

# MINI-BEAM™ SM2A312C & SM2A312C2

Self-contained ac-operated Infrared Convergent Mode Sensors



- Produce a well-defined .10" diameter sensing spot at a focus point .80" from the lens surface (SM2A312C) or 2.0" from the lens surface (SM2A312C2)
- Modulated infrared light beam for high excess gain and immunity to ambient light
- Switch-selectable for light or dark operate; highly repeatable, 1 millisecond response
- SPST solid state SCR output switches up to 300mA; convenient 2-wire hookup
- LED indicator lights when load is energized
- 24 to 240V ac operation (50-60Hz), 250V ac maximum
- Rugged, epoxy-encapsulated construction: meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12, and 13

These are small, rugged, infrared convergent beam sensors with high excess gain and fast response that produce a well-defined sensing spot at a fixed focal distance in front of the lens. Model SM2A312C produces a .10" diameter spot at a .80" focal distance. Model SM2A312C2 produces a .10" diameter spot at a focal distance of 2.0". This small, powerful infrared sensing spot makes these sensors useful for sensing small objects or objects of low reflectivity. They may also be used for accurate positioning control and position sensing, including sensing and positioning of transparent materials.

SM2A312C and C2 convergent sensors consist of an infrared LED light source, a sensitive phototransistor, an alignment indicator, and a custom-designed state-of-the-art CMOS integrated modulator/demodulator/amplifier circuit. Digital modulation and demodulation make these sensors highly immune to ambient light and electrical "noise".

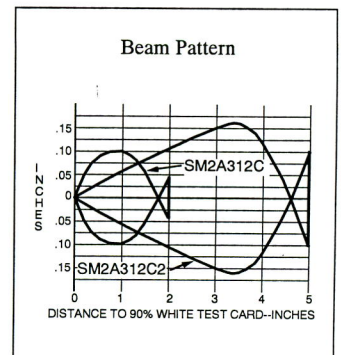
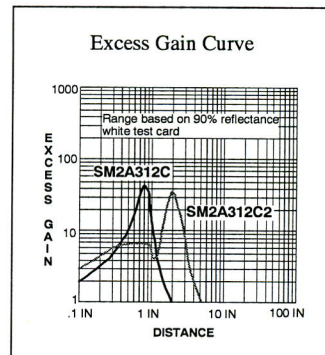
Alignment and system performance monitoring are simplified by an easily-visible rear panel red LED indicator that lights whenever the load is energized (i.e. when the sensor sees light in "light operate" mode, or when the sensor sees dark in "dark operate" mode).

Both models have SPST SCR solid-state relay contacts capable of switching loads of up to 300mA at 50°C ambient (derated to 100mA at 70°C ambient). These sensors connect in series with suitable loads, exactly like a mechanical limit switch. They may also be connected either in series (for "AND" or "NOR" logic functions) or parallel (for "OR" or "NAND" logic functions) with each other, and then this series or parallel sensor combination connected in series with the load. Their low output leakage current and low saturation voltage also make them

Model SM2A312C shown. Also available with QD (Quick Disconnect) cable fitting; see page 3.



Shown with optional SMB312S bracket (see page 4).



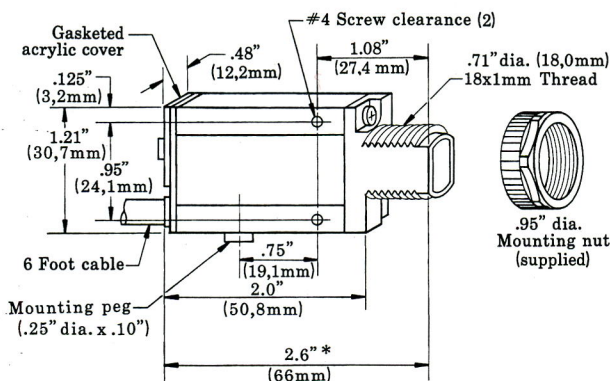
suitable for interfacing to programmable controllers and other solid-state circuitry.

The SM2A312CV and SM2A312CV2 operate from 24 to 240V ac (50-60Hz), and are fully protected against false pulse on power-up and inductive load transients.

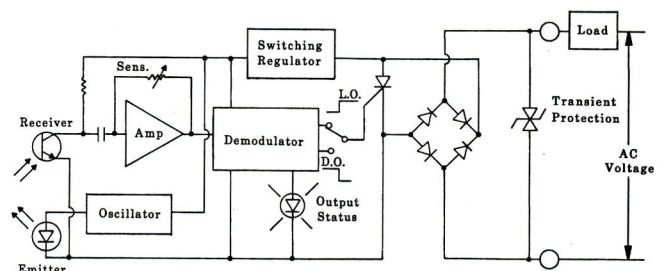
A convenient control on the back of the sensor allows a choice of either light- or dark-operate sensing mode. A rugged, clutched 15-turn slotted brass screw GAIN control potentiometer enables very precise adjustment of sensor sensitivity.

Banner MINI-BEAM sensors feature totally-encapsulated electronics in a rugged VALOX® housing, with o-ring sealing, acrylic lenses, and stainless steel screws. All models meet NEMA standards 1, 2, 3, 3S, 4, 4X, 12, and 13. Replacement lenses are available (see page 3).

## DIMENSION DRAWING, SM2A312CV & SM2A312CV2



## FUNCTIONAL SCHEMATIC, SM2A312CV & SM2A312CV2





## SPECIFICATIONS: SM2A312C & SM2A312C2

**SUPPLY VOLTAGE:** 24 to 240V ac (50-60Hz); 250V ac max.

**OUTPUT CONFIGURATION:** SPST SCR solid-state relay with either normally closed or normally open contact (light/dark operate selectable).

**OUTPUT RATING:** minimum load current 5mA; maximum steady-state load capability 300mA to 50 °C ambient (122 °F), 100mA to 70 °C ambient (158 °F). Inrush capability 3 amps for 1 second (non-repetitive); 10 amps for 1 cycle (non-repetitive). Off-state leakage current less than 1.7mA rms. On-state voltage drop  $\leq 5$  volts at 300mA load,  $\leq 10$  volts at 15mA load.

**OUTPUT PROTECTION:** protected against false pulse on power-up and inductive load transients.

**RESPONSE TIME:** 4 milliseconds ON, 4 milliseconds OFF. "OFF" response time does not include load response of up to 1/2 AC cycle (8.3 milliseconds). Response time spec. of load should be considered when important. 300 millisecond delay on power-up. **Repeatability:** 1.3 ms.

**LIGHT BEAM:** infrared (880 nm); convergent beam.  
**SM2A312C:** spot size .10" diameter at .80 (20 mm) focus point;  
**SM2A312C2:** spot size .10" diameter at 2.0" (50 mm) focus point.

**CONSTRUCTION:** reinforced VALOX® housing, totally encapsulated, o-ring sealing, acrylic lenses, stainless steel screws. Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12, and 13.

**CABLE:** PVC-jacketed 2-conductor cable (6' length) standard.

**ADJUSTMENTS:** LIGHT/DARK OPERATE select switch, and 15-turn slotted brass screw GAIN (sensitivity) adjustment potentiometer (clutched at both ends of travel). Both controls located on rear panel of sensor and protected by a gasketed, clear acrylic cover.

**INDICATOR LED:** red LED indicator on rear of unit is "ON" when the load is energized.

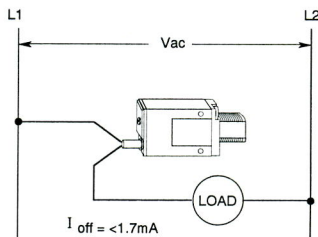
**OPERATING TEMPERATURE RANGE:** -20 to +70 degrees C (-4 to +158 degrees F).

## HOOKUP DIAGRAMS, SM2A312C and SM2A312C2

NOTE: output has a maximum load capacity of 300mA. Minimum load is 5mA (see specs.).

### BASIC AC HOOKUP

MINI-BEAM 2-wire ac sensors wire in series with an appropriate load. This combination, in turn, wires across the ac line.



These sensors operate in the range of 24 to 240V ac, and may be programmed for either normally open (N.O.) or normally closed (N.C.) operation by way of the light-dark operate switch on the back of the sensor. A 2-wire ac sensor may be connected exactly like a mechanical limit switch.

The sensor remains powered when the load is "off" by a residual current which flows through the load. The off-state leakage current (I) is always less than 1.7mA. The effect of this leakage current depends on the characteristics of the load. The voltage which appears across the load in the off-state is equal to the leakage current of the sensor multiplied by the resistance of the load:  $V(\text{off}) = 1.7\text{mA} \times R(\text{load})$ .

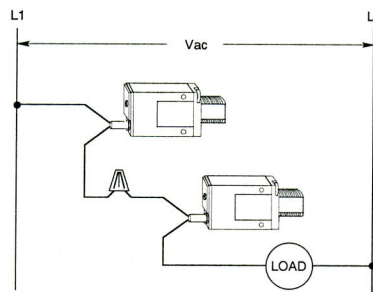
If this resultant off-state voltage is less than the guaranteed turn-off voltage of the load, then the interface is direct. If the off-state voltage causes the load to stay "on", then an artificial load resistor must be connected in parallel with the load to lower the effective resistance. Most loads, including most programmable controller inputs, will interface to 2-wire sensors with 1.7mA leakage current without an artificial load resistor. *These sensors are not polarity sensitive: all hookups are without regard to wire color.*

**WARNING: MINI-BEAM 2-wire ac sensors will be destroyed if the load becomes a short circuit!!**

### AC SENSORS IN SERIES

Multiple 2-wire ac MINI-BEAMS may be wired together in series for "AND" or "NOR" logic functions. The maximum number of sensors which may be wired in series to a load depends upon the level of the line voltage and the switching characteristics of the load. Each sensor connected in series adds an amount of voltage drop across the load. The amount of voltage drop that each sensor adds depends upon the current demand of the load. Each sensor in series adds approximately 5 volts drop across a 300mA load. A 15mA load will see about a 10 volt drop from each sensor added in series. To determine compatibility, compare the resultant on-state voltage across the load against the load's guaranteed turn-on voltage level (from the manufacturer's specifications).

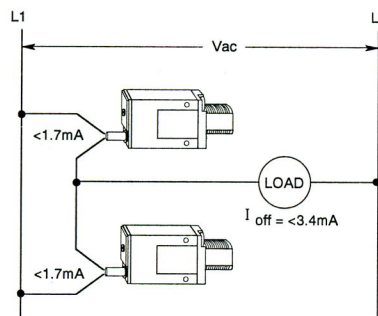
Most non-compatibility of series sensors with loads occurs in low-voltage applications (e.g. 12, 24, or 48V ac circuits) where the on-state voltage drop across the load is a significant percentage of the supply voltage. The power-up inhibit time (up to 300 milliseconds per sensor) is also additive.



### AC SENSORS IN PARALLEL

Multiple 2-wire ac MINI-BEAMS may be wired in parallel to a load for "OR" or "NAND" logic functions. With sensors wired in parallel, the off-state leakage current through the load is equal to the sum of the leakage currents required by the individual sensors. Consequently, loads with high resistance like small relays and solid state inputs may require artificial load resistors.

AC MINI-BEAMS wired together in parallel will *not* cause momentary drop-out of the load, as is experienced when wiring in parallel with contacts (see next page). However, it is likely that the power-up delay feature *will* cause a momentary drop-out of the load if an ac MINI-BEAM is wired in parallel with a different brand or model of 2-wire sensor.

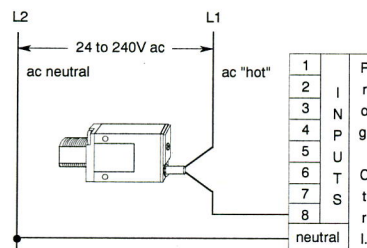


Contact the Banner applications group to verify compatibility.

### CONNECTION TO PROGRAMMABLE CONTROLLERS

2-wire ac MINI-BEAMS may be connected to the inputs of programmable controllers (PLC's), as shown in this drawing.

Connect ac "neutral" to "neutral" of the PLC. The sensor connects in series with the "hot" lead of the ac line.

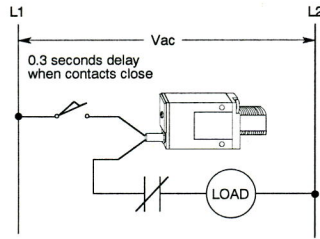




# Hookup Diagrams (continued)

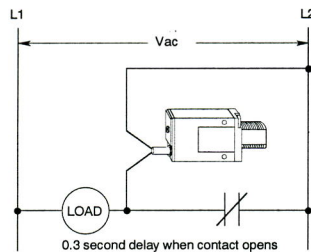
## AC SENSORS WITH SERIES CONTACTS

When 2-wire ac sensors are connected in series with mechanical limit switch or relay contacts, the sensor will receive power to operate only when all of the contacts are closed. The false-pulse protection circuit of the sensor will cause a 0.3 second delay between the time the contacts close and the time that the load can energize.



## AC SENSORS WITH PARALLEL CONTACTS

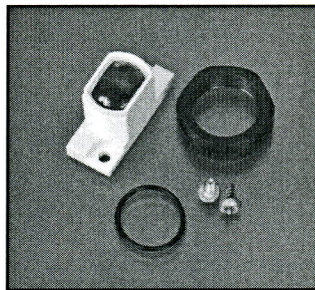
When 2-wire ac sensors are connected in parallel with mechanical switch or relay contacts, the sensor loses the voltage it needs to operate while any contact is closed. When all of the contacts open, the sensor's 0.3 second power-up delay may cause a momentary drop-out of the load.



## Modifications, Options, and Accessories

### Replacement Upper Covers and Mounting Nuts

Replacement upper covers are available. Upper cover model UC-300C.7 is the threaded "nose" of MINI-BEAM model SM312C (with its attached mounting flanges) which houses the lens and comprises the "front" of the sensor. Two replacement mounting screws and a black plastic 18-mm mounting nut are included. NOTE: the SM312C2, uses upper cover part number UC-300C2.



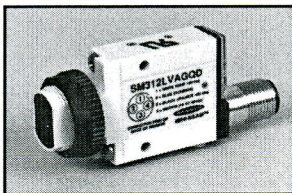
### Cable Length Modification: 30 Ft. Cable

MINI-BEAM sensors may be supplied with cables longer than the standard 6-foot length. The most readily available cable length is 30 feet. Lengths longer than 30 feet may also be quoted.

**Extension Cable** Model EC-312 4-conductor cable (brown, blue, black, white; without connectors) is available in 100-foot lengths. Order EC-312-100.

### Quick Disconnect (QD) Cable Option

All MINI-BEAM™ sensors are available with a Quick Disconnect (QD) cable fitting in lieu of attached cable (see photo). QD sensor models are designated by adding the letters "QD" to the model number. For example, the QD version of SM2A312C is "SM2A312CQD".



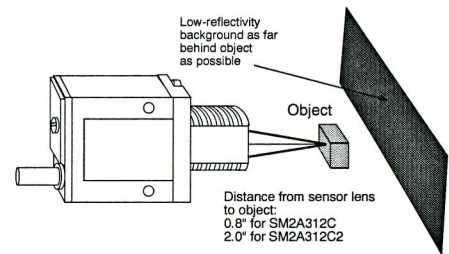
Sensor models SM2A312CQD and SM2A312C2QD use model MQDC-515 or MQDC-515RA 5-conductor *minifast*™ QD cable. Cable MQDC-515 has a straight connector; MQDC-515RA has a right-angled connector. Cables are PVC-covered, 15' in length, and must be ordered separately from the sensor. QD

## INSTALLATION and ALIGNMENT

Proper operation of these sensors requires that they be mounted securely and aligned properly. Excessive movement or vibration can result in intermittent or false operation caused by loss of alignment to the object. For best results, mount these sensors in an 18-mm hole by their threaded barrel or use the model SMB312S, SMB312B, or SMB312PD mounting bracket (see next page).

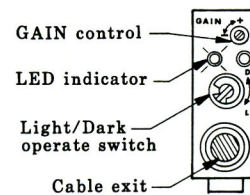
Begin with the sensor at the approximate position where it will be mounted. With power applied to the sensor, direct its infrared spot at the object approximately 0.8" (for model SM2A312C) or 2.0" (for model SM2A312C2) directly in front of the lens. Move the sensor very slightly toward or away from the object while observing the red "AID" indicator on the back of the sensor. Maximum reflected light and optimum sensor alignment to the object are indicated by the fastest LED pulse rate obtainable with the GAIN control set at the lowest setting required to light the LED. Mount the sensor at this position and distance.

Reliable convergent sensing requires that the sensor-to-object distance be held relatively constant. This may be a critical factor, especially when highly reflective background objects are present, or when the background is close to the object.



Best results will be attained under the following conditions: constant sensing distance from one object to the next, a background of low reflectivity, and the background as far from the object as possible.

## Adjustments (Sensor rear panel)



**GAIN control:** 15-turn clutched potentiometer; turn clockwise to increase.

**LED indicator:** red LED lights when the sensor sees its own reflected light from an object, and pulses at a rate proportional to the received light signal.

**LIGHT/DARK OPERATE switch:** in LIGHT operate (control fully clockwise), the sensor outputs conduct when an object is present. In DARK operate (control fully counterclockwise), the sensor outputs conduct when the object is absent.



**WARNING** This photoelectric presence sensor does NOT include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can result in *either* an energized or a de-energized sensor output condition.

Never use this product as a sensing device for personnel protection. Its use as a safety device may create an unsafe condition which could lead to serious injury or death.

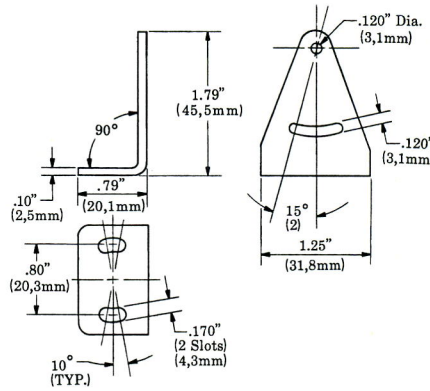
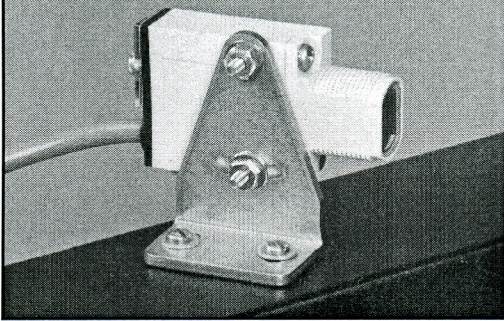
Only MACHINE-GUARD and PERIMETER-GUARD Systems, and other systems so designated, are designed to meet OSHA and ANSI machine safety standards for point-of-operation guarding devices. No other Banner sensors or controls are designed to meet these standards, and they must NOT be used as sensing devices for personnel protection.

cable wire colors are the same as the attached cable wire colors, and the hookup diagrams presented in this data sheet apply equally to attached cable models and QD models.



# Modifications and Accessories (continued)

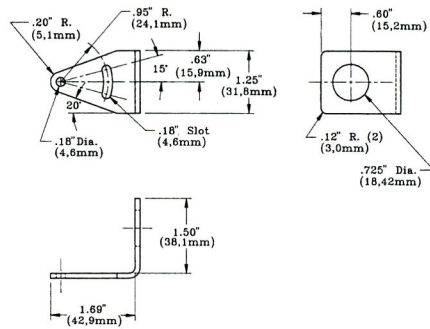
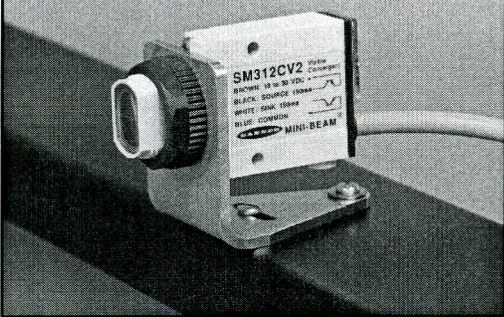
## SMB312S SIDE MOUNT BRACKET



**Model SMB312S** is a stainless steel 2-axis side mounting bracket for MINI-BEAM sensors. The sensor mounts to the bracket using two #4 mounting bolts (supplied).

This bracket allows  $\pm 15$  degrees of vertical-plane sensor adjustment and  $\pm 10$  degrees of bracket adjustment in the horizontal plane.

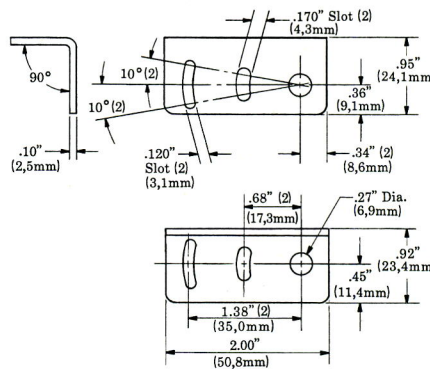
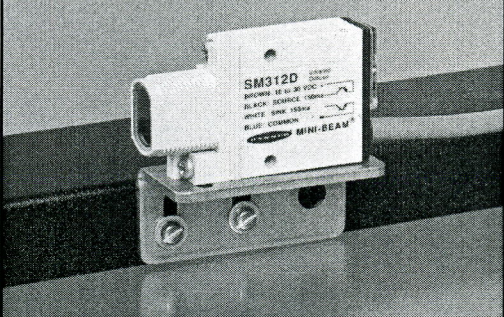
## SMB312PD FRONT MOUNT BRACKET



**Model SMB312PD** is a stainless steel barrel-mounting bracket for MINI-BEAM sensors. The sensor mounts to the bracket using its black plastic mounting nut (supplied with sensor).

This bracket allows  $\pm 15$  degrees of movement, and may be reversed and/or rotated from the position shown.

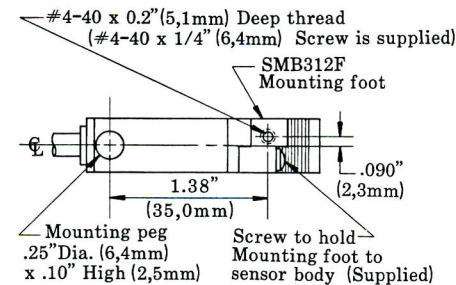
## SMB312B BOTTOM MOUNT BRACKET



**Model SMB312B** is a stainless steel 2-axis bottom mounting bracket for MINI-BEAM sensors. The sensor mounts to the bracket using its mounting peg and an SMB312F mounting foot (supplied).

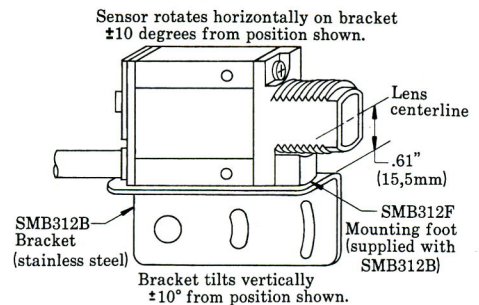
This bracket allows  $\pm 10$  degrees of horizontal-plane sensor adjustment and  $\pm 10$  degrees of bracket adjustment in the vertical plane.

## SMB312F MOUNTING FOOT



(Bottom view of dc model sensor shown)

**Model SMB312F** is a rugged plastic fixture that attaches securely beneath the MINI-BEAM sensor's barrel using a special extra-long upper cover mounting screw (supplied). In the bottom of the mounting foot is a brass-threaded screw insert which accommodates a #4-40 x 1/4" mounting screw (also supplied). This mounting screw is used, along with the sensor's built-in mounting peg, to attach the sensor to the SMB312B mounting bracket (shown above) or to a customer's own mounting bracket in custom installations.



**WARRANTY:** Banner Engineering Corporation warrants its products to be free from defects for a period of one year. Banner Engineering Corporation will repair or replace, free of charge, any product of its manufacture found to be defective at the time it is returned to the factory during the warranty period. This warranty does not cover damage or liability for the improper application of Banner products. This warranty is in lieu of any other warranty either expressed or implied.