

## Intrinsically safe dc sensor



SMI912 Series sensor, with CI3RC2 current amplifier module (left) and intrinsic safety barrier (right)

- Offers economy, performance and reliability in a rugged housing
- Provides standard limit-switch mounting hole spacing
- Use with approved intrinsically safety barriers and Banner MAXI-AMP™ model CI3RC2 current trip point amplifier
- Certified for use in all Classes, Groups, and Divisions of hazardous locations as defined by Article 500 of the National Electrical Code when used with approved I.S. barriers
- Provides 10 to 30 V dc supply voltage with NPN output
- Features a light- or dark-operate selection switch
- Available in opposed, polarized and non-polarized retroreflective, diffuse, convergent, and glass or plastic fiber optic sensing modes
- Ranges up to 60 meters
- Integral 3-pin Mini-style QD fitting; QD cordset required, see *Accessories*

Sensing Mode	Models	Range	
<p>OPPOSED</p>	Long-range opposed, 880 nm	60 m (200 ft)	
	Effective Beam: 13 mm (0.5 in)		SMI91EQD Emitter SMI91RQD Receiver
	Short-range opposed, 880 nm	3 m (10 ft)	
	Effective Beam: 3.5 mm (0.14 in)		SMI91ESRQD Emitter SMI91RSRQD Receiver
<p>RETRO</p>	Non-polarized retroreflective, 650 nm Visible Red	SMI912LVQD	150 mm to 9 m (6 in to 30 ft) <sup>1</sup>
<p>POLAR RETRO</p>	Polarized retroreflective, 650 nm Visible Red	SMI912LVAGQD	300 mm to 4.5 m (1 to 15 ft) <sup>1</sup>

Sensing Mode	Models	Range	
<p>DIFFUSE</p>	Long-range diffuse, 880 nm Infrared	SMI912DQD	760 mm (30 in)
	Short-range diffuse, 880 nm Infrared	SMI912DSRQD	380 mm (15 in)
<p>CONVERGENT VISIBLE RED</p>	Convergent, 650 nm Visible Red	SMI912CVQD	Focus at: 38 mm (1.5 in) Spot Size at Focus: 1.5 mm (0.06 in)
<p>PLASTIC FIBER</p>	Plastic fiber optic, 650 nm Visible Red	SMI912FPQD	See performance curves
<p>GLASS FIBER</p>	Glass fiber optic, 880 nm Infrared	SMI912EFQD Emitter SMI912RFQD Receiver	
	Glass fiber optic, 880 nm Infrared	SMI912FQD	

<sup>1</sup> Performance based on use of a model BRT-3 retroreflector (3-inch diameter). Actual sensing range may be more or less than specified, depending on the efficiency and reflective area of the retroreflector used.





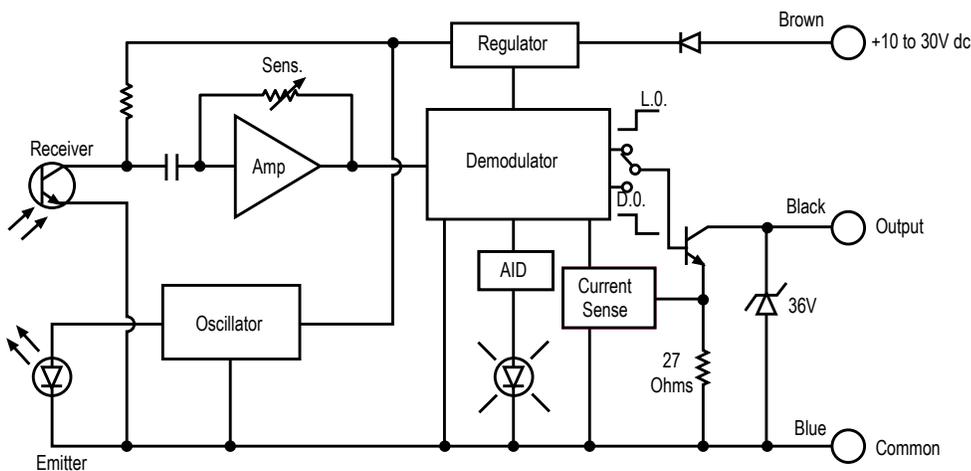
### WARNING: Not To Be Used for Personnel Protection

Never use this device as a sensing device for personnel protection. Doing so could lead to serious injury or death. This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.

## Overview

VALU-BEAM SMI912 Series sensors are designed for intrinsically safe operation in hazardous atmospheres. They are certified by FM Approvals and CSA as being intrinsically safe when used with approved intrinsic safety barriers.

SMI912 Series sensors may be wired for either two- or three-wire current-sinking operation. In the three-wire hookup, which requires two intrinsic-safety barriers, the sink current is 15 mA. The two-wire hookup, which requires one barrier, sinks  $\leq 10$  mA (OFF state) and  $\geq 20$  mA (ON state).



SMI912 Series sensors feature rugged, encapsulated construction, along with adjustable sensitivity and switchable light or dark operate. They also include Banner's exclusive Alignment Indicating Device system, which lights an indicator LED whenever the sensor "sees" its modulated light source, and pulses at a rate proportional to the received light signal strength.

Intrinsic safety barriers and current trip point amplifier model CI3RC2 are also available (see *Accessories*).

## Installation Notes



### WARNING: Explosion Hazard

Do not disconnect equipment unless power has been switched Off or the area is known to be non-hazardous.

### FM Installation

- Barriers must be installed in accordance with manufacturer's instructions.
- Barrier entity parameters must meet the following requirements:
  - $V_{oc}$  or  $V_t \leq V_{max}$   $C_a \geq C_i + C_{cable}$
  - $I_{sc}$  or  $I_t \leq I_{max}$   $L_a \geq L_i + L_{cable}$
- Maximum non-hazardous area voltage must not exceed 250V.
- For guidance on installation, see ANSI/ISA RP12.6, "Installation of Intrinsically Safe Instrument Systems for Hazardous (Classified) Locations."
- The sensors are suitable for installation without barriers in Class I Div. 2 Groups A, B, C, D; Class II Div. 2 Group G; and Class III Div. 2, when installed in (or through the wall of) a suitable enclosure with provision for connection of rigid metal conduit per the National Electrical Code, as acceptable to the local inspection authority having jurisdiction.

## CSA Installation

1. Barriers must be installed in accordance with manufacturer's instructions.
2. Barrier entity parameters must meet the following requirements:
  - $V_{oc} \leq V_{max}$   $C_a \geq C_i + C_{cable}$
  - $I_{sc} \leq I_{max}$   $L_a \geq L_i + L_{cable}$
3. Maximum non-hazardous area voltage must not exceed 250V.
4. Install in accordance with Canadian Electrical Code, Part I.
5. The sensors are suitable for installation without barriers in Class I Div. 2 Groups A, B, C, D when installed in (or through the wall of) a suitable enclosure with provision for connection of rigid metal conduit per the Canadian Electrical Code, as acceptable to the local inspection authority having jurisdiction.

In Div. 2 installations (without barriers), observe warning at left.

6. If barriers with Volt/Ohm parameters are used, the following parameters shall apply:

### One Single-Channel Barrier Systems

- one 28 V (max), 300  $\Omega$  (min)

### Two Single-Channel Barrier or One Dual-Channel Systems

- two 28 V (max), 600  $\Omega$  (min)
- one 28 V (max), 300  $\Omega$  (min) and one 10 V (max), 50  $\Omega$  (min)
- one 28 V (max), 300  $\Omega$  (min) and one 28 V diode return

### Sensor Entity Parameters

- $V_{max} (U_i) \leq 30V$  dc
- $I_{max} (I_i) \leq 350$  mA
- $P_i \leq 750$  mW
- $C_i = 0$   $\mu$ F
- $L_i = 0$  mH

## Wiring Connections

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SMI912 Series sensors are certified intrinsically safe ONLY when used with certified energy-limiting intrinsically safe barriers. Banner does not manufacture such barriers; however, our applications engineers can refer you to suppliers of certified barriers that will interface with Banner sensors. SMI912 Series sensors may be wired using Banner Current Amplifier Control Module CI3RC2. Note from the wiring diagrams that the installation may be made with either a single barrier (2-wire hookup) or with a double barrier (3-wire hookup). Emitter-only units (SMI91EQD, ESRQD, and EFQD) use the 2-wire hookup; all other models use either 2- or 3-wire hookup.

In the 2-wire configuration, the sensor will act as a current sink, drawing less than 10 mA in the OFF state and more than 20 mA in the ON state. The user must provide a current sensing device ("current sensor" in the diagram) to convert the current to a logic level. In the 3-wire configuration, the output may be used directly to control loads of less than 15 mA.

In selecting the barrier, it is important to consider the barrier's resistance. The sensor must have at least 10 volts across the brown and blue power leads for proper operation, and the barrier will cause a voltage drop due to its resistance. The formula that determines how much resistance is allowed is:

$R = 40$  (supply voltage – 10 volts). If the supply voltage is 24 V dc, then the maximum resistance is 560 ohms. If the supply voltage is 18 V dc, then the maximum resistance is 320 ohms. This includes the resistance of any current sensing device used (in the 2-wire configuration), so the barrier resistance must be further reduced by the current sensor resistance.

Note that, in the 3-wire hookup, the positive load barrier is in series with the load. This will result in an apparent saturation voltage of the output that is higher than the sensor output by the amount of  $I \times R$  (current times resistance) drop through the barrier.

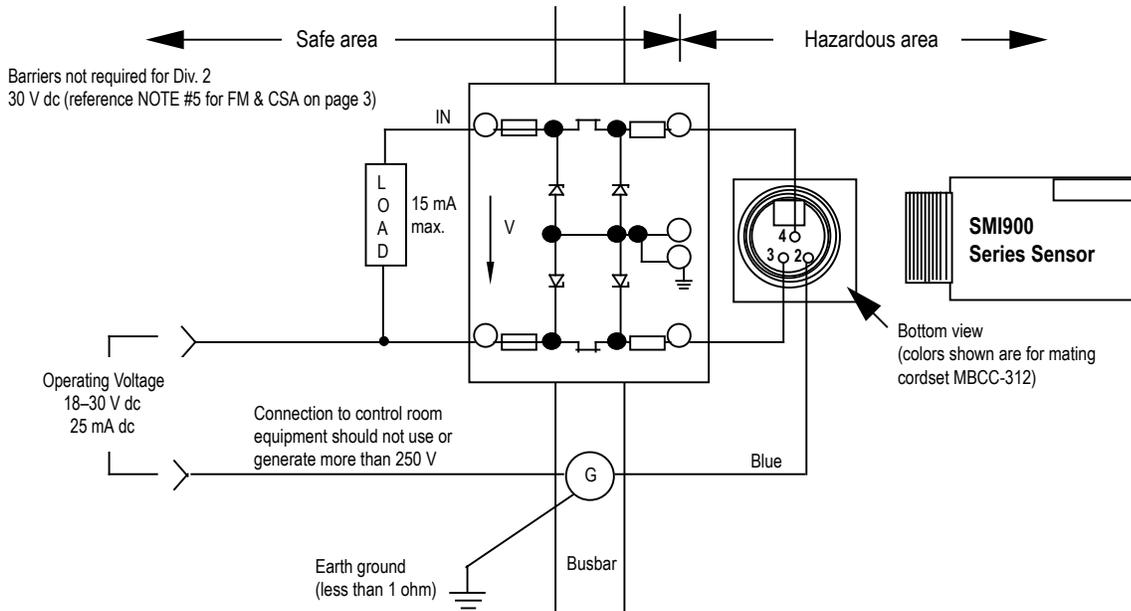
A "positive input" barrier is required for both supply and for load. The sensor's blue (negative supply) lead is normally connected to the ground terminal of the barrier.

The user is responsible for proper installation and maintenance of this equipment, and must conform with the certification requirements relating to barriers and to maximum allowable capacitance and inductance of the field wiring. If in doubt about these requirements, our applications engineers can refer you to the appropriate authority.



**CAUTION: Electrostatic Discharge (ESD)**

Special Conditions for Safe Use. Parts of the enclosure are non-conducting and may generate an ignition-capable level of ESD. Cleaning of the equipment shall be done only with a damp cloth.



**Note: Emitters have no output connection (no connection to black wire)**

Figure 1. Wiring for 3-Wire Connections

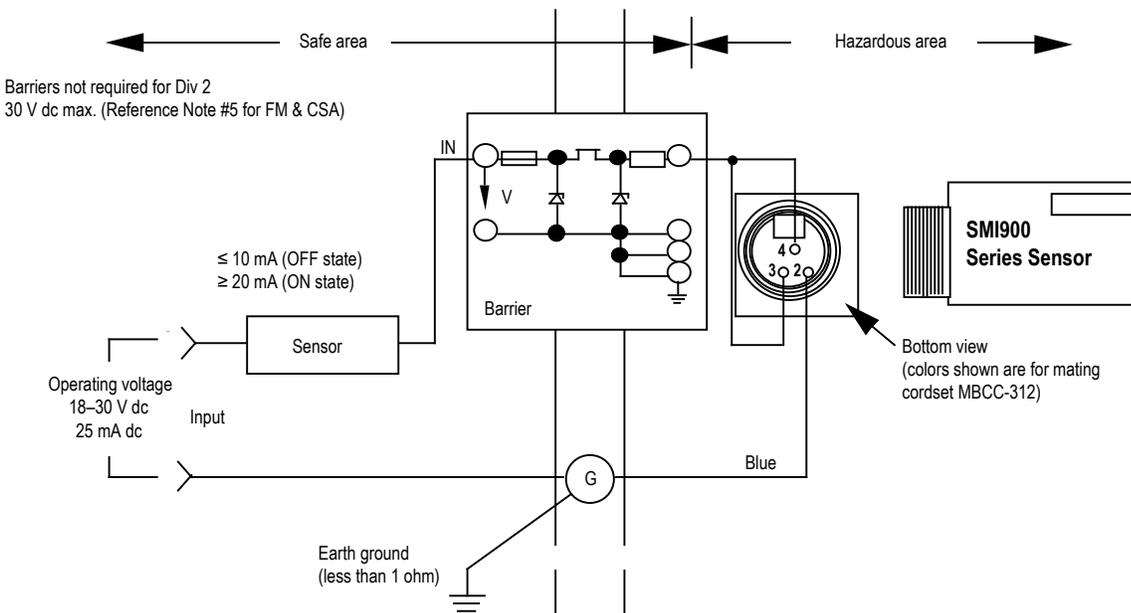


Figure 2. Wiring for 2-Wire Connections

## Specifications

### Supply Voltage and Current

Sensor only: requires 10 to 30 V dc, 25 mA maximum

### Sensing Beam

Infrared (880 nm) or visible red (650 nm), depending on model

### Adjustments

Light/Dark Operate select switch on rear of sensor  
Sensitivity control on rear of sensor allows precise gain setting (turn clockwise to increase gain)

### Indicators

Sensors include Banner's exclusive Alignment Indicating Device (AID™) system, which lights a top-mounted red indicator LED whenever the sensor "sees" its modulated light source, and pulses the LED at a rate proportional to the received light signal strength.

### Construction

Housing: reinforced PBT, totally encapsulated  
Lenses: molded acrylic  
Hardware: stainless steel

### Connections

Supplied with integral 3-pin Mini-style QD fitting; requires cordset model MBCC (see *Accessories*), purchased separately.

### Application Note

Special Conditions for Safe Use: Parts of the enclosure are non-conducting and may generate an ignition-capable level of ESD. Cleaning of the equipment shall be done only with a damp cloth.

### Output Configuration

Current sinking NPN open-collector transistor

### Output Rating

Three-wire hookup sinks 15 mA maximum, continuous (10 to 30 V dc)  
Two-wire hookup sinks  $\leq 10$  mA (OFF state) and  $\geq 20$  mA (ON state), 10 to 30 V dc.  
Outputs are short-circuit protected.

### Output Response Time

Opposed-mode receivers: 8 milliseconds ON/4 milliseconds OFF; independent of signal strength  
All other models: 4 milliseconds ON and OFF  
100 millisecond delay on power-up (output does not conduct during this time).

### Repeatability

Opposed mode: 1.0 millisecond  
All other modes: 1.3 milliseconds  
Repeatability is independent of signal strength.

### Environmental Ratings

Banner tested to NEMA standards 1, 2, 3, 3S, 4, 4X, 12, and 13, IEC IP66

### Operating Conditions

Temperature:  $-20$  °C to  $+70$  °C ( $-4$  °F to  $+158$  °F)  
Max. Relative Humidity: 90% @  $50$  °C (non-condensing)

### Certifications



## Design Standards

ATEX (European)	EN 60079-0, EN 60079-11, EN 60079-26
Canadian	CAN/CSA C22.2, No. 142-M1987, No.157-92, No. 1010.1, E60079-0, E60079-11
United States	FM Class 3600, 3610, and 3810, ANSI/ISA 61010-1 (82.02.01), ANSI/ISA 60079-0, 60079-11, and 60079-26.
IECEX	IEC 60079-0 (Ed.6.0); IEC 60079-11 (Ed. 6.0)

## Approvals

ATEX (European)	II 2 G Ex ib IIC T5 Gb Ta = $-40$ °C to $70$ °C - 03396; Entity FM12ATEX0094X Entity Parameters: VMax = 30 V, IMax = 350 mA, Ci = 0 $\mu$ F, Li = 0 mH.
Canadian	SMI 91 (a) Non-incendive for Class I, Division 2, Groups A, B, C and D, T5 Ta = $-40$ °C to $70$ °C a = 2LVQD, 2DQD, 2DSRQD, 2FQD, 2CVQD, 2LVAGQD or 2FPQD.
	SMI 91 (b) Non-incendive for Class I, Division 2, Groups A, B, C and D, T5 Ta = $-40$ °C to $70$ °C Intrinsically safe for Class I, Zone 1 Ex ib Group IIC T5 Ta = $-40$ °C to $70$ °C; - 03396, Entity Entity Parameters: VMax = 30 V, IMax = 350 mA, Ci = 0 $\mu$ F, Li = 0 mH. b = 1RQD, RSRQD, RFQD, EQD, ESRQD or EFQD.
United States	SMI 91 (a) Non-incendive for Class I, Division 2, Groups A, B, C and D, T5 Ta = $-40$ °C to $70$ °C Suitable for Class II and III, Division 2, Groups F and G*, T5 Ta = $-40$ °C to $70$ °C a = 2LVQD, 2DQD, 2DSRQD, 2FQD, 2CVQD, 2LVAGQD or 2FPQD.
	SMI 91 (b) Non-incendive for Class I, Division 2, Groups A, B, C and D, T5 Ta = $-40$ °C to $70$ °C Suitable for Class II and III, Division 2, Groups F and G*, T5 Ta = $-40$ °C to $70$ °C Intrinsically safe for Class I, Zone 1 AEx ib Group IIC T5 Gb Ta = $-40$ °C to $70$ °C - 03396; Entity Entity Parameters: VMax = 30 V, IMax = 350 mA, Ci = 0 $\mu$ F, Li = 0 mH. b = 1RQD, RSRQD, RFQD, EQD, ESRQD or EFQD.
IECEX	Ex ib IIC T5 Ta = $-40$ °C to $+70$ °C - 03396; Entity - IECEX FMG 14.0029X Entity Parameters: Vmax = 30 V, Imax = 350 mA, Ci=0 $\mu$ f, Li=0 mH

**BANNER VALU-BEAM®**  
 INSTALL PER MFG. DWG. 03396  
**MODEL: XXXXXXXXXXXXXXXXXXXX**  
 I<sub>max</sub> (Ii) = 350mA  
 V<sub>max</sub> (Ui) = 30VDC Ci = 0 Li = 0  
 XXXXX

**SP** NRTL/C LR41887 Exia  
 INTRINSICALLY SAFE/ SECURITE INTRINSIQUE

**Ex** FM12ATEX0094X  
 II 2 G Ex ib IIC T5 Gb Ta = -40°C to +70°C  
 CL I, ZN 1 AEx/Ex ib IIC T5 Gb  
 CL I, DIV 2 GP ABCD (CL II, III, DIV 2 GP EF US only)  
 IECEx FMG 14.0029X Ex ib IIC T5

**CE** 1725  
**FM** APPROVED

**BANNER VALU-BEAM®**  
 FOR HAZARDOUS LOCATIONS  
 INSTALL PER MFG. DWG. 03396  
**MODEL: XXXXXXXXXXXXXXXXXXXX**  
 I<sub>max</sub> (Ii) = 350mA  
 V<sub>max</sub> (Ui) = 30VDC Ci = 0 Li = 0  
 XXXXX

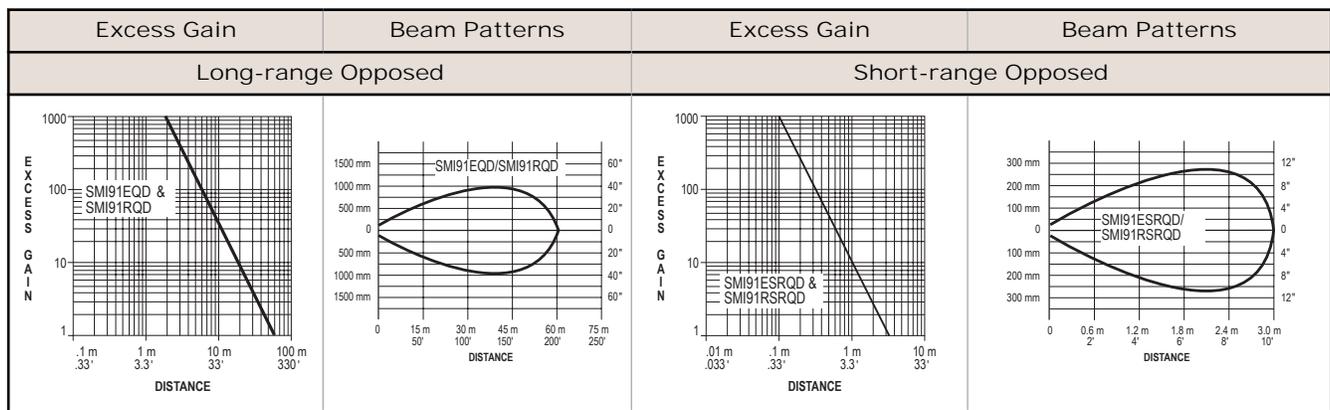
**SP** NRTL/C LR41887 Exia  
 INTRINSICALLY SAFE/ SECURITE INTRINSIQUE

**CE**

**FM** APPROVED  
 CL I, DIV 2 GP ABCD (CL II, III, DIV 2 GP EF US only)

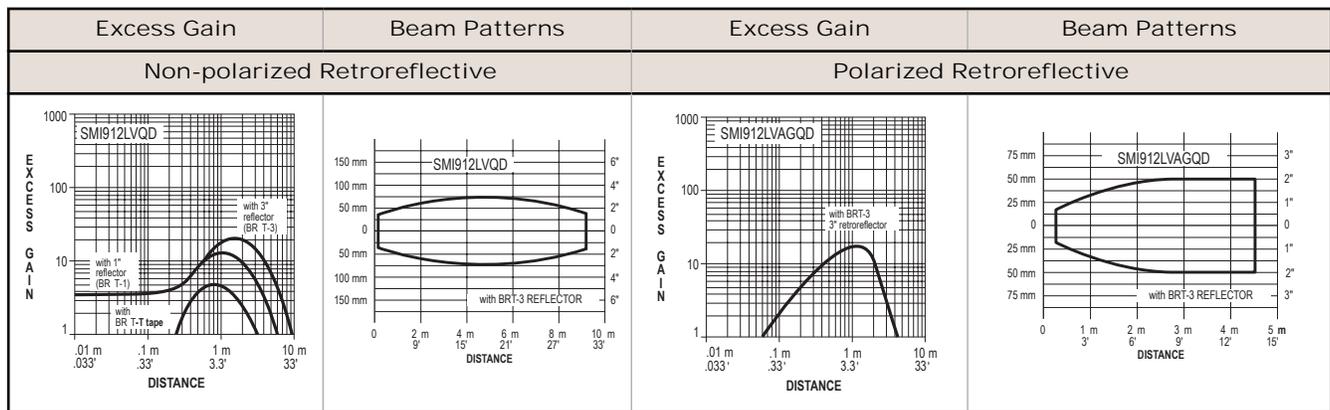
### Performance Curves

#### Opposed



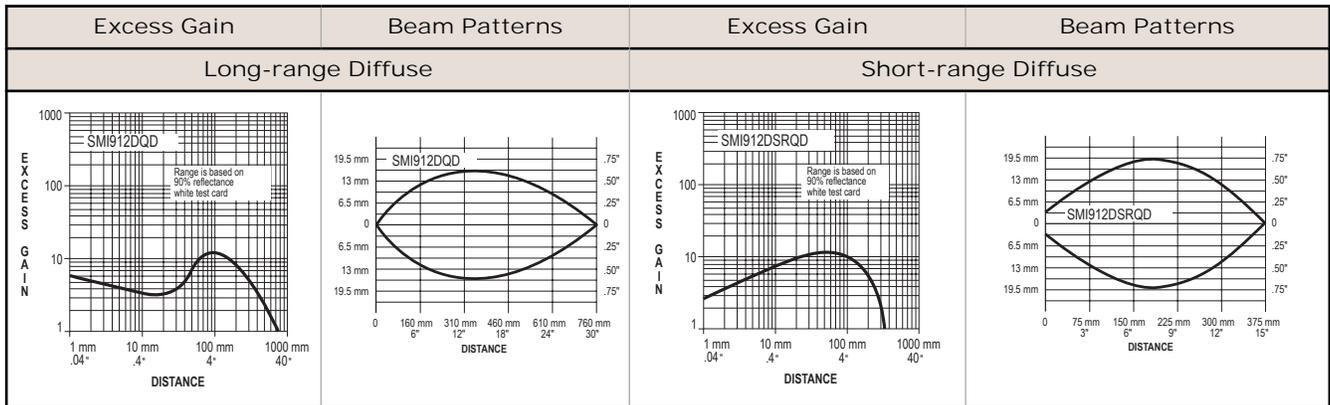
#### Retroreflective

Retroreflective performance based on use of a model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending on the efficiency and reflective area of the retroreflector used.

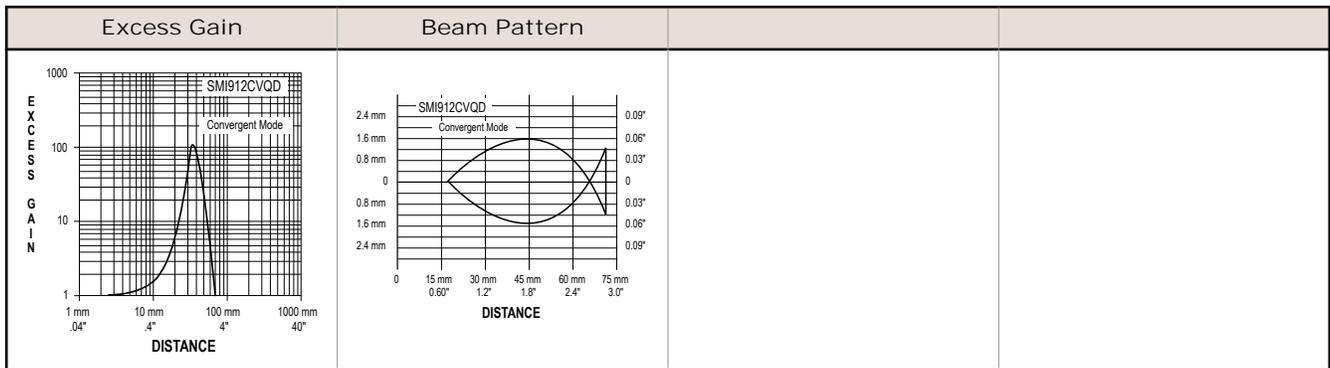


Diffuse

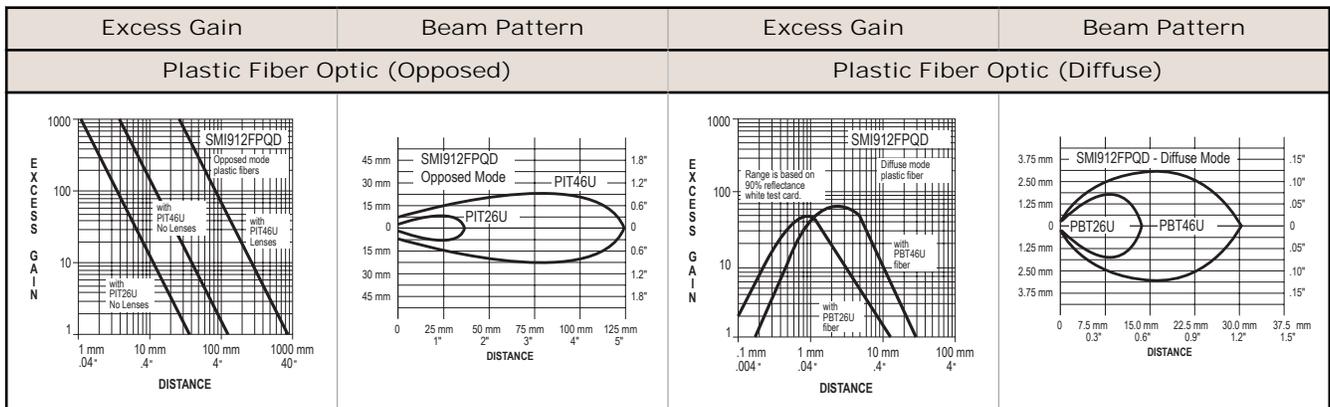
Diffuse mode performance based on use of 90% reflectance white test card.



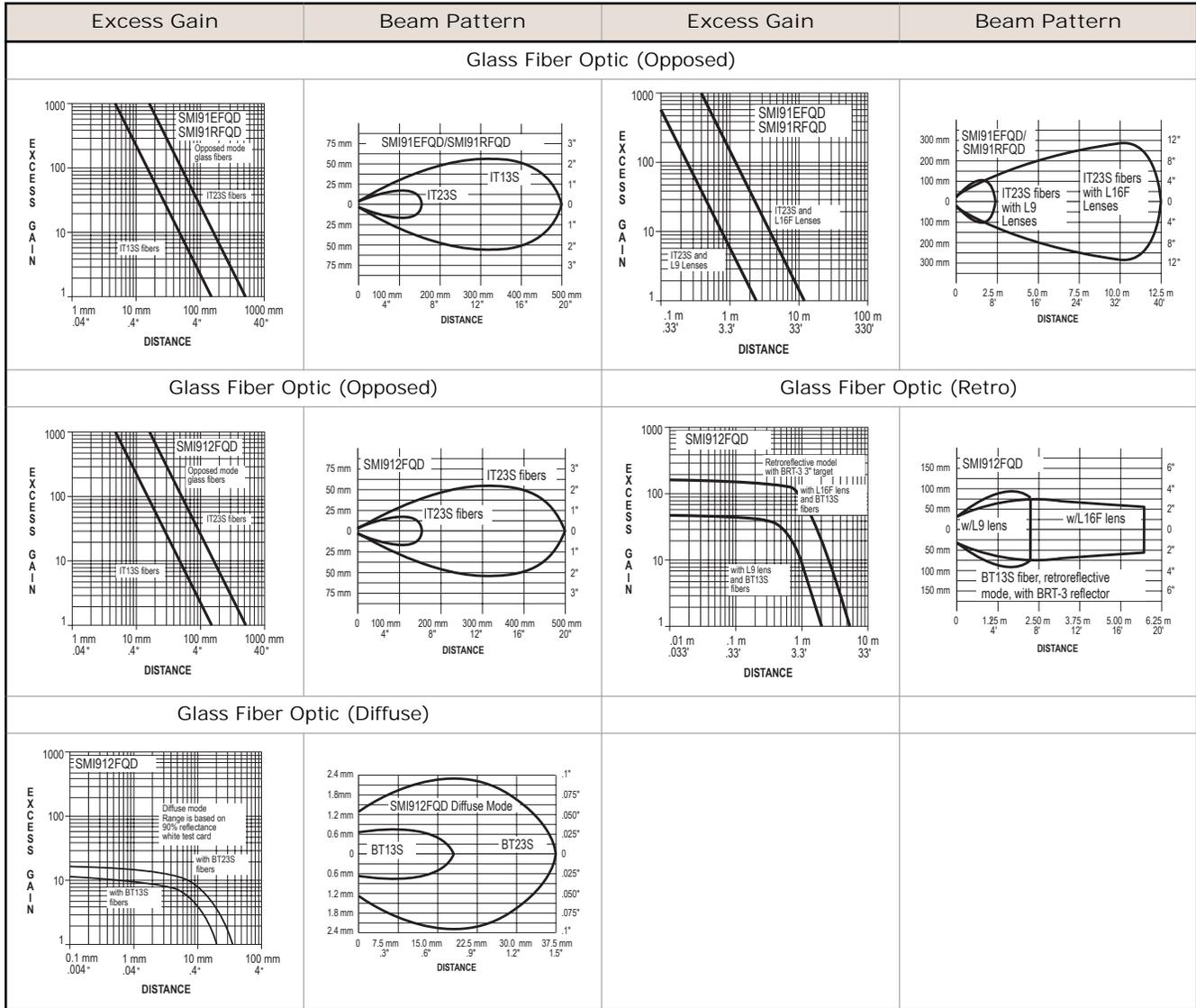
Convergent



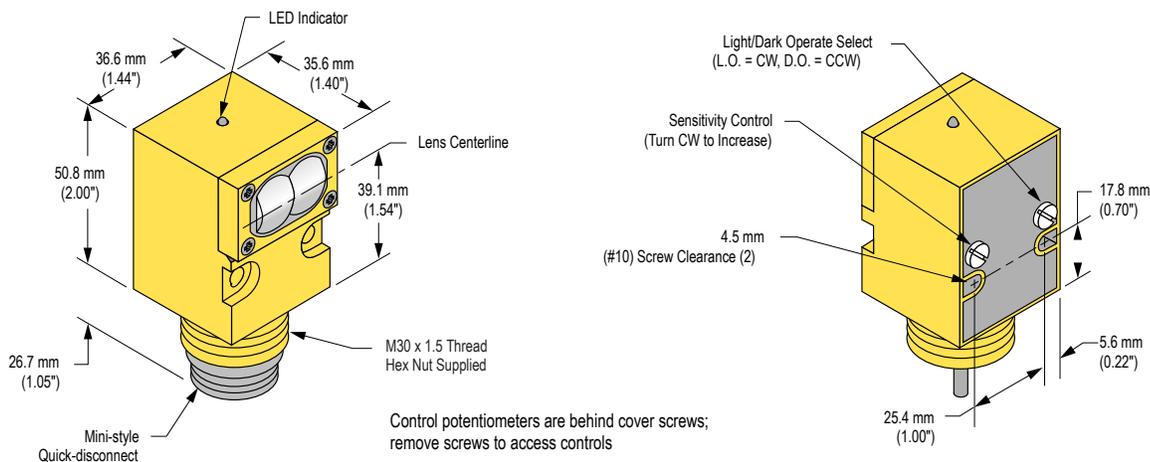
Plastic Fiber Optic



Glass Fiber Optic



Dimensions



## Accessories

3-Pin Mini-Style Cordsets					
Model	Length	Style	Dimensions	Pinout (Female)	
MBCC-306	1.83 m (6.5 ft)	Straight		<p>1 = Black 2 = Brown 3 = Blue</p>	
MBCC-312	3.66 m (12 ft)				
MBCC-330	9.14 m (30 ft)				
SMICC-306	1.83 m (6.5 ft)	Straight			<p>1 = Red/Black 2 = Red/White 3 = Green</p>
SMICC-312	3.66 m (12 ft)				
SMICC-330	9.14 m (30 ft)				
SM3OCC-306	1.83 m (6.5 ft)	Straight			<p>1 = Red/Black 2 = Red/White 3 = Green</p>
SM3OCC-312	3.66 m (12 ft)				

Mounting Brackets	
<p><b>SMB30A</b></p> <ul style="list-style-type: none"> <li>Right-angle bracket with curved slot for versatile orientation</li> <li>Clearance for M6 (1/4 in) hardware</li> <li>Mounting hole for 30 mm sensor</li> <li>12-ga. stainless steel</li> </ul> <p>Hole center spacing: A to B=40 Hole size: A=∅ 6.3, B= 27.1 x 6.3, C=∅ 30.5</p>	<p><b>SMB30MM</b></p> <ul style="list-style-type: none"> <li>12-ga. stainless steel bracket with curved mounting slots for versatile orientation</li> <li>Clearance for M6 (1/4 in) hardware</li> <li>Mounting hole for 30 mm sensor</li> </ul> <p>Hole center spacing: A = 51, A to B = 25.4 Hole size: A = 42.6 x 7, B = ∅ 6.4, C = ∅ 30.1</p>
<p><b>SMB30SC</b></p> <ul style="list-style-type: none"> <li>Swivel bracket with 30 mm mounting hole for sensor</li> <li>Black reinforced thermoplastic polyester</li> <li>Stainless steel mounting and swivel locking hardware included</li> </ul> <p>Hole center spacing: A=∅ 50.8 Hole size: A=∅ 7.0, B=∅ 30.0</p>	

## Current Trip-Point Modules

Current Trip-Point Module	
Model	Description
CI3RC2	<ul style="list-style-type: none"> <li>Self-contained module converts the SMI912 sensor's current output signal to a trip point switch.</li> <li>SPDT electromechanical relay switches loads that draw up to 5 amps. The SPST solid-state relay can switch a dc load of up to 30 V dc, max.; 20 mA max.</li> <li>Powered by either 105 to 130 V ac or 210 to 250 V ac.</li> <li>Supplies dc power to operate a single sensor or both the emitter and receiver of one SMI Series opposed-mode sensor pair. The sensor's input to the CI3RC2 is protected against short circuits. Built-in circuit diagnostics indicate an input overload by flashing an LED status light.</li> <li>Module has two isolated output switches, a 5-amp rated SPDT electromechanical relay and a solid-state transistor switch used for logic-level interfaces.</li> <li>May be ordered either alone or as a part of a kit.</li> </ul>

Current Trip-Point Module	
Model	Description
	<p><b>Supply Voltage</b> 105 to 130 V ac or 210 to 250 V ac, 50/60 Hz (8 VA)</p> <p><b>Output Configuration (SPDT electromechanical relay)</b> Contact rating: 250 V ac maximum, 24 V dc maximum, 5 amps maximum (resistive load), 1/10 HP at 240 V ac. Install transient suppressor (MOV) across contacts which switch inductive loads. Min. load: 12 V dc, 0.1 A. Closure time: 10 milliseconds maximum. Release time: 10 milliseconds maximum. Maximum switching speed: 20 operations/second. Mechanical life: 20,000,000 operations</p> <p><b>Output Configuration (Solid-state dc relay)</b> SPST optically-coupled transistor; 30 V dc maximum, 20 mA maximum.</p> <p><b>Emitter Power</b> +24 V dc at 25 mA maximum available at module pin #3</p> <p><b>Inputs</b> Trip point for output "OFF": <math>\leq 10</math> mA Trip point for output "ON": <math>\geq 20</math> mA Trip point range for input overload indication: <math>30 \text{ mA} \leq I \leq 80 \text{ mA}</math></p> <p><b>Indicators</b> Status Indicators for OUTPUT "ON" and INPUT overload/short</p> <p><b>Construction</b> Housing: rugged polyphenylene oxide (PPO®) 1.6" x 2.3" x 4" Standard round-pin 11-pole base. Use RS-11 socket or equivalent.</p> <p><b>Operating Conditions</b> Temperature: 0 °C to +50 °C (+32 °F to +122 °F)</p>

Intrinsic Safety Barriers			
Model (Barrier Only)	Barrier Description	Kit Model	Kit Description
CI B-1	Single-channel intrinsically safe barrier	CI 2BK-1	Includes CI3RC2 current amplifier, one RS-11 socket, one DIN-rail mount, one single-channel intrinsically safe barrier
CI 2B-1	Dual-channel intrinsically safe barrier (typically used in opposed-mode applications)	CI 2BK-2	Includes CI3RC2 current amplifier, one RS-11 socket, one DIN-rail mount, one dual-channel intrinsically safe barrier

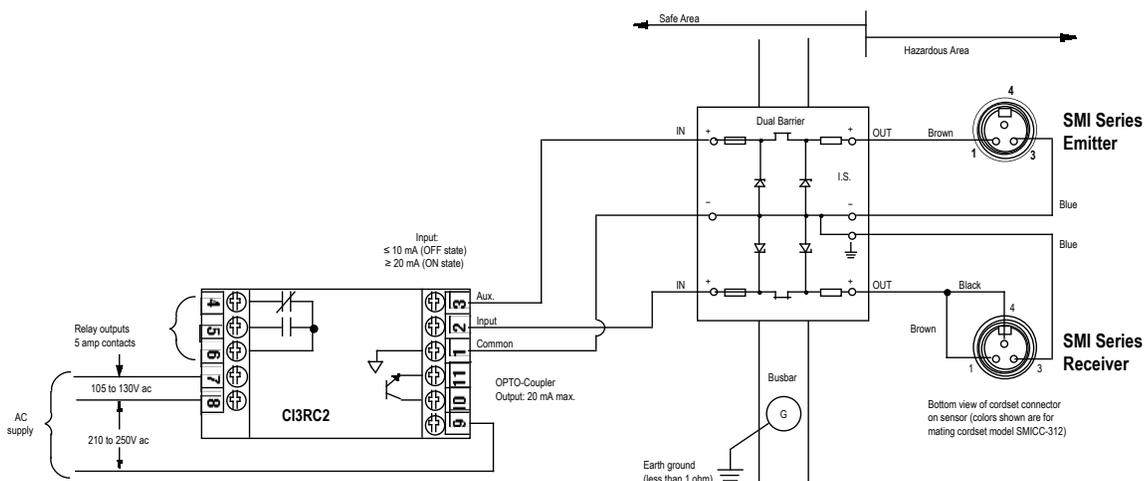


Figure 3. Wiring Connections - SMI912 Series Opposed Mode Emitters and Receivers

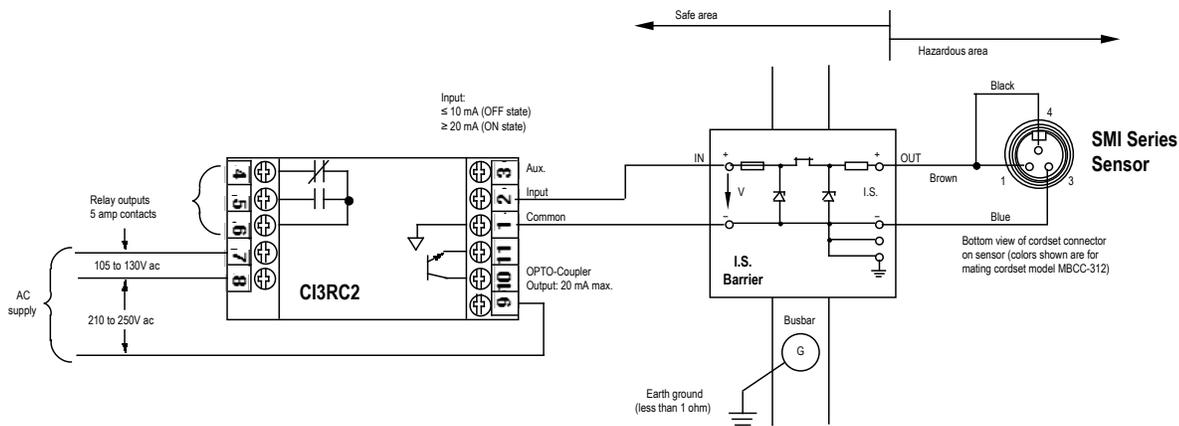


Figure 4. Wiring Connections - All Other SMI912 Series Sensors

## Repairs and Translations

Obtain assistance with product repairs by contacting your local Banner Engineering Corp distributor or by calling Banner directly at (763) 544-3164. Access literature translated into your native language on the Banner website at [www.bannerengineering.com](http://www.bannerengineering.com) or contact Banner directly at (763) 544-3164.

## Banner Engineering Corp Limited Warranty

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