

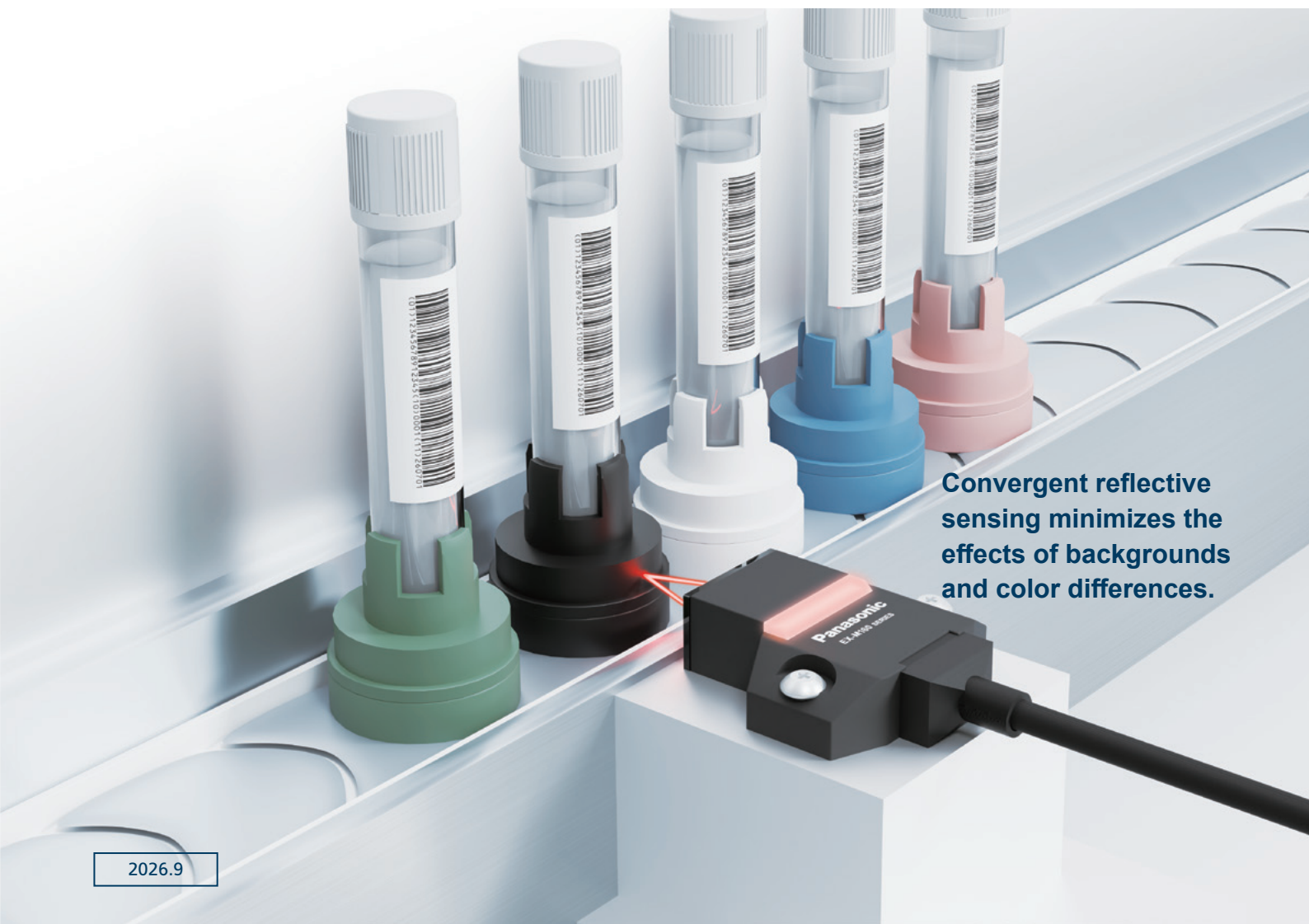
NEW

Amplifier Built-in Convergent Reflective Photoelectric Sensor

EX-M160 SERIES



Just install it. Detect only what matters.



**Convergent reflective
sensing minimizes the
effects of backgrounds
and color differences.**

Amplifier Built-in
Convergent Reflective Photoelectric Sensor

EX-M160 SERIES



Simpler design, installation, and maintenance.
Now convergent reflective sensing is the simple choice.



Sharp, precise convergent sensing

Combines sensing performance with cost-effectiveness. A new choice in compact photoelectric sensors

Reduced engineering work

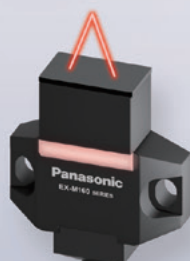
Supports 5 V to 24 V DC. Three head configurations and NPN / PNP outputs available

Easier installation

Solderless crimp connectors improve reliability and ease of installation

Reduced risk of failure

Three protection circuits standard on all models



Top sensing
EX-M16□H

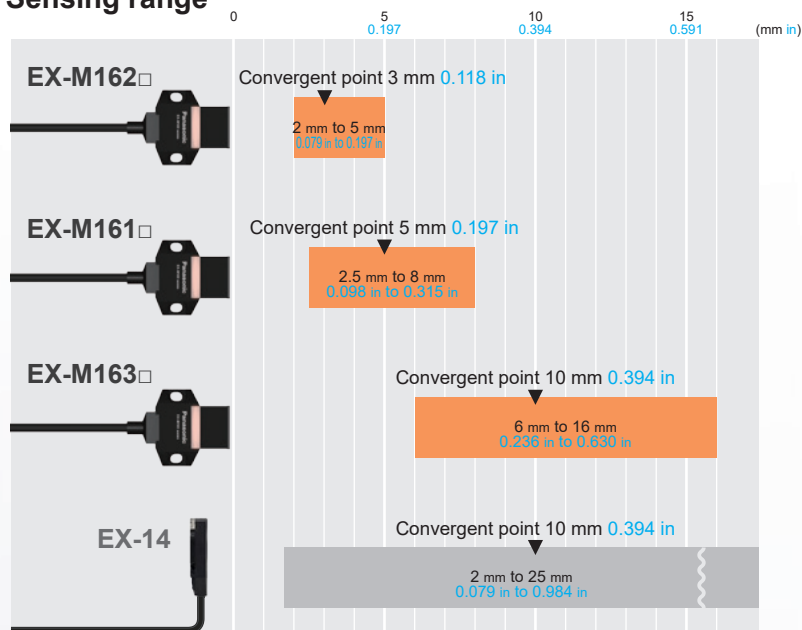


Front sensing
EX-M16□F

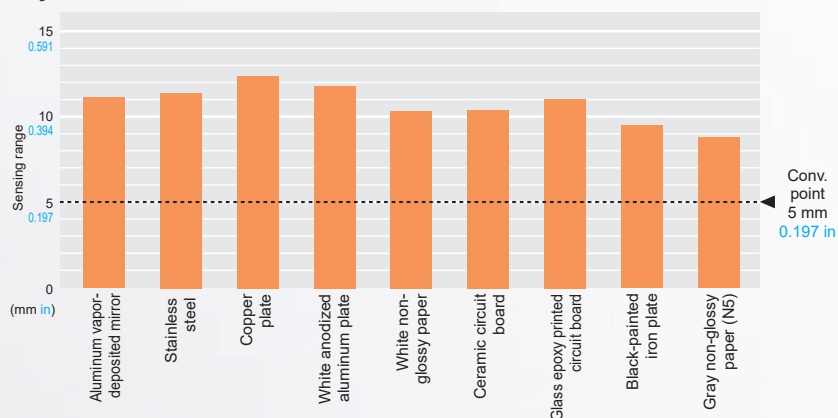


L type (top sensing)
EX-M16□L

● Sensing range



<By material:EX-M161H/F> *Typical values (sensing object size: 15 mm × 15 mm 0.591 in × 0.591 in)



● Cable / connector



● NPN / PNP output

NPN output type

EX-M16□

PNP output type

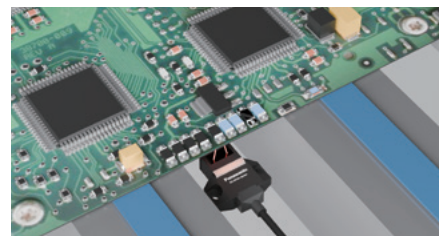
EX-M16□-P

(-P included in model number)

Applications



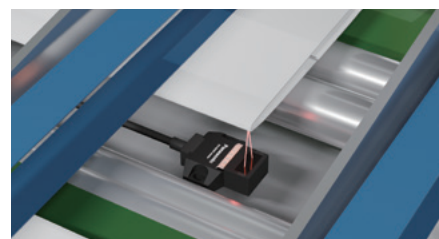
Chip tray edge detection



PCB presence detection



Test tube rack detection



Detection of printed materials in folding machines



Capacitor lead detection

How convergent reflective sensors work

Detects only within the area where the light-emitting and receiving optical axes intersect. Less susceptibility to the background facilitates stable detection of the intended workpiece.

Reduced influence of background objects

Suppresses false detection caused by background objects for stable sensing.

Easy installation and adjustment

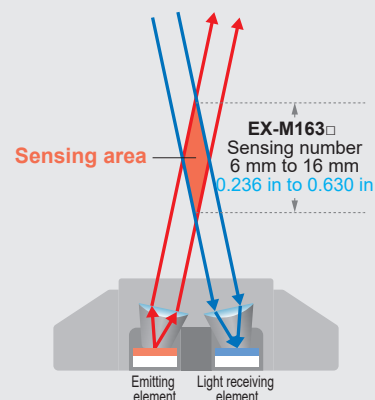
Achieves stable detection simply by installing the sensor. This feature also reduces adjustment work.

Resistant to workpiece misalignment

Tolerates positional shifts for stable detection.

Less susceptible to color differences

Provides stable detection regardless of differences in color or surface condition.



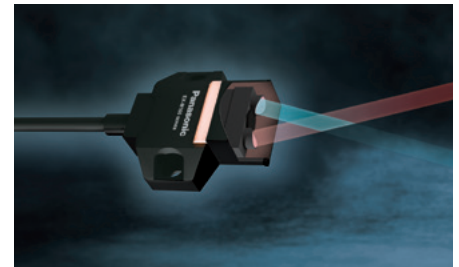
Combining convergent sensing performance with cost-effectiveness

The EX-M160 Series was created to resolve this dilemma.

Refined optical design and mounting technologies developed for convergent reflective sensors deliver an outstanding balance of performance, ease of use, and cost-effectiveness.

Stable detection with reduced background interference

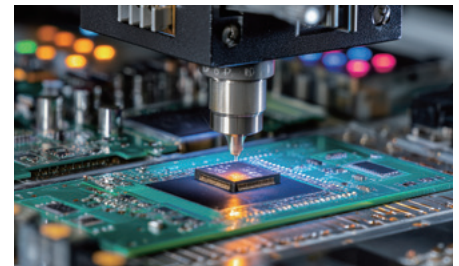
Optimized lens and element positioning enables stable detection while minimizing the effects of background objects. A high level of flexibility in installation position even in confined spaces supports a wide range of applications.



New mounting technology for consistent quality

High-precision mounting technology reduces variations in the light-emitting and receiving optical axes.

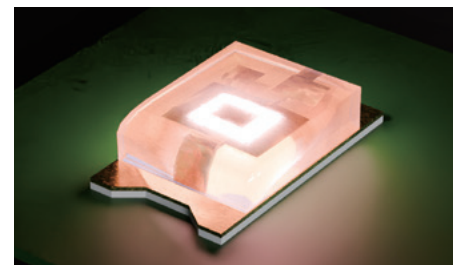
This feature ensures consistent sensing performance from product to product for reliable use.



180% higher light-emission power for stable detection

Approximately 180%* of the conventional light-emission power enables stable detection, even of difficult targets such as low-reflectance workpieces and black resin.

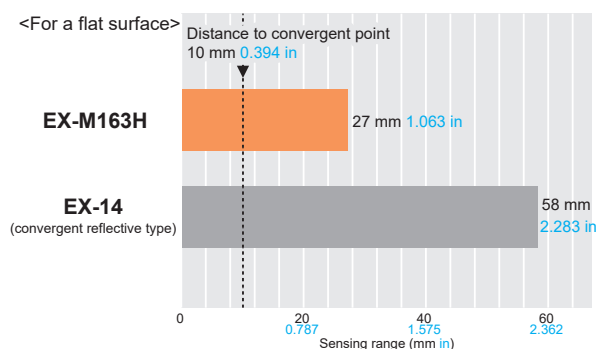
*Comparison with our **PM2** Series convergent reflective micro photoelectric sensors.



Hardly affected by background

A more tightly defined sensing range helps prevent false detection of background objects. Reduces background interference by approximately 35%* compared with the conventional model.

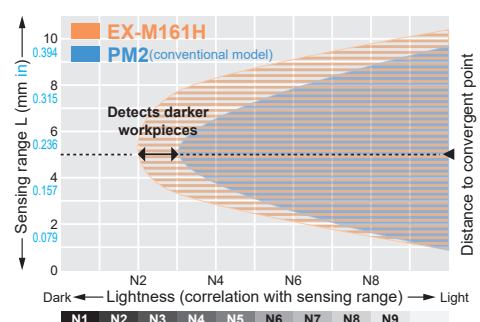
*Comparison with our **EX-14** convergent reflective sensor.



*The values above are for an aluminum vapor-deposited mirror.

Less susceptible to color differences

Even low-reflectance black workpieces, which were previously difficult to detect reliably, can now be detected consistently down to a lightness of N2.



Reduced engineering work

Supports 5 V to 24 V DC power supplies

Connect directly to devices ranging from 24 V PLCs to 5 V microcontrollers. With no need for conversion circuits or additional power supplies, this feature helps make equipment more compact, reduces costs, and reduces engineering work.



NPN / PNP output product line

The ability to choose the output to match your equipment's input specifications provides greater design flexibility and reducing engineering work.

NPN output type

EX-M16□

PNP output type

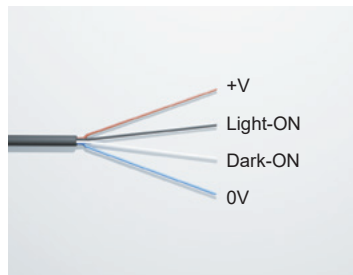
EX-M16□-P

(-P included in model number)

One model provides both Light-ON and Dark-ON outputs

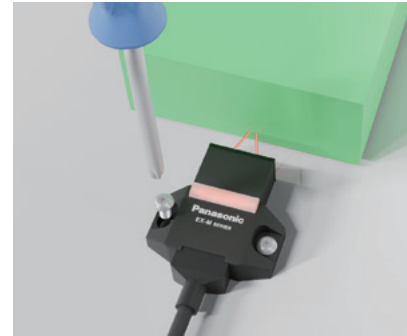
Two outputs allow you to select between ON when light is received and ON when light is not received.

Reduces total costs by helping prevent model selection errors and standardizing maintenance part numbers.

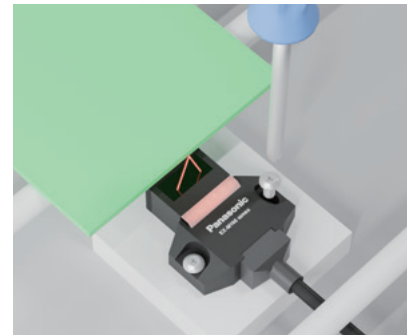


Mounting options

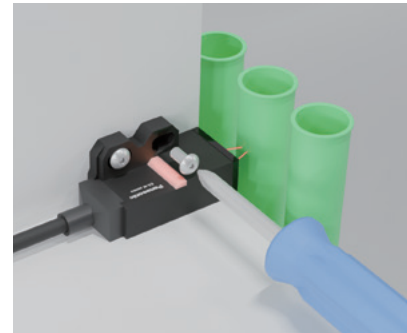
● Top sensing type



● Front sensing type

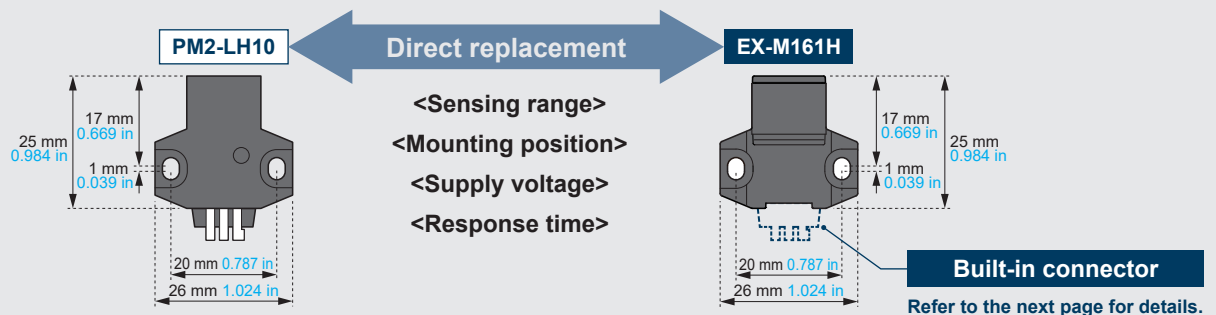


● L type (top sensing)

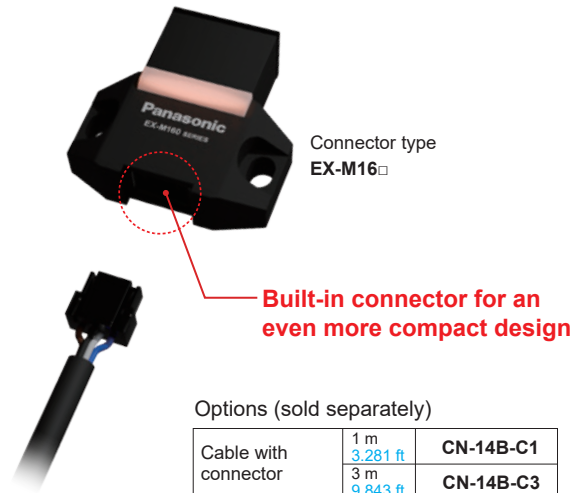


Convergent Reflective Micro Photoelectric Sensor

Compatible with the PM2 Series!



Built-in connector improves installation and maintenance

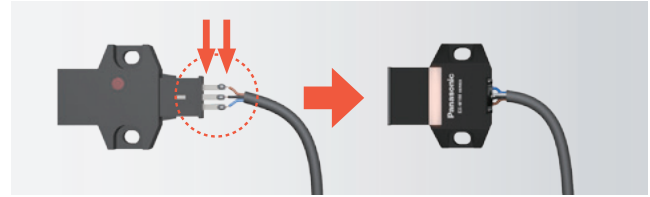


Options (sold separately)

Cable with connector	1 m 3.281 ft	CN-14B-C1
	3 m 9.843 ft	CN-14B-C3
Connector (Set includes 10 housings and 60 terminals.)		CN-14B

For details on recommended connectors and crimping tools, see P.7.

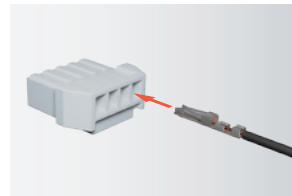
Compact, damage-resistant design



Because the connector protrudes from the unit, pressure applied to it can cause the connector to snap and become damaged.

The cable bends from its base, making it less susceptible to damage, while the built-in connector also reduces overall depth.

Easy installation with no soldering



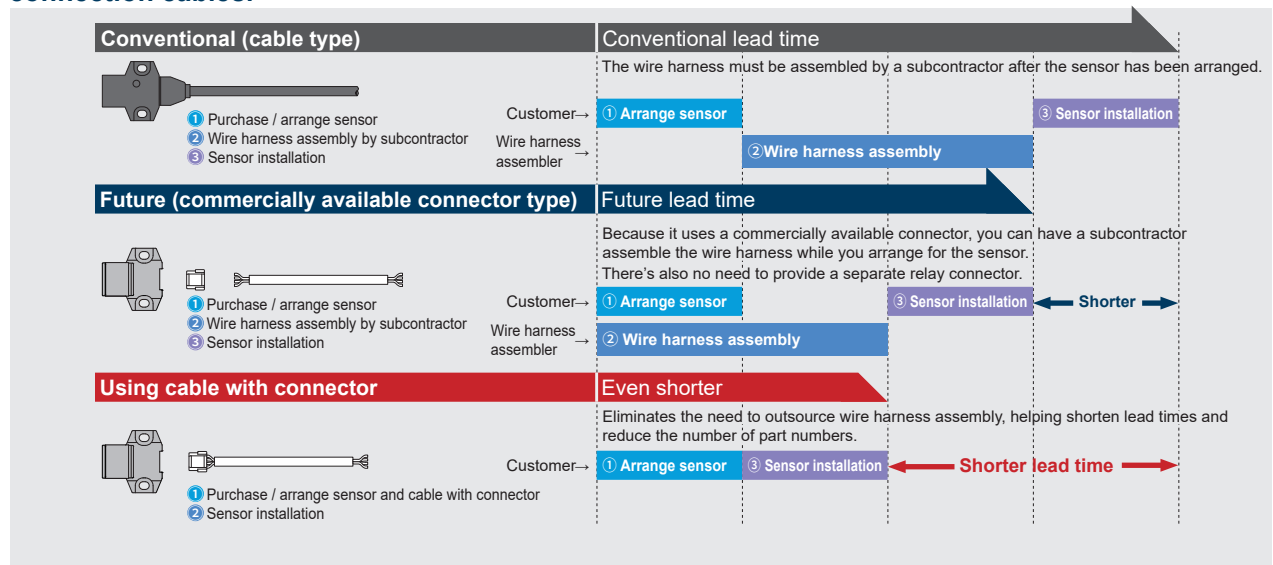
The crimp connector eliminates soldering work while also reducing variations in workmanship.

Easy to replace if damaged



The use of a commercially available connector also makes cable replacement easy. Helps reduce maintenance time.

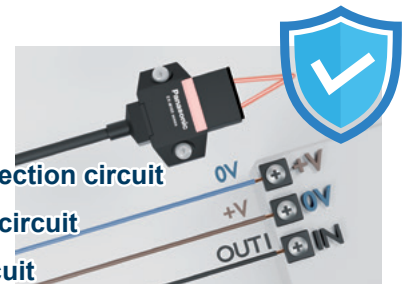
The use of a commercially available crimp connector significantly reduces the cost of assembling connection cables.



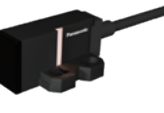
Three protection circuits as standard to reduce the risk of failure during wiring

Significantly reduces concerns about sensor failure caused by incorrect wiring during installation.

- Power supply reverse polarity protection circuit
- Output reverse polarity protection circuit
- Output short-circuit protection circuit



ORDER GUIDE

Type		Appearance	Sensing range (Note 2)		Model No.		Output operation
			Conv. point		NPN output	PNP output	
Connector type (Note 1)	Top sensing		5 mm 0.197 in	2.5 mm to 8 mm 0.098 in to 0.315 in	EX-M161H	EX-M161H-P	Equipped with two outputs Output 1: Light-ON Output 2: Dark-ON
			3 mm 0.118 in	2 mm to 5 mm 0.079 in to 0.197 in	EX-M162H	EX-M162H-P	
			10 mm 0.394 in	6 mm to 16 mm 0.236 in to 0.630 in	EX-M163H	EX-M163H-P	
	Front sensing		5 mm 0.197 in	2.5 mm to 8 mm 0.098 in to 0.315 in	EX-M161F	EX-M161F-P	
			3 mm 0.118 in	2 mm to 5 mm 0.079 in to 0.197 in	EX-M162F	EX-M162F-P	
			10 mm 0.394 in	6 mm to 16 mm 0.236 in to 0.630 in	EX-M163F	EX-M163F-P	
	L type (Top sensing)		5 mm 0.197 in	2.5 mm to 8 mm 0.098 in to 0.315 in	EX-M161L	EX-M161L-P	
			3 mm 0.118 in	2 mm to 5 mm 0.079 in to 0.197 in	EX-M162L	EX-M162L-P	
			10 mm 0.394 in	6 mm to 16 mm 0.236 in to 0.630 in	EX-M163L	EX-M163L-P	
Cable type	Top sensing		5 mm 0.197 in	2.5 mm to 8 mm 0.098 in to 0.315 in	EX-M161H-C1	EX-M161H-P-C1	
			3 mm 0.118 in	2 mm to 5 mm 0.079 in to 0.197 in	EX-M162H-C1	EX-M162H-P-C1	
			10 mm 0.394 in	6 mm to 16 mm 0.236 in to 0.630 in	EX-M163H-C1	EX-M163H-P-C1	
	Front sensing		5 mm 0.197 in	2.5 mm to 8 mm 0.098 in to 0.315 in	EX-M161F-C1	EX-M161F-P-C1	
			3 mm 0.118 in	2 mm to 5 mm 0.079 in to 0.197 in	EX-M162F-C1	EX-M162F-P-C1	
			10 mm 0.394 in	6 mm to 16 mm 0.236 in to 0.630 in	EX-M163F-C1	EX-M163F-P-C1	
	L type (Top sensing)		5 mm 0.197 in	2.5 mm to 8 mm 0.098 in to 0.315 in	EX-M161L-C1	EX-M161L-P-C1	
			3 mm 0.118 in	2 mm to 5 mm 0.079 in to 0.197 in	EX-M162L-C1	EX-M162L-P-C1	
			10 mm 0.394 in	6 mm to 16 mm 0.236 in to 0.630 in	EX-M163L-C1	EX-M163L-P-C1	

Notes: 1) A cable with connector is not included with the sensor. Please purchase the separately sold connector cable.
For details, refer to **OPTIONS** below.

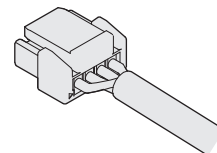
2) Value obtained using white non-glossy paper (15 mm × 15 mm 0.591 in × 0.591 in).

OPTIONS

Designation	Model No.	Description	
Cable with connector	CN-14B-C1	Length: 1 m 3.281 ft	Discrete wire. 0.08 mm² four-core cabtyre cable with connector on one end Cable outer diameter: ø3.1 mm ø0.122 in
	CN-14B-C3	Length: 3 m 9.843 ft	
Connector	CN-14B	Set includes 10 housings and 60 terminals.	

Cable with connector

- CN-14B-C1
- CN-14B-C3



Recommended connector

Molex housing: 5055650401, Terminal: 5054311000

Note: For details on the recommended products, please contact the manufacturer.

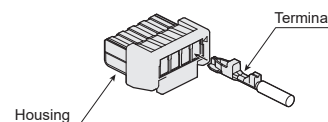
Recommended crimping tool

Molex part No.: 2002180300

Note: For details on the recommended products, please contact the manufacturer.

Connector

- CN-14B



SPECIFICATIONS

		Type	Connector type			Cable type					
			Top sensing	Front sensing	L type (Top sensing)	Top sensing	Front sensing	L type (Top sensing)			
Item	Model No.	NPN output	EX-M16□H	EX-M16□F	EX-M16□L	EX-M16□H-C1	EX-M16□F-C1	EX-M16□L-C1			
		PNP output	EX-M16□H-P	EX-M16□F-P	EX-M16□L-P	EX-M16□H-P-C1	EX-M16□F-P-C1	EX-M16□L-P-C1			
Applicable regulations and certifications			CE Marking (EMC Directive, RoHS Directive), UL/c-UL Recognition								
Sensing range (Note 2)			EX-M161□(-C1): 2.5 mm to 8 mm 0.098 in to 0.315 in (Convergent point: 5 mm 0.197 in) EX-M162□(-C1): 2 mm to 5 mm 0.079 in to 0.197 in (Convergent point: 3 mm 0.118 in) EX-M163□(-C1): 6 mm to 16 mm 0.236 in to 0.630 in (Convergent point: 10 mm 0.394 in)								
Hysteresis			20 % or less of operation distance (Note 2)								
Repeatability (perpendicular to sensing axis)			0.08 mm 0.003 in or less (Note 3)								
Supply voltage			5 V to 24 V DC ±10 % Ripple P-P 10 % or less								
Current consumption			25 mA or less								
2 outputs (Output 1, Output 2)			<NPN output type> Two NPN transistor open-collector outputs • Maximum sink current: 50 mA • Applied voltage: 30 V DC or less (between output and 0 V) • Residual voltage (Note 4): 1.0 V or less (at 50 mA sink current) 0.6 V or less (at 16 mA sink current)			<PNP output type> Two PNP transistor open-collector outputs • Maximum source current: 50 mA • Applied voltage: 30 V DC or less (between output and +V) • Residual voltage (Note 4): 1.0 V or less (at 50 mA source current) 0.6 V or less (at 16 mA source current)					
			Output operation						Output 1: Light-ON, Output 2: Dark-ON		
			Short-circuit protection						Incorporated		
Response time			0.8 ms or less (Note 5)								
Operation indicator			Orange LED (lights when light is received)								
Emitting element			Infrared LED (Peak emission wavelength: 850 nm 0.033 mil)								
Protective circuit			Incorporated (power supply reverse polarity protection and output reverse polarity protection)								
Environmental resistance	Ambient temperature		−10 °C to +55 °C +14 °F to +131 °F (No dew condensation or icing allowed), Storage: −25 °C to +80 °C −13 °F to +176 °F								
	Ambient humidity		35 % RH to 85 % RH, Storage: 35 % RH to 85 % RH								
	Ambient illuminance		Incandescent light: 5,000 lx or less at the light-receiving face								
	Withstand voltage		500 V AC for one minute between all supply terminals connected together and enclosure								
	Insulation resistance		20 MΩ or more, using 250 V DC megohmmeter								
	Vibration resistance		10 Hz to 500 Hz frequency, 3 mm 0.118 in double amplitude (maximum acceleration: 20 G), two hours each in X, Y, and Z directions (without power supply)								
	Shock resistance		500 m/s ² acceleration (50 G approx.) in X, Y and Z directions three times each (without power supply)								
	Operating altitude		2,000 m 6561.680 ft or less (Note 6)								
	Pollution degree		2								
Material			Enclosure: PBT, Indicator and lens: PC								
Cable			———— (Note 7)			0.08 mm ² four-core cabtyre cable, 1 m 3.281 ft					
Wiring length			Extension up to a total cable length of 50 m 164.042 ft is possible with cable having a conductor cross-sectional area of 0.3 mm ² or more (Note 8)								
Weight			Net weight: 4 g approx. Gross weight: 15 g approx.		Net weight: 3 g approx. Gross weight: 15 g approx.		Net weight: 15 g approx. Gross weight: 30 g approx.				

Notes: 1) Where measurement conditions have not been specified precisely, the conditions used were an ambient temperature of +23 °C **+73.4 °F**.

2) Value obtained using white non-glossy paper (15 mm × 15 mm **0.591 in × 0.591 in**).

3) Value obtained using white non-glossy paper (15 mm × 15 mm **0.591 in × 0.591 in**) at the center sensing distance.

4) The following conditions apply.

•Connector type: When using the separately sold **CN-14B-C3** cable with connector (3 m **9.843 ft**) or **CN-14B-C1** cable with connector (1 m **3.281 ft**)

•Cable type: 1 m **3.281 ft** cable length

5) Applies when the sink/source output current is 1 mA or greater and the cable length is 3 m **9.843 ft** or less.

6) Do not use or store this product in an environment pressurized above atmospheric pressure at an elevation of 0 m.

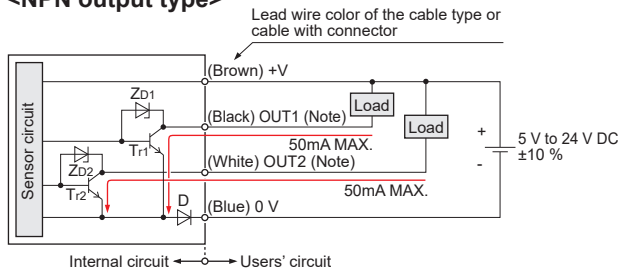
7) A cable with connector is not included with the sensor. Please purchase the separately sold connector cable.

For details, refer to **OPTIONS** (p.7).

8) When extending the cable beyond 3 m **9.843 ft**, verify that the sensor terminal voltage is 4.5 V or higher.

I/O circuit diagram

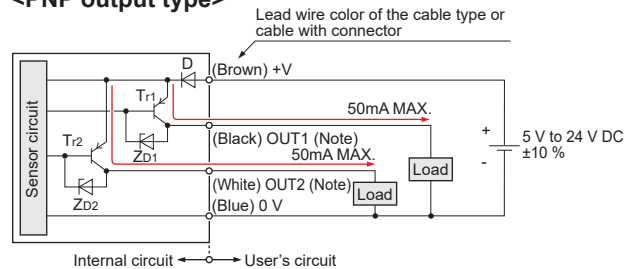
<NPN output type>



Note: Perform wiring according to the sensing application [Output 1 (Black): Light-ON; Output 2 (White): Dark-ON].
Always insulate the ends of any unused lead wires.

Symbols... D: Reverse polarity protection diode
ZD1, ZD2: Surge absorption zener diode
Tr1, Tr2: NPN output transistor

<PNP output type>



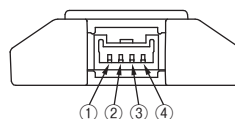
Note: Perform wiring according to the sensing application [Output 1 (Black): Light-ON; Output 2 (White): Dark-ON].
Always insulate the ends of any unused lead wires.

Symbols... D: Reverse polarity protection diode
ZD1, ZD2: Surge absorption zener diode
Tr1, Tr2: PNP output transistor

Output operation

	Lead wire color	Output operation
Output 1	Black	Light-ON
Output 2	White	Dark-ON

Terminal layout (Connector type)



Terminal No.	Terminal name
①	+V
②	Output 1
③	Output 2
④	0 V

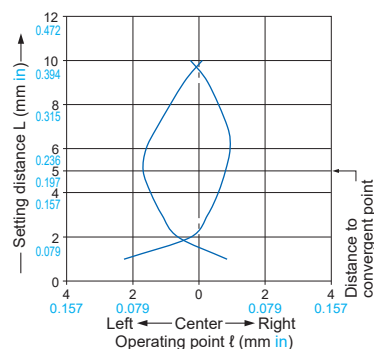
SENSING CHARACTERISTICS (TYPICAL)

*Always verify proper operation under actual installation conditions before use.
For the sensing characteristics of other models, please refer to the website.

EX-M161H□

Sensing fields

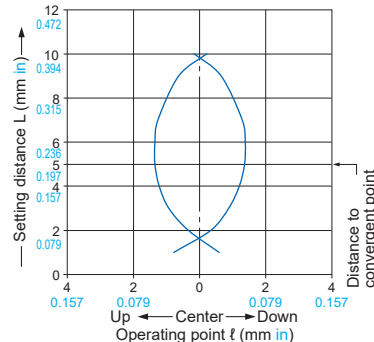
- Horizontal (left and right) direction



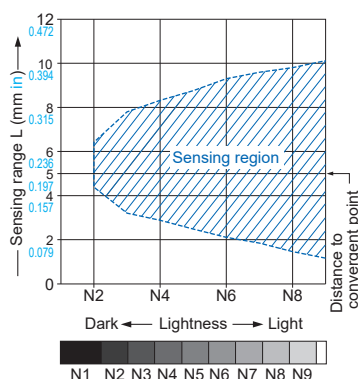
White non-glossy paper
(15 mm × 15 mm
0.591 in × 0.591 in)

When using sensors of the same model side by side, up to two units can be mounted in direct contact. However, interference may occur depending on sensor alignment and background conditions. Verify that there is no interference before use.

- Vertical (up and down) direction



Correlation between lightness and sensing range

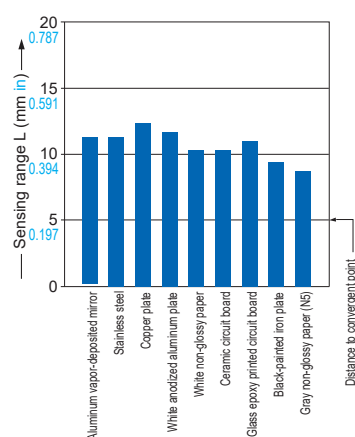


The sensing region (typical) is represented by oblique lines in the left figure. However, the sensitivity should be set with enough margin because of slight variation in products.

(Lightness shown on the left may differ slightly from the actual object condition.)

*Sensing object size: 15 mm × 15 mm 0.591 in × 0.591 in.

Correlation between material and sensing range



The bars in the graph indicate the sensing range (typical) for the respective material. However, there is a slight variation in the sensing range depending on the product. Further, if there is a reflective object (conveyor, etc.) in the background of the sensing object, since it affects the sensing, separate it by more than twice the sensing range shown in the left graph.

*Sensing object size: 15 mm × 15 mm 0.591 in × 0.591 in.

All models

- This catalog is intended to serve as a guide for product selection. Be sure to read the product Installation Instructions before use.



- Never use this product as a sensing device for personnel protection.
- In case of using sensing devices for personnel protection, use products which meet laws and standards, such as OSHA, ANSI or IEC etc., for personnel protection applicable in each region or country.

- This product has been developed / produced for industrial use only.
- This product is suitable for indoor use only.
- Do not install the product in locations where it may come into contact with organic solvents such as thinner, strong acids, alkalis, chemicals, water, or oils and grease.
- Since this device does not have a protective structure, ensure that liquid does not adhere to the device.

Power supply

- Note that applying a voltage greater than the rated voltage or directly applying AC power will result in damage or burning.
- Do not use during the initial transient time (approx. 50 ms) after the power supply is switched on.
- If power is supplied from a commercial switching regulator, ensure that the frame ground (F.G.) terminal of the power supply is connected to an actual ground.
- Make sure that the power supply input satisfies the following items.
 - The power supply unit must be certified for use in your region.
 - The output holding time of the power supply unit must be 20 ms or more.
 - The power supply unit must have a rated output voltage of 5 V to 24 V DC $\pm 10\%$, ripple P-P of 10% or less, and a current capacity of 0.5 A or greater.
 - If CE marking is required, the Safety Extra Low Voltage (SELV) or Protective Extra Low Voltage (PELV) of the power supply unit must comply with the EMC Directive.
 - When using the product as a UL Recognized product, use a UL-certified Class 2 power supply unit.
- If surges occur, take countermeasures such as connecting a surge absorber to the source of the surge occurrence.
- For DC power supply, always use an isolation transformer. If an autotransformer is used, this product or power supply may be damaged.
- To protect the product from abnormal voltages on the power supply line, use an isolated power supply with a built-in protection circuit.
- If using a power supply without a built-in protection circuit, always supply power to the product through a protective element such as a fuse.
- Depending on the duration of a momentary power interruption, the product may either continue operating or return to the same state as when power is first applied. Avoid using the product in environments where momentary power interruptions may occur.

Connector type

Cautions in plugging or unplugging a connector



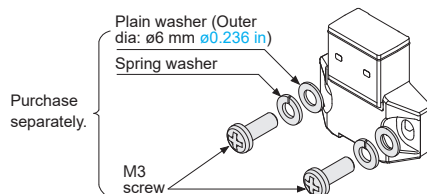
- Do not plug or unplug a connector more than 10 times.
- Be sure to hold a connector when plugging or unplugging it. Otherwise, it will cause a poor contact.

Attaching the connector

- Push the connector in securely until it clicks into place.

Mounting

- When securing the sensor with screws, use M3 screws and tighten to a torque of 0.49 N·m or less.
Further, use small, round type plain washers ($\phi 6$ mm $\phi 0.236$ in).

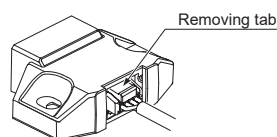


- Avoid using or storing the product in locations in an environment where dew condensation may occur due to a sudden temperature change.
- Performance may not be satisfactory in a strong electromagnetic field.
- Sensing performance is affected if there is a reflective object (conveyor, etc.) behind the sensing object although it depends on the material. Provide a sufficient distance from the reflective object.
- When using multiple sensors, install so that they do not receive each other's emitted light directly.
- When using sensors of the same model side by side, up to two units can be mounted in direct contact. However, interference may occur depending on sensor alignment and background conditions. Verify that there is no interference before use.

Wiring

- Before wiring work, always turn the power OFF.
- If equipment that generates electrical noise (such as switching regulators or inverter motors) is installed near the product, connect the equipment's frame ground (F.G.) terminal to ground.
- Connect the load so that the current flowing through the output line does not exceed 50 mA. Also, avoid incorrect wiring such as reversing the power supply polarity. Failure to do so will cause damage or burning.
- The overall length of the cable can be extended to 50 m 164.042 ft maximum with a cable size of 0.3 mm² or more. Check to make sure that the terminal voltage of this device is 4.5 V or more.
- In order to reduce noise, make the wiring as short as possible.
- Do not apply stress such as excessive bending or pulling to the extracted part of a cable.
- Perform installation and cable routing in a room temperature. Be careful not to cause excessive stress to cables after they are routed.
- Always insulate the ends of unused cables to prevent contact with other wires.
- Do not run the wires in parallel with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.

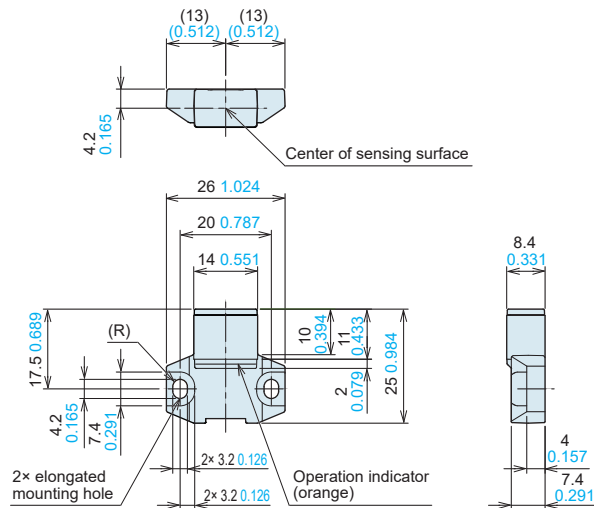
Disconnecting the connector



- When disconnecting the connector, always press the release latch while pulling it out.
- The maximum cable tensile strength is 9 N. Do not pull on the cable itself as doing so may break the conductor.

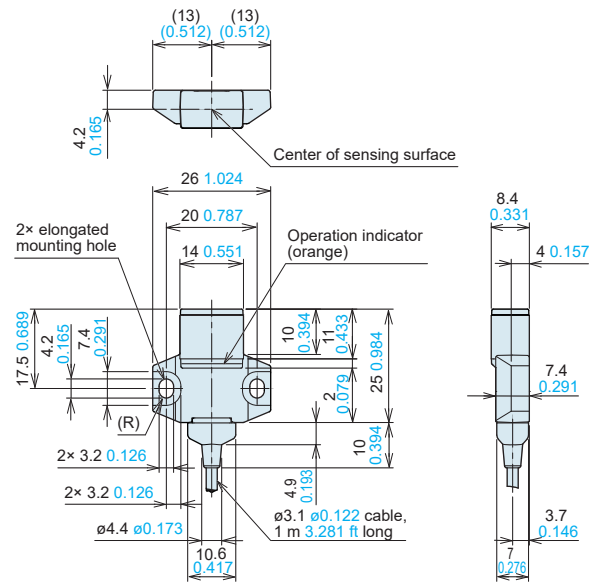
EX-M16□H EX-M16□H-P

Sensor



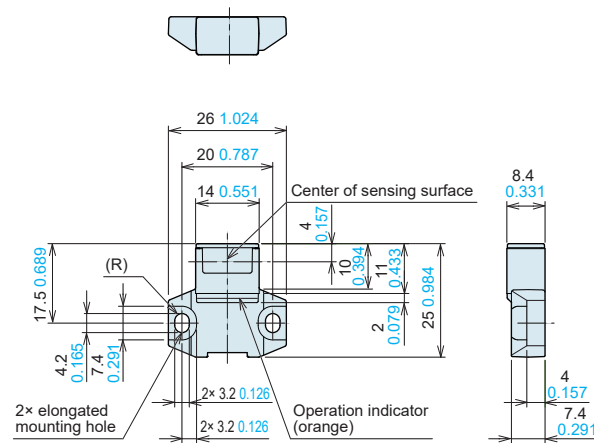
EX-M16□H-C1 EX-M16□H-P-C1

Sensor



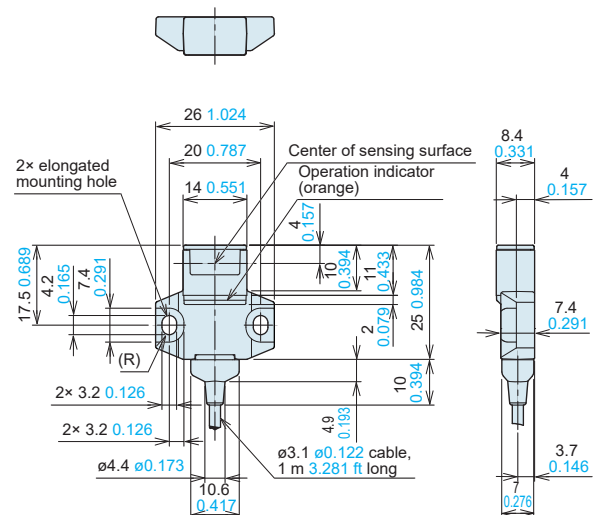
EX-M16□F EX-M16□F-P

Sensor



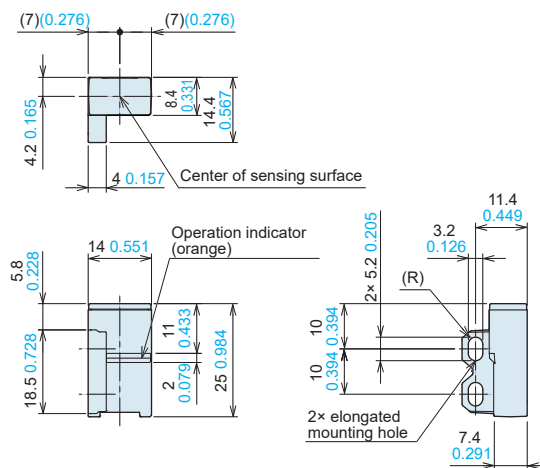
EX-M16□F-C1 EX-M16□F-P-C1

Sensor



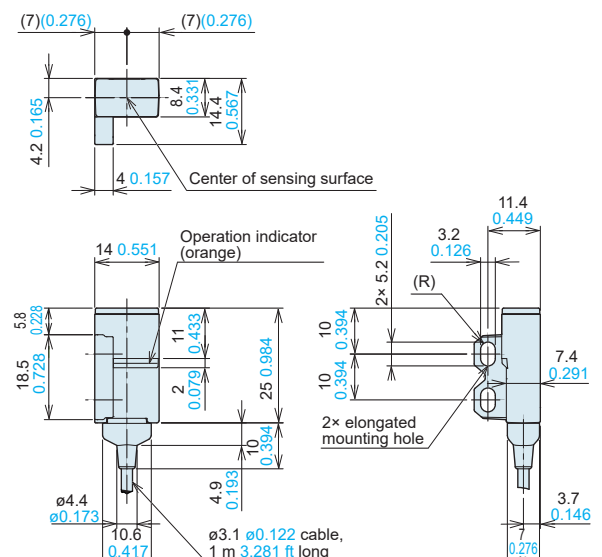
EX-M16□L EX-M16□L-P

Sensor



EX-M16□L-C1 EX-M16□L-P-C1

Sensor



Introducing the EX Family

The **EX Series** is designed to be a line of compact photoelectric sensors that are straightforward to use in the field and that provide lasting peace of mind. Beyond the convenience of a compact design with a built-in amplifier, the **EX-M160 Series** reflects Panasonic's uncompromising attention to the kind of value that specifications alone cannot convey, from stable convergent reflective sensing and high-precision mounting technology to manufacturing process improvements and quality built through automation. The **EX Series** will continue to create a new standard for compact photoelectric sensors.

Product line

● Convergent reflective type

Ultra-slim Photoelectric Sensor Amplifier Built-in EX-14 Ver.2  Slim 3.5 mm 0.138 in profile •Sensing range: 2 mm to 25 mm 0.079 in to 0.984 in •Bright two-color indicator •Sensor complies with ISO 13849-1. •IP67 protection EX-14	Ultra-compact Photoelectric Sensor Amplifier Built-in EX-24/26 Ver.2  M3 mounting •Sensing range: 2 mm to 25 mm 0.079 in to 0.984 in •Front sensing and side sensing types available. •Sensitivity adjuster (EX-26) •IP67 protection EX-24	Convergent Reflective Photoelectric Sensor Amplifier Built-in EX-40 SERIES  Long-distance type •Sensing range: up to 70 mm 2.756 in •Spot type also available. •Sensitivity adjuster (EX-43, EX-44) •IP67 protection EX-44
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● Other EX family products

Ultra-minute Photoelectric Sensor Amplifier Built-in EX-Z SERIES  Smallest size •Smallest sensor with built-in amplifier •Built-in slit on the front of the sensor Detects minute objects as small as $\varnothing 0.3$ mm $\varnothing 0.012$ in. (EX-Z11) •Mountable with M2 screws •IP67 protection EX-Z11	Threaded Miniature Photoelectric Sensor Amplifier Built-in EX-30 SERIES Ver.2  Single-point mounting •Single-point mounting •Sensing axis aligns with the mounting hole for easy design. •Same mounting dimensions as standard fibers (thru-beam: M4; reflective: M6)	Ultra-compact Laser Sensor Amplifier Built-in EX-L200 SERIES  Laser beam •Supports a wide range of sensing applications. •Long-distance sensing, thru-beam type: 3 m 9.843 ft •Spot reflective type: 300 mm 11.811 in •M3 screw mounting •Safe Class 1 visible laser
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