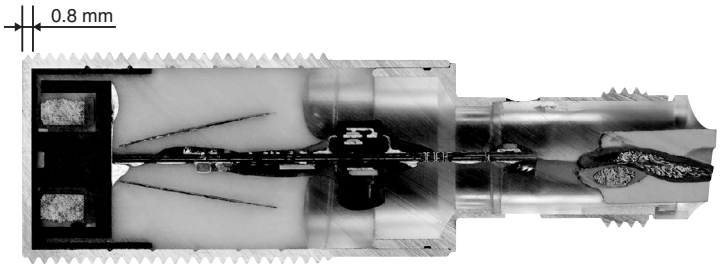
Inductive Proximity Sensor in full metal housing

E2FM

- Full body stainless steel housing for highest mechanical protection
- Low frequency modulation for metal chip immunity
- Flame retardant cable for high protection against welding spatter damage

Application

Full body stainless steel housing with 0.8 mm thick sensing face protection



Brush Test

The stainless-steel head shows minimal wear when cleaned with a metal brush.

E2FM

Standard sensor

Continuous Impact Test

More than 20 times the durability of standard sensors.

Standard sensor

The standard sensor with top wall thickness of 0.2 mm was penetrated after 10,000 impacts.

E2FM

The E2FM was not penetrated after 250,000 impacts (depth: 0.26 mm).

Features

Chemical and Oil Resistance (examples)

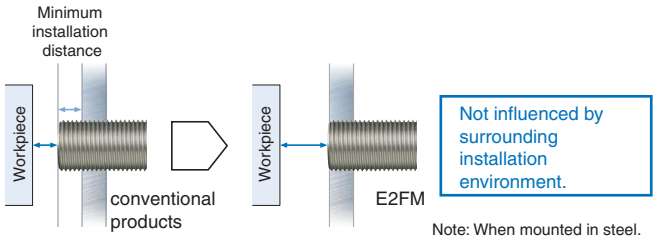
Tested resistance against:

- Sodium chloride
- Gasoline
- Dilute sodium hydroxide
- Dilute hydrochloric acid
- Mineral oil
- Barium hydroxide

Low frequency modulation...

...for metal chip immunity reducing false signals caused by spatter accumulation and small metal objects.

Flush mounting installation possible



Ordering Information

Sensors

DC 2-Wire, Pre-wired Connector Models

Appearance		Sensing distance	Output configuration	Operation mode	Model
Shielded	M8	1.5 mm	Polarity: Yes, Pin allocations: 1-4	NO	E2FM-X1R5D1-M1GJ
	M12	2 mm	Polarity: Yes, Pin allocations: 1-4		E2FM-X2D1-M1GJ
			No polarity: No, Pin allocations: 3-4		E2FM-X2D1-M1GJ-T
	M18	5 mm	Polarity: Yes, Pin allocations: 1-4		E2FM-X5D1-M1GJ
			No polarity: No, Pin allocations: 3-4		E2FM-X5D1-M1GJ-T
	M30	10 mm	Polarity: Yes, Pin allocations: 1-4		E2FM-X10D1-M1GJ
			No polarity: No, Pin allocations: 3-4		E2FM-X10D1-M1GJ-T

DC 3-Wire, M12 Connector Models

Appearance		Sensing distance	Output configuration	Operation mode	Model
Shielded	M8	1.5 mm	DC 3-Wire, PNP	NO	E2FM-X1R5B1-M1
	M12	2 mm			E2FM-X2B1-M1
	M18	5 mm			E2FM-X5B1-M1
	M30	10 mm			E2FM-X10B1-M1

Rating and Specifications

DC 2-Wire (E2FM-X□D□)

Size		M8	M12	M18	M30	M12	M18	M30
Shielded		Shielded						
Item	Model	E2FM-X1R5D1 -M1GJ	E2FM-X2D1 -M1GJ	E2FM-X5D1 -M1GJ	E2FM-X10D1 -M1GJ	E2FM-X2D1 -M1GJ-T	E2FM-X5D1 -M1GJ-T	E2FM-X10D1 -M1GJ-T
Sensing distance		1.5 mm±10%	2 mm±10%	5 mm±10%	10 mm±10%	2 mm±10%	5 mm±10%	10 mm±10%
Set distance		0 to 1.05 mm	0 to 1.4 mm	0 to 3.5 mm	0 to 7 mm	0 to 1.4 mm	0 to 3.5 mm	0 to 7 mm
Differential travel		15% max. of sensing distance						
Sensing object		Ferrous metal (The sensing distance decreases with non-ferrous metal. Refer to *Engineering Data* on page 5.)						
Standard sensing object		Iron, 8 × 8 × 1 mm	Iron, 12 × 12 × 1 mm	Iron, 30 × 30 × 1 mm	Iron, 54 × 54 × 1 mm	Iron, 12 × 12 × 1 mm	Iron, 30 × 30 × 1 mm	Iron, 54 × 54 × 1 mm
Response frequency *		200 Hz	100 Hz	100 Hz	50 Hz	100 Hz	100 Hz	50 Hz
Power supply voltage (operating voltage range)		12 to 24 VDC (10 to 30 VDC), ripple (p-p): 10% max.						
Leakage current		0.8 mA max.						
Output configuration		With polarity				Without polarity		
Control output	Switching capacity	3 to 100 mA						
	Residual voltage	3 V max. (Load current: 100 mA, Cable length: 2 m)				5 V max. (Load current: 100 mA, Cable length: 2 m)		
Indicators		Operation indicator (red LED), Setting/Operation indicator (green LED)						
Operation mode (with sensing object approaching)		NO						
Protection circuits		Surge suppressor, Load short-circuit protection						
Ambient temperature range		Operating/Storage: -25 to 70°C (with no icing or condensation)						
Ambient humidity range		Operating/Storage: 35% to 95% (with no condensation)						
Temperature influence		±20% max. of sensing distance at 23°C in the temperature range of -25 to 70°C.						
Voltage influence		±1% max. of sensing distance at rated voltage in the rated voltage ±15% range						
Insulation resistance		50 MΩ min. (at 500 VDC) between current-carrying parts and case						
Dielectric strength		1,000 VAC, 50/60 Hz for 1 minute between current carry parts and case						
Vibration resistance		Destruction: 10 to 55 Hz, 1.5 mm double amplitude for 2 hours each in X, Y, and Z directions						
Shock resistance		Destruction: 500 m/s² 10 times each in X, Y, and Z directions	Destruction: 1,000 m/s² 10 times each in X, Y, and Z directions					
Degree of protection		IEC 60529 IP67, DIN 40050 part 9: IP69k						
Connection method		Pig-tail Connector Models (Standard cable length: 0.3 m)						
Weight (packed state)		Approx. 65 g	Approx. 85 g	Approx. 110 g	Approx. 190 g	Approx. 85 g	Approx. 110 g	Approx. 190 g
Materials	Case	Stainless steel (SUS303)						
	Sensing surface	Stainless steel (SUS303)						
	(thickness)	(0.4 mm)	(0.8 mm)			(0.8 mm)		
	Clamping nuts	Stainless steel (SUS303)						
	Cable	PVC (flame retardant)						
	Toothed washer	Zinc-plated iron						
Accessories		Instruction manual						

* The response frequency of the DC switching section is an average value. Measurement conditions are as follows: standard sensing object, a distance of twice the standard sensing object, and a set distance of half the sensing distance.

DC 3-Wire (E2FM-X□B□)

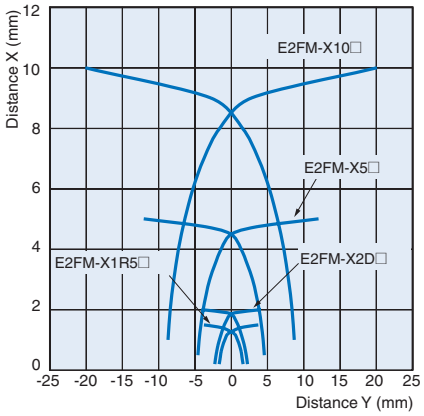
Size		M8	M12	M18	M30
Shielded		Shielded			
Item	Model	E2FM-X1R5B1-M1	E2FM-X2B1-M1	E2FM-X5B1-M1	E2FM-X10B1-M1
Sensing distance		1.5 mm±10%	2 mm±10%	5 mm±10%	10 mm±10%
Set distance		0 to 1.05 mm	0 to 1.4 mm	0 to 3.5 mm	0 to 7 mm
Differential travel		15% max. of sensing distance			
Sensing object		Ferrous metal (The sensing distance decreases with non-ferrous metal. Refer to *Engineering Data* on page 5.)			
Standard sensing object		Iron, 8 × 8 × 1 mm	Iron, 12 × 12 × 1 mm	Iron, 30 × 30 × 1 mm	Iron, 54 × 54 × 1 mm
Response frequency *		200 Hz	100 Hz	100 Hz	50 Hz
Power supply voltage (operating voltage range)		12 to 24 VDC (10 to 30 VDC), ripple (p-p): 10% max.			
Current consumption		10 mA max.			
Output configuration		PNP open collector output			
Control output	Switching capacity	200 mA max.			
	Residual voltage	2 V max. (Load current: 200 mA, Cable length: 2 m)			
Indicators		Operation indicator (yellow LED)			
Operation mode (with sensing object approaching)		NO			
Protection circuits		Reversed power supply polarity protection, Surge suppressor, Load short-circuit protection, and Reversed output polarity protection (except the E2FM-X1R5B1-M1)			
Ambient temperature range		Operating/Storage: -25 to 70°C (with no icing or condensation)			
Ambient humidity range		Operating/Storage: 35% to 95% (with no condensation)			
Temperature influence		±20% max. of sensing distance at 23°C in the temperature range of -25 to 70°C.			
Voltage influence		±1% max. of sensing distance in the rated voltage ±15% range (using the sensing distance at the rated voltage as standard)			
Insulation resistance		50 MΩ min. (at 500 VDC) between current-carrying parts and case			
Dielectric strength		1,000 VAC, 50/60 Hz for 1 minute between current carry parts and case			
Vibration resistance		Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions			
Shock resistance		Destruction: 500 m/s^2 10 times each in X, Y, and Z directions	Destruction: 1,000 m/s^2 10 times each in X, Y, and Z directions		
Degree of protection		IEC 60529 IP67, DIN 40050 part 9: IP69k			
Connection method		Connector Models			
Weight (packed state)		Approx. 45 g	Approx. 55 g	Approx. 75 g	Approx. 160 g
Materials	Case	Stainless steel (SUS303)			
	Sensing surface	Stainless steel (SUS303)			
	(thickness)	(0.4mm)	(0.8mm)		
	Clamping nuts	Stainless steel (SUS303)			
	Toothed washer	Zinc-plated iron			
Accessories		Instruction manual			

* The response frequency of the DC switching section is an average value. Measurement conditions are as follows: standard sensing object, a distance of twice the standard sensing object, and a set distance of half the sensing distance.

Engineering Data (Typical)

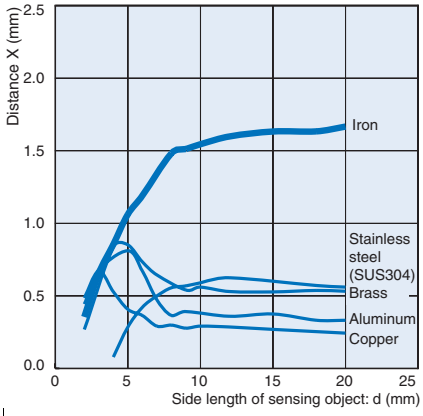
Sensing Area

E2FM-X□

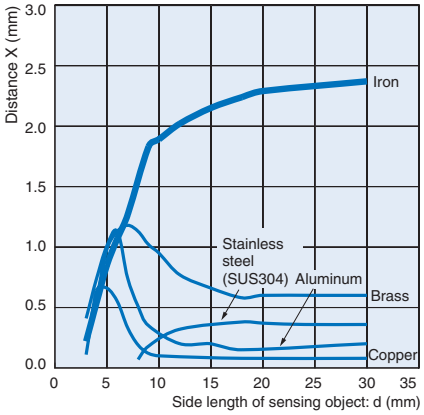


Influence of Sensing Object Size and Material

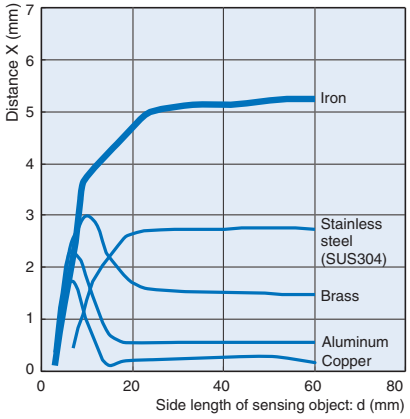
E2FM-X1R5□



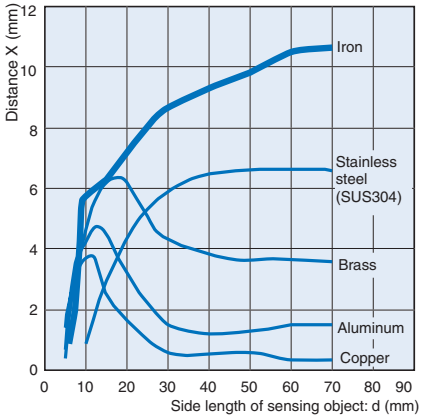
E2FM-X2□



E2FM-X5□

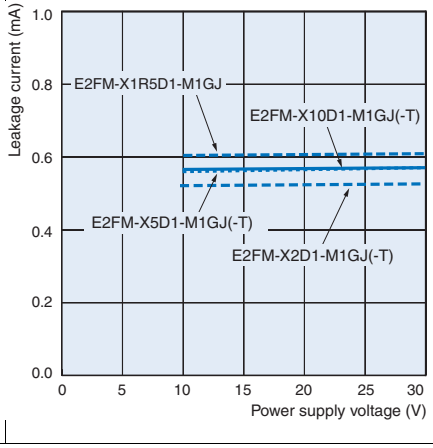


E2FM-X10□



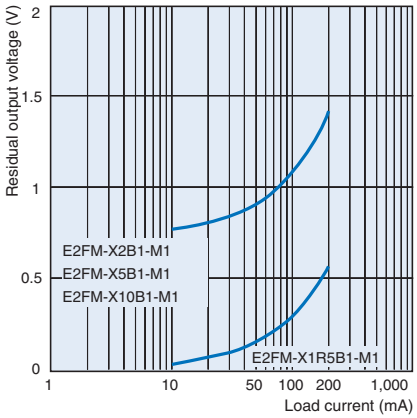
Leakage Current

E2FM-X□D1-M1GJ(-T)

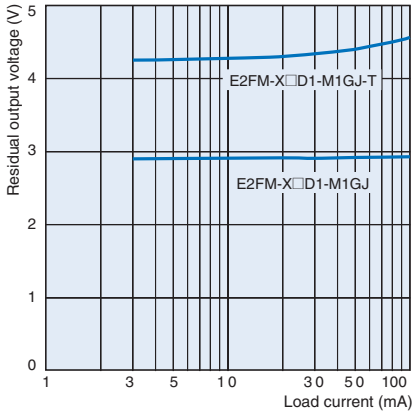


Residual Output Voltage

E2FM-X□B1-M1

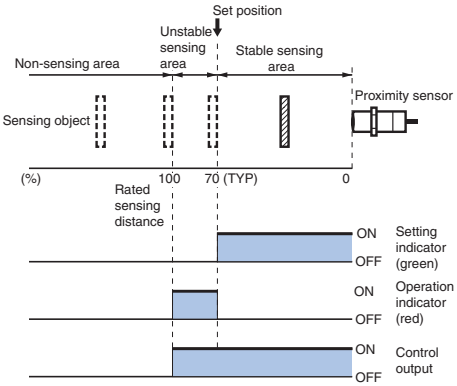
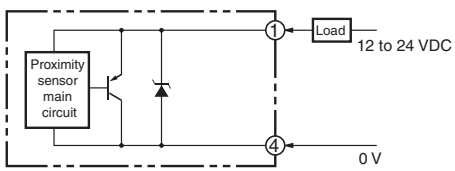
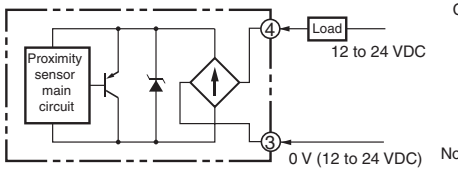


E2FM-X□D1-M1GJ(-T)

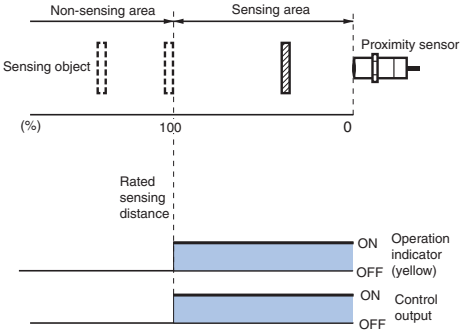
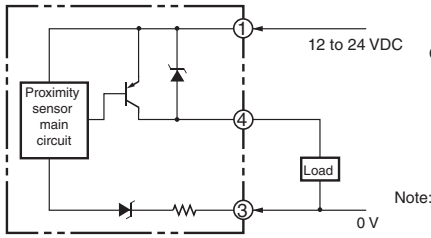
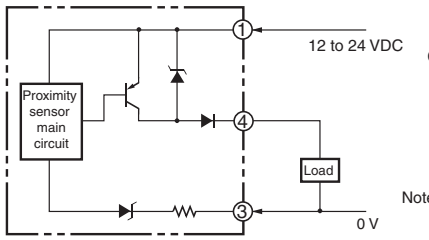


I/O Circuit Diagrams

DC 2-Wire Models

Operation mode	Model	Timing chart	Output circuit
NO	E2FM-X□D1-M1GJ		 Note: The load can be connected to either the +V or 0 V side.
	E2FM-X□D1-M1GJ-T		 Note 1. The load can be connected to either the +V or 0 V side. 2. The E2FM-X□□1-M1GJ-T has no polarity. There is no need to be concerned about the polarity of pins 3 and 4.

DC 3-Wire Models

Operation mode	Output configuration	Model	Timing chart	Output circuit
NO	PNP open-collector model	E2FM-X1R5B1-M1		 Note: There is no reversed output polarity protection diode.
		E2FM-X2B1-M1 E2FM-X5B1-M1 E2FM-X10B1-M1		

Safety Precautions

⚠ WARNING

This product is not designed or rated for ensuring safety of persons. Do not use it for such purposes.

Never use this product with an AC power supply. Otherwise, explosion may result.

Precautions for Safe Use

The following precautions must be observed to ensure safe operation.

1. Do not use the Sensor in an environment where inflammable or explosive gas is present.
2. Do not attempt to disassemble, repair, or modify any Sensors.
3. Power Supply Voltage
   Do not use a voltage that exceeds the rated operating voltage range. Applying a voltage that is higher than the operating voltage range may result in explosion or fire.
4. Incorrect Wiring
   Be sure that the power supply polarity and other wiring is correct. Incorrect wiring may cause explosion or fire.
5. Connection without a Load
   If the power supply is connected directly without a load, the internal elements may explode or burn. Be sure to insert a load when connecting the power supply.

Precautions for Correct Use

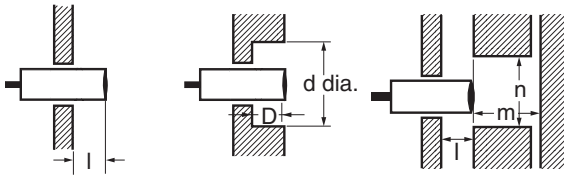
Do not use the Sensor under ambient conditions that exceed the ratings to ensure maximum lifetime:

1. Please do not use the Sensor in the following locations.
   (1) Outdoor locations directly subject to sunlight, rain, snow, or water droplets
   (2) Locations subject to atmospheres with chemical vapors, in particular solvents and acids
   (3) Locations subject to corrosive gas
2. The Sensor may malfunction if used near ultrasonic cleaning equipment, high-frequency equipment, transceivers, cellular phones, inverters, or other devices that generate a high-frequency electric field. Refer to the *Sensor General Catalog* for typical measures.
3. Laying the Sensor wiring in the same conduit or duct as high-voltage wires or power lines may result in incorrect operation and damage due to induction. Wire the Sensor using a separate conduit or independent conduit.
4. Cleaning
   Never use thinner or other solvents. Otherwise, the Sensor surface may be dissolved.

Design

Influence of Surrounding Metal

When the Proximity Sensor is embedded in metal, make sure that the clearances given in the following table are maintained. The values depend on the type of nuts used for mounting. Be sure to use the supplied nuts (SUS303).



(Unit: mm)

Model	Item: Embedding material	l	d	D	m	n
E2FM-X1R5□	Iron	0	8	0	4.5	30
	Aluminum	10	50	10	4.5	50
E2FM-X2□	Iron	0	12	0	8	40
	Aluminum	16	70	16	8	70
E2FM-X5□	Iron	0	18	0	20	60
	Aluminum	16	80	16	20	80
E2FM-X10□	Iron	0	30	0	40	100
	Aluminum	24	120	24	40	120

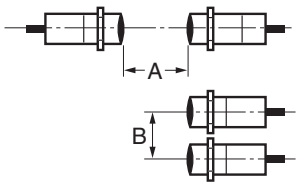
Note: The influence from other non-magnetic surrounding metals is nearly the same as that from aluminum.

Mutual Interference

When installing two or more Sensors face-to-face or side-by-side, ensure that the minimum distances given in the following table are maintained.

(Unit: mm)

Model / Item	A	B
E2FM-X1R5□	35	30
E2FM-X2□	40	35
E2FM-X5□	65	60
E2FM-X10□	110	100

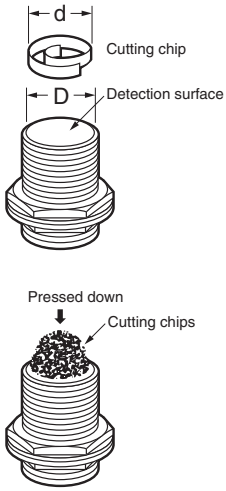


Chips from Cutting Aluminum or Cast Iron

Normally, chips from cutting aluminum or cast iron will not cause a detection signal to be output even if it adheres to or accumulates on the detection surface. In the following cases, however, a detection signal may be output. Remove the cutting chips in these cases.

1. If $d \geq \frac{2}{3} D$ at the center of the detection surface where d is the cutting chip size and D is the detection surface size

Model	Dimension (mm): D
E2FM-X1R5□	6
E2FM-X2□	10
E2FM-X5□	16
E2FM-X10□	28



Mounting

Do not tighten the nut with excessive force. A washer must be used with the nut. Do not use tightening force that exceeds the values in the following table.

Model	Torque
E2FM-X1R5□	9 N·m
E2FM-X2□	30 N·m
E2FM-X5□	70 N·m
E2FM-X10□	180 N·m

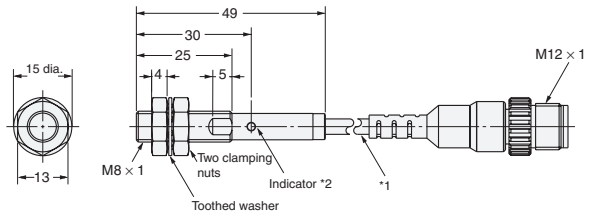
Dimensions

(Unit: mm)

Sensors

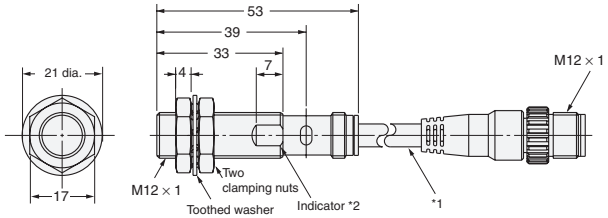
Pig-tail Connector Models

E2FM-X1R5D1-M1GJ



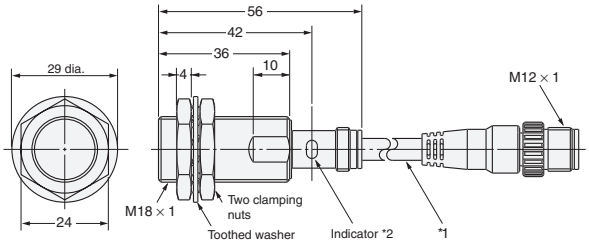
*1. 4-dia. vinyl-insulated round cable (flame retardant), Standard length; 300 mm
*2. Operation indicator (red/green)
Setting indicator (green)

E2FM-X2D1-M1GJ
E2FM-X2D1-M1GJ-T



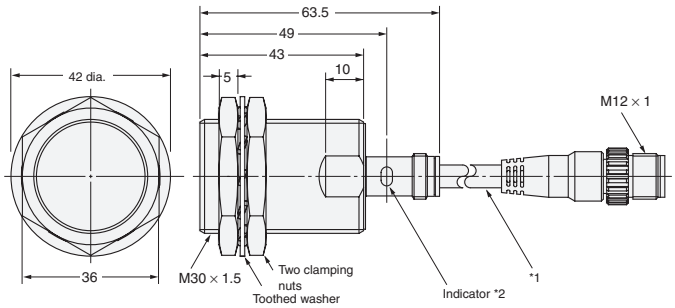
*1. 6-dia. vinyl-insulated round cable (flame retardant), Standard length; 300 mm
*2. Operation indicator (red/green)
Setting indicator (green)

E2FM-X5D1-M1GJ
E2FM-X5D1-M1GJ-T



*1. 6-dia. vinyl-insulated round cable (flame retardant), Standard length; 300 mm
*2. Operation indicator (red/green)
Setting indicator (green)

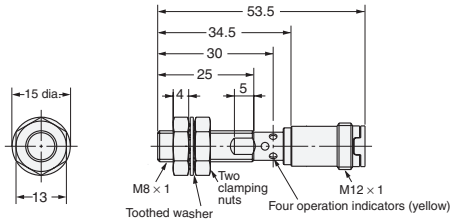
E2FM-X10D1-M1GJ
E2FM-X10D1-M1GJ-T



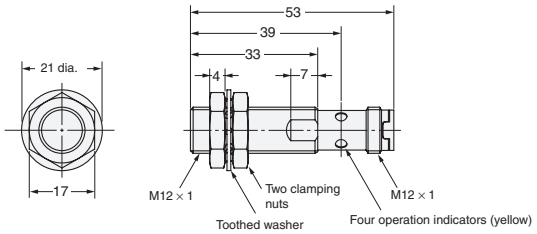
*1. 6-dia. vinyl-insulated round cable (flame retardant), Standard length; 300 mm
*2. Operation indicator (red/green)
Setting indicator (green)

M12 Connector Models

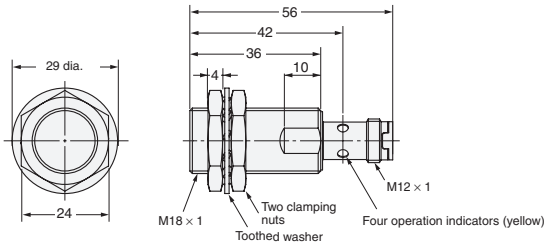
E2FM-X1R5B1-M1



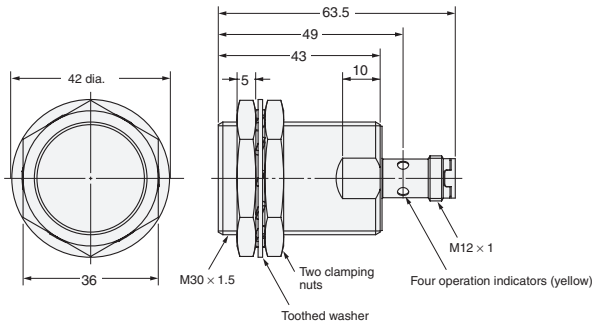
E2FM-X2B1-M1



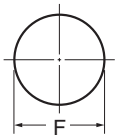
E2FM-X5B1-M1



E2FM-X10B1-M1



Mounting Hole Dimensions



Dimension	M8	M12	M18	M30
F (mm)	$8.5^{+0.5}_{0}$ dia.	$12.5^{+0.5}_{0}$ dia.	$18.5^{+0.5}_{0}$ dia.	$30.5^{+0.5}_{0}$ dia.

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