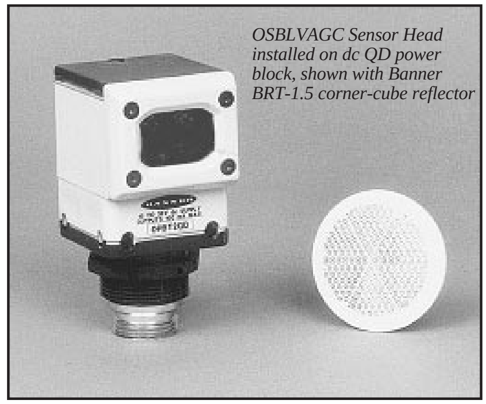
OMNI-BEAM™ Model OSBLVAGC Sensor Head for Clear Object Detection

Featuring Banner's Exclusive D.A.T.A.™ (patented*) Complete Self-diagnostic System

BANNER®
the photoelectric specialist

- **Polarized retroreflective mode sensor head with low switching hysteresis design; ideal for many *low-contrast sensing applications, especially clear object detection***
- **D.A.T.A.™ (Display and Trouble Alert) complete self-diagnostics system *displays an early warning* of specific sensing problems *before a failure occurs,* preventing expensive down-time**
- **D.A.T.A. system provides a *10-element LED signal strength indicator* for display of relative received signal level and optical contrast**
- **In the event of a sensing problem, the D.A.T.A. system *sends a warning signal* to the system controller or to an audible alarm**
- **Modular design with interchangeable power blocks for either AC or DC operation and provision for optional timing logic modules**
- **DC operation features *exclusive* Banner Bi-Modal™ output for *either* sinking *or* sourcing interface requirements**



OSBLVAGC Sensor Head installed on dc QD power block, shown with Banner BRT-1.5 corner-cube reflector

The OMNI-BEAM model OSBLVAGC is a polarized retroreflective mode sensor head module designed especially **for sensing of clear objects**. It includes Banner's patented* D.A.T.A.™ system (see below), *a complete early warning diagnostic system that enables precise monitoring of light signal strength and also alerts you to potential sensing problems before they occur.*

The OSBLVAGC sensor head module is built with a *low switching hysteresis design.* This, in combination with the unequalled signal strength and optical contrast indicating capabilities of the D.A.T.A. display sysem, makes the OSBLVAGC an outstanding, easy-to-use performer in many low contrast sensing applications. A discussion of low-hysteresis sensing and instructions for sensor setup are given on pages 3 and 4.

The special lens of the OSBLVAGC polarizes the emitted light and filters out unwanted reflections. A multi-turn GAIN control enables the precise sensitivity adjustment needed in low-contrast applications.

The Banner model OSBLVAGC must be paired with a standard OMNI-BEAM ac or dc power block module, which provides operating voltages to the sensor head and contains the sensor output switching device(s) to control the load. Compatible power blocks are listed on page 5.

*US patent no. 4965548

DC power block modules operate from 10-30V dc and include Banner's exclusive Bi-Modal™ solid-state output circuitry which includes both sinking and sourcing switching capabilities, depending upon the hookup configuration used. Each output is capable of 100 mA continuous load.

AC power blocks modules are available for either 105-130V or 210-250V ac. The output device is a solid-state relay capable of 500 mA continuous load.

Standard power blocks include an alarm output that signals the existence of sensing problems detected by the D.A.T.A. system.

The OSBLVAGC may also be used with optional timing logic modules (see page 5), which plug easily into the bottom of the sensor head and may be added to the sensor at any time.

The OSBLVAGC should be used only with high-quality corner cube retroreflectors such as Banner models BRT-.6, BRT-1, BRT-1.5, and BRT-3 (see excess gain curve and discussion, page 4). A selection of sensor mounting brackets is available (see page 6).

The Banner D.A.T.A.™ (Display and Trouble Alert)... *A complete Sensor Self-diagnostic System*

The OMNI-BEAM model OSBLVAGC Sensor Block includes Banner's exclusive, patented **D.A.T.A.**™ light system. ***D.A.T.A.*** *is the first and only complete early warning self-diagnostic system.* A multiple-element LED display is used to warn of an impending sensing problem due to any of the following causes:

Severe condensation or moisture
High temperature
Low supply voltage
Output overload (dc operation)
Gain too high
Low gain
Low optical contrast (light-to-dark differential)

When one or more of these sensing parameters goes beyond its predefined limits, the **D.A.T.A.** lights identify the cause of the problem by flashing a specific LED or a combination of LEDs in the array. Additionally, a separate alarm output changes state to signal the system controller or personnel that sensing conditions have become marginal.

The ten-element LED array also serves as a *signal strength indicator* that permits optimum alignment and continuous monitoring of signal strength and sensing contrast.

Operating status is fully displayed by separate LED indicators for "object sensed" and "output energized" conditions.

All indicators are viewed through a gasketed transparent LEXAN® top cover. This cover is easily removed for access to the multi-turn GAIN control, and to timing adjustments (when using optional timing logic module).

D.A.T.A. System Description

Banner's exclusive **D.A.T.A.** (Display and Trouble Alert) system warns of marginal sensing conditions usually before a sensing failure occurs. This self-checking diagnostic system warns of a problem by flashing one or more lights in a multiple-LED array, and by sending a warning signal to the system logic controller (or directly to an audible or visual alarm) by way of the OMNI-BEAM's dedicated alarm output.

The **D.A.T.A.** lights are located on the top of the sensor head and are viewed through a transparent LEXAN® cover. The **D.A.T.A.** lights are configured as follows:

1 **Moisture Alert:** Severe moisture *inside* the sensor head, caused by condensation or by entry of moisture when the access cover is removed, will cause the #1 light to flash.

2 **High Temperature Alert:** When the temperature *inside* the sensor head exceeds 70°C (+158°F), the #2 light will flash.

3 **Low Voltage** or **Overload Alert**: The number #3 light will flash whenever the sensor supply voltage drops below the minimum that is specified for the power block in use (see power block specifications, page 5). Power block outputs are also shut down to prevent damage to the load(s) from low voltage.

When using dc power block models OPBT2, OPBT2QD, or OPBT2QDH, the #3 light will flash if either the load output or the alarm output becomes shorted. Both outputs will be inhibited, and the circuit will "retry" the outputs every 1/10 second. The outputs will automatically reset and function normally when the short is corrected.

9 **High Gain Warning:** The #9 light will flash if the "dark" signal never goes below #4 on the display, and instruct the operator to decrease the gain (see photo above). There are two possible conditions:

1) The **High Gain Warning** alarm will come "on" if the "dark" signal slowly increases to the #4 level and remains at that level for a predetermined delay time. This condition is commonly caused by an increase (over time) of unwanted background reflections when using reflective sensing modes, such as diffuse (proximity) and convergent beam. The alarm will reset as soon as the cause of the unwanted light signal is removed, or if the GAIN control setting is reduced to bring the "dark" condition below the #4 level.

2) The **High Gain Warning** alarm will latch "on" if the "dark" signal does not fall below the #4 level during a sensing event. The alarm is automatically reset on any subsequent sensing event in which the "dark" sensing level falls below the #4 level. This is accomplished by reducing the GAIN control setting and/or by removing the cause of the unwanted light return in the "dark" condition.

10 **Low Gain Warning:** The #10 light will flash if the "light" signal never goes above #5 on the display, and instruct the operator to increase the gain (see photo, above). There are two possible conditions:

1) The **Low Gain Warning** alarm will come "on" if the light signal slowly decreases to the #5 level and remains at that level for a predetermined delay time. This situation most commonly occurs in opposed or retroreflective sensing systems, and is caused by a decrease in light in the unblocked condition (over time) due to obscured lenses or gradual sensor misalignment. The alarm will reset as soon as the light signal strength exceeds the #5 level.

2) The **Low Gain Warning** alarm will latch "on" if the light signal does not exceed the #5 level during a sensing event. The alarm is automatically reset by any subsequent sensing event in which the "light" signal exceeds the #5 level. This is accomplished by increasing the GAIN control setting and/or by lens cleaning and sensor realignment.

9 + 10 **Low Contrast Warning:** The #9 and #10 **D.A.T.A.** lights will flash simultaneously to indicate that there is not enough optical contrast for reliable sensing. This occurs when the "light" condition is at the #5 level and the "dark" condition is at the #4 level for a sensing event. If this warning occurs, the application should be fully re-evaluated to find ways to increase the differential between the "light" and "dark" conditions. The **Low Contrast** alarm is automatically reset by any subsequent sensing event in which the "light" signal exceeds the #5 level and the "dark" signal falls below the #4 level.

SENSE and LOAD Indicator LEDs

SENSE

The SENSE LED indicates when a target has been sensed. When the sensor head is programmed for LIGHT operate, it lights when the sensor receives enough light to exceed the #5 threshold. When programmed for DARK operate, it lights when the received signal falls below the #5 threshold. The SENSE LED is located at the far left end of the D.A.T.A. array.

LOAD

The LOAD indicator LED lights whenever the load is energized (after the timing function, if any). The LOAD LED is located at the far right end of the D.A.T.A. array.

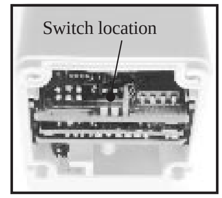
The SENSE and LOAD indicator LED locations are visible in the photograph above.

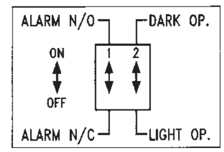
OSBLVAGC Sensor Head

Alarm and Output Programming

OMNI-BEAM sensor heads are field-programmable for *alarm output configuration* and for *light- or dark- operate*. The DIP switch, inside the sensor block, is accessible with the sensor block removed from the power block.

Programming Switch





Switch #1 selects alarm output configuration. With switch #1 "on", the alarm output is normally open (i. e., conducts with an alarm). Turning switch #1 "off" sets the alarm output to normally closed operation (i.e., output opens during an alarm).

The normally closed mode (switch #1 "off") is recommended. This allows a system controller to recognize a sensor power loss or an open sensor output as an alarm condition. The normally open alarm mode (switch #1 "on") should be used when the alarm outputs of multiple OMNI-BEAMs are wired in parallel to a common alarm or alarm input.

Switch #2 selects LIGHT operate (switch #2 "off") or DARK operate (switch #2 "on"). In the LIGHT operate mode, the OMNI-BEAM's load output will energize (after a time delay, if timing logic is employed) when the received light level is *greater* than the sensing threshold (i.e., when five or more **D.A.T.A.** lights are illuminated). In DARK operate, the output will energize (after a time delay, if any) when the received light level is *less* than the sensing threshold (i.e., when four or less **D.A.T.A.** lights are illuminated).When sensing in the retroreflective mode:

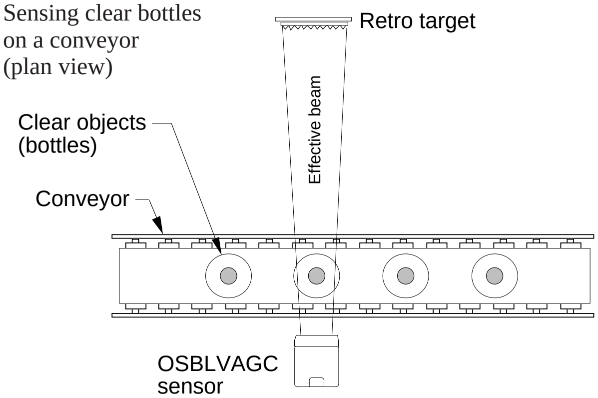
1) The DARK operate mode would be used to energize the OMNI-BEAM's output whenever an object is present, and *blocking the beam.*

2) The LIGHT operate mode would be used to energize the output whenever the beam is *unblocked* (i.e., object missing).

Theory and Setup

The OSBLVAGC is a *low-hysteresis retroreflective* sensor. Its emitted light is returned by a retroreflector back to the receiver photoelement. An object is sensed based on the decrease in reflected light signal at the receiver photoelement when an object comes between the sensor and the retroreflector. Low-hysteresis circuit design enables the sensor outputs to switch based on relatively small changes in light signal levels, such as the difference in received light level between a "clear object present" (or "dark") condition and a "clear object absent" (or "light") condition.

Figure 1. Typical application: Sensing clear bottles on a conveyor (plan view)



The OSBLVAGC's special polarizing lens reduces the possibility of false sensor response from reflections that may be returned from the object. **In the case of glass objects,** light returned from the object is reflected in the same plane as the emitted light, while the light returned by the retroreflector is rotated 90 degrees by the corner cubes in the reflector. The sensor's polarizing filter allows only the 90-degree rotated light from the reflector to pass through to the receiver photoelement. Sensing contrast is determined by the amount of absorption and scattering that occurs as the sensing beam passes twice through the glass object.

Plastic objects, due to their differing molecular structures, may rotate, reflect, and pass light to various extents. Plastics that rotate light 90 degrees and reflect it directly back to the OSBLVAGC cannot be detected retroreflectively because they can cause the sensor to respond falsely (or "prox") in what should be the "dark" condition. Plastics that do not reflect 90-degree rotated light back to the sensor can be detected in the same way as glass objects. Some trial-and-error experimentation may be required. Contact the Banner Applications Department for assistance. NOTE: as an alternative to the OSBLVAGC for plastic detection, consider the MINI-BEAM Plastic Detector System (SM31EPD/SM31RPD or SMA31EPD/SM2A31RPD), described in product data sheet P/N 03458.

Other small objects that do not entirely break the sensing beam, such as yarn and heavy wire or thread, may also be sensed. For such objects, take particular care to observe condition #1 (below). Use of a smaller reflector will minimize "spillage" of reflected light around a small object.

Optimum sensor setup is a matter of achieving as much difference in light level (optical contrast) as possible between the "object present" (or "dark") and "object absent" (or "light") conditions. Sensing will be most reliable when the following conditions are met (refer to Fig. 1):

1) The object blocks as much of the sensor's effective beam as possible. The distance from the sensor to the object(s) should be small in proportion to the distance between the object and the reflector. The object should pass as close to the sensor's lens as possible (a distance of as little as one inch is recommended). This helps to prevent transmitted light (that is distorted as it travels through the object) from reaching the reflector. Also, position the sensor or object such that the long axis of the object will be parallel to the vertical dividing line between the sensor lenses. Whenever possible, the object should present its largest dimension to the sensor.

2) Sensing reliability depends upon sensing contrast; therefore, there must be enough space between consecutive objects to establish a strong "light" condition. If the space is smaller than the effective beam diameter, sensing contrast will be diminished.

3) The object-to-sensor distance is held constant (e.g. the object's position is constrained by guide rails).

4) The sensor's lens window and the retroreflector are kept clean and properly aligned to each other. The lower the sensing contrast of the application, the more important is a clean reflector! Also, be aware that condensation on the reflector will reduce its efficiency. Proper sensor-reflector alignment is discussed in **Setup Procedure** (below).

Before attempting to set up the OSBLVAGC, read and understand **D.A.T.A. system Description** (page 2) and **Measuring Excess Gain and Contrast** (page 4).

Setup Procedure

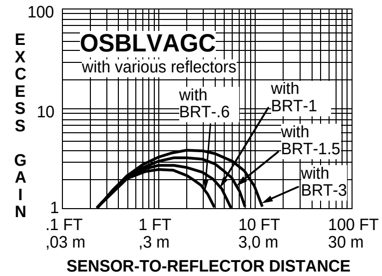
1) Select the location at which sensing will take place. Mount the sensor in place so that it cannot be moved inadvertently. The sensing location should conform to the requirements discussed above. (Continued p. 4.)

OSBLVAGC Sensor Head

(**Setup Procedure** continued from page 3)

2) With no load attached, apply power to the sensor. With the aid of an assistant if necessary, hold the reflector at its approximate mounting position, directly facing the sensor, and move it up/down and right/left while observing the D.A.T.A. display on the sensor. Find the center of the zone of reflector movement within which the most LEDs on the 10-element array remain "on". It may be necessary to decrease (rotate ccw) or increase (rotate cw) the sensor's 15-turn GAIN control to produce the most easily "readable" indications for fine tuning the reflector position. Mount the reflector at the center of this movement zone, directly facing the sensor.

3) Present the object to the sensor at the sensing point. Adjust the 15-turn GAIN control to light three LEDs on the D.A.T.A. array. Remove the object from the sensing position and note the number of LEDs that light with the object absent. If six or more LEDs are lit, optical contrast in the application is adequate. Four or more LEDs lit in the "dark" condition and/or five or less in the light condition represent inadequate sensing contrast and will trigger a warning from the sensor head. If possible, experiment by presenting different "views" of the object to the sensor, for the purpose of increasing contrast. The GAIN control should be set so that the "dark" signal does not light more than three LEDs.



This curve shows the excess gain of the OSBLVAGC sensor when it is used with different size retroreflectors. It also shows the maximum sensor-to-reflector distance for each reflector.

The larger the reflector, the higher the excess gain, the greater the possible sensor-to-reflector distance, and the wider the effective beam. If the objects to be sensed are small, a smaller (or partially masked) reflector might provide better optical contrast than a larger one. This is because the larger the reflector used, the larger the sensor's effective beam. Refer to Figure 1 (page 3). A larger reflector might cause light to "spill" around the edges of a small object and increase the light signal that the sensor sees in the "dark" condition.

Measuring Excess Gain and Contrast

The OMNI-BEAM's **D.A.T.A.** lights may be used to measure the *excess gain* and *contrast* in any sensing situation and during installation and maintenance.

Excess gain is a measurement of the amount of light energy falling on the receiver of a photoelectric sensor *over and above the minimum amount necessary to operate the sensor's amplifier*. Excess gain is expressed as a ratio:

$$\text{Excess gain (E.G.)} = \frac{\text{light energy falling on receiver}}{\text{amplifier threshold}}$$

Relationship between Excess Gain and D.A.T.A. System Lights

D.A.T.A. light LED number	Excess Gain	D.A.T.A. light LED number	Excess Gain
#1	0.5x E.G.	#6	1.1x
#2	0.7x	#7	1.2x
#3	0.8x	#8	1.3x
#4	0.9x	#9	1.7x
#5	1.0x	#10	2.2x (or more)

The amplifier threshold is the point at which the sensor's output switches. The OMNI-BEAM's threshold corresponds to the #5 level of the **D.A.T.A.** light array. That is, when LEDs #1 through #5 are lit, the excess gain of the received light signal is equal to "1x".

The table above ***(Relationship between Excess Gain and D.A.T.A. System Lights)*** shows how excess gain relates to the **D.A.T.A.** light array indication.

Contrast is the ratio of the amount of light falling on the receiver in the "light" state as compared to the "dark" state. Contrast is also referred to as "light-to-dark ratio". Optimizing the contrast in any sensing situation will increase the reliability of the sensing system. Contrast may be calculated if excess gain values are known for both the light and dark conditions:

$$\text{Contrast} = \frac{\text{Excess gain (light condition)}}{\text{Excess gain (dark condition)}}$$

To determine the contrast for any sensing application, present both the "light" and "dark" conditions to the OMNI-BEAM, and read the **D.A.T.A.** signal for each. Take the ratio of the two numbers (from the table above) that correspond to the highest **D.A.T.A.** light numbers registered for the "light" and "dark" conditions.

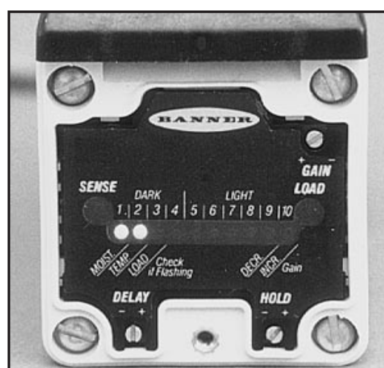
For example, if LEDs #1 through #8 come "on" in the "light" condition and LEDs #1 and #2 come "on" in the "dark" condition (as shown in the photos at right), the contrast (referring to the table above) is calculated as follows:

$$\text{Contrast} = \frac{1.3x}{0.7x} = 1.8$$

This value is expressed as "1.8:1" or "1.8-to-one".

The **best** sensor adjustment will cause all ten **D.A.T.A.** LEDs to come "on" for the "light" condition, and will cause no LEDs to come "on" in the "dark" condition. This is rarely possible when sensing clear materials. However, *it is important to always adjust a sensor for the greatest amount of contrast possible for any sensing situation.* The **D.A.T.A.** light system makes this easy. Suggestions for maximizing sensing contrast in your application are given in the ***Theory and Setup*** section on page 3.

LIGHT condition example: **D.A.T.A.** system LEDs #1 through #8 lit.



DARK condition example: **D.A.T.A.** system LEDs #1 and #2 lit.

OSBLVAGC Sensor Head

OSBLVAGC Sensor Head Specifications

Sensing mode: Polarized retroreflective; use with Banner BRT-.6, BRT-1, BRT-1.5, or BRT-3 corner cube retroreflector

Sensing beam: Visible red, 650 nm

Response time: 4 milliseconds on and off
Repeatability: 0.2 milliseconds

Construction: OMNI-BEAM sensor heads are molded from rugged VALOX® thermoplastic polyester for outstanding electrical and mechanical performance in demanding applications. The top view window is LEXAN® polycarbonate. Lenses are acrylic. Hardware is stainless steel. When assembled, all parts are fully gasketed. Rated NEMA 1, 2, 3, 3S, 4, 12, and 13 when assembled.

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

Delay upon power-up: 200 milliseconds maximum (power block outputs are non-conducting during this time

VALOX® and LEXAN® are registered trademarks of General Electric Company.

Logic Modules and Power Blocks for the OSBLVAGC Sensor Head

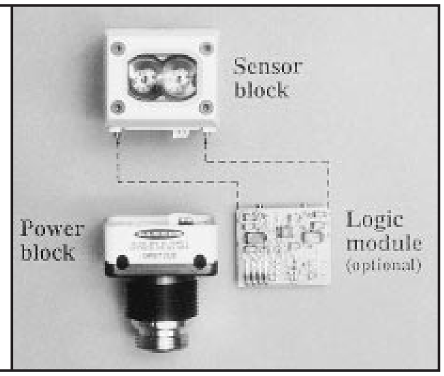
Logic Modules

Timing logic may be added to the OSBLVAGC at any time. Timing logic modules simply slide into the sensor block module. There are three models:

OLM5	ON-delay or OFF-delay or ON/OFF delay
OLM8	One-shot or delayed one-shot, 15 sec. max.
OLM8M1	One-shot or delayed one-shot, 1 sec. max.

OMNI-BEAM's sensor block and power block bolt and plug together quickly and easily.

An optional timing logic module may be added at any time.



Power Blocks

The **power block** determines the sensor operating voltage and also the sensor output switch configuration. Models are available with a built-in 6-foot long cable, or with either of two styles of quick-disconnect ("QD") plug-in cable fittings. See page 6 for detailed QD cable information. See also data sheet 32888 for further information about OMNI-BEAM power blocks.

Model	Operating Voltage, cabling
OPBT2	10 to 30V dc Bi-Modal, prewired cable
OPBT2QD	10 to 30V dc Bi-Modal, integral *minifast*™ QD
OPBT2QDH	10 to 30V dc Bi-Modal, integral *eurofast*™ QD*
OPBA2	105 to 130V ac, prewired cable
OPBA2QD	105 to 130V ac, integral *minifast*™ QD
OPBB2	210 to 250V ac, prewired cable
OPBB2QD	210 to 250V ac, integral *minifast*™ QD

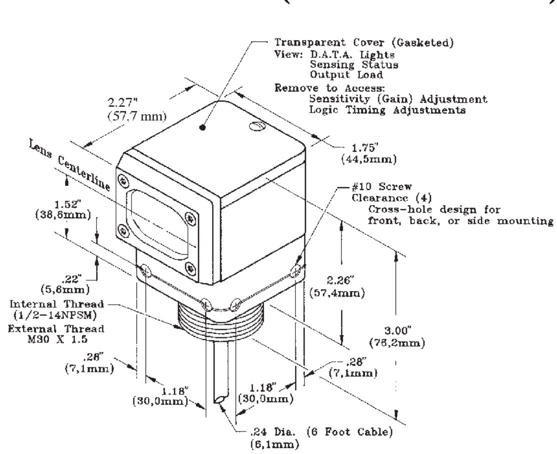
*Contact factory for availability of *eurofast*™ models.

WARNING OMNI-BEAM 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.

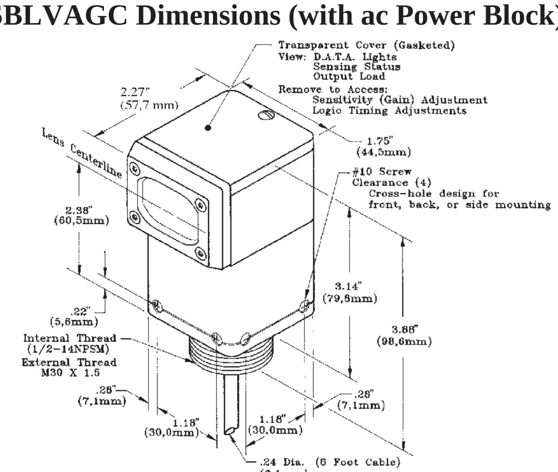
Never use these products as sensing devices for personnel protection. Their use as safety devices may create an unsafe condition which could lead to serious injury or death.

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.

OSBLVAGC Dimensions (with dc Power Block)



OSBLVAGC Dimensions (with ac Power Block)



OMNI-BEAM Accessories

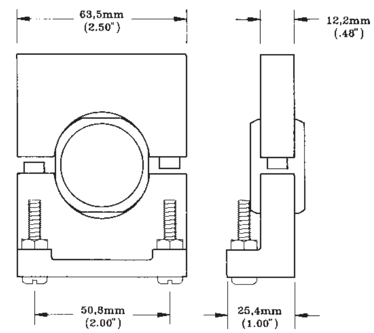
SMB30S Swivel Mounting Bracket and SMB30C Split Clamp Mounting Bracket

Accessory mounting bracket model SMB30S is a swivel mount bracket whose adjustable swivel ball locks in place when its two clamping bolts are tightened. Bracket material is black VALOX®. Hardware is stainless steel, and mounting bolts are included. This bracket may be used with OMNI-BEAMs and other sensors having M30 x 1,5 threads. Bracket dimensions are given below.

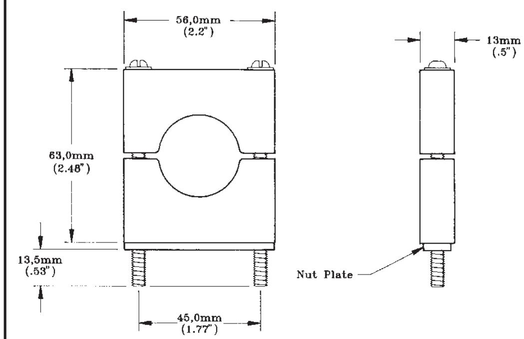
The model SMB30C split clamp bracket is a VALOX® bracket similar to the SMB30S but without the adjustable ball. The bracket grips the sensor by the sensor's threaded base. See dimensions, below right.

SMB30S

SMB30S

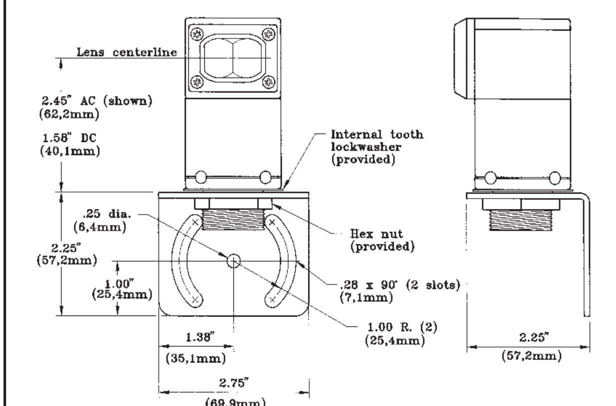


SMB30C



SMB30MM 2-axis Bracket

Accessory mounting bracket model SMB30MM (right) has curved mounting slots for versatility in mounting and orientation. The OMNI-BEAM mounts to the bracket by its threaded base, using a jam nut and lockwasher (supplied). The curved mounting slots have clearance for 1/4-inch screws. Bracket material is 11-gauge stainless steel.



HF1-2NPS Flexible Cable Protector (not shown)

This black nylon assembly easily slips over the cable of prewired OMNI-BEAM models and threads into the base of the power block. A flexible extender prevents sharp cable bends and extends the life of cable that is subject to repeated flexing.

The HF1-2NPS is resistant to gasoline, alcohol, oil, grease, solvents, and weak acids. It has a working temperature range of -30 to +100°C (-22 to +212°F). The HF1-2NPS is sold in packages of 10 pieces, and is UL recognized and CSA certified.

Quick-disconnect Cables

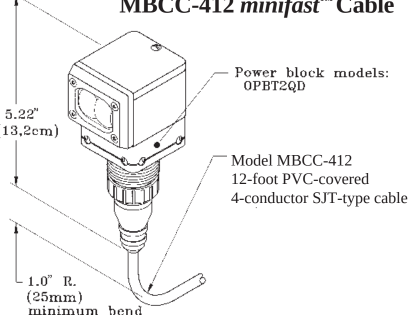
Quick-disconnect cables are available in two styles: *minifast*™ SJT-type and *eurofast*™ ST-style* (for standard dc power blocks only). They are ideal for use in situations where it is desireable to be able to substitute or replace the sensor and/or cabling.

Standard OMNI-BEAM dc power blocks use 4-conductor cables. **Standard ac models** use cables with 5 conductors. It is impossible to plug either an ac or a dc sensor into the wrong cable.

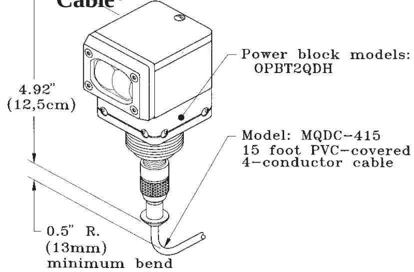
Minifast cables are 12 feet long. Eurofast cables are 15 feet long. All quick-disconnect cables have 22 AWG conductors. Dimensional information and cable/power block compatibility are given in the drawings below. See also table of power blocks, page 5.

*Contact the factory for availability of *eurofast*™ QD models

Dimension Information, MBCC-412 *minifast*™ Cable



Dimension Information, MQDC-415 *eurofast*™ Cable*



Dimension Information, MBCC-512 *minifast*™ Cable