PHOTOELECTRIC SENSORS
E3FA/E3RA/E3FB/E3RB

A new generation in sensing performance

• Simplicity
  • Simple selection
  • Simple installation

• One family for all
  • All standard applications covered
  • A wide variety of models
  • Models designed for special applications

• Non-stop detection
  • High quality and reliability
  • High EMC protection
  • High light immunity
  • Robust and waterproof housing

Features

Simplicity
Omron’s compact E3FA series of photoelectric sensors is simple and quick to mount, as well as easy and intuitive to set-up. The large and robust adjuster makes life much easier for installers to adjust the sensor, as does the bright, high-power red LED, which is clearly visible for easy alignment, even over longer distances. Similarly, the sensor’s LED status indicator can be viewed from long distances and wide angles.

One family for all
Typically installed in industrial plants ranging from food and beverage, textiles, ceramics and brick production, through to logistics, there’s always an E3FA model to fit your application.
This extensive photoelectric sensor series with high reliability and enhanced performance includes through-beam, retroreflective and diffuse reflective types in straight and radial versions. Straight versions are also available with background-suppression, limited-reflective detection, and transparent object detection types for special applications.

Non-stop detection
Especially designed for machines that never stop, the rugged E3FA series offers completely reliable sensing in a robust and waterproof housing that can withstand even high-pressure cleaning. Exceeding market standards, this series also has high EMC protection and light immunity. In addition, there is the added benefit of the high-power LED, which contributes to high sensing stability even in environments with dust or vibrations.
E3FA/E3RA/E3FB/E3RB
Ordering Information

Sensors (E3FA/E3RA Plastic housing) [Refer to Dimensions on page 14.]

<table>
<thead>
<tr>
<th>Sensor type</th>
<th>Sensing distance</th>
<th>Connection method</th>
<th>NPN output</th>
<th>PNP output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through-beam *1.</td>
<td>pre-wired</td>
<td>set E3FA-TN11 2M</td>
<td>Emitter E3FA-TN11-L 2M</td>
<td>set E3FA-TP11 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>set E3FA-TN11-D 2M</td>
<td>Emitter E3FA-TN11-L 2M</td>
<td>set E3FA-TP11-D 2M</td>
</tr>
<tr>
<td></td>
<td>M12 connector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retro-reflective *2.</td>
<td>pre-wired</td>
<td>E3FA-RN11 2M</td>
<td>E3FA-RP11 2M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E3FA-RN21</td>
<td>E3FA-RP21</td>
<td></td>
</tr>
<tr>
<td>Coaxial Retro-reflective *2.</td>
<td>pre-wired</td>
<td>E3RA-RN11 2M</td>
<td>E3FA-RP11 2M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E3FA-RN22</td>
<td>E3FA-RP22</td>
<td></td>
</tr>
<tr>
<td>Diffuse-reflective</td>
<td>pre-wired</td>
<td>E3FA-DN11 2M</td>
<td>E3FA-DP11 2M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E3FA-DN21</td>
<td>E3FA-DP21</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E3FA-DN12 2M</td>
<td>E3FA-DP12 2M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E3FA-DN13 2M</td>
<td>E3FA-DP13 2M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BGS (background suppression)</td>
<td>pre-wired</td>
<td>E3FA-LN11 2M</td>
<td>E3FA-LP11 2M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E3FA-LN21</td>
<td>E3FA-LP21</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E3FA-LN12 2M</td>
<td>E3FA-LP12 2M</td>
<td></td>
</tr>
<tr>
<td>Limited distance reflective</td>
<td>pre-wired</td>
<td>E3FA-VN11 2M</td>
<td>E3FA-VP11 2M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transparent detected with P-opaquing function *2.</td>
<td>pre-wired</td>
<td>E3FA-BN11 2M</td>
<td>E3FA-BP11 2M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E3FA-BN21</td>
<td>E3FA-BP21</td>
<td></td>
</tr>
<tr>
<td>Through-beam *1.</td>
<td>pre-wired</td>
<td>set E3RA-TN11 2M</td>
<td>Emitter E3RA-TN11-L 2M</td>
<td>set E3RA-TP11 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>set E3RA-TN11-D 2M</td>
<td>Emitter E3RA-TN11-L 2M</td>
<td>set E3RA-TP11-D 2M</td>
</tr>
<tr>
<td></td>
<td>M12 connector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retro-reflective *2.</td>
<td>pre-wired</td>
<td>E3RA-RN11 2M</td>
<td>E3RA-RP11 2M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E3RA-RN21</td>
<td>E3RA-RP21</td>
<td></td>
</tr>
<tr>
<td>Diffuse reflective</td>
<td>pre-wired</td>
<td>E3RA-DN11 2M</td>
<td>E3RA-DP11 2M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E3RA-DN21</td>
<td>E3RA-DP21</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E3RA-DN12 2M</td>
<td>E3RA-DP12 2M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E3RA-DN13 2M</td>
<td>E3RA-DP13 2M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1. The set type includes the emitter and receiver.
*2. The Reflector is sold separately. Select the Reflector model most suited to the application.
### Sensors (E3FB/E3RB Metal housing) [Refer to Dimensions on page 15.]

<table>
<thead>
<tr>
<th>Sensor type</th>
<th>Sensing distance</th>
<th>Connection method</th>
<th>NPN output</th>
<th>PNP output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through-beam *1.</td>
<td></td>
<td>pre-wired</td>
<td>set E3FB-TN11 2M</td>
<td>set E3FB-TP11 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td>Emitter E3FB-TN11-L 2M</td>
<td>Emitter E3FB-TP11-L 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Receiver E3FB-TN11-D 2M</td>
<td>Receiver E3FB-TP11-D 2M</td>
</tr>
<tr>
<td>Retro-reflective *2.</td>
<td>0.1 to 4 m</td>
<td>pre-wired</td>
<td>E3FB-RN11 2M</td>
<td>E3FB-RP11 2M</td>
</tr>
<tr>
<td></td>
<td>with E39-R1S</td>
<td>M12 connector</td>
<td>E3FB-RN21</td>
<td>E3FB-RP21</td>
</tr>
<tr>
<td>Coaxial Retro-reflective *2.</td>
<td>0 to 500 mm</td>
<td>pre-wired</td>
<td>E3FB-RN12 2M</td>
<td>E3FB-RP12 2M</td>
</tr>
<tr>
<td></td>
<td>with E39-R1S</td>
<td>M12 connector</td>
<td>E3FB-RN22</td>
<td>E3FB-RP22</td>
</tr>
<tr>
<td>Diffuse-reflective</td>
<td>100 mm</td>
<td>pre-wired</td>
<td>E3FB-DN11 2M</td>
<td>E3FB-SP11 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td>E3FB-DN21</td>
<td>E3FB-SP21</td>
</tr>
<tr>
<td></td>
<td>300 mm</td>
<td>pre-wired</td>
<td>E3FB-DN12 2M</td>
<td>E3FB-SP12 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td>E3FB-DN22</td>
<td>E3FB-SP22</td>
</tr>
<tr>
<td></td>
<td>1 m</td>
<td>pre-wired</td>
<td>E3FB-DN13 2M</td>
<td>E3FB-SP13 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td>E3FB-DN23</td>
<td>E3FB-SP23</td>
</tr>
<tr>
<td>BGS (background suppression)</td>
<td>100 mm</td>
<td>pre-wired</td>
<td>E3FB-LN11 2M</td>
<td>E3FB-SP11 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td>E3FB-LN21</td>
<td>E3FB-SP21</td>
</tr>
<tr>
<td></td>
<td>200 mm</td>
<td>pre-wired</td>
<td>E3FB-LN12 2M</td>
<td>E3FB-SP12 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td>E3FB-LN22</td>
<td>E3FB-SP22</td>
</tr>
<tr>
<td>Limited distance reflective</td>
<td>10 to 50 mm</td>
<td>pre-wired</td>
<td>E3FB-VN11 2M</td>
<td>E3FB-VP11 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td>E3FB-VN21</td>
<td>E3FB-VP21</td>
</tr>
<tr>
<td>Transparent detected with P-opaquing function *2.</td>
<td>100 to 500 mm with E39-RP1</td>
<td>pre-wired</td>
<td>E3FB-BN11 2M</td>
<td>E3FB-BP11 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td>E3FB-BN21</td>
<td>E3FB-BP21</td>
</tr>
<tr>
<td>Transparent detected with P-opaquing function *2.</td>
<td>0.1 to 2 m with E39-RP1</td>
<td>pre-wired</td>
<td>E3FB-BN12 2M</td>
<td>E3FB-BP12 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td>E3FB-BN22</td>
<td>E3FB-BP22</td>
</tr>
<tr>
<td>Through-beam *1.</td>
<td>15 m</td>
<td>pre-wired</td>
<td>set E3RB-TN11 2M</td>
<td>set E3RB-TP11 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td>Emitter E3RB-TN11-L 2M</td>
<td>Emitter E3RB-TP11-L 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Receiver E3RB-TN11-D 2M</td>
<td>Receiver E3RB-TP11-D 2M</td>
</tr>
<tr>
<td>Retro-reflective *2.</td>
<td>0.1 to 3 m</td>
<td>pre-wired</td>
<td>E3RB-RN11 2M</td>
<td>E3RB-RP11 2M</td>
</tr>
<tr>
<td></td>
<td>with E39-R1S</td>
<td>M12 connector</td>
<td>E3RB-RN21</td>
<td>E3RB-RP21</td>
</tr>
<tr>
<td>Diffuse reflective</td>
<td>100 mm</td>
<td>pre-wired</td>
<td>E3RB-DN11 2M</td>
<td>E3RB-SP11 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td>E3RB-DN21</td>
<td>E3RB-SP21</td>
</tr>
<tr>
<td></td>
<td>300 mm</td>
<td>pre-wired</td>
<td>E3RB-DN12 2M</td>
<td>E3RB-SP12 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td>E3RB-DN22</td>
<td>E3RB-SP22</td>
</tr>
<tr>
<td></td>
<td>700 mm</td>
<td>pre-wired</td>
<td>E3RB-DN13 2M</td>
<td>E3RB-SP13 2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M12 connector</td>
<td>E3RB-DN23</td>
<td>E3RB-SP23</td>
</tr>
</tbody>
</table>

*1. The set type includes the emitter and receiver.
*2. The Reflector is sold separately. Select the Reflector model most suited to the application.
Reflectors [Refer to Dimensions on page 16.]
Reflectors required for Retro-reflective Sensors: A Reflector is not provided with the Sensor. Be sure to order a Reflector separately.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Sensing distance</th>
<th>Appearance</th>
<th>Model</th>
<th>Quantity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>E3FA-R</td>
<td>0.1 to 4 m</td>
<td>E39-R15</td>
<td>1</td>
<td></td>
<td>for E3FA-R, E3RA-R, E3FB-R, and E3RB-R</td>
</tr>
<tr>
<td>E3FB-R</td>
<td>0 to 500 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E3FA-B</td>
<td>100 to 500 mm</td>
<td>E39-RP1</td>
<td>1</td>
<td></td>
<td>for E3FA-B and E3FB-B</td>
</tr>
<tr>
<td>E3FB-B</td>
<td>0.1 to 2 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mounting brackets [Refer to Dimensions on page 16.]
A Mounting Bracket is not enclosed with the Sensor. Order a Mounting Bracket separately if required.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Appearance</th>
<th>Model (Material)</th>
<th>Quantity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>all types</td>
<td></td>
<td>E39-L183 (SUS 304)</td>
<td>1</td>
<td>Mounting bracket</td>
</tr>
<tr>
<td>E3FA-□</td>
<td></td>
<td>E39-L182 (POM)</td>
<td>1</td>
<td>Flush mounting bracket</td>
</tr>
</tbody>
</table>

Sensor I/O connectors
Models for Connectors: A Connector is not provided with the Sensor. Be sure to order a Connector separately.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Size</th>
<th>Cable</th>
<th>Appearance</th>
<th>Cable type</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>M12 connector types</td>
<td>M12</td>
<td>Standard</td>
<td>2 m</td>
<td>4-wire</td>
<td>XS2F-B12PVC4S2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 m</td>
<td></td>
<td>XS2F-B12PVC4S5M</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 m</td>
<td></td>
<td>XS2F-B12PVC4A2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 m</td>
<td></td>
<td>XS2F-B12PVC4A5M</td>
</tr>
</tbody>
</table>

Model Number Legend

E3□-□□□□□-(□)□

1. Series name
FA: Cylindrical, Straight type, Plastic housing
RA: Cylindrical, Radial type, Plastic housing
FB: Cylindrical, Straight type, Metal housing
RB: Cylindrical, Radial type, Metal housing

2. Sensing method
T: Through-beam
R: Retro-reflective
D: Diffuse-reflective
L: Background suppression
V: Limited distance reflective
B: Transparent detected with P-opaques function

3. Output
P: PNP
N: NPN

4. Connection
1: Cable
2: Connector, M12, 4-pin

5. Difference of Sensing distance
Sequential number

6. Emitter/Receiver
D: Receiver
L: Emitter

7. Cable length
Blank: Connector type
e.g., E3FA-TP11 2M;
Cylindrical, Straight type, Plastic housing/Through-beam/PNP/Cable/Difference of Sensing distance/Cable length of 2M
E3RA-TN12-D;
Cylindrical, Radial type, Plastic housing/Through-beam/NPN/Connector, M12, 4-pin/Difference of Sensing distance/Receiver/Connector type
E3FA-VP12;
Cylindrical, Straight type, Plastic housing/Limited distance reflective/PNP/Connector, M12, 4-pin/Difference of Sensing distance/Connector type
**Specifications**

**Straight type (E3FA/E3FB)**

<table>
<thead>
<tr>
<th>Model</th>
<th>Sensing method</th>
<th>Through-beam</th>
<th>Retro-reflective</th>
<th>Coaxial Retro-reflective</th>
<th>Diffuse-reflective</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPN output</td>
<td>Pre-wired</td>
<td>E3FA@TN11 2M</td>
<td>E3FA@RN11 2M</td>
<td>E3FA@DN11 2M</td>
<td>E3FA@DN13 2M</td>
</tr>
<tr>
<td></td>
<td>M12 Connector</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PNP output</td>
<td>E3FA@TP12 2M</td>
<td>E3FA@RP12 2M</td>
<td>E3FA@DP12 2M</td>
<td>E3FA@DP13 2M</td>
</tr>
<tr>
<td></td>
<td>M12 Connector</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensing distance</td>
<td>20 m</td>
<td>0.1 to 4 m (with E39-R1S)</td>
<td>0 to 500 mm (with E39-R1S)</td>
<td>100 mm (white paper: 300 × 300 mm)</td>
<td>300 mm (white paper: 300 × 300 mm)</td>
</tr>
<tr>
<td>Spot diameter (typical)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>40 × 45 mm</td>
<td>40 × 50 mm</td>
</tr>
<tr>
<td>Standard sensing object</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Sensing distance of 100 mm</td>
<td>Sensing distance of 300 mm</td>
</tr>
<tr>
<td>Differential travel</td>
<td>7 mm dia.min.</td>
<td>75 mm dia.min.</td>
<td>75 mm dia.min.</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Directional angle</td>
<td>2° min.</td>
<td>2° min.</td>
<td>2° min.</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Light source (wavelength)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Power supply voltage</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Current consumption</td>
<td>40 mA max.</td>
<td>(Emitter 25 mA max. Receiver 15 mA max.)</td>
<td>25 mA max.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control output</td>
<td>NPN/PNP (open collector)</td>
<td>Load current: 100 mA max. (Residual voltage: 3 V max.), Load power supply voltage: 30 VDC max.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation mode</td>
<td>Light-ON/Dark-ON selectable by wiring</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indicator</td>
<td>Operation indicator (orange)</td>
<td>Stability indicator (green)</td>
<td>Power indicator (green): only Emitter of Through-beam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection circuits</td>
<td>Reversed power supply polarity protection, Output short-circuit protection and Reversed output polarity protection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response time</td>
<td>0.5 ms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity adjustment</td>
<td>One-turn adjuster</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient illumination (Receiver side)</td>
<td>Incandescent lamp: 3,000 lx max./ Sunlight: 10,000 lx max.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>Operating: -25 to 55°C/ Storage: -30 to 70°C (with no icing or condensation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient humidity range</td>
<td>Operating: 35 to 85%RH/ Storage: 35 to 95%RH (with no condensation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>20 MΩ min. at 500 VDC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dielectric strength</td>
<td>1,000 VAC at 50/60 Hz for 1 min. between current-carrying parts and case</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration resistance</td>
<td>Destruction: 10 to 55 Hz, 1.5 mm double amplitude for 2 hours each in X, Y and Z directions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock resistance</td>
<td>Destruction: 500 m/s² 3 times each in X, Y and Z directions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IEC: IP67, DIN 40050-9: IP69K*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Weight (packed state/only sensor)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Sensing method</th>
<th>Through-beam</th>
<th>Retro-reflective</th>
<th>Coaxial Retro-reflective</th>
<th>Diffuse-reflective</th>
</tr>
</thead>
<tbody>
<tr>
<td>M12 Connector</td>
<td>Pre-wired</td>
<td>E3FA: Approx. 110 g/ Approx. 50 g, respectively,</td>
<td>E3FA: Approx. 60 g/ Approx. 50 g, respectively,</td>
<td>E3FA: Approx. 20 g/ Approx. 10 g, respectively,</td>
<td>E3FA: Approx. 50 g/ Approx. 20 g, respectively,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E3FB: Approx. 175 g/ Approx. 65 g, respectively,</td>
<td>E3FB: Approx. 95 g/ Approx. 65 g, respectively,</td>
<td>E3FB: Approx. 50 g/ Approx. 20 g, respectively,</td>
<td></td>
</tr>
</tbody>
</table>

**Connector**

<table>
<thead>
<tr>
<th>Item</th>
<th>Sensing method</th>
<th>Through-beam</th>
<th>Retro-reflective</th>
<th>Coaxial Retro-reflective</th>
<th>Diffuse-reflective</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E3FA: Approx. 30 g/ Approx. 10 g, respectively,</td>
<td>E3FA: Approx. 60 g/ Approx. 50 g, respectively,</td>
<td>E3FA: Approx. 20 g/ Approx. 10 g, respectively,</td>
<td>E3FA: Approx. 50 g/ Approx. 20 g, respectively,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E3FB: Approx. 85 g/ Approx. 20 g, respectively,</td>
<td>E3FB: Approx. 95 g/ Approx. 65 g, respectively,</td>
<td>E3FB: Approx. 50 g/ Approx. 20 g, respectively,</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Material**

<table>
<thead>
<tr>
<th>Item</th>
<th>Case</th>
<th>Lens and Display</th>
<th>Adjuster</th>
<th>Nut</th>
<th>Accessories</th>
</tr>
</thead>
</table>

*IP69K Degree of Protection Specifications
IP69K is a protection specification stipulated by DIN 40050 Part 9 of the German standards. The test item is sprayed with 80°C water from a nozzle of a specified shape at a water pressure of 80 to 100 bar. The amount of water is 14 to 16 liters per minute. The distance between the test item and the nozzle is 10 to 15 cm. The water is discharged at angles of 0°, 30°, 60°, and 90° from the horizontal plane for 30 seconds at each angle while the test item is rotated horizontally.**
**IP69K Degree of Protection Specifications**

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The test item is sprayed with 80°C water from a nozzle of a specified shape at a water pressure of 80 to 100 bar. The amount of water is 14 to 16 liters per minute.

The distance between the test item and the nozzle is 10 to 15 cm. The water is discharged at angles of 0°, 30°, 60°, and 90° from the horizontal plane for 30 seconds at each angle while the test item is rotated horizontally.
Radial type (E3RA/E3RB)

<table>
<thead>
<tr>
<th>Model</th>
<th>Sensing method</th>
<th>Through-beam</th>
<th>Retro-reflective</th>
<th>Diffuse-reflective</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPN output Pre-wired</td>
<td>E3RA(-TN11 2M)</td>
<td>E3RA(-R11 2M)</td>
<td>E3R(-DN11 2M)</td>
<td>E3R(-DN13 2M)</td>
</tr>
<tr>
<td>Item</td>
<td>M12 Connector</td>
<td>E3RA(-RN21)</td>
<td>E3RA(-DN22)</td>
<td>E3RA(-DN23)</td>
</tr>
<tr>
<td>PNP output Pre-wired</td>
<td>E3RB(-TP11 2M)</td>
<td>E3RB(-RP11 2M)</td>
<td>E3R(-DP11 2M)</td>
<td>E3R(-DP13 2M)</td>
</tr>
<tr>
<td></td>
<td>M12 Connector</td>
<td>E3RB(-DN21)</td>
<td>E3R(-DP21)</td>
<td>E3R(-DP23)</td>
</tr>
</tbody>
</table>

Sensing method
- Through-beam
- Retro-reflective
- Diffuse-reflective

Sensing distance
- 15 m
- 0.1 to 3 m (with E39-R15)
- 100 mm (white paper: 300 x 300 mm)
- 300 mm (white paper: 300 x 300 mm)
- 700 mm (white paper: 300 x 300 mm)

Spot diameter (typical)
- Opaque: 35 x 40 mm
- Sensing distance of 100 mm
- 40 x 45 mm
- Sensing distance of 300 mm
- 90 x 120 mm
- Sensing distance of 700 mm

Standard sensing object
- Opaque: 7 mm dia.min.
- Opaque: 75 mm dia.min.

Differential travel
- 2° min.
- 2° min.

Directional angle
- 2° min.

Light source (wavelength)
- Red LED (624 nm)

Power supply voltage
- 10 to 30 VDC (include voltage ripple of 10%(p-p) max.)

Current consumption
- 40mA max.
- (Emitter 25 mA max. Receiver 15 mA max.)
- 25 mA max.

Control output
- NPN/PNP (open collector)
- Load current: 100 mA max. (Residual voltage: 2 V max.), Load power supply voltage: 30 VDC max.

Operation mode
- Light-ON/Dark-ON selectable by wiring

Indicator
- Operation indicator (orange)
- Stability indicator (green)
- Power indicator (green): only Emitter of Through-beam

Protection circuits
- Reversed power supply polarity protection, Output short-circuit protection and Reversed output polarity protection

Response time
- 0.5 ms

Sensitivity adjustment
- One-turn adjuster

Ambient illumination (Receiver side)
- Incandescent lamp: 3,000 lx max./ Sunlight: 10,000 lx max.

Ambient temperature range
- Operating: -25 to 55°C/ Storage: -30 to 70°C (with no icing or condensation)

Ambient humidity range
- Operating: 35 to 95%RH/ Storage: 35 to 95%RH (with no condensation)

Insulation resistance
- 20 MΩ min. at 500 VDC

Dielectric strength
- 1,000 VAC at 50/60 Hz 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/s² 3 times each in X, Y and Z directions

Degree of protection
- IEC: IP67, DIN 40050-9: IP69K *

Weight (packed state/only sensor)
- Pre-wired cable (2M)
  - E3RA: Approx. 110 g/ Approx. 50 g, respectively
  - E3RB: Approx. 175 g/ Approx. 65 g, respectively
- Connector
  - E3RA: Approx. 30 g/ Approx. 10 g, respectively
  - E3RB: Approx. 85 g/ Approx. 20 g, respectively
- E3RA: Approx. 20 g/ Approx. 10 g
  - E3RB: Approx. 50 g/ Approx. 20 g

Material
- Case: E3RA: ABS, E3RB: Nickel-brass
- Lens and Display: PMMA
- Adjuster: POM
- Nut: E3RA: ABS, E3RB: Nickel-brass

Accessories
- Instruction sheet
- M18 nuts (4 pcs)
- Instruction sheet
- M18 nuts (2 pcs)

*IP69K Degree of Protection Specifications
IP69K is a protection specification stipulated by DIN 40050 Part 9 of the German standards.
The test item is sprayed with 80°C water from a nozzle of a specified shape at a water pressure of 80 to 100 bar. The amount of water is 14 to 16 liters per minute.
The distance between the test item and the nozzle is 10 to 15 cm. The water is discharged at angles of 0°, 30°, 60°, and 90° from the horizontal plane for 30 seconds at each angle while the test item is rotated horizontally.
**E3FA/E3RA/E3FB/E3RB**

**Engineering Data (Typical)**

---

**Parallel Operating Range**

**Through-beam Models**

E3F-T1, E3R-T1

---

**Retro-reflective Models**

E3F-R1, E3R-R1

---

**E3F-R2**

Reflector: E39-R1S

---

**Transparent detected with P-opaquing function**

E3F-B1

---

E3F-B2

Reflector: E39-RP1

---

**Operating Range**

**Diffuse-reflective Models**

E3F-D1, E3F-D2

---

E3R-D1, E3R-D2

---

**E3F-D3, E3R-D3**

Sensing object: white paper

---

Sensing object: 300 × 300 white paper

---

**BGS Models**

E3F-L1

---

E3F-L2

Sensing object: white paper

---

Sensing object: white paper

---

**Limited distance reflective**

E3F-V

Sensing object: glass (t=1.0)
**Excess Gain vs. Distance**

Through-beam Models

**Retro-reflective Models**

**E3F-R□1, E3R-R□1**

**E3F-R□2**

Diffuse reflective Models

**E3F-D□1, E3F-D□2, E3R-D□1, E3R-D□2**

**E3F-D□3, E3R-D□3**

**Transparent detected with P-opaung function**

**E3F-B□1**

**E3F-B□2**

**Limited distance reflective**

**E3F-V□**

**Sensing Object Size vs. Distance**

Diffuse reflective Models

**E3F-D□1, E3F-D□2, E3R-D□1, E3R-D□2**

**E3F-D□3, E3R-D□3**
Sensing Distance vs. Sensing Object Material

BGS Models

<table>
<thead>
<tr>
<th>Material</th>
<th>E3F-L01 Sensing Distance (mm)</th>
<th>E3F-L02 Sensing Distance (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White paper</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Black paper</td>
<td>80</td>
<td>150</td>
</tr>
<tr>
<td>SUS</td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

Dark Excess Gain vs. Sensing Object Characteristics

Transparent detected with P-opaques function

<table>
<thead>
<tr>
<th>Operating Level</th>
<th>Relative amount of light received</th>
</tr>
</thead>
<tbody>
<tr>
<td>No sensing object</td>
<td>Empty</td>
</tr>
<tr>
<td>Round, 500-ml PET bottle</td>
<td>Empty</td>
</tr>
<tr>
<td>Square, 500-ml PET bottle</td>
<td>Empty</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating Level</th>
<th>Relative amount of light received</th>
</tr>
</thead>
<tbody>
<tr>
<td>No sensing object</td>
<td>Empty</td>
</tr>
<tr>
<td>Round, 500-ml PET bottle</td>
<td>Empty</td>
</tr>
<tr>
<td>Square, 500-ml PET bottle</td>
<td>Empty</td>
</tr>
</tbody>
</table>
### Output circuit diagram

#### PNP Output

**Model** | **Operation mode** | **Timing charts** | **Operation selector** | **Output circuit**
--- | --- | --- | --- | ---
E3F-TP | Light-ON | Light incident, Light interrupted | Connect the pink wire (Pin(2)) to the brown (Pin(1))<br>Load (e.g., relay) | Through-beam Receivers, Retro-reflective Models, Diffuse-reflective Models, Limited reflective Models.<br>Transparent detected with P-opaquing function.<br>Loading: 10 V DC<br>Load: 100 mA max.<br>(Control output)
E3F-RP | Dark-ON | Light incident, Light interrupted | Connect the pink wire (Pin(2)) to the blue (Pin(3)) or open the pink wire (Pin(2))<br>Load (e.g., relay) |<br><br>Through-beam Emitter<br>Load (Relay) |<br>**Pink** | 10 to 30 VDC | 100 mA max.<br>(Control output)
E3F-VP | Light-ON | Light incident, Light interrupted | Connect the pink wire (Pin(2)) to the brown (Pin(1))<br>Load (e.g., relay) |<br><br>Light incident<br>Light interrupted<br>Operate<br>Reset<br>(Between blue and black leads)<br>Load (e.g., relay)<br>Operate<br>Reset<br>(Between blue and black leads)
E3F-BP | Dark-ON | Light incident, Light interrupted | Connect the pink wire (Pin(2)) to the blue (Pin(3)) or open the pink wire (Pin(2))<br>Load (e.g., relay) |<br><br>Background suppression.
E3R-TP | Light-ON | Light incident, Light interrupted | Connect the pink wire (Pin(2)) to the brown (Pin(1))<br>Load (e.g., relay) |<br><br>Light incident<br>Light interrupted<br>Operate<br>Reset<br>(Between blue and black leads)<br>Load (e.g., relay)<br>Operate<br>Reset<br>(Between blue and black leads)
E3R-RP | Dark-ON | Light incident, Light interrupted | Connect the pink wire (Pin(2)) to the blue (Pin(3)) or open the pink wire (Pin(2))<br>Load (e.g., relay) |<br><br>Background suppression.
E3R-DP | Light-ON | Light incident, Light interrupted | Connect the pink wire (Pin(2)) to the brown (Pin(1))<br>Load (e.g., relay) |<br><br>Light incident<br>Light interrupted<br>Operate<br>Reset<br>(Between blue and black leads)<br>Load (e.g., relay)<br>Operate<br>Reset<br>(Between blue and black leads)
E3R-LP | Dark-ON | Light incident, Light interrupted | Connect the pink wire (Pin(2)) to the blue (Pin(3)) or open the pink wire (Pin(2))<br>Load (e.g., relay) |<br><br>Background suppression.
**NPN Output**

<table>
<thead>
<tr>
<th>Model</th>
<th>Operation mode</th>
<th>Timing charts</th>
<th>Operation selector</th>
<th>Output circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light-ON</td>
<td></td>
<td></td>
<td>Connect the pink wire (Pin(2)) to the brown (Pin(1)) or open the pink wire (Pin(2))</td>
<td>Through-beam Receivers, Retro-reflective Models, Diffuse-reflective Models, Limited reflective Models. Transparent detected with P-opaquing function.</td>
</tr>
<tr>
<td>Dark-ON</td>
<td></td>
<td></td>
<td>Connect the pink wire (Pin(2)) to the blue (Pin(3))</td>
<td>Through-beam Emitter</td>
</tr>
</tbody>
</table>

**Connector Pin Arrangement**

**M12 Connector Pin Arrangement**

**Connectors (Sensor I/O connectors)**

**M12 4-wire Connectors**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Wire color</th>
<th>Connector pin No.</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>Brown</td>
<td>➀</td>
<td>Power supply (+V)</td>
</tr>
<tr>
<td></td>
<td>White</td>
<td>➁</td>
<td>L(on) - D(on) selectable</td>
</tr>
<tr>
<td></td>
<td>Blue</td>
<td>➂</td>
<td>Power supply (0 V)</td>
</tr>
<tr>
<td></td>
<td>Black</td>
<td>➃</td>
<td>Output</td>
</tr>
</tbody>
</table>

**Through-beam Emitter**

**Background suppression.**

**Light incident**

**Light interupted**

**Operate**

**Reset**

**Operation indicator (orange)**

**Stability indicator (Green)**

**Load (e.g., relay)**

**10 to 30 VDC**

**100 mA max.**

**Control output**

**Photo-electric Sensor Main Circuit**

**Pin No.**

**Wire color**

<table>
<thead>
<tr>
<th>Brown</th>
<th>White</th>
<th>Blue</th>
<th>Black</th>
</tr>
</thead>
</table>

**E3FA/E3RA/E3FB/E3RB**

**Model**

**Operation mode**

**Timing charts**

**Operation selector**

**Output circuit**

**Connectors (Sensor I/O connectors)**

**M12 4-wire Connectors**

**Classification**

**Wire color**

**Connector pin No.**

**Application**
### Nomenclature

<table>
<thead>
<tr>
<th>Straight type, Plastic housing</th>
<th>Radial type, Plastic housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>with an adjuster:</td>
<td>with an adjuster:</td>
</tr>
<tr>
<td>E3FA-T□-D</td>
<td>E3RA-T□-D</td>
</tr>
<tr>
<td>E3FA-R□</td>
<td>E3RA-R□</td>
</tr>
<tr>
<td>E3FA-D□</td>
<td>E3RA-D□</td>
</tr>
<tr>
<td>E3FA-V□</td>
<td></td>
</tr>
<tr>
<td>E3FA-B□</td>
<td>without an adjuster:</td>
</tr>
<tr>
<td>E3FA-T□-L *</td>
<td>E3RA-T□-L *</td>
</tr>
</tbody>
</table>

* The Emitter has two Power indicators (Green) instead of the Stability indicator (Green) and the Operation indicator (Orange).

<table>
<thead>
<tr>
<th>Straight type, Metal housing</th>
<th>Radial type, Metal housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>with an adjuster:</td>
<td>with an adjuster:</td>
</tr>
<tr>
<td>E3FB-T□-D</td>
<td>E3RB-T□-D</td>
</tr>
<tr>
<td>E3FB-R□</td>
<td>E3RB-R□</td>
</tr>
<tr>
<td>E3FB-D□</td>
<td>E3RB-D□</td>
</tr>
<tr>
<td>E3FB-V□</td>
<td></td>
</tr>
<tr>
<td>E3FB-B□</td>
<td>without an adjuster:</td>
</tr>
<tr>
<td>E3FB-T□-L *</td>
<td>E3RB-T□-L *</td>
</tr>
</tbody>
</table>

* The Emitter has two Power indicators (Green) instead of the Stability indicator (Green) and the Operation indicator (Orange).

### Safety Precautions

Refer to Warranty and Limitations of Liability.

**WARNING**

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

**CAUTION**

Never use the product with an AC power supply.
Do not use the product with voltage in excess of the rated voltage.

Do not use the product with incorrect wiring.
Otherwise, explosion, fire, malfunction may result.

---

**Precautions for Safe Use**

Be sure to follow the safety precautions below for added safety.

1. Do not use the sensor under the environment with explosive, flammable or corrosive gas.
2. Do not use the sensor under the oil or chemical environment.
3. Do not use the sensor in the water, rain or outdoors.
4. Do not use the sensor in the environment where humidity is high and condensation may occur.
5. Do not use the sensor under the environment under the other conditions in excess of rated.
6. Do not use the sensor in place that is exposed by direct sunlight.
7. Do not use the sensor in place where the sensor may receive direct vibration or shock.
8. Do not use the thinner, alcohol, or other organic solvents.
9. Never disassemble, repair nor tamper with the sensor.
10. Please process it as industrial waste.

**Precautions for Correct Use**

1. Laying Sensor wiring in the same conduit or duct as high-voltage wires or power lines may result in malfunction or damage due to conduit or use shielded cable.
2. Do not pull on the cable with excessive force.
3. If a commercial switching regulator is used, ground the FG (frame ground) terminal.
4. The sensor will be available 100 ms after the power supply is tuned ON. Start to use the sensor 100 ms or more after turning ON the power supply. If the load and the sensor are connected to separate power supplies, be sure to turn ON the sensor first.
5. Output pulses may be generated even when the power supply is OFF. Therefore, it is recommended to first turn OFF the power supply for the load or the load line.
6. The sensor must be mounted using the provided nuts. The proper tightening torque range of E3FA/E3RA plastic housing series is between 0.4 and 0.5 N·m. The proper tightening torque of E3FB/E3RB metal housing series is 20 N·m max.
### E3FA/E3RA/E3FB/E3RB

#### Sensors (E3FA/E3RA Plastic housing)

**E3FA series**

**Pre-wired Models**

- E3FA-T□11
- E3FA-R□11
- E3FA-D□11
- E3FA-L□11
- E3FA-V□11
- E3FA-B□11

**M12 Connector Models**

- E3FA-T□21
- E3FA-R□21
- E3FA-D□21
- E3FA-L□21
- E3FA-V□21
- E3FA-B□21

**E3RA series**

**Pre-wired Models**

- E3RA-T□11
- E3RA-R□11
- E3RA-D□11

**M12 Connector Models**

- E3RA-T□21
- E3RA-R□21
- E3RA-D□21

---

**Dimensions**

Tolerance class IT16 applies to dimensions in this data sheet unless otherwise specified.

<table>
<thead>
<tr>
<th>Emitter</th>
<th>Receiver</th>
<th>Left Side View</th>
<th>Right Side View</th>
<th>Bottom View</th>
<th>Mounting Holes</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 dia.</td>
<td>14.9 dia.</td>
<td>10.7 dia.</td>
<td>18.5 dia.</td>
<td>18.5 dia.</td>
<td>18.5 dia.</td>
</tr>
<tr>
<td>8 dia.</td>
<td>35.9 dia.</td>
<td>34.5 dia.</td>
<td>18.5 dia.</td>
<td>18.5 dia.</td>
<td>18.5 dia.</td>
</tr>
</tbody>
</table>

**Terminal No.**

<table>
<thead>
<tr>
<th>1</th>
<th>+V</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>L/on · D/on selectable</td>
</tr>
<tr>
<td>3</td>
<td>0V</td>
</tr>
<tr>
<td>4</td>
<td>Output</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Emitter</th>
<th>Receiver</th>
<th>Left Side View</th>
<th>Right Side View</th>
<th>Bottom View</th>
<th>Mounting Holes</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 dia.</td>
<td>14.9 dia.</td>
<td>10.7 dia.</td>
<td>18.5 dia.</td>
<td>18.5 dia.</td>
<td>18.5 dia.</td>
</tr>
<tr>
<td>8 dia.</td>
<td>35.9 dia.</td>
<td>34.5 dia.</td>
<td>18.5 dia.</td>
<td>18.5 dia.</td>
<td>18.5 dia.</td>
</tr>
</tbody>
</table>

**Terminal No.**

<table>
<thead>
<tr>
<th>1</th>
<th>+V</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>L/on · D/on selectable</td>
</tr>
<tr>
<td>3</td>
<td>0V</td>
</tr>
<tr>
<td>4</td>
<td>Output</td>
</tr>
</tbody>
</table>

---

**Specifications**

- E3FA-B
- E3FA-V
- E3FA-D
- E3FA-R
- E3FA-T
- E3FA-L

- E3RA-T
- E3RA-R
- E3RA-D

---

**Notes**

- Vinyl insulated round cord 4 dia. 4 cores (conductor cross sectional area 0.128 mm² (AWG26) insulation outside diameter 0.85 dia.) standard length 2 m
- Tolerance class IT16 applies to dimensions in this data sheet unless otherwise specified.
- Emitter Optical axis
- Receiver Optical axis
- Optical axis

---

**Emitter indicator (green)**

- E3FA-B
- E3FA-R
- E3FA-D
- E3FA-V
- E3FA-B

---

**Operation indicator (orange)**

- E3RA-T
- E3RA-R
- E3RA-D

---

**Mounting Holes**

- E3RA-T
- E3RA-R
- E3RA-D
E3FA/E3RA/E3FB/E3RB

Sensors (E3FB/E3RB Metal housing)

**E3FB series**

*Pre-wired Models*
- E3FB-T□11
- E3FB-R□11
- E3FB-D□11
- E3FB-L□11
- E3FB-V□11
- E3FB-B□11

**E3FB series**

*M12 Connector Models*
- E3FB-T□21
- E3FB-R□21
- E3FB-D□21
- E3FB-L□21
- E3FB-V□21
- E3FB-B□21

---

**E3RB series**

*Pre-wired Models*
- E3RB-T□11
- E3RB-R□11
- E3RB-D□11

**E3RB series**

*M12 Connector Models*
- E3RB-T□21
- E3RB-R□21
- E3RB-D□21

---

**Terminal No.**  **Specification**
1  +V
2  L’on · D’on selectable
3  0V
4  Output

---

**Mounting Holes**
- Left side view
- Front view
- Right side view
- Rear view
- Bottom view

---

**Mounting Holes**
- Left side view
- Front view
- Right side view
- Rear view
- Bottom view
Attached nut

Material: ABS (for E3FA/E3RA)
Nickel-brass (for E3FB/E3RB)

Accessories (Order Separately)

**Reflectors**

**E39-R1S**

**E39-RP1**

**Mounting brackets**

**E39-L183**

**Mounting brackets**

**E39-L182**
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