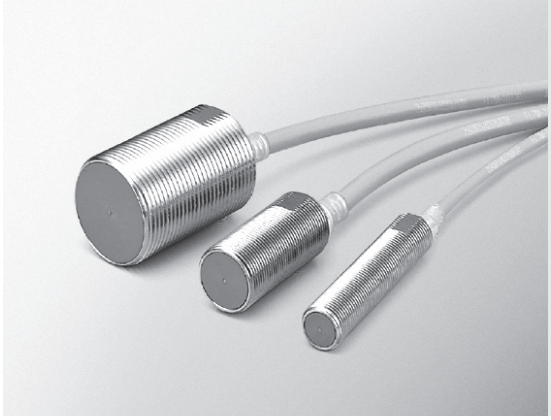
AC/DC2-wire Type Cylindrical Proximity Switches

FL7M Series | No-polarity 2-wire general-purpose switches are easy to use.



- 2-wire type for both AC and DC greatly reduces wiring man-hours
- Stable sensing area displayed by setting indicator (green/red LED)
- **Indicator lamp can be seen even from the rear**
  (preleaded and preleaded connector types)
- **Compact and space-saving**
- **Sealed to IP67**
- Enhanced circuit protection (surge absorption, load short-circuit)

ORDER GUIDE

● Standard (pre-leaded) type (2 m cable)

Exterior		Sensing distance	Operation mode	Setting indicator	Catalog listing
	M12	3mm	N.O.	○	**FL7M-3T7HD**
	M18	7mm	N.O.	○	**FL7M-7T7HD**
	M30	10mm	N.O.	○	**FL7M-10T7D**

● Connector type

Exterior		Sensing distance	Operation mode	Setting indicator	Catalog listing
	M12	3mm	N.O.	○	**FL7M-3T7HD-CN**
	M18	7mm	N.O.	○	**FL7M-7T7HD-CN**
	M30	10mm	N.O.	○	**FL7M-10T7D-CN**

● Pre-leaded connector type (30 cm cable)

Exterior		Sensing distance	Operation mode	Setting indicator	Catalog listing
	M12	3mm	N.O.	○	**FL7M-3T7HD-CN03**
	M18	7mm	N.O.	○	**FL7M-7T7HD-CN03**
	M30	10mm	N.O.	○	**FL7M-10T7D-CN03**

● Accessories (sold separately)

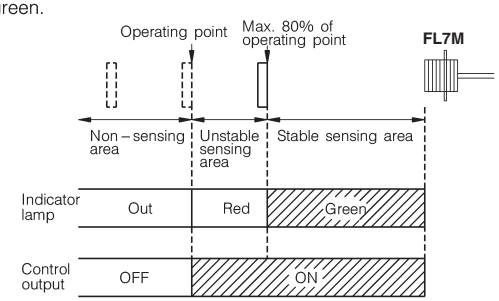
Name	Appearance	O.D.	Catalog listing
Mounting bracket		For M12	**FL-PA112**
		For M18	**FL-PA118**
		For M30	**FL-PA130**
Protective cover		For M12	**FL-PA12**
		For M18	**FL-PA18**
		For M30	**FL-PA30**
Spatter-guarded protective cover		For M08	**FL-PA08W**
		For M12	**FL-PA12W**
		For M18	**FL-PA18W**
		For M30	**FL-PA30W**

SPECIFICATIONS

Catalog listing			FL7M-3T7HD(-CN,-CN03)	FL7M-7T7HD(-CN,-CN03)	FL7M-10T7D(-CN,-CN03)
Actuation method			High-frequency oscillation type (shielded)		
Rated sensing distance			3±0.3mm	7±0.7mm	10±1 mm
Usable sensing distance			0 to 2.1 mm	0 to 4.9 mm	0 to 7 mm
Standard target object			12×12mm, 1mm thick iron	18×18mm, 1mm thick iron	30×30mm, 1mm thick iron
Differential travel			10% max. of sensing distance		
Rated supply voltage			100/200Vac, 50/60Hz 24Vdc		
Operating voltage range			40 to 250 Vac, 20 to 250 Vdc		
Leakage current			When AC power supply is used: 2.0mA max. (100/200Vac), When DC power supply is used: 1.1mA max. (24Vdc)		
Control output			Switching current: 5 to 100mA (at 30Vdc supply voltage: 5 to 20mA) Voltage drop: When AC power supply is used 10V max., When DC power supply is used 6V max. Output dielectric strength: 250V (at both AC and DC power supplies)		
Operating frequency			When AC power supply is used 25Hz When DC power supply is used 1 KHz	When AC power supply is used 25Hz When DC power supply is used 500 Hz	When AC power supply is used 25Hz When DC power supply is used 400Hz
Temperature characteristics			±10% max. for the range of –25 to +70˚C when +25˚C is taken as standard temperature in sensing distance.		–10 to +60˚C
Supply voltage characteristics			±1% max. with +15% voltage fluctuation with rated supply voltage as standard voltage in sensing distance		
Indicator lamps			Operation indication: Lights (red or green) at output Setting indication: Lights (green) in stable sensing area		
Operating temperature range			–25 to +70˚C		–10 to +60˚C
Insulation resistance			50MΩ min. (at 500Vdc)		
Dielectric strength			4,000 Vac, 50/60 Hz for 1minute		
Vibration resistance			10 to 55Hz, 1.5mm peak-to-peak amplitude, 2 hrs in X, Y and Z directions		
Shock resistance			980 m/s^2 10 time in X,Y and Z directions		
Protection			IP67 (IEC standard), IP67G (JEM standard)		
Weight	Standard (pre-leaded type)		Approx. 90 g Main unit with 2 m pre-leaded cable	Approx. 160 g Main unit with 2 m pre-leaded cable	Approx. 270 g Main unit with 2 m pre-leaded cable
Circuit protection			Surge absorption, load short-circuit protection (at 20 to 40Vdc)		
Wiring method			Connector, pre-leaded connector, pre-leaded		
Material	Switch	Case	Ni-plated brass		
		Sensing face	PBT		
	Connector	Housing	**-CN**:Ni-plated Zn, **-CN03**:polyester elastomer		
		Holder	PBT		
		Contact	**-CN**:Sn-plated brass, **-CN03**:Gold-plated brass		

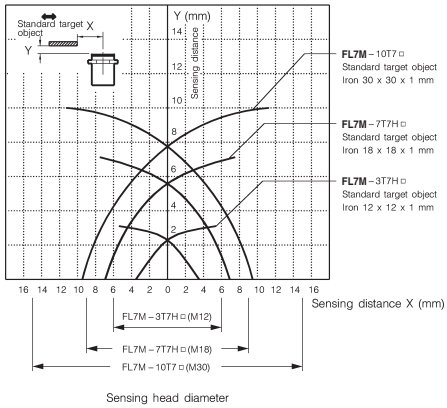
ABOUT SETTING INDICATION

The proximity switch can detect objects reliably by bringing the proximity switch close to the target object and setting the switch at the position where the indicator lamp changes from red to green.



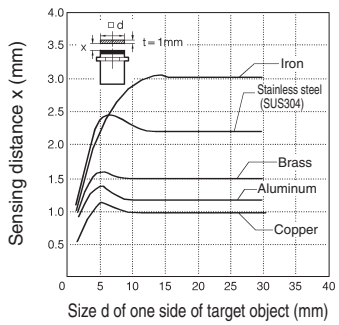
Note: When the target object is made of a different material such as aluminum, copper and stainless steel to the standard target object (iron), the setup point where the indicator lamp changes color is shorter than 80% maximum.

SENSING AREA (typical)

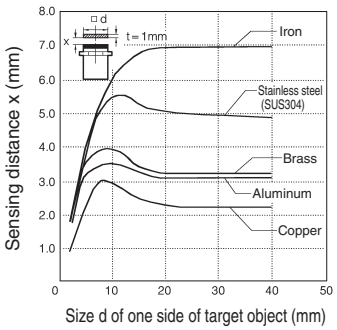


SENSING DISTANCE ACCORDING TO MATERIAL & SIZE OF OBJECT (typical)

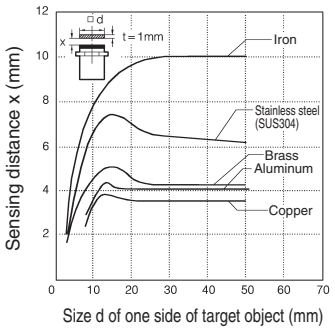
●FL7M-3T7H□



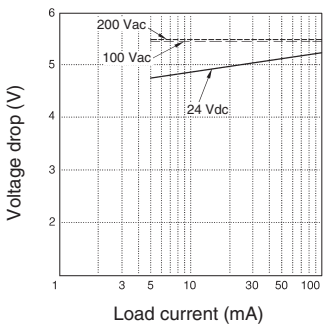
●FL7M-7T7H□



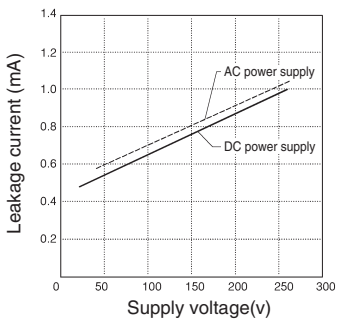
●FL7M-10T7□



VOLTAGE DROP (typical)



LEAKAGE CURRENT (typical)

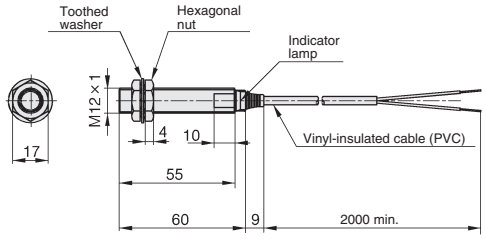


EXTERNAL DIMENSIONS

(unit: mm)

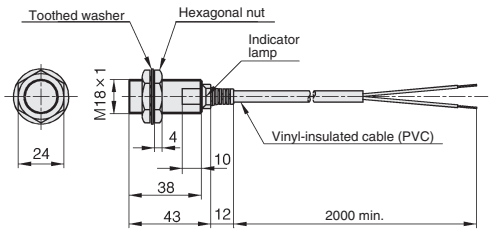
Standard (preleaded) type

FL7M-3T7HD



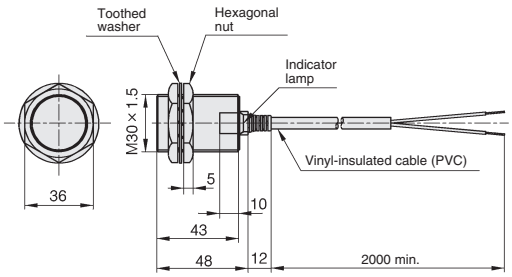
Vinyl-insulated cable (oil-resistant: 0.3 mm^2, 60/0.08 dia., 2-core) dia. 4. Cap color: orange.

FL7M-7T7HD



Vinyl-insulated cable (oil-resistant: 0.5 mm^2, 45/0.12 dia., 2-core) dia. 6. Cap color: orange.

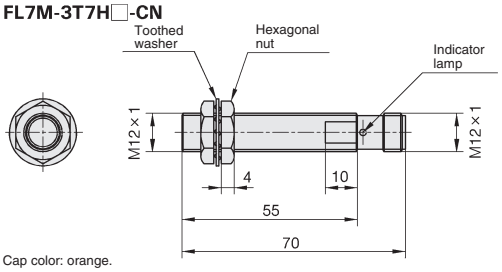
FL7M-10T7D



Vinyl-insulated cable (oil-resistant: 0.5 mm^2, 45/0.12 dia., 2-core) dia. 6. Cap color: orange.

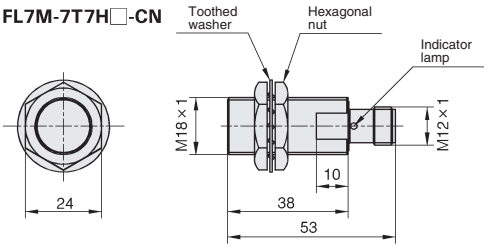
Connector type

FL7M-3T7H□-CN



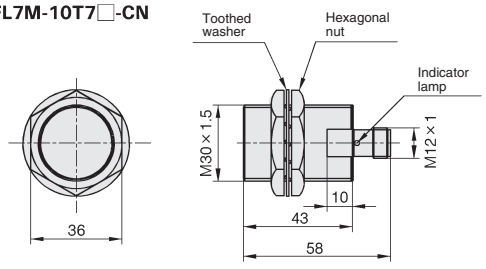
Cap color: orange.

FL7M-7T7H□-CN



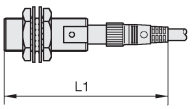
Cap color: orange.

FL7M-10T7□-CN

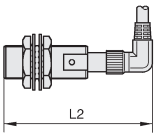


Cap color: orange.

Note:



When using a straight-type connector, dimension L1 is the overall length plus about 30 mm.

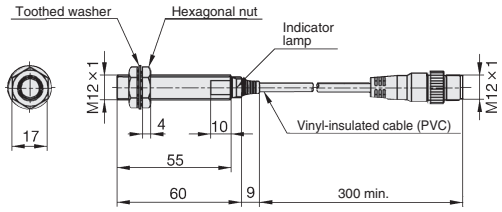


When using an angled connector, dimension L2 is the overall length plus 20 mm.

● **Preleaded connector type**

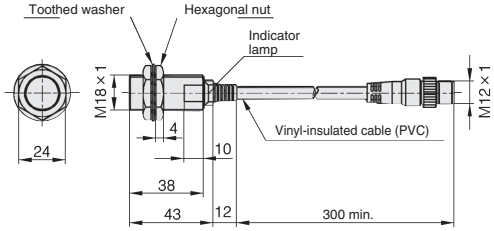
(unit: mm)

FL7M-3T7H□-CN03



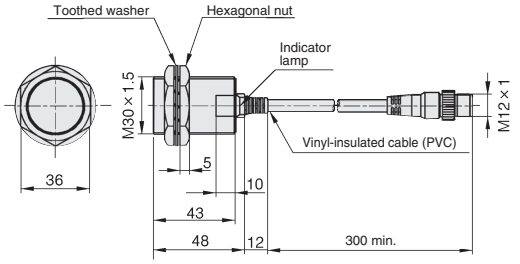
Vinyl-insulated cable (oil-resistant: 0.3 mm^2, 60/0.08 dia., 2-core) dia. 4. Cap color: orange.

FL7M-7T7H□-CN03



Vinyl-insulated cable (oil-resistant: 0.5 mm^2, 45/0.12 dia., 2-core) dia. 6. Cap color: orange.

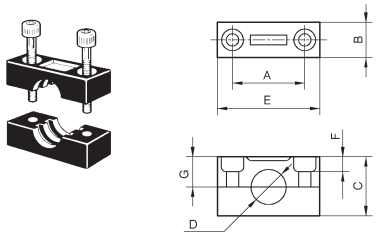
FL7M-10T7□-CN03



Vinyl-insulated cable (oil-resistant: 0.5 mm^2, 45/0.12 dia., 2-core) dia. 6. Cap color: orange.

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.

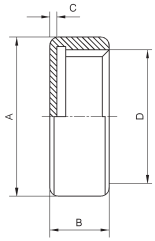
Catalog listing	Dimensions (mm)							Screw size	
	A	B	C	D	E	F	G	Dia.	Neck
FL-PA112	25	12	20	12dia.	36	6	9.5	M4	25
FL-PA118	30/32	15	30	18dia.	45	7.5	14.5	M5	35
FL-PA130	40/45	15	50	30dia.	60	10	24.5	M5	55

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)

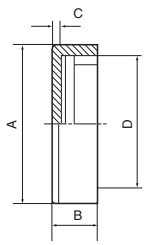
Protective covers made of polyacetal resin are available for shielded models. Select a model according to the switch's external dimensions.



Catalog listing	Dimensions (mm)			
	A	B	C	D
FL-PA12	14dia.	5	0.5	M12x1
FL-PA18	21dia.	6	0.5	M18x1
FL-PA30	33dia.	8	1.5	M30x1.5

SPATTER-GUARDED PROTECTIVE COVER (sold separately)

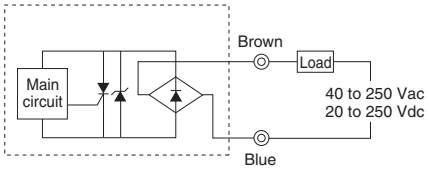
Spatter-guarded protective covers made of fluorine resin and designed especially for shielded switches are available. Select a model according to the switch's external dimensions.



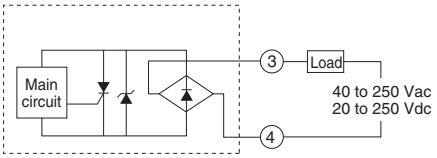
Catalog listing	Dimensions (mm)			
	A	B	C	D
FL-PA08W	10dia.	5	0.5	M8x1
FL-PA12W	15dia.	5	0.7	M12x1
FL-PA18W	22dia.	6	0.7	M18x1
FL-PA30W	34dia.	8	1.5	M30x1.5

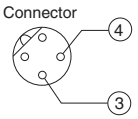
WIRING DIAGRAMS

Preleaded type



Preleaded connector type





- The load may be connected to either pole.
- 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*1

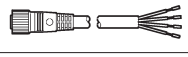
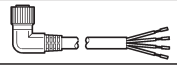
Item	Specifications
Insulation resistance	Max. 100 MΩ(by 500 Vdc megger)
Dielectric strength	1,500 Vac for 1 minute (between contacts, and between contact and connector housing)
Initial contact resistance	Max. 40 mΩ(with 3A current to connected male and female connectors. Semiconductor lead-specific resistance not included.)
Mating/unmating force	0.4 to 4.0 N per contact
Mating cycles	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^2, 3 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

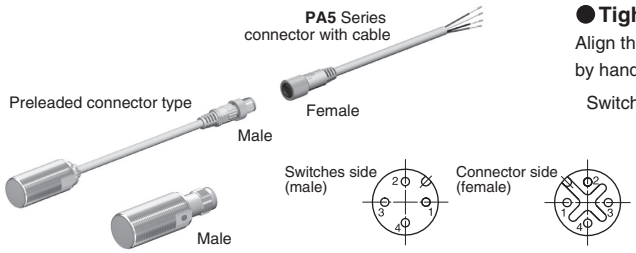
Note 1: Specifications assume Azbil male/female connectors.
Note 2: The recommended torque is 0.4 to 0.6 N-m. If fastened poorly, the IP67 protection is lost, or looseness occurs. Fasten the connector securely by hand.

CABLE WITH CONNECTOR

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

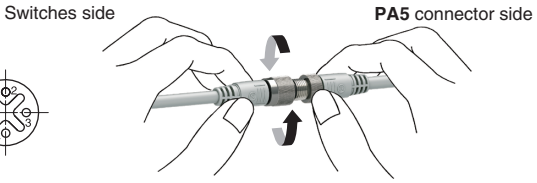
● PA5 Series connector with cable

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	**PA5-4J SX2SK**	1: brown, 2: white, 3: blue, 4: black
			5 m	**PA5-4J SX5SK**	1: brown, 2: white, 3: blue, 4: black
			2 m	**PA5-4J LX2SK**	1: brown, 2: white, 3: blue, 4: black
			5 m	**PA5-4J LX5SK**	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.



PRECAUTIONS FOR USE

1. Mounting

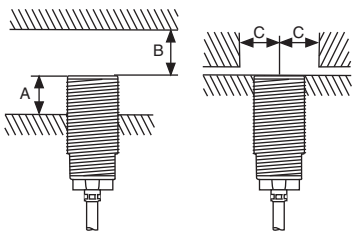
Catalog listing	Max. tightening torque (N·m)
FL7M-3T7H□	20
FL7M-7T7H□	70
FL7M-10T7□	180

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. Shaded areas indicate surrounding metal other than the target object.

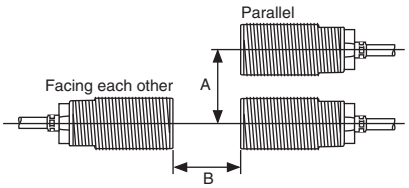


A: Distance from sensing face of proximity switch to mounting surface
B: Distance from surface of iron plate to sensing face of proximity switch.
C: Distance from surface of iron plate to center of proximity switch when A=0
Catalog listing

Catalog listing	A(mm)	B(mm)	C(mm)
FL7M-3T7H□	0	8	9
FL7M-7T7H□	0	20	13.5
FL7M-10T7□	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.



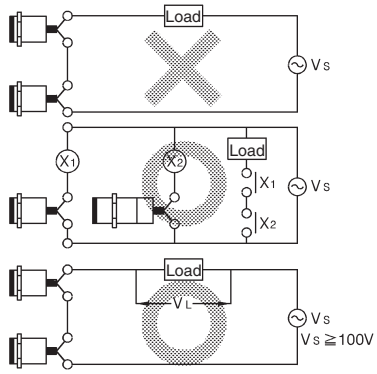
Catalog listing	A(mm)	B(mm)
FL7M-3T7H□	20	30
FL7M-7T7H□	35	50
FL7M-10T7□	70	100

4. Cautions for series or parallel connection

4.1 Series connection (AND switching circuit)

In case of either 100 Vac or 200 Vac, the voltage which is applied to the load in the ON condition is VL = VS - (output voltage drop x number of units) (V). Note that the load will not be activated unless VL is more than the minimum activating voltage of the load.

When more than 2 units are connected in series and are used in an AND switching circuit, the maximum number of units is 3. (Pay attention to the VS value shown in the figure below.)

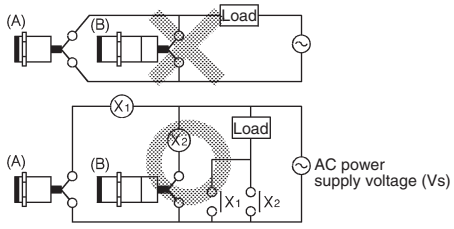


4.2 Parallel connection (OR switching circuit)

In principle it is not possible to use more than 2 proximity switches in parallel as an OR switching circuit. A parallel connection can be used only if A and B do not operate at the same time and if it is not necessary to hold the load. However, consumption current (leakage current) will be multiplied by n (the number of proximity switches), and recovery failure will occur more easily.

If A and B operate at the same time and if it is necessary to retain the load, a parallel connection cannot be used. Under these conditions, when A is turned ON, the voltage at both ends of A and B drops to approx. 10V, allowing load current to flow through A. When a target object approaches B, the switching element of B cannot be activated because the voltage at both ends of B is too low. When A is again turned OFF, the voltage at both ends of A and B increases to the power supply voltage, and at this point B can be turned ON for the first time.

During this time, since there is a period (approx. 10 ms) when both A and B are OFF, the load is momentarily reset. In order to retain the load, use a relay as shown below.



5. Loads that cause inrush current

When the proximity switch is connected to a load such as an electromagnetic switch, lamp or motor that causes inrush current, use the switch within the rated current, which includes the inrush current.

6. Connection to power supply and load

Be sure to connect the proximity switch to the power supply via the load. If the switch is connected directly to the power supply, the switch will be damaged. Also, output does not have polarity, so the load can be connected to either side of the power supply. However, we recommend connecting the load to the non-grounded side to prevent short-circuiting of the power supply if a ground fault caused by damage to the proximity switch occurs.

7. Operation upon power ON

After the power is turned ON, it takes at most 80 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.

8. 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.

9. 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-107** to **C-113** as well as the instruction manual and product specification for this switch.