Adjustable Range Reflective Photoelectric Sensor

EQ-500 SERIES

Related Information
- General terms and conditions ............. F-17
- Sensor selection guide .................. P.283-
- Glossary of terms / General precautions ........... P.1359~ / P.1405
- China’s CCC mark .......................... P.1409

Long range sensing capability to 2.5 m 8.202 ft
Stable sensing unaffected by color or gloss

Long sensing range
An adjustable range to 2.5 m 8.202 ft allows plenty of space for installation. 1 m 3.281 ft sensing range type also available. Adjust the volume easily to suit your needs when using at close range.

Hardly affected by background objects
Because the sensor doesn’t detect objects outside the preset sensing field by using the 2-segment photodiode adjustable range system, it will not malfunction even if someone walks behind the sensing object or machines or conveyors are in the background.

Note: Please note that malfunction may occur when there are specular objects or objects with a mirror-like surface in the background. Refer to the "PRECAUTIONS FOR PROPER USE" section.

Impervious to variations color or angle
The optical system has been optimized. Since the sensor is hardly influenced at all by angles or the gloss of objects compared to the previous model, it is possible to detect both white objects and black objects at almost a constant distance.

The difference in sensing range between white non-glossy paper and gray non-glossy paper (lightness: 5) is approx 5% when set at a distance of 2 m 6.562 ft.

Convenient terminal block type
Cabling enabled by way of a terminal block that eliminates waste.

OPERABILITY
An easy to set adjuster with indicator
Equipped with a 2-turn adjuster with indicator, making it easy to set for short or long distances.

Note: For EQ-5:T only.
**APPLICATIONS**

**Level check within the hopper**
The distance to the object can be set to enable residual amount sensing in the hopper regardless of color.

**Confirmation of the passage of packages on a conveyor belt**
Can accurately detect packages even if they vary in size and color.

**VARIETIES**

**Equipped with both NPN and PNP outputs**
We’ve added a DC-voltage type with NPN and PNP transistor outputs all in one sensor. Its BGS / FGS function controls any background effects for more stable sensing.

**Multi-voltage**
Because it can function with 24 to 240 V AC and 12 to 240 V DC, almost any power supply anywhere in the world will do.

**Convenient timer function models**
Types with an ON-delay / OFF-delay timer available.
OFF-delay, e.g. useful when the response of the connected device is slow, ON-delay, e.g. useful to detect objects that take a long time to move.
- Operation: ON-delay, OFF-delay
- Timer period: 0.1 to 5 sec.
  (individual setting possible)

**FUNCTIONS**

**BGS / FGS functions make even the most challenging settings possible!**

**The BGS function is best suited for background not present**
When object and background are separated
The sensor judges that an object is present when light is received at position A of the light-receiving element (2-segment element).
This is useful if the object and background are far apart.
Not affected if the background color changes or someone passes behind the conveyor.

**The FGS function is best suited for background present**
When object and background are close together
When the object is glossy or uneven
The sensor judges that no object is present when light is received at position B of the light receiving element (2-segment element) (The conveyor is detected). This function is useful if the object and the background are close together or if the object is glossy or uneven.
However, sensing is impossible if there is no background (conveyor, etc.).

**Note:** Refer to “BGS / FGS function” of “PRECAUTIONS FOR PROPER USE” for operation of BGS / FGS function.
ENVIRONMENTAL RESISTANCE

**Little affected by contamination on lens**

Even if the lens surface gets somewhat dirty from dust particles, there is very little change in the operation field, by usage adjustable range system.

**Waterproof**

IP67 protection permits use in environments where water may splash.

Note: However, take care that if it is exposed to water splashes during operation, it may detect a water drop itself.

### ORDER GUIDE

<table>
<thead>
<tr>
<th>Type</th>
<th>Appearance</th>
<th>Sensing range</th>
<th>Model No.</th>
<th>Supply voltage</th>
<th>Output</th>
<th>Timer function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-voltage</td>
<td>With timer</td>
<td>0.1 to 2.5 m 0.328 to 2.022 ft</td>
<td>EQ-501</td>
<td>24 to 240 V AC ±10 % or 12 to 240 V DC ±10 %</td>
<td>Relay contact 1a</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>EQ-501T</td>
<td>10 to 240 V AC or DC</td>
<td>ON-delay / OFF-delay timer (Timer period: 0.1 to 5 sec.)</td>
<td>—</td>
</tr>
<tr>
<td>DC-voltage</td>
<td>With timer</td>
<td>0.1 to 1.0 m 0.328 to 3.281 ft</td>
<td>EQ-502</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>EQ-502T</td>
<td>—</td>
<td>ON-delay / OFF-delay timer (Timer period: 0.1 to 5 sec.)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1 to 2.5 m 0.328 to 2.022 ft</td>
<td>EQ-511</td>
<td>12 to 24 V DC ±10 %</td>
<td>NPN open-collector transistor</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>EQ-511T</td>
<td>—</td>
<td>ON-delay / OFF-delay timer (Timer period: 0.1 to 5 sec.)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>EQ-512</td>
<td>—</td>
<td>PNP open-collector transistor / Equipped with 2 outputs</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>EQ-512T</td>
<td>—</td>
<td>ON-delay / OFF-delay timer (Timer period: 0.1 to 5 sec.)</td>
<td>—</td>
</tr>
</tbody>
</table>

### OPTION

<table>
<thead>
<tr>
<th>Designation</th>
<th>Model No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor mounting bracket</td>
<td>MS-EQ5-01</td>
<td>Foot / back angled mounting bracket</td>
</tr>
</tbody>
</table>

Sensor mounting bracket • MS-EQ5-01

Two M5 (length 30 mm 1.181 in) screws with washers and two nuts are attached.
## SPECIFICATIONS

<table>
<thead>
<tr>
<th>Item</th>
<th>EQ-501</th>
<th>EQ-501T</th>
<th>EQ-502</th>
<th>EQ-502T</th>
<th>EQ-511</th>
<th>EQ-511T</th>
<th>EQ-512</th>
<th>EQ-512T</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adjustable range</strong></td>
<td>0.2 to 2.5 m 0.656 to 8.202 ft</td>
<td>0.2 to 1.0 m 0.656 to 3.281 ft</td>
<td>0.2 to 2.5 m 0.656 to 8.202 ft</td>
<td>0.2 to 1.0 m 0.656 to 3.281 ft</td>
<td></td>
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</tr>
<tr>
<td><strong>Sensing range at max. setting distance</strong></td>
<td>0.1 to 2.5 m 0.328 to 8.202 ft</td>
<td>0.1 to 1.0 m 0.328 to 3.281 ft</td>
<td>0.1 to 2.5 m 0.328 to 8.202 ft</td>
<td>0.1 to 1.0 m 0.328 to 3.281 ft</td>
<td></td>
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<tr>
<td><strong>Hysteresis</strong></td>
<td>10 % or less of operation distance</td>
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</tr>
<tr>
<td><strong>Supply voltage</strong></td>
<td>24 to 240 V AC ±10 % or 12 to 240 V DC ±10 %</td>
<td>Rippled P-P 10 % or less</td>
<td></td>
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</tr>
<tr>
<td><strong>Power / Current consumption</strong></td>
<td>AC: 4 VA or less DC: 3 W or less</td>
<td>Rippled P-P 10 % or less</td>
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<tr>
<td><strong>Output</strong></td>
<td>Relay contact 1a</td>
<td>Switchable either Detection-ON or Detection-OFF</td>
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<tr>
<td><strong>Protection</strong></td>
<td>IP67 (IEC)</td>
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</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>–20 to +55 °C –4 to +131 °F (No dew condensation or icing allowed), Storage: –30 to +70 °C –22 to +158 °F</td>
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<tr>
<td><strong>Ambient humidity</strong></td>
<td>35 to 85 % RH, Storage: 35 to 85 % RH</td>
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</tr>
<tr>
<td><strong>Vibration resistance</strong></td>
<td>10 to 55 Hz frequency, 1.5 mm 0.059 in amplitude in X, Y and Z directions for two hours each</td>
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<tr>
<td><strong>Shock resistance</strong></td>
<td>500 ms² acceleration (50 g approx.) in X, Y and Z directions for three times each</td>
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<tr>
<td><strong>Emitting element</strong></td>
<td>Infrared LED (Peak emission wavelength: 855 nm 0.034 mJ, modulated)</td>
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</tr>
<tr>
<td><strong>Material</strong></td>
<td>Enclosure: ABS, Front cover: Polycarbonate, Display cover: Polycarbonate</td>
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<tr>
<td><strong>Cable</strong></td>
<td>Suitable for round cable ø8 to ø11 mm ø0.354 to ø0.433 in</td>
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<tr>
<td><strong>Cable length</strong></td>
<td>Total length up to 100 m 328.084 ft is possible with 0.3 mm², or more, cable tyre cable.</td>
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<tr>
<td><strong>Weight</strong></td>
<td>Net weight: 100 g approx.</td>
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</tr>
<tr>
<td><strong>Accessory</strong></td>
<td>Adjusting screwdriver: 1 pc.</td>
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</tr>
</tbody>
</table>

Notes:
1) Where measurement conditions have not been specified precisely, the conditions were used at an ambient temperature of +23 °C ±3.4 °F.
2) The adjustable range stands for the maximum sensing range which can be set with the distance adjuster. The sensor can also detect an object 0.1 m 0.328 ft, or more, away.
3) The adjustable range, sensing range and hysteresis are specified for white non-glossy paper (200 × 200 mm 7.874 × 7.874 in) as the object.
4) Note that the detection may be unstable depending on the mounting conditions or the sensing object. Refer to "Automatic interference prevention function" of "PRECAUTIONS FOR PROPER USE" for details.

Environmental resistance:
- 2,000 V AC for one min. among supply terminals, non-supply metal parts and relay contact output terminals, 1,000 V AC for one min. between relay contacts
- 1,000 V AC for one min. between all supply terminals connected together and enclosure

Insulation resistance:
- 100 MQ, or more, with 500 V DC megger among supply terminals, non-supply metal parts and relay contact output terminals as well as between relay contacts
- 20 MQ, or more, with 250 V DC megger between all supply terminals connected together and enclosure

Shock resistance:
- 500 ms² acceleration (50 g approx.) in X, Y and Z directions for three times each

Automatic interference prevention function:
- Incorporated (Note 4)
I/O CIRCUIT AND WIRING DIAGRAMS

EQ-501(T)  EQ-502(T)

I/O circuit diagram

Terminal No.

Supply voltage
24 to 240 V AC ±10 %
12 to 240 V DC ±10 %

Relay contact output
(1a)

Internal circuit

EQ-511(T)  EQ-512(T)

I/O circuit diagram

Terminal arrangement diagram

EQ-500 SERIES

SENSING CHARACTERISTICS (TYPICAL)

Sensing fields

• Setting distance: 1 m 3.281 ft
• Setting distance: 2.5 m 8.202 ft

Correlation between material

White non-glossy paper
Black rubber
Plywood
Cardboard
White glossy paper
Gray non-glossy paper (Lightness: 5)
Gray non-glossy paper (Lightness: 8)
Non-glossy paper

Correlation between color

White non-glossy paper and sensing range

Correlation between sensing object size and sensing range

These bars indicate the sensing range with the respective colors when the distance adjuster is set to a sensing range of 2.5 m (8.202 ft) / 1 m (3.281 ft) long, respectively, with white non-glossy paper.

This curve shows the characteristics with the maximum sensing range set to 2.5 m (8.202 ft), with white non-glossy paper (200 × 200 mm 7.874 × 7.874 in).

Emitted beam

These bars indicate the sensing range with the respective colors when the distance adjuster is set to a sensing range of 2.5 m (8.202 ft) / 1 m (3.281 ft) long, respectively, with white non-glossy paper.

The sensing range also varies depending on material.

Symbols... D: Reverse supply polarity protection diode
ZD1, ZD2: Surge absorption zener diode
Tr1: NPN output transistor
Tr2: PNP output transistor
ZD1, ZD2: Surge absorption zener diode

Adjustable Range Reflective Photoelectric Sensor

White non-glossy paper (200 × 200 mm 7.874 × 7.874 in) and sensing range

Correlation between sensing object size and sensing range

•••

Terminal arrangement diagram

Symbols... D: Reverse supply polarity protection diode
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Adjustable Range Reflective Photoelectric Sensor

White non-glossy paper (200 × 200 mm 7.874 × 7.874 in) and sensing range

Correlation between sensing object size and sensing range

•••

Terminal arrangement diagram

Symbols... D: Reverse supply polarity protection diode
ZD1, ZD2: Surge absorption zener diode
Tr1: NPN output transistor
Tr2: PNP output transistor
ZD1, ZD2: Surge absorption zener diode

Adjustable Range Reflective Photoelectric Sensor

White non-glossy paper (200 × 200 mm 7.874 × 7.874 in) and sensing range

Correlation between sensing object size and sensing range

•••
EQ-502 (T) EQ-512 (T)

**Sensing characteristics (typical)**

<table>
<thead>
<tr>
<th>Sensing fields</th>
<th>Correlation between material (200 × 200 mm 7.874 × 7.874 in) and sensing range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting distance: 0.5 m 1.640 ft</td>
<td>These bars indicate the sensing range with the respective objects when the distance adjuster is set to a sensing range of 1 m 3.281 ft / 0.5 m 1.640 ft, respectively, with white non-glossy paper. The sensing range also varies depending on material.</td>
</tr>
<tr>
<td>Setting distance: 1 m 3.281 ft</td>
<td>These bars indicate the sensing range with the respective objects when the distance adjuster is set to a sensing range of 1 m 3.281 ft / 0.5 m 1.640 ft, respectively, with white non-glossy paper. The sensing range also varies depending on material.</td>
</tr>
</tbody>
</table>

**Emitted beam**

- White non-glossy paper
- White gloss paper
- Orange
grey non-glossy paper
- Yellow
- Blue
- Green
- Lightness: 5
- Gray non-glossy paper
- Black

**Correlation between sensing object size and sensing range**

- These bars indicate the sensing range with the respective objects when the distance adjuster is set to a sensing range of 1 m 3.281 ft / 0.5 m 1.640 ft, respectively, with white non-glossy paper.
- The sensing range may be affected. In that case, mount the sensor, while checking light-up of the stable indicator (green).

**Precautions for proper use**

- Never use this product as a sensing device for personnel protection.
- In case of using sensing devices for personnel protection, use products which meet laws and standards, such as OSHA, ANSI or IEC etc., for personnel protection applicable in each region or country.

**Mounting**

- The tightening torque should be 0.8 N·m or less.
- Care must be taken regarding the sensor mounting direction with respect to the object’s direction of movement.

**Automatic interference prevention function**

- When the sensors are mounted closely, use them in the interference prevented area, as shown below.

**Selection Guide**

- M5 nut (length 30 mm 1.181 in)
- Screw with washers

- Correct
- Incorrect

- When detecting a specular object (aluminum or copper foil, etc.) or an object having a glossy surface or coating, please note that there are cases when the object may not be detected due to a change in angle, wrinkles on the object surface, etc.
- If a specular body is present in the background, faulty operation may be caused due to a small change in the angle of the background body. In that case, install the sensor at an inclination and confirm the operation with the actual sensing object.

- When a specular body is present below the sensor, use the sensor by tilting it slightly upwards to avoid faulty operation.

- This product is not easily affected by the reflected light intensity since this sensor is the adjustable range reflective type. When the reflected light intensity is remarkably low, the sensing range may be affected. In that case, mount the sensor, while checking light-up of the stable indicator (green).

- The mounting screws of the terminal cover and display cover should certainly be tightened to maintain water-resistance; the tightening torque of the screws should be 0.3 to 0.5 N·m.

- The mounting screws of the interference prevented area should be tightened to 0.3 to 0.5 N·m.

- Note that the detection may be unstable depending on the mounting conditions or the sensing object to be used.

In the state that this product is mounted, be sure to check the operation with the actual sensing object to be used.
PRECAUTIONS FOR PROPER USE

Wiring

- Check all wiring before applying power since incorrect wiring may damage the internal circuit. Also, carefully tighten the terminal screws so that the wires of adjacent terminals do not touch.
- The tightening hole for the terminal cover fixing screws inclines 70 degrees to the terminal cover, as shown in the figure below. To avoid damaging this product or screw, take care when tightening or loosening a screw.

![Screwdriver for terminal cover fixing](image)

- To maintain water-resistance, the cable should have an outer diameter between ø9 to ø11 mm ø0.354 to ø0.433 in with a smooth covering material that allows the attached conduit connector to be securely tightened; the tightening torque of the screw should be of 1.5 to 2.0 N·m.
- If an external surge voltage exceeding 4 kV is impressed (DC-voltage type: 1 kV), the internal circuit will be damaged, and a surge suppressing element should be used.
- Prepare the cable end as shown below.

![Conduit connector construction and cabling](image)

**Conduit connector construction and cabling**

- To avoid damaging the sensing object or screwdriver. Turning with excessive strength will cause damage to the adjuster.

**Dimensions of the suitable crimp terminals**

(Unit: mm in)

<table>
<thead>
<tr>
<th>Round type</th>
<th>Y-shaped type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø 3.6 or more</td>
<td>Ø 3.6 or more</td>
</tr>
<tr>
<td>7.5 or less</td>
<td>22 or less</td>
</tr>
<tr>
<td>17 or less</td>
<td>10 or less</td>
</tr>
<tr>
<td>0.66 or less</td>
<td>0.39 or less</td>
</tr>
<tr>
<td>0.26 or less</td>
<td>0.16 or less</td>
</tr>
</tbody>
</table>

**Note:** Use crimp terminals with insulating sleeves. Recommended crimp terminal: Nominal size 1.25 × 3.5 0.049 × 0.138 in.

**Part description**

<table>
<thead>
<tr>
<th>Operation mode switch</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection-Detectable on mode is obtained when the switch is turned fully clockwise (L side).</td>
<td></td>
</tr>
<tr>
<td>Detection-Off mode is obtained when the switch is turned fully counterclockwise (D side).</td>
<td></td>
</tr>
</tbody>
</table>

**BGS / FGS function (DC-voltage type only)**

- DC-voltage type sensor incorporates BGS / FGS function. Select either the BGS or FGS function depending on the positions of the background and sensing object.
- BGS / FGS function is set with the operation mode switch.
- FGS function is used when the sensing object contacts the background (conveyor, etc).
- Depends on a selection of either BGS or FGS function, the output operation changes as follows.

![Detectable range](image)

**Non-detectable area**

<table>
<thead>
<tr>
<th>BGS</th>
<th>L-ON</th>
<th>D-ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FGS</th>
<th>L-ON</th>
<th>D-ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>
**PRECAUTIONS FOR PROPER USE**

**Timer function (EQ-5□T only)**
- **EQ-5□T** incorporates an OFF-delay timer, which is useful when the response of the connected device is slow, etc., and an ON-delay timer, which is useful for detecting objects that move slowly, for example.
- The OFF-delay and ON-delay timers can be used simultaneously.
- For DC-voltage type, set the DIP switch for the timer mode to ‘Timer ON’ side.

**Stability indicator**
- Since the **EQ-500** series uses a 2-segment photodiode as its receiving element, and sensing is done based on the difference in the incident beam angle of the reflected beam from the sensing object, the output and the operation indicator (orange) operate according to the object distance.
- Furthermore, the stability indicator (green) shows the margin of the setting distance.

**Others**
- Do not use during the initial transient time (50 ms) after the power supply is switched on.
- Its distance adjuster is mechanically operated. Do not drop; avoid other shocks.

**DIMENSIONS (Unit: mm in)**

The CAD data in the dimensions can be downloaded from our website.

<table>
<thead>
<tr>
<th>EQ-501(T)</th>
<th>EQ-502(T)</th>
<th>EQ-511(T)</th>
<th>EQ-512(T)</th>
</tr>
</thead>
</table>

Assembly dimensions with sensor mounting bracket

**MS-EQ5-01 (Optional) (Foot angled mounting)**

Material: Cold rolled carbon steel (SPCC)

Two M5 (length 30.181 in) screws with washers and two nuts are attached.