MULTI-BEAM®

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

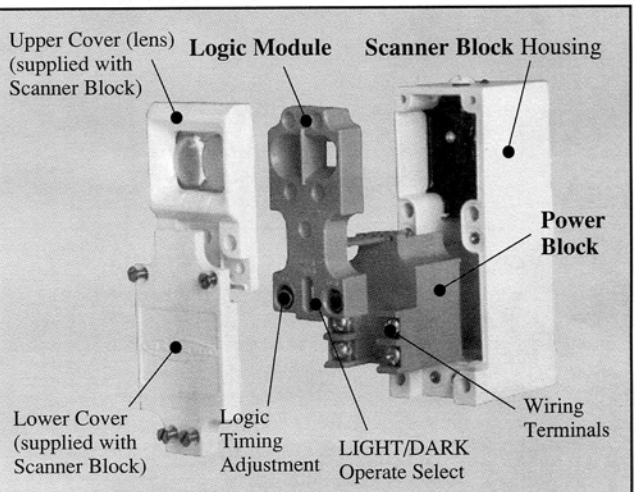
BANNER® the photoelectric specialist

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 and 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. 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 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.

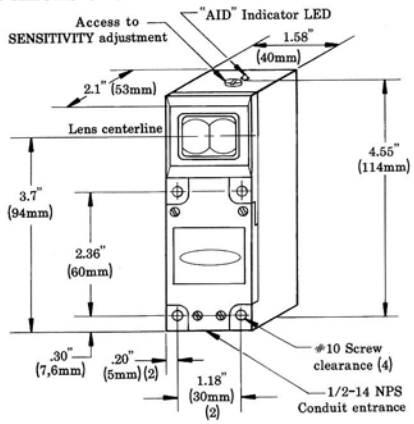
Power block and logic modules are purchased separately. This modular design, with field-replaceable power block and logic modules, permits a large variety of sensor configurations, resulting in exactly the right sensor for any retroreflective mode photoelectric application.

MULTI-BEAM 3- and 4-wire retroreflective mode scanner blocks include four different standard models. The high power model (model SBLX1) offers the greatest optical sensing power of any industrial retroreflective sensor.



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.

Dimensions

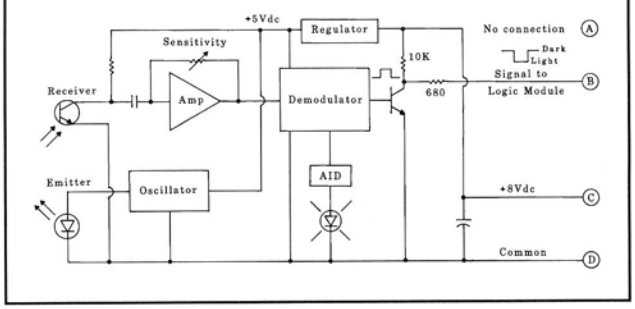


The circuitry of all MULTI-BEAM components is encapsulated within rugged, corrosion-resistant VALOX® housings that meet or exceed NEMA 1, 3, 12, and 13 ratings. MULTI-BEAM 3- and 4-wire retroreflective mode scanner blocks include Banner's exclusive, patented* Alignment Indicating Device (AID™) system,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

Functional Schematic



Specifications (see also "Modifications", page 2)

Supply Voltage: Input power and output connections 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: 1 millisecond "on" and "off"; high-gain modelSBLX1 10 milliseconds "on" and "off"; independent of signal strength.

Repeatability of Response: 0.3 milliseconds (1.5 milliseconds for SBLX1); independent of signal strength.

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

Alignment Indicator: Red LED on top of scanner block. Banner's exclusive, patented Alignment Indicating Device (AID™) circuit lights the LED whenever the sensor detects it's own 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.

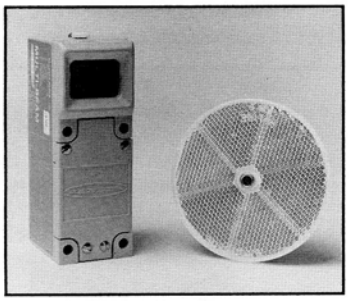
Operating Temperature Range: -40 to +70° C (-40 to +158° F).

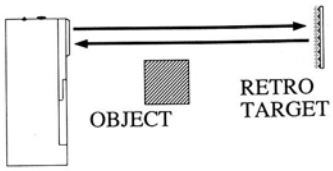
WARNING These photoelectric presence sensors do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A sensor failure or malfunction can result in *either* an energized or a de-energized sensor output condition.

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.

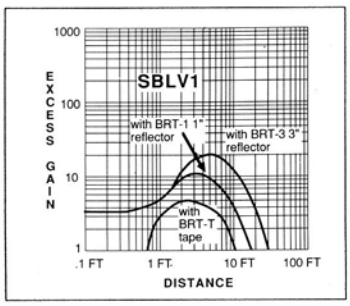
RETROREFLECTIVE MODE Scanner Blocks

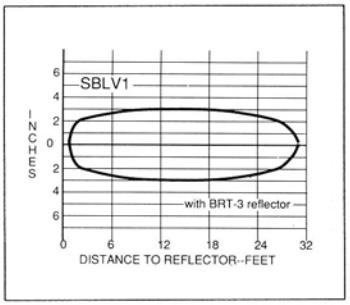




Retroreflective mode MULTI-BEAMs combine emitter and receiver into one unit. A retroreflective target is used to return the emitted light to the receiver along the same optical axis. Sensing occurs when an object passes between the sensor and the reflector, interrupting the beam. A variety of retroreflective materials are available (see next page and Banner catalog).

VISIBLE RED, GENERAL APPLICATIONS

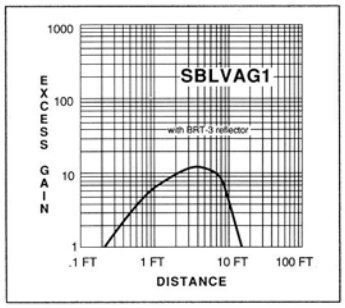


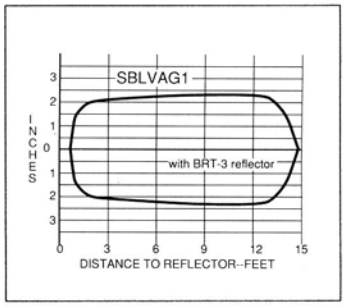


model
SBLV1
Range: 6 in. to 30 ft.
(0,15 to 9m)
Response: 1ms on/off
Beam: visible red, 650nm

SBLV1: a visible red beam makes alignment very easy. SBLV1 is the first choice for most retroreflective applications. Not for use in dirty environments; rather use opposed mode, or see SBL1 & SBLX1, below. Do not locate retroreflector closer than 6 inches (15cm) from sensor.

VISIBLE RED, ANTI-GLARE FILTER

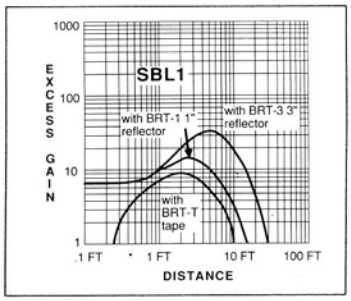


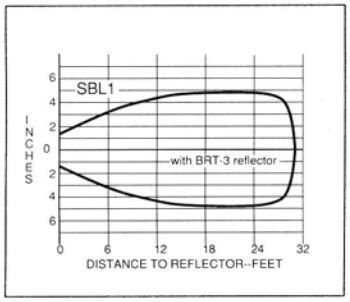


model
SBLVAG1
Range: 12 in. to 15 ft.
(0,3 to 4,5m)
Response: 1ms on/off
Beam: visible red, 650nm

SBLVAG1: uses anti-glare filter for immunity to direct reflections from shiny objects. Use only with models BRT-3 or BRT-1.5 retroreflective targets. Use only in clean environments. Do not locate retroreflector closer than 12 inches (30cm) from sensor.

INFRARED, GENERAL APPLICATIONS

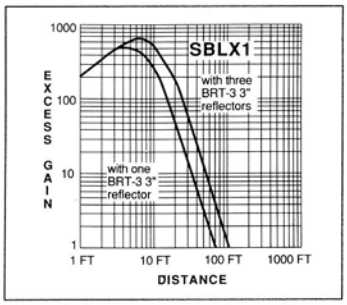


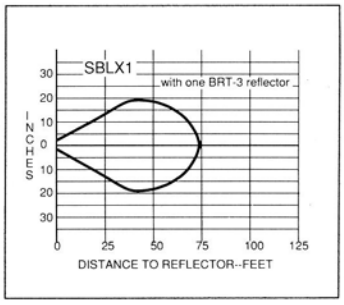


model
SBL1
Range: 1 in. to 30 ft.
(2,5cm to 9m)
Response: 1ms on/off
Beam: infrared, 940nm

SBL1: use where invisible beam is advantageous (e.g. security applications or film processing). First choice for retroreflective sensing in slightly or moderately dirty environments. Do not use when object to break the beam has a shiny surface, unless the angle of light to the surface can be predicted.

INFRARED, HIGHEST GAIN





model
SBLX1
Range: 10 to 75 ft. (3 to 22m) with one BRT-3 target; 10 to 100 ft. (3 to 30m) with three BRT-3 targets
Response: 10ms on/off
Beam: infrared, 880nm

SBLX1: highest gain available in a retroreflective sensor. Use for all applications requiring more than 30-foot range where opposed mode sensors cannot be used. Objects must pass at a distance of at least 10 feet from the sensor to be reliably sensed.

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": 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.- SBLV1MHS, 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

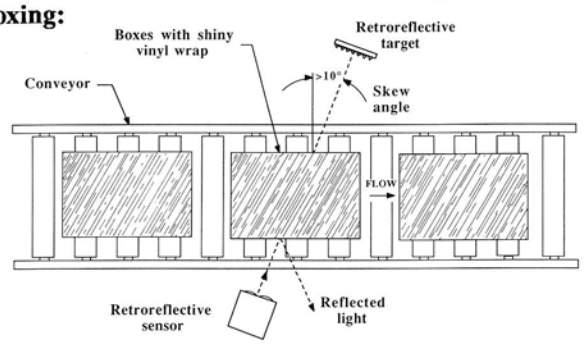
Retroreflective mode photoelectric sensing is ideal for many applications for which opposed mode sensing would be the first choice, but where sensing is possible from only *one* side of the process. "Retro" is the most popular sensing mode for conveyor applications where objects are large and the environment is relatively clean. It is also the most common sensing mode used in code reading applications using retroreflective code plates.

Retroreflective sensors work with special target materials that reflect the emitted light beam back to the sensor. The efficiency of these targets (and, therefore, the sensing range) depends upon the *size* and the *reflectivity* of the target. Size is important because, at ranges beyond a few feet, the retro target may not intercept the complete beam. At an extended range, a 3" diameter target will intercept nine times as much light as a 1" diameter target (the area ratio is the square of the diameter ratio). The 1" target will, therefore, require nine times the excess gain required for the 3" target. At extended ranges, a *cluster* of targets can yield higher gain and longer range than one target alone. At close range, however, both targets may intercept the beam equally well. Recommended reflectors available from Banner are listed in the table at the right. See the Banner product catalog for additional information.

Reflectivity is a function of target construction. Most plastic targets are made up of small, highly efficient corner-cube reflectors. Most reflective tape, on the other hand, uses glass beads or smaller, less efficient corner cubes. The retroreflective materials listed in the table at the right are listed in order of reflectivity, the 3" diameter model BRT-3 corner-cube retroreflector being the best.

Successful retroreflective mode sensing depends upon adequate optical contrast between the dark (beam broken) state and the light (beam unbroken) state. Retroreflective sensing, therefore, works best with objects of *low* reflectivity. Highly reflective objects such as glass, polished metal, mirrors, etc. may not be sensed because they can reflect as much or nearly as much light back to the sensor as does the retroreflective target. This effect is known as "proxing", and can in some cases be overcome by sensing at a "skew" angle to the object's surface (see drawing below; see also step 5a, next page). Use of a polarizing filter and corner-cube reflector may also help to minimize "proxing" (see section 5c, next page). At the other extreme, *transparent* objects are difficult to sense retroreflectively because they may not sufficiently interrupt the sensor's light beam.

Retroreflective scanning using a skew angle to avoid proxing:

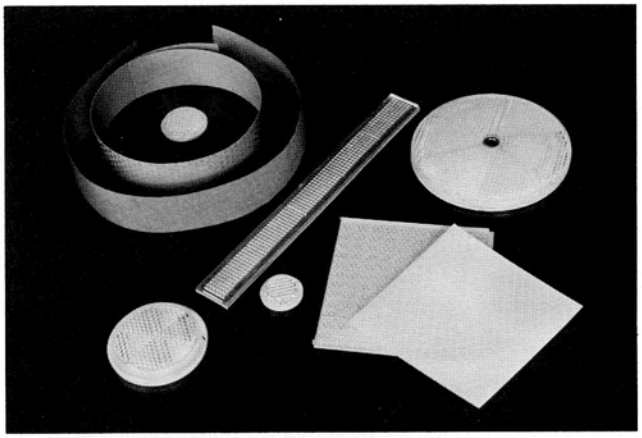


Proper operation of retroreflective mode sensors requires that they be mounted securely and aligned properly. Excessive movement or vibration can result in intermittent or false operation caused by loss of alignment to the retroreflective target. Banner offers a variety of 2- and 3-axis mounting brackets for use with MULTI-BEAM sensors. See the Banner product catalog for bracket information.

NOTE: The Alignment Indicating Device (AID) system LED on the top of the sensor is used in the following alignment procedure:

1) Begin with the sensor at the desired distance from the retroreflective target and at the approximate position where it will be mounted. Retroreflective targets are rather forgiving to beam angle in that they do not begin to lose effectiveness until they are more than 15 degrees off of perpendicular to the beam axis. An object at the "sensing position" should pass through the "core" of the sensor's light beam.

Retroreflective Target Materials



MULTI-BEAM retroreflective sensors require special retroreflective targets for proper operation. The reflector models listed below are recommended. For information on the complete line of Banner retroreflective materials, see the Banner product catalog.

BRT-3	3" dia. round corner-cube reflector with central mounting hole
BRT-1.5	1.5" dia. round corner-cube reflector with mounting flange
BRT-1	1" dia. round corner-cube reflector with mounting flange
BRT-L	Linear target, 0.75"H x 6.5"W, with adhesive backing
BRT-THG	High-grade micro corner-cube tape, in tape, squares, and sheets; various widths and lengths, adhesive backing
BRT-T	Reflective tape, 1" wide, various lengths, adhesive backing
BRT-THT	High-temperature reflective tape, 1" wide, various lengths, adhesive backing

2) Apply power to the MULTI-BEAM power block (terminals #1 and #2; observe polarity on DC models). Perform one of the following steps (see notes below):

a) If the *target* position is fixed, tilt the *sensor* up/down and rotate right/left to obtain the fastest indicator LED pulse rate (no object at the sensing position). Secure the sensor in position.

b) If the *sensor* position is fixed, move the *target* up/down and right/left to obtain the fastest indicator LED pulse rate (no object at the sensing position). Secure the target in position.

NOTES: If in either case the LED appears to be "on" steadily, it is actually pulsing at a rate too fast to be seen. Slow the pulsing to a "countable" rate by reducing the sensitivity (counterclockwise rotation of the adjustment). Being able to detect a change in the pulse rate when the position of the sensor or reflector is changed will allow accurate alignment.

With visible light sensors, it should be possible to visually "sight" the red sensing beam on the target, and then make final sensor and/or target position adjustments using the LED indicator.

At long sensing distances (over 15 feet) "finding" the target with the sensor beam may be difficult. Take a second target and walk backwards away from the sensor, always keeping the target aligned to the beam (up/down/right/left target movement; observe LED indicator). When you reach the target's mounting surface, the correct target position or necessary sensor orientation changes will be obvious.

3) Turn the sensor's SENSITIVITY control to the fully clockwise position. (This is a 15-turn control, clutched at both ends of travel.)

4) Place the object to be detected at the sensing position. If the alignment indicator LED goes "off", check operation by alternately removing and replacing the object. The LED should "follow" the action by coming "on" when the object is present and going "off" when the

object is present. If this occurs, alignment is complete. NOTE: a *steady* "on" condition of the LED with the object absent is the best situation, but this may not always be possible to achieve.

5) If the alignment indicator stays "on" when the object is *present at the sensing position*, the MULTI-BEAM is reacting to light reflected directly from the object ("proxing" is taking place). Reduce the sensitivity (counterclockwise rotation of the adjustment) until the alignment indicator LED goes "off", plus two more full turns. Remove the object from the sensing position and check that the alignment indicator LED goes "on" steadily or is pulsing at more than two beats per second. Then repeat step #4 (above).

NOTE: If the sensor cannot be adjusted so that the LED goes from "on" to "off" when the object is placed in position, consider the following alternatives:

a) If the object has flat sides, mount the sensor and retroreflective target so that the light beam encounters the object's reflecting surface at an angle. The angle may be either vertical or horizontal, or both. Angles of 10 to 15 degrees are sufficient. This often eliminates many unwanted reflections.

b) If the distance to the retroreflective target is more than a few feet, try using a larger target (or several targets) to reflect more light back to the sensor (as compared to the light reflected back to the sensor from the object). If possible, substitute a more efficient retroreflective material (i.e. - a plastic corner-cube reflector in place of reflective tape, etc.). These measures will increase the optical contrast (light-to-dark ratio) between the retroreflective target and the object.

c) If the application allows use of a *visible* light retroreflective sensor, try model SBLVAG1, which uses a polarizing filter to minimize "proxing" effects. The light returned to the sensor from a shiny object is blocked from reaching the receiver by a specially oriented polarizing filter in the sensor's upper cover, while the light reflected from a *corner-cube* retroreflective target is allowed through. (NOTE: you *must* use a corner-cube type reflector in this application.)

6) When you are satisfied with alignment, secure the MULTI-BEAM in position and complete the wiring by connecting the load to the output circuit of the power block (terminal #3 and/or #4). Refer to the hookup information for the power block in use (this information is packed with the power block). Check operation of the load by alternately placing an object in front of the lens and then removing it. The load and the LED indicator 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!*

TROUBLESHOOTING TABLE

SYMPTOM	PROBABLE CAUSE	CORRECTION
Alignment indicator never comes "on", and output never switches the load.	Sensitivity is too low. Retro target is outside of the MULTI-BEAM's field of view. Loose connection. Failure of a sensor component.	Turn sensitivity control clockwise to increase gain. Follow alignment procedure. Check power supply at power block terminals #1 and #2. Test MULTI-BEAM using Banner model LMT. Replace failed module.
Alignment indicator never comes "on", but load is switched correctly.	Broken alignment indicator LED (sensor will continue to operate).	Replace scanner block (if alignment indicator is required).
Alignment indicator is always "on", and output never switches.	False light returned by object passing through sensing beam. Optical crosstalk from broken lens (only likely with model SBLX1). Failure of sensor component.	Turn sensitivity control counterclockwise to decrease gain. Angle the sensor if object is shiny. Use model SBLVAG1 if range allows. Turn sensitivity control counterclockwise to decrease gain. Tighten upper cover screws. Replace upper cover assembly (model UC-L; see Banner catalog). Test MULTI-BEAM using Banner model LMT. Replace failed module.
Alignment indicator follows the sensing action, normally, but the output is energized all of the time.	Output of power block failed (shorted).	Replace power block module. Check load demand against power block switch rating.
Alignment indicator follows the sensing action, normally, but the output never energizes.	Failure of logic module or power block. Loose connection.	Test MULTI-BEAM using Banner model LMT. Replace failed module. Check wires to load.
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).	Increase difference in reflectivity between the light and dark conditions (Follow alignment procedure, step #5). Evaluate alternative sensing methods.

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