

# SMI30 Series Intrinsically Safe Sensors



Rugged, NEMA 6P-plus sensors in 30 mm threaded PBT barrel housings



- 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, intrinsically safe 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

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	SMI30RN6RCQ
Models with 1 ms response time		Repeatability: 360 $\mu$ s		Repeatability: 210 $\mu$ s
	Emitters	SMI306EYQ		SMI306EYCQ
	Receivers (light operate)	SMI30AN6RYQ		SMI30AN6RYCQ
	Receivers (dark operate)	SMI30RN6RYQ		SMI30RN6RYCQ



### 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

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 30V dc. These sensors carry entity approval from Factory Mutual Research and CSA for intrinsically safe operation in hazardous atmospheres. 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 defined by Article 500 of the National Electrical Code (see classifications, above right). SMI30 Series sensors are also certified by Factory Mutual and CSA as non-incendive devices when used in Division 2 locations (except Groups E and F) 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  $\leq 10$  mA (OFF state) and  $\geq 20$  mA (ON state).



Intrinsic safety barriers are available from Banner. Current trip point amplifier CI3RC2 is also offered. Several mounting brackets are available.

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).

## 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

## Wiring Information

SMI30 Series sensors are certified intrinsically safe ONLY when used with certified energy-limiting intrinsically safe barriers. Emitter units use a two-wire hookup (there is no output connection). Note from the wiring/hookup diagram that the receiver installation may be made using either a single barrier (2-wire hookup) or with a dual channel barrier (3-wire hookup). In the 2-wire configuration, the sensor acts as a current sink, drawing less than 10 mA in the OFF state and more than 20 mA in the ON state. The customer must provide a current sensing device ("current sensor" in the diagram) to convert the current to a logic level. SMI30 Series sensors may be used with Banner Current Amplifier Control Module CI3RC2.

The CI3RC2 module may be purchased (with model RS-11 module socket, one dual-channel barrier, and DIN rail barrier mounts included) by specifying kit model CI2BK-2. One dual-channel intrinsic barrier (alone) may be ordered by specifying model CI2B-1. See [Accessories](#) on page 6.

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 sensors 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.

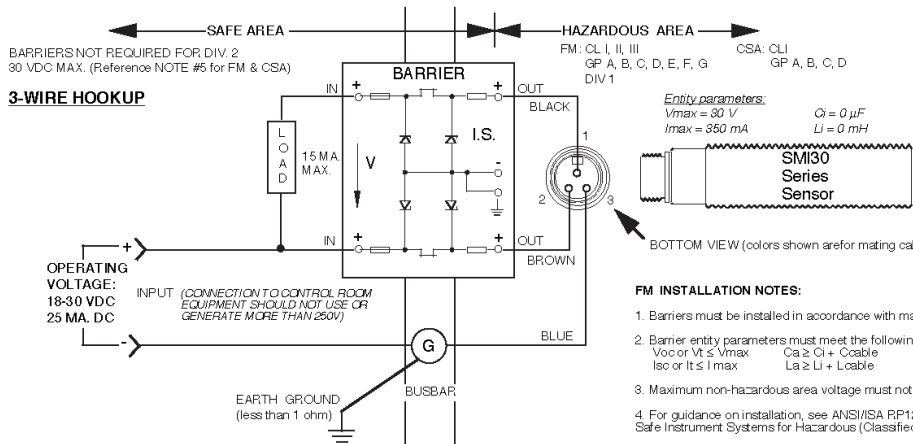
Note that, in the 3-wire hookup, the barrier is in series with the load. This results in an apparent saturation voltage of the output that is higher than the sensor output by the amount of  $I \times R$  (current times voltage) drop through the barrier.

Emitters use the 2-wire hookup; receivers use either 2- or 3-wire hookup. Review to the models table for a summary of models.

Barriers are generally classified as either "positive input" or "negative input". SMI30 Series intrinsically safe sensors require "positive input" barriers for both supply and load. The blue (negative supply) lead of the sensor is normally connected to the ground terminal of the barrier.

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

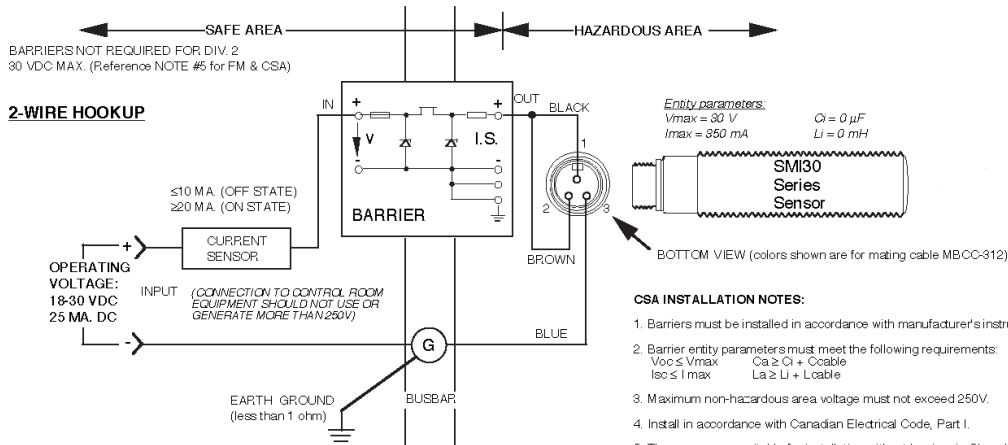
## Hookup Diagrams



**FM INSTALLATION NOTES:**

1. Barriers must be installed in accordance with manufacturer's instructions.
2. Barrier entity parameters must meet the following requirements:  
 $V_{oc} \text{ or } V_t \leq V_{max}$      $C_a \geq C_i + C_{cable}$   
 $I_{sc} \text{ or } I_t \leq I_{max}$      $L_a \geq L_i + L_{cable}$
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.

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



**CSA INSTALLATION NOTES:**

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 the following warnings:

**WARNING: EXPLOSION HAZARD**  
DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

**AVERTISSEMENT: RISQUE D'EXPLOSION**  
AVANT DE DECONNECTER L'EQUIPEMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENTS EST DESIGNIE NON DANGEREUX.

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 Models		Frequency "A"	Frequency "B"	Frequency "C"
10ms Models	Emitter	SMI306EQ	SMI306EBQ	SMI306ECQ
	Receiver LL Opr.	SMI30AN6RQ	SMI30AN6RBQ	SMI30AN6RCQ
	Receiver Dk. Opr.	SMI30RN6RQ	SMI30RN6RBQ	SMI30RN6RCQ
1ms Models	Emitter	SMI306EYQ	_____	SMI306EYCQ
	Receiver LL Opr.	SMI30AN6RYQ	_____	SMI30AN6RYCQ
	Receiver Dk. Opr.	SMI30RN6RYQ	_____	SMI30RN6RYCQ

NO CHANGES MAY BE MADE TO THIS DRAWING WITHOUT PRIOR APPROVAL OF FACTORY MUTUAL AND CSA



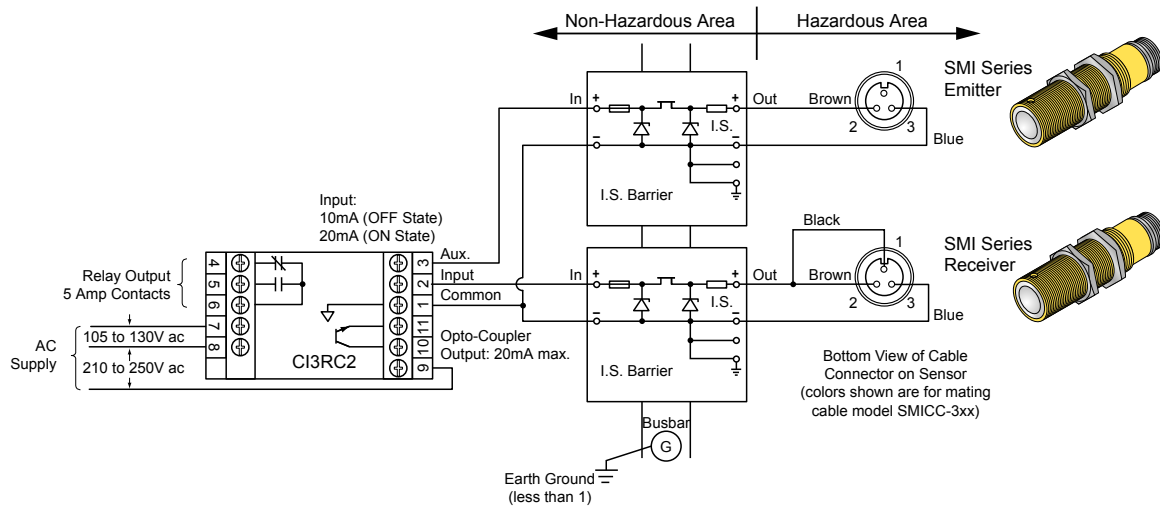
Banner Engineering Corp.  
9714 Tenth Avenue North  
Minneapolis, MN 55441

MANUFACTURING DRAWING #35392 rev. A  
**HOOKUP DIAGRAM: SMI30 SERIES**  
**INTRINSICALLY-SAFE SENSORS**

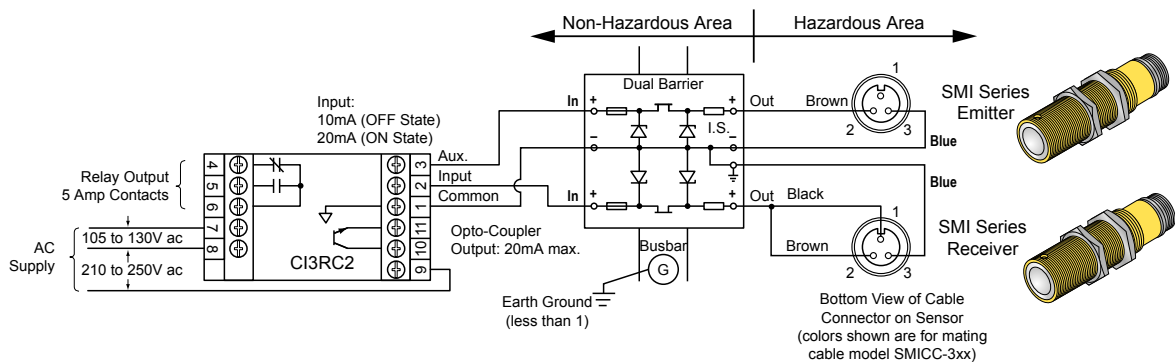
## MAXI-AMP CI3RC2 Current Amplifier Module

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.

### Hookup Using Two Single-Channel Barriers



### Hookup Using One Dual-Channel Barrier



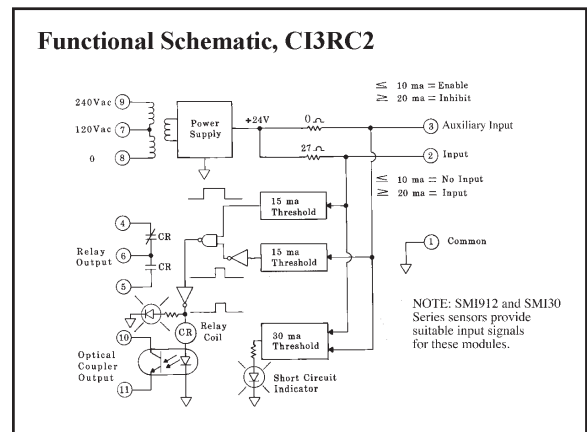
Both sensors of the opposed mode pair are wired to model CI3RC2 using the two-wire hookup, which requires the use of two single channel or one dual channel intrinsic safety barrier(s). In this mode, the SMI30 receiver sinks less than or equal to 10 milliamps in the "OFF" state and greater than or equal 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 250V 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 250V ac, 50/60 Hz (8VA)

##### Indicator LEDs

#### Output Configuration

##### SPDT Electromechanical Relay

Contact rating: 250V ac max., 24V dc max., 5 amps max. (resistive load), 1/10 HP at 240V ac. Install transi-

General	Output Configuration
<p>Status indicator for OUTPUT "ON" and INPUT overload/short.</p> <p><b>Operating Temperature</b> 0 to 50 °C (32 to 122 °F)</p> <p><b>Inputs</b> Trip point for output "OFF": ≤ 10 milliamps Trip point for output "ON": ≥ 20 milliamps Trip point range for input overload indication: 30mA ≤ I ≤ 80mA</p> <p><b>Construction</b> Rugged NORYL® polyphenylene oxide (PPO™) housing, 1.6" x 2.3" x 4". Standard round-pin 11-pole base. Use RS-11 socket or equivalent.</p>	<p>ent 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</p> <p><b>Solid-State DC Relay</b> SPST optically-coupled transistor 30V dc max., 20mA max</p>

## SMI30 Specifications

### Supply Voltage

Emitters: 10 to 30V dc at 25 mA  
Receivers: 10 to 30V dc at 15 mA max. Division 1 use, with barriers, requires minimum system supply voltage of 10V. See [Wiring Information](#) on page 2.

### 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.

### Construction

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.

### Mounting Alternatives

30 mm clearance hole  
SMB30C split clamp mounting bracket; SMB30MM two-axis mounting bracket; SMB30S swivel mounting bracket. See [Accessories](#) on page 6

### Output

Receivers only: Current sinking NPN open-collector transistor. Three-wire hookup sinks 15 mA maximum continuous, 10-30V dc. Two-wire hookup sinks ≤10 mA (OFF state) and ≥20 mA (ON state), 10-30V 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 to +70 °C (-40 to +18 °F).

### Cable

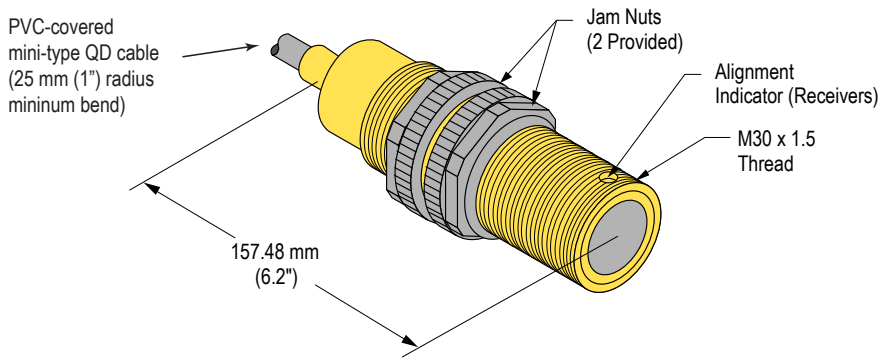
Three-wire mini-type QD cable (12 ft. long model SMICC-312 or 30 ft. long model SMICC-330).  
Cable electrical properties: 40 pF/ft.; 0.20 μH/ft.  
Order cable separately from sensor.

Certifications	
ATEX (European)	II 2 G Ex ib IIC T5 Ta = -40°C to 70°C - 35331; Entity FM12ATEX094X Entity Parameters: V <sub>Max</sub> = 30 V, I <sub>Max</sub> = 350 mA, C <sub>i</sub> = 0, L <sub>i</sub> = 0.
Canada	I / 1 / Ex ib / IIC / T5 Ta = 70°C - 35331; Entity Non-incendive for Class I, Division 2, Groups A, B, C and D, T5 Ta = -40°C to 70°C Entity Parameters: V <sub>Max</sub> = 30 V, I <sub>Max</sub> = 350 mA, C <sub>i</sub> = 0.3 μF, L <sub>i</sub> = 0 mH. a = 6EQ, 6EBQ, 6ECQ, 6EYQ, AN6RQ, AN6RBQ, AN6RCQ, RN6RQ, RN6RBQ, RN6RCQ, 6EYQ, N6RYQ, AN6RYCQ, RN6RYQ, RN6RYCQ.

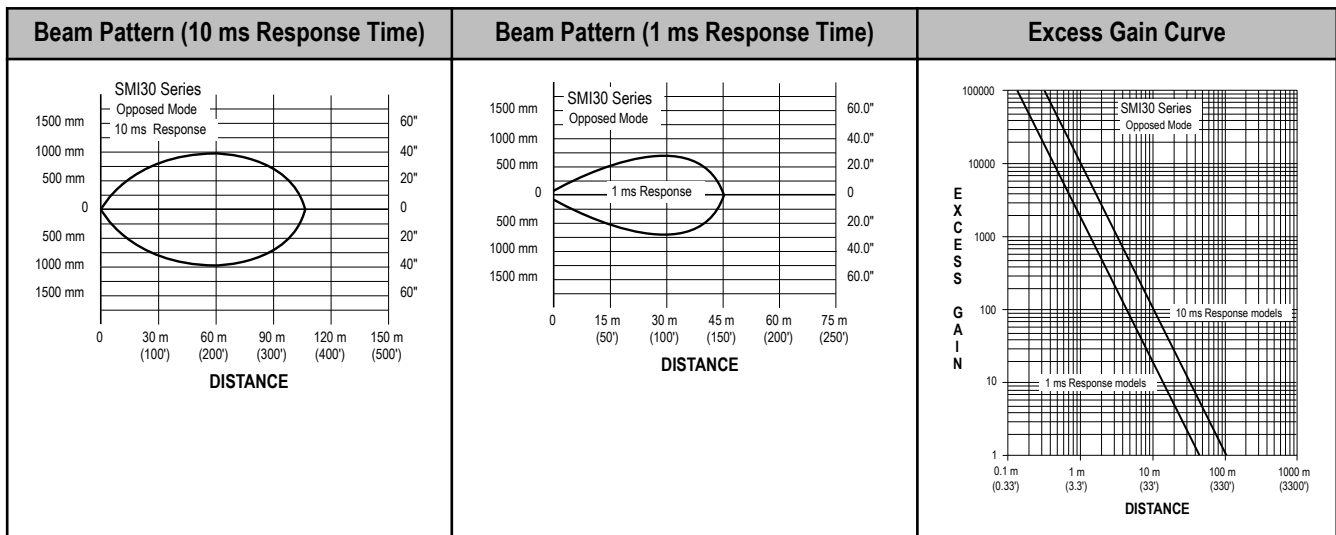
Certifications	
United States	Intrinsically safe for Class I, Zone 1 AEx ib Group IIC T5 Ta = -40°C to 70°C - 35331; Entity Non-incendive for Class I, Division 2, Groups A, B, C and D, T5 Ta = -40°C to 70°C Entity Parameters: $V_{Max} = 30\text{ V}$ , $I_{Max} = 350\text{ mA}$ , $C_i = 0$ , $L_i = 0$ . $a = 6EQ, 6EBQ, 6ECQ, 6EYCQ, AN6RQ, AN6RBQ, AN6RCQ, RN6RQ, RN6RBQ, RN6RCQ, 6EYQ, N6RYQ, AN6RYCQ, RN6RYQ, RN6RYCQ$ .

FM12ATEXD094X	
	 LR41887 NRTL/C Exia INTRINSICALLY SAFE/ SECURITE INTRINSEQUE

**Dimensions**



**Performance Curves**



**Accessories**

**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", and 0.70" diameter; slotted widths of 0.04", 0.10" and 0.20".

Used with SM30 and SMI30 models.



**Intrinsic Safety Kits for use with Intrinsic Safe Sensors**

Kit CI2BK-1 (36860) includes a CI3RC2 current amplifier, one RS- 11 socket, one DIN-rail mount, and one single-channel intrinsically safe barrier.

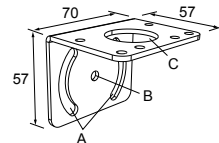
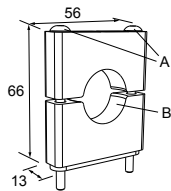
Kit CI2BK-2 (36605) includes a CI3RC2 current amplifier, one RS- 11 socket, one DIN-rail mount, and one dual-channel intrinsically safe barrier.

Barriers are available separately:

- Single channel barrier (model CIB-1, p/n 27030)
- Dual channel barrier (model CI2B-1, p/n 36865)

**Mounting Brackets**

<p><b>SMB30C</b></p> <ul style="list-style-type: none"> <li>• 30 mm split clamp, black PBT bracket</li> <li>• Stainless steel mounting hardware included</li> <li>• Mounting hole for 30 mm sensor</li> </ul> <p><b>Hole center spacing:</b> A=ø 45  <b>Hole size:</b> B=ø 27.2</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 (¼ in) hardware</li> <li>• Mounting hole for 30 mm sensor</li> </ul> <p><b>Hole center spacing:</b> A = 51, A to B = 25.4  <b>Hole size:</b> A = 42.6 x 7, B = ø 6.4, C = ø 30.1</p>
<p><b>SMB30S</b></p> <ul style="list-style-type: none"> <li>• Swivel bracket with 30 mm mounting hole for sensor</li> <li>• Adjustable captive swivel ball</li> <li>• Black reinforced thermo-plastic polyester</li> <li>• Stainless steel mounting and swivel locking hardware included</li> </ul>	<p><b>Special Conditions for Safe Use.</b> Parts of the enclosure are non-conducting and may generate an ignition-capable level of ESD. Clean the equipment with a damp cloth only.</p>



<p>Hole center spacing: A=∅ ##.#                  Hole size: A=∅ ##.#, B=∅ ##.#</p>
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**Cables**

3-Pin Mini-Style Cordsets for Intrinsically Safe Sensors				
Model	Length	Style	Dimensions (mm)	Pinout (Female)
SMICC-306	1.83 m	Threaded, straight		<p>1 = Black                  2 = Brown                  3 = Blue</p>
SMICC-312	3.66 m			
SMICC-330	9.14 m			

**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.

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