

# FF Series IP69K-rated Photoelectric Sensors



**FFR3-BN-1E**

## M18 (18 mm) stainless steel - DC

- 30 models - diffuse, polarized reflective, retro-reflective and through-beam
- 20 m maximum reading distance
- M12 quick disconnect (purchase cable separately)
- 316L stainless steel housing
- Supply voltage: 10 - 30 VDC
- LED light status indicators: yellow (output), green (teach-in function for some diffuse and reflective models)
- IP69K rated for food and beverage applications
- Complete protection against electrical damage
- M18 mounting hex nuts included



FF Series Photoelectric Sensor Selection Chart							
Part Number	Price	Sensing Range	Output State	Logic	Connection	Wiring	Characteristic Curves
<b>Diffuse</b>							
<b>FFR3-BN-1E</b>	<-->	100mm (3.9 in.)	N.O./N.C. complementary	NPN	M12 (12mm) connector (purchase cable separately)	Diagram 3	Chart Set 1
<b>FFR3-BP-1E</b>	<-->			PNP		Diagram 4	Chart Set 1
<b>FFR3-ON-1E</b>	<-->		N.O./N.C. selectable	NPN		Diagram 1	Chart Set 1
<b>FFR3-OP-1E</b>	<-->			PNP		Diagram 2	Chart Set 1
<b>FFI7-BN-1E</b>	<-->	400mm (15.7 in.)	N.O./N.C. complementary	NPN		Diagram 3	Chart Set 2
<b>FFI7-BP-1E</b>	<-->			PNP		Diagram 4	Chart Set 2
<b>FFI7-ON-1E</b>	<-->		N.O./N.C. selectable	NPN		Diagram 1	Chart Set 2
<b>FFI7-OP-1E</b>	<-->			PNP		Diagram 2	Chart Set 2
<b>FFI8-BN-1E</b>	<-->	800mm (31.5 in.)	N.O./N.C. complementary	NPN		Diagram 3	Chart Set 3
<b>FFI8-BP-1E</b>	<-->			PNP		Diagram 4	Chart Set 3
<b>FFI8-ON-1E</b>	<-->		N.O./N.C. selectable	NPN		Diagram 1	Chart Set 3
<b>FFI8-OP-1E</b>	<-->			PNP		Diagram 2	Chart Set 3
<b>Polarized reflective*</b>							
<b>FFRP-BN-1E •</b>	<-->	4m (13.1 ft)	N.O./N.C. complementary	NPN	M12 (12mm) connector (purchase cable separately)	Diagram 3	Chart Set 4
<b>FFRP-BP-1E •</b>	<-->			PNP		Diagram 4	Chart Set 4
<b>FFRP-ON-1E •</b>	<-->		N.O./N.C. selectable	NPN		Diagram 1	Chart Set 4
<b>FFRP-OP-1E •</b>	<-->			PNP		Diagram 2	Chart Set 4
<b>FFRN-BN-1E</b>	<-->		N.O./N.C. complementary	NPN		Diagram 3	Chart Set 4
<b>FFRN-BP-1E</b>	<-->			PNP		Diagram 4	Chart Set 4
<b>FFRN-ON-1E</b>	<-->		N.O./N.C. selectable	NPN		Diagram 1	Chart Set 4
<b>FFRN-OP-1E</b>	<-->			PNP		Diagram 2	Chart Set 4
<b>Retro-reflective for transparent objects*</b>							
<b>FFRL-BN-1E</b>	<-->	1m (3.3 ft)	N.O./N.C. complementary	NPN	M12 (12mm) connector (purchase cable separately)	Diagram 3	Chart Set 5
<b>FFRL-BP-1E</b>	<-->			PNP		Diagram 4	Chart Set 5
<b>FFRL-ON-1E</b>	<-->		N.O./N.C. selectable	NPN		Diagram 1	Chart Set 5
<b>FFRL-OP-1E</b>	<-->			PNP		Diagram 2	Chart Set 5
<b>Through-beam**</b>							
<b>FFIZ-BN-1E •</b>	Receiver	<-->	N.O./N.C. complementary	NPN	M12 (12mm) connector (purchase cable separately)	Diagram 3	Chart Set 6
<b>FFIZ-BP-1E •</b>	Receiver	<-->		PNP		Diagram 4	Chart Set 6
<b>FFIZ-ON-1E •</b>	Receiver	<-->	N.O./N.C. selectable	NPN		Diagram 1	Chart Set 6
<b>FFIZ-OP-1E •</b>	Receiver	<-->		PNP		Diagram 2	Chart Set 6
<b>FFIH-00-1E</b>	Emitter	<-->	Receiver dependent	Receiver dependent		Diagram 5	Chart Set 6
<b>FFIH-X0-1E†</b>	Emitter	<-->				Diagram 6	Chart Set 6

**NOTES:**

† Check function

\*Receivers include one round (84mm dia.) RL110 reflector. Purchase additional reflectors separately.

\*\*Purchase one receiver and one emitter for a complete set.

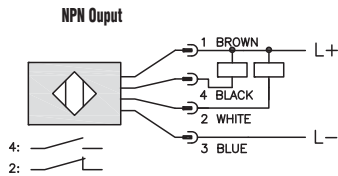
• Sensors without sensitivity adjustment

Switching Element Function		
	Thru-beam and Reflective Models	Diffuse Reflective Models
<b>Light on</b>	N.C.	N.O.
<b>Dark on</b>	N.O.	N.C.

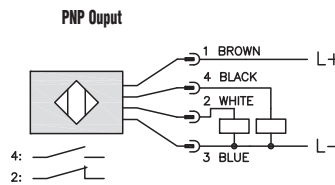
# FF Series IP69K-rated Photoelectric Sensors

## Wiring Diagrams

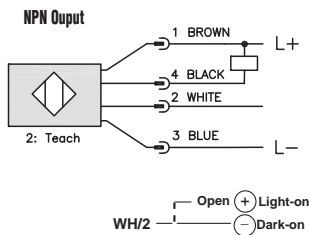
**Diagram 1**



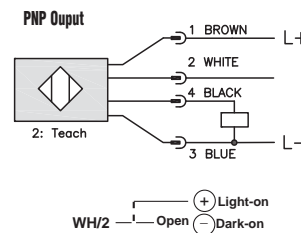
**Diagram 2**



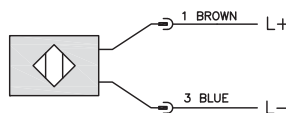
**Diagram 3**



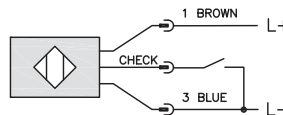
**Diagram 4**



**Diagram 5**



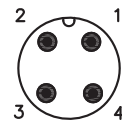
**Diagram 6**



2-meter Axial Cable version: check is black  
M12 Connector: check is Pin 2 (white)

### Connector

M12 Connector

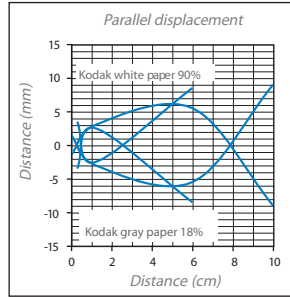
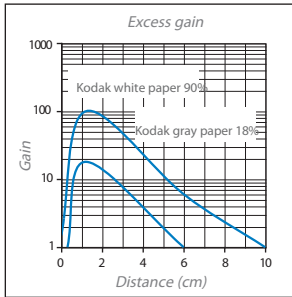


# FF Series IP69K-rated Photoelectric Sensors

## Characteristic curves

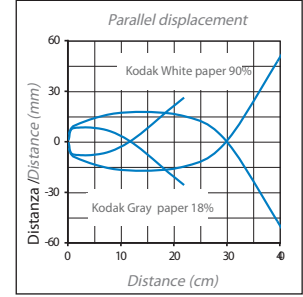
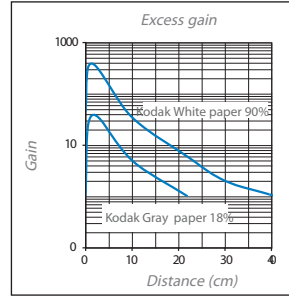
**Chart Set 1**

FFR3/\*\*-1E



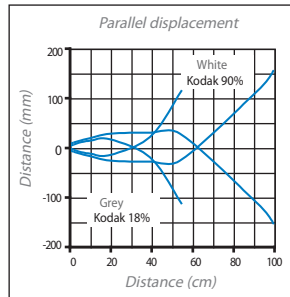
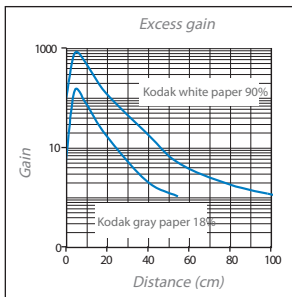
**Chart Set 2**

FFI7/\*\*-1E



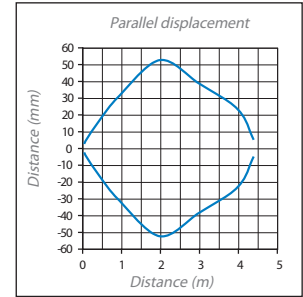
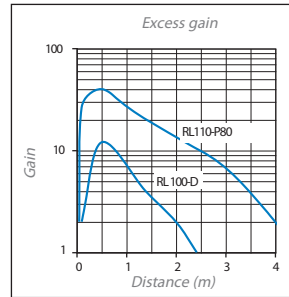
**Chart Set 3**

FFI8/\*\*-1E



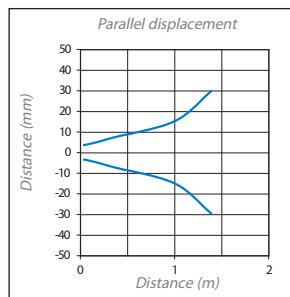
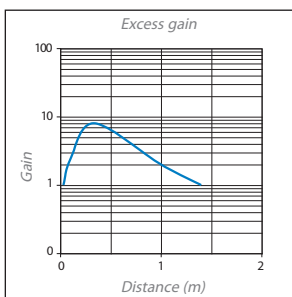
**Chart Set 4**

FFRN/\*\*-1E - FFRP/\*\*-1E



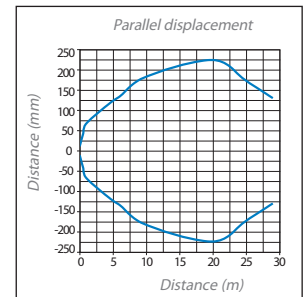
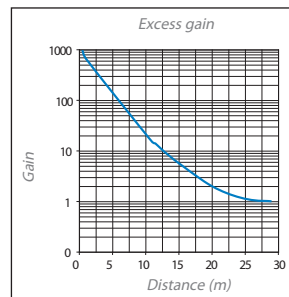
**Chart Set 5**

FFRL/\*\*-1E



**Chart Set 6**

FFIH/\*\*-1E + FFIZ/\*\*-1E



# FF Series IP69K-rated Photoelectric Sensors

FF Series 18 mm Photoelectric Sensors Specifications								
Type	Diffuse Reflective			Polarized Reflective			Through-beam <sup>5</sup>	
Model Series	FFR3	FFI7	FFI8	FFRL	FFRN	FFRP	FFIZ	FFIH
<b>Sensing Distance</b>	100 mm <sup>1</sup>	400 mm <sup>2</sup>	800 mm <sup>3</sup>	1 m	4 m <sup>4</sup>		20 m	
<b>Light Spot Diameter</b>	10 mm @ 100 mm	50 mm @ 400 mm	180 mm @ 800 mm	80 mm @ 1 m	200 mm @ 4 m		600 mm @ 20 m	
<b>Emission</b>	Red (660 nm)	Infrared (660 nm)	Infrared (880 nm)	Red (660 nm)			–	Infrared (880 nm)
<b>Sensitivity</b>	Teach					None		
<b>Output Type</b>	See individual parts on Selection Chart							
<b>Operating Voltage</b>	10-30VDC							
<b>No-load Supply Current</b>	≤30mA					≤25mA	40mA	
<b>Operating (Load) Current</b>	≤100mA							
<b>Off-state (Leakage) Current</b>	≤10µA at 30 VDC							
<b>Voltage Drop</b>	2V max at 100mA							
<b>Switching Frequency</b>	500 Hz					250 Hz	–	
<b>Ripple</b>	≤10%							
<b>Time Delay Before Availability (tv)</b>	200ms							
<b>Short-Circuit Protection</b>	Yes, switch auto-resets after load is removed							
<b>Operating Temperature</b>	-13°F to 176°F (-25°C to 80°C)							
<b>Protection Degree (DIN 40050)</b>	IEC IP68, IP69K							
<b>LED Indicators- Switching Status</b>	Green ON: teach function available Green OFF: teach function blocked Green Fast flashing: fine teach active Green Slow Flashing: teach in progress Yellow ON: Output state - Excess gain O models*; Light state - Excess gain B models*					Yellow: Output state - O models Light state - B models		Yellow: Supply on
<b>Housing Material</b>	316L stainless steel							
<b>Lens Material</b>	Poly methyl methacrylate (PMMA), FDA certified							
<b>Exit Connector</b>	Grilamid							
<b>Shock/Vibration</b>	See terminology section							
<b>Tightening Torque</b>	50 Nm (36.88 lb-ft)							
<b>Weight</b>	120g (4.23 oz)							
<b>Connection</b>	M12 plug							
<b>Agency Approvals</b>	CE, cULus file E187310, ECOLAB, RoHS, Johnson Diversey							

<sup>1</sup>With 100x100mm white matte paper

<sup>2</sup>With 200x200mm white matte paper

<sup>3</sup>With 400x400mm white matte paper

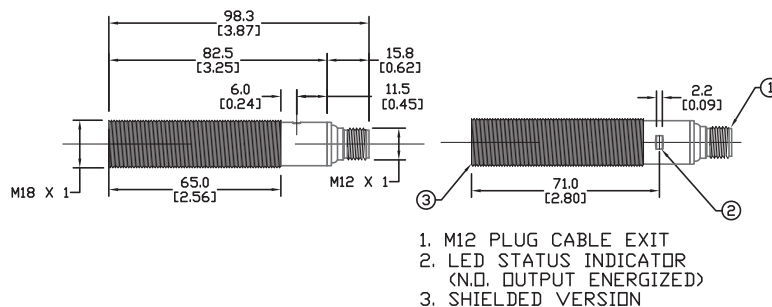
<sup>4</sup>With standard diameter 84mm RL110 reflector, included with sensor

<sup>5</sup> An emitter and receiver pair must be ordered for a complete sensor set.

\*Note: Yellow LED Fixed On: Excess Gain ≤2. Yellow LED flashing: Excess Gain <2

## Dimensions

mm(in)



**Warning: These products are not safety sensors and are not suitable for use in personal safety applications.**

# Sensors Accessories – IP69K-rated Cables

## Cables with quick-disconnect plugs

- Industry standard axial and right-angle M12 or 1/2" micro connectors with open leads
- 5m and 10m cable lengths

- PVC (polyvinyl chloride) jacket for food and beverage industrial applications
- IP69K rated for food and beverage industrial applications
- 316L stainless steel coupling nut
- EPDM o-ring

M12 Quick-Disconnect Cables (Euro, Micro DC-Single Key)							
Part Number	Price	Length	Poles	Connector	LED	Jacket	Dimensions
<b>M12 Quick-Disconnects</b>							
EVT221	<--->	5m (16.4ft)	4	Axial	No	Orange PVC	Figure 4
EVT222	<--->	5m (16.4ft)	4	Right-angle	No	Orange PVC	Figure 1
EVT223	<--->	10m (32.8ft)	4	Axial	No	Orange PVC	Figure 4
EVT224	<--->	10m (32.8ft)	4	Right-angle	No	Orange PVC	Figure 1
<b>Micro AC Volt 1/2 Inch - 20UNF Cables</b>							
<b>1/2" Quick-Disconnects</b>							
E18446	<--->	5m (16.4ft)	3	Axial	No	Yellow PVC	Figure 6
E18447	<--->	5m (16.4ft)	3	Right-angle	No	Yellow PVC	Figure 5
E18448	<--->	10m (32.8ft)	3	Axial	No	Yellow PVC	Figure 6
E18449	<--->	10m (32.8ft)	3	Right-angle	No	Yellow PVC	Figure 5



## Patch cables with quick-disconnect plugs on each end

Available patch cables include:

- Industry standard M12 screw-lock connectors
- One male and one female connector

- Axial and right-angle connector models
- 0.3m, 0.6m, 1m, 2m and 5m cable lengths
- PVC (polyvinyl chloride) jacket for food and beverage industrial applications
- IP69K rating, suitable for food and beverage industrial applications
- 316L stainless steel coupling nut
- EPDM o-ring

M12 Patch Cables with Quick-Disconnect on Each End (Euro, Micro DC-Single Key)						
Part Number	Price	Length	Poles	Connectors	Jacket	Dimensions
<b>M12 Quick-Disconnect Patch Cables</b>						
EVT225	<--->	0.3m (0.98ft)	4	Axial female plug to axial male plug	Orange PVC	Figure 3
EVT226	<--->	0.3m (0.98ft)	4	Right angle female plug to axial male plug	Orange PVC	Figure 2
EVT227	<--->	0.6m (1.97ft)	4	Axial female plug to axial male plug	Orange PVC	Figure 3
EVT228	<--->	0.6m (1.97ft)	4	Right angle female plug to axial male plug	Orange PVC	Figure 2
EVT229	<--->	1m (3.3ft)	4	Axial female plug to axial male plug	Orange PVC	Figure 3
EVT230	<--->	1m (3.3ft)	4	Right angle female plug to axial male plug	Orange PVC	Figure 2
EVT231	<--->	2m (6.6ft)	4	Axial female plug to axial male plug	Orange PVC	Figure 3
EVT232	<--->	2m (6.6ft)	4	Right angle female plug to axial male plug	Orange PVC	Figure 2
EVT233	<--->	5m (16.4ft)	4	Axial female plug to axial male plug	Orange PVC	Figure 3
EVT234	<--->	5m (16.4ft)	4	Right angle female plug to axial male plug	Orange PVC	Figure 2



Company Information

Systems Overview

Programmable Controllers

Field I/O

Software

C-more & other HMI

Drives

Soft Starters

Motors & Gearbox

Steppers/ Servos

Motor Controls

Proximity Sensors

Photo Sensors

Limit Switches

Encoders

Current Sensors

Pressure Sensors

Temperature Sensors

Pushbuttons/ Lights

Process

Relays/ Timers

Comm.

Terminal Blocks & Wiring

Power

Circuit Protection

Enclosures

Tools

Pneumatics

Safety

Appendix

Product Index

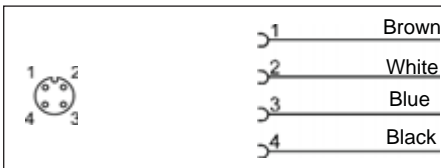
Part # Index

# Sensors Accessories – IP69K-rated Cables

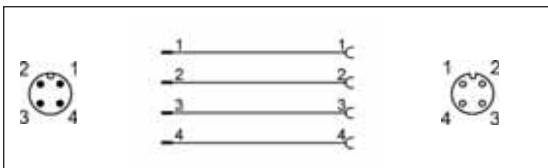
Cable Specifications		
Specification	M12	1/2"
<b>Length</b>	0.3m (0.98ft), 0.6m (1.97ft), 1m (3.3ft), 2m (6.6ft), 5m (16.4ft), 10m (32.8ft)	5m (16.4ft), 10m (32.8ft)
<b>Nominal Voltage</b>	250 VAC/300 VDC	300 VAC/VDC
<b>Max Current</b>	4A	4A
<b>Protection Degree</b>	IEC IP67 / IP68 / IP69K	IEC IP67 / IP68 / IP69K
<b>Material Nut</b>	316L Stainless steel	316L Stainless steel
<b>Jacket Material</b>	PolyVinyl Chloride (PVC)	PolyVinyl Chloride (PVC)
<b>Housing Material</b>	PolyVinyl Chloride (PVC)	PolyVinyl Chloride (PVC)
<b>Contacts Material</b>	Gold plated	Gold plated
<b>Tightening Torque</b>	0.6 to 1.5 Nm	
<b>Conductors Cross Section (AWG)</b>	22 AWG	22 AWG
<b>Ø Outer Cable</b>	4.9 mm	4.5 mm
<b>Temperature Range</b>	-25° to 100°C (-13° to 212°F)	-10° to 100°C (14° to 212°F)
<b>Environmental</b>	Halogen free, Silicone free	Halogen free, Silicone free
<b>Bending Radius</b>	min. 10 x cable diameter	
<b>Agency Approvals</b>	UL E191684	UL E177636

## Wiring - M12 DC

EVT221, EVT222, EVT223, EVT224

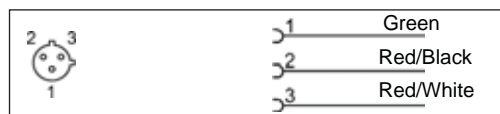


EVT225, EVT226, EVT227, EVT228, EVT229,  
EVT230, EVT231, EVT232, EVT233, EVT234



## Wiring - 1/2" Micro AC

E18446, E18447, E18448, E18449



## UL Reference

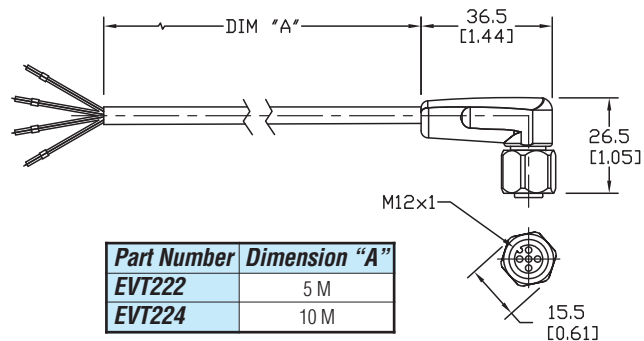
Part Number	UL Catalog Number
<b>EVT221</b>	ADOGH040VAS0005E04
<b>EVT222</b>	ADOAH040VAS0005E04
<b>EVT223</b>	ADOGH040VAS0010E04
<b>EVT224</b>	ADOAH040VAS0010E04
<b>EVT225</b>	VDOGH040VAS00.3E04STGH040VAS
<b>EVT226</b>	VDOAH040VAS00.3E04STGH040VAS
<b>EVT227</b>	VDOGH040VAS00.6E04STGH040VAS
<b>EVT228</b>	VDOAH040VAS00.6E04STGH040VAS
<b>EVT229</b>	VDOGH040VAS0001E04STGH040VAS
<b>EVT230</b>	VDOAH040VAS0001E04STGH040VAS
<b>EVT231</b>	VDOGH040VAS0002E04STGH040VAS
<b>EVT232</b>	VDOAH040VAS0002E04STGH040VAS
<b>EVT233</b>	VDOGH040VAS0005E04STGH040VAS
<b>EVT234</b>	VDOAH040VAS0005E04STGH040VAS

# Sensors Accessories – IP69K-rated Cables

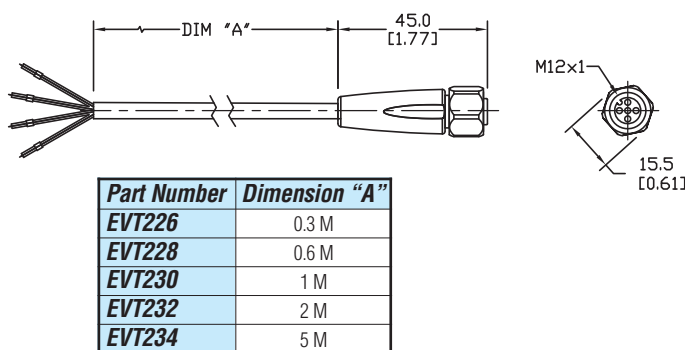
## Dimensions

mm [inches]

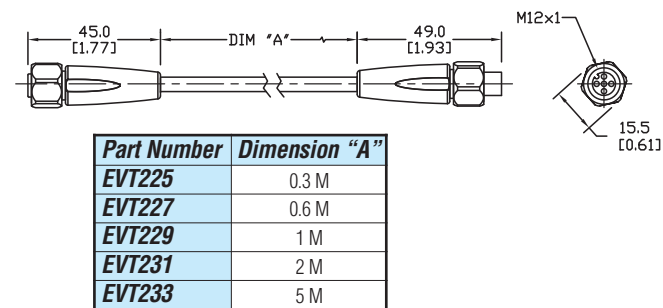
**Figure 1**



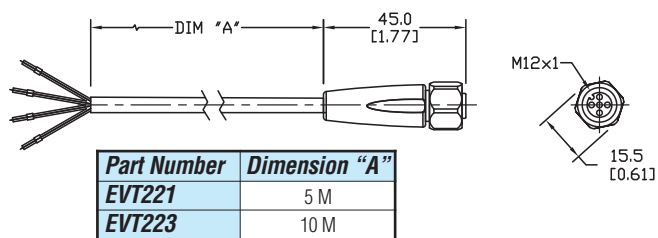
**Figure 2**



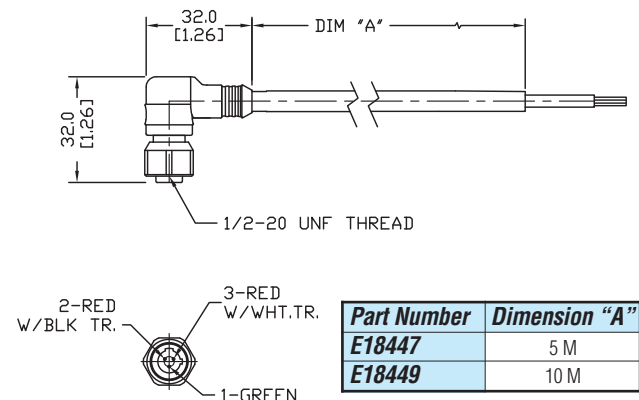
**Figure 3**



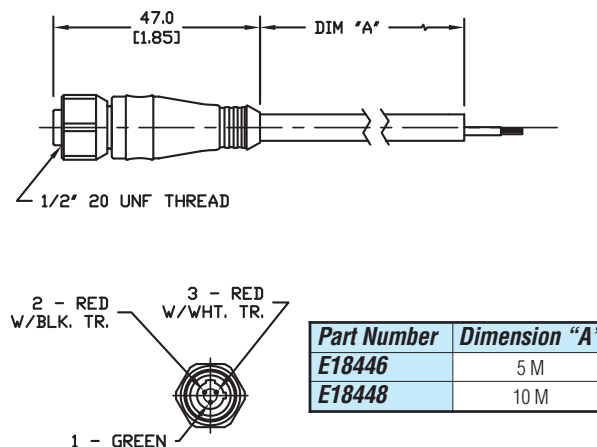
**Figure 4**



**Figure 5**



**Figure 6**



# Accessories: Reflectors and Shutters

## RL series reflectors for polarized reflective photoelectric sensors (all models)

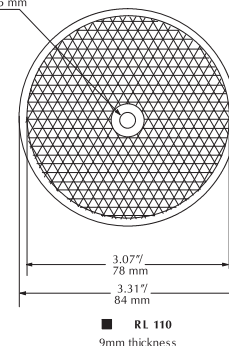
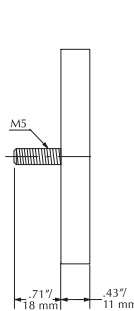
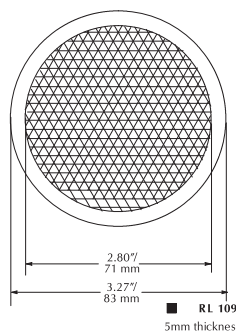
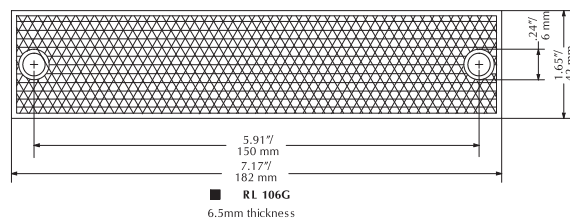
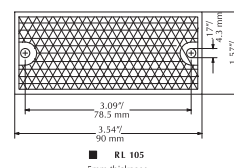
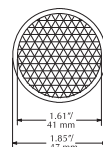
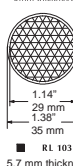
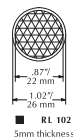
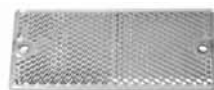
- Suitable for use with polarized light photoelectric sensors
- Shapes and sizes for most applications
- Miniature types for close mounting in multiple sensor installations
- Single hole, dual hole and stud mounting types available
- 10 reflectors per package

## Installation notes

- Keep the reflector surface clean to ensure peak detection performance. This is especially true when the maximum sensing range is being used. Clean using a damp cloth
- When selecting a reflector, it is important to consider the ambient conditions it will be exposed to. Dusty or high humidity conditions may reduce the sensing range as much as 90%.
- Reflectors should be positioned at a 90° angle to the optical axis with a tolerance of ±15°.

## Dimensions

inches [mm]



Specifications	RL102	RL103	RL104	RL105	RL106G	RL110 <sup>3</sup>
<b>Model</b>	RL102	RL103	RL104	RL105	RL106G	RL110 <sup>3</sup>
<b>Price (10 per pack)</b>	<--->	<--->	<--->	<--->	<--->	<--->
<b>% Sensing Range Using SSP<sup>1</sup></b>	50%	40%	50%	50%	50%	100%
<b>% Sensing Range Using QXP<sup>1</sup></b>	--	35%	60%	50%	45%	100%
<b>Dimensions</b>	Ø26mm	Ø36mm	Ø47mm	90x40mm	182x42mm	Ø84mm
<b>Degree of Protection<sup>2</sup></b>	IEC IP67					
<b>Mounting</b>	Customer-supplied adhesive or other mounting method required			two Ø4.3mm holes	two Ø6mm holes	one Ø5mm hole
<b>Materials</b>	Reflective face: PMMA Polymethylmethacrylate (acrylic); base material: ABS (Acrylonitrile-butadiene-styren)					
<b>1 Refer to individual catalog pages for detailed explanations of these photoelectric sensors.</b>						
<b>2 Not recommended for applications involving moist air environments or water immersion.</b>						
<b>3 All reflective sensors are shipped with an RL110 reflector.</b>						

## ST0S1 through ST0S8 shutters for M18 (18 mm) through-beam sensors (SSE / SSR)

- Reduces the emitted beam, allowing the detection of small targets
- Shutter consists of a threaded ring-nut, a protective lens, an O-ring and an aperture, which can screw onto the optical head of either the emitter or receiver. The table above shows the sensing distance and minimal detectable object.

Sensing Distance (when used with SSE / SSR Model Photoelectric switches)						
Model	ST0S1	ST0S2	ST0S3	ST0S4	ST0S6	ST0S8
<b>Pieces Per Pack</b>	1	1	1	1	1	1
<b>Price</b>	<--->	<--->	Discontinued	<--->	<--->	<--->
<b>Ø x shutter (mm)</b>	1	2	3	4	6	8
<b>Distance (m)</b>	N/A	N/A	1	1.5	3.5	6.5
<b>object (mm)</b>	N/A	N/A	1.5	2	3	4



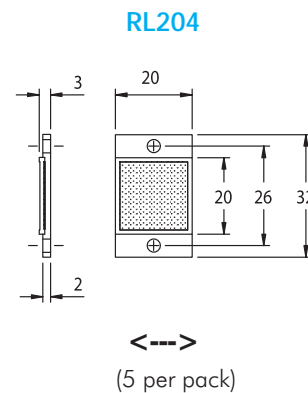
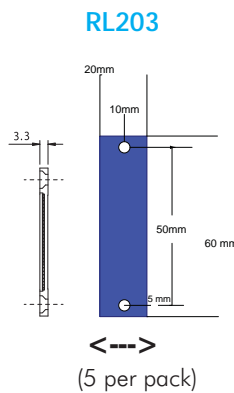
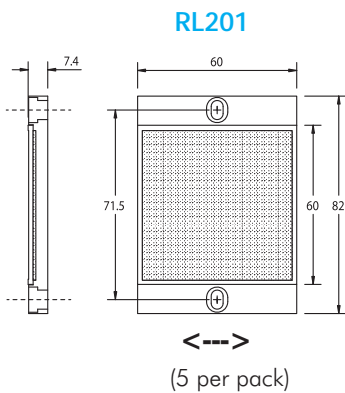
# Accessories: Reflectors, Adapters & Mounting Brackets

## RL series reflectors for polarized reflective Laser photoelectric sensors (FALN series)

- Suitable for use with polarized light Laser photoelectric sensors
- Sizes for most applications
- Miniature types for close mounting in multiple sensor installations
- 5 reflectors per package

Specifications			
Model	RL201	RL203	RL204
Sensing Range Using FALN <sup>1</sup>	30m	7m	7m
Dimensions	60mm x 82mm	19mm x 60mm	20mm x 32mm
Mounting	two Ø4mm holes	two Ø5mm holes	two Ø3mm holes
Degree of Protection <sup>2</sup>	IEC IP67		
Materials	Acrylic/polycarbonate		

**1** Refer to individual catalog pages for detailed explanations of these photoelectric sensors.  
**2** Not recommended for applications involving moist air environments or water immersion.  
**Note:** All reflective sensors are shipped with an RL110 reflector. Purchase additional reflectors separately.



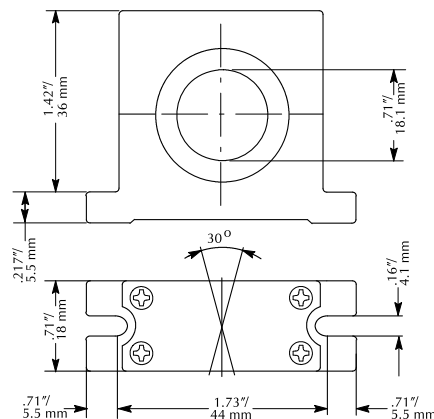
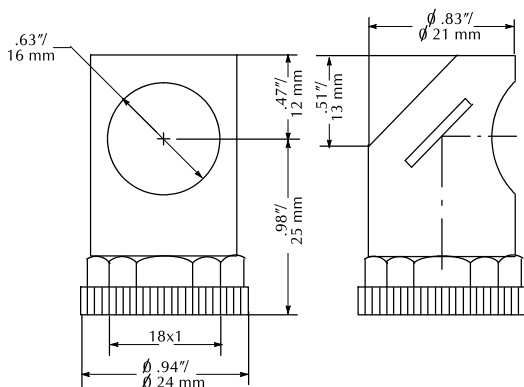
## ST03 right-angle M18 (18 mm) beam adapter

For use with M18 retroreflective and through-beam photoelectric switches (not for use with diffuse reflection sensors). Allows 90° light detection using an internal mirror set at 45° to the optical axis. Sensitivity loss is about 20-30%.



## ST02 plastic swivel bracket M18 (18 mm)

Plastic mounting bracket for use with M18 photoelectric switches. Has a ball-joint and set screws to adjust sensor orientation. Allows orientation in all directions for retroreflective and through-beam sensors. (Will not work with C18 series).



# Accessories: Mounting Brackets

## ST12A axial bracket

For mounting M12 (12 mm) sensors. Has two mounting holes (use 3 mm screws) and allows the rotation of an optical axis for right-beam angle adapter sensors.

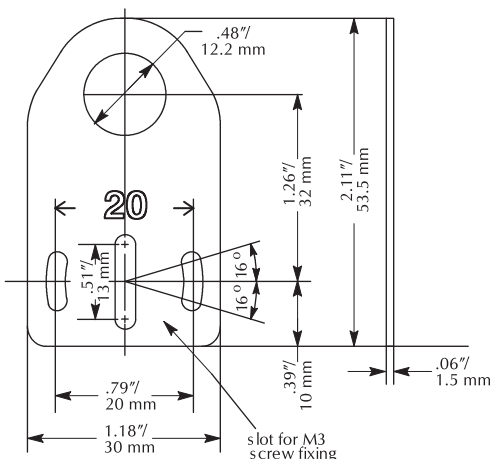


## ST12C right-angle bracket

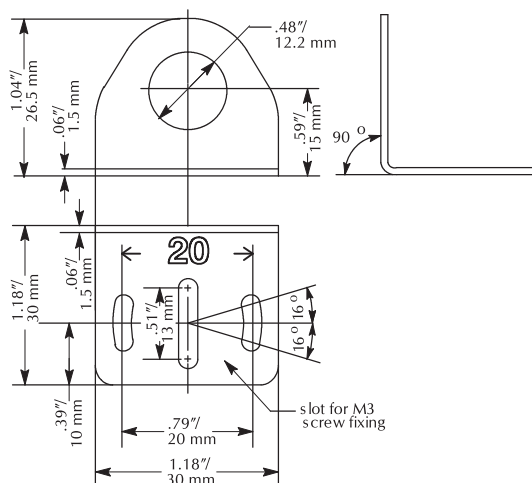
Angular mounting bracket for use with M12 (12 mm) sensors. Has two mounting holes (use 3 mm screws) and allows the rotation of an optical axis for axial sensors.



Brackets		
Part Number	Price	Description
ST12A	<-->	Metal axial bracket for 12 mm sensors, 1/pk
ST12A7W	<-->	316L stainless steel axial bracket for 12 mm sensors, 1/pk



Brackets		
Part Number	Price	Description
ST12C	<-->	Metal right angle bracket for 12 mm sensors, 1/pk
ST12C7W	<-->	316L stainless steel right angle bracket for 12 mm sensors, 1/pk



## ST18A axial bracket

Mounting bracket for M18 (18mm) sensors. Has two mounting holes (use 4 mm screws) and allows the rotation of an optical axis for right-beam angle adapter sensors.

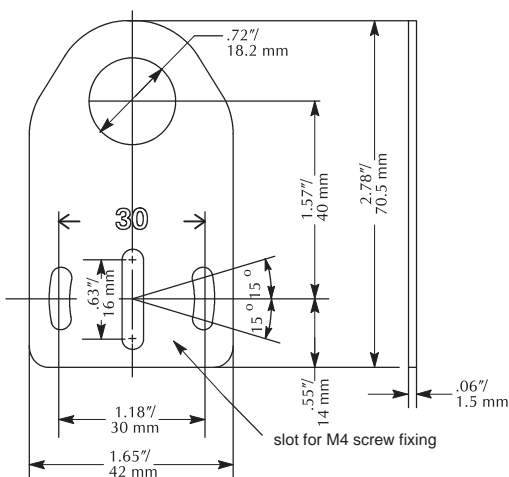


## ST18C right-angle bracket

Angular mounting bracket for M18 (18 mm) sensors. Has two mounting holes (use 4 mm screws) and allows the rotation of an optical axis for axial sensors.



Brackets		
Part Number	Price	Description
ST18A	<-->	Metal axial bracket for 18 mm sensors, 1/pk
ST18A7W	<-->	316L stainless steel axial bracket for 18 mm sensors, 1/pk



Brackets		
Part Number	Price	Description
ST18C	<-->	Metal right angle bracket for 18 mm sensors, 1/pk
ST18C7W	<-->	316L stainless steel right angle bracket for 18 mm sensors, 1/pk

