MULTI-BEAM®

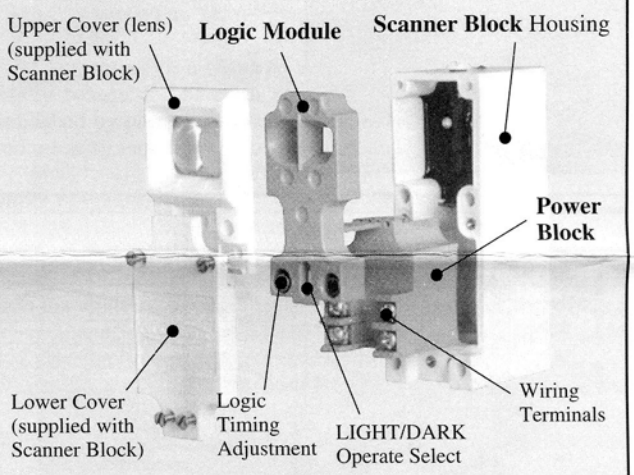
3- & 4-wire Opposed Mode Scanner Blocks for MULTI-BEAM® Modular Photoelectric Sensors

BANNER® the photoelectric specialist

A Banner MULTI-BEAM Sensor is a compact *modular* self-contained photoelectric switch consisting of three components: a scanner block, a power block, and a logic module. The *scanner block*, described in this data sheet, comprises the housing for the sensor and contains a complete modulated photoelectric amplifier, the emitter or receiver optoelements and lenses, and space for the other modules.

The *power block module* provides the interface between the scanner block and the external circuit. It contains a power supply for the MULTI-BEAM emitter or receiver plus a switching device to interface the receiver to the circuit to be controlled. 3- and 4-wire dc power block modules operate from dc voltages and are discussed in data sheet 03499. 3- and 4-wire ac power blocks operate from ac voltages and are covered in data sheet 03501. The *logic module* (data sheet 03304) interconnects the power block and receiver scanner block both electrically and mechanically. It provides the desired timing logic function (if any) plus the ability to program the output for either light- or dark-operate.

The emitter of a MULTI-BEAM opposed mode emitter-receiver pair does not require a logic module. Emitter scanner blocks are supplied with a blade-pin to interconnect the scanner block and power block. Power block and logic modules are purchased separately. This modular design, with field-replaceable power block and logic modules, permits a large variety of sensor configurations, resulting in exactly the right sensor for any opposed mode photoelectric application.



A scanner block consists of a scanner block housing, an upper cover assembly, and a lower cover. Other modular components (logic module and power block module) are purchased separately.

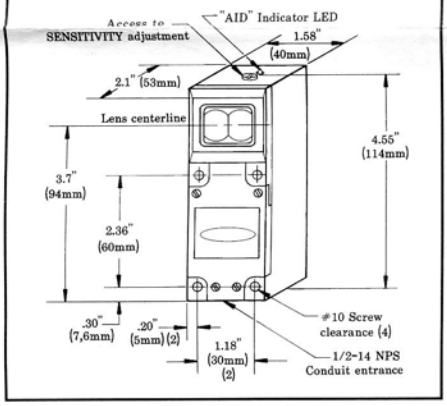
MULTI-BEAM 3- and 4-wire opposed mode scanner blocks include five different standard emitter and receiver combinations. The high power models (those with 10 millisecond response time) offer the greatest optical sensing power of any industrial LED opposed mode sensor pairs.

The circuitry of all MULTI-BEAM components is encapsulated within rugged, corrosion-resistant VALOX® housings that meet or exceed NEMA 1, 3, 12, and 13 ratings. MULTI-BEAM 3- and 4-wire receiver scanner blocks include Banner's exclusive, patented* Alignment Indicating Device (AID™) system, which lights a top-mounted LED when the sensor sees its modulated emitter and pulses at a rate proportional to the strength of the received light signal.

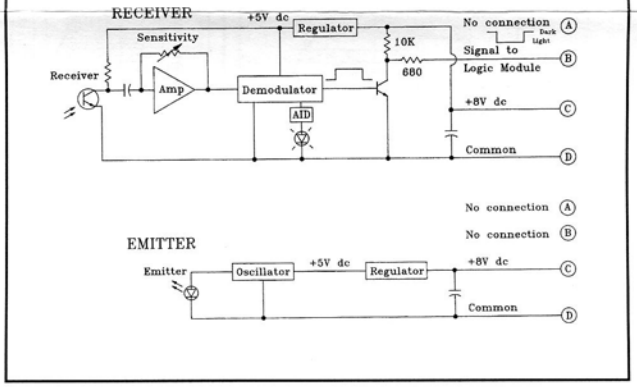
All MULTI-BEAM scanner blocks are totally solid-state for unlimited life.

***US patent 4356393.**

Dimensions



Functional Schematics



Specifications (see also "Modifications", page 2)

Supply Voltage: Input power for both emitter and receiver, and output connections for the receiver are made via 3- or 4-wire power blocks. See data sheet 03499 (DC Power Blocks) or 03501 (AC Power Blocks), or refer to the Banner product catalog.

Response Time (receiver scanner blocks, independent of signal strength**):**
1 millisecond "on" and "off";
High-gain models ("X" model suffix) 10 milliseconds "on" and "off".

Sensitivity Adjustment (receiver scanner blocks): Easily-accessible, located on top of receiver scanner block beneath o-ring gasketed nylon screw cover. 15-turn clutched control; rotate clockwise to increase sensitivity.

Alignment Indicator (receiver scanner blocks): Red LED on top of receiver scanner block. Banner's exclusive, patented Alignment Indicating Device (AID™) circuit lights the LED whenever the receiver detects the emitter's modulated light source, and pulses the LED at a rate proportional to the received light level.

Construction: Reinforced VALOX® housing; components totally encapsulated. Stainless steel hardware. Meets NEMA standards 1, 3, 12, and 13.

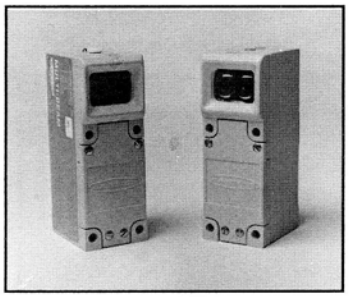
Operating Temperature Range: -40 to +70° C (-40 to +158° F).

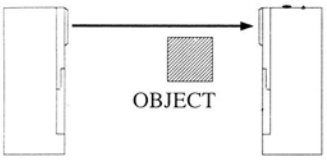
WARNING These photoelectric presence sensors do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A sensor failure or malfunction can result in *either* an energized or a de-energized sensor output condition.

Never use these products as sensing devices for personnel protection. Their use as safety devices may create an unsafe condition which could lead to serious injury or death.

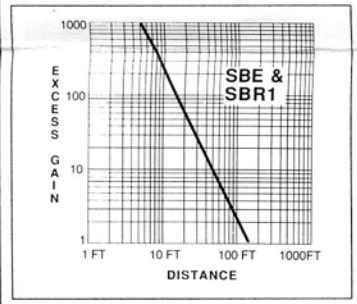
Only MACHINE-GUARD and PERIMETER-GUARD Systems, and other systems so designated, are designed to meet OSHA and ANSI machine safety standards for point-of-operation guarding devices. No other Banner sensors or controls are designed to meet these standards, and they must NOT be used as sensing devices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

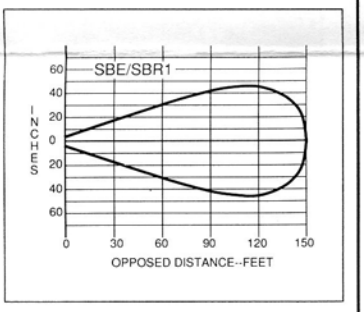
OPPOSED MODE Scanner Blocks





Opposed mode MULTI-BEAMs consist of an emitter and a receiver, which are sold separately. They provide the highest excess gain and the longest sensing range of all sensing modes, and are recommended for use whenever possible. Sensing takes place when an object breaks the light beam. Both infrared and visible red types are available. All models have Banner's exclusive AID™ alignment system (see note, page 3).

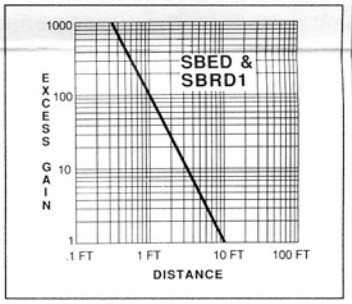


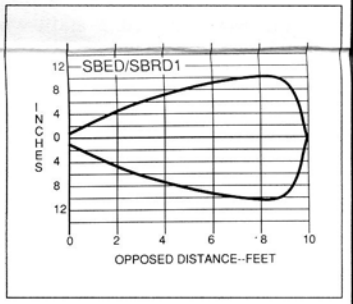


models
SBE & SBR1

Range: 150 feet (45m)
Response: 1ms on/off
Beam: infrared, 940nm
Effective beam: 1" dia.

SBE/SBR1: this opposed pair has the highest gain available at 1 millisecond response.

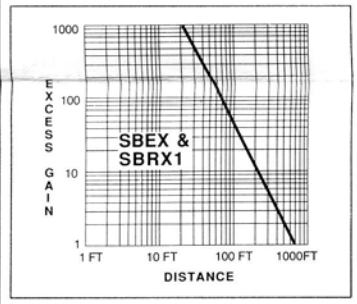


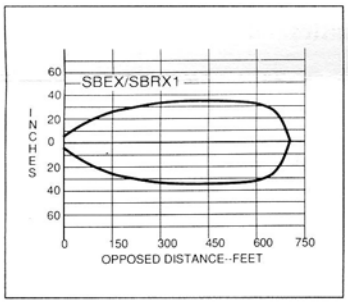


models
SBED & SBRD1

Range: 10 feet (3m)
Response: 1ms on/off
Beam: infrared, 880nm
Effective beam: .12" dia.

SBED/SBRD1: fast response and small effective beam; will detect objects as small as 1/4 inch in crossection moving at up to 10 feet per second. Best choice for repeatability of position sensing.

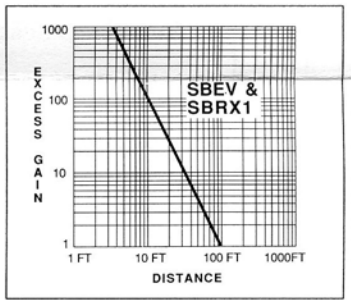


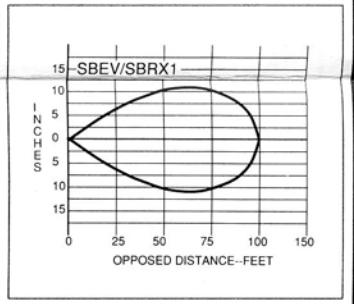


models
SBEX & SBRX1

Range: 700 feet (200m)
Response: 10ms on/off
Beam: infrared, 940nm
Effective beam: 1" dia.

SBEX/SBRX1: best choice for opposed sensing in extremely dirty environments. Use for outdoor applications and all applications requiring opposed range of 100 feet or more. Also useable side-by-side for long-distance mechanical convergent sensing. Alignment is difficult beyond 400 feet.

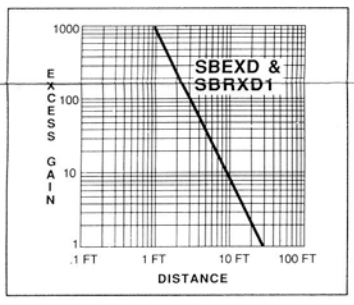


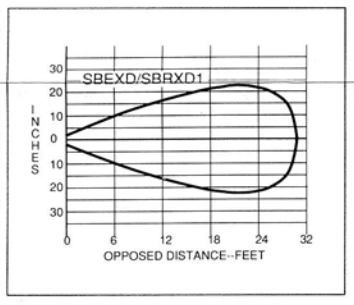


models
SBEV & SBRX1

Range: 100 feet (30m)
Response: 10ms on/off
Beam: visible red, 650nm
Effective beam: 1" dia.

SBEV/SBRX1: SBEV has visible red beam for easiest alignment and system monitoring.





models
SBEXD & SBRXD1

Range: 30 feet (9m)
Response: 10ms on/off
Beam: infrared, 880nm
Effective beam: .12" dia.

SBEXD/SBRXD1: wide beam angle and high gain for the most forgiving emitter-receiver alignment.

MULTI-BEAM Scanner Block Modifications

The following are popular modifications to MULTI-BEAM 3- & 4-wire scanner blocks. *They are not stocked, but are available on a quote basis.*

HIGH SPEED MODIFICATION "MHS": receiver scanner blocks with 1 millisecond response may be modified for 300 microsecond (0.3 millisecond) response. This modification is designated by adding suffix "MHS" to the scanner block model number (e.g.- SBR1MHS, etc.). The MHS modification reduces the available excess gain by about 50%, and also decreases the sensor's immunity to some forms of electrical "noise".

ZERO HYSTERESIS MODIFICATION "MZ": amplifier hysteresis may be removed from 3- and 4-wire scanner blocks when attempting to sense very small signal changes (contrasts less than 3). This modification is designated by adding suffix "MZ" (Modified Zero Hysteresis). Be sure that all variables affecting the sensor's optical response remain constant before ordering the zero hysteresis modification.

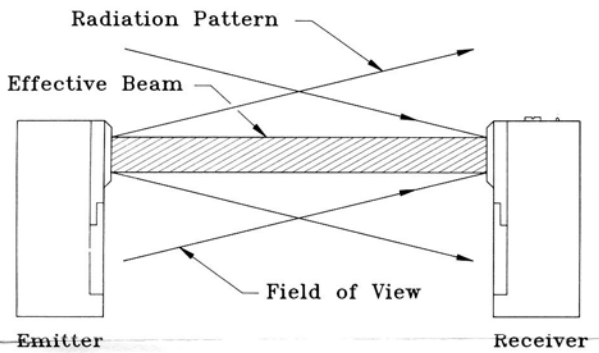
INSTALLATION AND ALIGNMENT

Opposed ("beam break") sensing will always result in the most reliable sensing system, as long as the item to be detected is opaque to light. Opposed sensing is the most efficient sensing mode, and offers the highest level of optical energy to overcome lens contamination, sensor misalignment, or long scanning ranges.

NOTES ABOUT THE "EFFECTIVE BEAM":

The size of the lens of the emitter and receiver of an opposed sensor pair determines the size of the pair's *effective beam.* The effective beam may be pictured as a rod which connects the profile of the emitter lens to the profile of the receiver lens. This rod will be tapered if the two lenses are *of different sizes.* The effective beam is the "working" part of the photoelectric beam: it is the portion of the beam which must be completely interrupted in order for an object to be reliably sensed. It should not be confused with the actual radiation pattern of the emitter, or with the field of view of the receiver (see figure 1, below).

Figure 1. Effective beam and field of view.



The effective beam size of MULTI-BEAM scanner block pair models SBE/SBR1, SBEX/SBRX1, and SBEV/SBRX1 is one inch in diameter. Models SBED/SBRD1 and SBEXD/SBRXD1 have a 1/8 inch diameter effective beam. The lens of the emitter or receiver or both may be *apertured* to detect objects having a profile smaller than the effective beam. The lens(es) may simply be covered with an opaque tape, leaving an opening of the size desired at the center of the lens(es). Manufactured apertures are usually constructed using a thin, opaque material like metal foil. A rectangular or "slit" aperture is usually more effective than is a small round hole.

About Banner's Alignment Indicating Device (AID™) System:

"AID" (Alignment Indicating Device, US patent #4356393) is an exclusive built-in feature that permits optimum alignment and continuous monitoring of the photoelectric system. The red receiver LED indicator is "on" when the receiver "sees" the modulated light from the emitter LED and "off" when the beam is broken. In addition, a low frequency pulse rate is superimposed on the LED indicator. When alignment is marginal, the pulse rate will be about once per second (indicating an excess gain of 1). As alignment is improved, the pulse rate increases, indicating increased excess gain. Optimum sensor alignment is indicated by the fastest pulse rate.

The AID feature also signals when maintenance is needed. Any pulse rate less than two or three beats per second indicates marginal performance, even though the MULTI-BEAM is still *functioning* properly. Whenever the pulse rate is slow, the lenses should be cleaned and/or the alignment checked.

If the alignment indicator on the receiver appears to be "on" steadily with no pulsing evident, it is actually pulsing at a rate that is too fast to be seen. A "steadily on" LED indicates an excess gain of *at least 20X.*

The Alignment Indicating Device is used in the alignment procedures described in this data sheet.

ALIGNMENT AT SHORT RANGE

At ranges within a few feet, the enormous power of opposed MULTI-BEAM scanner blocks makes alignment simple. However, even at short range, it may be important to *optimize* alignment, especially if high excess gain is needed to "burn through" dirt, dust, steam, etc.

The best way to align a receiver to its emitter at short range is to drastically reduce the strength of the light signal. This is easily accomplished by placing a diffuser, such as a sheet of paper or light-colored masking tape, in front of the emitter and/or receiver lens.

For short-range alignment:

1) Begin with the emitter mounted securely in place. At ranges up to a few feet, the receiver may simply be mounted using line-of-sight alignment. At distances beyond a few feet, loosely mount the receiver opposite the emitter, leaving a means for movement. Banner offers a variety of 2- and 3-axis mounting brackets for use with MULTI-BEAM sensors. See the Banner product catalog for bracket information.

2) If sensing is to be at an exact location, tie a string around the emitter at the center of its lens and extend it to the center of the receiver lens to make certain that the *center* of the beam will intersect the sensing point.

3) Apply power to the emitter and receiver power blocks at terminals #1 and #2 (observe polarity on DC power block models). The Alignment Indicating Device LED on the reciever should now be "on" (steadily or pulsing).

4) If the indicator LED is "on" steadily, place a diffusing material (paper, tape, etc) in front of the lens of the emitter and/or receiver. Use enough thickness to cause the receiver LED to pulse at an easily countable rate (one to five beats per second). Now move the receiver up/down/left/right (include rotation) to try to increase the pulse rate. Secure the receiver in the position where the pulse rate is fastest, or in the center of the area where the alignment LED is "on" steadily.

5) Increase the receiver sensitivity to maximum. The SENSITIVITY control, located under the white nylon access screw next to the indicator LED, is a 15-turn potentiometer clutched at both ends of rotation. To increase receiver sensitivity, turn the control clockwise with a small flat-blade screwdriver .

6) Place the object to be detected at the sensing position. If the receiver alignment LED goes "off", **alignment is complete.**

NOTE: If the receiver alignment LED does not go "off" when the object is in place at the sensing position, the reason may be one or both of the following:

a) FLOODING: A portion of the effective beam may be passing around one or both sides of the object. Check the profile that the object presents to the beam and compare it to the size of the effective beam. Install apertures if needed. Also, move the object back and forth to locate the center of the beam.

b) BURN-THROUGH: If the object is non-metallic and has thin walls, there may be too much light energy for the object to completely block. With the object in place in the sensing position, decrease the sensitivity adjustment (CCW rotation) until the receiver indicator LED goes "off", plus two more full turns. Remove the object and confirm that the LED indicator comes "on" and is pulsing more than two beats per second. If this fails, consider using an alternate sensing scheme (e.g. - convergent, diffuse, or visible retroreflective sensing).

ALIGNMENT AT LONG RANGE

When long scanning distances are needed, the requirement for accurate alignment becomes much more important. It is very difficult to align opposed mode sensors at a separation of 50 feet or more after they have been permanently mounted. It is far easier to first mount the emitter, and install a long extension cord on the receiver. Slowly walk the receiver back to the receiver mounting location while moving the receiver up/down/left/right (include rotation) to track the center of the emitted beam. At long scanning distances, accurate angular sensor alignment is even more important than vertical or horizontal placement.

Alternatively, the receiver mounting position may be determined by walking backward from the emitter with the Banner model BT-1 BEAM TRACKER™ . The Beam Tracker is a battery-operated hand-held device which will sense the beam of a MULTI-BEAM emitter with approximately the same sensitivity as the equivalent MULTI-BEAM receiver. The BEAM TRACKER includes Banner's Alignment Indicating Device circuitry. Once the best receiver position has been determined, the receiver may be permanently mounted after fine adjustment is made using the receiver's own Alignment Indicating Device LED.

NOTES ON ALIGNMENT OF VISIBLE EMITTERS:
Emitter scanner block model SBEV emits a visible red light which can simplify alignment to the SBRX1. If a retroreflective target is temporarily placed in front of the lens of the SBRX1, the emitter can be aligned by sighting the SBEV's visible red image on the target. Sight toward the receiver from behind the SBEV emitter, looking over and past the top of the scanner block (figure 2). Move the emitter up/down/left/right (include rotation) until the visible red image (returned by the retroreflective target) is seen. Remove the retroreflective target and adjust the SBRX1's position for optimum alignment using its Alignment Indicating Device LED.

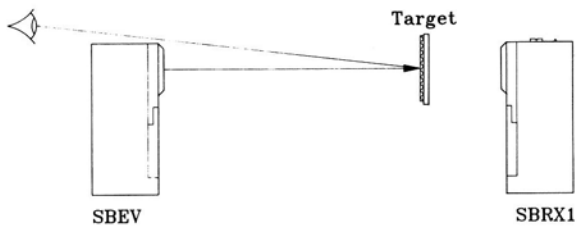
FINAL ADJUSTMENTS AND CHECKOUT

Secure all mounting hardware. Complete the wiring by connecting the load to the output circuit of the receiver power block (terminal #3 and/or #4: refer to the hookup information for the power block in use). Hookup information is packed with the power block.

Check the operation of the load by alternately placing an opaque object in front of the lens and then removing it. The load and the receiver alignment indicator LED should "follow" the action. Adjust the logic module timing (if any) as required.

NOTE: Logic modules (except models LM1, LM2, and LM10) include a light/dark operate programming jumper. Removing the jumper will *invert* the output state of the power block (from normally open to normally closed, or vice-versa). *CAUTION: do not attempt to remove the programming jumper while power is applied to the MULTI-BEAM!*

Figure 2. Use of a retroreflective target to align SBEV visible emitter to SBRX1 receiver.



TROUBLESHOOTING TABLE

SYMPTOM	PROBABLE CAUSE	CORRECTION
Receiver alignment indicator never comes "on", and output never switches the load.	Sensitivity is too low.	Turn sensitivity control clockwise to increase gain.
	Emitter and receiver misaligned.	Follow alignment procedure.
	Obscured or broken lens(es).	Clean or replace upper cover assembly.
	Loose connection.	Check power supply at power block terminals #1 and #2 (both power blocks).
	Failure of a sensor component.	Test MULTI-BEAM receiver using Banner model LMT. Replace failed module.
Receiver alignment indicator never comes "on", but load is switched correctly.	Broken alignment indicator LED (sensor will continue to operate).	Replace receiver scanner block (if alignment indicator is required).
Receiver alignment indicator is always "on", and output never switches.	"Burn-through" is occurring.	Reduce gain by: reducing receiver sensitivity (CCW), intentional emitter/receiver misalignment, adding lens aperture on emitter or receiver.
	Object too small to break effective beam.	Add lens apertures .
	Receiver is responding to "noise".	Use Banner model BT-1 BEAM TRACKER to locate "noise" source.
	Failure of sensor component.	Test MULTI-BEAM receiver using Banner model LMT. Replace failed module.
Receiver alignment indicator follows the sensing action, normally, but the output is energized all of the time.	Output of power block failed (shorted).	Replace receiver power block module. Check load demand against receiver power block switch rating.
Receiver alignment indicator follows the sensing action, normally, but the output never energizes.	Failure of logic module or power block.	Test MULTI-BEAM receiver using Banner model LMT. Replace failed module.
	Loose connection.	Check wires to load.
Receiver sensitivity cannot be set to sense the difference between the light and dark conditions. The sensitivity is either too high or too low.	Low optical contrast (less than 2:1). Object too transparent.	Evaluate alternative sensing methods.
	Object too small to break effective beam.	Add lens apertures to shape effective beam to match the profile of the object.

Banner Engineering Corp. 9714 Tenth Ave. No. Minneapolis, MN 55441 Telephone: (763) 544-3164 FAX (applications): (763) 544-3573