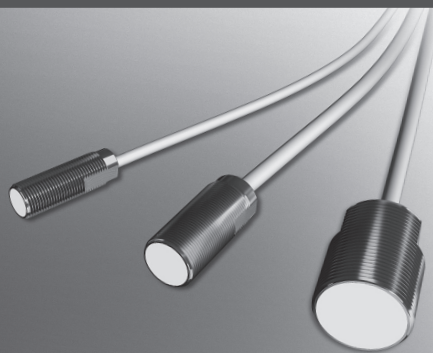


# DC2-Wire Spatter-Guarded Cylindrical Proximity Switches



## Model FL7M

A variety of anti-spatter measures make these switches the optimum for welding processes on the automotive production line.



- With Teflon coating on the body housing and a Teflon resin head surface, it's difficult for spatter to stick
- Flame-resistant cable. Noncombustible cable is also available
- Connector type is also available
- UL/CE certified (excluding some models)

- PHOTOELECTRIC SENSORS & SWITCHES
- MEASUREMENT SENSORS
- PROXIMITY SWITCHES
- LIMIT SWITCHES
- SAFETY KEY SWITCHES
- CYLINDRICAL
- SQUARE
- TECHNICAL GUIDE

FL7M (DC2)  
Regular

FL7M (DC2)  
Long Distance No-Polarity

FL7M (DC2)  
Spatter-Guarded

FL7S

FL7M-C (DC2)  
Environment-Resistant

FL7M-A (DC2)  
Aluminum-Chip Resistant

FL7M (DC2)  
Unshielded


FL7M (AC/DC2)

FL7M (DC3)


## ORDER GUIDE

### ● Polarity type


#### Preleaded types

Exterior		Sensing distance	Operation mode	Setting indicator	Spatter-guarded	Flexible, Flame-resistant cable	Catalog listing
Appearance	Size (O.D.)						
	M12	3 mm	N.O.	●	●	●	FL7M-3J6HW-R
			N.C.		●	●	FL7M-3K6HWE-R
	M18	7 mm	N.O.	●	●	●	FL7M-7J6HW-R
			N.C.		●	●	FL7M-7K6HWE-R
	M30	10 mm	N.O.	●	●	●	FL7M-10J6W-R
			N.C.		●	●	FL7M-10K6WE-R

#### Preleaded connector types

Exterior		Sensing distance	Operation mode	Setting indicator	Spatter-guarded	Flexible, Flame-resistant cable	Connector		Catalog listing	
Appearance	Size (O.D.)						+	-		
	M12	3 mm	N.O.	●	●	●	1	4	FL7M-3J6HW-CN03	
			N.O.	●	●	●	4	3	FL7M-3J6HW-CN03A	
			N.C.		●	●	●	1	2	FL7M-3K6HWE-CN03
	M18	7 mm	N.O.	●	●	●	1	4	FL7M-7J6HW-CN03	
			N.O.	●	●	●	4	3	FL7M-7J6HW-CN03A	
			N.C.		●	●	●	1	2	FL7M-7K6HWE-CN03
	M30	10 mm	N.O.	●	●	●	1	4	FL7M-10J6W-CN03	
			N.O.	●	●	●	4	3	FL7M-10J6W-CN03A	
			N.C.		●	●	●	1	2	FL7M-10K6WE-CN03

#### Quick Lock connector type

Exterior		Sensing distance	Operation mode	Setting indicator	Spatter-guarded	Flexible, Flame-resistant cable	Connector		Catalog listing
Appearance	Size (O.D.)						+	-	
	M12	3 mm	N.O.	●	●	●	1	4	FL7M-3J6HW-SN03
			N.C.		●	●	●	1	2
	M18	7 mm	N.O.	●	●	●	1	4	FL7M-7J6HW-SN03
			N.C.		●	●	●	1	2
	M30	10 mm	N.O.	●	●	●	1	4	FL7M-10J6W-SN03
			N.C.		●	●	●	1	2


Compatible with OMRON Smartclick connectors.

Smartclick  is a registered trademark of OMRON Corporation.




## ● No-polarity type


### Preleaded types

Exterior		Sensing distance	Operation mode	Setting indicator	Spatter-guarded	Flexible, Flame-resistant cable	Catalog listing
Appearance	Size (O.D.)						
(cable length 2 m) 	M12	3 mm	N.O.	●	●	●	FL7M-3W6HWT-R
	M18	7 mm	N.O.	●	●	●	FL7M-7W6HWT-R
	M30	10 mm	N.O.	●	●	●	FL7M-10W6WT-R

### Preleaded connector types

Exterior		Sensing distance	Operation mode	Setting indicator	Spatter-guarded	Flexible, Flame-resistant cable	Connector	Catalog listing
Appearance	Size (O.D.)						No-polarity	
(cable length 30 cm) 	M12	3 mm	N.O.	●	●	●	3 - 4	FL7M-3W6HWT-CN03
	M18	7 mm	N.O.	●	●	●	3 - 4	FL7M-7W6HWT-CN03
	M30	10 mm	N.O.	●	●	●	3 - 4	FL7M-10W6WT-CN03



### Quick Lock connector type

Exterior		Sensing distance	Operation mode	Setting indicator	Spatter-guarded	Flexible, Flame-resistant cable	Connector	Catalog listing
Appearance	Size (O.D.)						No-polarity	
(cable length 30 cm) 	M12	3 mm	N.O.	●	●	●	3 - 4	FL7M-3W6HWT-SN03
	M18	7 mm	N.O.	●	●	●	3 - 4	FL7M-7W6HWT-SN03
	M30	10 mm	N.O.	●	●	●	3 - 4	FL7M-10W6WT-SN03

Compatible with OMRON Smartclick connectors.

Smartclick  Smartclick is a registered trademark of OMRON Corporation.

## ● Accessories (sold separately)

Name	Appearance	O.D.	Catalog listing
Mounting bracket		For M12	FL-PA112
		For M18	FL-PA118
		For M30	FL-PA130
Spatter-guarded protective cover		For M12	FL-PA12W
		For M18	FL-PA18W
		For M30	FL-PA30W

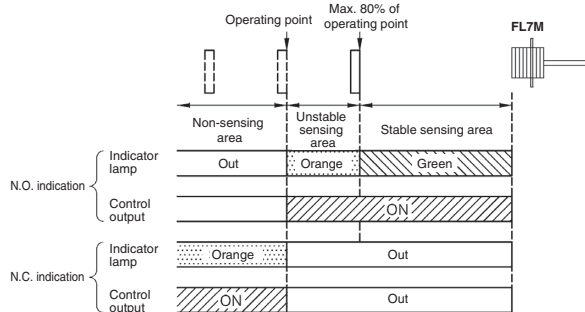
## SPECIFICATIONS

### ● Preleaded and preleaded connector types (-CN03), Quick Lock types (-SN03)

Catalog listing		FL7M-3□6HW(E)(T) (-R, -CN03, -SN03)	FL7M-7□6HW(E)(T) (-R, -CN03, -SN03)	FL7M-10□6W(E)(T) (-R, -CN03, -SN03)
Actuation method		High-frequency oscillation		
Rated sensing distance		3 ±0.3 mm	7 ±0.7 mm	10 ±1 mm
Usable sensing distance		0 to 2.1 mm	0 to 4.9 mm	0 to 7.0 mm
Standard target object		12 x 12 x 1 mm iron	18 x 18 x 1 mm iron	30 x 30 x 1 mm iron
Differential travel		15% max. of sensing distance		
Rated supply voltage		12/24 Vdc		
Operating voltage range		10 to 30 Vdc		
Leakage current		0.55 mA max.		
Control output	Switching current	3 to 100 mA		
	Voltage drop	Polarity type: 3.0V max. (with 100 mA switching current, 2 m cable) No-polarity type: 5.0V max. (with 100 mA switching current, 2 m cable)		
	Output dielectric strength	30 Vdc		
Operating frequency		Min. 1.5 kHz		Min. 500 Hz
Temperature drift		±10% max. of sensing distance for the -25 to +70°C range, taking +25°C as the standard temp.		
Supply voltage drift		±1% max. of sensing distance with ±15% voltage fluctuation, taking rated supply voltage as standard voltage		
Indicator lamps		N.O. type: Operation indication: lights up (orange or green) upon output Setting indication: lights up (green) in stable sensing area N.C. type: Operation indication: orange light goes out in sensing area		
Operating temperature		-25 to +70°C		
Insulation resistance		50 MΩ min. (by 500 Vdc megger)		
Dielectric strength		1,000 Vac, 50/60 Hz for 1 minute		
Vibration resistance		10 to 55 Hz, 1.5 mm peak-to-peak amplitude, 2 hrs each in X, Y and Z directions		
Shock resistance		980 m/s <sup>2</sup> 10 times each in X, Y and Z directions		
Protective structure		IP67 (IEC standard), IP67G (JEM standard)		
Weight (main unit with 2m preleaded cable)		Approx. 60 g	Approx. 130 g	Approx. 230 g
Circuit protection		Surge absorption, load short-circuit protection, reverse connection protection circuit		
Wiring method		Preleaded (2 m cable), Preleaded connector (30 cm cable), Quick Lock connector (30 cm cable)		
Material	Switch	Ni-plated brass		
	Case	Nylon		
	Housing	Polyester elastomer		
	Connector	Glass-lined polyester resin		
	Contacts	Gold-plated brass		

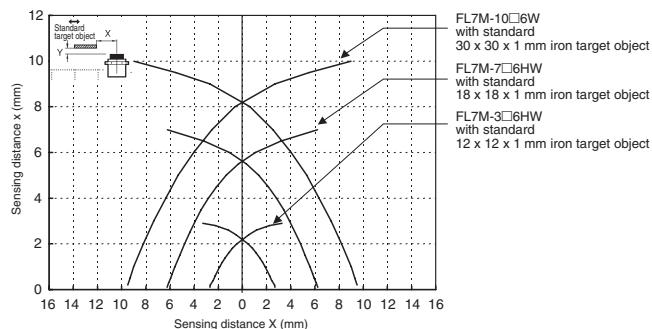
## USING THE SETTING INDICATOR

The proximity switch can be set up to detect objects reliably by bringing the switch progressively closer to the target object and installing the switch at the point where the indicator lamp (N.O. indication) changes from orange to green.



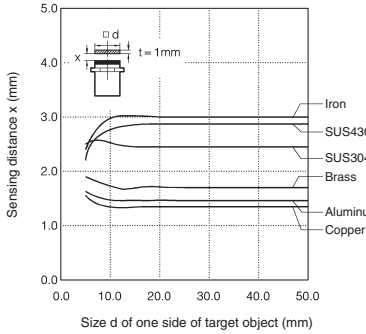
\*When the target object is made of a different material (such as aluminum, copper or stainless steel) from the standard target object (iron), the distance at which the indicator lamp changes color is shorter than the 80% maximum.

## SENSING AREA (typical)

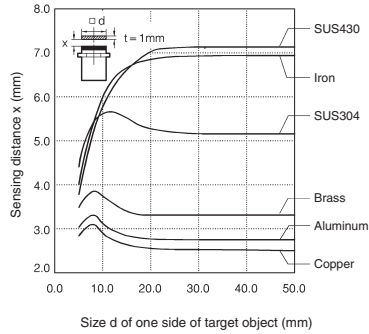


## SENSING DISTANCE ACCORDING TO MATERIAL AND SIZE OF OBJECT (typical)

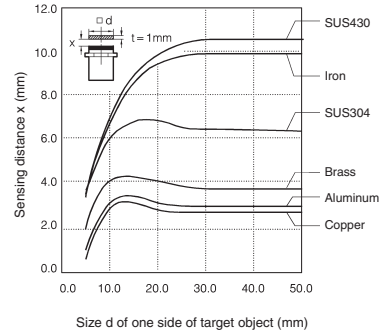
FL7M-3□6HW



FL7M -7□6HW

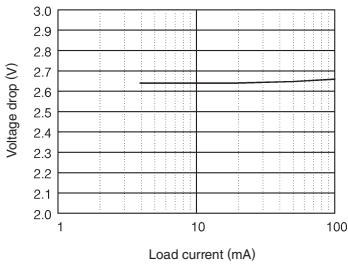


FL7M -10□6W

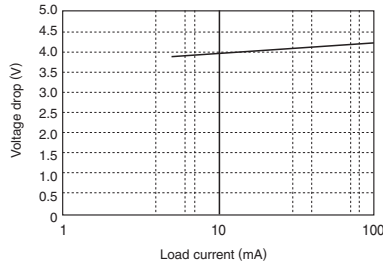


## VOLTAGE DROP (typical)

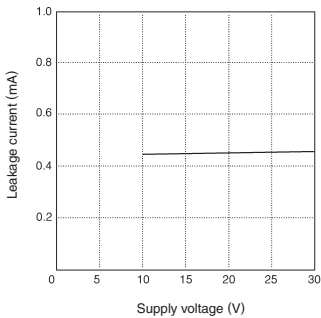
### ● Polarity type



### ● No-polarity type



## LEAKAGE CURRENT (typical)



PHOTOELECTRIC  
SENSORS &  
SWITCHES

MEASUREMENT  
SENSORS

PROXIMITY  
SWITCHES

LIMIT  
SWITCHES

SAFETY  
KEY SWITCHES

CYLINDRICAL

SQUARE

TECHNICAL  
GUIDE

FL7M (DC2)  
Regular

FL7M (DC2)  
Long-Distance No-Polarity

FL7M (DC2)  
Spallor-Guarded

FL7S

FL7M-C (DC2)  
Environment-Resistant

FL7M-A (DC2)  
Aluminum-Chip Resistant

FL7M (DC2)  
Unshielded

FL7M (AC/DC2)

FL7M (DC3)

Connector  
with cable



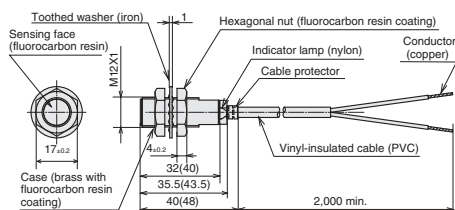
See page  
**F-001**

## EXTERNAL DIMENSIONS

(unit: mm)

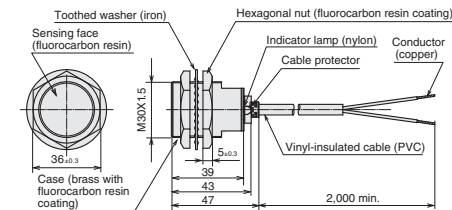
### Prelead type

#### FL7M-3□6HW□□-R



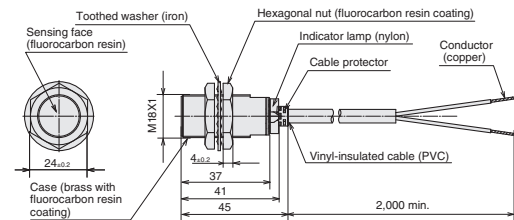
Vinyl-insulated cable (flame-resistant, oil-resistant, vibration-resistant):  
0.3 mm<sup>2</sup>, 3/20/0.08 dia., 2-core, dia. 4.1  
Cap color: white

#### FL7M-10□6W□□-R



Vinyl-insulated cable (flame-resistant, oil-resistant, vibration-resistant):  
0.5 mm<sup>2</sup>, 7/15/0.08 dia., 2-core, dia. 5.7  
Cap color: white.

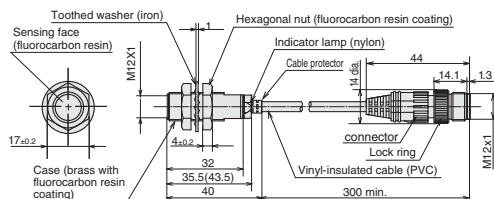
#### FL7M-7□6HW□□-R



Vinyl-insulated cable (flame-resistant, oil-resistant, vibration-resistant):  
0.5 mm<sup>2</sup>, 7/15/0.08 dia., 2-core, dia. 5.7  
Cap color: white.

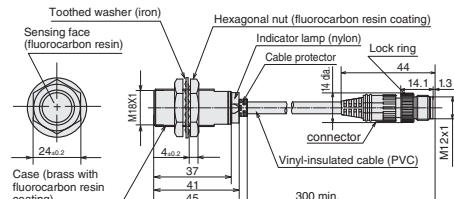
### Prelead connector type

#### FL7M-3□6HW□□-CN03



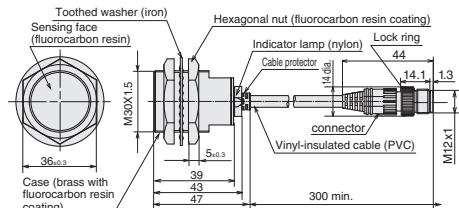
Vinyl-insulated cable (flame-resistant, oil-resistant, vibration-resistant):  
0.3 mm<sup>2</sup>, 2-core, dia. 4.1  
Cap color: white.

#### FL7M-7□6HW□□-CN03



Vinyl-insulated cable (flame-resistant, oil-resistant, vibration-resistant):  
0.5 mm<sup>2</sup>, 2-core, dia. 5.7  
Cap color: white.

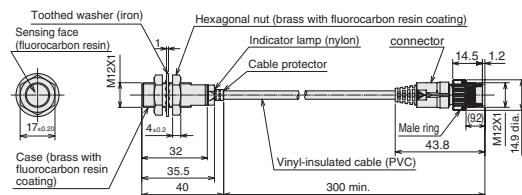
#### FL7M-10□6W□□-CN03



Vinyl-insulated cable (flame-resistant, oil-resistant, vibration-resistant):  
0.5 mm<sup>2</sup>, 2-core, dia. 5.7  
Cap color: white.

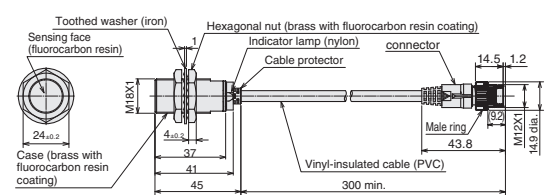
### Quick Lock connector type

#### FL7M-3□6HW□□-SN03



Vinyl-insulated cable (flame-resistant, oil-resistant, vibration-resistant):  
0.3 mm<sup>2</sup>, 3/20/0.08 dia., 2-core, dia. 4.1  
Cap color: gray

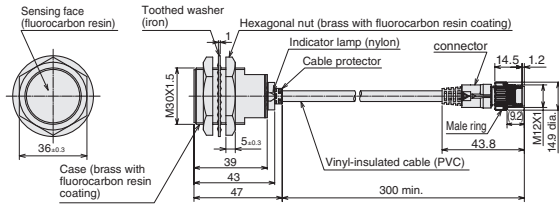
#### FL7M-7□6HW□□-SN03



Vinyl-insulated cable (flame-resistant, oil-resistant, vibration-resistant):  
0.5 mm<sup>2</sup>, 7/15/0.08 dia., 2-core, dia. 5.7  
Cap color: gray

## Quick Lock connector type

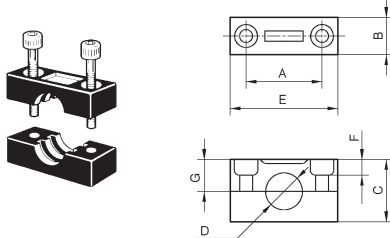
### FL7M-10□6W□□-SN03



Vinyl-insulated cable (flame-resistant, oil-resistant, vibration-resistant):  
0.3 mm<sup>2</sup>, 7/15/0.08 dia., 2-core, dia. 5.7  
Cap color: gray

## ■ MOUNTING BRACKET (sold separately)

Mounting brackets are made of polyacetal resin.  
Two screws and two washers are provided for each bracket.



FL-PA118 and FL-PA130 screw holes are oblong.

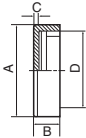
Catalog listing	Dimensions (mm)							Screw size	
	A	B	C	D	E	F	G	Dia.	Neck
FL-PA112	25	12	20	12dia.	36	6	9.5	M4	25
FL-PA118	30/32	15	30	18dia.	45	7.5	14.5	M5	35
FL-PA130	40/45	15	50	30dia.	60	10	24.5	M5	55

## Allowable tightening torque of bracket screws

Catalog listing	Max. torque (N-m)
FL-PA112	0.98
FL-PA118	1.5
FL-PA130	1.5

## ■ SPATTER-GUARDED PROTECTIVE COVER (sold separately)

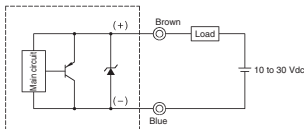
Spatter-guarded protective covers made of fluorine resin and designed especially for shielded switches are available.  
Select a model according to the switch's external dimensions.



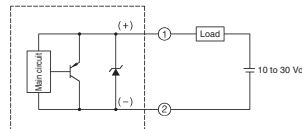
Catalog listing	Dimensions (mm)			
	A	B	C	D
FL-PA12W	15dia.	5	0.7	M12 x 1
FL-PA18W	22dia.	6	0.7	M18 x 1
FL-PA30W	34dia.	8	1.5	M30 x 1.5

## ■ WIRING DIAGRAMS

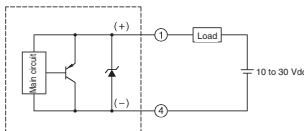
### ● Polarity type Prelead type



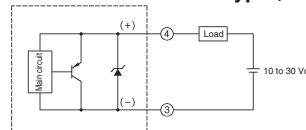
### (Prelead connector / Quick lock connector) type (N.C.: CN03, SN03 type)



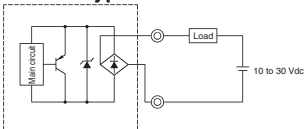
### (Prelead connector / Quick lock connector) type (N.O.: CN03, SN03 type)



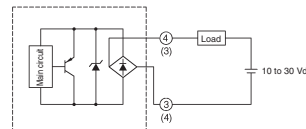
### Prelead connector type (N.O. : CN03A type)



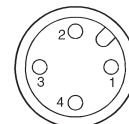
### ● No-polarity type Prelead type



### (Prelead connector / Quick lock connector) type (CN03, SN03 type)



- The load may be connected to either pole.
- A load must be used when power is supplied to the switch. Although there is short-circuit protection, a combination of a short circuit and wrong wiring can permanently damage the switch.
- The LED operates normally during a load short circuit, so check the wiring if the output is wrong.
- Fasten connectors tightly by hand.



## CONNECTOR SPECIFICATIONS<sup>1</sup>

Item	Specifications	
	Connector type (polarity type only) / Prelead connector type	Quick Lock connector type
Insulation resistance	Max. 100 MΩ (by 500 Vdc megger)	
Dielectric strength	1,500 Vac for 1 minute (between contacts, and between contact and connector housing)	1,000 Vac for 1 minute (between contacts, and between contact and connector housing)
Initial contact resistance	Max. 40 mΩ (with 3A current to connected male and female connectors. Semiconductor lead-specific resistance not included.)	
Mating/unmating force	0.4 to 4.0 N per contact	
Mating cycles	Min. 50	
Connector nut tightening torque	Min. 0.8 N·m*2	
Cable pullout strength	Min. 100 N	
Vibration resistance	10 to 55 Hz, 1.5 mm peak-to-peak amplitude, for 2 hours each in X, Y and Z directions	
Impact resistance	300 m/s <sup>2</sup> , 3 times each in X, Y and Z directions	980 m/s <sup>2</sup> , 10 times each in X, Y and Z directions
Protective structure	IP67	
Ambient operating temperature	-10 to +70°C	
Ambient storage temperature	-20 to +80°C	
Ambient operating humidity	Max. 95% RH	
Material	Contacts: Gold-plated brass Contact holder: Glass-lined polyester resin Housing: Polyester elastomer Coupling: Ni-plated brass O-ring: NBR	Contacts: Gold-plated brass Contact holder: Glass-lined polyester resin Housing: Polyester elastomer Coupling: Ni-plated zinc alloy O-ring: Fluorine rubber

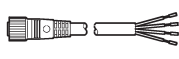
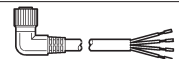
\*1: Specifications assume Azbil male/female connectors.

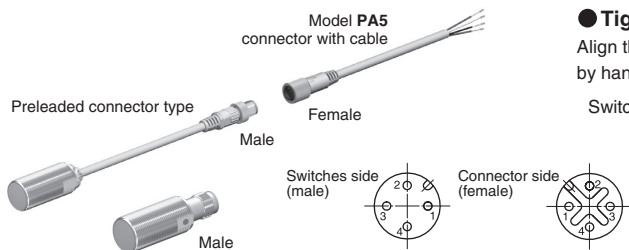
\*2: The recommended torque is 0.4 to 0.6 N·m. If fastened poorly, the IP67 protection is lost, or looseness occurs. Fasten the connector securely by hand.

## CONNECTOR WITH CABLE

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

### ● Model PA5 connector with cable

Shape	Power supply	Cord properties	Cord length	Catalog listing	Lead colors
	DC	Vinyl-insulated cord with high resistance to oil and vibration (UL/NFPA79 CM, CL3)	2 m	PA5-4ISX2SK	1: brown, 2: white, 3: blue, 4: black
			5 m	PA5-4ISX5SK	1: brown, 2: white, 3: blue, 4: black
			2 m	PA5-4ILX2SK	1: brown, 2: white, 3: blue, 4: black
			5 m	PA5-4ILX5SK	1: brown, 2: white, 3: blue, 4: black

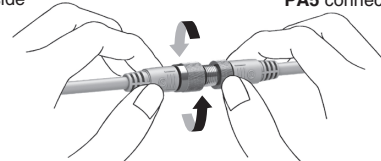


### ● Tightening the connector

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.

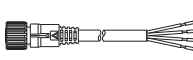
Switches side

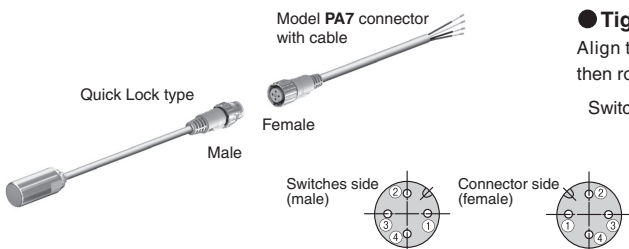
PA5 connector side



Be sure to use a Model PA7 connector with cable when connecting Quick Lock type switch.

### ● Model PA7 connector with cable

Shape	Power supply	Cord properties	Cord length	Catalog listing	Lead colors
	DC	Vinyl-insulated cord with high resistance to oil and vibration (UL/NFPA79 CM)	2 m	PA7-4ISX2SK	1: brown, 2: white, 3: blue, 4: black
			5 m	PA7-4ISX5SK	1: brown, 2: white, 3: blue, 4: black

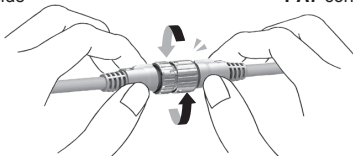


### ● Tightening the connector

Align the triangle mark and mate the male and female connector then rotate 45 degree to match the keys on the rings by hand.

Switches side

PA7 connector side



Compatible with OMRON Smartclick connectors.

Smartclick is a registered trademark of OMRON Corporation.

## PRECAUTIONS FOR USE

### 1. Mounting

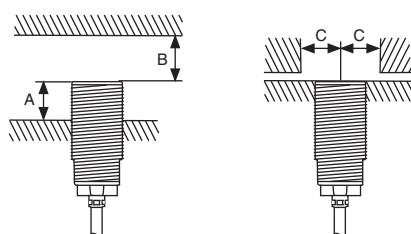
Catalog listing	Max. tightening torque (N-m)
FL7M-3□6H□	7
FL7M-7□6H□	15
FL7M-10□6□	40

\*The table shows the allowable tightening torque when toothed washers (provided) are used.

\*The allowable tightening torque varies depending on the materials and surface conditions of the mounting plates, mounting housings, nuts, washers and other parts used for the switch. Check that the torque is appropriate for the actual combination of parts used before putting the switch into operation.

### 2. 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.

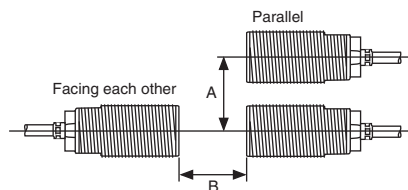
Dimensions in parentheses apply if a hexagonal nut is attached to the front.

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

Catalog listing	A(mm)	B(mm)	C(mm)
FL7M-3□6H□	0	8	9
FL7M-7□6H□	0	20	13.5
FL7M-10□6□	0	40	22.5

### 3. 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.



Catalog listing	A(mm)	B(mm)
FL7M-3□6H□	20	30
FL7M-7□6H□	35	50
FL7M-10□6□	70	100

### 4. Cautions for series or parallel connection

#### 4.1 Series connection (AND switching circuit)

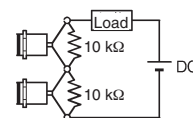
When connecting two or more proximity switches in series, erroneous output (1 to 3 ms) may occur without the rated current being supplied to each of the switches. For this reason, series connection of proximity switches is not recommended. However, if proximity switches must be connected in series, a resistor of 10 kΩ must be put in parallel to each of the switches. Note that the maximum leakage current in a series connection will be 3.5 mA. Operation lag also will occur, resulting in increased voltage drop, and the operation indicator lamp will not light.

Operation lag =

$$40 \text{ ms} \times (\text{No. of switches in series} - 1)$$

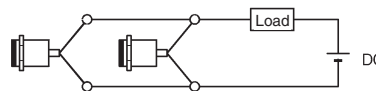
Voltage drop =

$$\text{Voltage drop of single switch} \times \text{No. of switches in series}$$



#### 4.2 Parallel connection (OR switching circuit)

- If two or more proximity switches are connected in parallel, total leakage current increases according to the following formula, and may result in the load not turning OFF. (Leakage current = Leakage current of single switch x No. of switches in parallel)
- When two or more switches in parallel turn ON, one (or more) of their operating indicators may not light up. This is normal.



### 5. Relay loads

The voltage drop of these FL7M switches is 3V. Pay attention to this voltage drop when using a relay load. (With 12 Vdc relays, switching is not possible.)

### 6. Operation upon power ON

After the power is turned ON, it takes at most 40 ms until the proximity switch is ready for sensing. If the load and the proximity switch use different power supplies, be sure to turn the proximity switch ON before turning the load ON.

### 7. Influence of leakage current

A minimal current flows as leakage current for operating the circuits even when the proximity switch is OFF. Keep this in mind when turning off connected loads.

### 8. Minimum cable bend radius (R)

The minimum bend radius (R) of the cable is 3 times the cable diameter. Take care not to bend the cable beyond this radius. Also, do not excessively bend the cable within 30 mm of the cable lead-in port.

Before use, thoroughly read the "Precautions for use" and "Precautions for handling" in the Technical Guide on pages C-095 to C-101 as well as the instruction manual and product specification for this switch.



Please read "Terms and Conditions" from the following URL before ordering and use.

<https://www.azbil.com/products/factory/order.html>

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## Azbil Corporation

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