Stainless Steel Sensing Face Proximity Switch

**FL7S Series**
The FL7S is a proximity switch 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.
- Switches 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.

* Connector-type cables are also available for the FL7S Series.
  - PA5-4ISX FK-E (incombustible cable)
  - PA5-4ISX UK-E (flame-resistant cable)

### ADVANTAGES OF FL7S SWITCHES

#### 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 switch 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
- Stationary: FL7M-7J6HD
  - Survives 5 min of brushing
- Rotating: 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
- Stationary: FL7M-7J6HD
  - Housing survives 310 repetitions
- Rotating: 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!
- Suitable range for FL7S/2/5/8 Series
- Distance between welding gun and switch (mm)

<table>
<thead>
<tr>
<th>Welding current (A)</th>
<th>Distance between welding gun and switch (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC or AC</td>
<td>12.7 25.4 51 76 102 127 152 306</td>
</tr>
<tr>
<td>10,000</td>
<td>160mT 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 switch operates without error even when it is installed as close as approx. 12.7 mm from the welding gun.*

![Image of welding current and distance](image-url)

- 10,000
- 20,000
- 30,000
- 160mT
- 315mT
- 470mT
- 80mT
- 160mT
- 235mT
- 120mT
- 80mT
- 60mT
- 50mT
- 40mT
- 20mT

- 12.7
- 25.4
- 51
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- 102
- 127
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- 306

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### 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></td>
<td></td>
<td>Wiring</td>
<td>Output</td>
<td>+</td>
</tr>
<tr>
<td>Shape example (M18)</td>
<td>Outer diameter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Cable length: M8=80 cm, others=30 cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M8</td>
<td>1.5 mm</td>
<td>2-wire no-polarity</td>
<td>N.O.</td>
<td>—</td>
</tr>
<tr>
<td>M8</td>
<td>1.5 mm</td>
<td>2-wire NPN</td>
<td>N.O.</td>
<td>1</td>
</tr>
<tr>
<td>M12</td>
<td>2 mm</td>
<td>2-wire no-polarity</td>
<td>N.O.</td>
<td>—</td>
</tr>
<tr>
<td>M18</td>
<td>5 mm</td>
<td>2-wire no-polarity</td>
<td>N.O.</td>
<td>—</td>
</tr>
<tr>
<td>M30</td>
<td>8 mm</td>
<td>2-wire no-polarity</td>
<td>N.O.</td>
<td>—</td>
</tr>
</tbody>
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<tr>
<td>Shape example (M18)</td>
<td>Outer diameter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Cable length: 5 m)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M8</td>
<td>1.5 mm</td>
<td>2-wire no-polarity</td>
<td>FL7S-1W6W-L5</td>
</tr>
<tr>
<td>M12</td>
<td>2 mm</td>
<td>2-wire no-polarity</td>
<td>FL7S-2W6W-L5</td>
</tr>
<tr>
<td>M18</td>
<td>5 mm</td>
<td>2-wire no-polarity</td>
<td>FL7S-5W6W-L5</td>
</tr>
<tr>
<td>M30</td>
<td>8 mm</td>
<td>2-wire no-polarity</td>
<td>FL7S-8W6W-L5</td>
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</tbody>
</table>

### SPECIFICATIONS

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

#### Actuation method
- High-frequency oscillation type

#### Rated sensing distance
- 1.5±0.15 mm
- 2±0.2 mm
- 5±0.5 mm
- 8±0.8 mm

#### Standard target object
- Iron 8 x 8 mm, t=1 mm
- Iron 12 x 12 mm, t=1 mm
- Iron 18 x 18 mm, t=1 mm
- Iron 30 x 30 mm, t=1 mm

#### Differential travel
- Max. 15% of sensing distance

#### Rated supply voltage
- 12/24 Vdc

#### Operating voltage range
- 10 to 30 Vdc

#### Current consumption
- 10 mA max.
- 2V max.
- 10 μA max.
- 100 mA max.

#### Operating frequency
- 5 Hz
- 4 Hz
- 5 Hz

#### Temperature characteristics
- ±10% of sensing distance (25°C) (–10 to +60°C)

#### Operating indicator
- Lights (red) at output ON

#### Storage temperature range
- –10 to +60°C

#### Dielectric strength
- 500 Vac, 50/60 Hz between case and electrically live metals

#### Vibration resistance
- 55 Hz, 1 mm peak-to-peak amplitude, 2 hours in X, Y, and Z directions

#### Shock resistance
- 294 m/s², 6 times in X, Y, and Z directions

#### Protection
- IP67

#### Electromagnetic field noise resistance
- 100mT
- 250mT

#### Sensing face thickness
- 0.4 mm
- 0.7 mm

#### Weight
- -CN 30 g
- -LS 190 g
- 0.4 mm
- 0.7 mm

#### Circuit protection
- Reverse connection protection circuit
- Output short-circuit protection circuit

#### Material
- Stainless steel 303 (with spatter and slag proof special coating)

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*1: Does not detect non-ferrous metals.
*2: Avoid using this switch in an environment always subject to splashing water or oil.
*3: AC/DC magnetic field 85 ms or less
**EXTERNAL DIMENSIONS**

*Preleded connector type*

**FL7S-J6W-CN08**

- Sensing face (SUS303, t=0.4, special resin coat)
- Toothed washer (brass, special resin coat)
- Insulated cord, 3 dia. (PVC)
- Hexagonal nut (brass, special resin coat)
- Case (SUS303, special resin coat)

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

- Sensing face (Stainless steel, t=0.4, fluoropolymer coated)
- Hexagonal nut (brass, special resin coat)
- Washing head (Brass, fluoropolymer coated)
- Insulated cord, 4.8 dia., VW-1
- Indicator

**FL7S-2W6W-CN03(B)**

- Sensing face (SUS303, t=0.4, special resin coat)
- Hexagonal nut (brass, special resin coat)
- Washing head (Brass, fluoropolymer coated)
- Case (Stainless steel, fluoropolymer coated)

**FL7S-5W6W-CN03(B)**

- Sensing face (SUS303, t=0.7, special resin coat)
- Hexagonal nut (brass, special resin coat)
- Washing head (Brass, fluoropolymer coated)
- Case (Stainless steel, fluoropolymer coated)

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

- Sensing face (SUS303, t=0.7, special resin coat)
- Hexagonal nut (brass, special resin coat)
- Washing head (Brass, fluoropolymer coated)
- Case (Stainless steel, fluoropolymer coated)

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

*Preleded type*

**FL7S-1W6W-L5**

- Sensing face (SUS303, t=0.4, fluoropolymer coated)
- Hexagonal nut (brass, special resin coat)
- Insulated cord, 3.3 dia. (PVC) with sleeving tube
- Indicator

**FL7S-2W6W-L5**

- Sensing face (SUS303, t=0.7, special resin coat)
- Hexagonal nut (brass, special resin coat)
- Insulated cord, 3.3 dia. (PVC) with sleeving tube
- Indicator

**FL7S-5W6W-L5**

- Sensing face (SUS303, t=0.7, special resin coat)
- Hexagonal nut (brass, special resin coat)
- Insulated cord, 5 dia. (PVC), VW-1

**FL7S-8W6W-L5**

- Sensing face (SUS303, t=0.7, special resin coat)
- Hexagonal nut (brass, special resin coat)
- Insulated cord, 5 dia. (PVC), VW-1

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


## OUTPUT CIRCUIT AND WIRING

### Preleaded connector type

#### 2-wire non-polarity type

- CN03

```
[Diagram]
```

- CN03B

```
[Diagram]
```

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

#### 3-wire type

- PNP

```
[Diagram]
```

- NPN

```
[Diagram]
```

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

### Preleaded type

```
[Diagram]
```

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

## CONNECTOR WITH CABLE

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

### PA5 Series connector with cable

<table>
<thead>
<tr>
<th>Shape</th>
<th>Power supply</th>
<th>Cord properties</th>
<th>Cord length</th>
<th>Catalog listing</th>
<th>Lead colors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DC</td>
<td>Vinyl-insulated cord with high resistance to oil and vibration (UL/NFPA79 CM, CL3)</td>
<td>2 m</td>
<td>PAS-4I SX2SK</td>
<td>1: brown, 2: white, 3: blue, 4: black</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 m</td>
<td>PAS-4I SX5SK</td>
<td>1: brown, 2: white, 3: blue, 4: black</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 m</td>
<td>PAS-4I LX2SK</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>5 m</td>
<td>PAS-4I LX5SK</td>
<td>1: brown, 2: white, 3: blue, 4: black</td>
</tr>
</tbody>
</table>

### Tightening the connector

Align the grooves and rotate the fastening nut on the PA5 connector by hand until it fits tightly with the connector on the switches side.
1. Influence of surrounding metal

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

Shaded areas indicate surrounding metal other than the target object.
A: Distance from sensing face of proximity switch to mounting surface
B: Distance from surface of iron plate to sensing face of proximity switch.
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

<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>0</td>
<td>4.5</td>
<td>8</td>
</tr>
<tr>
<td>FL7S-2</td>
<td>0</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>FL7S-5</td>
<td>2.5</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>FL7S-8</td>
<td>2.5</td>
<td>24</td>
<td>23</td>
</tr>
</tbody>
</table>

2. Mutual interference prevention

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

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

3. Mounting

<table>
<thead>
<tr>
<th>Catalog listing</th>
<th>Max tightening torque (N-m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL7S-1</td>
<td>8</td>
</tr>
<tr>
<td>FL7S-2</td>
<td>15</td>
</tr>
<tr>
<td>FL7S-5</td>
<td>30</td>
</tr>
<tr>
<td>FL7S-8</td>
<td>60</td>
</tr>
</tbody>
</table>