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SMI30 Intrinsically Safe Series Sensor

Datasheet

No revision without agency approval.

To view or download the latest technical information about this product, including specifications, dimensions, accessories, and wiring, go to www.bannerengineering.com.



- Designed for use with approved amplifiers and intrinsically safe barriers in explosive environments
- Very high excess gain; 350-foot range (standard 10 ms models)
- Fast 1 ms response models (152-foot range) available by special order
- Totally sealed, self-contained, threaded-barrel opposed mode sensor pairs in rugged 30 mm PBT housings
- Highly immune to noise: the best noise immunity of any self-contained emitter/receiver pair
- Internal alignment indicator LED may be viewed either from the side or from the front of the receiver through the lens
- Integral mini-type 3-pin "QD" (quick-disconnect) connector

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.

SMI30 Models

Response Time		Models		
		Frequency "A" (standard)	Frequency "B" (special order)	Frequency "C" (special order)
Models with 10 ms response time		Repeatability: 1 ms	Repeatability: 1.6 ms	Repeatability: 2.3 ms
	Emitters	**SMI306EQ**	**SMI306EBQ**	**SMI306ECQ**
	Receivers (light operate)	**SMI30AN6RQ**	**SMI30AN6RBQ**	**SMI30AN6RCQ**
	Receivers (dark operate)	**SMI30RN6RQ**	**SMI30RN6RBQ**	
Models with 1 ms response time		Repeatability: 360 µs		**Repeatability: 210 µs**
	Emitters	**SMI306EYQ**		**SMI306EYCQ**
	Receivers (light operate)	**SMI30AN6RYQ**		**SMI30AN6RYCQ**
	Receivers (dark operate)	**SMI30RN6RYQ**		

Overview

Banner SMI30 Series intrinsically safe barrel sensors are extremely rugged and powerful opposed mode infrared sensor pairs designed for the most demanding industrial applications. Their high excess gain (350 foot range) provides enough sensing power to penetrate the heaviest contamination (see Excess Gain Curve). Electronics are fully epoxy-encapsulated for maximum resistance to mechanical shock and vibration. Positive sealing at both ends, with no exposed epoxy interfaces, eliminates all leak paths (including capillary leakage). Construction exceeds NEMA 6P (IEC IP 67) standards. Sensors are approximately 1.2 inches in diameter by 4 inches long. SMI30 series dc receivers operate from 10 to 30 V dc.

SMI30 Series sensors are certified as being intrinsically safe when used with approved intrinsic safety barriers. SMI30 Series sensors are suitable for intrinsically safe use in hazardous locations as listed in the Approvals table (see *SMI30 Specifications on page 5*). SMI30 Series sensors are also certified as non-incendive devices when used in Class I, Division 2, Groups A, B, C, and D locations without intrinsic safety barriers.

SMI30 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 (or one dual barrier), the sink current is 15 mA. The two-wire hookup, which requires one barrier, sinks ≤ 10 mA (OFF state) and ≥ 20 mA (ON state).

Intrinsic safety barriers and current trip point amplifier model CI3RC2 are also available (see *Accessories on page 7*).

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SMI30 Series receivers have a red LED alignment indicator that lights whenever the receiver "sees" its modulated light source. Emitters have a red LED to indicate "power on". All LED indicators are mounted internally to preserve the waterproof integrity of the sensor housing, and are visible from both the side and front of the sensor through the sensor's quad-ring sealed acrylic lens.

The innovative circuitry used in SMI30 Series emitters and receivers provides the best noise immunity of any self-contained opposed mode sensor pair. For applications where optical crosstalk between sensors might be a problem, SMI30 Series emitters and receivers are available with a choice of three modulation frequencies (frequency "A", frequency "B", or frequency "C"). This makes it possible to use high-powered sensor pairs of different frequencies in close proximity to each other without crosstalk. (NOTE: frequency "A" is standard; frequencies "B" and "C" are available by special order. An emitter and its receiver must be of the same modulation frequency.) See the models table for a summary of models.

Each unit is supplied with two hexagonal jam nuts. A 30 mm clearance hole is required for mounting, and mounting bracket models SMB30MM, SMB30S, and SMB30C are available. All models have a built-in standard quick-disconnect ("QD") connector. "QD" models mate with 12-foot long model SMICC-312 or 30-foot long model SMICC-330 mini-type QD cable (sold separately from sensor).

Installation Instructions

Ex/HazLoc Applications

WARNING

EXPLOSIVE ATMOSPHERES/HAZARDOUS LOCATIONS

- It is the user's responsibility to ensure that all local, state, and national laws, rules, codes, or regulations relating to the installation and use of this device in any particular application are satisfied. This device must be installed by a Qualified Person[1], in accordance with this document and applicable regulations.

WARNING

EXPLOSION HAZARD

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

CAUTION

ELECTROSTATIC DISCHARGE (ESD) SPECIAL CONDITIONS FOR SAFE USE

Parts of the enclosure are non-conducting and can generate an ignition-capable level of ESD.

- Clean the equipment with only a damp cloth.

General Notes and Conditions for Use:

See Specifications and Wiring Diagrams for important information concerning entity parameters, permissible locations, electrical connections and certifications.

In addition to the warning above concerning user responsibility, the installation must comply with the following:

- All installations must comply with all manufacturer's instructions.
- U.S. Installations: The relevant requirements of the National Electrical Code® (ANSI/NFPA-70 (NEC®) and when appropriate ANSI/ISA-RP12.06.01 Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations.
- Canadian Installations: The relevant requirements of the Canadian Electrical Code (CSA C22.1).
- ATEX and IECEx Installations: The relevant requirements of EN IEC 60079-14 and applicable National regulations.
- For quick disconnect (QD) models only: Use Banner **SMICC9-3##** cordsets (see *Accessories on page 7*) or suitable quick disconnect cordsets with threaded retaining nut (see *SMI30 Specifications on page 5*). The cordset must be securely fastened using the QD retaining nut to prevent disconnection.

Do not attempt any repairs to this device; it contains no field-replaceable parts or components. Tampering and/or replacement with non-factory components may adversely affect the safe use of the system.

1. A Qualified Person is a person who, by possession of a recognized degree or certificate of professional training, or who, by extensive knowledge, training and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work.

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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 $I_t \leq I_{max}$
- $La \geq L_i + L_{cable}$

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

- V_{max} (Ui) ≤ 30 V DC
- I_{max} (Ii) ≤ 350 mA
- $P_i \leq 750$ mW
- $C_i = 0$ µF
- $L_i = 0$ mH

The ambient operating temperature range of the sensors is –40 °C to +70 °C (–40 °F to +158 °F).

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. In Div. 2 installations (without barriers), observe Explosion Hazard warning at the beginning of this section.

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 Explosion Hazard warning at the beginning of this section.

Maximum non-hazardous area voltage that the Intrinsically safe barrier is connected to must not exceed 250 V.

Control (Installation) Drawing p/n 35392 has been replaced by this document.

Wiring Connections

The SMI30 Series sensor is 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. SMI30 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 (SMI30EQD, 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)**.

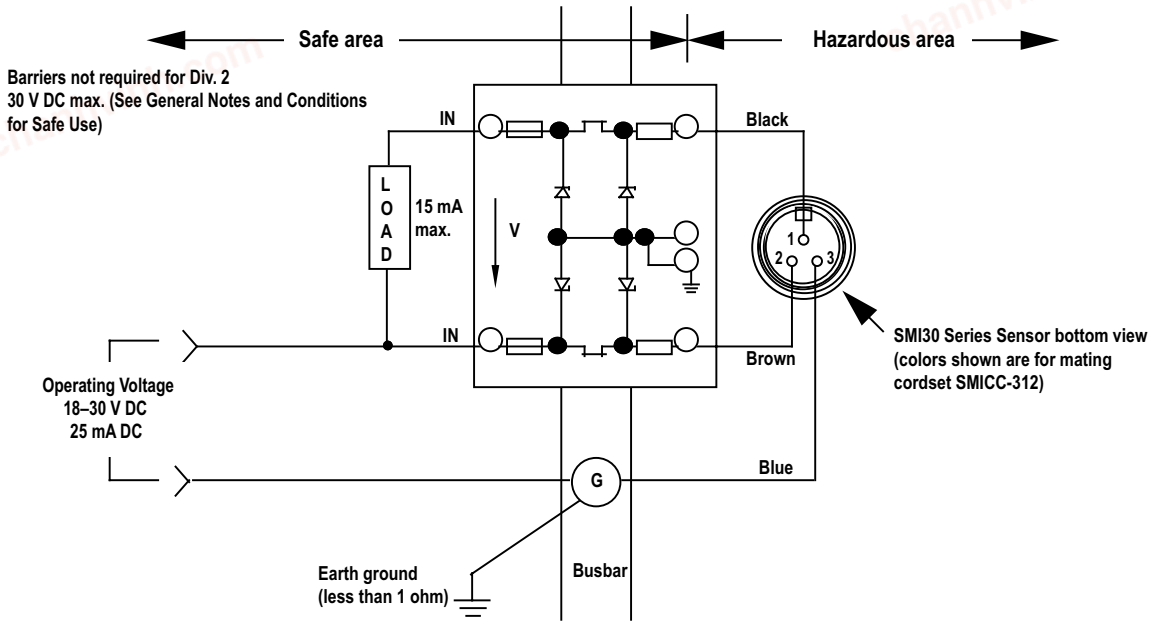
If the supply voltage is 24 V dc, then the maximum resistance is 560 ohms. If the supply voltage is 18 V dc, then the maximum resistance is 320 ohms. This includes the resistance of any current sensing device used (in the 2-wire configuration), so the barrier resistance must be further reduced by the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

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

Figure 1: Wiring for 3-Wire Connections

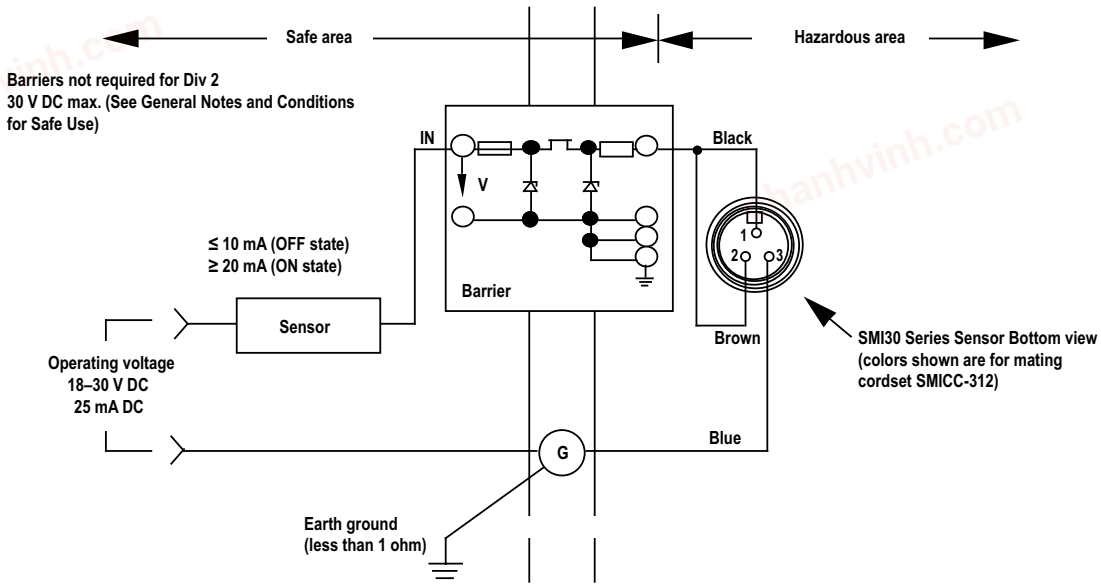


Figure 2: Wiring for 2-Wire Connections

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SMI30 Specifications

Supply Voltage and Current
Emitters: 10 to 30 V DC at 25 mA

Receivers: 10 to 30 V DC at 15 mA maximum Division 1 use, with barriers, requires minimum system supply voltage of 10 V. See *Wiring Connections on page 3*.

Sensing Beam
880 nanometers, infrared; effective beam size 0.75 inch diameter

Indicator
Internal red LED lights whenever the receiver sees its modulated light source. Emitters have red "power on" indicator LED. All indicators are visible through the lens or from side of the sensor.

Mounting Alternatives
30 mm clearance hole

SMB30C split clamp mounting bracket; SMB30MM two-axis mounting bracket; SMB30S swivel mounting bracket. See *APG30S Aperture Kit on page 7*

Cable
Three-wire 7/8 in-16UNF QD cable (12 ft. long model SMICC-312 or 30 ft. long model SMICC-330)

Cable electrical properties: 40 pf/ft.; 0.20 µH/ft

Order cable separately from sensor

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 must be done only with a damp cloth

Output Rating
Receivers only: Current sinking NPN open-collector transistor. Three-wire hookup sinks 15 mA maximum continuous, 10 to 30 V DC. Two-wire hookup sinks ≤10 mA (OFF state) and ≥20 mA (ON state), 10 to 30 V DC. Outputs are short-circuit protected.

Response Time
10 milliseconds on/off (models with 1 ms response are available by special order)

Repeatability
See excess gain curve. Response Time and Repeatability specifications are independent of signal strength.

Operating Temperature
–40 °C to +70 °C (–40 °F to +158 °F)

Construction
Banner tested to NEMA 6P, IEC IP67

30 mm diameter tubular threaded PBT housing, positive sealing at both ends; quad-ring sealed acrylic lens. Electronics are fully epoxy encapsulated. Two PBT jam nuts are provided.

Connections
Connecting 3-pin 7/8 in-16UNF QD Cordsets (see *Cordsets on page 8*): Female single-ended

Multiconductor cable (at minimum): UL Style 2517, 22 AWG wire, rated ≥ 80 °C

MINI QD connector: must have threaded 7/8-16UNF retaining nut

Certifications

CE 2809

Banner Engineering BV Park Lane, Culliganlaan 2F bus 3, 1831 Diegem, BELGIUM

UKCA 1725

Turck Banner LTD Blenheim House, Blenheim Court, Wickford, Essex SS11 8YT, Great Britain

Exia NRTL/C

FM APPROVED

IEC IECEx FMG 14.0029X
ATEX FM12ATEX0094X
FM21UKEX0211X
FM CoC 0003046293 (US)
FM CoC 0003046293C (CAN)

Design Standards	
ATEX (European)	EN IEC 60079-0, EN 60079-11
Canada	CAN/CSA C22.2: No.0-M91, No.142-M1987, No.157-92, No.213-M1987, No.1010.1, E60079-0 and E60079-11
United States	FM Class 3600, 3610, and 3810; ANSI/ISA 61010-1 (82.02.01), 60079-0 and 60079-11
IECEx	IEC 60079-0, IEC 60079-11

Approvals	
SMI30(a)	a = 6EQ, 6EBQ, 6ECQ, 6EYCQ, AN6RQ, AN6RBQ, AN6RCQ, RN6RQ, RN6RBQ, RN6RCQ, 6EYQ, AN6RYQ, AN6RYCQ, RN6RYQ, RN6RYCQ.
ATEX (European)	II 2 G Ex ib IIC T5 Gb Ta = –40°C to 70°C - 35331; Entity Entity Parameters: U_i = 30 V, I_i = 350 mA, P_i = 750 mW, C_i = 0, L_i = 0.
Canadian	I / 1 / Ex ib / IIC / T5 Ta = –40°C to 70°C - 35331; Entity CL I, Zn 1 Ex ib IIC T5 -40°C ≤ Ta ≤ +70°C; Entity 35331 (Non-incendive) NI / I,II,III / 2 / ABCDG / T5 Entity Parameters: V_{Max} = 30 V, I_{Max} = 350 mA, P_i = 750 mW, C_i = 0, L_i = 0.

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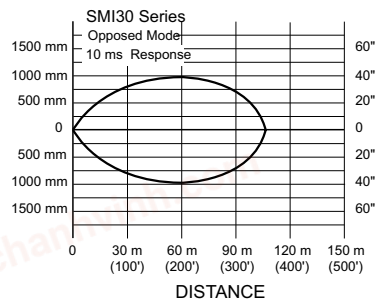
Approvals	
United States	I / 1 / AEx ib / IIC / T5 Ta = –40°C to 70°C - 35331; Entity CL I, Zn 1 AEx ib IIC T5 Gb -40°C ≤ Ta ≤ +70°C; Entity 35331 (Non-incendive) NI / I,II,III / 2 / ABCDG / T5 Ta = -40°C to 70°C Entity Parameters: V_{Max} = 30 V, I_{Max} = 350 mA, P_i = 750 mW, C_i = 0, L_i = 0.
IECEx	Ex ib IIC T5 Gb Ta = –40 °C to +70 °C - 35331; Entity Entity Parameters: V_{Max} = 30 V, I_{Max} = 350 mA, C_i = 0, L_i = 0

XXXXXXXXXXXXXXXX
Banner Engineering Corp.
Mpls, MN 55441 USA
10 to 30 V DC, 25 mA
INSTALL PER DRAWING 35331
NRTL/C
EXIA

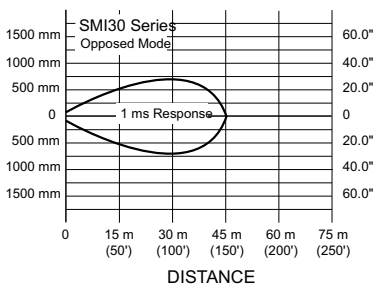
CE 2809
II 2 G Ex ib IIC T5 Gb
Ta = -40°C to +70°C
FM12ATEX0094X IECEx FMG 14.0029X
FM APPROVED
FM21UKEX0211X
FM20US0068X
FM20CA0032X
UK CA 1725
CLI, Zn 1 AEx ib IIC T5 Gb

SMI30 Performance Curves

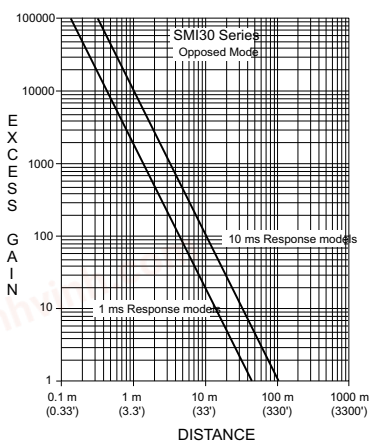
Beam Pattern (10 ms Response Time)



Beam Pattern (1 ms Response Time)

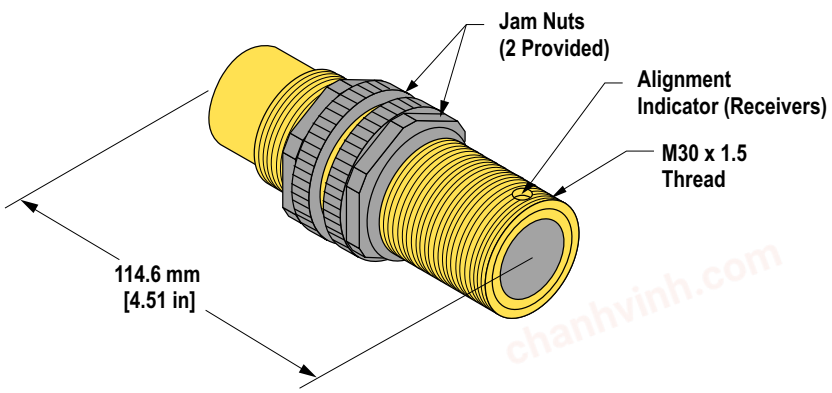


Excess Gain Curve



SMI30 Series Sensor Dimensions

All measurements are listed in millimeters [inches], unless noted otherwise. Connector not shown.



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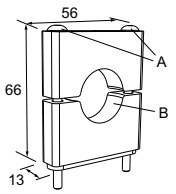
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Accessories

Brackets

SMB30C

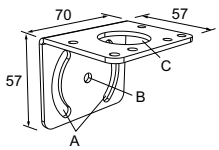
- 30 mm split clamp, black PBT bracket
- Stainless steel mounting hardware included
- Mounting hole for 30 mm sensor



Hole center spacing: A=ø 45**Hole size:** B=ø 27.2

SMB30MM

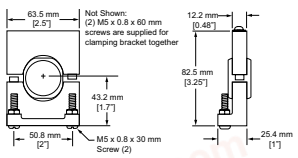
- 12-ga. stainless steel bracket with curved mounting slots for versatile orientation
- Clearance for M6 (¼ in) hardware
- Mounting hole for 30 mm sensor



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

SMB30S

- Swivel bracket with 30 mm mounting hole for sensor
- Adjustable captive swivel ball
- Black reinforced thermoplastic polyester
- Stainless steel mounting and swivel locking hardware included



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

APG30S Aperture Kit

These new water-tight apertures for SM30 Series sensors may be used to size and shape the effective beam or to limit excess gain for avoiding "burn-through" effects. Apertures are sold as a kit, which includes a thread-on stainless steel housing, a flat glass lens, two quad-ring seals, and 3 round and 3 slotted aperture disks.

The stainless steel aperture housing functions equally well with VALOX® and stainless steel sensor models. The glass lens is useful for protecting the SM30's acrylic lens against substances that are hostile to acrylics, such as concentrated acids and alkalis and industrial solvents.

Aperture sizes include the following:

- Round: .06", .12", and .70" diameter
- Slotted: .04", .10", and .20" wide

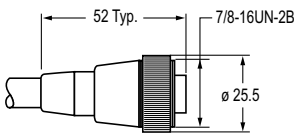
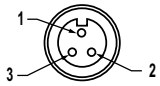
APG30S
Kit includes round apertures of 0.05 in, 0.12 in, and 0.70 in diameter; slotted widths of 1 mm (0.04 in), 0.10 in and 0.20 in. Used with SM30 and SMI30 models.



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Cordsets

3-pin 7/8-in Cordsets for Intrinsically Safe Sensors—Single Ended

Model	Length	Style	Dimensions (mm)	Pinout (Female)
SMICC-306	2 m (6.56 ft)	Threaded, straight		 1 = Black 2 = Brown 3 = Blue
SMICC-312	4 m (13.12 ft)			
SMICC-330	10 m (32.81 ft)			

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

MAXI-AMP CI3RC2 Current Amplifier Module

Banner MAXI-AMP module model CI3RC2 (part number 36606) is a self-contained module that converts the current output signal of an SMI30 Series sensor to a trip point switch.

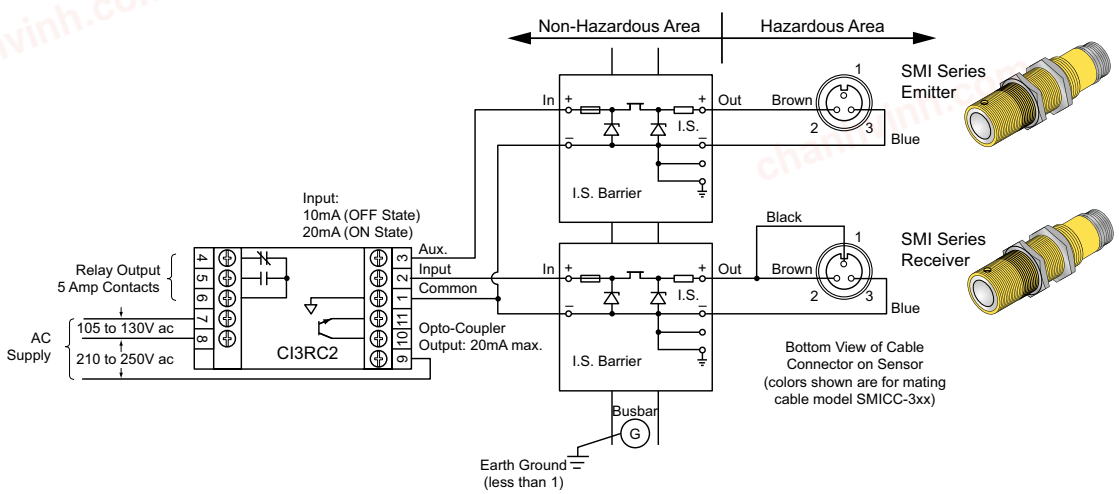


Figure 3: Hookup Using Two Single-Channel Barriers

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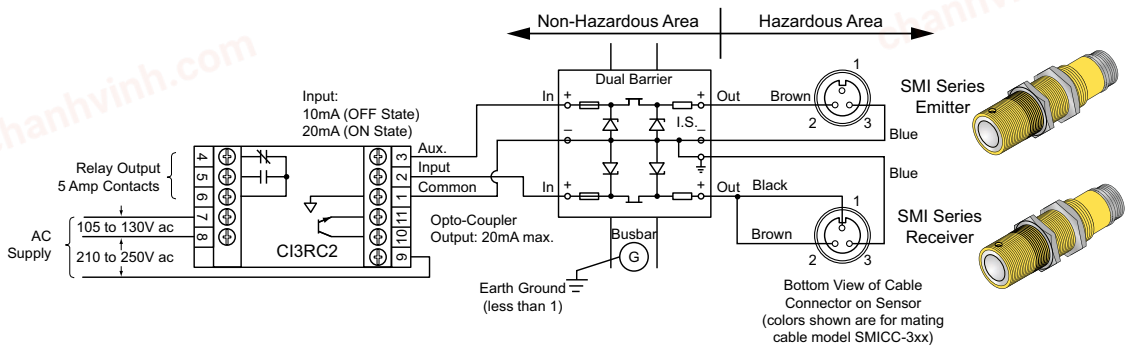


Figure 4: Hookup Using One Dual-Channel Barrier

Both sensors of the opposed mode pair are wired to model CI3RC2 using the two-wire hookup, which requires the use of two single channel or one dual channel intrinsic safety barrier(s). In this mode, the SMI30 receiver sinks less than or equal to 10 milliamps in the "OFF" state and greater than or equal to 20 milliamps in the "ON" state. The CI3RC2 senses this current change and switches internal relays that are easily wired to most loads and/or additional control circuitry.

Model CI3RC2 is powered by either 105 to 130 or 210 to 250 V ac. The CI3RC2 supplies power to operate both the emitter and receiver.

Inputs are protected against short circuits. Built-in circuit diagnostics indicate an overload of either input by pulsing an LED status light.

The CI3RC2 module has two isolated output switches. There is a 5 amp rated SPDT electromechanical relay, and a solid-state transistor switch which may be used for logic-level interfaces. For more information, refer to the datasheet packed with the CI3RC2.

CI3RC2 Specifications

General

Supply Voltage
105 to 130 or 210 to 250 V ac, 50/60 Hz (8 VA)

Indicator LEDs
Status indicator for OUTPUT "ON" and INPUT overload/short.

Operating Temperature
0 °C to +50 °C (+32 °F to +122 °F)

Inputs
Trip point for output "OFF": ≤ 10 milliamps
Trip point for output "ON": ≥ 20 milliamps
Trip point range for input overload indication: 30 mA ≤ I ≤ 80 mA

Construction
Rugged NORYL® polyphenylene oxide (PPO™) housing, 1.6" × 2.3" × 4".
Standard round-pin 11-pole base. Use RS-11 socket or equivalent.

Output Configuration

SPDT Electromechanical Relay
Contact rating: 250 V ac max., 24 V dc max., 5 amps max. (resistive load), 1/10 HP at 240 V ac. Install transient suppressor (MOV) across contacts that switch inductive loads.
Closure time: 10 milliseconds max.
Release time: 10 milliseconds max.
Maximum switching speed: 20 operations/second
Mechanical life: 20,000,000 operations

Solid-State DC Relay
SPST optically-coupled transistor
30 V dc max., 20 mA max

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 or contact Banner directly at (763) 544-3164.

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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.

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