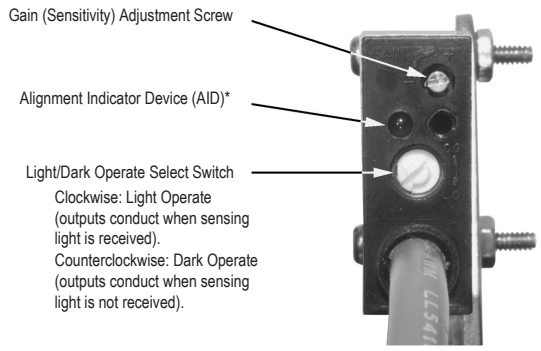
MINI-BEAM® AC Voltage Series Sensor

Quick Start Guide

Self-contained photoelectric sensors

Sensor Features



*U.S. Patent no. 4356393

WARNING:

- **Do not use this device for personnel protection**
- Using this device for personnel protection could result in serious injury or death.
- This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A device failure or malfunction can cause either an energized (on) or de-energized (off) output condition.

Models

Model[1]	Sensing Mode	Range	LED
SMA31E	Opposed Emitter	3 m (10 ft)	Infrared, 880 nm
SM2A31R	Opposed Receiver		
SMA31EL	Opposed Emitter - Long Range	30 m (100 ft)	
SM2A31RL	Opposed Receiver - Long Range		
SMA31EPD	Opposed Emitter Clear Plastic Detection	0 to 300 mm (0 to 12 in)	Visible red, 650 nm
SM2A31RPD	Opposed Receiver Clear Plastic Detection	Actual range varies, depending upon the light transmission properties of the plastic material being sensed.	
SM2A312LV	Non-Polarized Retroreflective	5 m (15 ft)	
SM2A312LVAG	Polarized Retroreflective	50 mm to 2 m (2 in to 7 ft)	
SM2A312LP	Extended-Range Polarized Retroreflective	10 mm to 3 m (0.4 in to 10 ft)	
SM2A312D	Diffuse	380 mm (15 in)	Infrared, 880 nm
SM2A312DBZ		300 mm (12 in)	
SM2A312W	Divergent Diffuse	130 mm (5 in)	
SM2A312C	Convergent	16 mm (0.65 in) Focus	Infrared, 880 nm
SM2A312C2		43 mm (1.7 in) Focus	
SM2A312CV		16 mm (0.65in) Focus	Visible red, 650 nm
SM2A312CV2		43 mm (1.7 in) Focus	
SM2A312CVG		16 mm (0.65 in) Focus	Visible green, 560 nm
SM2A312F	Glass Fiber Optic	Range varies, depending on sensing mode and fiber optics used.	Infrared, 880 nm
SM2A312FV			Visible red, 650 nm
SM2A312FP	Plastic Fiber Optic		

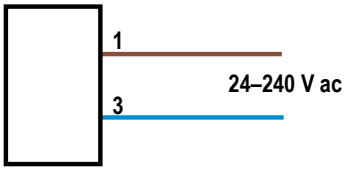
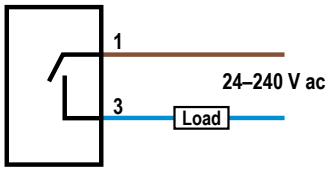
Installation Instructions

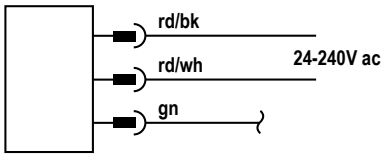
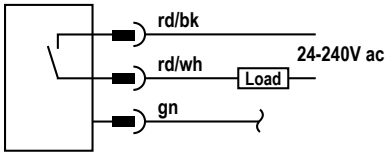
Wiring Diagrams

The output type for all models is SPST solid-state 2-wire.

[1] Standard 2 m (6.5 ft) cable models are listed.

- To order the 9 m (30 ft) cable model, add the suffix “W/30” (for example, SMA31E W/30).
- To order the 3-pin Micro-style QD model, add the suffix “QD” (for example, SMA31EQD).

Emitters with Attached Cable	All Other Models with Attached Cable	Key
		1. Brown 3. Blue

Emitters with Quick Disconnect (3-pin Micro-Style)	All Other Models with Quick Disconnect (3-pin Micro-Style)
	

Mount the Device

1. If a bracket is needed, mount the device onto the bracket.
2. Mount the device (or the device and the bracket) to the machine or equipment at the desired location. Do not tighten the mounting screws at this time.
3. Check the device alignment.
4. Tighten the mounting screws to secure the device (or the device and the bracket) in the aligned position.

Sensor Alignment

Note: Follow proper electronic shock discharge (ESD) precautions when adjusting the Gain potentiometer or the LO/DO switch.

Note: When turning the Light/Dark Operate Select switch, be careful not to damage the small tabs on the switch.

1. Using line-of-sight, position the MINI-BEAM sensor to its emitter (opposed-mode sensing) or to its target (all other sensing modes).

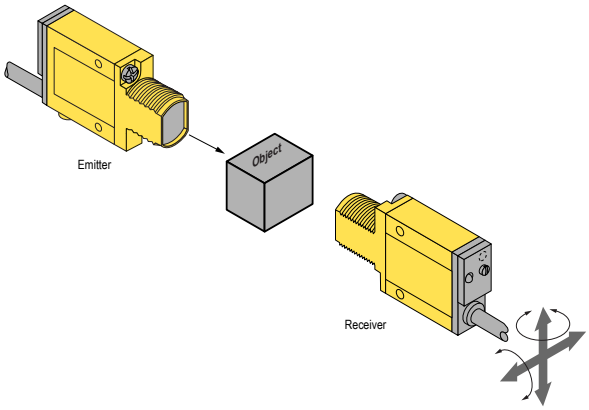
   When using a retroreflective sensor, the target is the retroreflector (“retro target”). For diffuse or convergent sensing modes, the target is the object to be detected.
2. Apply power to the sensor (and to the emitter, if using the opposed mode).
3. Using a small, flat-blade screwdriver, turn the 15-turn Gain control to maximum (the clockwise end of rotation).

   The Gain control is clutched at both ends to avoid damage, and will “free-wheel” when either endpoint is reached.

   If the MINI-BEAM sensor is receiving its light signal, the red LED Alignment indicator is ON and flashing at a rate proportional to the signal strength (a faster flash rate = more signal).
4. Move the sensor (or move the retro target, if applicable) up-down-right-left, including angular rotation, to find the center of the movement zone within which the LED indicator remains ON.

   Reducing the Gain setting reduces the size of the movement zone and enables more precise alignment.
5. Repeat the alignment motions after each Gain reduction.
6. When optimum alignment is achieved, mount the sensor, and the emitter or retro target, if applicable, securely in that position.
7. Increase the Gain to maximum.
8. Test the sensor by placing the object to be detected in the sensing position, then removing it.
   The Alignment indicator LED turns ON when the sensing beam is established (Light condition), and turns OFF when the beam is broken (Dark condition). If the Alignment indicator LED stays ON for both sensing conditions, see the following tips for each sensing mode.

Opposed Mode Alignment



"Flooding" occurs when a portion of the sensing beam passes around the object to be sensed. "Burn-through" occurs when a portion of the emitter's light energy passes through a thin or translucent object, and is sensed by the receiver.

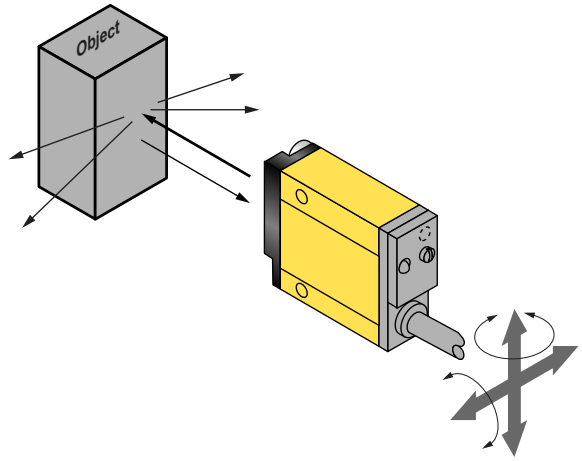
To correct either problem, do one or more of the following to reduce the light energy:

- Reduce the Gain adjustment on the receiver
- Add an aperture to one or both lenses (MINI-BEAM apertures, available from Banner, fit neatly inside the lens assembly)
- Intentionally misalign the emitter and receiver

Note:

- Light condition: sensor output is ON when there is no object in the beam
- Dark condition: sensor output is ON when there is an object in the beam

Diffuse Mode Alignment



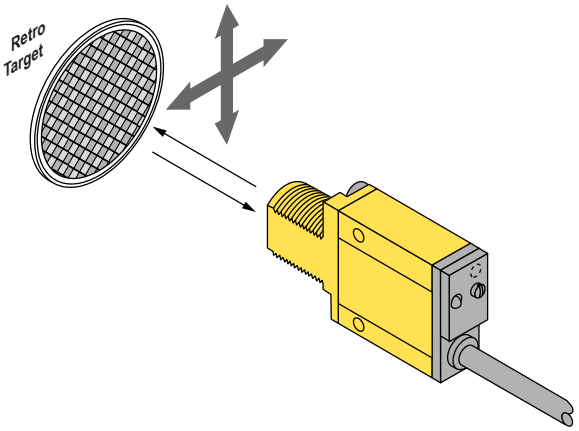
If the Alignment LED does not go OFF when the object is removed from the beam, the sensor is probably detecting light reflected from some background object. To remedy this problem:

- Reduce the reflectivity of the background by painting the surface(s) flat-black, scuffing any shiny surface, or drilling a large hole, directly opposite the diffuse sensor
- Move the sensor closer to the object to be detected and reduce the Gain adjustment. Rule of thumb for diffuse sensing: The distance to the nearest background object should be at least three times the sensing distance

Note:

- Light condition: sensor output is ON when there is no object in the beam
- Dark condition: sensor output is ON when there is an object in the beam

Retroreflective Mode Alignment



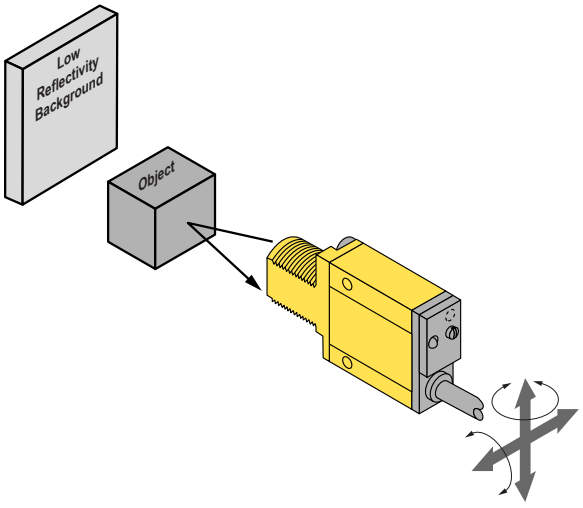
A highly reflective object may reflect enough light back to a retroreflective sensor to allow that object to slip through the beam, without being detected. This problem is called "proxing," and the following methods may be used to correct it:

- Position the sensor and retro target so the beam will not strike a shiny surface perpendicular to the sensor lens
- Reduce the Gain adjustment
- Add a polarizing filter (for model SM2A312LV)

Note:

- Light condition: sensor output is ON when there is no object in the beam
- Dark condition: sensor output is ON when there is an object in the beam

Convergent Mode Alignment



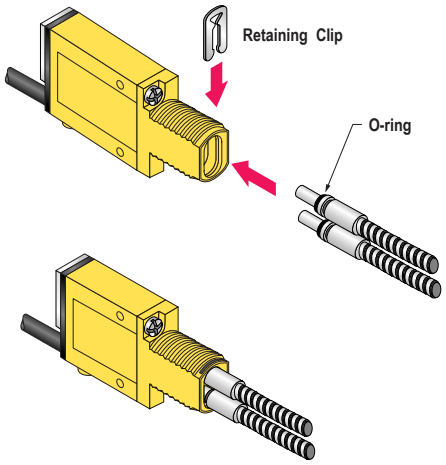
The sensing energy of a convergent mode sensor is concentrated at the specified focus point. Convergent mode sensors are less sensitive to background reflections, compared with diffuse mode sensors. However, if background reflections are a problem:

- Skew the sensor position at a 10° to 25° angle to eliminate direct reflections from shiny background surfaces
- Reduce the reflectivity of the background by painting the surface(s) flat-black, scuffing any shiny surface, or drilling a large hole, directly opposite the sensor
- Reduce the Gain adjustment

Note:

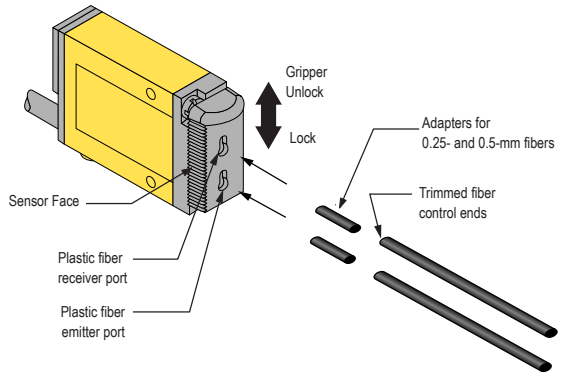
- Light condition: sensor output is ON when there is no object in the beam
- Dark condition: sensor output is ON when there is an object in the beam

Glass Fiber Installation



1. Install the O-ring (supplied with the fiber) on each fiber end, as shown in the drawing.
2. While pressing the fiber ends firmly into the ports on the sensor front, slide the U-shaped retaining clip (supplied with the sensor) into the slot in the sensor's barrel, until it snaps into place.

Plastic Fiber Installation



1. With supplied fiber cutter, make a clean cut at the control ends of fibers.
2. Unlock the fiber gripper as shown in the drawing.
3. Apply appropriate fiber adaptors to the fiber, if needed.
4. Gently insert the prepared fiber ends into the ports as far as they will go.
5. Slide the fiber gripper back to lock, as shown in the drawing.

Specifications

Supply Voltage and Current
24 to 240 V ac (50/60 Hz), 250 V ac maximum

Supply Protection Circuitry
Protected against transient voltages

Output Configuration
SPST SCR solid-state relay with either normally closed or normally open contact (light/dark operate selectable); 2-wire hookup

Output Rating
Minimum load current 5 mA; maximum steady-state load capability 300 mA to 50 °C ambient (122 °F) 100 mA to 70 °C ambient (158 °F)
Inrush capability: 3 amps for 1 second (non repetitive); 10 amps for 1 cycle (non repetitive)
OFF-state leakage current: less than 1.7 mA rms
ON-state voltage drop: ≤ 5 V at 300 mA load, ≤ 10 V at 15 mA load

Output Protection Circuitry
Protected against false pulse on power-up

Output Response Time
Opposed: 2 millisecond on and 1 millisecond off
Non-Polarized and Polarized Retro, Convergent, and Plastic Fiber Optic: 4 milliseconds on and off
Diffuse and Glass Fiber Optic: 8 milliseconds on and off
OFF response time specification does not include load response of up to 1/2 ac cycle (8.3 milliseconds). Response time specification of load should be considered when important.

Note: 300 millisecond delay on power-up.

Repeatability
Opposed: 0.3 milliseconds
Non-Polarized and Polarized Retro, Convergent, and Plastic Fiber Optic: 1.3 milliseconds
Diffuse and Glass Fiber Optic: 2.6 milliseconds
Response time and repeatability specifications are independent of signal strength.

Indicators
Red indicator LED on rear of sensor is ON when the load is energized

Construction
Reinforced thermoplastic polyester housing, totally encapsulated, o-ring sealing, acrylic lenses, stainless steel screws

Environmental Rating
Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 6, 12, and 13; IEC IP67

Connections
PVC-jacketed 2-conductor 2 m (6.5 ft) or 9 m (30 ft) cables, or 3-pin Micro-style QD fitting; QD cables available separately

Operating Conditions
Temperature: –20 °C to +70 °C (–4 °F to +158 °F)
90% at +50 °C maximum relative humidity (non-condensing)

Application Notes
Overload conditions can destroy ac MINI-BEAM sensors. Directly wiring sensor without load series, across hot and neutral will damage sensor (except emitter models).
Low-voltage use requires careful analysis of the load to determine if the sensor's leakage current or on-state voltage will interfere with proper operation of the load.
The false-pulse protection feature may cause momentary drop-out of the load when the sensor is wired in series or parallel with mechanical switch contacts.

Required Overcurrent Protection

WARNING: Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.

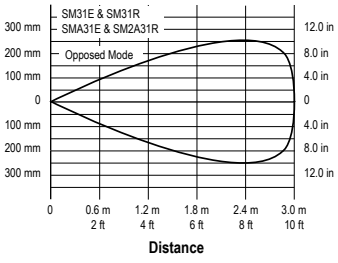
Overcurrent protection is required to be provided by end product application per the supplied table.
Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply.
Supply wiring leads < 24 AWG shall not be spliced.
For additional product support, go to *www.bannerengineering.com*.

Supply Wiring (AWG)	Required Overcurrent Protection (Amps)
20	5.0
22	3.0
24	2.0
26	1.0
28	0.8
30	0.5

Certifications

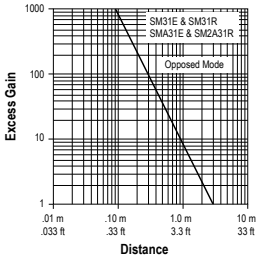
Performance Curves for SM31Ex Emitter and SM31Rx Receiver Models

Beam Pattern for SM31E/R

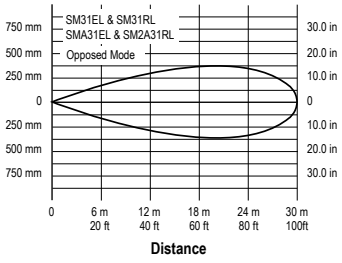


Effective Beam: 3.5 mm

Excess Gain Curve for SM31E/R

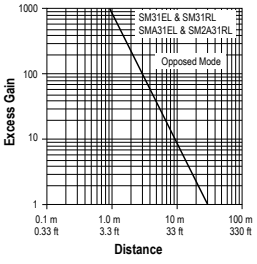


Beam Pattern for SM31EL/RL



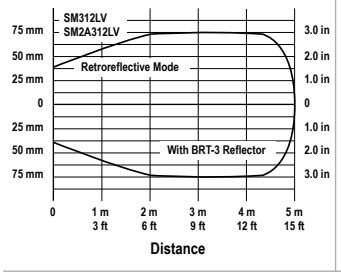
Effective Beam: 13 mm

Excess Gain Curve for SM31EL/RL

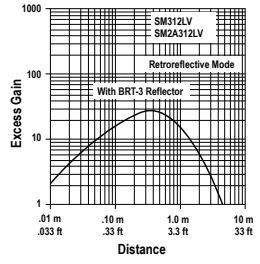


Performance Curves for the SM312Lx Retroreflective Models

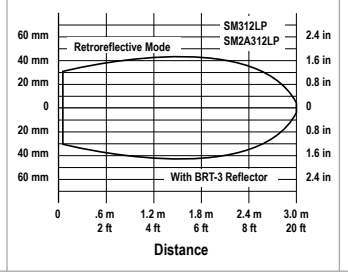
Beam Pattern for SM312LVxx



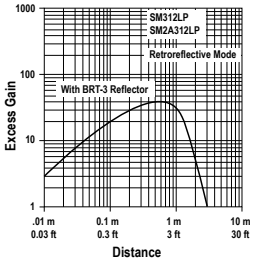
Excess Gain Curve for SM312LVxx

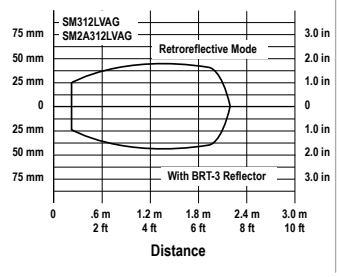
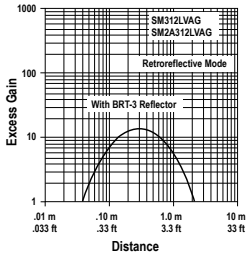


Beam Pattern for SM312LP

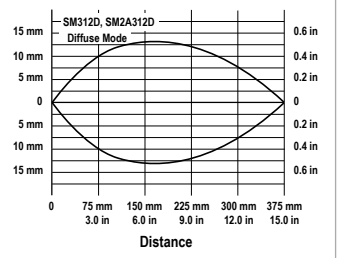
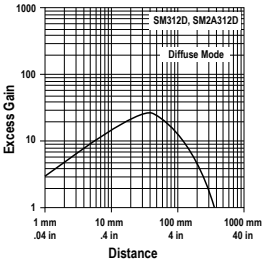
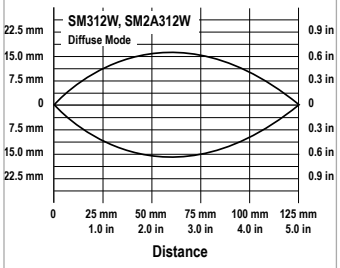
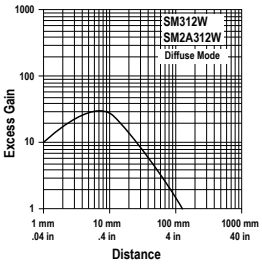
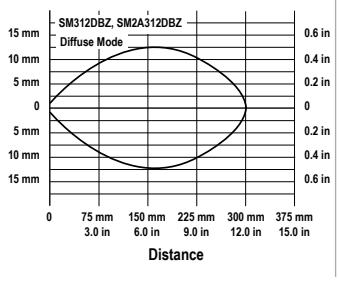
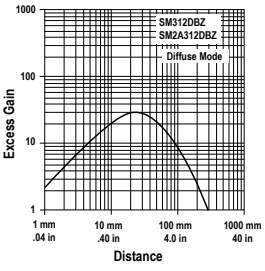


Excess Gain Curve for SM312LP

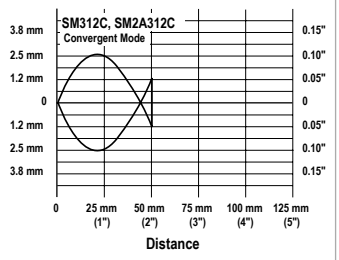
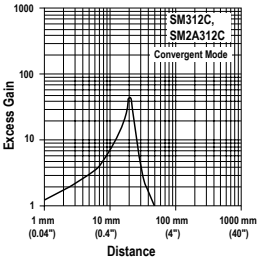
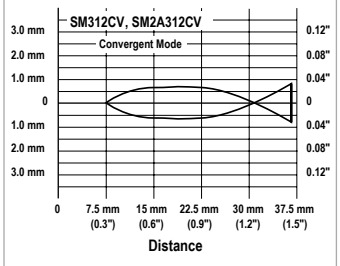
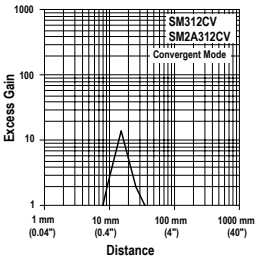
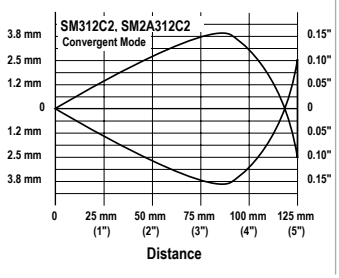
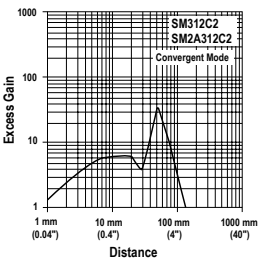
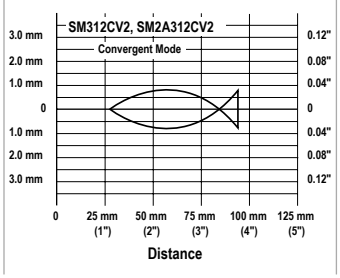
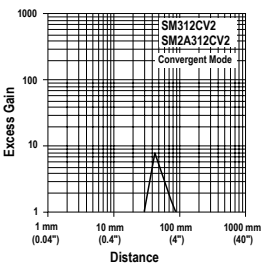


Beam Pattern for SM312LVxx	Excess Gain Curve for SM312LVxx	Beam Pattern for SM312LP	Excess Gain Curve for SM312LP
			

Performance Curves for the SM312Dx and SM312W Diffuse Models

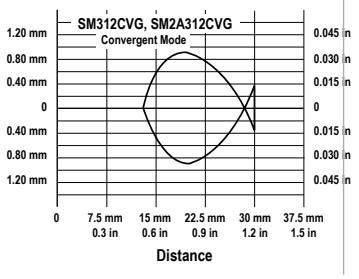
Beam Pattern for SM312Dx	Excess Gain Curve for SM312Dx	Beam Pattern for SM312W	Excess Gain Curve for SM312W
			
			

Performance Curves for the SM312Cx Convergent Models

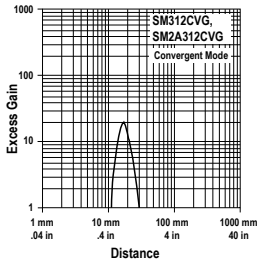
Beam Pattern for SM312C	Excess Gain Curve for SM312C	Beam Pattern for SM312CV	Excess Gain Curve for SM312CV
			
			

Performance is based on a 90% reflectance white test card.

Beam Pattern for SM312CVG



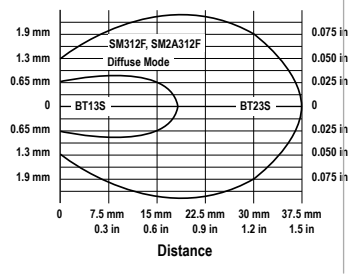
Excess Gain Curve for SM312CVG



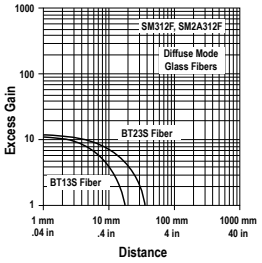
Performance Curves for the SM312F Glass Fiber Optic Models

Diffuse Mode

Beam Pattern for SM312F

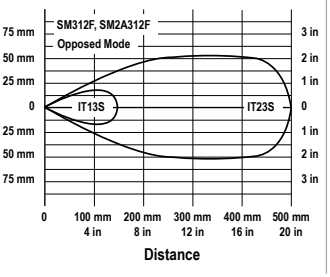


Excess Gain Curve for SM312F

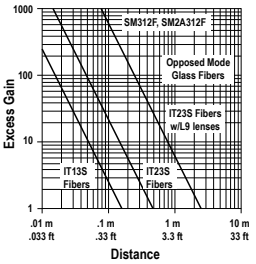


Opposed Mode

Beam Pattern for SM312F

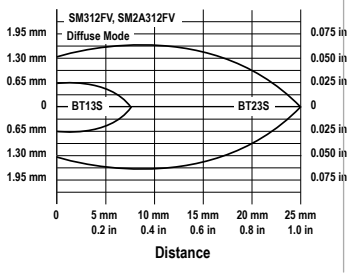


Excess Gain Curve for SM312F

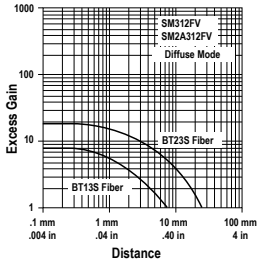


Diffuse Mode

Beam Pattern for SM312FV

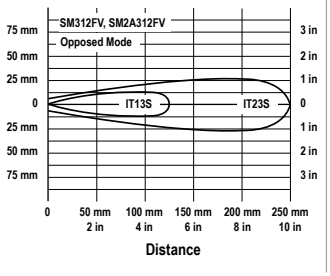


Excess Gain Curve for SM312FV

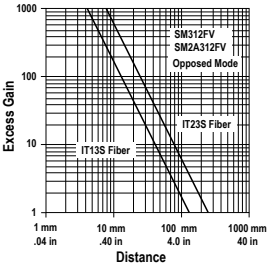


Opposed Mode

Beam Pattern for SM312FV



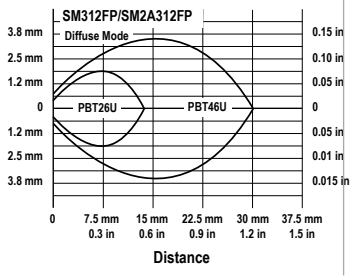
Excess Gain Curve for SM312FV



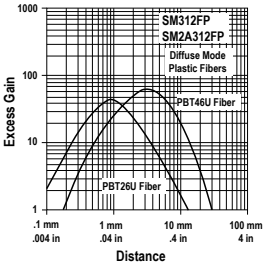
Performance Curves for the SM312FP Plastic Fiber Models

Diffuse Mode

Beam Pattern for SM312FP

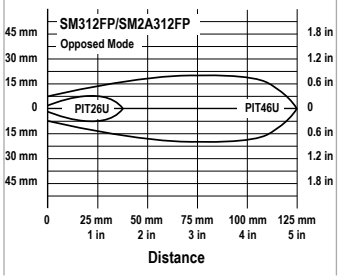


Excess Gain Curve for SM312FP

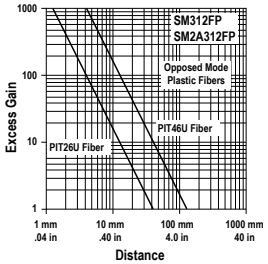


Opposed Mode

Beam Pattern for SM312FP

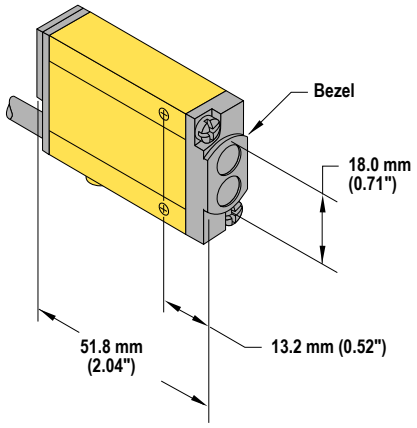


Excess Gain Curve for SM312FP

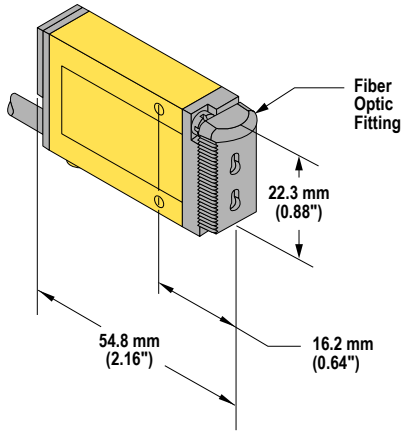


Dimensions

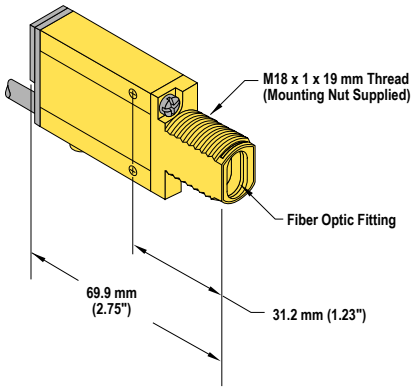
Divergent Diffuse Models (Suffix DBZ and W)



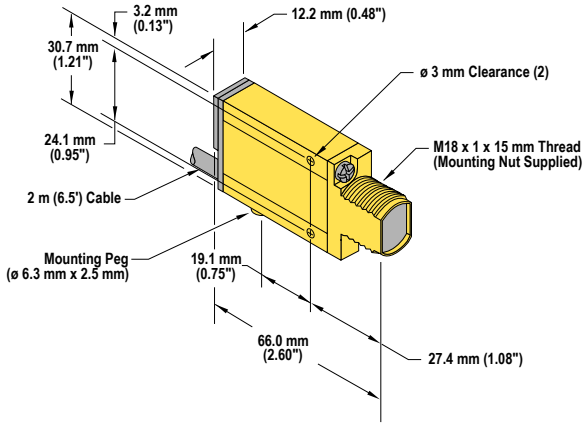
Plastic Fiber Models (Suffix FP)



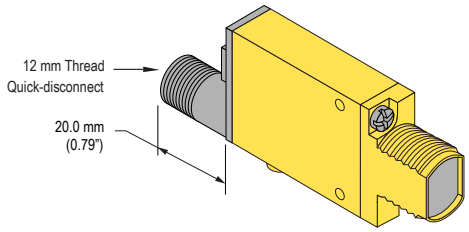
Glass Fiber Models (Suffix F, FV)



Cabled Models (Suffix E, EL, EPD, R, RL, RPD, LV, LVAG, LP, D, C, C2, CV, CV2, and CVG)



QD Models



Banner Engineering Corp. Limited Warranty

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

THIS LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED (INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), AND WHETHER ARISING UNDER COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE.

This Warranty is exclusive and limited to repair or, at the discretion of Banner Engineering Corp., replacement. **IN NO EVENT SHALL BANNER ENGINEERING CORP. BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR ANY EXTRA COSTS, EXPENSES, LOSSES, LOSS OF PROFITS, OR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES RESULTING FROM ANY PRODUCT DEFECT OR FROM THE USE OR INABILITY TO USE THE PRODUCT, WHETHER ARISING IN CONTRACT OR WARRANTY, STATUTE, TORT, STRICT LIABILITY, NEGLIGENCE, OR OTHERWISE.**

Banner Engineering Corp. reserves the right to change, modify or improve the design of the product without assuming any obligations or liabilities relating to any product previously manufactured by Banner Engineering Corp. Any misuse, abuse, or improper application or installation of this product or use of the product for personal protection applications when the product is identified as not intended for such purposes will void the product warranty. Any modifications to this product without prior express approval by Banner Engineering Corp will void the product warranties. All specifications published in this document are subject to change; Banner reserves the right to modify product specifications or update documentation at any time. Specifications and product information in English supersede that which is provided in any other language. For the most recent version of any documentation, refer to: *www.bannerengineering.com*.

For patent information, see *www.bannerengineering.com/patents*.

© Banner Engineering Corp. All rights reserved