FL7S Series

Stainless Steel Sensing Face Proximity Sensor

The FL7S is a proximity sensor having a stainless steel sensing face and housing, and is specially designed for welding applications on the automobile manufacturing line.

- The sensing face is integrated into a stainless steel housing having high shock resistance and superior abrasion resistance
- Sensors have a spatter and slag proof special coating
- An electromagnetic field noise elimination circuit is built in
- The lineup includes M8, M12, M18 and M30 models

ADVANTAGES OF FL7S SENSORS

- The sensing face is integrated into a single stainless steel housing.
- Special spatter-resistant coating
- Highly resistant to electromagnetic field noise from welding!

FL7S SERIES ENDURANCE TEST RESULTS

Two endurance tests were made in order to develop a sensor that could meet the severe requirements demanded by users in the field. The FL7S Series has proven to have superior performance in both tests.

Sensing face strength tests

**TEST-1**
The Metal Brush Test (measurement of abrasion resistance)

- Test condition
  - Brush: Stainless steel brush
  - Rotation speed: 130 cycles/min

- Test results:
  - FL7M-7J6HD: Survives 5 min of brushing
  - FL7M-7J6HW: Survives 25 min of brushing
  - FL7S-5W6W-CN03: Operation is normal even after 200 minutes!

**TEST-2**
Repetitive Shock Test (measurement of shock resistance)

- Test condition
  - Brush: Stainless steel brush
  - Rotation speed: 130 cycles/min

- Test results:
  - FL7M-7J6HD: Housing survives 310 repetitions
  - FL7M-7J6HW: Housing survives 5,000 repetitions
  - FL7S-5W6W-CN03: Operation is normal even after 200,000 repetitions!

Resistance to electromagnetic field noise from welding: With conventional sensors, welding sparking leads to hard-to-remove spatter and slag. The big problem is the scratches caused by the abrasive metal brush used to remove the stuck spatter and slag. Yamatake has solved this major problem by creating for the FL7S Series a stainless steel sensing face that resists abrasion. The Metal Brush!

Distance between welding gun and sensor

<table>
<thead>
<tr>
<th>Welding current (A) (DC or AC)</th>
<th>Distance between welding gun and sensor (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000</td>
<td>180mT 80mT 40mT 25mT 20mT 16mT 13mT 7mT</td>
</tr>
<tr>
<td>20,000</td>
<td>315mT 160mT 80mT 50mT 40mT 30mT 25mT 13mT</td>
</tr>
<tr>
<td>30,000</td>
<td>470mT 235mT 120mT 80mT 60mT 50mT 40mT 20mT</td>
</tr>
</tbody>
</table>

Ex.: When the welding current is 10,000A, the sensor operates without error even when it is installed as close as approx. 12.7mm from the welding gun.
### SELECTION GUIDE

#### Preleaded connector type

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Sensing distance (Ferrous material only)</th>
<th>Operation Mode</th>
<th>Connector</th>
<th>Catalog listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape example (M18)</td>
<td>Outer diameter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Cable length: M8=80cm, others=30cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M8</td>
<td>1.5mm</td>
<td>2-wire no-polarity</td>
<td>N.O.</td>
<td>FL7S-1W6W-CN03</td>
</tr>
<tr>
<td>M8</td>
<td>1.5mm</td>
<td>3-wire NPN</td>
<td>N.O.</td>
<td>FL7S-1A6W-CN08</td>
</tr>
<tr>
<td>M12</td>
<td>2mm</td>
<td>2-wire no-polarity</td>
<td>N.O.</td>
<td>FL7S-1D6W-CN08</td>
</tr>
<tr>
<td>M18</td>
<td>5mm</td>
<td>2-wire no-polarity</td>
<td>N.O.</td>
<td>FL7S-1D6W-CN08</td>
</tr>
<tr>
<td>M30</td>
<td>8mm</td>
<td>2-wire no-polarity</td>
<td>N.O.</td>
<td>FL7S-1D6W-CN08</td>
</tr>
</tbody>
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#### Preleaded type

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</tr>
</thead>
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<tr>
<td>Shape example (M18)</td>
<td>Outer diameter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Cable length: 5m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M8</td>
<td>1.5mm</td>
<td>2-wire no-polarity</td>
<td>N.O.</td>
<td>FL7S-1W6W-L5</td>
</tr>
<tr>
<td>M12</td>
<td>2mm</td>
<td>2-wire no-polarity</td>
<td>N.O.</td>
<td>FL7S-2W6W-L5</td>
</tr>
<tr>
<td>M18</td>
<td>5mm</td>
<td>2-wire no-polarity</td>
<td>N.O.</td>
<td>FL7S-5W6W-L5</td>
</tr>
<tr>
<td>M30</td>
<td>8mm</td>
<td>2-wire no-polarity</td>
<td>N.O.</td>
<td>FL7S-8W6W-L5</td>
</tr>
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### SPECIFICATIONS

<table>
<thead>
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<th>Catalog listing</th>
<th>Preleaded connector type</th>
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<tbody>
<tr>
<td>FL7S-1W6W-CN08</td>
<td>FL7S-1W6W-CN03(B)</td>
<td>FL7S-1W6W-L5</td>
</tr>
<tr>
<td>FL7S-2W6W-CN03(B)</td>
<td>FL7S-2W6W-L5</td>
<td>FL7S-2W6W-L5</td>
</tr>
<tr>
<td>FL7S-5W6W-CN03(B)</td>
<td>FL7S-5W6W-L5</td>
<td>FL7S-5W6W-L5</td>
</tr>
<tr>
<td>FL7S-8W6W-CN03(B)</td>
<td>FL7S-8W6W-L5</td>
<td>FL7S-8W6W-L5</td>
</tr>
</tbody>
</table>

- **Actuation method**: High-frequency oscillation type
- **Rated sensing distance**: 1.5±0.15mm
- **Standard target object**: Iron 8 × 8mm, t=1mm
- **Differential travel**: Max. 15% of sensing distance
- **Rated supply voltage**: 12/24V dc
- **Operating voltage range**: 10 to 30V dc
- **Current consumption**: 10mA max.
- **Voltage drop at ON**: 2V/2V max.
- **Leakage current**: 10µA max.
- **Switching current**: 1mA max.
- **Operating frequency**: 5Hz
- **Temperature characteristics**: −10 to +15% of sensing distance (25°C) (−10 to +60°C)
- **Operating indicator**: Lights (red) at output ON
- **Operating temperature range**: −10 to +60°C
- **Storage temperature range**: −10 to +60°C
- **Insulation resistance**: 50MΩ max., DC 500V
- **Dielectric strength**: 1,000Vac, 50/60Hz between case and electrically live metals
- **Vibration resistance**: 55Hz, 1mm peak-to-peak amplitude, 2 hours in X, Y and Z directions
- **Shock resistance**: 294m/s², 6 times in X, Y and Z directions
- **Protection**: IP67
- **Electromagnetic field noise resistance**: 100mT
- **Sensing face thickness**: 0.4mm
- **Weight**: 30g
- **Material**: Stainless steel 303 (with spatter and slag proof special coating)

**Note 1**: Does not detect non-ferrous metals.
**Note 2**: Avoid using this sensor in an environment always subject to splashing water or oil.
**EXTERNAL DIMENSIONS**

**Prebleded connector type**

<table>
<thead>
<tr>
<th>Model</th>
<th>Dimensions (unit: mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL7S-1W6W-CN08</td>
<td></td>
</tr>
</tbody>
</table>

- Sensing face (SUS303, t=0.7 special resin coat)
- Hexagonal nut (brass, special resin coat)
- Washer (special resin coat)
- Indicator

| FL7S-1W6W-CN03(B) | |

- Sensing face (SUS303, t=0.7 special resin coat)
- Hexagonal nut (brass, special resin coat)
- Case (SUS303, special resin coat)
- Indicator

| FL7S-8W6W-CN03(B) | |

- Sensing face (SUS303, t=0.7 special resin coat)
- Hexagonal nut (brass, special resin coat)
- Case (SUS303, special resin coat)
- Indicator

**Prebleded type**

<table>
<thead>
<tr>
<th>Model</th>
<th>Dimensions (unit: mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL7S-1W6W-L5</td>
<td></td>
</tr>
</tbody>
</table>

- Sensing face (Stainless steel, t=0.7 special resin coat)
- Hexagonal nut (brass, special resin coat)
- Case (SUS303, special resin coat)
- Label

| FL7S-2W6W-L5 | |

- Sensing face (Stainless steel, t=0.7 special resin coat)
- Hexagonal nut (brass, special resin coat)
- Case (SUS303, special resin coat)
- Label

| FL7S-5W6W-L5 | |

- Sensing face (Stainless steel, t=0.7 special resin coat)
- Hexagonal nut (brass, special resin coat)
- Case (SUS303, special resin coat)
- Label

| FL7S-8W6W-L5 | |

- Sensing face (Stainless steel, t=0.7 special resin coat)
- Hexagonal nut (brass, special resin coat)
- Case (SUS303, special resin coat)
- Label

**Note:** When the sensor is flush-mounted in metal, be sure to mount it so that the top of the sensing face projects 2 to 2.5mm from the metal surface.
**OUTPUT CIRCUIT AND WIRING**

- **Preleaded connector type**

  **2-wire non-polarity type**

  ![Diagram](image1)

  - The load can be connected to either of the power supplies.

  ![Diagram](image2)

  - The load can be connected to either of the power supplies.

- **3-wire type**

  ![Diagram](image3)

  - The load can be connected to either of the power supplies.

  ![Diagram](image4)

  - The load can be connected to either of the power supplies.

- **Preleaded type**

  ![Diagram](image5)

  - The load can be connected to either of the power supplies.

### Cable with connector

Be sure to use a **PA5 Series cable with connector** when connecting a preleaded connector or connector-type sensor.

**PA5 Series cable with connector**

<table>
<thead>
<tr>
<th>Shape</th>
<th>Power supply</th>
<th>Cable properties</th>
<th>Cable length</th>
<th>Cable listing</th>
<th>Lead colors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DC</td>
<td>Oil-resistant flexible; UL2464; flame-resistant; EN-compliant</td>
<td>2m</td>
<td>PA5-4ISX2MK-E</td>
<td>1: brown, 2: white, 3: blue, 4: black</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5m</td>
<td>PA5-4ISX5MK-E</td>
<td>1: brown, 2: white, 3: blue, 4: black</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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**Tightening the connector**

Align the grooves and rotate the fastening nut on the **PA5 connector** by hand until it tightly with the connector on the sensors side.

**Preleaded connector type**

![Diagram](image6)

**Connectors side (male)**

![Diagram](image7)

**Connectors side (female)**

![Diagram](image8)
**PRECAUTIONS FOR USE**

1. **Influence of surrounding metal**

   Metal other than the target object surrounding the sensor may influence operating characteristics. Leave space between the sensor and surrounding metal as shown below.

   Shaded areas indicate surrounding metal other than the target object.

   A: Distance from sensing face of proximity sensor to mounting surface

   B: Distance from surface of iron plate to sensing face of proximity sensor.

   Dimensions in parentheses apply if a hexagonal nut is attached to the front.

   C: Distance from surface of iron plate to center of proximity switch when A=0

2. **Mutual interference prevention**

   When mounting proximity sensors either parallel to or facing each other, mutual interference may cause the sensor to malfunction. Maintain at least the distances indicated in the figures below.

### Catalog listing

<table>
<thead>
<tr>
<th>Catalog listing</th>
<th>A(mm)</th>
<th>B(mm)</th>
<th>C(mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL7S-1</td>
<td>16</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>FL7S-2</td>
<td>24</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>FL7S-5</td>
<td>36</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>FL7S-8</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>