

NEW

OMRON

# Proximity Sensor with All-stainless Housing

E2FM



realizing



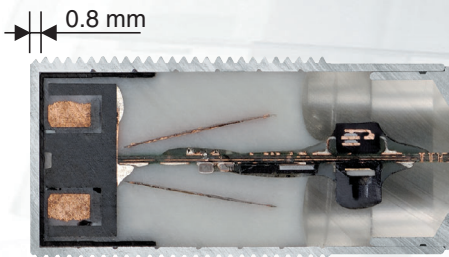


# Highly Durable Proximity Sensor for Tough Environments

Proximity Sensor with All-stainless Housing  
**E2FM**

## 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.



## Built-in Chip Immunity

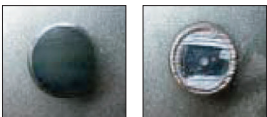
Chip immunity performance has been provided to greatly reduce false signals caused by spatter accumulation and other causes, almost eliminating the needs for cleaning, e.g., with metal brushes.



## Brush Test



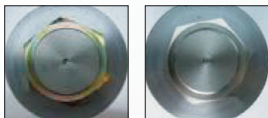
After 3 Minutes



E2FM E2EQ (Spatter-resistant)

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

## Continuous Impact Test



E2ES The E2ES with a 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).

More than 20 times the durability of the E2ES!

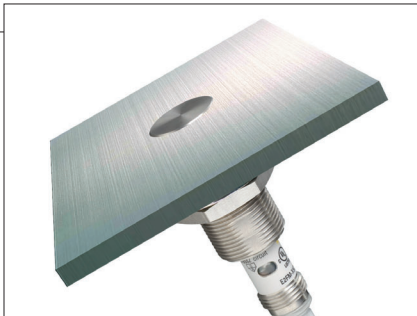
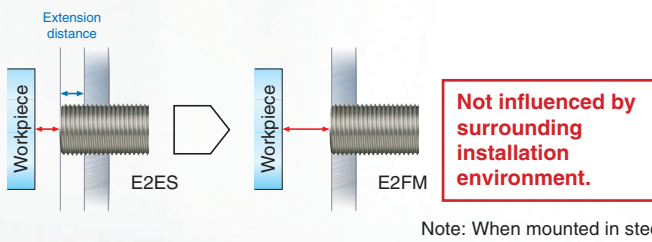
## Chemical and Detergent Proof

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.

## Flush Mounting



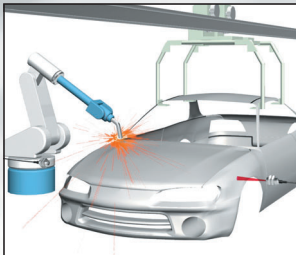
## Main Performance Comparison to Previous OMRON Products

Face thickness			Sensing distance			Response frequency			Ambient operating temperature	
	E2FM	E2ES		E2FM	E2ES		E2FM	E2ES	E2FM	E2ES
M8	0.4 mm	---	M8	1.5 mm	---	M8	200 Hz	---	-25 to 70°C	0 to 50°C
M12	0.8 mm	---	M12	2.0 mm	---	M12	100 Hz	---		
M18	0.8 mm	0.2 mm	M18	5.0 mm	4.0 mm	M18	100 Hz	12 Hz		
M30	0.8 mm	0.2 mm	M30	10.0 mm	8.0 mm	M30	50 Hz	8 Hz		

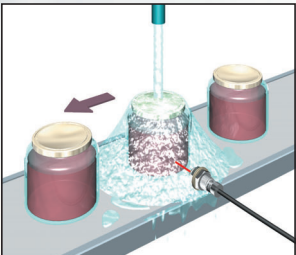
## Lineup Includes Small-diameter (M8 and M12) and DC 3-Wire Models.

Considering all application possibilities, we included small-diameter (M8 and M12) and DC 3-wire models that provided the same long-distance detection as previous M18 and M30 models.

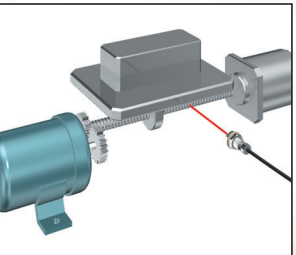
## Main Application Examples



Welding Processes



Processes Subject to Chemicals or Washing Fluids




Metal Processing



# E2FM


## Ordering Information

### 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 (See note.)
	M12	2 mm				E2FM-X2D1 (See note.)
	M18	5 mm				E2FM-X5D1 (See note.)
	M30	10 mm				E2FM-X10D1 (See note.)

Note: Fluororesin-coated models are also available. The model number is E2FM-QX□D1.

### DC 3-Wire, Pre-wired Models


Size	Sensing distance			Model	
				Output: NPN NO	Output: PNP NO
Shielded 	M8	1.5 mm		E2FM-X1R5C1	E2FM-X1R5B1
	M12	2 mm		E2FM-X2C1	E2FM-X2B1
	M18	5 mm		E2FM-X5C1	E2FM-X5B1
	M30	10 mm		E2FM-X10C1	E2FM-X10B1

### DC 2-Wire, Pig-tail Connector Models

Size	Sensing distance			Output	Operation mode	Model
Shielded 	M8	1.5 mm		Polarity Pin allocations: 1-4	NO	E2FM-X1R5D1-M1GJ (See note.)
				Polarity Pin allocations: 1-4		E2FM-X2D1-M1GJ (See note.)
	M12	2 mm		No polarity Pin allocations: 3-4		E2FM-X2D1-M1GJ-T (See note.)
				Polarity Pin allocations: 1-4		E2FM-X5D1-M1GJ (See note.)
	M18	5 mm		No polarity Pin allocations: 3-4		E2FM-X5D1-M1GJ-T (See note.)
				Polarity Pin allocations: 1-4		E2FM-X10D1-M1GJ (See note.)
	M30	10 mm		No polarity Pin allocations: 3-4		E2FM-X10D1-M1GJ-T (See note.)







Note: Fluororesin-coated models are also available. The model number is E2FM-QX□D1.

### DC 3-Wire, M12 Connector Models

Size	Sensing distance			Model	
				Output: NPN NO	Output: PNP NO
Shielded 	M8	1.5 mm		E2FM-X1R5C1-M1	E2FM-X1R5B1-M1
	M12	2 mm		E2FM-X2C1-M1	E2FM-X2B1-M1
	M18	5 mm		E2FM-X5C1-M1	E2FM-X5B1-M1
	M30	10 mm		E2FM-X10C1-M1	E2FM-X10B1-M1

## Accessories (Order Separately)

### Sensor I/O Connectors

Size	Cable length	Sensor I/O Connector	Applicable Proximity Sensors
Straight 	2 m	XS2F-D421-DD0	E2FM-X□D1-M1GJ-T
	5 m	XS2F-D421-GD0	
L-shaped 	2 m	XS2F-D422-DD0	
	5 m	XS2F-D422-GD0	
Straight 	2m	XS2F-D421-DA0-A	E2FM-X□D1-M1GJ
	5m	XS2F-D421-GA0-A	
L-shaped 	2m	XS2F-D422-DA0-A	
	5m	XS2F-D422-GA0-A	
Straight 	2m	XS2F-D421-DC0-A	E2FM-X□C1-M1 E2FM-X□B1-M1
	5m	XS2F-D421-GC0-A	
L-shaped 	2m	XS2F-D422-DC0-A	
	5m	XS2F-D422-GC0-A	

# E2FM

## Rating and Specifications

### DC 2-Wire (E2FM-X□D□)

Size Shielded Model		M8	M12	M18	M30	M12	M18	M30
		Shielded						
Item		E2FM-X1R5D1 -□	E2FM-X2D1 -□	E2FM-X5D1 -□	E2FM-X10D1 -□	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 <i>Engineering Data</i> on page 8.)						
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 (See note 1.)		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 (See note 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 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						
Connection method		No indication: Pre-wired model (Standard cable length: 2 m) -M1GJ-□ models: Junction connector models (Standard cable length: 300 mm)						
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						

Note: 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. Ask your OMRON representative for details.

## 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 8.)			
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 (See note 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.			
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) (See note 2.) B1 models: PNP open collector, NO (normally open) (See note 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 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 <sup>2</sup> 10 times each in X, Y, and Z directions	Destruction: 1,000 m/s <sup>2</sup> 10 times each in X, Y, and Z directions		
Degree of protection		IEC 60529 IP67			
Connection method		No indication: Pre-wired model (Standard cable length: 2 m) -M1 models: Connector models			
Weight (packed state)		Approx. 45 g	Approx. 55 g	Approx. 75 g	Approx. 160 g
Materials	Case	Stainless steel (SUS303)			
	Sensing surface (thickness)	Stainless steel (SUS303)			
		(0.4mm)	(0.8mm)		
	Clamping nuts	Stainless steel (SUS303)			
	Toothed washer	Zinc-plated iron			
Accessories		Instruction manual			

Note: 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.

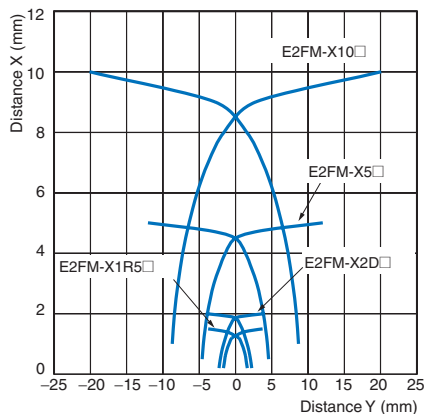
2. NC (normally closed) models are also available. Ask your OMRON representative for details.

# E2FM

## Engineering Data (Typical)

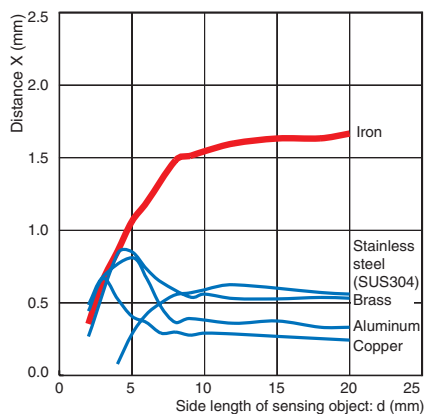
### Sensing Area

#### E2FM-X□

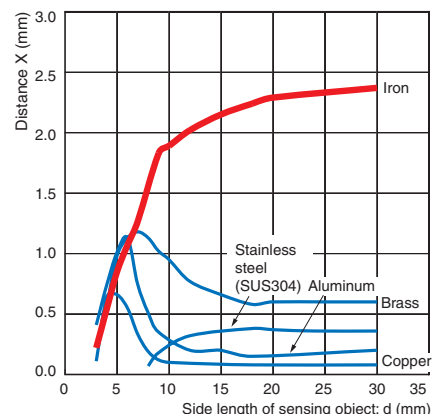


### Influence of Sensing Object Size and Material

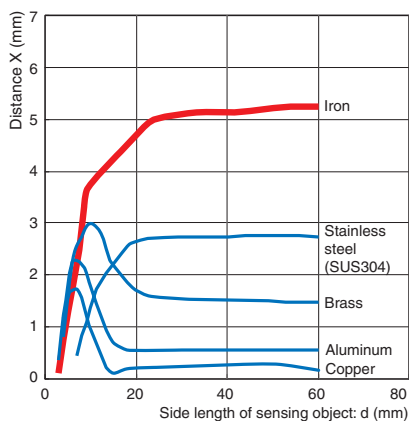
#### E2FM-X1R5□



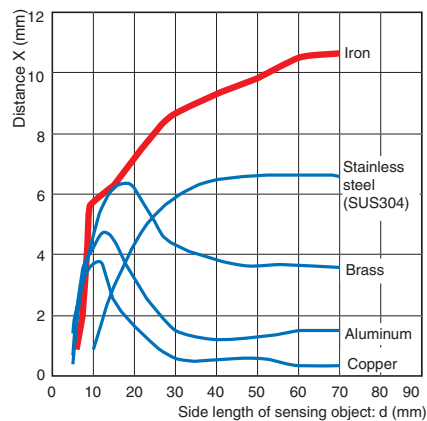
#### E2FM-X2□



#### E2FM-X5□

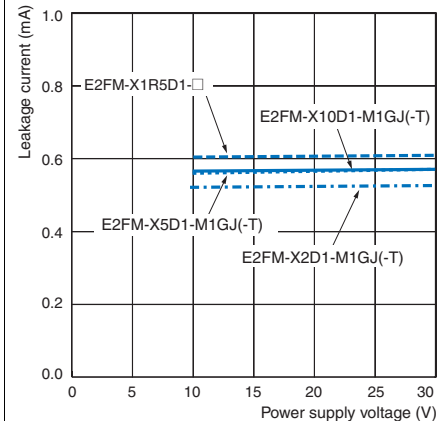


#### E2FM-X10□



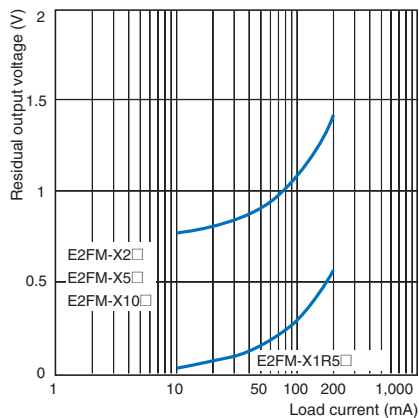
### Leakage Current

#### E2FM-X□D1-M1GJ(-T)

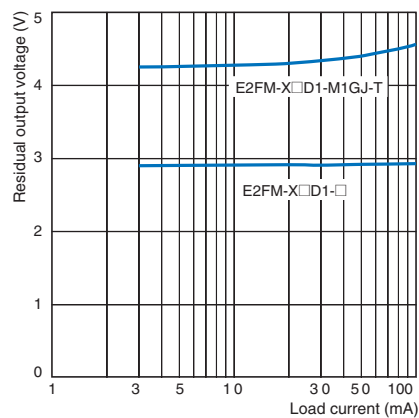


### Residual Output Voltage

#### E2FM-X□C□/B□



#### E2FM-X□D1-M1GJ(-T)



## 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>
	E2FM-X□D1-M1GJ-T		<p>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.</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>Note: There is no reversed output polarity protection diode on M8 models.</p>
	PNP open-collector model	E2FM-X1R5B□ E2FM-X2B□ E2FM-X5B□ E2FM-X10B□		<p>Note: There is no reversed output polarity protection diode on M8 models.</p>



## 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

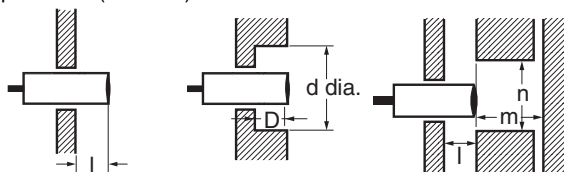
Do not use the Sensor under ambient conditions that exceed the ratings.

- 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 *Sensor General Catalog* 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

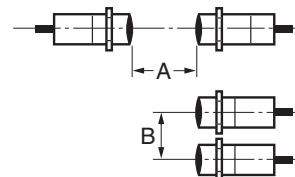
Note: The influence from other non-magnetic surrounding metals is nearly the same as that from aluminum.

### 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

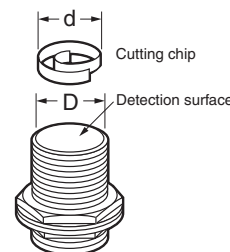


### Chips from Cutting Aluminum or Cast Iron

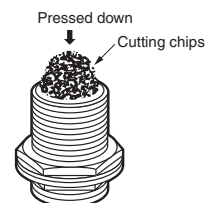
Normally, chips from cutting aluminum or cast iron will not cause a detection signal to be output even if it adheres to or accumulates on the detection surface. In the following cases, however, a detection signal may be output. Remove the cutting chips in these cases.

- 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

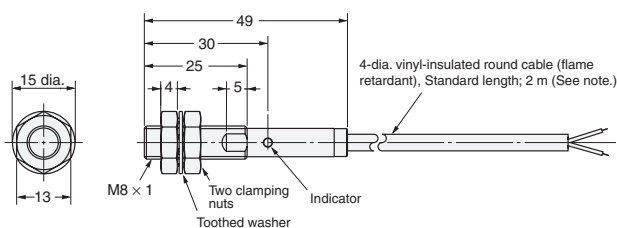


## Dimensions

### Sensors

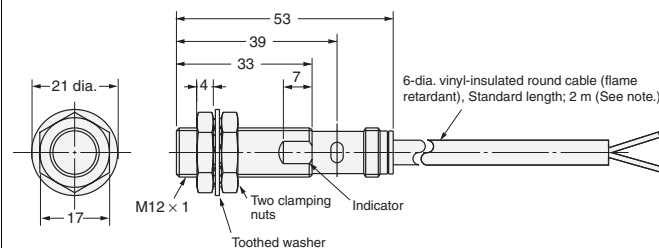
#### Pre-wired Models

##### E2FM-X1R5□



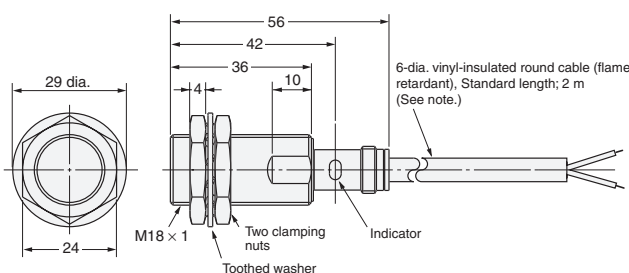
Note: 4 dia., 2 conductors (conductor cross-section: 0.2 mm<sup>2</sup>, insulator diameter: 1.4 mm)  
4 dia., 3 conductors (conductor cross-section: 0.2 mm<sup>2</sup>, insulator diameter: 1.2 mm)

##### E2FM-X2□



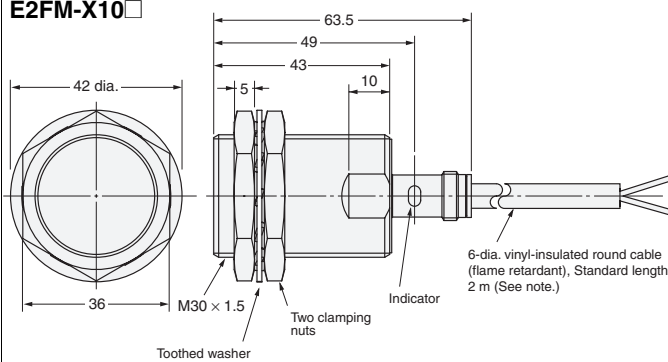
Note: 6 dia., 2 conductors (conductor cross-section: 0.5 mm<sup>2</sup>, insulator diameter: 1.75 mm)  
6 dia., 3 conductors (conductor cross-section: 0.5 mm<sup>2</sup>, insulator diameter: 1.75 mm)

##### E2FM-X5□



Note: 6 dia., 2 conductors (conductor cross-section: 0.5 mm<sup>2</sup>, insulator diameter: 1.75 mm)  
6 dia., 3 conductors (conductor cross-section: 0.5 mm<sup>2</sup>, insulator diameter: 1.75 mm)

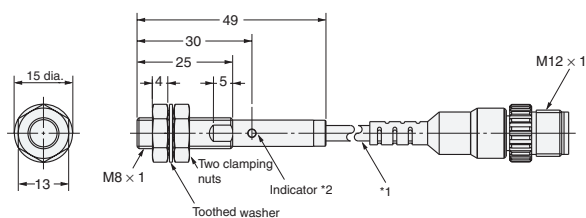
##### E2FM-X10□



Note: 6 dia., 2 conductors (conductor cross-section: 0.5 mm<sup>2</sup>, insulator diameter: 1.75 mm)  
6 dia., 3 conductors (conductor cross-section: 0.5 mm<sup>2</sup>, insulator diameter: 1.75 mm)

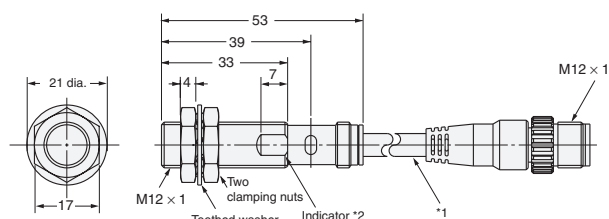
### Pig-tail Connector Models

##### E2FM-X1R5D1-M1GJ



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

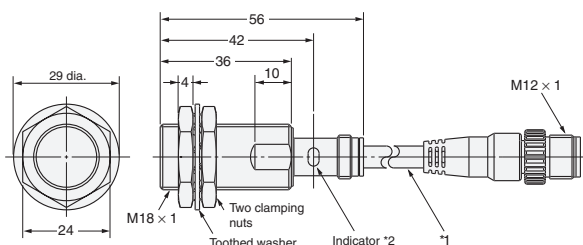
##### E2FM-X2D1-M1GJ E2FM-X2D1-M1GJ-T



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

##### E2FM-X5D1-M1GJ

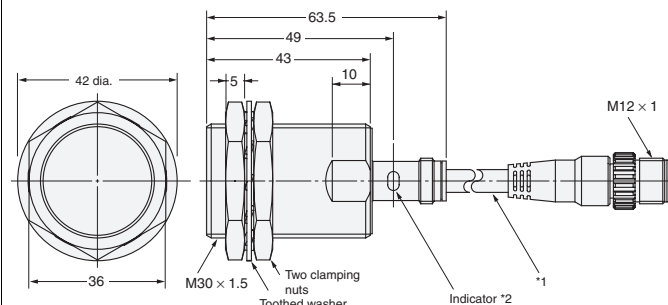
##### E2FM-X5D1-M1GJ-T



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

##### E2FM-X10D1-M1GJ

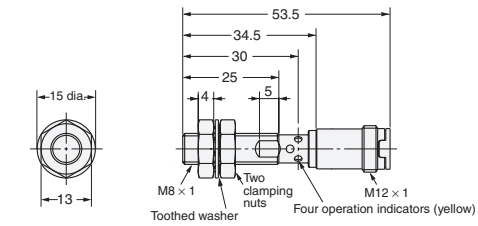
##### E2FM-X10D1-M1GJ-T



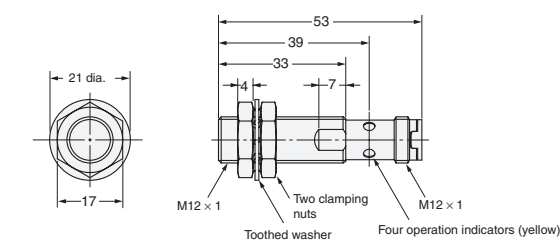
\*1. 6-dia. vinyl-insulated round cable (flame retardant), Standard length; 300 mm  
\*2. Operation indicator (red/green)  
Setting indicator (green)

M12 Connector Models

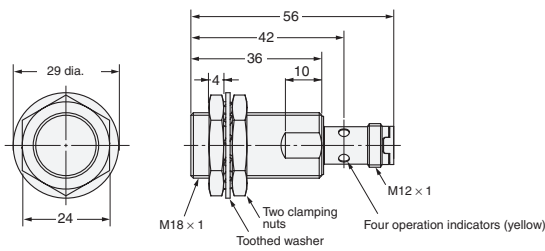
E2FM-X1R5B1-M1



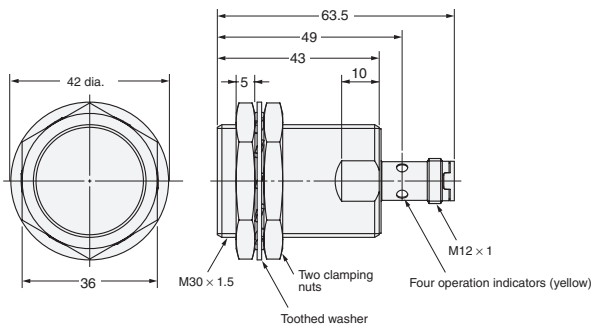
E2FM-X2B1-M1



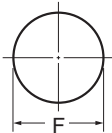
E2FM-X5B1-M1



E2FM-X10B1-M1



Mounting Hole Dimensions



Dimension	M8	M12	M18	M30
F (mm)	8.5 <sup>+0.5</sup> <sub>0</sub> dia.	12.5 <sup>+0.5</sup> <sub>0</sub> dia.	18.5 <sup>+0.5</sup> <sub>0</sub> dia.	30.5 <sup>+0.5</sup> <sub>0</sub> dia.



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To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. D103-E1-02

**In the interest of product improvement, specifications are subject to change without notice.**

**OMRON Corporation**

**Industrial Automation Company**

**Technology Development Center H.Q.  
Integration Strategy & Business  
Development Center**

Shiokoji Horikawa, Shimogyo-ku,  
Kyoto, 600-8530 Japan

Tel: (81)75-344-7123/Fax: (81)75-344-7172

**Regional Headquarters**

**OMRON EUROPE B.V.**

Wegalaan 67-69, NL-2132 JD Hoofddorp  
The Netherlands

Tel: (31)2356-81-300/Fax: (31)2356-81-388

**OMRON ELECTRONICS LLC**

1 East Commerce Drive, Schaumburg,  
IL 60173 U.S.A.

Tel: (1)847-843-7900/Fax: (1)847-843-8568

**OMRON ASIA PACIFIC PTE. LTD.**

83 Clemenceau Avenue, #11-01, UE Square,  
239920 Singapore

Tel: (65)6835-3011/Fax: (65)6835-2711

**OMRON (CHINA) CO., LTD.**

Room 2211, Bank of China Tower,  
200 Yin Cheng Road (M),  
Shanghai, 200120 China

Tel: (86)21-5037-2222/Fax: (86)21-5037-2200