# OMNI-BEAM™

## OSBEF Fiber Optic Emitter
## OSBRF Fiber Optic Receiver

*for use with Banner glass fiber optics*

BANNER
the photoelectric specialist

- **Infrared opposed mode fiber optic sensor heads; for use with Banner *glass* fiber optic assemblies**
- **Use with OMNI-BEAM™ power blocks and optional logic modules**

The Banner OMNI-BEAM™ models OSBEF emitter and OSBRF receiver are an infrared opposed-mode fiber optic sensor pair, compatible with Banner individual *glass* fiberoptic assemblies. Because the receiver and emitter are separate units, they are ideal for applications in which it is inconvenient to route fiber optic assemblies to both sides of a process from a single sensor.

Opposed mode sensing ranges (fibers only, without lenses added) are up to 6 inches with 1/16-inch glass fibers and 13 inches with 1/8-inch glass fibers. Lenses may be added to 1/8-inch glass fibers on both the emitter and the receiver for longer-range fiber optic sensing. There are two active fiber optic ports on both the emitter and receiver. This allows two pairs of opposed fibers to be configured for "both parts present" (two-channel DARK AND) logic.

The OSBRF receiver features Banner's exclusive* D.A.T.A.™ sensor alignment and self-diagnostic system which identifies sensing problems and warns of them via a dedicated alarm output. Also included are switchable light/dark operate, and selectable sensing hysteresis and LED indicator array scale factor. Receiver programming is done via convenient DIP switches inside the base of the OSBRF sensor head (page 2).

## *Specifications, models OSBEF & OSBRF*

**SENSING BEAM:** infrared, 880nm (for *glass* fiber optics only).

**SENSITIVITY ADJUSTMENT (OSBRF receiver):** easily accessible; located beneath a transparent plastic cover. A 15-turn clutched potentiometer (rotate clockwise to increase gain).

**RESPONSE TIME (OSBRF receiver):** 2 milliseconds on/off, independent of signal strength.

**REPEATABILITY of RESPONSE (OSBRF receiver):** 0.01 millisecond, independent of signal strength.

**INDICATORS and ALARMS (OSBRF receiver):** exclusive* D.A.T.A.™ system (**D**isplay and **T**rouble **A**lert), a 10-element LED array, indicates sensing contrast and optimal alignment, and in addition warns of sensing problems due to: severe condensation or moisture, high internal temperature, low supply voltage, output overload (in dc operation), gain too high, and gain too low. A separate *SENSE* indicator LED lights whenever an object is sensed. A separate *LOAD* indicator LED lights whenever the load is energized (after any programmed timing function, if a logic module is installed). A separate alarm output signals marginal sensing conditions.

**CONSTRUCTION:** rugged, molded VALOX® thermoplastic polyester housing. Transparent top window of Lexan® polycarbonate. Acrylic lenses; stainless steel hardware. When assembled, all parts are fully gasketed.

**OPERATING TEMPERATURE RANGE:** -40 to +70 degrees C (-40 to +158 degrees F).

**PROTECTION (receiver):** false-pulse suppression on power-up.

**DELAY UPON POWER-UP (receiver):** 200 milliseconds, maximum (power block outputs are non-conducting during this time).

***US patent no. 4965548**

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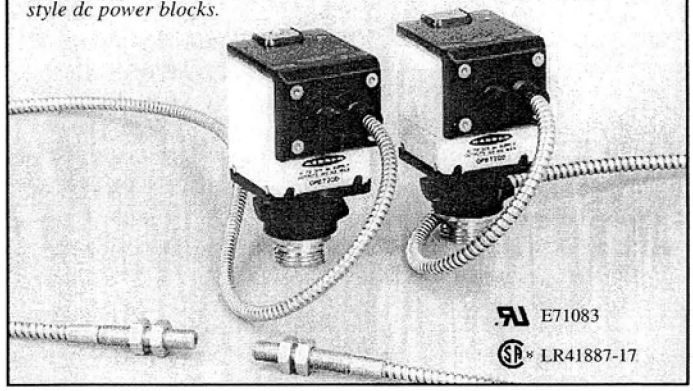
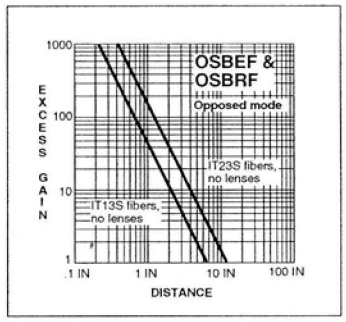
*OSBEF and OSBRF sensor heads shown with individual glass fiber optic assemblies attached, and mounted on quick-disconnect (QD) style dc power blocks.*

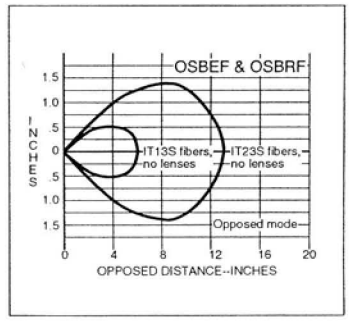


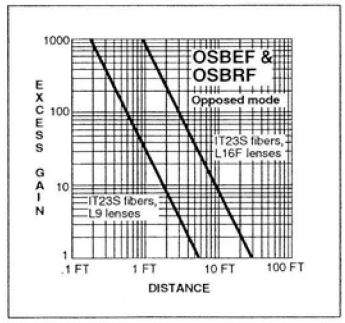

The OSBEF and OSBRF each require an OMNI-BEAM power block to supply operating voltages and interface the receiver to the circuit to be controlled and to external alarm circuitry (see *Power Block Module Information*, below). Optional plug-in timing logic modules (model OLM5 or OLM8) converts the basic ON/OFF OSBRF receiver to either a one-shot or a delay timing logic control, with programmable timing ranges. See data sheet P/N 03533 or the Banner catalog for further information about logic capability.

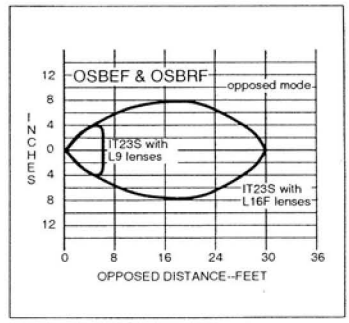
### *Excess Gain Curves*




### *Beam Patterns*




### *Power Block Module Information*

The model OSBEF emitter uses *either* standard OMNI-BEAM or E-series OMNI-BEAM power blocks. The OSBRF receiver uses standard OMNI-BEAM power blocks *only*.

**E-series OMNI-BEAM** ac and dc power blocks are covered in data sheet P/N 03540 and the Banner product catalog.

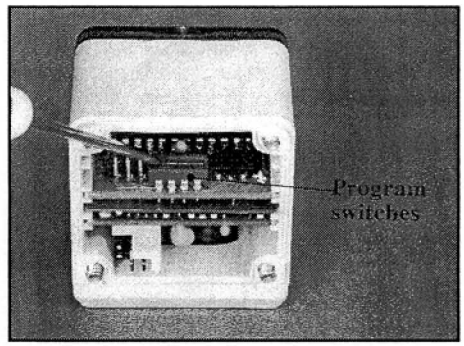
**Standard OMNI-BEAM** ac and dc power blocks are covered in data sheet P/N 03522 and the Banner product catalog.

Printed in USA

P/N 03546A4A

# Sensor Head Programming

The OMNI-BEAM model OSBRF infrared fiber optic receiver sensor head is field-programmable for four operating parameters. A set of four programming DIP switches is located inside the base of the sensor head (see photo at right), and is accessible with the sensor block removed from the power block.

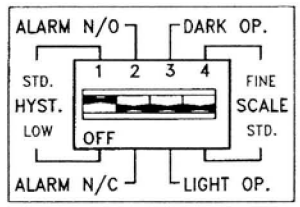



**Switch #1** selects the amount of sensing hysteresis. Hysteresis is an electronic sensor design consideration which states that the amount of received light signal required to operate the sensor's output is not the same as the amount required to release the output. This differential prevents the sensing output from "buzzing" or "chattering" when a light signal at or near the sensing threshold level is detected.

Setting switch #1 to the "on" position programs the sensor head for "normal" hysteresis. The NORMAL setting is ordinarily used for average-to-high contrast sensing applications. *The LOW setting is used for low-contrast situations like the detection of subtle differences in opacity.* NOTE: when the "low" hysteresis setting is used (switch #1 "off"), care must be taken to ensure that all sensing conditions remain completely stable.

**Switch #2** selects the alarm output configuration. With switch #2 "on", the alarm output is normally open (i. e., it conducts with an alarm). Turning switch #2 "off" programs the alarm output for normally closed operation (i.e., the output opens during an alarm).

The normally closed mode (switch #2 "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 #2 "on") should be used when the alarm outputs of multiple OMNI-BEAMs are wired in parallel to a common alarm or alarm input.




**Switch #3** selects LIGHT operate (switch #3 "off") or DARK operate (switch #3 "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).

For example, when sensing in the opposed (beam-break) 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).

**Switch #4** selects the STANDARD (switch #4 "off") or FINE (switch #4 "on") scale factor for the **D.A.T.A.** light signal strength indicator array. This switch should always be in the "off" position, except for close differential sensing situations, like *some* color registration applications, which also require the LOW hysteresis setting (switch #1 "off").

**Factory DIP switch settings:**

The following are the factory program settings for OMNI-BEAM OSBRF sensor heads:

**Switch #1:** "on" = normal hysteresis
**Switch #2:** "off" = normally closed alarm output
**Switch #3:** "off" = light operate of load output
**Switch #4:** "off" = standard scale factor for signal strength meter

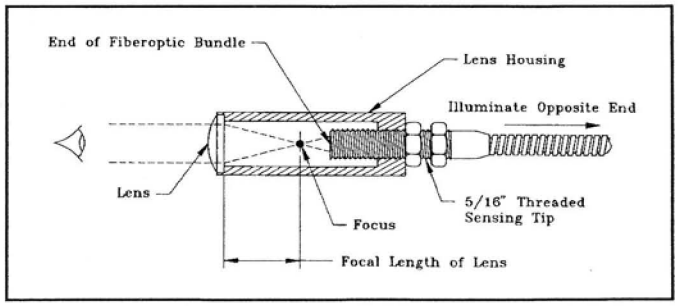
## NOTE: Attachment of Lenses to Banner 5/16"-24 Threaded Fiber Optic Assemblies

Lenses are sometimes added to fiber optic assemblies for extending opposed mode sensing range. Banner offers the following lens assemblies for use with fiber optic assemblies having 5/16"-24 threaded sensing tips (e.g. fiber model IT23S):

| MODEL | LENS SIZE | FOCAL LENGTH | HOUSING | NOTES |
|---|---|---|---|---|
| **L9** | 12,5mm (1/2") | 12,5mm (1/2") | Aluminum | Suitable for all but highly corrosive environments |
| **L16F** | 25mm (1") | 44mm (1.7") | Delrin | Maximum operating temperature is 100°C (212°F) |
| **L16FAL** | 25mm (1") | 44mm (1.7") | Aluminum | Suitable for all but highly corrosive environments |
| **L16FSS** | 25mm (1") | 44mm (1.7") | Stainless steel | Suitable for all environments |

Lenses are most efficient when they are located slightly beyond their focal length distance from the sensing end of the fiber optic bundle. The easiest way to focus a lens is to treat it like a magnifying glass.

Illuminate the fiber optic bundle at the threaded end of the fiber optic assembly by directing the opposite end toward a visible light source (e.g.- an incandescent bulb, visible LED, sunlight, etc.). Thread the lens onto the fiber optic assembly until the end of the fiber optic bundle comes into sharp focus under the lens. Then, back off (unthread) the lens assembly from the point of sharpest focus by one to three full turns. The illuminated bundle should now appear slightly blurred. This is the optimum setting, and the lens may be secured in position using one of the jam nuts provided. Refer to the drawing at the right.



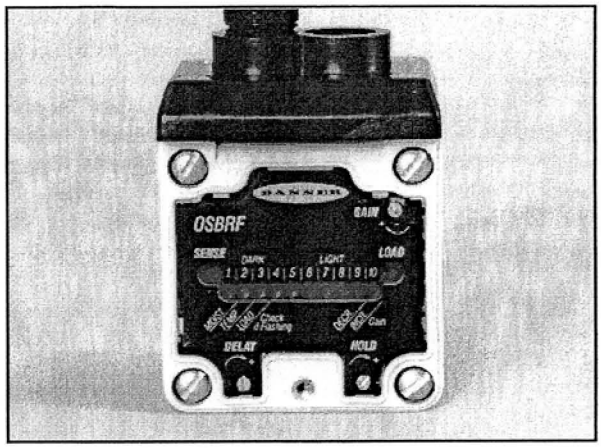

**WARNING** This photoelectric presence sensor does NOT include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can result in *either* an energized or a de-energized sensor output condition.

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

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

# D.A.T.A.™ Sensor Self-diagnostic System

The OSBRF receiver's exclusive **D.A.T.A.**™ LED 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 OSBRF'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). 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. 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.

# Measuring Excess Gain and Contrast

The OSBRF receiver'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:

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

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 below ***(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.

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

| D.A.T.A. light LED number | STANDARD scale factor | FINE* scale factor | D.A.T.A. light LED number | STANDARD scale factor | FINE* scale factor |
|---|---|---|---|---|---|
| #1 | 0.25x E.G. | 0.5x E.G. | #6 | 1.3x | 1.1x |
| #2 | 0.35x | 0.7x | #7 | 1.7x | 1.2x |
| #3 | 0.5x | 0.8x | #8 | 2.2x | 1.3x |
| #4 | 0.7x | 0.9x | #9 | 2.9x | 1.7x |
| #5 | 1.0x | 1.0x | #10 | 3.7x (or more) | 2.2x (or more) |

*NOTE: the scale factor is selected by programming switch #4 inside the sensor head (see page 2). "OFF" = STANDARD; "ON" = FINE. Use the FINE scale only for setup and monitoring of close-differential sensing applications where LOW hysteresis is required.

***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.

## Contrast Values and Corresponding Guidelines

| Contrast | Recommendation |
|---|---|
| 1.2 or less | ***Unreliable.*** Evaluate alternative sensing schemes. |
| 1.2 to 2 | ***Poor contrast.*** Use the LOW hysteresis setting and the FINE scale factor. |
| 2 to 3 | ***Low contrast.*** Sensing environment must remain perfectly clean and all other sensing variables must remain stable. |
| 3 to 10 | ***Good contrast.*** Minor sensing system variables will not affect sensing reliability. |
| 10 or greater | ***Excellent contrast.*** Sensing should remain reliable as long as the sensing system has enough excess gain for operation. |

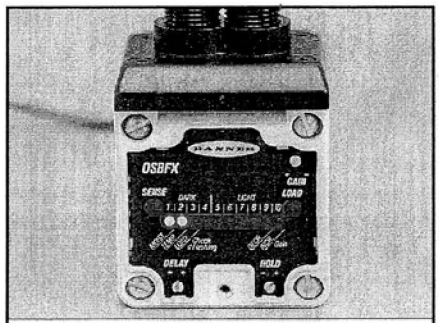
For example, if LEDs #1 through #8 come "on" in the "light" condition and LEDs #1 and #2 come "on" in the "dark" condition (as shown in the photos at right), the contrast (referring to the table at the top of this page) is calculated as follows:

$$\text{Contrast} = \frac{2.2x}{0.35x} = 6$$

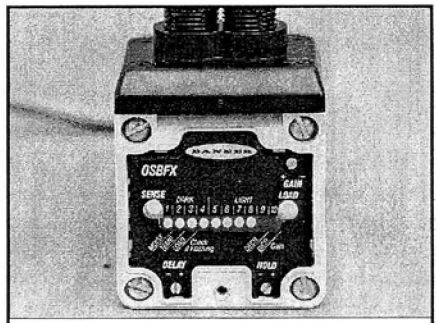
This value is expressed as "6:1" or "six-to-one".

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. In this situation (such as an application in which an object breaks a the beam of an opposed mode emitter and receiver):

$$\text{Contrast is } \textit{greater} \text{ than } \frac{3.7x}{0.25x} = 15{:}1$$



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



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

Of course, it is not always possible to adjust a sensor to maintain this much contrast. 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. The ***Contrast Values and Corresponding Guidelines*** table (above) gives general guidelines for contrast values.



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