

E2FM

Highly Durable Proximity Sensor for Tough Environments

- Completely stainless-steel housing
- Aluminum chip immunity
- Embedding installation to metal (steel) fittings
- Chemical resistance certified by Ecolab Europe
- Lineup includes pre-wire models and DC 3-wire NPN output models with fluororesin coating.



 Be sure to read *Safety Precautions* on page 9.

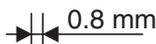
Note: Models with a fluororesin coating also use vinyl chloride for the cable material and require separate protection.

* Excluding DC 3-wire M8 pre-wired models (E2FM-X1R5B□/-X1R5C□).

Features

One-piece completely stainless-steel housing with a face thickness of 0.8 mm

The face thickness is approximately 4 times that of previous models (E2ES) to enable sensing in even more severe conditions than ever.

 0.8 mm



Brush Test



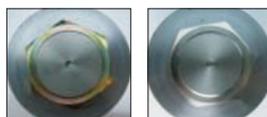
After 3 Minutes



E2FM E2EQ
(Spatter-resistant)

The stainless-steel head means almost no wear when cleaned with a metal brush.

Continuous Impact Test



E2ES E2FM
The E2ES with a top wall thickness of 0.2 mm was **penetrated** after 10,000 impacts.
The E2FM was not **penetrated** after 250,000 impacts (depth: 0.26 mm).

More than 20 times the durability of the E2ES!

Chemical and Detergent Proof

The one-piece completely stainless-steel housing of the sensing section withstands the following chemicals better.

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

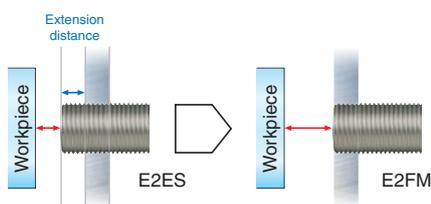
Note: Cannot be used for explosion-proof applications.

Built-in Chip Immunity

Chip immunity performance has been provided to greatly reduce false signals caused by spatter accumulation and other causes, almost eliminating the needs for cleaning, e.g., with metal brushes.



Flush Mounting



Not influenced by surrounding installation environment.

Note: When mounted in steel.



Main Performance Comparison to Previous OMRON Products

Face thickness

	E2FM	E2ES
M8	0.4 mm	---
M12	0.8 mm	---
M18	0.8 mm	0.2 mm
M30	0.8 mm	0.2 mm

Sensing distance

	E2FM	E2ES
M8	1.5 mm	---
M12	2.0 mm	---
M18	5.0 mm	4.0 mm
M30	10.0 mm	8.0 mm

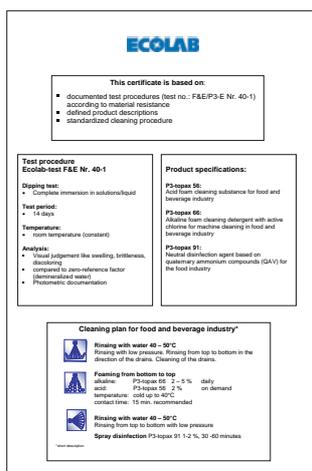
Response frequency

	E2FM	E2ES
M8	200 Hz	---
M12	100 Hz	---
M18	100 Hz	12 Hz
M30	50 Hz	8 Hz

Ambient operating temperature

E2FM	E2ES
-25 to 70°C	0 to 50°C

The chemical resistance has been certified by Ecolab Europe



E2FM

Ordering Information

Sensors [Refer to *Dimensions* on page 10.]

DC 2-Wire, Pre-wired Models

Size	Sensing distance	Output	Operation mode	Model	
Shielded 	M8	1.5 mm	DC 2-Wire (polarity)	NO	E2FM-X1R5D1 2M *
	M12	2 mm			E2FM-X2D1 2M *
	M18	5 mm			E2FM-X5D1 2M *
	M30	10 mm			E2FM-X10D1 2M *

* Fluororesin-coated models are also available. The model numbers are E2FM-QX□D. The cable material, however, is vinyl chloride and requires separate protection.

DC 2-wire Pre-wired Smartclick Connector Models (M12)

Size	Sensing distance	Output	Operation mode	Model
Shielded 	M8	Polarity Pin allocations: 1-4	NO	E2FM-X1R5D1-M1TGJ 0.3M
		No polarity Pin allocations: 3-4		E2FM-X2D1-M1TGJ 0.3M
	M12	Polarity Pin allocations: 1-4		E2FM-X2D1-M1TGJ-T 0.3M
		No polarity Pin allocations: 3-4		E2FM-X5D1-M1TGJ 0.3M
	M18	Polarity Pin allocations: 1-4		E2FM-X5D1-M1TGJ-T 0.3M
		No polarity Pin allocations: 3-4		E2FM-X10D1-M1TGJ 0.3M
	M30	Polarity Pin allocations: 1-4		E2FM-X10D1-M1TGJ-T 0.3M
		No polarity Pin allocations: 3-4		

DC 3-Wire, Pre-wired Models

Size	Sensing distance	Model	
		Output configuration: NPN NO	Output configuration: PNP NO
Shielded 	M8	E2FM-X1R5C1 2M	E2FM-X1R5B1 2M
	M12	E2FM-X2C1 2M	E2FM-X2B1 2M
	M18	E2FM-X5C1 2M	E2FM-X5B1 2M
	M30	E2FM-X10C1 2M	E2FM-X10B1 2M

DC 3-Wire, M12 Connector Models

Size	Sensing distance	Model	
		Output configuration: NPN NO	Output configuration: PNP NO
Shielded 	M8	E2FM-X1R5C1-M1	E2FM-X1R5B1-M1 *
	M12	E2FM-X2C1-M1	E2FM-X2B1-M1 *
	M18	E2FM-X5C1-M1	E2FM-X5B1-M1 *
	M30	E2FM-X10C1-M1	E2FM-X10B1-M1 *

* Fluororesin-coated models are also available. The model numbers are E2FM-QX□B1-M1. The cable material, however, is vinyl chloride and requires separate protection.

Accessories (Order Separately)

Sensor I/O Connectors (M12)

(Models for Connectors and with Pre-wired Connectors: A Connector is not provided with the Sensor. Be sure to order a Connector separately.)

[Refer to XS2, XS5.]

Appearance	Cable length	Sensor I/O Connector model number	Applicable Proximity Sensor model number
	2m	XS2F-D421-DC0-A	E2FM-X□C1-M1 E2FM-X□B1-M1
	5m	XS2F-D421-GC0-A	
	2m	XS2F-D422-DC0-A	
	5m	XS2F-D422-GC0-A	

Note: Refer to *Introduction to Sensor I/O Connectors* for details.

Ratings and Specifications

DC 2-Wire (E2FM-X□D□)

Size		M8	M12	M18	M30
Shielded		Shielded			
Item	Model	E2FM-X1R5D1-□	E2FM-X2D1-□	E2FM-X5D1-□	E2FM-X10D1-□
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 <i>Engineering Data</i> on page 7.)			
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 *1		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.			
Leakage current		0.8 mA max.			
Output configuration		With polarity			
Control output	Switching capacity	3 to 100 mA			
	Residual voltage	3 V max. (Load current: 100 mA max., Cable length: 2 m)			
Indicators		Operation indicator (red LED), Setting/Operation indicator (green LED)			
Operation mode (with sensing object approaching)		NO *2			
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-carrying 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			
Connection method		Unmarked: Pre-wired Models (Standard cable length: 2 m) Models ending with -M1GJ-□: Pre-wired Connector Models (Standard cable length: 300 mm)			

E2FM

Item		Size	M8	M12	M18	M30
		Shielded	Shielded			
		Model	E2FM-X1R5D1-□	E2FM-X2D1-□	E2FM-X5D1-□	E2FM-X10D1-□
Weight (packed state)	Pre-wired Models (2 m)	Approx. 105 g	Approx. 190 g	Approx. 215 g	Approx. 295 g	
	Pre-wired Connector Models	Approx. 65 g	Approx. 85 g	Approx. 110 g	Approx. 190 g	
Materials	Case	Stainless steel (SUS303)				
	Sensing surface (thickness)	Stainless steel (SUS303)				
		(0.4 mm)	(0.8 mm)			
	Clamping nuts	Stainless steel (SUS303)				
	Cable	PVC (flame retardant)				
Toothed washer	Zinc-plated iron					
Accessories		Instruction manual				

*1. 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.

*2. NC (normally closed) models are also available. Contact your OMRON representative.

DC 3-Wire (E2FM-X□C□, E2FM-X□B□)

Size		M8	M12	M18	M30
Shielded		Shielded			
Item	Model	E2FM-X1R5□	E2FM-X2□	E2FM-X5□	E2FM-X10□
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 <i>Engineering Data</i> on page 7.)			
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 *1		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)		C1 Models: NPN open collector, NO (normally open) *2 B1 Models: PNP open collector, NO (normally open) *2			
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-carrying 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			
Connection method		Unmarked: Pre-wired Models (Standard cable length: 2 m) Models ending with -M1: Connector Models			
Weight (packed state)	Pre-wired Models (2 m)	---	Approx. 170 g	Approx. 190 g	Approx. 275 g
	Pre-wired Connector Models	Approx. 45 g	Approx. 55 g	Approx. 75 g	Approx. 160 g
Materials	Case	Stainless steel (SUS303)			
	Sensing surface (thickness)	Stainless steel (SUS303)			
		(0.4 mm)	(0.8 mm)		
	Clamping nuts	Stainless steel (SUS303)			
Toothed washer	Zinc-plated iron				
Accessories		Instruction manual			

*1. 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.

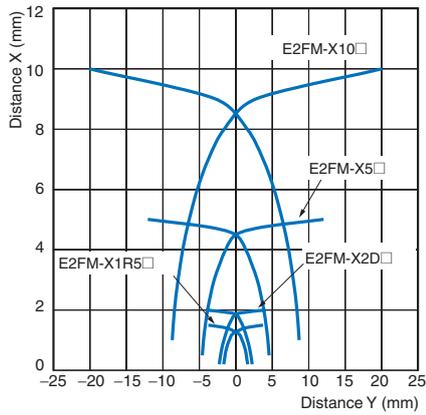
*2. NC (normally closed) models are also available. Contact your OMRON representative.

E2FM

Engineering Data (Typical)

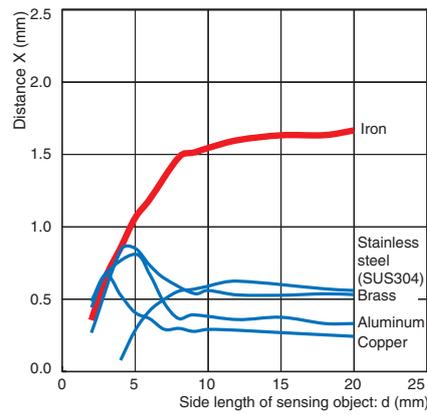
Sensing Area

E2FM-X□

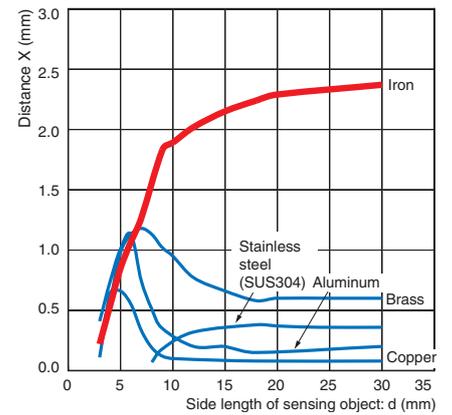


Influence of Sensing Object Size and Material

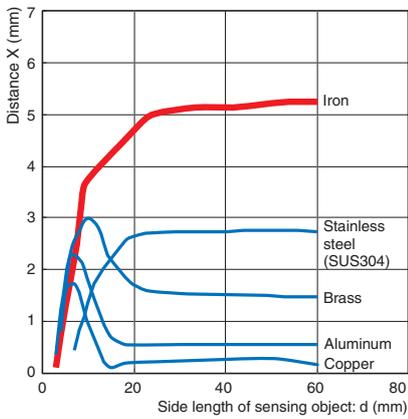
E2FM-X1R5□



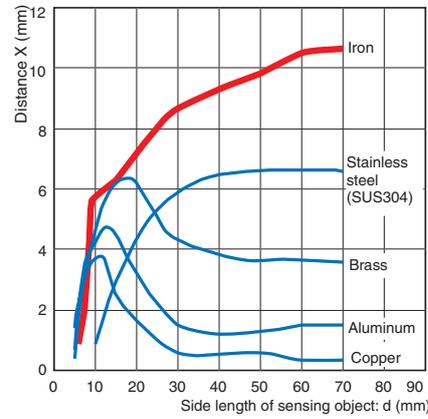
E2FM-X2□



E2FM-X5□

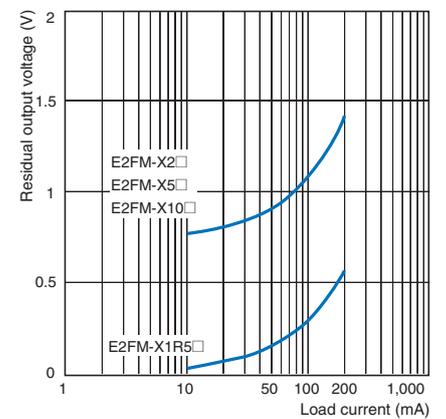


E2FM-X10□



Residual Output Voltage

E2FM-X□C□/B□



I/O Circuit Diagrams

DC 2-Wire Models

Operation mode	Model	Timing chart	Output circuit
NO	E2FM-X□D1-□		<p>Note: The load can be connected to either the +V or 0 V side.</p>

DC 3-Wire Models

Operation mode	Output configuration	Model	Timing chart	Output circuit
NO	NPN open-collector model	E2FM-X1R5C□ E2FM-X2C□ E2FM-X5C□ E2FM-X10C□		<p>* There is no reversed output polarity protection diode.</p>
		PNP open-collector model	E2FM-X1R5B□ E2FM-X2B□ E2FM-X5B□ E2FM-X10B□	

E2FM

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.

- Do not use the Sensor in an environment where inflammable or explosive gas is present.
- Do not attempt to disassemble, repair, or modify any Sensors.
- 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.
- Incorrect Wiring
Be sure that the power supply polarity and other wiring is correct. Incorrect wiring may cause explosion or fire.
- 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

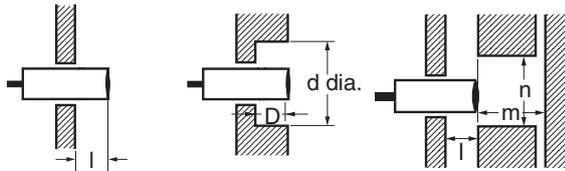
Do not use the Sensor under ambient conditions that exceed the ratings.

- Do not use the Sensor in the following locations.
 - Outdoor locations directly subject to sunlight, rain, snow, or water droplets
 - Locations subject to atmospheres with chemical vapors, in particular solvents and acids
 - Locations subject to corrosive gas
- 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 *Technical Guide Photoelectric Sensors* for typical measures.
- 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.
- 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

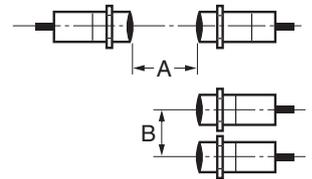
Note: The influence from other non-magnetic surrounding metals is nearly the same as that from aluminum.

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

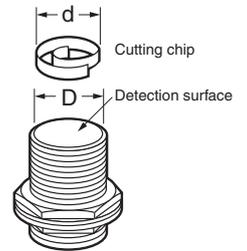


Chips from Cutting Aluminum

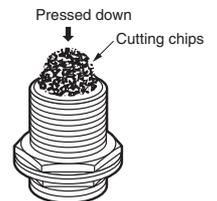
Normally, chips from cutting aluminum or cast iron will not cause a detection signal to be output even if it adheres to or accumulates on the detection surface. In the following cases, however, a detection signal may be output. Remove the cutting chips in these cases.

- 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



- If the cutting chips are pressed down



● 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

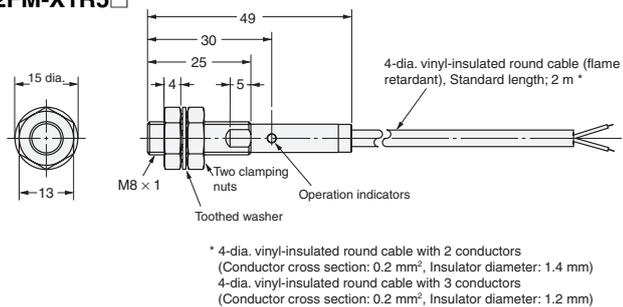


Dimensions

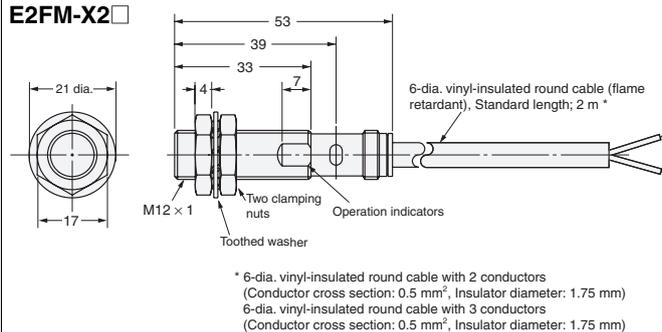
Sensors

Pre-wired Models

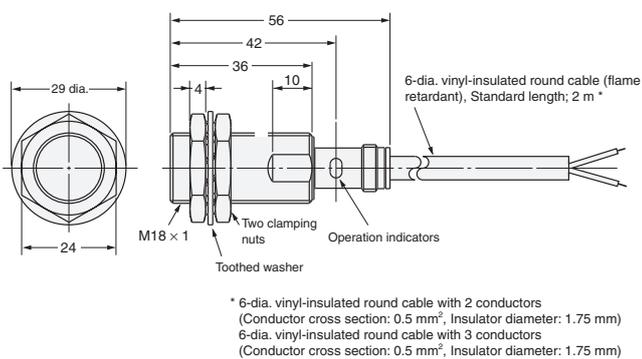
E2FM-X1R5□



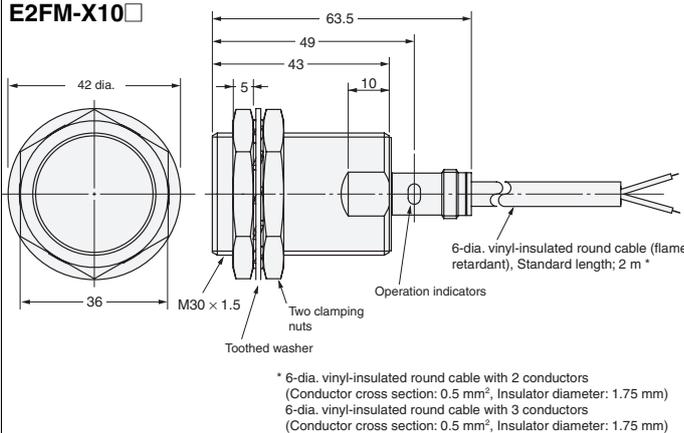
E2FM-X2□



E2FM-X5□

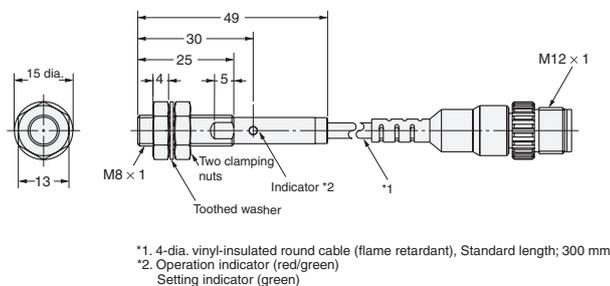


E2FM-X10□

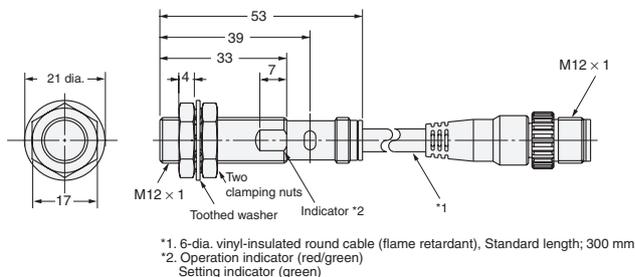


Pre-wired Connector Models

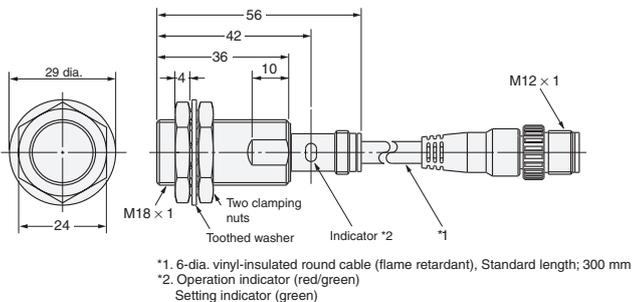
E2FM-X1R5D□-M1GJ-□



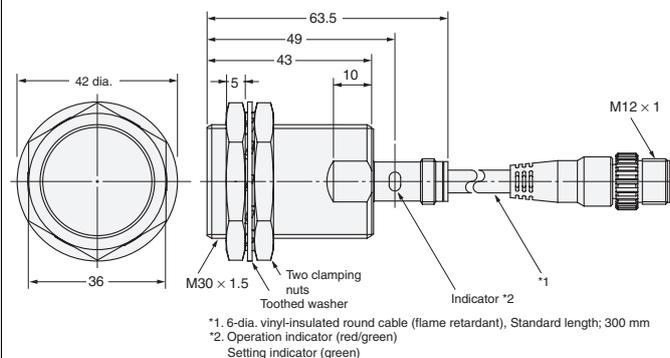
E2FM-X2D□-M1GJ-□



E2FM-X5D□-M1GJ-□



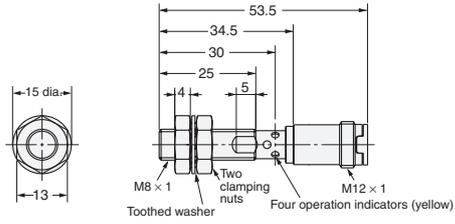
E2FM-X10D□-M1GJ-□



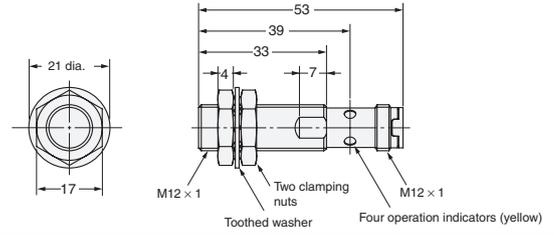
E2FM

M12 Connector Models

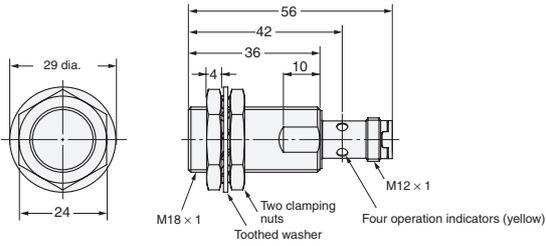
E2FM-X1R5□□-M1



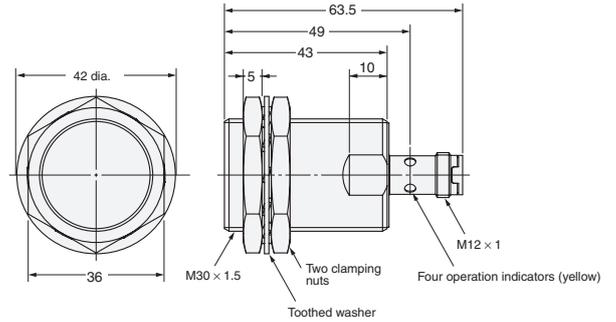
E2FM-X2□□-M1



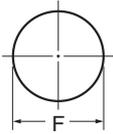
E2FM-X5□□-M1



E2FM-X10□□-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.

Read and Understand This Catalog

Please read and understand this catalog before purchasing the products. Please consult your OMRON representative if you have any questions or comments.

Warranty and Limitations of Liability

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

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Application Considerations

SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this catalog.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

Disclaimers

CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

PERFORMANCE DATA

Performance data given in this catalog is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

ERRORS AND OMISSIONS

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