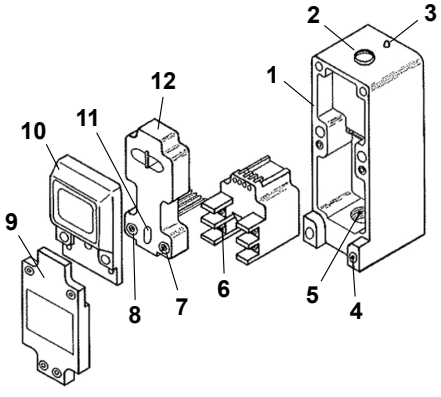
MULTI-BEAM 3- and 4-Wire Opposed Mode Scanner Blocks

Datasheet

Three- and Four-Wire Opposed Mode Scanner Blocks for MULTI-BEAM Modular Photoelectric Sensors



1. Scanner block housing
2. Sensitivity adjustment
3. Status/alignment indicator LED
4. Mounting hole
5. Conduit entrance
6. Wiring terminals on the power block
7. Logic timing adjustment
8. Logic timing adjustment
9. Lower cover, supplied with the scanner block
10. Upper cover (lens), supplied with the scanner block
11. Light/dark operate select
12. Logic module

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.

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.

Models

Opposed mode MULTI-BEAMs consist of an emitter and receiver, which are sold separately. They provide the highest excess gain and the longest sensing range of all sensing models, 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.

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

Models	Range	Response Time	Beam
SBE Emitter	45 m (150 ft)	1 ms	Infrared, 940 nm (Beam diameter of 1 inch)
SBR1 Receiver			

SBED/SBRD1. With a fast response and small effective beam, this pair will detect objects as small as 1/4-inch in cross-section and moving at up to 10 feet per second. This is the best choice for repeatability of position sensing.

Models	Range	Response Time	Beam
SBED Emitter	3 m (10 ft)	1 ms	Infrared, 880 nm (Beam diameter of 0.12 inch)
SBRD1 Receiver			

SBEX/SBRX1. This pair is the best choice for opposed sensing in extremely dirty environments. Use these models for outdoor applications and all applications requiring an opposed range of 100 feet or more. You may also use these models side-by-side for long-distance mechanical convergence sensing. Alignment is difficult beyond 400 feet.

Models	Range	Response Time	Beam
SBEX Emitter	200 m (700 ft)	10 ms	Infrared, 940 nm (Beam diameter of 1 inch)
SBRX1 Receiver			

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

Models	Range	Response Time	Beam
SBEV Emitter	30 m (100 ft)	10 ms	Visible Red, 650 nm (Beam diameter of 1 inch)
SBRX1 Receiver			

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ПРОМЭЛЕКТРОНИКА/ sales@prom-elec.com

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

Models	Range	Response Time	Beam
SBEXD Emitter	9 m (30 ft)	10 ms	Infrared, 880 nm (Beam diameter of 0.12 inch)
SBRXD1 Receiver			

MULTI-BEAM Scanner Block Modifications

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

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). Verify all variables affecting the sensor's optical response remain constant before ordering the zero hysteresis modification.

High Speed Modification "MHS". Scanner blocks with 1 millisecond response may be modified for 300 microsecond (0.3 ms) response. This modification is designated by adding suffix "MHS" to the scanner block model number (for example, **SBF1MHS**). The MHS modification reduces the available excess gain by about 50% and also decreases the sensor's immunity to some forms of electrical noise.

Overview

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 datasheet, 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 plus a switching device to interface the sensor to the circuit to be controlled. Three- and four-wire dc power block modules operate from dc voltages and are discussed in datasheet 03499. Three- and four-wire ac power blocks operate from ac voltages and are covered in datasheet 03501.

The **logic module** (datasheet 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 MULT-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.

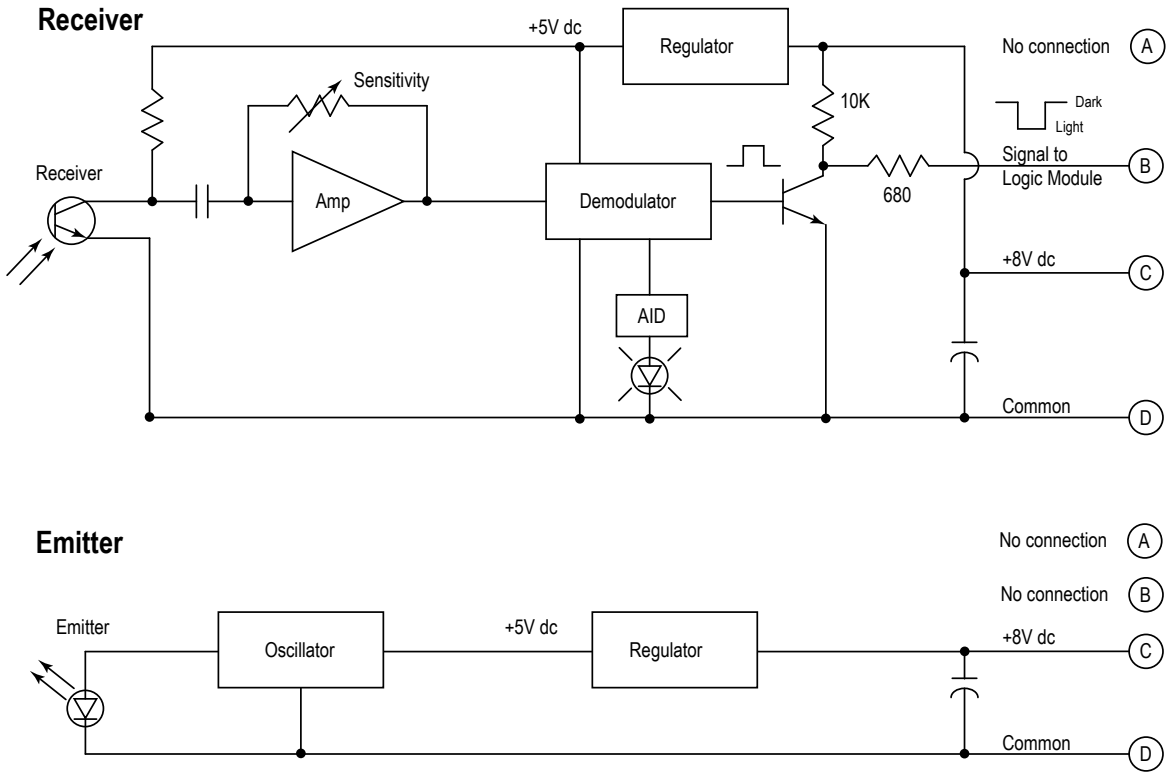
MULTI-BEAM 3- and 4-wire scanner blocks include several different standard emitter and receiver combinations. The high power models (those with 10 millisecond response time) offer the greatest optical sensing power of any industrial LED opposed mode sensor pairs.

The circuitry of all MULTI-BEAM components is encapsulated within rugged, corrosion-resistant VALOX® housings that meet or excess NEMA 1, 3, 12, and 13 ratings. MULTI-BEAM 3- and 4-wire receiver scanner blocks include Banner's exclusive, patented [1], Alignment Indicating Device (AID™) system, which lights a top-mounted LED when the sensors 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.

[1] U.S. patent 4356393

Figure 1. Functional Schematic



Banner's Alignment Indicating Device (AID™) System

Banner's Alignment Indicating Device (AID) system [2] is an exclusive built-in feature that permits optimum alignment and continuous minoring of the photoelectric system. The red receiver LED indicator is on when the receiver sees the modulated light from the emitter and is 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 tells you when maintenance is necessary. Any pulse rate less than two per second indicates marginal performance; the unit, however, is still functioning properly. When the pulse rate slows to less than two per second, clean the lenses and check the alignment.

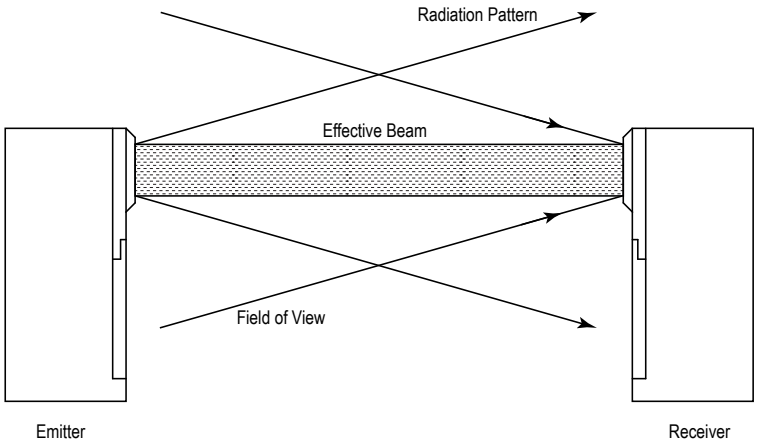
Installation and Alignment

Opposed (beam break) sensing results 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 scanner 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 that 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 that must be completely interrupted 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.

[2] U.S. Patent 4356393

Figure 2. 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). Manufacturer apertures are usually constructed using a thin, opaque material like metal foil. A rectangular or "slit" aperture is usually more effective than a round hole.

Aligning at Short Range

At ranges within a few feet, the power of the 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.

1. Mount the emitter securely in place. At ranges up to a few feet, the receiver may 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. Refer to the Banner product catalog for bracket information.
2. If sensing is at an exact location, tie a string around the emitter at the center of its lens and extend it to the center of the receiving lens to verify the center of the beam intersects 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 (AID) LED on the receiver should now be on (either solid or pulsing).
4. If the indicator LED is solid, 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 solid.
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.

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

- **Flooding**. A portion of the effective beam may be passing around one of 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.
- **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 alternative sensing scheme, for example convergent, diffuse, and visible retroreflective sensing.

Aligning at Long Range

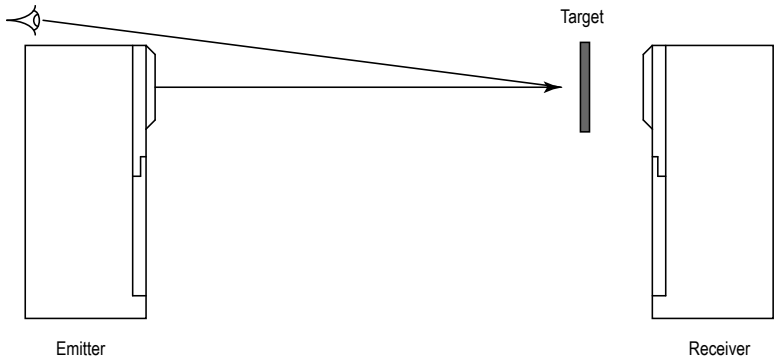
When long distances are needed, accurate alignment is much more important. It is difficult to align opposed mode sensors at a separation of 50 feet or more after they have been permanently mounted.

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 emitter beam. At long scanner distances, accurate angular sensor alignment is even more important then 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 that 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 (AID) circuitry. After the best receiver position is determined, make fine adjustments to the position using the receiver's own AID LED, then permanently mount the receiver.

Aligning Visible Emitters. Emitter scanner block model SBEV emits a visible red light that 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. 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 AID LED.

Figure 3. Using a Retroreflective Target to Align the SBEV Visible Emitter to the SBRX1 Receiver.



Final Adjustment and Test

When alignment is completed and mounting hardware secured, finish wiring the scanner block by connecting the load to the output circuit of the power block (terminals 3 and/or 4). Refer to the hookup diagram for the power block in use. Check the operation of the load by placing an object in front of the sensing component (lens or sensing tip) and removing it. The load and the alignment indicator LED should follow the action. Adjust the logic module timing (if any), as required.

Logic modules (except models LM1, LM2, and LM10) include a light/dark 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 remove the programming jumper while power is applied to the MULTI-BEAM.

If you have any difficulties with the installation of your sensing system, contact your local Banner Engineering Corp representative or contact our applications engineers during normal business hours.

Troubleshooting

Symptom	Probably Cause	Solution
Receiver alignment indicator never comes on and the output never switches the load.	Sensitivity is too low.	Turn the sensitivity control clockwise to increase the gain.
	Emitter and receiver are misaligned.	Follow the alignment procedure.
	Obscured or broken lens(es).	Clean or replace the upper cover assembly.
	Loose connection.	Check the power supply at the power block terminals 1 and 2 (both power blocks).
	Sensor component failure.	Test the MULTI-BEAM receiver using Banner model LMT. Replace the failed module.
Receiver alignment indicator never comes on, but the load is switched correctly.	Broken alignment indicator LED (sensor continues to operate).	Replace the receiver scanner block (if the alignment indicator is required).
Receiver alignment indicator is always on and the output never switches	"Burn-through" is occurring.	Reduce the gain by reducing the receiver sensitivity (CCW), intentional emitter/receiver misalignment, or adding a lens aperture to the emitter or receiver.
	The object is too small to break the effective beam.	Add a lens aperture.

Symptom	Probably Cause	Solution
	Receiver is responding to "noise."	Use Banner model BT-1 BEAM TRACKER to locate the "noise" source.
	Sensor component failure.	Test the MULTI-BEAM receiver using Banner model LMT. Replace the failed module.
Receiver alignment indicator follows the sensing action, normally, but the output is energized all the time.	Output of power block failed (shorted).	Replace the receiver power block module. Check the load demand against the receiver power block switch rating.
Receiver alignment indicator follows the sensing action, normally, but the output never energizes.	Logic module or power block failure.	Test the MULTI-BEAM receiver using Banner model LMT. Replace the failed module.
	Loose connection.	Check the 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). The object is too transparent.	Evaluate alternative sensing methods.
	The object is too small to break the effective beam.	Add lens apertures to shape the effective beam to match the profile of the object.

Specifications

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 datasheet 03499 (DC power blocks) or 03501 (AC power blocks) for more information.

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

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

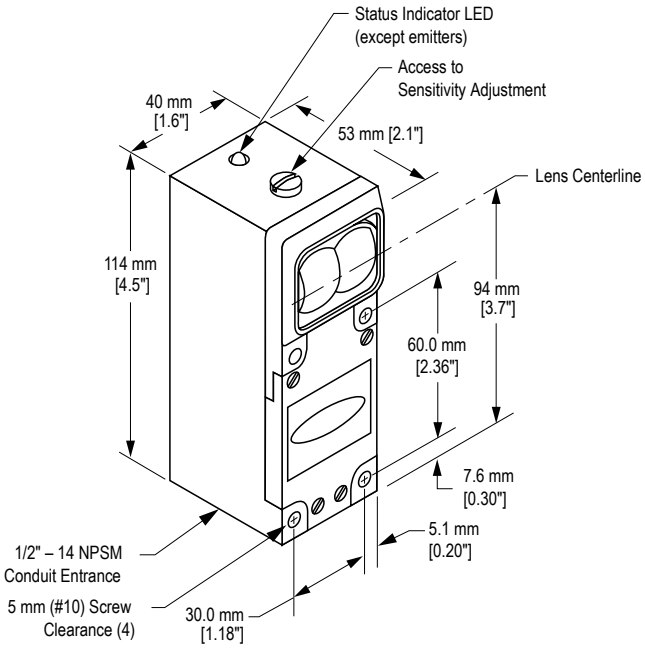
Response Time (Receiver Scanner Blocks, independent of signal strength)
1 millisecond on and off
High-gain models (X model suffix) 10 milliseconds on and off

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

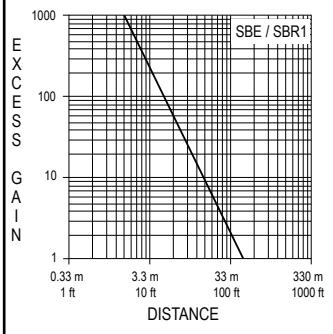
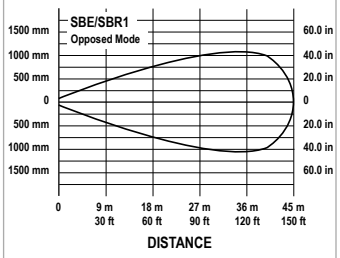
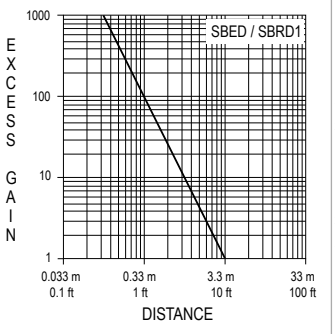
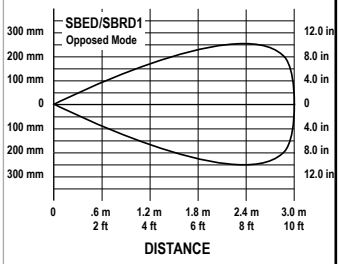
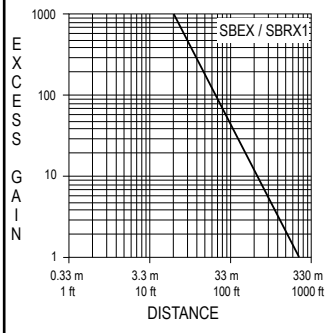
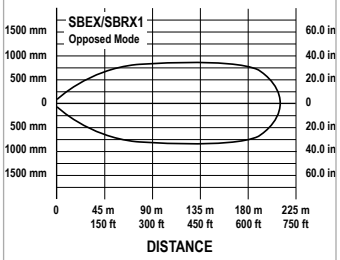
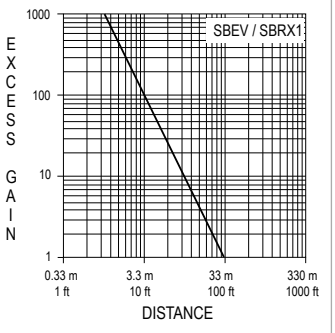
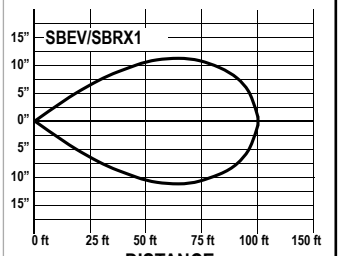
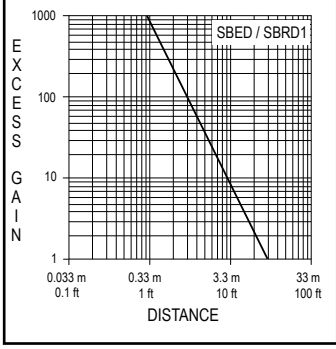
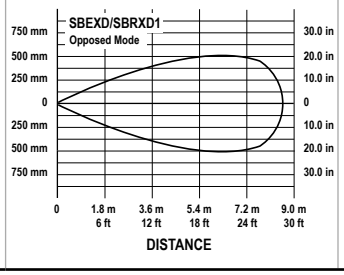
Alignment Indicator (Receiver Scanner Blocks)
Red LED on top of receiver scanner block
Banner's exclusive, patented Alignment Indicating Device (AID™) circuit lights the LED when the receiver sensor detects the emitter's modulated light source and pulses the LED at a rate proportional to the received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

Dimensions

All measurements are listed in millimeters [inches], unless noted otherwise.



Performance Curves

Excess Gain	Beam Pattern	Excess Gain	Beam Pattern
			
			
			

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