Cylindrical Inductive Full-Metal Long-Distance Proximity Sensors (Factor 1 on Iron and Aluminum)

PRFD-K Series (DC 3-wire)

PRODUCT MANUAL

For your safety, read and follow the considerations written in the instruction manual, other manuals and Autonics website.

The specifications, dimensions, etc. are subject to change without notice for product improvement. Some models may be discontinued without notice.

Safety Considerations

- Observe all 'Safety Considerations' for safe and proper operation to avoid hazards.
- ⚠ symbol indicates caution due to special circumstances in which hazards may occur.

⚠ Warning Failure to follow instructions may result in serious injury or death.

01. Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime/disaster prevention devices, etc.)
Failure to follow this instruction may result in personal injury, economic loss or fire.

02. Do not use or store the unit in the place where flammable/explosive/ corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact, or salinity may be present.
Failure to follow this instruction may result in explosion or fire.

03. Do not disassemble or modify the unit.
Failure to follow this instruction may result in fire.

04. Do not connect, repair, or inspect the unit while connected to a power source.
Failure to follow this instruction may result in fire.

05. Check 'Connections' before wiring.
Failure to follow this instruction may result in fire.

⚠ Caution Failure to follow instructions may result in injury or product damage.

01. Use the unit within the rated specifications.
Failure to follow this instruction may result in fire or product damage.

02. Use a dry cloth to clean the unit, and do not use water or organic solvent.
Failure to follow this instruction may result in fire.

03. Do not supply power without load.
Failure to follow this instruction may result in fire or product damage.

Cautions during Use

- Follow instructions in 'Cautions during Use'.
  Otherwise, it may cause unexpected accidents.
- 10-30 VDC⎓ power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
- Use the product at least 1 min after supplying power.
  The sensor is stabilized by the internal temperature compensation.
  If sensor stabilization is not completed, sensing performance deteriorates.
- Wire as short as possible and keep away from high voltage lines or power lines, to prevent surge and inductive noise.
  Do not use near the equipment which generates strong magnetic force or high frequency noise (transceiver, etc.).
  In case installing the product near the equipment which generates strong surge (motor, welding machine, etc.), use diode or varistor to remove surge.
- If the surface is rubbed with a hard object, PTFE coating can be worn out.
- This unit may be used in the following environments.
  - Indoors (UL Type 1 Enclosure)
  - Altitude max. 2,000 m
  - Pollution degree 3
  - Installation category II

Cautions for Installation

- Install the unit correctly with the usage environment, location, and the designated specifications.
- The waterproof function may be damaged if the product is subjected to impact from a hard object or bent excessively or repeatedly.
- Do NOT pull the Ø 5 mm cable with a tensile strength of 50 N or over. It may result in fire due to the broken wire.
- When extending wire, use AWG 23 cable or over within 200 m.

Ordering Information

This is only for reference, the actual product does not support all combinations.
For selecting the specified model, follow the Autonics website.

PRFD ❶ ❷ ❸ - ❹ ❺ ❻ - ❼ - ❽

❶ Characteristic
No-mark: General type
A: Spatter-resistant type

❷ Connection
No-mark: Cable type
W: Cable connector type
CM: Connector type

❸ DIA. of sensing side
Number: DIA. of sensing side (unit: mm)

❹ Sensing distance
Number: Sensing distance (unit: mm)

❺ Power supply
D: 10 - 30 VDC

❻ Control output
N: NPN Normally Open
P: PNP Normally Open

❼ Cable
V: Oil resistant cable type

❽ Detection feature
K: Factor 1 on Fe/Al

Product Components

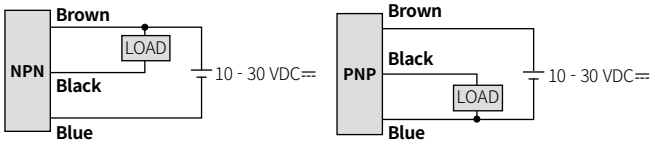
- Product × 1
- Instruction manual × 1
- Nut × 2
- Washer × 1

Sold Separately

- M12 Connector cable: C□D(H)4-□
- Fixing bracket: P90-R□
- Spatter protection cover: P90-M□

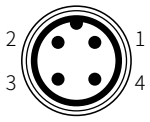
Connections

■ Cable type



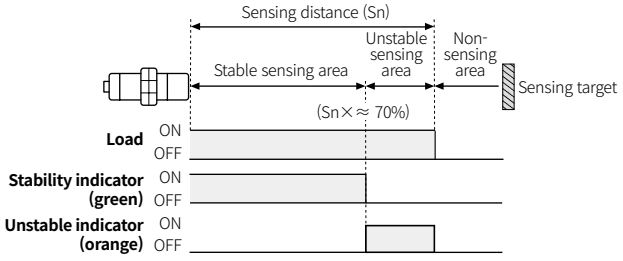
■ Cable connector / Connector type

- For wire and LOAD connection, follow the cable type connection.
- Fasten the connector not to shown the thread. (0.39 to 0.49 N m)
- Fasten the vibration part with PTFE tape.



Pin	Color	Function
①	Brown	VCC
②	-	-
③	Blue	0 V
④	Black	OUT

Operation Timing Chart



Specifications

Installation	Flush type		
General	PRFD□12-3D□-□-K	PRFD□18-7D□-□-K	PRFD□30-12D□-□-K
Spatter-resistant	PRFDA□12-3D□-□-K	PRFDA□18-7D□-□-K	PRFDA□30-12D□-□-K
DIA. of sensing side	Ø 12 mm	Ø 18 mm	Ø 30 mm
Sensing distance [01]	3 mm	7 mm	12 mm
Setting distance	0 to 2.1 mm	0 to 4.9 mm	0 to 8.4 mm
Hysteresis	≤ 15 % of sensing distance		
Standard sensing target: iron	21 × 21 × 1 mm	30 × 30 × 1 mm	54 × 54 × 1 mm
Response frequency [02]	10 Hz	10 Hz	10 Hz
Affection by temperature	≤ ± 23 % for sensing distance at ambient temperature 20 °C		
Indicator	Stable indicator (green), unstable indicator (orange), Abnormal detect indicator (cross-flashing green, orange)		
Certification	CE UK CA cULus		

01) Use accessories (nut, washer) made of SUS. Or, sensing distance cannot be guaranteed.
02) The response frequency is the average value. The standard sensing target is used and the width is set as 2 times of the standard sensing target, 1/2 of the sensing distance for the distance.

Unit weight (package)	Ø 12 mm	Ø 18 mm	Ø 30 mm
Cable type	≈ 80 g (≈ 110 g)	≈ 100 g (≈ 135 g)	≈ 165 g (≈ 220 g)
Cable connector type	≈ 35 g (≈ 60 g)	≈ 55 g (≈ 90 g)	≈ 120 g (≈ 180 g)
Connector type	≈ 15 g (≈ 40 g)	≈ 32 g (≈ 67 g)	≈ 85 g (≈ 140 g)

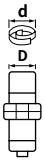
Power supply	10 - 30 VDC⎓ (ripple P-P: ≤ 10 %)
Current consumption	≤ 20 mA
Control output	≤ 100 mA
Residual voltage	≤ 2.5 V
Protection circuit	Surge protection circuit, output short over current protection circuit, reverse polarity protection
Insulation resistance	≥ 50 MΩ (500 VDC⎓ megger)
Dielectric strength	Between the charging part and the case : 1,000 VAC~ 50 / 60Hz for 1 minute
Vibration	1.5 mm double amplitude at frequency 10 to 55 Hz in each X, Y, Z direction for 2 hours
Shock	1,000 m/s² (≈ 100 G) in each X, Y, Z direction for 10 times)
Ambient temp. [01]	-25 to 70 °C, storage: -25 to 70 °C (no freezing or condensation)
Ambient humi.	35 to 95 %RH, storage: 35 to 95 %RH (no freezing or condensation)
Protection rating	Cable type, cable connector type: IP66, IP67 (IEC standard) Connector type: IP66, IP67 (IEC standard), IP67G (JEM standard), IP68
Connection	Cable type / Cable connector type / Connector type model
Cable spec.	Ø 5 mm, 3-wire
Wire spec.	AWG 23 (0.08 mm, 60-core), insulator diameter: Ø 1.25 mm
Connector	M12 plug connector
Material	Oil resistant cable (dark gray): oil resistant polyvinyl chloride (PVC)
General	Case / Nut: stainless steel 303 (SUS303), washer: stainless steel 304 (SUS304), sensing side[02]: stainless steel 303 (SUS303)
Spatter-resistant	Case / Nut: stainless steel 303 (SUS303, PTFE coated), rear cap: stainless steel 303 (SUS303), washer: stainless steel 304 (SUS304), sensing side[02]: stainless steel 303 (SUS303, PTFE coated)

01) UL approved surrounding air temperature 60 °C
02) Thickness: DIA. of sensing side Ø 12 mm, Ø 18 mm: 0.4 mm / DIA. of sensing side Ø 30 mm: 0.5 mm

Effect of Aluminum Scraps

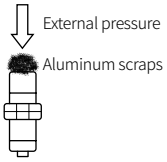
When aluminum scraps are attached or stacked at sensing side, the proximity sensor does not detect and sensing signal is OFF.
However, the below cases may occur to sensing signal. In this case, remove the scraps.

- When the size of aluminum scraps (d) is bigger than 2/3 of the sensing side size (D)



Sensing side \ Size	D (mm)
Ø 12 mm	10
Ø 18 mm	16
Ø 30 mm	28

- When aluminum scraps are attached on the sensing side by external pressure



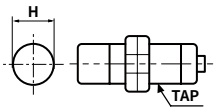
Correction Factor

Based on standard sensing target size.

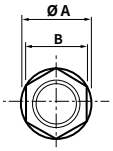
Detection target material / Sensing side	Iron	Aluminum	Stainless Steel	Brass	Copper
Ø 12 mm	1	1	0.5	0.6	1.1
Ø 18 mm	1	1	0.6	0.9	1.1
Ø 30 mm	1	1	0.6	1	1.1

Cut-out Dimensions

• Unit: mm, Refer to the dimension in the product manual or on the Autonics website.



	Ø 12 mm	Ø 18 mm	Ø 30 mm
Mounting hole (H)	Ø 12.5 $^{+0.5}_{0}$	Ø 18.5 $^{+0.5}_{0}$	Ø 30.5 $^{+0.5}_{0}$
TAP	M12×1	M18×1	M30×1.5

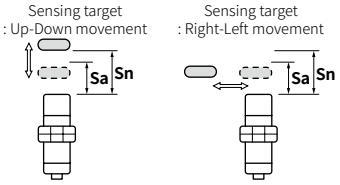


	Ø 12 mm	Ø 18 mm	Ø 30 mm
Ø A	21	29	42
B	17	24	36

Setting Distance Formula

• Detecting distance can be changed by the shape, size or material of the target.
For stable sensing, intall the unit within the 70 % of sensing distance.
Setting distance (Sa) = Sensing distance (Sn) × 70 %

• When the sensing target is placed over approx. 70% of sensing distance (Sn), the operation indicator (orange) turns ON. When the target is placed within approx. 70 % of sensing distance (Sn), the stability indicator (green) turns ON.
Use the sensor at the position where the stability indicator turns ON.

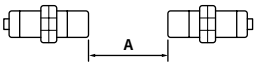


Mutual-interference & Influence by Surrounding Metals

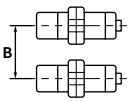
■ Mutual-interference

When plural proximity sensors are mounted in a close row, malfunction of sensor may be caused due to mutual interference.
Therefore, be sure to provide a minimum distance between the two sensors, as below table.

[Face to Face]

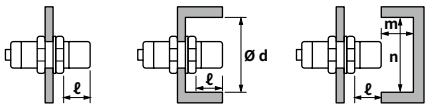


[Parallel]



■ Influence by surrounding metals

When sensors are mounted on metallic panel, it must be prevented sensors from being affected by any metallic object except target. Therefore, be sure to provide a minimum distance as below chart.

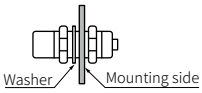


(unit: mm)

Item \ Sensing side	Ø 12 mm	Ø 18 mm	Ø 30 mm
A	40	65	110
B	35	60	100
ℓ	0	0	0
Ø d	12	18	30
m	8	20	40
n	40	60	100

Tightening Torque

Use the provided washer to tighten the nuts.
The allowable tightening torque table is for inserting the washer as below.



Strength \ Sensing side	Ø 12 mm	Ø 18 mm	Ø 30 mm
Tightening torque	25 N m	70 N m	180 N m

Durability Test

High resistance to the impact of removing Welding sludge attached to the sensing face

■ Metallic brush test

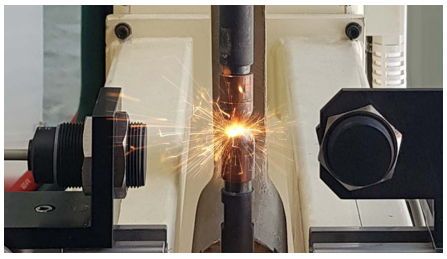
• Test model: PRFD18, testing object: stainless cup brush, rotation speed: 80 RPM, testing time: 3 hours

Test conditions	Result
	

Electromagnetic Resistance Test

Large current from welding generates magnetic field which can affect the proximity sensor to malfunction due to noise. This product, however, can be used near strong noise without malfunctioning, thanks to excellent electromagnetic resistance.
This test is conducted in the environment of welding. Minimum sensing distance can be different by welding environment.

• Test model: all Series, welding current: 13,000 A, installation direction: front and side

Test conditions	Remarks
	Recommended to use spatter protection cover (sold separately) for general type.

■ Minimum sensing distance between weld and sensor

Installation direction \ Sensing side	Ø 12 mm	Ø 18 mm	Ø 30 mm
Front	70 mm	60 mm	70 mm
Side	60 mm	60 mm	70 mm

IP67G (JEM standard)

■ Used oil (for reference only)

Oil type	JIS standard	Oil name	Kinetic viscosity (mm^2/s, 40°C)	PH
Lubricating oil	—	Velocite Oil No.3	2	—
Water-insoluble cutting fluid	2-5	Tectyl Cut 527	27	—
Water-soluble cutting fluid	—	Tectyl Cool 263C	—	9.5 (10% Solution)

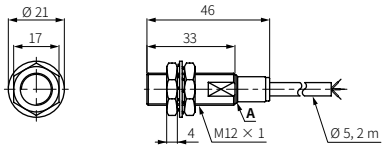
• IP67G means oil (drops and powders) from all directions completely blocked. It obtains the protection rating of enhanced oil resistance. (Pass the dropping test for 48 hours with the above oil)

Dimensions

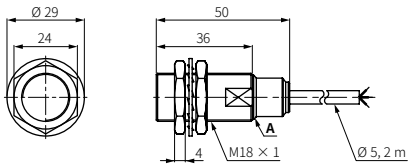
- Unit: mm, For refer detailed drawings, follow the Autonics website.
- The indicator operates by detection state. Refer to the 'Specifications' for details.

A	Indicator

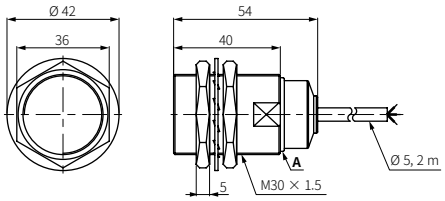
- PRFD12-3DN-V-K
- PRFD12-3DP-V-K
- PRFDA12-3DN-V-K
- PRFDA12-3DP-V-K



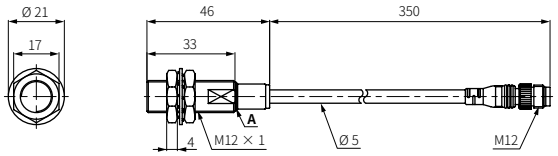
- PRFD18-7DN-V-K
- PRFD18-7DP-V-K
- PRFDA18-7DN-V-K
- PRFDA18-7DP-V-K



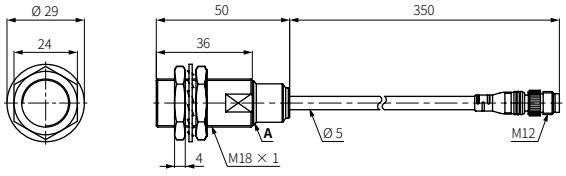
- PRFD30-12DN-V-K
- PRFD30-12DP-V-K
- PRFDA30-12DN-V-K
- PRFDA30-12DP-V-K



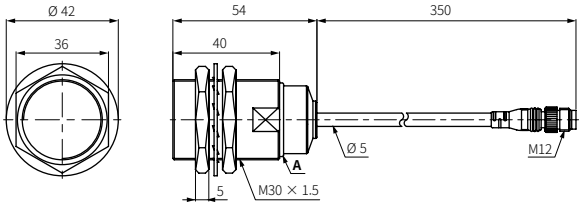
- PRFDW12-3DN-V-K
- PRFDW12-3DP-V-K
- PRFDAW12-3DN-V-K
- PRFDAW12-3DP-V-K



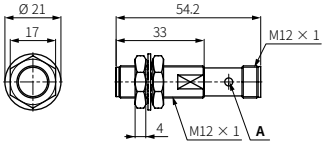
- PRFDW18-7DN-V-K
- PRFDW18-7DP-V-K
- PRFDAW18-7DN-V-K
- PRFDAW18-7DP-V-K



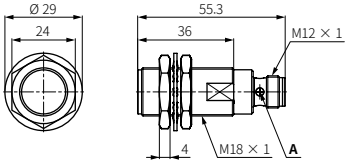
- PRFDW30-12DN-V-K
- PRFDW30-12DP-V-K
- PRFDAW30-12DN-V-K
- PRFDAW30-12DP-V-K



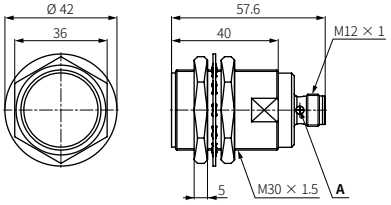
- PRFDCM12-3DN-K
- PRFDCM12-3DP-K
- PRFDACM12-3DN-K
- PRFDACM12-3DP-K



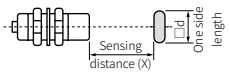
- PRFDCM18-7DN-K
- PRFDCM18-7DP-K
- PRFDACM18-7DN-K
- PRFDACM18-7DP-K



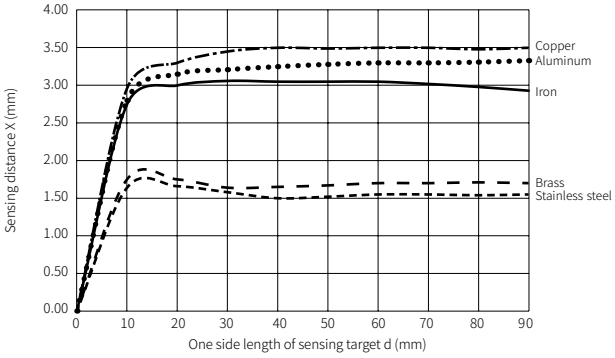
- PRFDCM30-12DN-K
- PRFDCM30-12DP-K
- PRFDACM30-12DN-K
- PRFDACM30-12DP-K



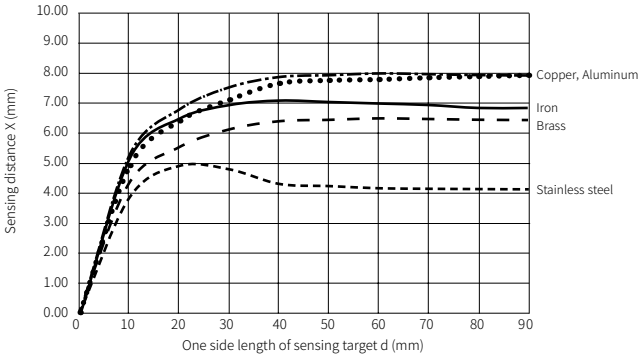
Sensing Distance Feature Data by Target Material and Size



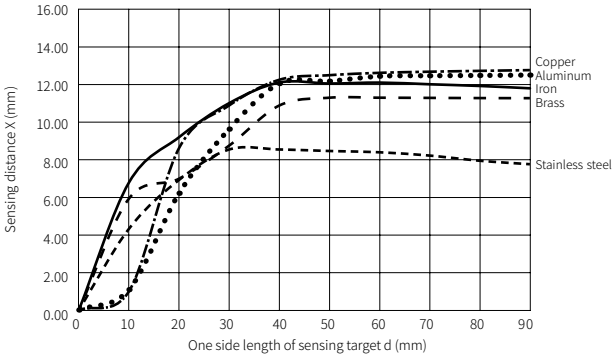
• Ø 12 mm



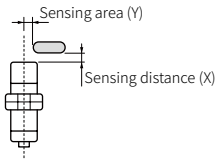
• Ø 18 mm



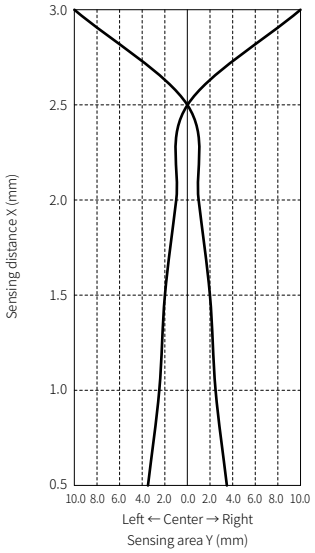
• Ø 30 mm



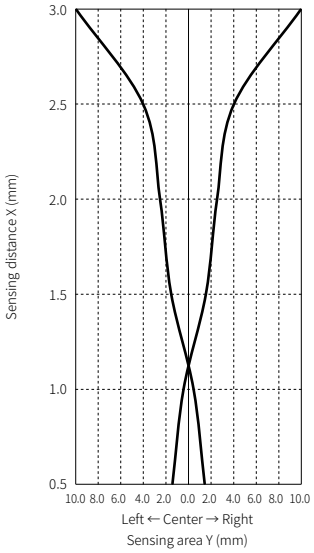
Sensing Distance Feature Data by Parallel (left/right) Movement



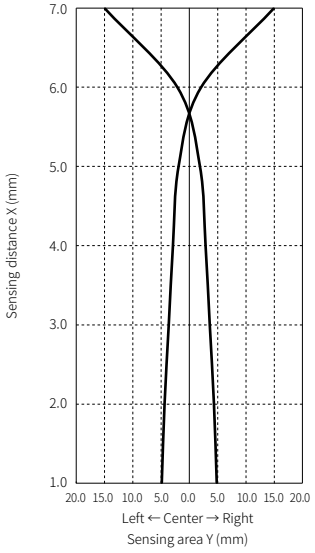
• Ø 12 mm (iron)



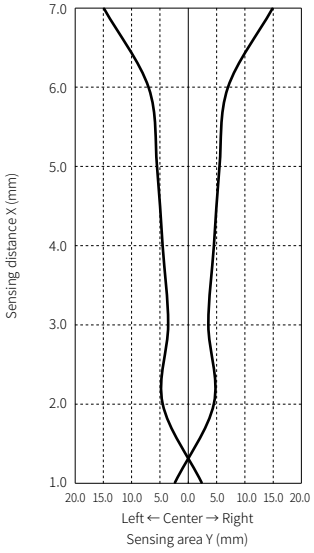
• Ø 12 mm (aluminum)



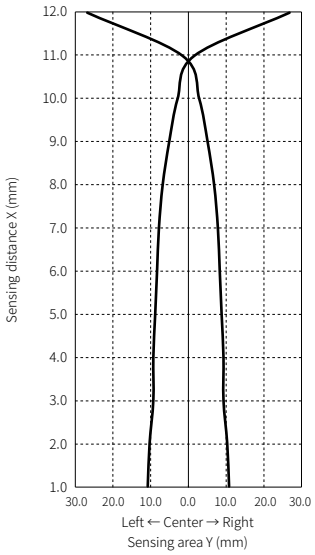
• Ø 18 mm (iron)



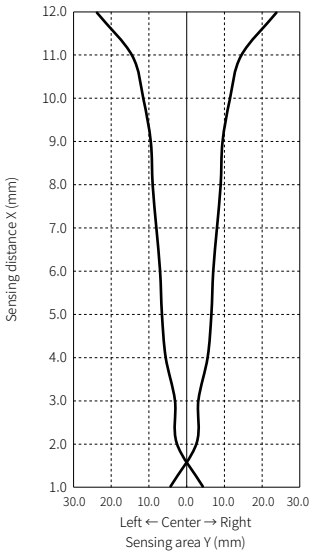
• Ø 18 mm (aluminum)



• Ø 30 mm (iron)



• Ø 30 mm (aluminum)



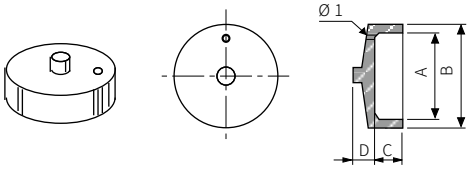
Sold Separately: M12 Connector Cable

• For detailed information, refer to the 'M8/M12 Connector Cable' manual.

Appearance	Power	Connector 1	Connector 2	Length	Feature	Model
	DC	M12 (Socket-Female) 4-pin	3-wire	2 m	PVC	CID3-2
				5 m		CID3-5
	DC	M12 (Socket-Female) 4-pin	3-wire	2 m	Oil resistant PVC	CIDH3-2
				5 m		CIDH3-5
	DC	M12 (Socket-Female) 4-pin, L type	3-wire	2 m	PVC	CLD3-2
				5 m		CLD3-5
	DC	M12 (Socket-Female) 4-pin, L type	3-wire	2 m	Oil resistant PVC	CLDH3-2
				5 m		CLDH3-5

Sold Separately: Protection Cover (P90-M□)

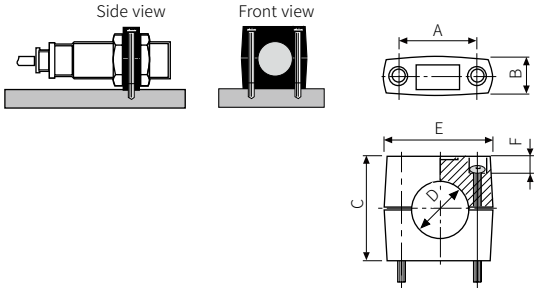
The welding tip (spatter) generated during arc welding has a property of sticking to plastics and metals. If several welding tips are attached to the front or body of the proximity sensor, it may be difficult to replace the body or cause a malfunction. When using a general type proximity sensor, use a silicone protective cover (sold separately). Only for flush (shield) type.



Item (mm) \ Model	P90-M12	P90-M18	P90-M30
A	Ø 11	Ø 17	Ø 28.5
B	Ø 14	Ø 21	Ø 33
C	5.0	6.0	8.0
D	1.0	3.0	6.0
Applied sensing side size	M12	M18	M30

Sold Separately: Fixing Bracket (P90-R□)

If fixing holes are not made for cylindrical proximity sensor, use a cylindrical fixing bracket as below. For Non-flush (non-shield) type, be sure effect by ambient material.



Item (mm) \ Model	P90-R12	P90-R18	P90-R30
A	24 ± 0.2	32 ± 0.2	45 ± 0.2
B	≤ 11.5	≤ 16	≤ 16
C	20	30	50
D	Ø 12	Ø 18	Ø 30
E	≤ 34.4	≤ 47	≤ 60
F	6.0	10	10
Fixing bolt	M4 × 20	M5 × 30	M5 × 50
Applied sensing side size	M12	M18	M30