

# MINI-BEAM® AC Voltage Series Sensor



## Quick Start Guide

Self-contained photoelectric sensors

### Sensor Features

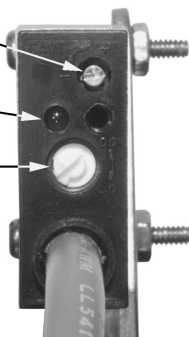
Gain (Sensitivity) Adjustment Screw

Alignment Indicator Device (AID)\*

Light/Dark Operate Select Switch

Clockwise: Light Operate  
(outputs conduct when sensing light is received).

Counterclockwise: Dark Operate  
(outputs conduct when sensing light is not received).



### 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.

\*U.S. Patent no. 4356393

## Models

Model <sup>1</sup>	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)	Infrared, 880 nm
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)	Infrared, 880 nm
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)	Infrared, 880 nm
SM2A312C	Convergent	16 mm (0.65 in) Focus	
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			

## Installation Instructions

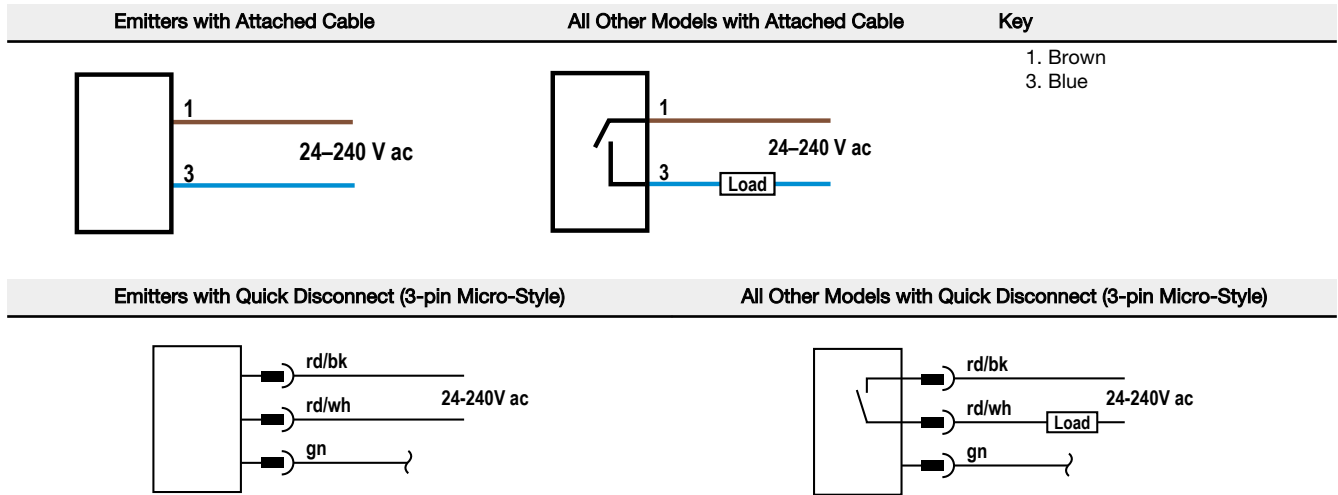
### Wiring Diagrams

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

<sup>1</sup> 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).





## 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



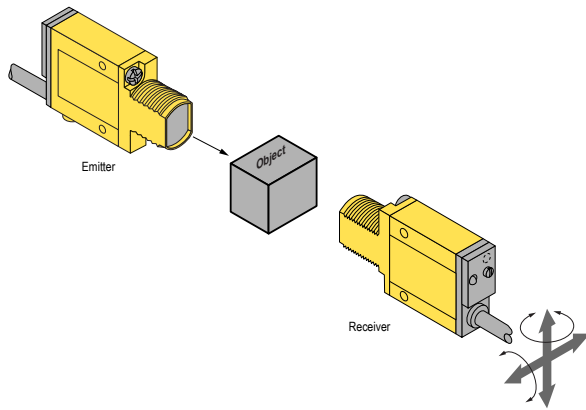
**Note:** Follow proper electronic shock discharge (ESD) precautions when adjusting the Gain potentiometer or the LO/DO switch.



**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:

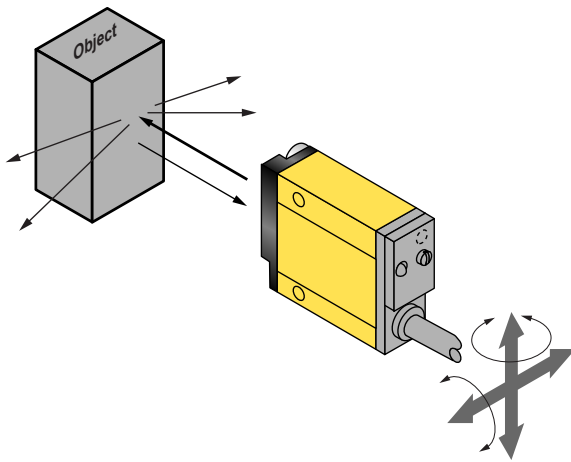
- Reduce the Gain adjustment on the receiver
- Add an aperture to one or both lenses (MINI-BEAM apertures, available from Banner, fit neatly inside the lens assembly)
- Intentionally misalign the emitter and receiver



**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:

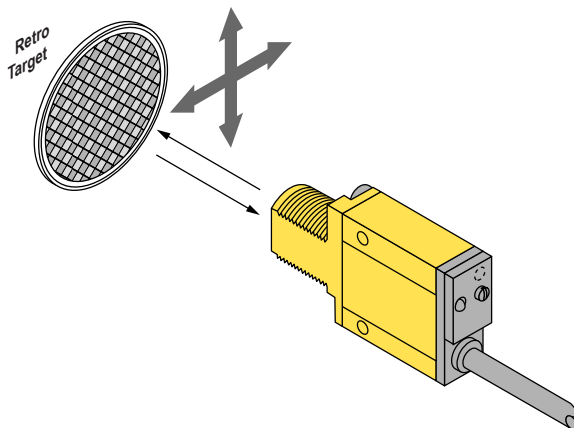
- Reduce the reflectivity of the background by painting the surface(s) flat-black, scuffing any shiny surface, or drilling a large hole, directly opposite the diffuse sensor
- Move the sensor closer to the object to be detected and reduce the Gain adjustment. Rule of thumb for diffuse sensing: The distance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

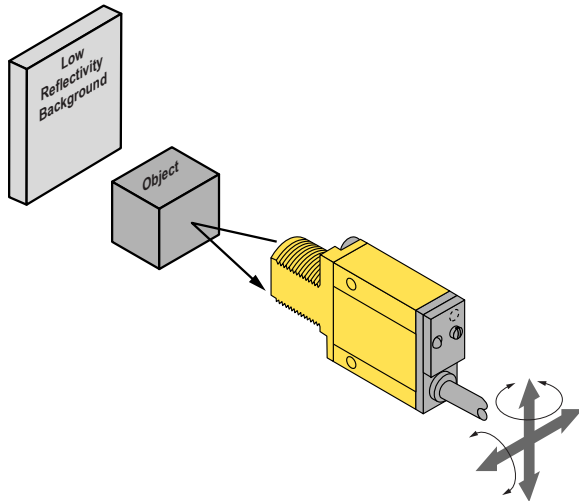
- Position the sensor and retro target so the beam will not strike a shiny surface perpendicular to the sensor lens
- Reduce the Gain adjustment
- Add a polarizing filter (for model SM2A312LV)



**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



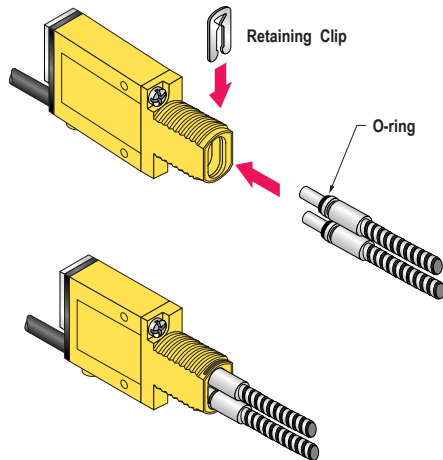
The sensing energy of a convergent mode sensor is concentrated at the specified focus point. Convergent mode sensors are less sensitive to background reflections, compared with diffuse mode sensors. However, if background reflections are a problem:

- 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:**

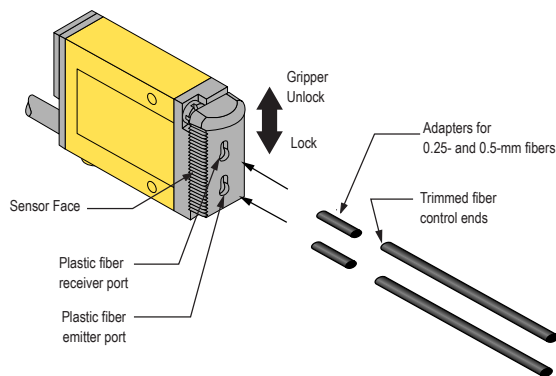
- Light condition: sensor output is ON when there is no object in the beam
- Dark condition: sensor output is ON when there is an object in the beam

### 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:  $\leq 5$  V at 300 mA load,  $\leq 10$  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.

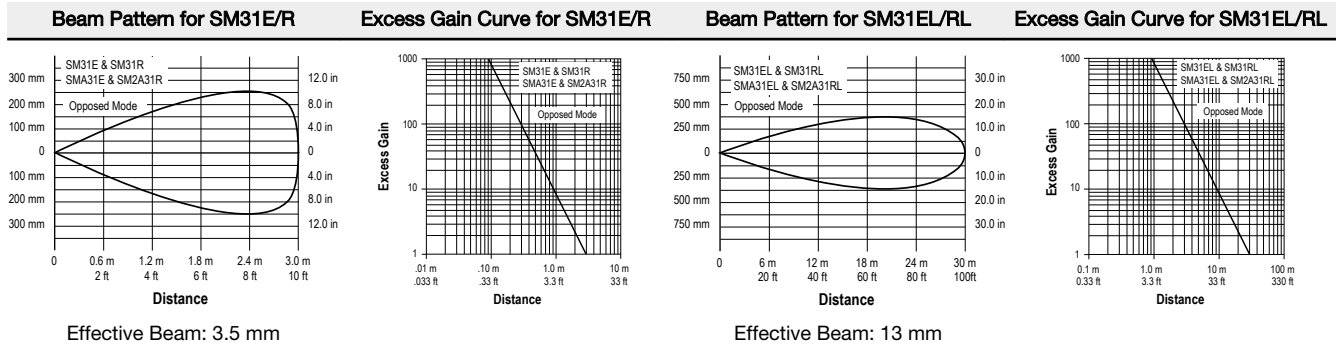
Supply wiring leads  $< 24$  AWG shall not be spliced. For additional product support, go to [www.bannerengineering.com](http://www.bannerengineering.com).

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

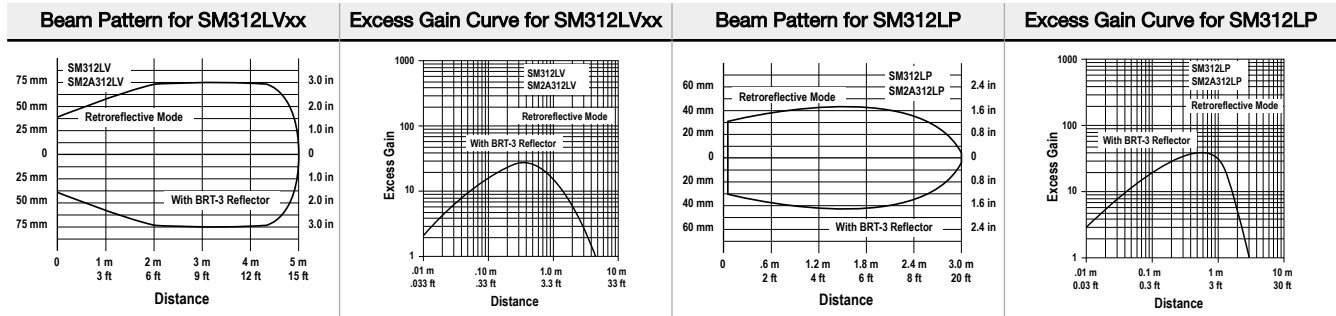
### Certifications

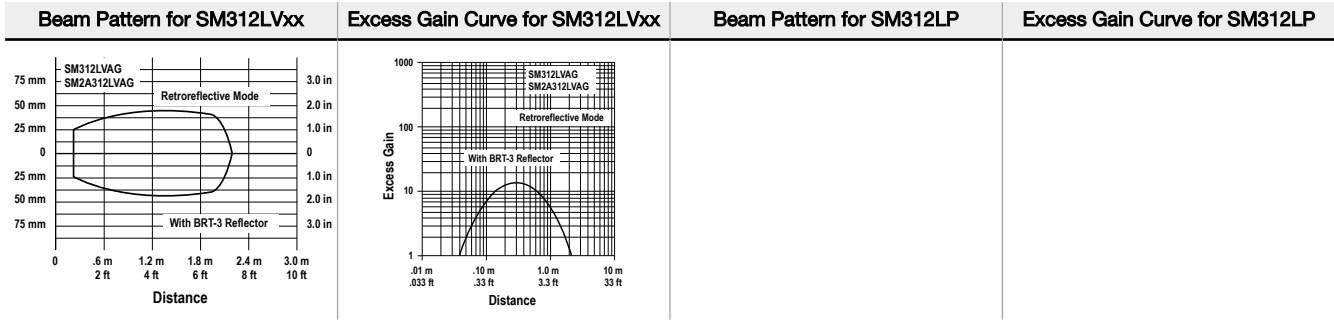


## Performance Curves for SM31Ex Emitter and SM31Rx Receiver Models

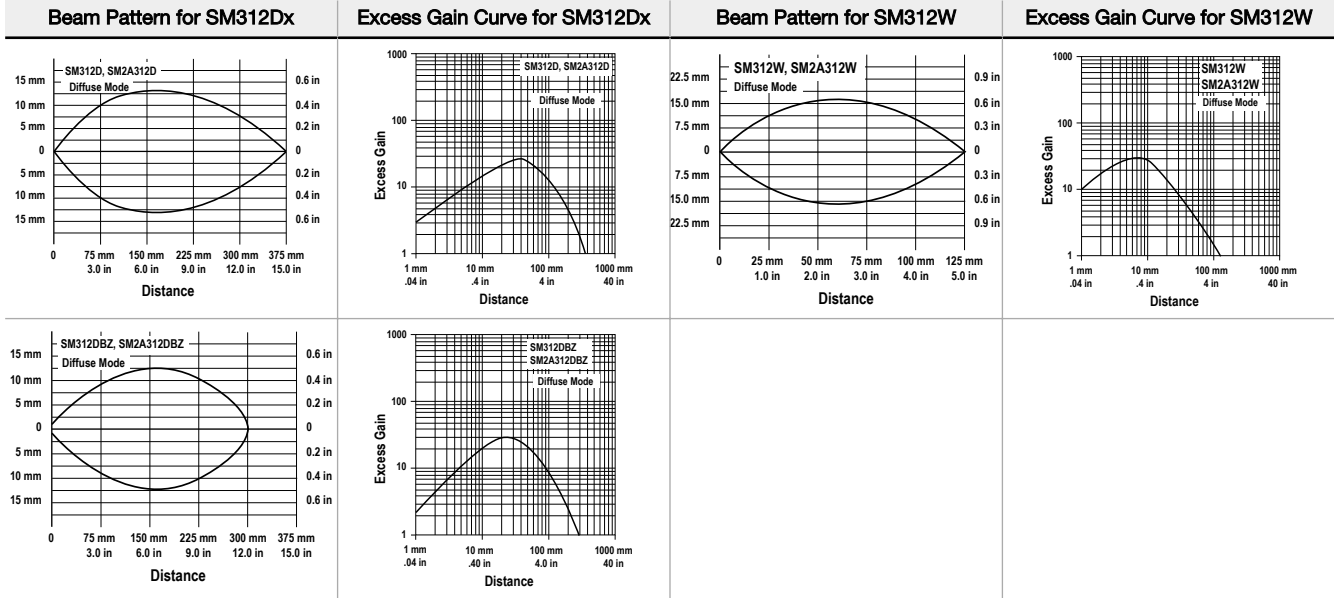


## Performance Curves for the SM312Lx Retroreflective Models

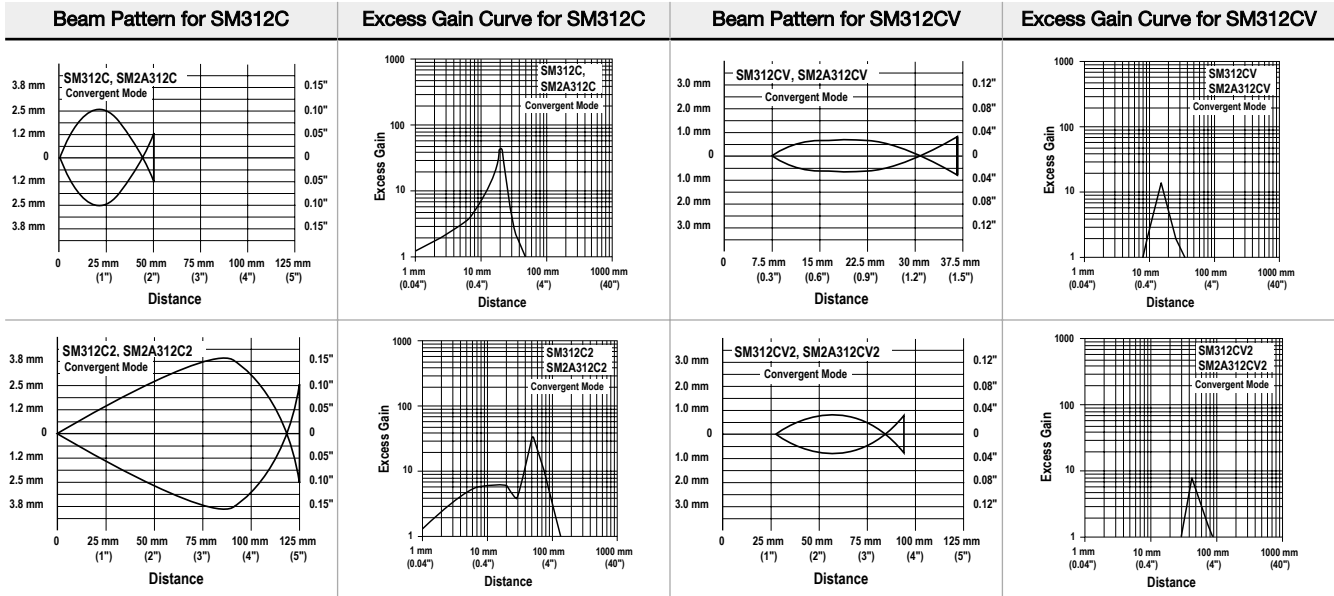




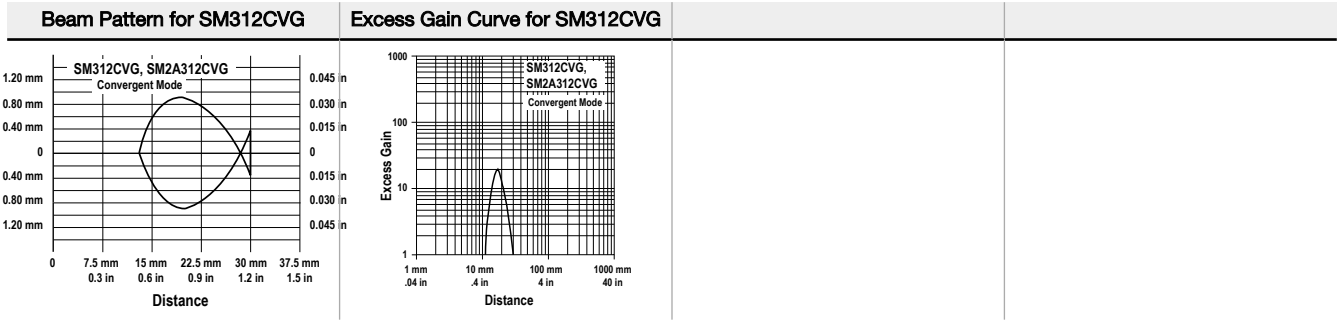
Performance Curves for the SM312Dx and SM312W Diffuse Models



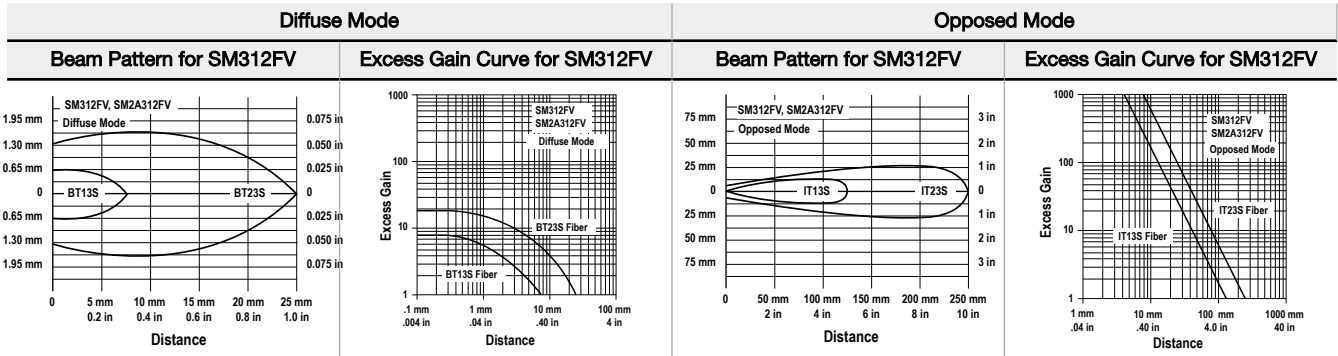
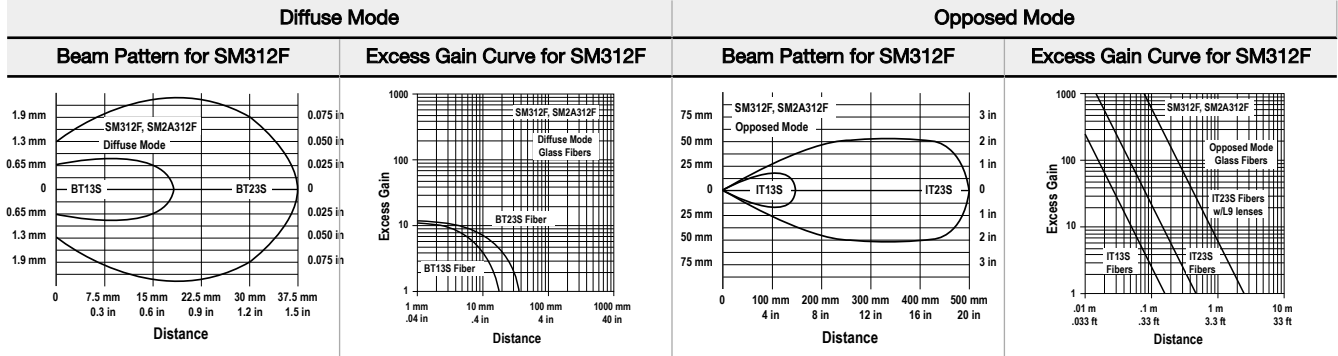
Performance Curves for the SM312Cx Convergent Models



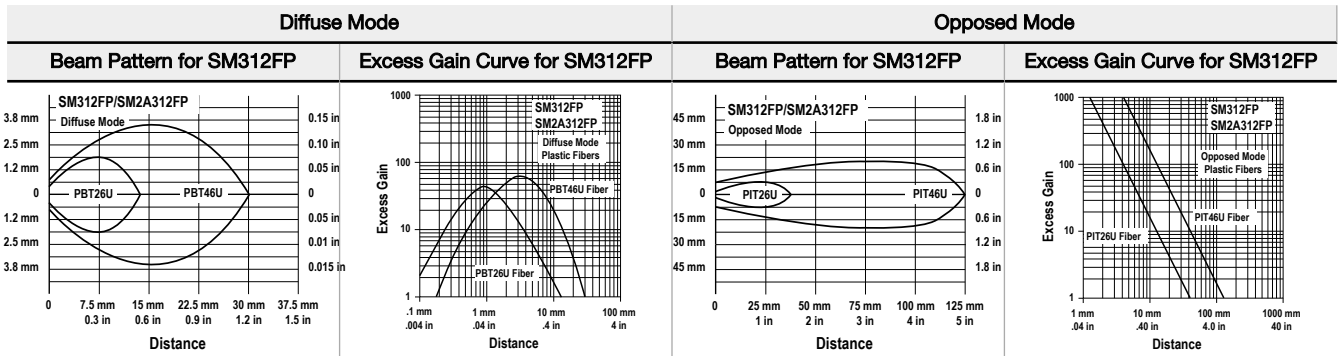
Performance is based on a 90% reflectance white test card.



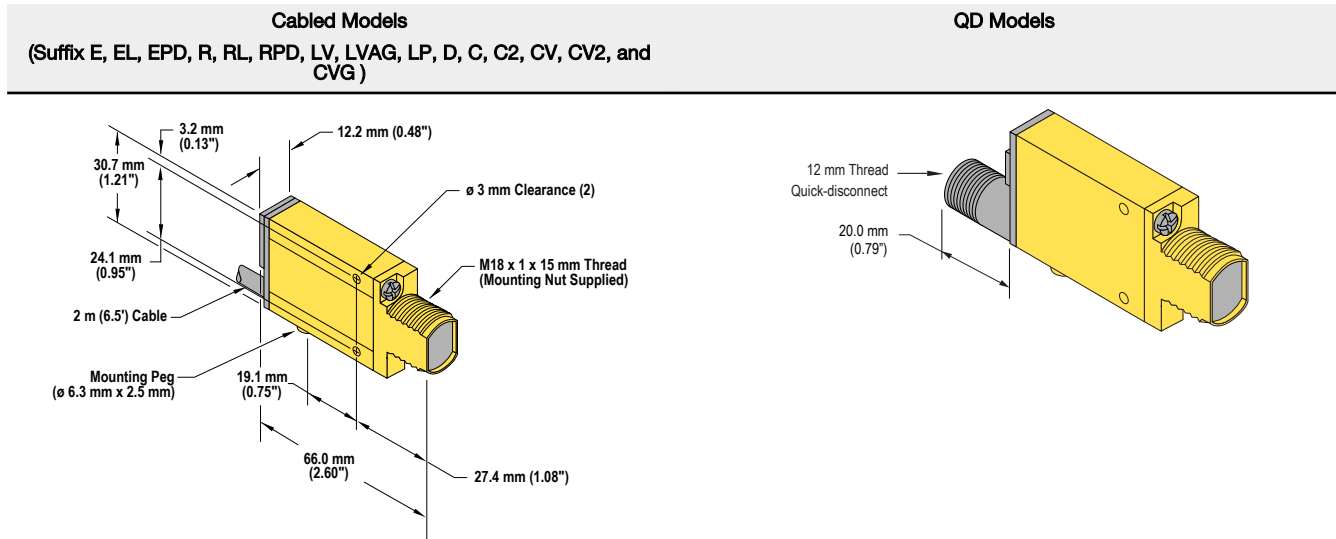
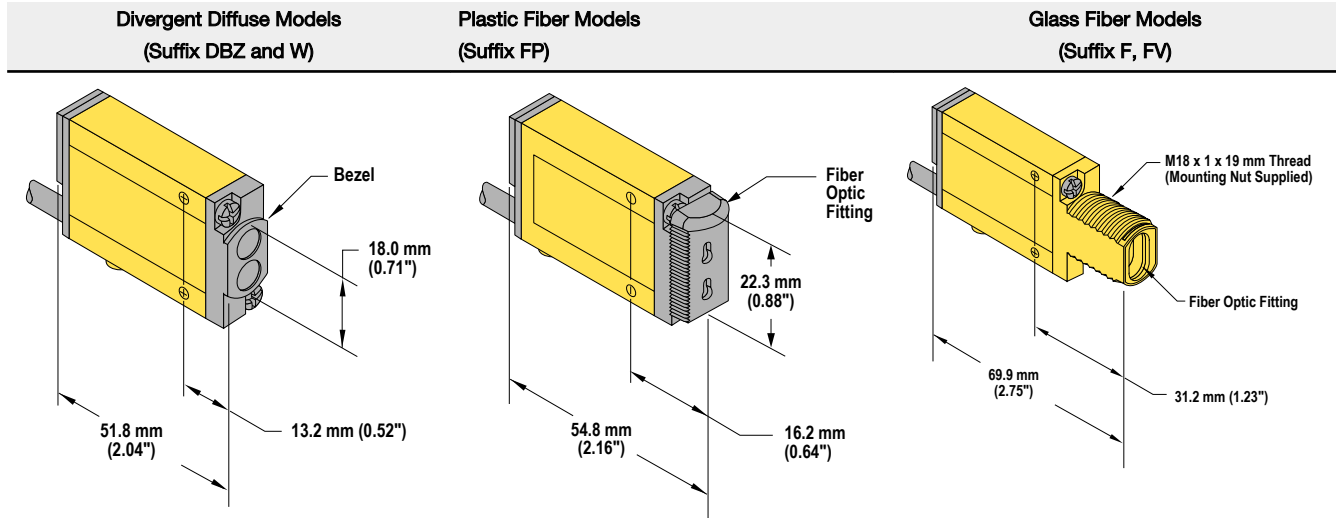
Performance Curves for the SM312F Glass Fiber Optic Models



Performance Curves for the SM312FP Plastic Fiber Models



Dimensions



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