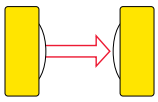
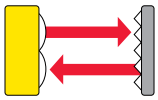
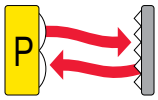
VALU-BEAM SMI912 Series

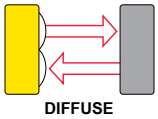
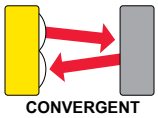
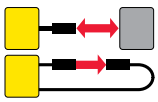
Intrinsically safe dc sensor

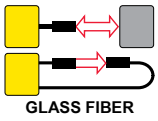
SMI912 Series sensor, with CI3RC2 current amplifier module (left) and intrinsic safety barrier (right)

- 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 30V 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	Voltage
 OPPOSED	Long-range opposed, 880 nm Effective Beam: 13 mm (0.5 in)	SMI91EQD Emitter	60 m (200 ft)	10 to 30V dc
		SMI91RQD Receiver		
	Short-range opposed, 880 nm Effective Beam: 3.5 mm (0.14 in)	SMI91ESRQD Emitter	3 m (10 ft)	
		SMI91RSRQD Receiver		
 RETRO	Non-polarized retroreflective, 650 nm Visible Red	SMI912LVQD	150 mm to 9 m (6 in. to 30 ft) *	10 to 30V dc
 POLAR RETRO	Polarized retroreflective, 650 nm Visible Red	SMI912LVAGQD	300 mm to 4.5 m (1 to 15 ft) *	

* 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.

Sensing Mode		Models	Range	Voltage
 DIFFUSE	Long-range diffuse, 880 nm Infrared	SMI912DQD	760 mm (30 in)	10 to 30V dc
	Short-range diffuse, 880 nm Infrared	SMI912DSRQD	380 mm (15 in)	
 CONVERGENT VISIBLE RED	Convergent, 650 nm Visible Red	SMI912CVQD	Focus at: 38 mm (1.5 in) Spot Size at Focus: 1.5 mm (0.06 in)	
 PLASTIC FIBER	Plastic fiber optic, 650 nm Visible Red	SMI912FPQD	See performance curves	10 to 30V dc

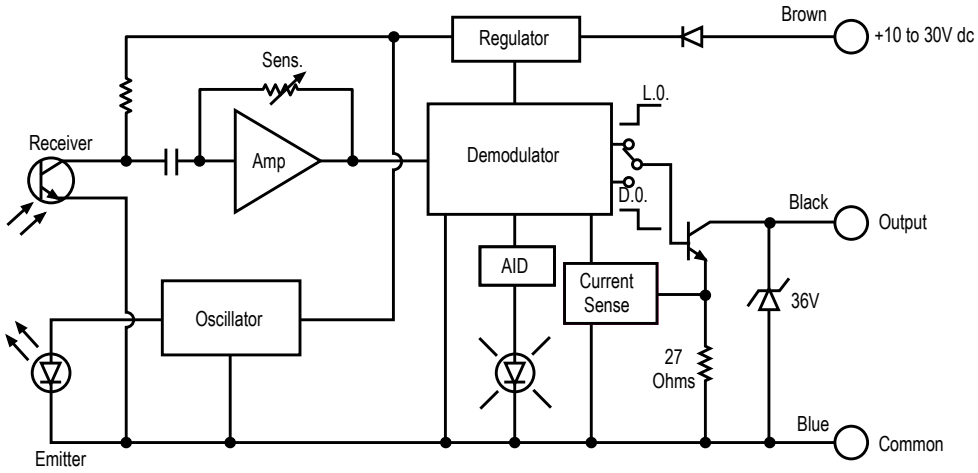
Sensing Mode		Models	Range	Voltage
	Glass fiber optic, 880 nm Infrared	SMI912EFQD Emitter		
		SMI912RFQD Receiver		
 GLASS FIBER	Glass fiber optic, 880 nm Infrared	SMI912FQD		

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 Factory Mutual Research, CSA, and KEMA 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 ≤ 10 mA (OFF state) and ≥ 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

1. Barriers must be installed in accordance with manufacturer's instructions.
2. Barrier entity parameters must meet the following requirements:

- Voc or Vt ≤ Vmax Ca ≥ Ci + Ccable
- Isc or It ≤ I max La ≥ Li + Lcable

3. Maximum non-hazardous area voltage must not exceed 250V.

4. For guidance on installation, see ANSI/ISA RP12.6, “Installation of Intrinsically Safe Instrument Systems for Hazardous (Classified) Locations.”

5. 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:
   - Voc ≤ Vmax Ca ≥ Ci + Ccable
   - Isc ≤ I max La ≥ Li + Lcable
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 Ω (min)

Two Single-Channel Barrier or One Dual-Channel Systems

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

Sensor Entity Parameters

- Vmax (Ui) ≤ 30V dc
- Imax (Ii) ≤ 350 mA
- Pi ≤ 750 mW
- Ci = 0 µF
- Li = 0 mH

Specifications

Supply Voltage and Current

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

Division 1 use (with barriers): requires a minimum system supply voltage of 10 volts (see hookup information and hookup diagrams).

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

Output Configuration

Current sinking NPN open-collector transistor

Output Rating

Three-wire hookup sinks 15 mA maximum, continuous (10 to 30V dc)

Two-wire hookup sinks ≤ 10 mA (OFF state) and ≥ 20 mA (ON state), 10 to 30V 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).

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.

Repeatability

Opposed mode: 1.0 millisecond

All other modes: 1.3 milliseconds

Repeatability is independent of signal strength.

Environmental Ratings

Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12, and 13, IEC IP66

Operating Conditions

Temperature: –20 to +70 °C (–4 to +158 °F)

Max. Relative Humidity: 90% @ 50 °C (non-condensing)

Certifications	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.

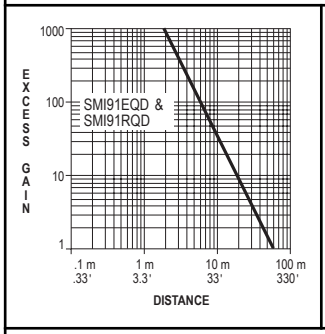
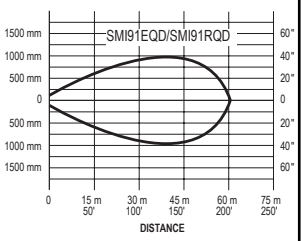
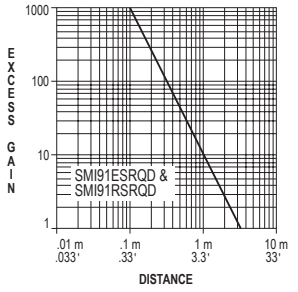
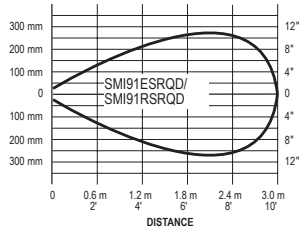
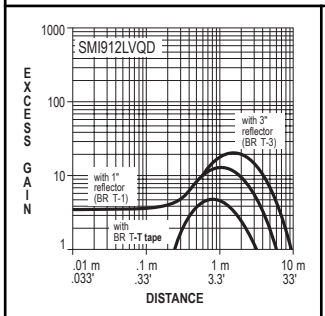
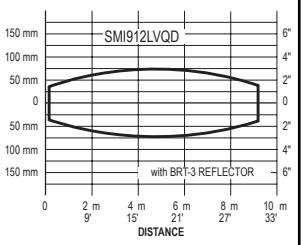
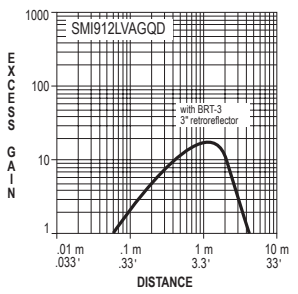
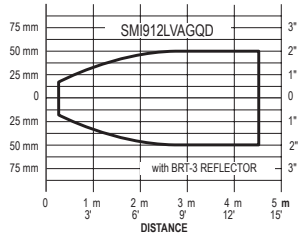
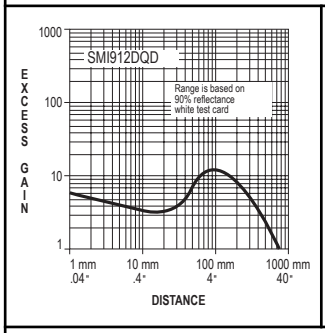
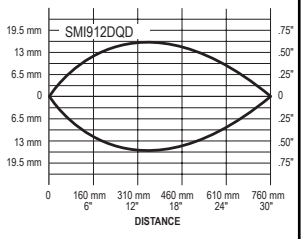
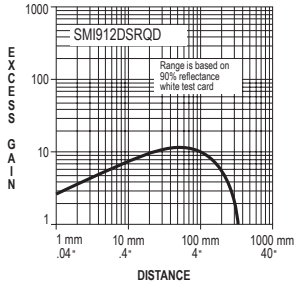
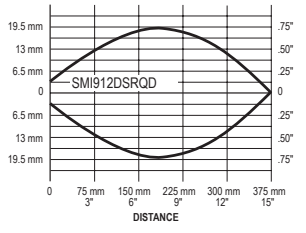
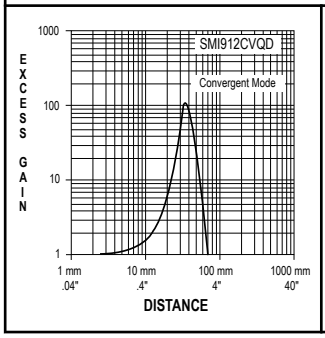
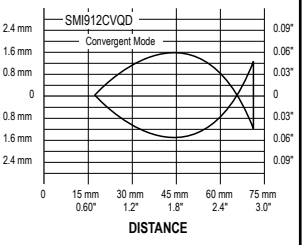
Design Standards

ATEX (European)	EN 60079-0, EN 60079-11, EN 60079-26
Canadian	CAN/CSA C22.2 No. 0-M91, 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.

Approvals

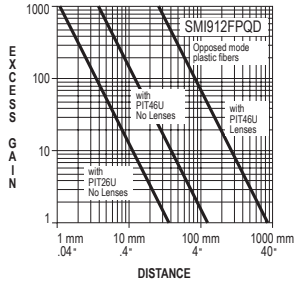
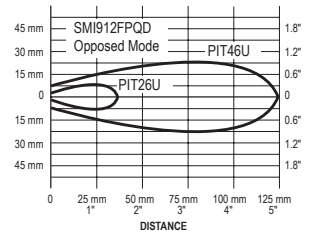
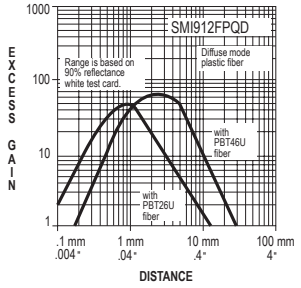
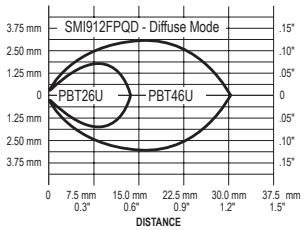
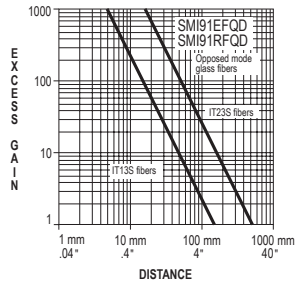
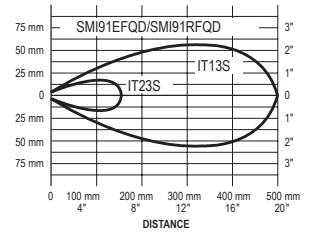
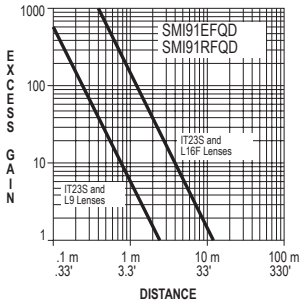
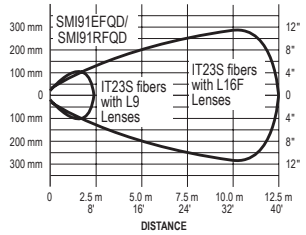
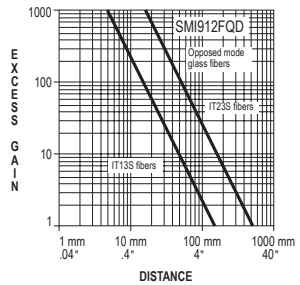
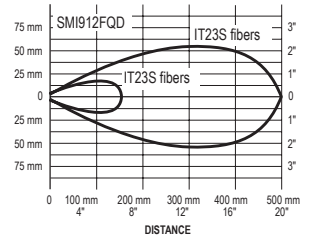
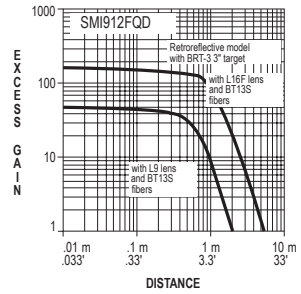
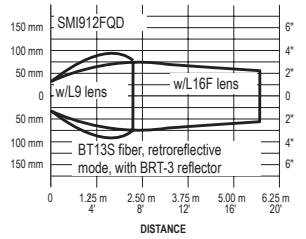
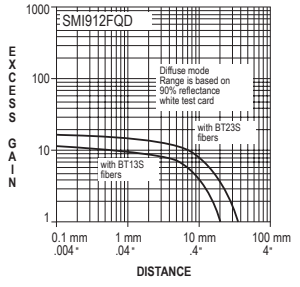
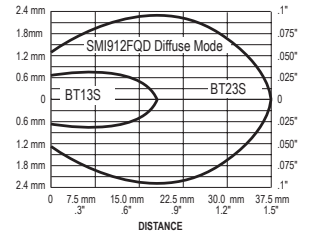
ATEX (European)	II 2 G Ex ib IIC T5 Ta = -40°C to 70°C - 03396; Entity FM12ATEX094X Entity Parameters: VMax = 30 V, IMax = 350 mA, Ci = 0 µF, Li = 0 mH.
Canadian	**SMI91(a)** Non-incendive for Class I, Division 2, Groups A, B, C and D, T5 Ta = -40°C to 70°C a = 2LVQD, 2DQD, 2DSRQD, 2FQD, 2CVQD, 2LVAGQD or 2FPQD.
	SMI91(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 AEx ib Group IIC T5 Ta = -40°C to 70°C; - 03396, Entity Entity Parameters: VMax = 30 V, IMax = 350 mA, Ci = 0 µF, Li = 0 mH. b = 1RQD, RSRQD, RFQD, EQD, ESRQD or EFQD.
United States	**SMI91(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.
	SMI91(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 Ta = -40°C to 70°C - 03396; Entity Entity Parameters: VMax = 30 V, IMax = 350 mA, Ci = 0 µF, Li = 0 mH. b = 1RQD, RSRQD, RFQD, EQD, ESRQD or EFQD.

Performance Curves

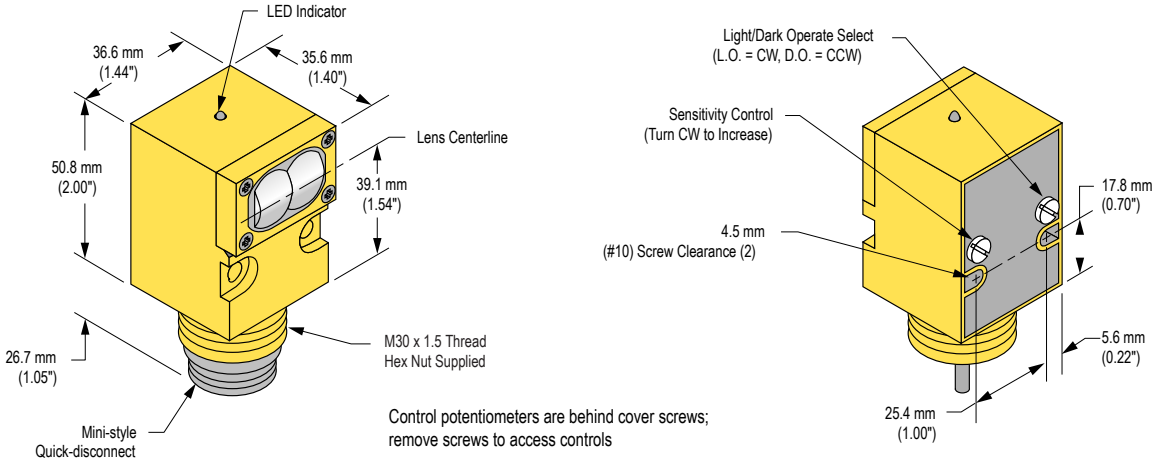
Excess Gain	Beam Patterns	Excess Gain	Beam Patterns
Long-range Opposed		Short-range Opposed	
			
Non-polarized Retroreflective		Polarized Retroreflective	
			
Long-range Diffuse		Short-range Diffuse	
			
Convergent			
			

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

Excess Gain	Beam Pattern	Excess Gain	Beam Pattern
Plastic Fiber Optic (Opposed)		Plastic Fiber Optic (Diffuse)	
			
Glass Fiber Optic (Opposed)			
			
Glass Fiber Optic (Opposed)		Glass Fiber Optic (Retro)	
			
Glass Fiber Optic (Diffuse)			
			

Dimensions



Wiring Connections

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 (see page 9). Note from the hookup diagrams (page 8) 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:

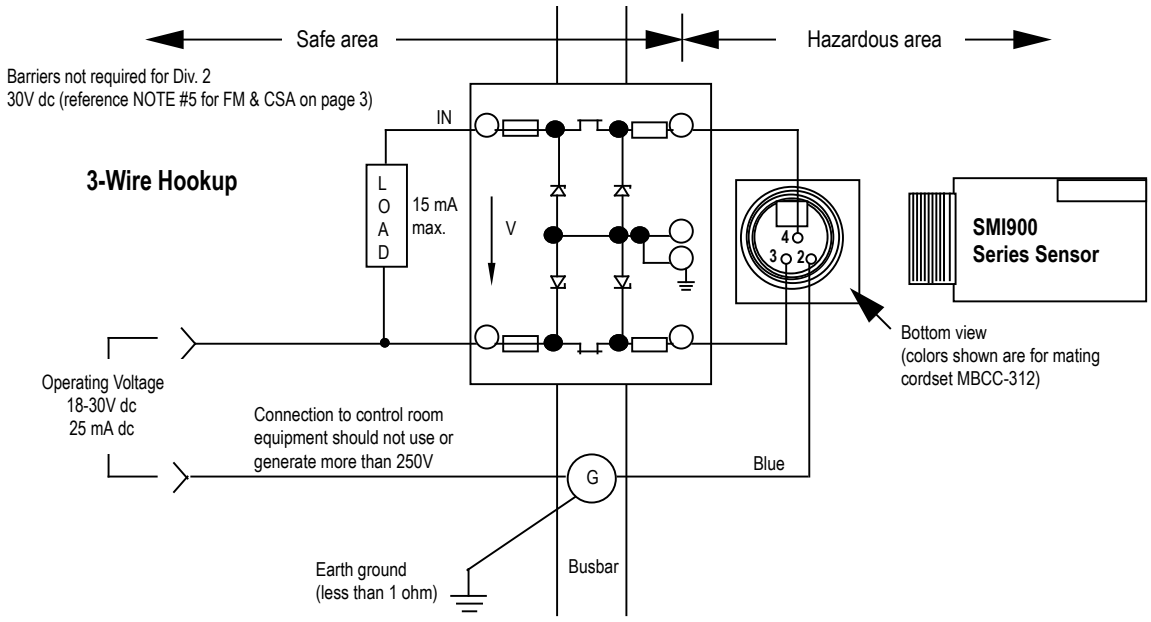
R = 40 (supply voltage – 10 volts)

If the supply voltage is 24V dc, then the maximum resistance is 560 ohms. If the supply voltage is 18V 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.

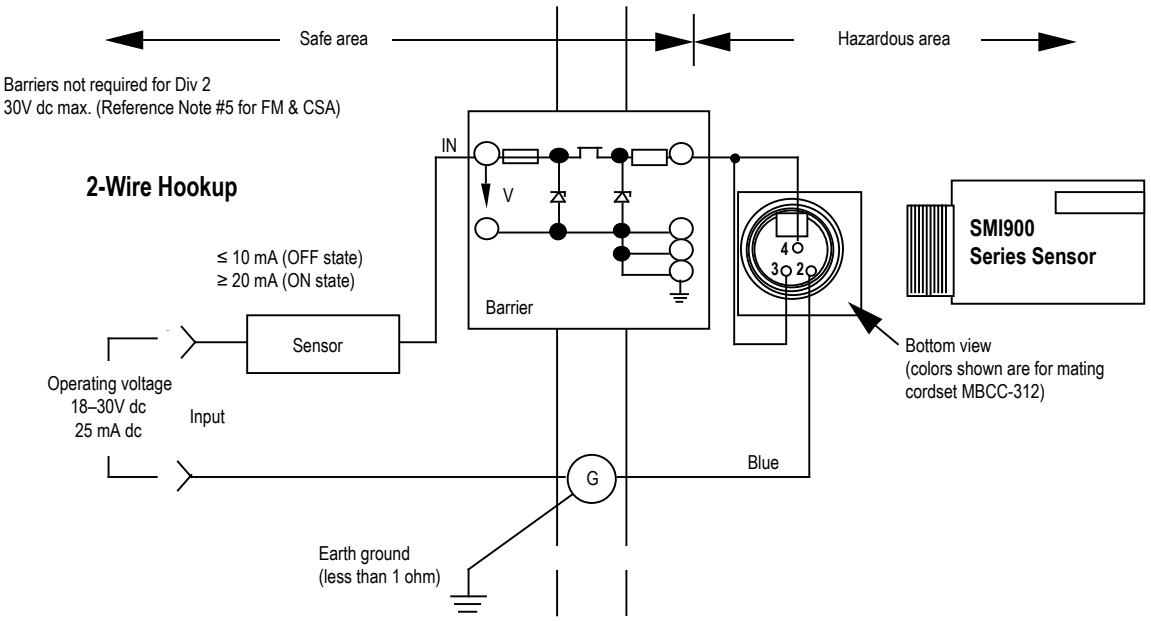
Note that, in the 3-wire hookup, the positive load barrier is in series with the load. This will result in an apparent saturation voltage of the output that is higher than the sensor output by the amount of I × R (current times resistance) drop through the barrier.

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.

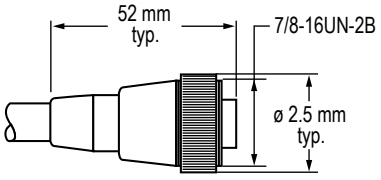
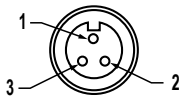
The user is responsible for proper installation and maintenance of this equipment, and must conform with the certification requirements relating to barriers and to maximum allowable capacitance and inductance of the field wiring. If in doubt about these requirements, our applications engineers can refer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



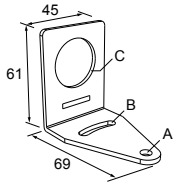
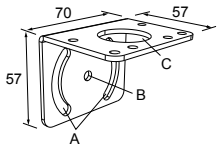
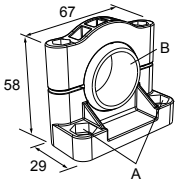
Note: Emitters have no output connection (no connection to black wire)



Accessories

3-Pin Mini-Style Cordsets				
Model	**Length**	**Style**	**Dimensions**	**Pinout**
MBCC-306	2 m (6.5 ft)	Straight		
MBCC-312	4 m (12 ft)			
MBCC-330	9 m (30 ft)			

1 = Black
2 = Brown
3 = Blue

Mounting Brackets	
SMB30A • Right-angle bracket with curved slot for versatile orientation • Clearance for M6 (¼ in) hardware • Mounting hole for 30 mm sensor • 12-ga. stainless steel  **Hole center spacing:** A to B=40 **Hole size:** A=ø 6.3, B= 27.1 x 6.3, C=ø 30.5	**SMB30MM** • 12-ga. stainless steel bracket with curved mounting slots for versatile orientation • Clearance for M6 (¼ in) hardware • Mounting hole for 30 mm sensor  **Hole center spacing:** A = 51, A to B = 25.4 **Hole size:** A = 42.6 x 7, B = ø 6.4, C = ø 30.1
SMB30SC • Swivel bracket with 30 mm mounting hole for sensor • Black reinforced thermo-plastic polyester • Stainless steel mounting and swivel locking hard-ware included  **Hole center spacing:** A=ø 50.8 **Hole size:** A=ø 7.0, B=ø 30.0	

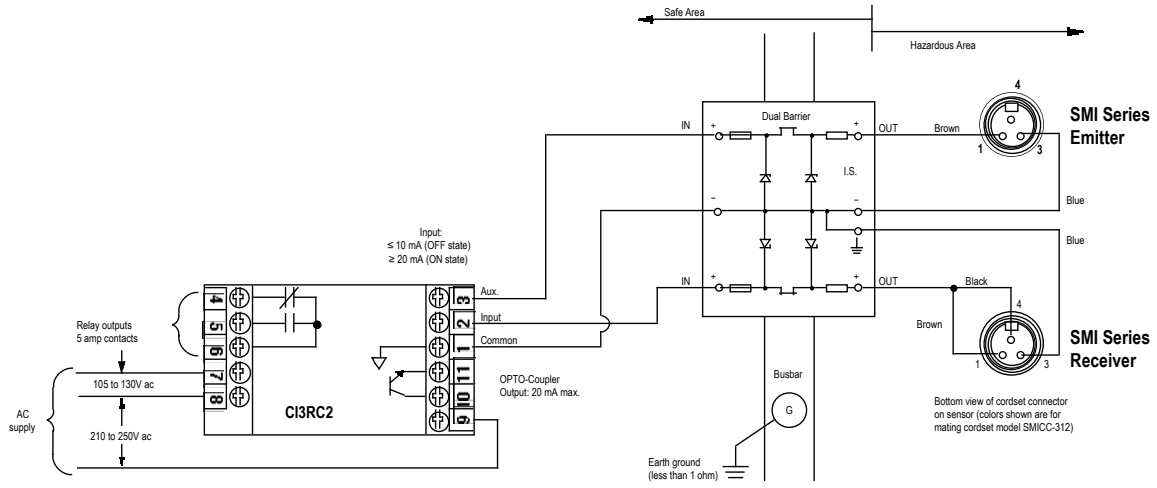
Current Trip-Point Modules

Current Trip-Point Module	
Model	**Description**
CI3RC2	• Self-contained module converts the SMI912 sensor's current output signal to a trip point switch. • SPDT electromechanical relay switches loads that draw up to 5 amps. The SPST solid-state relay can switch a dc load of up to 30V dc, max.; 20 mA max. • Powered by either 105-130V ac or 210-250V ac. • Supplies dc power to operate a single sensor or both the emitter and receiver of one SMI Series op-posed-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. • Module has two isolated output switches, a 5-amp rated SPDT electromechanical relay and a solid-state transistor switch used for logic-level interfaces. • May be ordered either alone or as a part of a kit.
	Supply Voltage 105 to 130V ac or 210 to 250V ac, 50/60 Hz (8 VA) **Output Configuration (SPDT electromechanical relay)** Contact rating: 250V ac maximum, 24V dc maximum, 5 amps maximum (resistive load), 1/10 HP at 240V ac. Install transient suppressor (MOV) across contacts which switch inductive loads. Min. load: 12V dc, 0.1A. Closure time: 10 milliseconds maximum. Release time: 10 milliseconds maximum.

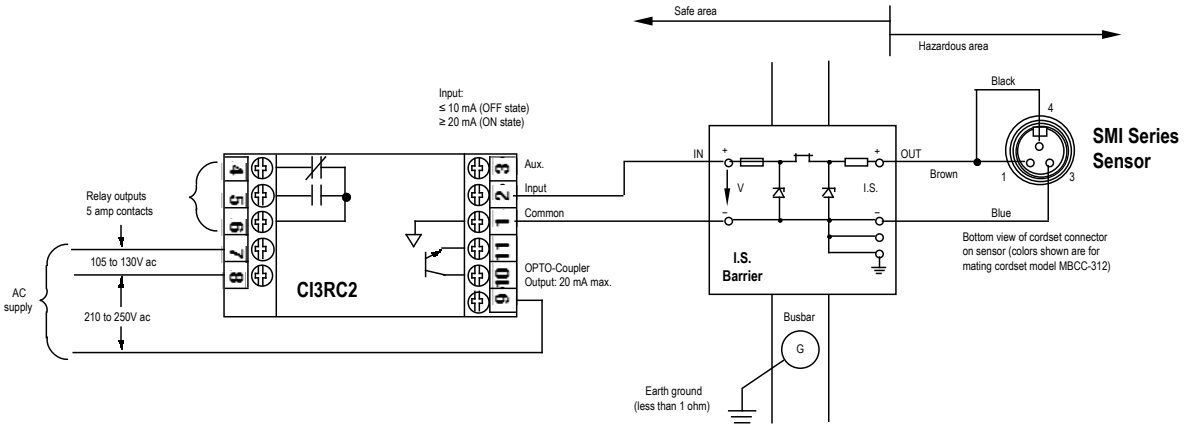
Current Trip-Point Module	
Model	**Description**
	Maximum switching speed: 20 operations/second. Mechanical life: 20,000,000 operations **Output Configuration (Solid-state dc relay)** SPST optically-coupled transistor; 30V dc maximum, 20 mA maximum. **Emitter Power** +24V dc at 25 mA maximum available at module pin #3 **Inputs** Trip point for output "OFF": ≤ 10 mA Trip point for output "ON": ≥ 20 mA Trip point range for input overload indication: 30 mA ≤ I ≤ 80 mA **Indicators** Status Indicators for OUTPUT “ON” and INPUT overload/short **Construction** Housing: rugged polyphenylene oxide (PPO®) 1.6" x 2.3" x 4" Standard round-pin 11-pole base. Use RS-11 socket or equivalent. **Operating Conditions** Temperature: 0 to +50 °C (+32 to +122 °F)

Intrinsic Safety Barriers			
Model (Barrier Only)	**Barrier Description**	**Kit Model**	**Kit Description**
CIB-1	Single-channel intrinsically safe barrier	**CI2BK-1**	Includes CI3RC2 current amplifier, one RS-11 socket, one DIN-rail mount, one single-channel intrinsically safe barrier
CI2B-1	Dual-channel intrinsically safe barrier (typically used in opposed-mode applications)	**CI2BK-2**	Includes CI3RC2 current amplifier, one RS-11 socket, one DIN-rail mount, one dual-channel intrinsically safe barrier

Wiring Connections - SMI912 Series Opposed Mode Emitters and Receivers



Wiring Connections - All Other SMI912 Series Sensors



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