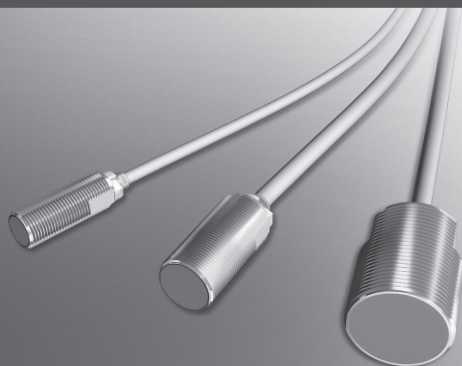


# DC2-Wire Aluminum-Chip Resistant Cylindrical Proximity Switches



**Model FL7M-A** | Detects workpieces reliably even if aluminum or cast iron chips accumulate on the sensing head.



- DC2-wire proximity switches can be directly connected to programmable controllers and N.C. units. This reduces wiring costs
- Firefly indicator lamp can be checked even from the rear
- Tough IP67 seal
- Certified EN-compliant
- 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


### ● Preleaded types

Exterior		Sensing distance	Operation mode	Setting indicator	Oil resistant cable	Catalog listing
Appearance	Size (O.D.)					
	M12	2 mm	N.O.	●	●	FL7M-2J6AD
			N.C.		●	FL7M-2K6A
	M18	4 mm	N.O.	●	●	FL7M-4J6AD
			N.C.		●	FL7M-4K6A
	M30	8 mm	N.O.	●	●	FL7M-8J6AD
			N.C.		●	FL7M-8K6A


### ● Preleaded connector types

Exterior		Sensing distance	Operation mode	Setting indicator	Oil resistant, flexible cable	Connector		Catalog listing
Appearance	Size (O.D.)					+	-	
	M12	2 mm	N.O.	●	●	1	4	FL7M-2J6AD-CN03
			N.C.		●	1	2	FL7M-2K6A-CN03
	M18	4 mm	N.O.	●	●	1	4	FL7M-4J6AD-CN03
			N.O.	●	●	4	3	FL7M-4J6AD-CN03A
	M30	8 mm	N.C.		●	1	2	FL7M-4K6A-CN03
			N.O.	●	●	1	4	FL7M-8J6AD-CN03
	M30	8 mm	N.O.	●	●	4	3	FL7M-8J6AD-CN03A
			N.C.		●	1	2	FL7M-8K6A-CN03

### ● Quick Lock connector type

Exterior		Sensing distance	Operation mode	Setting indicator	Oil resistant, flexible cable	Connector		Catalog listing
Appearance	Size (O.D.)					+	-	
	M12	2 mm	N.O.	●	●	1	4	FL7M-2J6AD-SN03
			N.O.		●	1	2	FL7M-2K6A-SN03
	M18	4 mm	N.O.	●	●	1	4	FL7M-4J6AD-SN03
			N.C.		●	1	2	FL7M-4K6A-SN03
	M30	8 mm	N.O.	●	●	1	4	FL7M-8J6AD-SN03
			N.C.		●	1	2	FL7M-8K6A-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	<b>FL-PA112</b>
		For M18	<b>FL-PA118</b>
		For M30	<b>FL-PA130</b>
Protective cover		For M12	<b>FL-PA12</b>
		For M18	<b>FL-PA18</b>
		For M30	<b>FL-PA30</b>
Spatter-guarded protective cover		For M8	<b>FL-PA08W</b>
		For M12	<b>FL-PA12W</b>
		For M18	<b>FL-PA18W</b>
		For M30	<b>FL-PA30W</b>

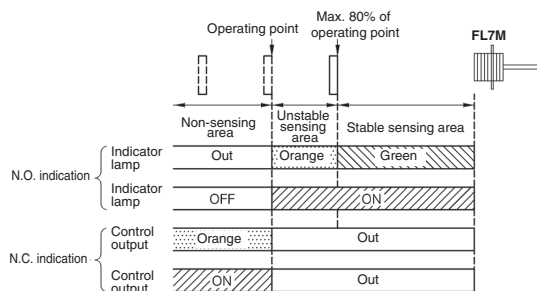
■ **SPECIFICATIONS**

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

Catalog listing	FL7M-2J6AD, FL7M-2K6A	FL7M-4J6AD, FL7M-4K6A	FL7M-8J6AD, FL7M-8K6A
Actuation method	High-frequency oscillation (shielded)		
Rated sensing distance	2 ± 0.2 mm	4 ± 0.4 mm	8 ± 0.8 mm
Usable sensing distance	0 to 1.4 mm	0 to 2.8 mm	0 to 5.6 mm
Standard target object	12 x 12 x 1 mm iron	30 x 30 x 1 mm iron	54 x 54 x 1 mm iron
Differential travel	20% 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 3V max., output dielectric strength 30 Vdc		
Operating frequency	500 Hz	100 Hz	60 Hz
Temperature drift	± 10% max. for the -25 to +70°C range	± 10% max. of sensing distance for the 0 to +50°C range, or ± 20% for the -25°C to +70°C range when 25°C is taken as standard temperature	
Supply voltage drift	± 1% max. of sensing distance with ± 15% voltage fluctuation, taking rated supply voltage as standard voltage		± 2.5% max. of sensing distance with ± 15% voltage fluctuation, taking rated supply voltage as standard voltage
Indicator lamps	N.O. type: Operation indication: lights (orange or green) at output ON Setting indication: lights (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. (at 500 Vdc)		
Dielectric strength	1000 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), IP67G(JEM)		
Weight (preleaded type)	Approx. 60 g	Approx. 130 g	Approx. 230 g
Circuit protection	Surge absorption, load short-circuit protection, reverse connection protection		
Wiring method	Preleaded (2 m cable), Preleaded connector (30 cm cable), Quick Lock connector (30 cm cable)		
Material	Switch	Case	Ni-plated brass
		Sensing face	PBT
	Connector	Housing	Polyester elastomer
		Holder	Glass-lined polyester resin
		Contact	Gold-plated brass

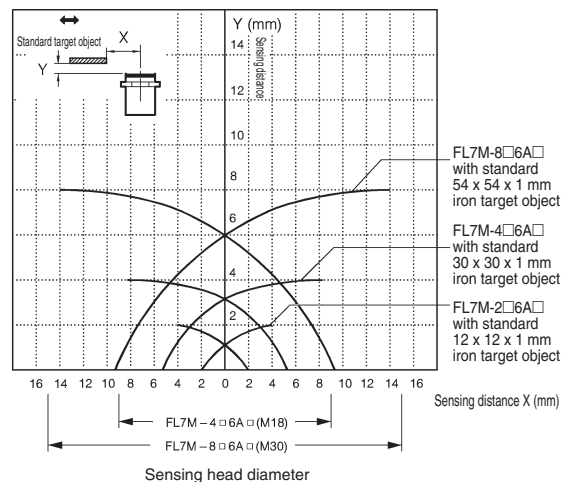
■ **USING THE SETTING INDICATOR**

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.



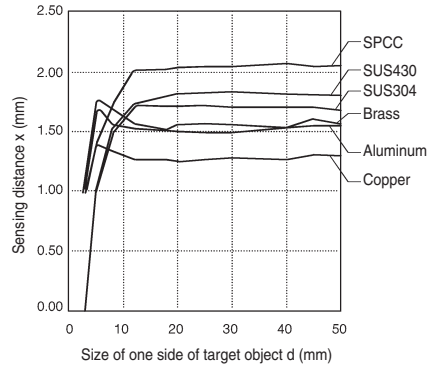
\*When the target object is made of a different material (such as aluminum, copper or stainless steel) from the standard target object (iron), the distance at which the indicator lamp changes color is shorter than the 80% maximum.

■ **SENSING AREA (typical)**

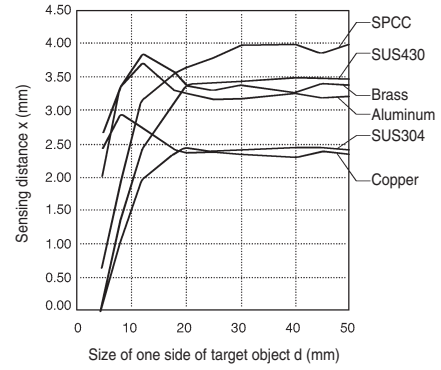


## SENSING DISTANCE ACCORDING TO MATERIAL AND SIZE OF OBJECT (typical)

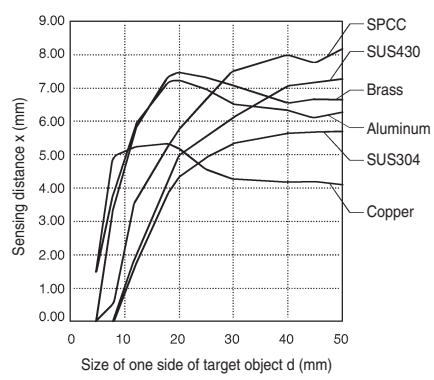
### ● FL7M-2□6A□



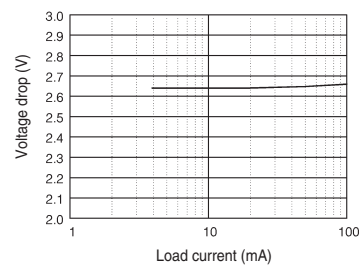
### ● FL7M-4□6A□



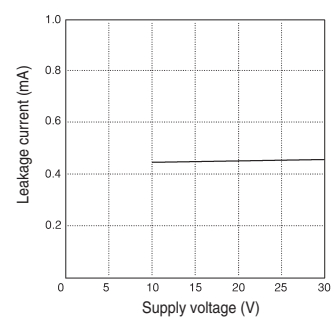
### ● FL7M-8□6A□



## VOLTAGE DROP CHARACTERISTICS (typical)



## LEAKAGE CURRENT CHARACTERISTICS (typical)

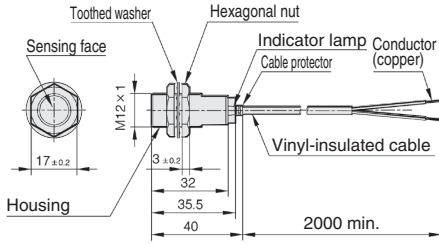


# EXTERNAL DIMENSIONS

(unit: mm)

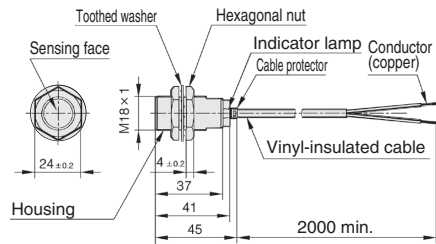
## Preleaded type

### FL7M-2□6A□



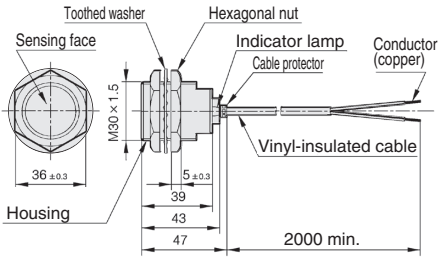
Vinyl-insulated cable (oil-resistant: 0.3 mm<sup>2</sup>, 27/0.12 dia., 2-core), dia. 4.1  
Cap color: blue.

### FL7M-4□6A□



Vinyl-insulated cable (oil-resistant: 0.5 mm<sup>2</sup>, 20/0.18 dia., 2-core), dia. 5.7  
Cap color: blue.

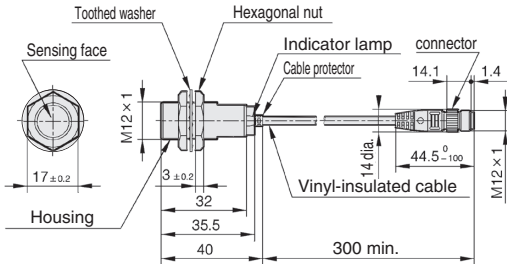
### FL7M-8□6A□



Vinyl-insulated cable (oil-resistant: 0.5 mm<sup>2</sup>, 20/0.18 dia., 2-core), dia. 5.7  
Cap color: blue.

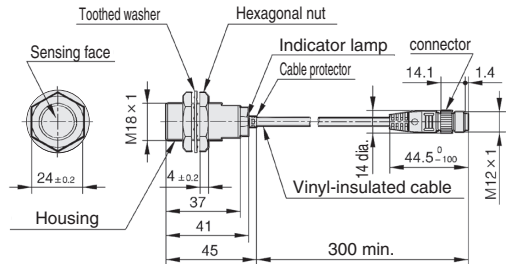
## Preleaded Connector type

### FL7M-2□6A□-CN03



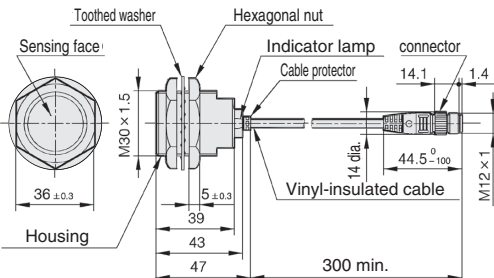
Vinyl-insulated cable (oil-resistant, vibration-resistant):  
0.3 mm<sup>2</sup>, 3/20/0.08 dia., 2-core), 4.1 dia.  
Cap color: blue

### FL7M-4□6A□-CN03



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

### FL7M-8□6A□-CN03



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

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-Guard

FL7S

FL7M-C (DC2)  
Environment-Resistant

FL7M-A (DC2)  
Aluminum-Chip Resistant

FL7M (DC2)  
Unshielded

FL7M (AC/DC2)

FL7M (DC3)

Connector  
with cable



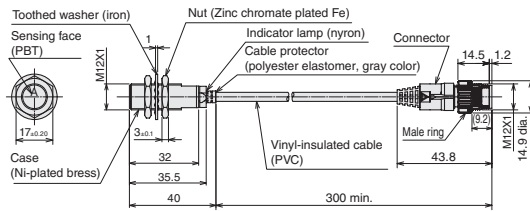
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F-001

## EXTERNAL DIMENSIONS

(unit: mm)

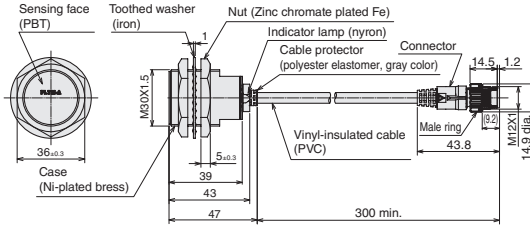
### Quick Lock connector type

#### FL7M-2□6A□-SN03



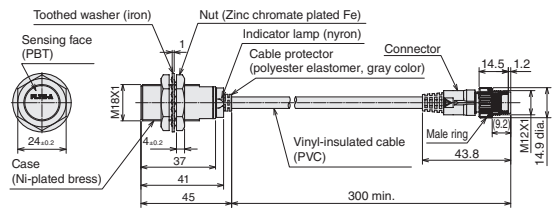
Vinyl-insulated cable (oil-resistant, vibration-resistant: 0.3 mm<sup>2</sup>, 27/0.12 dia., 2-core), dia. 4.1.  
Cap color: gray.

#### FL7M-8□6A□-SN03



Vinyl-insulated cable (oil-resistant, vibration-resistant: 0.5 mm<sup>2</sup>, 20/0.18 dia., 2-core), dia. 5.7.  
Cap color: gray.

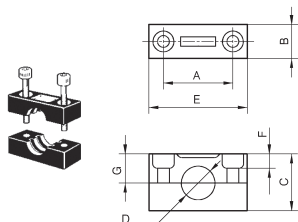
#### FL7M-4□6A□-SN03



Vinyl-insulated cable (oil-resistant, vibration-resistant: 0.5 mm<sup>2</sup>, 20/0.18 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.

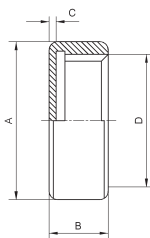
Catalog listing	Dimensions (mm)							Screw size	
	A	B	C	D	E	F	G	Dia.	Neck
FL-PA112	25	12	20	12dia.	36	6	9.5	M4	25
FL-PA118	30/32	15	30	18dia.	45	7.5	14.5	M5	35
FL-PA130	40/45	15	50	30dia.	60	10	24.5	M5	55

### Allowable tightening torque of bracket screws

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

## PROTECTIVE COVER (sold separately)

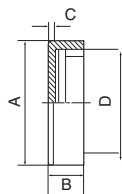
Protective covers made of polyacetal resin are available for shielded models.  
Select a model according to the switch's external dimensions.



Catalog listing	Dimensions (mm)			
	A	B	C	D
FL-PA12	14dia.	5	0.5	M12 x 1
FL-PA18	21dia.	6	0.5	M18 x 1
FL-PA30	33dia.	8	1.5	M30 x 1.5

## SPATTER-GUARDED PROTECTIVE COVER (sold separately)

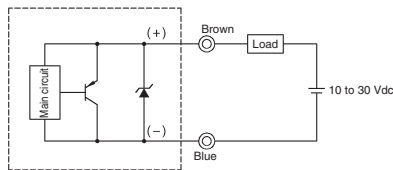
Spatter-guarded protective covers made of fluorine resin and designed especially for shielded switches are available.  
Select a model according to the switch's external dimensions.



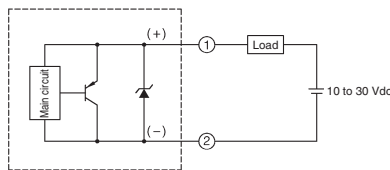
Catalog listing	Dimensions (mm)			
	A	B	C	D
FL-PA12W	15dia.	5	0.7	M12 x 1
FL-PA18W	22dia.	6	0.7	M18 x 1
FL-PA30W	34dia.	8	1.5	M30 x 1.5

## WIRING DIAGRAMS

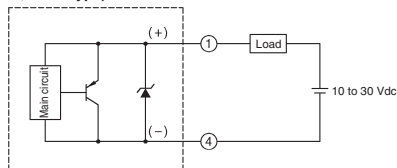
### Preloaded type



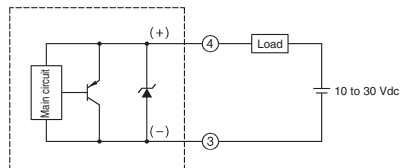
### (Preloaded connector / Quick lock connector) type (N.C.: CN03, SN03 type)



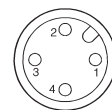
### (Preloaded connector / Quick lock connector) type (N.O.: CN03, SN03 type)



### Preloaded connector type (N.O.: CN03A 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) / Preleaded connector type	Quick Lock connector type
Insulation resistance	Max. 100 MΩ (by 500 Vdc megger)	Max. 50 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.

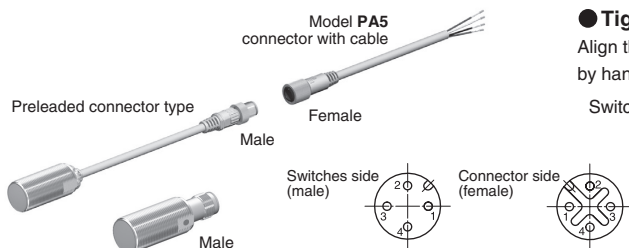
\*2: The recommended torque is 0.4 to 0.6 N·m. If fastened poorly, the IP67 protection is lost, or looseness occurs. Fasten the connector securely by hand.

## CONNECTOR WITH CABLE

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

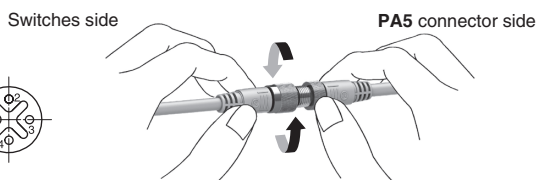
### ● Model PA5 connector with cable

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

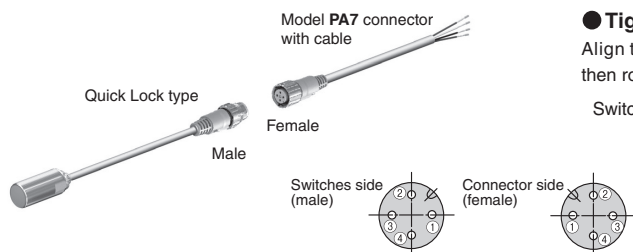
Align the grooves and rotate the fastening nut on the PA5 connector by hand until it fits tightly with the connector on the switches side.



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

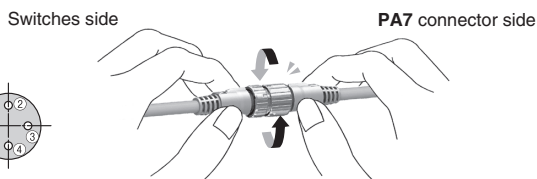
### ● Model PA7 connector with cable

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.



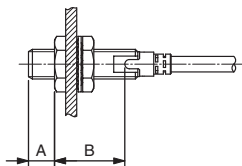
Compatible with OMRON Smartclick connectors.

Smartclick is a registered trademark of OMRON Corporation.

## PRECAUTIONS FOR USE

### 1. Mounting

The allowable tightening torque varies according to the distance from the sensing face.



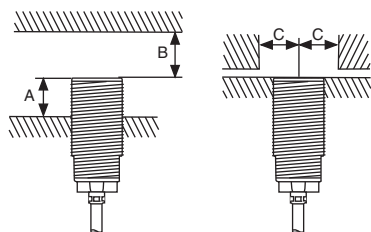
Catalog listing	Length A (mm)	Max. tightening torque (N·m)	
		A	B
FL7M-2□6A□	10	20	30
FL7M-4□6A□	0	—	70
FL7M-8□6A□	0	—	150

Note: 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.



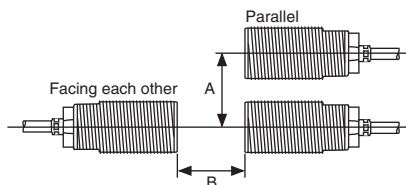
- A:** Distance from sensing face of proximity switch to mounting surface
- B:** Distance from surface of iron plate to sensing face of proximity switch.
- C:** Distance from surface of iron plate to center of proximity switch when A=0

Shaded areas indicate surrounding metal other than the target object.

Catalog listing	A(mm)	B(mm)	C(mm)
FL7M-2□6A□	0	6	9.0
FL7M-4□6A□	0	20	13.5
FL7M-8□6A□	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-2□6A□	20	30
FL7M-4□6A□	35	50
FL7M-8□6A□	70	100

### 4. Cautions for series or parallel connection

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

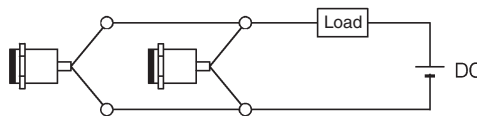
When connecting two or more proximity switches in series, erroneous output (1 to 3 ms) may occur without the rated current being supplied to each of the switches. For this reason, series connection of proximity switches is not recommended. However, if proximity switches must be connected in series, a 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.

$$\text{Operation lag} = 80 \text{ ms} \times (\text{No. of switches in series} - 1)$$

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

#### 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 FL7M-A 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)

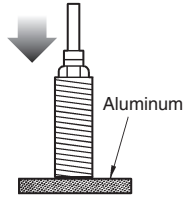
The minimum bend radius (R) of the cable is 3 times the cable diameter. Take care not to bend the cable beyond this radius. Also, do not excessively bend the cable within 30 mm of the cable lead-in port.



## 9. ALUMINUM CHIPS AND CAST IRON CHIPS

Generally, even if aluminum and cast iron chips are attached to or pressing against the sensing face, no signal is output. Take care, however, because under the conditions described below, a signal may sometimes be output.

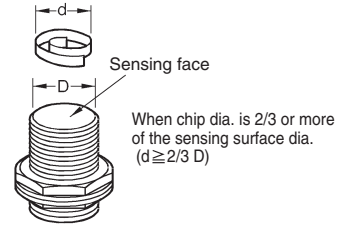
### 9.1 FL7M-2□6A□



Length of one side of aluminum chip	FL7M-2J6AD
0.1 mm max.	OFF
0.5 mm approx	OFF
2 mm max.	OFF or ON
4 mm min.	ON

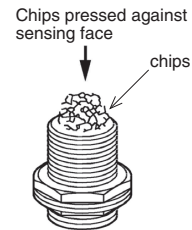
### 9.2 FL7M-4□6A□, FL7M-8□6A□

(1) Chip size (d) x size of sensing face (D)



Dimensions	D (mm)
<b>Catalog listing</b>	
FL7M-4J6AD, FL7M-4K6A	16
FL7M-8J6AD, FL7M-8K6A	28

(2) When chips are pressed against sensing face



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

Advanced Automation Company

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1-12-2 Kawana, Fujisawa  
Kanagawa 251-8522 Japan

URL: <https://www.azbil.com>

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