to 70°C (with no icing or condensation) *  |                                      |  |   |   |
| Ambient humidity range                           |                  | Operating/Storage: 35% to 95% (with no condensation)  |                                      |  |   |   |
| Temperature influence                            |                  | ±10% max. of sensing distance at 23°C in the temperature range of -25 to 70°C   |                                      |  |   |   |
| Voltage influence                                |                  | ±2.5% max. of sensing distance at rated voltage in the rated voltage ±10% range   |                                      | ±2.5% max. of sensing distance at rated voltage in the rated voltage ±20% range  | ±2.5% max. of sensing distance at rated voltage in the rated voltage ±10% range |   |
| Insulation resistance                            |                  | 50 MΩ min. (at 500 VDC) between current-carrying parts and case   |                                      |  |   |   |
| Dielectric strength                              |                  | 1,000 VAC, 50/60 Hz for 1 minute between current-carrying parts and case  |                                      |  |   |   |
| Vibration resistance                             |                  | Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions  |                                      |  |   |   |
| Shock resistance                                 |                  | Destruction: 500 m/s <sup>2</sup> 3 times each in X, Y, and Z directions  |                                      |  |   | Destruction: 500 m/s <sup>2</sup> 10 times each in X, Y, and Z directions |
| Degree of protection                             |                  | IEC 60529 IP67, in-house standards: oil-resistant *   |                                      |  |   |   |
| Connection method                                |                  | Pre-wired Models (Standard cable length: 2 m)   |                                      |  |   |   |
| Weight (packed state)                            |                  | Approx. 70 g  |                                      | Approx. 80 g   | Approx. 100 g   | Approx. 210 g   |
| Materials  | Case             | Heat-resistant ABS  |                                      |  | Aluminum die-cast   | Heat-resistant ABS  |
|  | Sensing surface  | Heat-resistant ABS  |                                      |  |   |   |
| Accessories                                      |                  | Mounting Bracket, Instruction manual  |                                      | Instruction manual   |   |   |

\* For environments that require oil resistance, the upper limit of the ambient operating temperature range is 40°C.

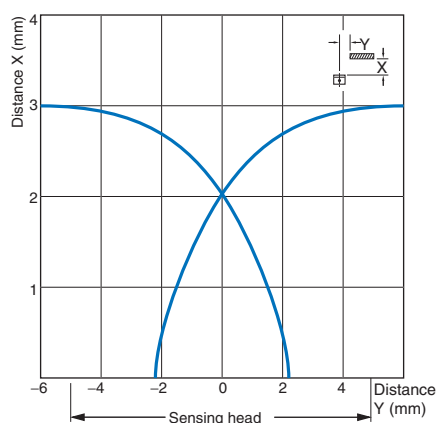
## Engineering Data (Reference Value)

### Sensing Area

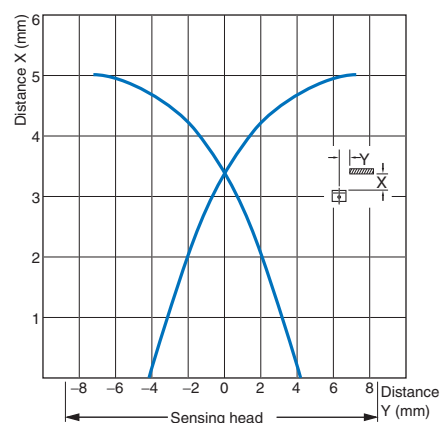
TL-W1R5M□1



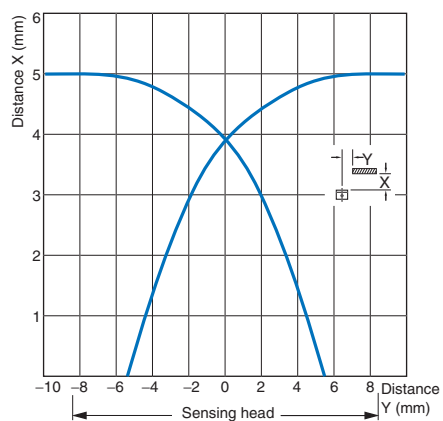
TL-W3M□1



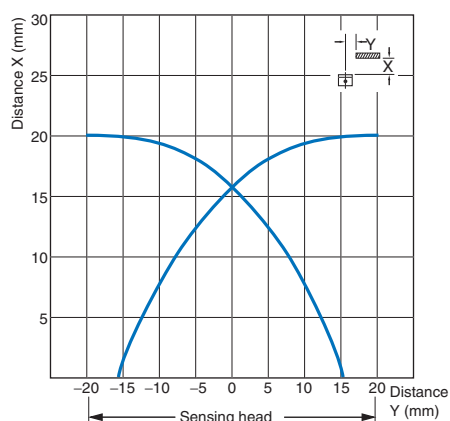
TL-W5M□1/W5MD□



TL-W5E/-W5F

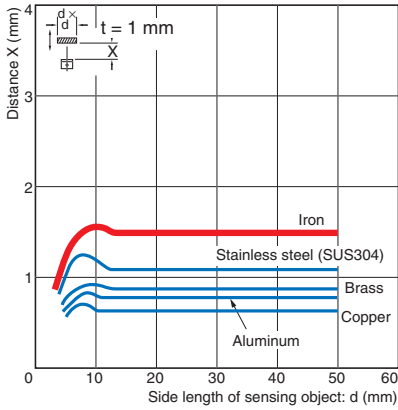


TL-W20□

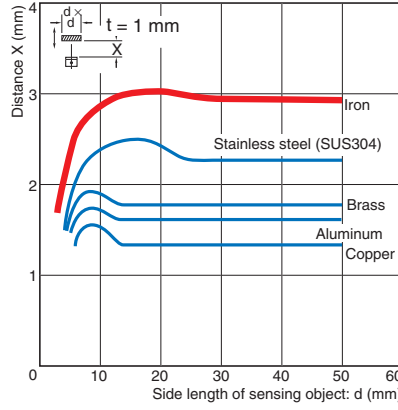


Influence of Sensing Object Size and Material

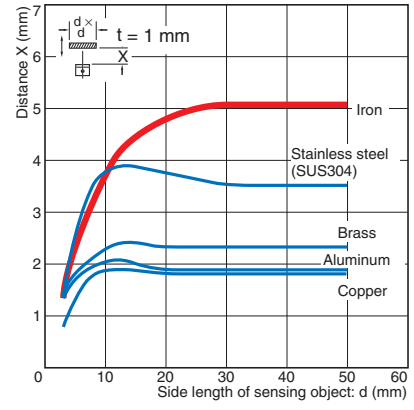
TL-W1R5M□1



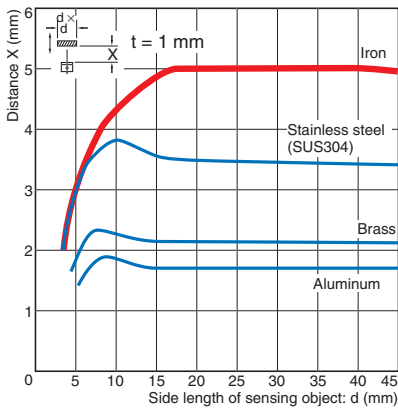
TL-W3M□1



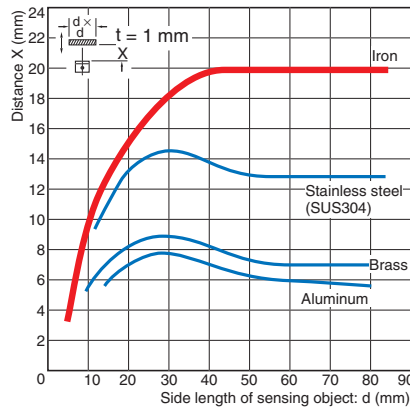
TL-W5M□1



TL-W5E□/-W5F□/-W5MD□



TL-W20□



I/O Circuit Diagrams

DC 2-Wire Models

| Model    | Operation mode | Timing chart | Output circuit   |
|----------|----------------|--------------|--|
| TL-W5MD1 | NO             |              | <p>Note: The load can be connected to either the +V or 0 V side.</p> |
| TL-W5MD2 | NC             |              |  |

DC 3-Wire Models

| Model                              | Operation mode | Output configuration | Timing chart  | Output circuit   |
|------------------------------------|----------------|----------------------|---|--|
| TL-W1R5MC1<br>TL-W3MC1<br>TL-W5MC1 | NO             | NPN                  | <p>Sensing object</p> <p>Present Not present</p> <p>Output transistor (load)</p> <p>ON OFF</p> <p>Detection indicator (red)</p> <p>ON OFF</p>   | <p>* Load current: 100 mA max.</p>   |
| TL-W3MC2<br>TL-W5MC2               | NC             | NPN                  | <p>Sensing object</p> <p>Present Not present</p> <p>Output transistor (load)</p> <p>ON OFF</p> <p>Detection indicator (red)</p> <p>ON OFF</p>   | <p>* Load current: 100 mA max.</p>   |
| TL-W1R5MB1                         | NO             | PNP                  | <p>Sensing object</p> <p>Present Not present</p> <p>Output transistor (load) (between blue and black leads)</p> <p>ON OFF</p> <p>Detection indicator (red)</p> <p>ON OFF</p>  | <p>* Load current: 100 mA max.</p>   |
| TL-W3MB1                           | NO             | PNP                  | <p>Sensing object</p> <p>Present Not present</p> <p>Output transistor (load) (between blue and black leads)</p> <p>ON OFF</p> <p>Detection indicator (red)</p> <p>ON OFF</p>  | <p>* Load current: 100 mA max.</p>   |
| TL-W3MB2                           | NC             | PNP                  | <p>Sensing object</p> <p>Present Not present</p> <p>Output transistor (load) (between blue and black leads)</p> <p>ON OFF</p> <p>Detection indicator (red)</p> <p>ON OFF</p>  | <p>* Load current: 100 mA max.</p>   |
| TL-W5E1<br>TL-W20ME1               | NO             | NPN                  | <p>Sensing object</p> <p>Present Not present</p> <p>Load (between brown and black leads)</p> <p>Operate Reset</p> <p>Output voltage (between black and blue leads)</p> <p>High Low</p> <p>Detection indicator (red)</p> <p>ON OFF</p> | <p>*1. Load current: 200 mA max.<br/>*2. When a transistor is connected.</p> |
| TL-W5E2<br>TL-W20ME2               | NC             | NPN                  | <p>Sensing object</p> <p>Present Not present</p> <p>Load (between brown and black leads)</p> <p>Operate Reset</p> <p>Output voltage (between black and blue leads)</p> <p>High Low</p> <p>Detection indicator (red)</p> <p>ON OFF</p> | <p>*1. Load current: 200 mA max.<br/>*2. When a transistor is connected.</p> |
| TL-W5F1                            | NO             | PNP                  | <p>Sensing object</p> <p>Present Not present</p> <p>Load (between blue and black leads)</p> <p>Operate Reset</p> <p>Output voltage (between blue and black leads)</p> <p>High Low</p> <p>Detection indicator (red)</p> <p>ON OFF</p>  | <p>*1. Load current: 200 mA max.<br/>*2. When a transistor is connected.</p> |
| TL-W5F2                            | NC             | PNP                  | <p>Sensing object</p> <p>Present Not present</p> <p>Load (between blue and black leads)</p> <p>Operate Reset</p> <p>Output voltage (between blue and black leads)</p> <p>High Low</p> <p>Detection indicator (red)</p> <p>ON OFF</p>  | <p>*1. Load current: 200 mA max.<br/>*2. When a transistor is connected.</p> |

## Safety Precautions

Refer to *Warranty and Limitations of Liability*.

**⚠ WARNING**

This product is not designed or rated for ensuring safety of persons either directly or indirectly. Do not use it for such purposes.



### Precautions for Correct Use

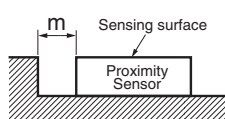
Do not use this product under ambient conditions that exceed the ratings.

● **Design**

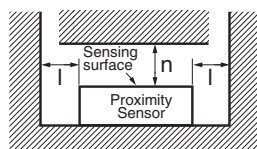
#### Influence of Surrounding Metal

When mounting the Sensor within a metal panel, ensure that the clearances given in the following table are maintained. Failure to maintain these distances may cause deterioration in the performance of the Sensor.

Metal on a Single Side  
(Not Exceeding the Height of the Sensor Surface)



Metals on Both Sides and in Front of the Sensor

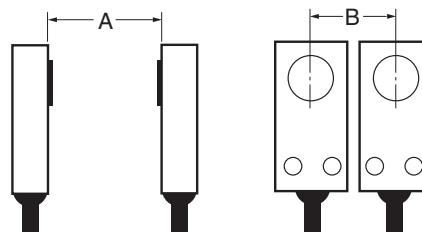


#### Influence of Surrounding Metal (Unit: mm)

| Model           | Distance | l  | m  | n   |
|-----------------|----------|----|----|-----|
| TL-W1R5M□1      |          | 2  | 0  | 8   |
| TL-W3MC□/-W3MB□ |          | 3  |    | 12  |
| TL-W5MD□        |          | 5  |    | 20  |
| TL-W5MC□        |          |    |    |     |
| TL-W20ME□       |          | 25 | 16 | 100 |
| TL-W5E□/-W5F□   |          | 0  | 0  | 20  |

#### Mutual Interference

When installing Sensors face-to-face or side-by-side, ensure that the minimum distances given in the following table are maintained.



#### Mutual Interference (Unit: mm)

| Model           | Distance | A         | B         |
|-----------------|----------|-----------|-----------|
| TL-W1R5MC1      |          | 75 (50)   | 25 (8) *  |
| TL-W1R5MB1      |          | 75        | 25        |
| TL-W3MC□/-W3MB□ |          | 90 (60)   | 30 (10) * |
| TL-W5MD□        |          | 120 (80)  | 60 (30)   |
| TL-W5MC□        |          |           |           |
| TL-W20ME□       |          | 200 (100) | 200 (100) |
| TL-W5E□/-W5F□   |          | 50        | 35        |

Note: Values in parentheses apply to Sensors operating at different frequencies.

\* Mutual interference will not occur for close-proximity mounting if models with different frequencies are used together.

● **Mounting**

- Use M3 flat-head screws to mount the TL-W1R5M□1 and TL-W3M□.
- Do not exceed the torque in the following table when tightening the resin cover screws.

| Model           | Torque   |
|-----------------|----------|
| TL-W1R5M□1      | 0.98 N·m |
| TL-W3MC□/-W3MB□ |          |
| TL-W5MD□        |          |
| TL-W20M□        | 1.5 N·m  |

● **Adjustment**

#### Turning ON the Power

An error pulse will occur (approximately 1 ms) if adjustments are made when turning ON the power or making AND connections.

#### Applicable e-CON Connector Models and Manufacturers

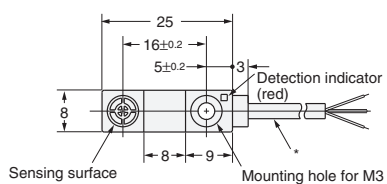
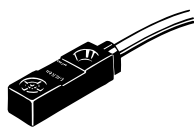
The companies and model number of e-CON connections that can be used with Sensor cables are listed in the following table. Confirm applicability when purchasing e-CON connectors for connection to Pre-wired Sensors.

| Model         | Applicable e-CON Connector     | Manufacturer |
|---------------|--------------------------------|--------------|
| TL-W1R5□/-W3□ | XN2A-1470 Cable Plug Connector | OMRON        |

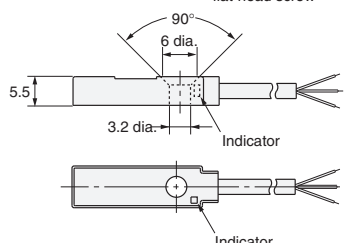
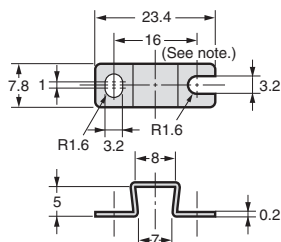
Dimensions

(Unit: mm)  
Tolerance class IT16 applies to dimensions in this data sheet unless otherwise specified.

TL-W1R5MB1  
TL-W1R5MC1



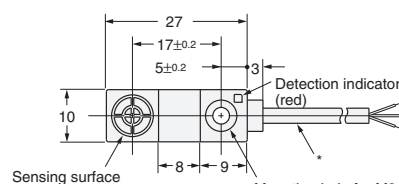
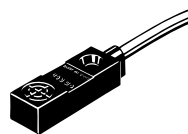
Mounting Bracket (Attachment)



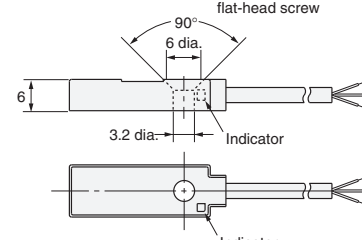
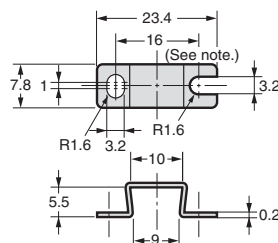
\* 2.9-dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.14 mm<sup>2</sup>, Insulator diameter: 0.9 mm), Standard length: 2 m

Note: Mounting hole dimension: 17 ±0.2.  
Material: Stainless steel (SUS304)

TL-W3MB□  
TL-W3MC□



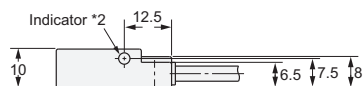
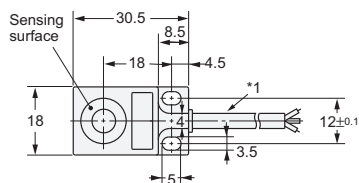
Mounting Bracket (Attachment)



\* 2.9-dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.14 mm<sup>2</sup>, Insulator diameter: 0.9 mm), Standard length: 2 m

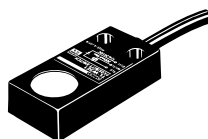
Note: Mounting hole dimension: 17 ±0.2.  
Material: Stainless steel (SUS304)

TL-W5MB□  
TL-W5MC□  
TL-W5MD□

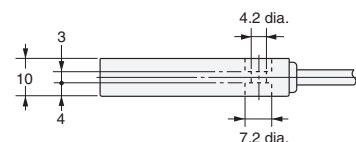
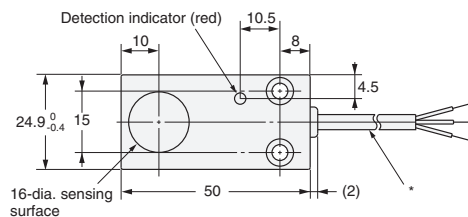
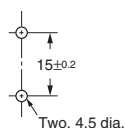


\*1. TL-W5MB□/TL-W5MC□  
4-dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.2 mm<sup>2</sup>, Insulator diameter: 1.2 mm), Standard length: 2 m  
TL-W5MD□  
4-dia. vinyl-insulated round cable with 2 conductors (Conductor cross section: 0.3 mm<sup>2</sup>, Insulation diameter: 1.3 mm), Standard length: 2 m  
\*2. B/C Models: Detection indicator (red)  
D Models: Operation indicator (red), Setting indicator (green)

TL-W5E□  
TL-W5F□

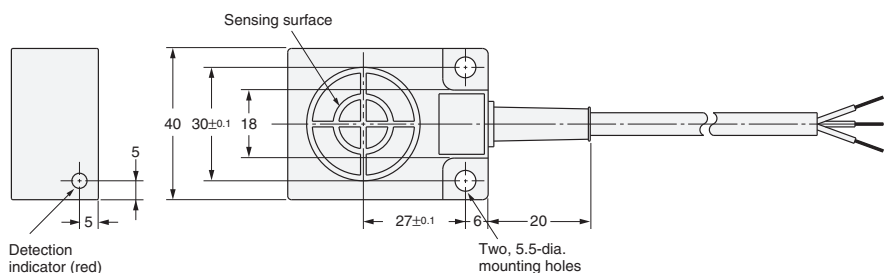
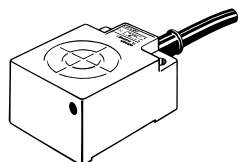


Mounting Hole Dimensions



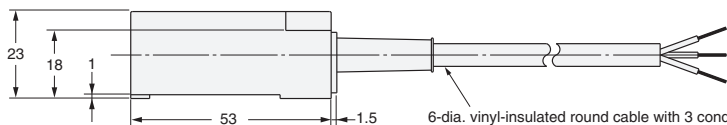
\* 4-dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.2 mm<sup>2</sup>, Insulator diameter: 1.2 mm), Standard length: 2 m

TL-W20ME□



Detection indicator (red)

Two, 5.5-dia. mounting holes



6-dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.5 mm<sup>2</sup>, Insulator diameter: 1.9 mm), Standard length: 2 m



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Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А