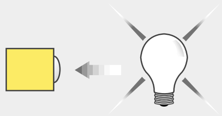
Understanding Sensing Terms

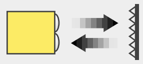
Data Reference Tables

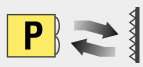
International Distributor List



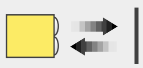
AMBIENT LIGHT RECEIVERS: Ambient light receivers, such as MULTI-BEAM model SBAR1, are operated by sunlight, room light, or laser light sources. These sensors are also used to sense the large amounts of infrared light (heat energy) emitted by hot or molten glass, metal, or plastic during processing of these materials.

OPPOSED (A.K.A. "THROUGH-BEAM") SENSING MODE: The opposed mode requires a separate emitter and receiver that are positioned opposite each other so that the light from the emitter shines directly on the receiver. An object is sensed when it interrupts the light beam. The opposed mode is the most efficient use of photoelectric sensing energy, and offers the highest level of excess gain for reliable sensing through dirt, fog, or other challenging environments.

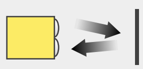




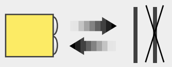
RETROREFLECTIVE (A.K.A. "RETRO") SENSING MODE: Retroreflective mode sensors have both the emitter and the receiver in the same housing. A light beam is established between the sensor and a special retroreflective target (see page 636). An object is sensed when it interrupts the light beam. Retro is the most popular sensing mode for conveyor control and similar applications where there is an advantage to have a sensor on only one side of the sensing process. Polarized retroreflective sensors are used when the object to be detected is highly reflective. Special laser retro sensors, such as Q45LL (pages 122 and 438), offer very long range and accurate sensing repeatability.



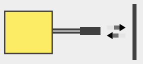
DIFFUSE (A.K.A. "PROXIMITY") SENSING MODE: Diffuse mode sensors contain both the emitter and the receiver in the same housing. An object is detected when the receiver captures the small percentage of emitted light that is reflected back to the sensor from the surface of the object itself. Minimal lensing is used so as to project the emitted light in a broad (diffused) pattern and give the receiver a wide field of view. Special models called divergent mode sensors use no lenses at all for extremely forgiving alignment to objects that are difficult for reflective sensors to sense, such as clear materials and very small parts.



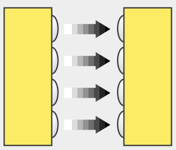
CONVERGENT BEAM SENSING MODE: The convergent mode is similar to the diffuse sensing mode because an object is sensed when the receiver sees light reflected back to the sensor by the object itself. Unlike diffuse mode sensors, however, convergent sensors use additional optics to produce a small and well-defined sensing area, focused at a fixed point ahead of the sensor lens. Because convergent sensors make much more efficient use of sensing light energy, they can sense relatively non-reflective materials and objects with small reflective surfaces. They are, however, much less forgiving to sensing distance, as compared to diffuse mode sensors.

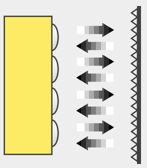


FIXED-FIELD AND ADJUSTABLE FIELD SENSING MODES: Fixed-field sensors use two receivers and a comparator circuit to cancel sensing response whenever the intensity of the reflected light reaching the long-range receiver exceeds the intensity of the reflected light reaching the close-range receiver. As a result, any object lying beyond the sensor's fixed "cutoff point" can be reliably ignored. Adjustable field sensors use an array of multiple receiver elements, which allows the sensor circuitry to move the locations of the cutoff point with a simple adjustment.

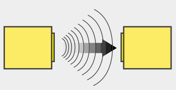


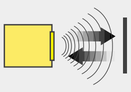
FIBER OPTIC SENSING MODES: Transparent fibers of glass or plastic may be used for conducting and guiding photoelectric sensing light energy. Individual fibers are usually used in pairs for opposed mode sensing. Bifurcated fibers combine the emitted and received light in the same assembly, and are usually used for diffuse mode sensing. Bifurcated fiber optics are sometimes fitted with an optional lens for retroreflective mode sensing. Fiber optics comprise the smallest photoelectric sensors and can fit into extremely tight spaces. Most glass fiber optics are able to withstand sensing environments where there are corrosive materials and/or where the temperature is too high for sensor electronics. Most sensor families include models for use with fiber optics.



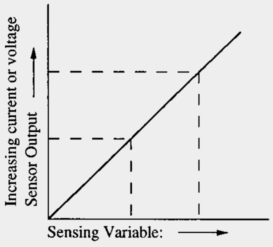


LIGHT SCREENS (A.K.A. LIGHT CURTAINS): A light screen is an array of photoelectric beams configured to sense objects passing anywhere through an area (i. e. - through a sensing plane). Some light screens, such as MINI-ARRAY or BEAM-ARRAY™ models work together with a microprocessor-based controller to measure and/or profile one dimension of an object that passes through the sensing plane. Other light screens, such as LS Series sensors (page 458), are designed simply for sensing the presence of a part in the sensing plane, and are usually used for parts counting or die ejection verification. Safety light screens, such as the MINI-SCREEN®, include the necessary self-checking redundant circuitry necessary to allow their use in personnel safety applications. See the Banner Machine Safety Products Catalog and the "Important Safety Warning" inside the front cover of this catalog.

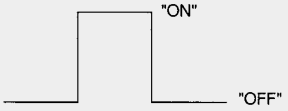




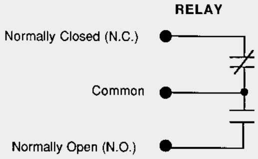
ULTRASONIC SENSING MODES: Ultrasound may be used for opposed mode or reflective proximity mode detection of clear materials and other objects that are difficult to detect with photoelectric sensors. Ultrasonic proximity mode sensors can measure the time delay between the emitted sound and the returned echo, and produce an accurate measurement of sensing distance. Ultrasonic analog proximity sensors produce an output that has a highly linear relationship to sensing distance. Ultrasonic proximity sensors with switched outputs, such a OMNI-BEAM™ and Q45U models, offer a "high/low level" mode that can directly control fill level of liquids or solids. (See the Banner Measurement and Inspection Sensor Catalog)



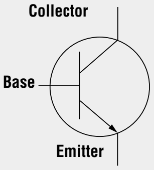
ANALOG RESPONSE: Most sensors offer a switched (discrete) output. Sensors with an analog output produce a variable voltage or current that is proportional to some sensing parameter. The output of an analog photoelectric sensor is proportional to the strength of the received light signal (see Analog OMNI-BEAM™ sensors, page 44). The output of an analog ultrasonic proximity mode sensor is proportional to the distance from the sensor to the object that is returning the sound echo. (See the Banner Measurement and Inspection Sensor Catalog)



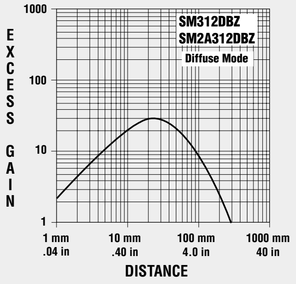
SWITCHED (A.K.A. DISCRETE OR BINARY) OUTPUT: Most sensors are used for presence sensing and offer a relay as an output switching device. The relay switch is always in either one of two states: open or closed ("ON" or "OFF").

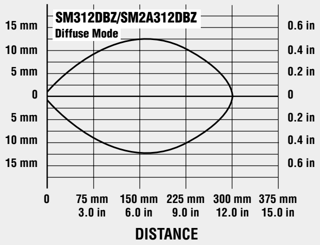


ELECTROMECHANICAL ("E/M") RELAYS offer one or more "hard" contacts (metal-to-metal) and are switched to the opened or closed position by applying voltage to an electromagnetic coil. E/m relays can switch the highest power levels. They are limited by slow switching speed and a finite mechanical life.



SOLID-STATE RELAYS use switching elements such as transistors for dc loads and SCRs or FETs for ac loads. Solid-state relays offer fast switching speed and infinite life. They are limited by their power ratings, and are protected in most sensors against damage from overload by additional circuitry.





EXCESS GAIN: Excess gain is a photoelectric sensor specification. It is a measurement of the amount of light falling on the receiver over and above the minimum amount of light required to just operate the sensor's amplifier. Excess gain is plotted versus sensing distance. Excess gain values are used to predict the reliability of a photoelectric sensor operating in a known sensing environment (see, below).

Excess Gain Guidelines

Operating Environment	Excess Gain Required
CLEAN AIR: No dirt buildup on lenses or reflectors	1.5
SLIGHTLY DIRTY: Slight buildup of lint, paper, dust, moisture, or film on lenses or reflectors; lenses cleaned regularly	5
MODERATELY DIRTY: Obvious contamination of lenses and reflector, but not obscured; lenses cleaned occasionally or when necessary	10
VERY DIRTY: Heavy contamination of lenses; fog, mist or dust; minimal cleaning of lenses	50 or more

BEAM PATTERN: Beam patterns are two-dimensional plots of sensor response versus sensing distance. They can be helpful in predicting sensor performance. A beam pattern for an opposed mode sensor pair represents the boundary within which the receiver will effectively "see" the emitted light beam, assuming no angular misalignment between the emitter and receiver. Retroreflective beam patterns are plotted using a model BRT-3 retroreflective target. Diffuse and convergent mode beam patterns represent the boundary within which the edge of 200 x 250 mm (8 x 10 in) Kodak 90% reflectance white test card is detected as it moves into the sensing area. A beam pattern is affected by many sensing variables, and should be considered as a guideline and not as an exact specification.

ENVIRONMENTAL RATING: Banner sensors and modules are rated for their suitability for use in various sensing environments using two rating systems: National Electrical Manufacturers Association (NEMA) and The International Electrotechnical Commission (IEC).

NEMA Standards Publication No. 250 guidelines are outlined:

NEMA 1	Indoor Use	Protects against accidental contact by personnel & falling dirt
NEMA 2	Indoor Use	Protects against falling dirt, liquid & light splash
NEMA 3	Outdoor Use	Protects against rain, sleet, snow, dirt & dust
NEMA 3S	Outdoor Use	Protects against rain, sleet, snow, dirt, dust & ice buildup
NEMA 4	In- or Outdoor	Protects against dirt, dust, hosedown (and heavy splash)
NEMA 4X	In- or Outdoor	Protects against dirt, dust, hosedown & corrosion
NEMA 6	In- or Outdoor	Protects against dirt, dust, hosedown & occasional submersion
NEMA 6P	In- or Outdoor	Protects against dirt, dust, hosedown & prolonged submersion
NEMA 7	Indoor Use	For use in areas of explosive gases or vapors or combustible dust
NEMA 9	Indoor Use	For use in areas of atmospheres containing combustible dust
NEMA 12	Indoor Use	Protects against dirt, dust, light splash & oil or coolant seepage
NEMA 13	Indoor Use	Protects against dirt, dust, light splash & oil or coolant spray

The rating system established by IEC Publications 144 and 529 define the following "IP" ratings:

1ST CHARACTERISTIC: Protection against contact and penetration of solid bodies

Numeral	Short Description
0	Non-protected
1	Protected against solid objects greater than 50 mm
2	Protected against solid objects greater than 12 mm
3	Protected against solid objects greater than 2.5 mm
4	Protected against solid objects greater than 1.0 mm
5	Dust protected
6	Dust-tight

2ND CHARACTERISTIC: Protection against the penetration of liquids

Numeral	Short Description
0	Non-protected
1	Protected against dripping water
2	Protected against dripping water when tilted up to 15°
3	Protected against spraying water
4	Protected against splashing water
5	Protected against water jets
6	Protected against heavy seas
7	Protected against the effects of immersion
8	Protected against submersion

INTRINSICALLY-SAFE (A.K.A. "I.S.") SENSORS: Intrinsic safety is a design technique applied to electrical equipment, including sensors, for use in hazardous (explosive) locations. The technique involves limiting electrical and thermal energy to a level below that required to ignite a specific hazardous atmosphere. I.S. sensors are used with intrinsic safety barriers, which are protective components designed to limit the voltage and current within the hazardous atmosphere. See the SMI912 Series, page 180 and the SMI30 Series, page 342.

NAMUR SENSORS: NAMUR photoelectric sensors are 2-wire devices that change their internal resistance relative to the intensity of the received light. They are designed for use with certified switching amplifiers with intrinsically-safe circuits, which convert this change to a binary output signal. NAMUR sensors are most commonly used in hazardous (explosive) sensing environments. See the Q45AD9 Series, page 140 and the MIAD9 Series, page 232.