Analog OMNI-BEAM™ Sensors
with Voltage Sourcing Outputs

BANNER® the photoelectric specialist

- **Proven OMNI-BEAM optical performance in sensors with analog voltage sourcing outputs**
- **Ideal for applications requiring a continuously variable control voltage that is either directly or inversely related to a sensing parameter; "mirror-image" outputs**
- **Analog output is ripple-free and temperature-stable**
- **Non-interactive NULL and SPAN controls for ease of adjustment**
- **Built-in 10-element LED display indicates output voltage**
- **Models available for diffuse, convergent, and fiber optic sensing modes, and for ac or dc supply voltages**

Banner Analog OMNI-BEAM™ Sensors combine the proven optical performance of standard OMNI-BEAM™ sensors with a 0 to 10V dc or 10 to 0V dc sourcing analog output power block to produce a highly versatile and practical analog photoelectric control. Analog photoelectric sensors are especially useful in applications such as process control, where it is necessary to monitor an object's position or size to produce a variable control voltage for an analog device such as a motor speed control. Analog photoelectric sensors are also used to monitor the optical reflectivity or optical clarity of materials.

Analog OMNI-BEAM sensors provide a variable dc voltage output that is either directly related ("non-inverting" output) or inversely related ("inverting" output) to the strength of the received light signal. When properly adjusted, the two analog outputs are mirror-images of each other, with their output voltage plots intersecting at 5 volts (see page 3). Each sensor has multi-turn NULL and SPAN controls to set the minimum and maximum limits of the sensor's sourcing voltage outputs. An innovative, custom-designed analog sensor circuit design allows NULL and SPAN to be adjusted *without interaction*, greatly simplifying the setup adjustment procedure. A convenient 10-element moving-dot LED array gives a visual indication of relative light signal change and power block voltage output to within the nearest volt.

Analog OMNI-BEAM sensors consist of two basic "building blocks": a sensor head and a power block. The *sensor head* contains optical components, an analog amplifier, NULL and SPAN adjustment controls, and LED indicator array circuitry. Sensor heads are available for diffuse, convergent, and fiber optic sensing modes. Fiber optic mode models include infrared and visible-light glass fiber optic models, and a visible-light plastic fiber optic model. The *power block* contains power supply and analog voltage output circuits, and is offered in three basic models: model OPBT3 (for +15 to 30V dc), model OPBA3 (for 105 to 130V ac), and model OPBB3 (for 210 to 250V ac). Power block models are listed in the table on page 2.

Power blocks are available with either an attached 6-foot PVC-covered cable or an integral QD (Quick-disconnect) connector. Twelve-foot lengths of mating *minifast*™ quick-disconnect cable are sold separately.

To order an Analog OMNI-BEAM sensor, specify the following:
1) a sensor head model (from pages 3, 4, and 5), and
2) a power block model (from page 2).

Shown are models OASBD (l) and OASBFP with coiled plastic fiber optic assembly (r); shown with OPBT3QD QD-style dc power blocks.

Specifications

Power requirements:
+15 to 30V dc, **OPBT3** power block models
105 to 130V ac (50/60Hz), **OPBA3** power block models
210 to 250V ac (50/60Hz), **OPBB3** power block models

Sensing range: see individual sensor head specifications

Output:
The output is an analog voltage that is related to the intensity of the light reaching the receiver.

The relationship between the 0 to 10V dc analog output voltage and the received light signal intensity is determined by the wiring configuration, and may be either direct or inverse.

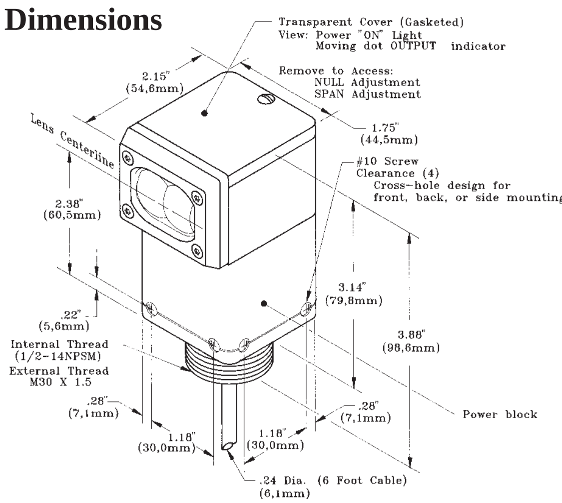
Output capacity 10mA, maximum. Both outputs may be used simultaneously, but the *maximum total load* may not exceed 10mA. Outputs are protected against short-circuit and overload.

(Specifications are continued on page 2)

⚠ **Please read Personnel Safety *WARNING*, page 8.**

A comprehensive introduction to the theory and use of photoelectric analog sensors begins on page 5.

Dimensions



The sensor head module and the power block module are sold separately.

Specifications (continued from page 1)

Response time: Output response is the sum of the sensor's fixed R-C time constant and the programmable R-C time constant. 63% of any output transition will occur within the period of the total time constant. Fixed response times are as follows:

OASBD, F, FV, FP sensor heads = R-C time constant 1.5 ms
OASBCV sensor head = R-C time constant 3.3 ms
OASBDX, FX sensor heads = R-C time constant 15.0 ms

The programmable R-C time constant is set using the switches located at the base of the sensor head (see "Adjustment Procedure", page 3):

All switches "off" = 1 ms	Switch #3 "on" = 1 sec
Switch #1 "on" = 10 ms	Switch #4 "on" = 10 sec
Switch #2 "on" = 100 ms	

If more than one switch is "on", the time constant is additive.

Adjustments:
NULL: Null is adjusted (for the condition of greatest received light) until the #1 LED on the moving dot LED output display just turns "off" (only the POWER indicator LED should be "on" at this point). Further decrease the NULL adjustment until the inverting output just reaches 0 volts, or until the non-inverting output just reaches +10V dc. Refer to the Adjustment Procedure (page 3) and the hookup diagrams below.

SPAN: Span is adjusted to produce the desired voltage swing between the lightest and darkest sensing conditions. Minimum guaranteed signal contrast (i.e. minimum SPAN) which will result in a 10 volt output swing is 1.5:1. Maximum guaranteed signal contrast (i.e. maximum SPAN) that will result in a 10 volt output swing is 16:1.

Both controls are 15-turn clutched potentiometers with slotted brass elements, located beneath a gasketed cover on top of the sensor. A small, flat-bladed screwdriver is required for adjustment.

Status indicators:
Located on top of the sensor head:
Power ON: a red LED lights whenever power is applied to the power block;

Output: Ten-element moving-dot LED array indicates approximate voltage output.

Output connector:
6-foot attached PVC-covered cable is standard. Cable may be spliced: order 100-foot long extension cable model EC312-100 for power block OPBT3, or EC915-100 for power block models OPBA3 and OPBB3.

Power block models with "QD" suffix have an integral threaded standard quick-disconnect connector. Twelve-foot long mating quick-disconnect (QD) cables are sold separately. See table below for more information.

Construction:
Housing: molded VALOX® thermoplastic polyester
Top view window: transparent Lexan® polycarbonate
Hardware: stainless steel
When properly assembled, all components are fully gasketed.
Fully assembled unit is rated NEMA 1, 3, 4, 12, and 13.

Operating temperature range:
0 to 50°C (+32 to 122°F).

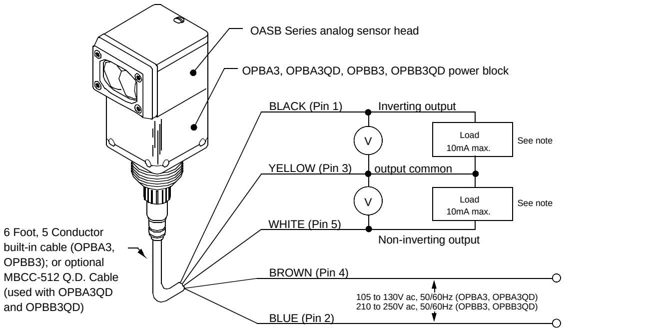
Humidity: 95% maximum relative humidity (non-condensing).

Selecting a Power Block Module

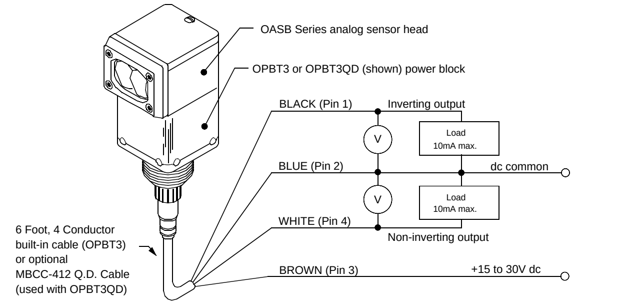
A power block module performs the dual functions of providing the proper operating voltage for the sensor block and of interfacing the sensor block to the circuit to be controlled. See *Specifications* section (page 1) for information on power block output load capacity. Below is a list of power block modules that may be used with the Analog OMNI-BEAM sensor block modules. *Sensor block and power block must be ordered separately.*

Model	Output(s)	Required supply voltage	Cable Type
OPBA3	analog solid-state voltage sourcing (2)	105 to 130V ac (50/60 Hz)	6-ft. 5-conductor PVC-covered cable
OPBA3QD	analog solid-state voltage sourcing (2)	105 to 130V ac (50/60 Hz)	MBCC-512 cable required (see below)
OPBB3	analog solid-state voltage sourcing (2)	210 to 250V ac (50/60 Hz)	6-ft. 5-conductor PVC-covered cable
OPBB3QD	analog solid-state voltage sourcing (2)	210 to 250V ac (50/60 Hz)	MBCC-512 cable required (see below)
OPBT3	analog solid-state voltage sourcing (2)	+15 to 30V dc, 100mA max.	6-ft. 4-conductor PVC-covered cable
OPBT3QD	analog solid-state voltage sourcing (2)	+15 to 30V dc, 100mA max.	MBCC-412 cable required (see below)

Hookup Information: OPBA3, OPBA3QD, OPBB3, AC Input OPBB3QD Analog Output Power Blocks



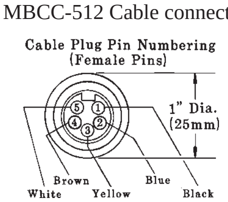
Hookup Information: OPBT3 and OPBT3QD DC Input Analog Output Power Blocks



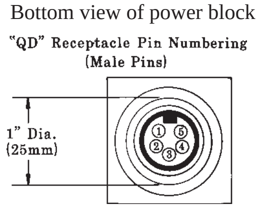
NOTE: If both outputs are used simultaneously, the maximum total load may not exceed 10 mA.

MBCC-type *minifast*™ QD Cables for QD model power blocks (purchase cables separately; see table above)

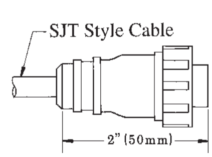
MBCC-512 Cable connector



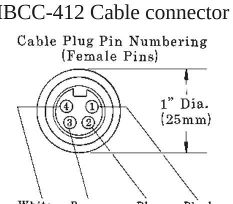
Bottom view of power block



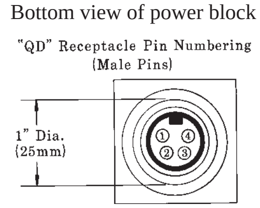
Side view of connector



MBCC-412 Cable connector



Bottom view of power block



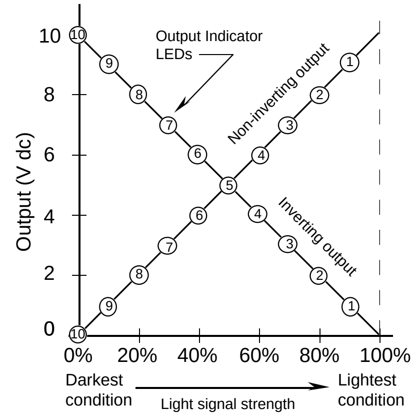
Adjustment Procedure, Analog OMNI-BEAM Sensors

1) Before adjusting the NULL and SPAN, slide the OALM board out from the base of the sensor head and set the output response time at the DIP switch. Refer to the photo (below right) and the information printed on the OALM board. Switch settings are given in the *Specifications* section (page 2, top). Longer time settings are useful for "smoothing" sensor response. Slide the OALM board back into the sensor head.

2) Begin with the sensor mounted at the sensing position and connected, per the hookup diagrams on page 2, for the desired output (inverting or non-inverting). The most precise adjustment is attained by using a voltmeter connected to monitor the desired output, as shown in the hookup diagrams. Present the "lightest" expected sensing condition to the sensor (the condition that results in the *most light seen* by the receiver). Next, perform either step #3 or step #4.

Top view of Analog OMNI-BEAM showing the NULL and SPAN controls and the moving-dot LED display.

The Analog OMNI-BEAM's moving-dot LED array indicates approximate output voltage and relative light signal strength.



3) To adjust the inverting output: monitor the voltage on the black wire. Adjust the NULL control to the point where the output *just reaches* 0 volts*. Then present to the sensor the "darkest" expected sensing condition (the condition that results in *least light seen* by the receiver), and adjust the SPAN control to *just reach* 10 volts output.

4) To adjust the non-inverting output: monitor the voltage on the white wire. Adjust the NULL control to the point where the output *just reaches* 10 volts. Then present to the sensor the "darkest" expected sensing condition (the condition that results in the *least light seen* by the receiver), and adjust the SPAN control to *just reach* 0 volts* output.

As can be seen from the graph (above, right), the slopes of the two 0-to-10V outputs are mirror-images of each other, and the plots intersect at 5 volts output. When the 0 and 10 volt points of one output have been properly set, the other output will track very close to the predicted values.

Other voltage ranges may be used. The practicality of doing so depends upon conditions specific to each individual application. Substitute the lower voltage for "0 volts", and the higher voltage for "10 volts" in the preceding adjustment instructions. When a range of other than 0 to 10 volts is used the NULL and SPAN controls will no longer be non-interactive. If you require further assistance, contact your Banner field sales representative or a factory applications engineer.

The OALM analog board slides easily in and out of the sensor head.

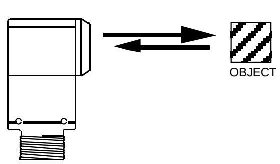
**Adjust the pot for minimum voltage near 0 volts dc. Voltmeter may not indicate exactly 0 volts.*

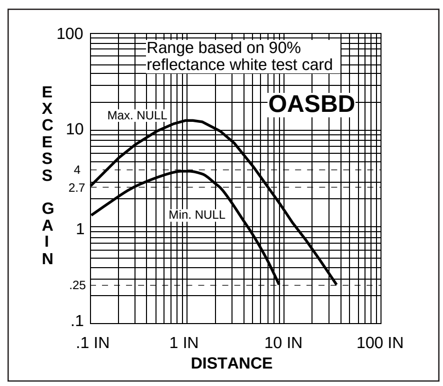
Diffuse (Proximity) Mode: models OASBD and OASBDX

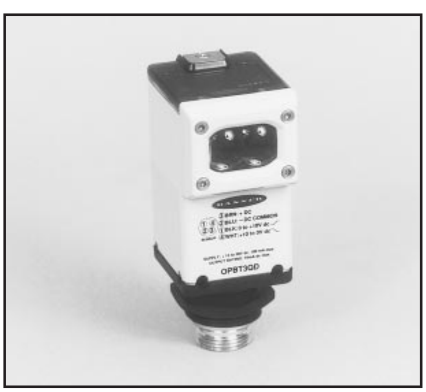
Model OASBD

Beam: infrared, 880nm

Maximum Response Range
(at maximum NULL and maximum SPAN):
36 inches (0,9m)





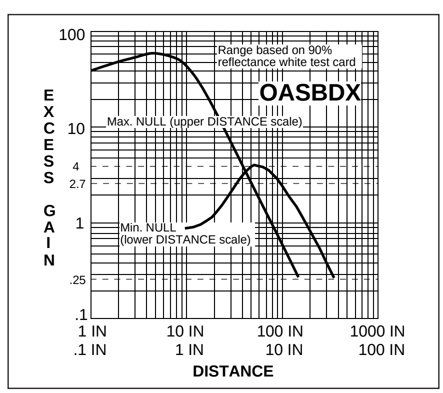


NOTE: The target used to plot the OSBD and OSBDX response curves is a 90% reflectance white test card which measures 16 inches by 20 inches (400mm x 500mm). Actual sensor response must consider both the relative surface reflectivity and the actual reflective surface area of any target.

Model OASBDX

Beam: infrared, 880nm

Maximum Response Range
(at maximum NULL and maximum SPAN):
12 feet (3,7m)



Fiber Optic models OASBF, OASBFX, OASBFV, and OASBFP

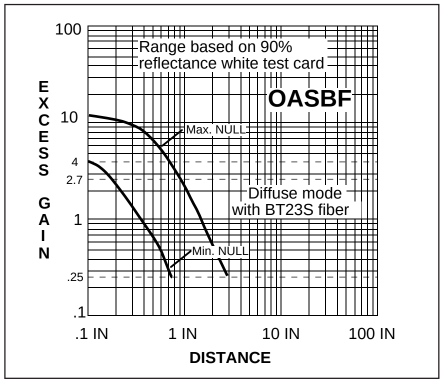
Sensors for use with Glass Fiber Optics

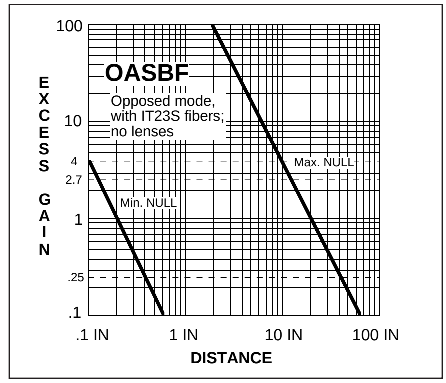
Bifurcated fiber, diffuse sensing | *Individual fiber pair, opposed sensing*

Model OASBF ➢

Infrared light source, 880nm

Model OASBF. OASBFX and OASBFV are identical in appearance to the OASBF.

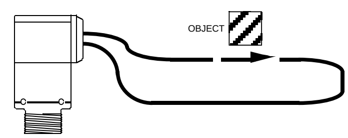


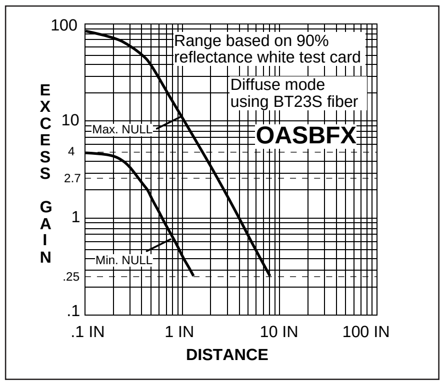


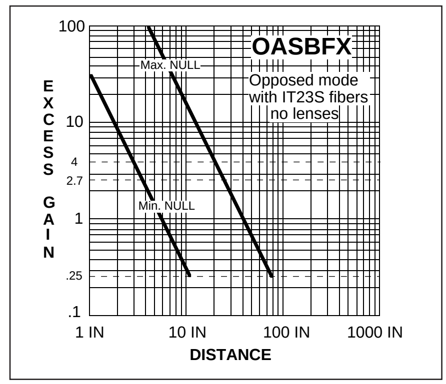
Model OASBFX ➢

High-power infrared light source, 880nm

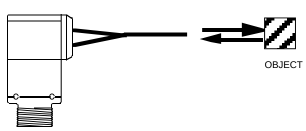
Opposed fiber optic mode





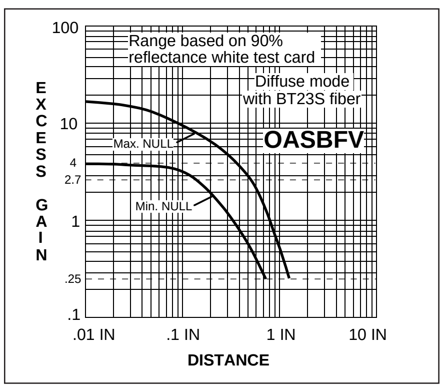


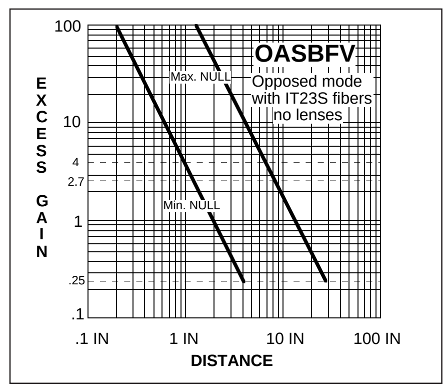
Diffuse fiber optic mode



Model OASBFV ➢

Visible red light source, 650nm

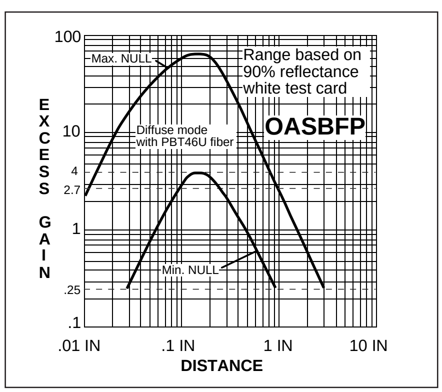


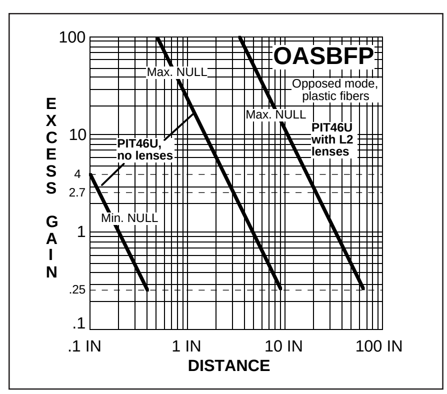


Model OASBFP *Sensor for use with Plastic Fiber Optics*

Visible red light source, 650nm

Model OASBFP, shown with coiled, bifurcated plastic fiber optic assembly.





See pages 5 through 8 for a comprehensive discussion on the theory and use of analog sensors.

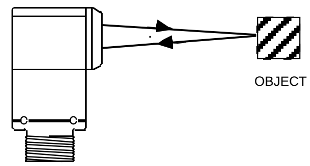
Convergent Beam Mode: model OASBCV

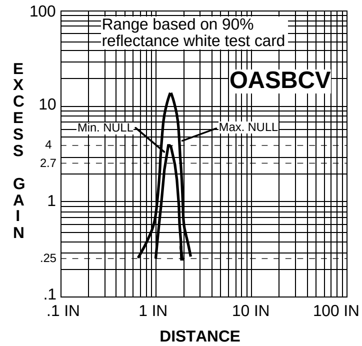
See pages 5 through 8 for a comprehensive discussion on the theory and use of analog sensors.

Model **OASBCV**

Beam: visible red, 650nm

Maximum Response Range: focus at 1.5 inches (38mm)



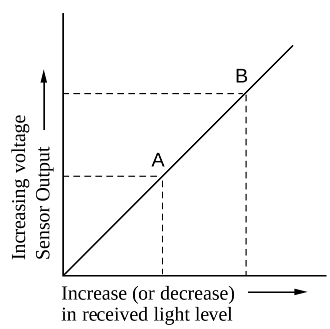


Photoelectric Sensing Modes and Their Use in Analog Control

Every analog sensing application requires that the sensor produce a predictable change in output that directly corresponds with a predicted mechanical change. The analog sensor output usually produces a measureable change in voltage or current.

In the case of a photoelectric sensor, the mechanical change within the process being monitored must produce a change in light intensity at the sensor's receiver. Most analog sensor applications involve the tracking of a process represented by a change between specific light levels, say "level A" and "level B" (**see Figure 1**).

Figure 1. Concept: analog response



The best photoelectric sensor for any analog application is one which:

1) Senses the greatest amount of light level change between levels A and B,
2) Produces a constantly increasing or decreasing change change of output between levels A and B.

Also, in applications where no circuitry is available to integrate or otherwise condition the sensor output, it is often desireable or necessary that the sensor produce an output which tracks *linearly* between levels A and B.

The selection of the best Analog OMNI-BEAM sensor for a specific application is a matter of:

1) Selecting the sensor head that has the optimum optical response per the above criteria, and
2) Configuring the sensor optics within the application to optimize these same criteria.

An understanding of the differences between the various photoelectric sensing modes greatly simplifies sensor selection decisions. The Banner *Handbook of Photoelectric Sensing* offers a discussion of sensing modes. The following discussion presents, in general terms, how each sensing mode is most commonly used for analog sensing applications.

Diffuse mode sensor heads are primarily used for two types of applications:

1) Distance measurement over relatively long distances (i.e. several inches or feet), or
2) Reflectivity measurement or monitoring.

Diffuse (Proximity) Sensing Mode: models OASBD and OASBDX

Distance measurement applications include stack height control, web loop control (**Figure 2**), and bin level control. Successful photoelectric distance measurement usually demands that the reflectivity of the material being sensed remain constant. If the material being sensed has a specular (shiny) surface, then the angle of the sensor to the material's surface must also remain constant. These sensing constraints severely limit the use of photoelectric sensors for distance measurement. For long distance measurement, analog ultrasonic sensors (**Figure 3**) are often the first choice. Ultrasonic sensors measure the elapsed time between a sound transmission and the returned echo. Consequently, analog ultrasonic sensors have the benefit of offering an output that is truly linear with sensing distance.

Figure 2. Loop control

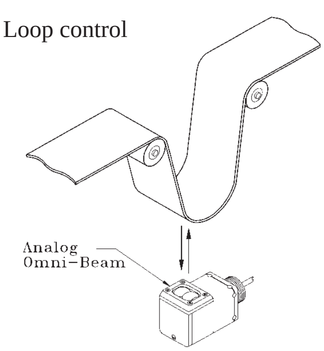
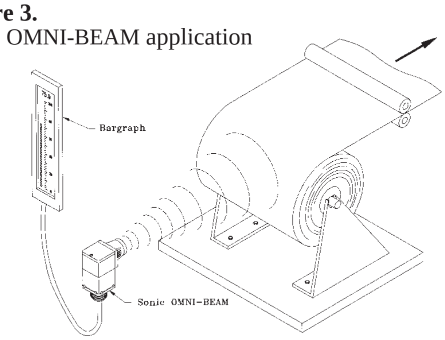
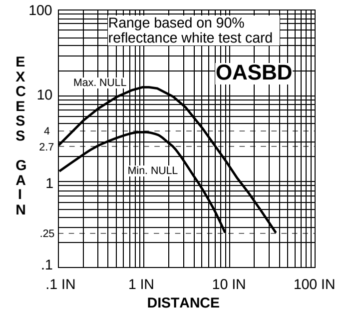


Figure 3.
Sonic OMNI-BEAM application



In applications where the material being tracked is absorbent to sound, analog photoelectric sensor become the first choice. Sound-abosrbent materials include cloth fabrics, carpeting, loose-fiber insultation, and open-cell foam.

Figure 4. Excess gain curve: OASBD



Excess gain curves may be used to predict the general response of diffuse mode analog sensors. **Figure 4** is a plot of distance vs. excess gain for sensor model OASBD. The sensor's NULL control is adjusted so that the received signal at the maximum sensing distance produces an excess gain of 4X. This is the point at which the inverted output first reaches zero volts, or at which the non-inverted output just reaches 10 volts. When NULL is set for 4X excess gain, there is no interaction between the NULL and SPAN adjustments.

From the plot of maximum NULL, the minimum distance (where excess gain is 4X) can be as far as 5.5 inches from the sensor lens. The minimum distance can be as close as .15 inch. However, from .15 inch outward, the excess gain increases until the target is just over 1.0 inch away, and then decreases. Most applications require the excess gain to constantly decrease with increasing target distance. It follows that a minimum NULL setting will place the 4X excess gain point at about 1 inch (i.e. at the top of the curve).

Minimum SPAN required to produce a full 10 volt output swing represents an optical contrast of 1.5:1 (i.e. a change in excess gain from 4X to 2.7X). Maximum SPAN corresponds to a contrast ratio of 16:1 (i.e. a change from 4X to .25X).

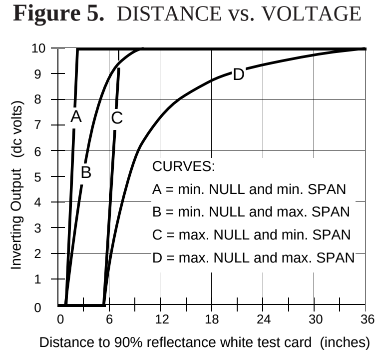
From the excess gain plots for the OASBD, the sensing distances for the limits of adjustment can be estimated:

Settings	NULL	SPAN	Change in Excess Gain	Range of Measurement
#1	MAX	MAX	4X to .25X	5.5 to 36 inches
#2	MAX	MIN	4X to 2.7X	5.5 to 7 inches
#3	MIN	MAX	4X to .25X	1 to 9 inches
#4	MIN	MIN	4X to 2.7X	1 to 2 inches

Sensor output voltage changes in proportion to change in excess gain. The excess gain plots for the OSBD (**Figure 4**) appear fairly linear beyond the signal peak at 1 inch. This is because the excess gain curve is plotted on a log scale. Excess gain decreases at an exponential rate with increasing distance. **Figure 5** illustrates how the output for model OSBD would respond at the four extreme settings of the NULL and SPAN controls (as listed in the table above). These plots are for the inverting output. Note that greater linearity of response is possible over short distances (i.e. with lower SPAN settings).

It is important to keep in mind that the actual reflective properties of the material to be sensed can have a dramatic effect on actual sensor response. The performance reference for all diffuse mode sensors is a Kodak 90% reflectance white test card. Objects with lower reflectivity will be "seen" over a shorter range. Objects with surfaces that are specular (i.e. shiny of mirror-like) can produce very high excess gain when viewed squarely at right angles by a diffuse mode sensor, but produce very low excess gain when viewed at an angle only a few degrees off of perpendicular. Also, the size of the Kodak test card is 8x10 inches. Smaller objects may return less ligh energy to the sensor.

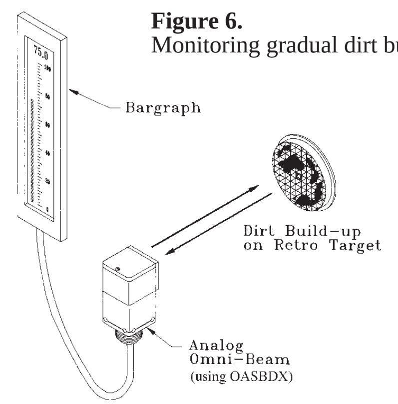
Figure 5. DISTANCE vs. VOLTAGE



In short, photoelectric analog distance measurement is dependent upon too many variables to allow meaningful performance curves to be published. Each Banner Analog OMNI-BEAM sensor head has a specified maximum response distance. This is the distance to a 90% reflectance white test card where the excess gain is .25X, and assumes that the NULL ans SPAN controls are both set to maximum. It is always best to determine analog response empirically. Whenever possible, sample materials should be sent to Banner's Application Engineering Group via your local Banner Field Sales Engineer. When necessary, your process may be avaluated on-site by our Field Sales Engineer, using test sensors.

Analog OMNI-BEAM model OASBDX may be used with a retroreflective target (such as model BRT-3) to monitor the gradual accumulation of dirt, dust, frost, or other contaminants that attenuate the passage of light (**Figure 6**). In practice, the retroreflective target is mounted to a surface where the buildup is to be monitored. In some applications, the target and sensor lens are both allowed to accumulate buildup. This same technique may be used to monitor density levels of smoke or other airborne particles which flow between the OASBDX and its retroreflector.

Figure 6.
Monitoring gradual dirt buildup



Convergent Beam Sensing Mode: model OASBCV

A convergent beam sensor uses a lens system that focuses the emitted light to an exact point in front of the sensor, and focuses the receiver element on the same point. This is a very efficient use of reflective sensing energy. Most objects with small profiles can be reliably sensed.

A convergent beam sensor will detect an object of a given reflectivity at the sensor's focus point, plus and minus some distance. This sensing area, centered on the focus point, is called the sensor's *depth of field*. The size of the depth of field depends upon the reflectivity of the object to be sensed. The excess gain curves for model OASBCV (**Figure 7**) are plotted using a Kodak 90% reflectance white test card.

Most of the analog distance measuring applications that use convergent model OASBCV utilize half of the response curve. Distance measurement usually begins at the focus (1.5 inches from the sensor lens) and moves farther out, away from the sensor (**Figure 8**). It is evicent from the excess gain curve that an analog convergent beam sensor best monitors object displacements of less than .5 inch.

Much smaller displacements may be measured if the convergent beam sensor can be located such that the edge of the object enters the focus point from the side (**Figure 9**). In this type of application, the reflectivity of the object and the angle of the object's surfce to the sensor lens *must* remain constant.

Specular surfaces can "confuse" a convergent beam sensor. When viewed straight-on, mirror-like reflections can cause a shiny surfce to be seen far beyond the normal depth of field, and small changes in viewing angle can cause complete loss of the received light signal.

Model OASBCV uses a visible red (650nm) light source. Consequently, this sensor may be used successfully in some applications to monitor the reflectivity differences contributed by a change in object color. However, a convergent beam sensor may be used to monitor such color changes only if the sensing distance and other factors contributing to the object's surface reflectivity remain constant. Color monitoring applications always require a feasibility study. Your Banner Field Sales Engineer or Factory Applications Engineer can assist with testing.

Fiber Optic Sensing Modes: models OASBF, OASBFX, OASBFV, OASBFP

Fiber optics offer many possibilities for analog sensing and control. Individual fiber optics may be used for opposed or mechanical convergent sensing. Bifurcated fiber optics may be used for diffuse mode sensing. Selection of fiber diameter (plastic fibers) or fiber bundle diameter (glass fibers) affords a means of customizing the sensing optics for optimum analog response. Fiber optics also offer ease of sensor mounting, especially in tight locations.

Figure 7. Excess gain curve: OASBCV

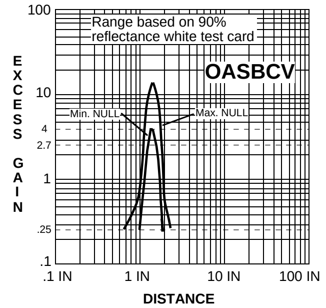


Figure 8. Convergent mode, depth-of-field

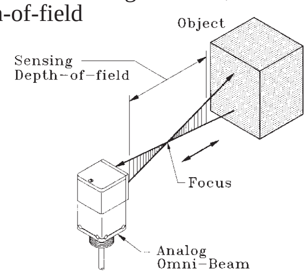
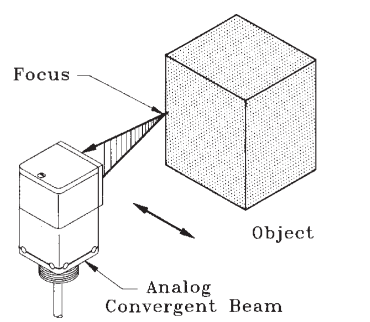


Figure 9. Displacement Measurement



Individual fiber optics:

Glass or plastic individual fiber optics are used in an opposed configuration for distance measurement (**Figure 10**). If a pair of fibers are kept in alignment with one another while moving apart, the decrease in excess gain is predicted directly by the inverse square law. This fact is illustrated by the straight-line excess gain curves for opposed mode sensors (**Figure 11**). Long distance measurement is accomplished by adding lens assemblies to individual fiber optics with threaded end tips. Give consideration to the warnings about flexing of glass fiber optics whenever a fiber optic is repeatedly moved back and forth over a long distance.

A pair of fiber optics with a small fiber or fiber bundle will offer highly accurate measurement over short distances.

One way to accurately measure small displacements is to position a pair of opposed fiber optics so that the displacement between two surfaces causes misalignment of the two fibers. **Figure 12** illustrates how linear displacement may be monitored. Rectangular glass fiber optic assemblies can be used to monitor displacement over a long distance with relative fiber movement occuring along the *length* of the rectangular bundle termination. **Figure 12** also illustrates how opposed glass fiber optics with rectangular sensing ends may be used for very precise displacement measurement with movement across the *width* of the rectangular termination. **Figure 13** shows how opposed fiber optics are used to measure *angular* displacement within any specified plane of rotation.

Figure 10. Fiber optic opposed distance measurement

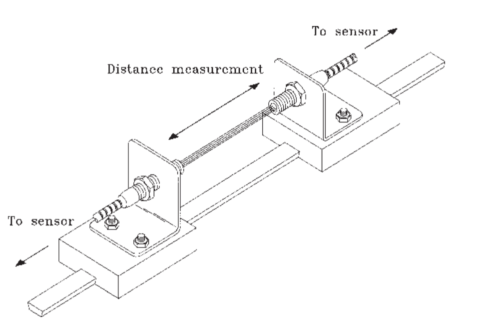


Figure 11. Excess gain: OASBFX

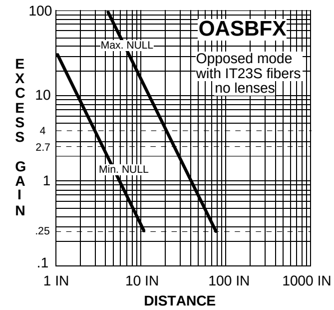


Figure 12. Linear displacement with rectangular fibers

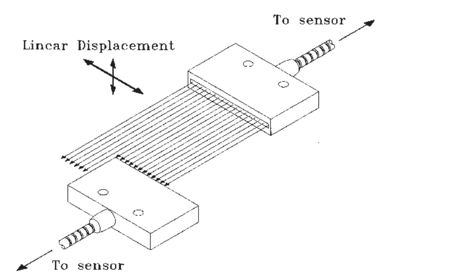
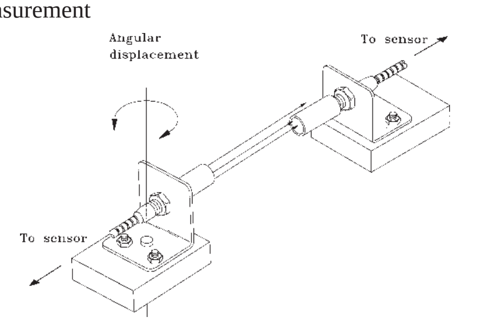
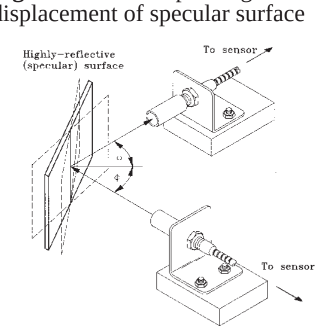


Figure 13. Fiber optic angular displacement measurement



A pair of individual fiber optic assemblies may be used in the specular reflection sensing mode for monitoring the angular displacement of a specular (shiny) surface (**Figure 14**). Two threaded fibers are used and both are fitted witha lens assembly. The lenses are threaded into each fiber sensing end until the end of the fiber (or fiber bundle) comes into sharp focus (appearing magnified) as viewed throught the lens. The two fiber/lens assemblies are then mounted at equal and opposite angles (e.g. 45 de-

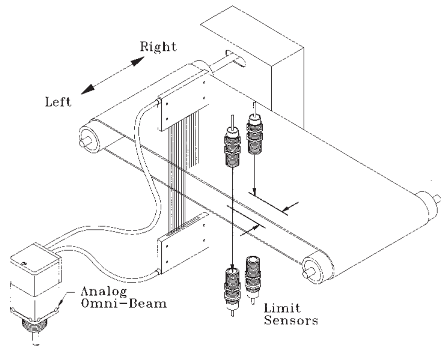
Figure 14. Fiber optic angular displacement of specular surface



grees, etc) from the perpendicular to the specular surface that is to be monitored for angular skew.

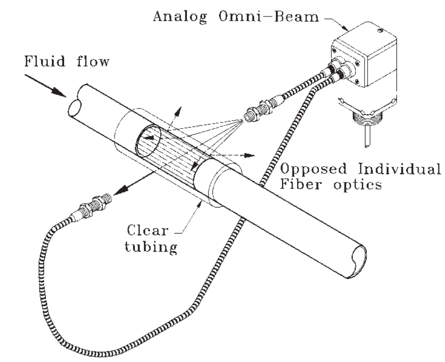
Opposed fiber optics may be used to measure the width (profile) of an object as a function of the percentage of the beam that it blocks. This same approach is used for monitoring the position of the edge of an opaque material. One common application is edge-guiding, as shown in **Figure 15**. Glass fiber optics with rectangular terminations serve an important role in many size and position monitoring applications.

Figure 15. Fiber optic opposed edge guiding



Opposed fiber optics are commonly applied for monitoring the optical clarity of a material. For example, a clear section of tubing is often inserted along a gas or liquid pipeline, and opposed fiber optics are used to establish a light path across the centerline of the tubing (**Figure 16**). Turbidity, chemical change, pollutants, etc. may affect the amount of light transmitted across the clear section. The light source of models OASBF and OASBFX is infrared (invisible) and the light source used for models OASBFV and OASBFP is visible red. The light-absorbing characteristics of the material being monitored may dictate the use of either visible red or infrared light. Whenever necesary, please contact your Field Sales Engineer or the Banner Application Engineering staff to discuss your particular sensing requirements.

Figure 16. Turbidity monitoring



Bifurcated fiber optics:

Bifurcated fiber optics may sometimes be successfully applied to monitor distance to a surface (**Figure 17**). As the excess gain curve in **Figure 18** suggests, distance measurement with bifurcated fiber optics is possible only over relatively short ranges. Repeatability of distance sensing with bifurcated fiber optics demands that the reflectivity of the surface and the viewing angle to the surface remain constant. Once the relative reflectivity of the surface to be monitored is known, the desired response to the predicted displacement can be obtained through selection of sensor head and fiber (or fiber bundle) size. Your Banner Field Sales Engineer or Factory Applications Engineer can assist you with the best selection.

WARNING These analog photoelectric 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* a high or a low sensor output voltage.

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.

Figure 17.
Fiber optic diffuse distance measurement

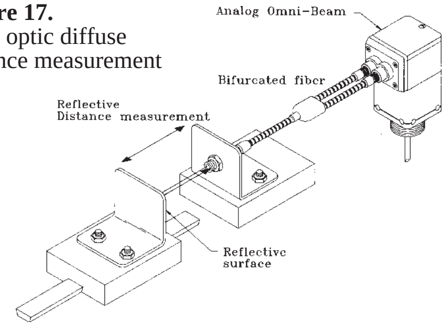
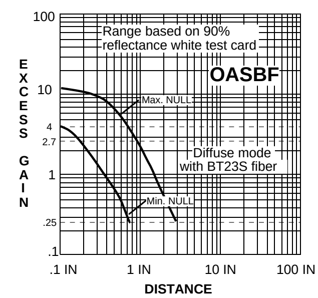


Figure 18. Excess gain: OASBF



Bifurcated fiber optics may be used for monitoring the reflective characteristics of a material surface that maintains ists distance and orientation to the sensing end tip (**Figure 19**). The visible red light sources of models OASBFV and OASBP are particularly useful for monitoring reflectivity differences due all or in part to color change.

Fotonic™ sensors are laboratory grade systems which use a bifurcated fiber optic assembly as the sensing component for non-contact measurement of surface conditions or any variable (e.g. force, temperature, pressure, etc.) that can be converted to displacement. Banner Analog OMNI-BEAM sensors *are not* meant to replace fotonic systems. However, with careful selection of sensor head and fiber optic assembly, a fiber optic analog OMNI-BEAM system may function adequately in some small displacement sensing applications.

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Figure 19.
Surface reflectivity monitoring