



# **TRI-TRONICS®**

## **Smart Photoelectric Solutions Since 1954**



## **Photoelectric Sensor User Guide**

**2007 - 2008**

**800-237-0946   ttco.com   813-886-4000**



*Smart Photoelectric  
Solutions Since 1954*

## Photoelectric Sensors, Fiber Optic Light Guides and Controls

### The Company

*TRI-TRONICS COMPANY, INC.* was formed in 1954 as an engineering oriented firm specifically devoted to the design and manufacture of high quality Photoelectric Sensors and Controls. We have earned a reputation as a leading innovator in photoelectric technology and developed a number of revolutionary products. Our sensors are sold through a worldwide network of technical sales Representatives and stocking Distributors.

### The Products

The Company designs and manufactures Photoelectric Sensors, Fiberoptic Light Guides and Controls for a wide variety of industrial applications. Included are sensors for use in the opposed, retroreflective, proximity and convergent modes. The product line includes registration mark/color perception sensors, miniature models, DC and AC sensors, fiberoptic light guides, controls and complete systems.

### Recent Developments

Many new and innovative products have been introduced recently, including the **MINI-EYE™** miniature sensor, the all-purpose **EZ-EYE™** sensor, and the **RETROSMART™**, a high performance, clear object sensor. The **RETROSMART™** performs flawless detection of anything...from clear filled PET bottles to shiny cans. We have also increased our selection of **Plastic Fiberoptic Light Guides**.

### The Facilities

*TRI-TRONICS* owns and operates a 28,000 sq. ft. facility in Tampa, Florida, close to Tampa International Airport.

### Services

*TRI-TRONICS* offers a wide variety of innovative Photoelectric Sensors and Controls to fit nearly all industrial applications. Marketing, Sales and Engineering personnel welcome inquiries and will offer solutions to even the most difficult sensing problems.



**ttco.com**

Product Selection Guide

Fundamentals of Photoelectric Sensing

Photoelectric Sensors

Fiberoptic Light Guides

Plug-in Control Modules

Accessories

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Glossary of Terms, Index, Request Forms

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# GENERAL APPLICATION SENSORS

PAGE



## SMARTEYE® EZ-PRO™ 2-1

- Automatic adjusting, local or remote
- One-Touch Autoset™



## SMARTEYE® PRO & PRO REMOTE 2-9

- Automatic, self-adjusting
- Optional remote AUTOSSET™ or action alert output



## SMARTEYE® MARK II 2-17

- Enhanced performance with respect to the Classic SMARTEYE®
- Very high speed and resolution
- 50 microsecond response



## SMARTEYE® MARK III 2-25

- Miniature, high performance
- DIN Rail mountable



## SMARTEYE® CLASSIC 2-34

- High speed
- High resolution



## OPTI-EYE® 2-42

- Economical DIN rail mount sensor
- Miniature general purpose sensor
- Changeable optical blocks

# GENERAL APPLICATION SENSORS

NEW!



## EZ-EYE™

- Affordable, all-purpose sensor
- EZ to use Push-button adjustment

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NEW!



## MINI-EYE™

- Standard & 18 mm Mounting Models
- Thru-Beam models
- Laser Thru-Beam models
- M8 4-PIN connector or 6 ft. potted cable

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## MITY-EYE®

- AC & DC Miniature Sensors
- General purpose sensor
- Changeable optical blocks

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## TINY-EYE®

- Miniature, tamperproof sensor
- Proximity or Thru-Beam models

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## U.S. EYE®

- AC/DC Sensor with Timer, Relay or Triac Output Options
- Conventional sensor with unique features

2-79

**NEW!**



## SMARTEYE® RETROSMART

PAGE

2-83

- Flawless detection of clear FULL bottles and shiny cans
- No proxing on shiny objects
- Detection of irregular shaped clear objects



## SMARTEYE® STEALTH-UV

**NEW!**

2-89

- Digital Models
- Analog Models
- Designed to detect the presence of invisible fluorescent materials
- Fiberoptic options
- Up to 24" range



## SMARTEYE® DCS

2-94

- Remote, digitally controlled sensor
- Highest resolution of any model
- Parameters can be changed dynamically



## LABEL•EYE®

2-101

- Optimized for label detection
- AUTOSET™ set up
- Low cost



## SMARTEYE® EXTREME HIGH-INTENSITY

2-104

- Thru-Beam
- Fiber Optic
- Penetrates many packaging materials for content verification

# REGISTRATION MARK SENSORS

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## SMARTEYE® COLORMARK II

2-109

- High Resolution Registration Mark Sensor
- 5 LED color options
- 50 microsecond response time



## MARK•EYE® PRO

2-115

- High Resolution Registration Mark Sensor
- White LED
- AUTOSET™
- Remote Set-Up option



## MARK•EYE®

2-121

- Opacity Mode Gap Sensor
- Low cost
- AUTOSET™

DANGER

WARNING

DANGER

TRI-TRONICS industrial control products are designed for machine control in factory automation applications only.

They were not designed to meet OSHA and ANSI safety standards. Therefore, they should never be used in personal safety applications.

The output devices incorporated into the TRI-TRONICS controls and industrial sensors can fail in either the energized or de-energized state. Therefore, if inappropriately used in "people" protection systems, an unsafe operating condition may result which could lead to serious injury.



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## FIBEROPTIC SENSING SOLUTIONS

3-1

- Standard Glass
- Miniature Glass
- Custom



## PLASTIC FIBEROPTIC LIGHT GUIDES

3-24

- Wider selection of tips
- Economical
- Coaxial bundle



## CONTROL MODULES

4-1

- Power Supplies
- Logic Functions
- Relay & TRIAC



## ACCESSORIES

5-1

- Cables
- Reflectors
- Reflector Mounting Brackets
- Fiber optic Accessories
- Power Supplies Accessories
- Testing Supplies
- Optical Blocks
- Sensor Mounting Brackets



## DATA REFERENCE TABLES

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## GLOSSARY, INDEX, REQUEST FORMS

7-1

# NEW! @ TTCO

## RETROSMART™

High-Performance  
Clear Object  
Sensor

Flawless detection  
of anything...from  
FULL clear bottles  
to shiny cans.



- Designed specifically to detect transparent/translucent plastic or glass containers, as well as shiny metal cans.
- Operates in the retroreflective (beam break) sensing mode, using a high performance reflector (AR6151 reflector included with sensor).
- Optimum range (distance to reflector) 6 in. to 8 ft. (15.24 cm to 2.4 m).
- AUTOSET™ setup routine requires a single push of a button with the reflector in view.

*See Page 2-83*

# NEW! @ TTCO



## MINI-EYE™

Our Lowest  
Cost Sensor  
That  
Outperforms  
Anything  
in its Price  
Range!

Miniature  
Photoelectric  
Sensor

 **TRI-TRONICS®**

- Sensors are available with either infrared (IR) or red LED light source, and either NPN or PNP output transistor
- Standard and 18 mm mounting models
- Fixed Optics - Proximity, Retroreflective, Polarized Retroreflective, and Thru-Beam
- Laser Thru-Beam models
- Immune to indirect ambient light and strobes

*See Page 2-55*





## A collection of various household items including cardboard boxes, cleaning products like bleach and dish soap, food items like a burger box and instant noodle cups, and personal care products like deodorant and medicine bottles.

- 
- A collection of various household products including cleaning supplies, personal care items, and food items, illustrating the types of goods that can be sold on Amazon.

# NEW! @ TTCO

Wider Selection of  
Plastic Fiberoptic Light Guides



- Economical
- Coaxial bundle

*See Page 3-24*



## Fundamentals of Photoelectric Sensing

# Fundamentals of Photoelectric Sensing

Today's photoelectric sensor is one of the most versatile non-contact sensing devices known to man. The reliability of photoelectric "eyes" or "sensors" took a giant leap forward in the early 1970s when the light emitting diode (LED) replaced the fragile incandescent light source.

This solid-state light source also enables the designer to eliminate most problems previously caused by ambient room light. Modern pulse modulated photoelectric sensors respond only to the light emitted by their own light source.

This capability allows the sensor to be very sensitive and responsive to small light changes that occur to the light beam path between the light source lens and the receiving lens.

For an object to be detected, it must affect the intensity of the light beam reaching the sensor's light detector in one of two ways:

- The object must break or diminish an existing light beam path between the light source lens and receiver lens—Beam Break mode. (See Figure 1-1-1a)
- The object itself must diffuse or reflect the light beam to the receiving lens—Beam Make mode. (See Figure 1-1-1b)

One sure way to simplify the selection of a photoelectric sensor to fit your application is to remember that you only have two choices—Beam Make or Beam Break.

## Contrasting Light Levels

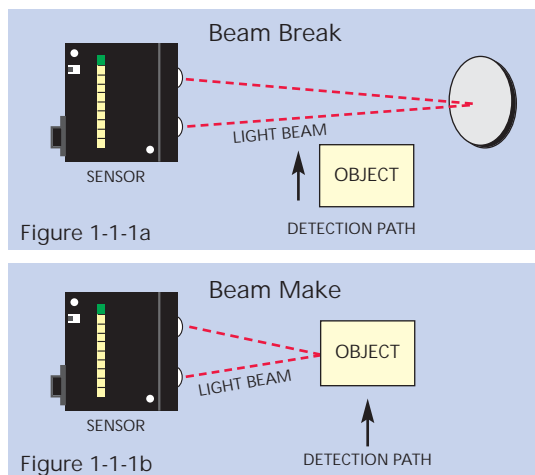
The sensing task of any digital switching photoelectric sensor is to respond to and resolve the difference between the contrasting light levels and switch its output accordingly.

When operating in the Beam Break mode, the intensity of the light beam reaching the receiving lens is in its brightest or lightest state condition before an object is introduced into the light beam path. Introducing an object into the light beam path will block out, or diminish, the intensity of the received light beam, resulting in the darkest state condition. (See Figure 1-1-2a)

In the Beam Make mode, the darkest state condition is before an object is placed in the light beam path. The lightest state condition is when an object is introduced into the light beam path so as to bounce, or reflect, the light beam to the receiving lens. (See Figure 1-1-2b)

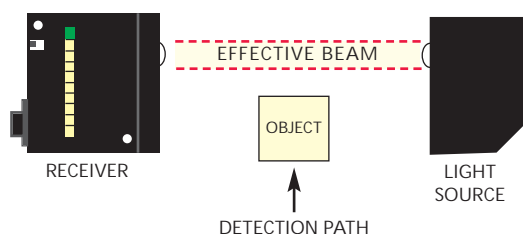
The amount of difference or deviation of the intensity of the light beam in its lightest state condition vs. the intensity of the received light beam in the darkest state is called "contrast."

These contrasting light levels define the degree of difficulty of the sensing task. In real estate, it is well known that the three most important considerations are location, location, location. In photoelectric sensing, the three most important considerations are contrast, contrast, contrast.



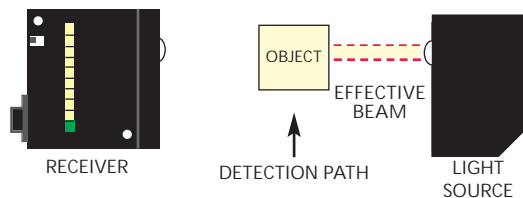
## Beam Break

### Light State



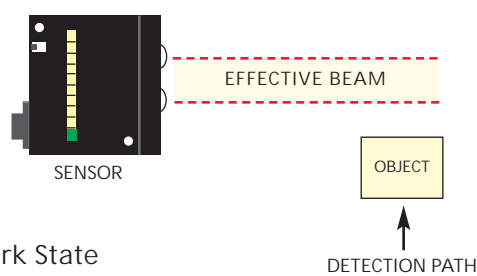
Light and Dark State Figure 1-1-2a

### Dark State



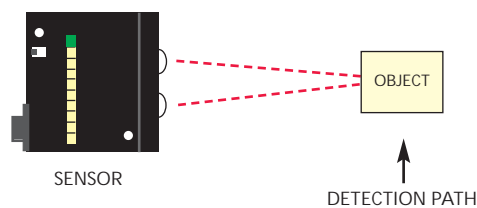
## Beam Make

### Dark State



Light and Dark State Figure 1-1-2b

### Light State



# Beam Break Sensing

## Opposed Mode

In the Opposed Mode of sensing, two separate devices utilizing either lensed or fiberoptic light guides are used to make or break a beam.

- One unit is the light source.
- The other is the receiver.

In this mode, the light source transmits a beam of light across the detection path to the receiver. Detection occurs when an object interrupts, or sufficiently diminishes, the intensity of the received light beam. (See Figure 1-2-1)

Unfortunately, Beam Break sensing is often overlooked as a result of the initial cost of purchasing and installing two separate devices and the sometimes tedious task of alignment. However, the opposed mode of sensing has distinct advantages when detecting opaque products. It provides the most reliable sensing method under very adverse conditions, such as

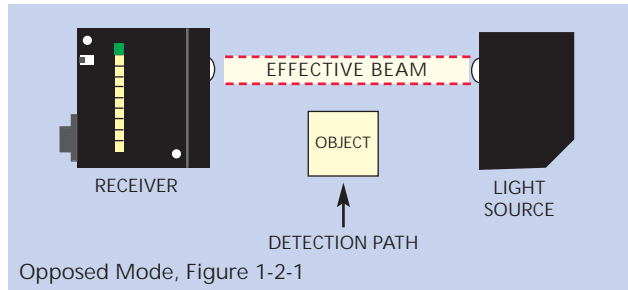
dusty, dirty, and moisture-laden environments.

*Remember...when opaque, go Beam Break.*

## Retroreflective Mode

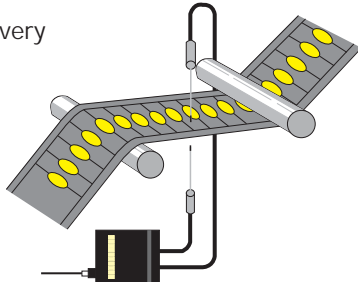
The Retroreflective sensor contains both the light source and receiving device in one housing. A unique dual lens system or bifurcated fiber optic light guide establishes the transmitted light beam path and the returned light beam path on the same axis. When a retroreflective sensor or fiber is pointed or aimed at a reflector, the light beam is reflected back to the receiving lens or fiber. (See Figure 1-3-1) Sensor alignment with a prismatic reflector can be skewed by 10 to 15 degrees and, still a strong light beam will return to the receiving lens on exactly the same axis as the original transmitted light beam.

To detect presence or absence of objects, the light beam path is directed across the detection path so that

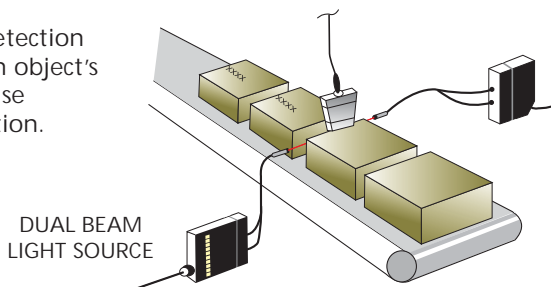


## Opposed Mode

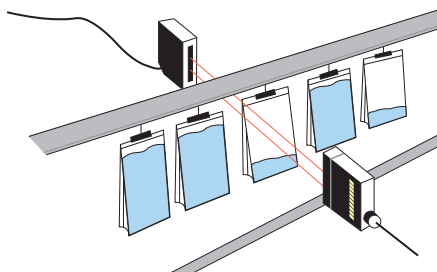
1. Detection of very small objects.



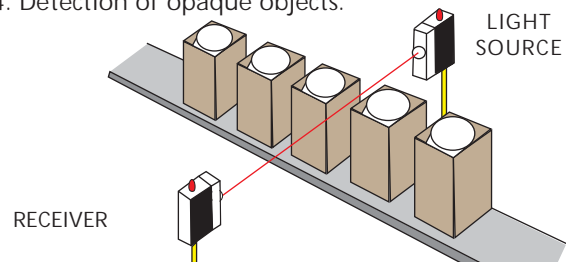
2. Detection of an object's precise location.



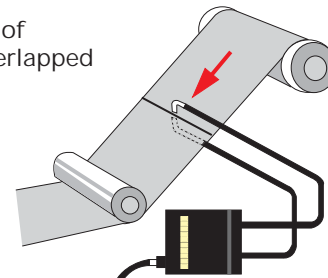
3. Detection of fill levels in containers.



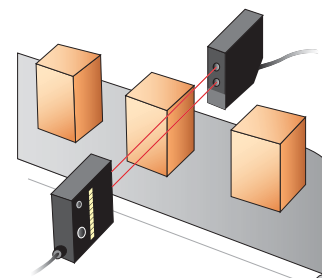
4. Detection of opaque objects.



5. Detection of splices or overlapped materials.



6. Detection of container contents.



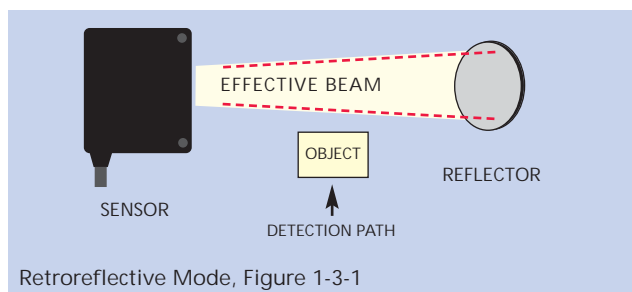
# Beam Break Sensing

passing opaque objects interrupt the light beam. When the light beam is broken or when the intensity of the received light beam is reduced below a threshold level, the sensor responds by switching its output.

When sensing small parts, the recommended choice is opposed mode sensing using fiberoptic light guides. The retroreflective sensor is generally low in cost and easy to install. However, care must be taken to ensure that shiny objects passing near the sensor do not reflect a light beam off the surface of the object strong enough to accidentally switch the sensor's output.

This undesirable characteristic of the retroreflective sensor is referred to as proxing. To prevent proxing, the sensor's light beam can be aligned on an angle of incidence that reflects the light beam away from the receiving lens. Another way to reduce proxing is to polarize the light

beam. Polarized light helps to ensure that only the light beam reflected off the prismatic reflector reaches the sensor's receiver. While reducing the response to light reflected off the surface of the sensed object, polarizing reduces sensing range.



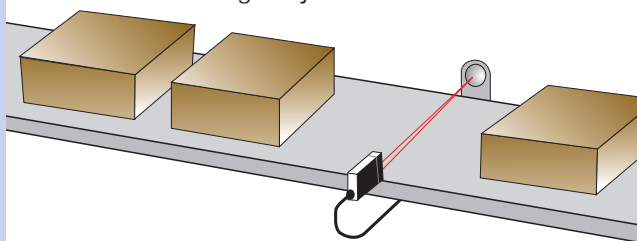
## Transparent/Shiny Object Detection

In the past, the retroreflective sensor has been the most effective choice when detecting opaque objects. However, recently things have changed! Thanks to advances in technology, the new RETROSMART™ retroreflec-

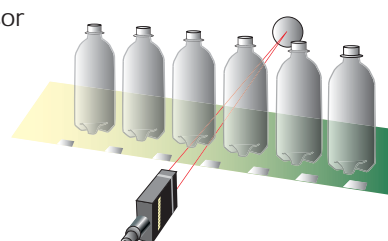
tive sensor can – absolutely, without fail, detect ANY transparent/translucent or shiny object. The RETROSMART sensor provides a single, non-chattering output for each transparent PET bottle or shiny metal can that passes through the sensor's narrow, red light beam.

## Retroreflective Mode

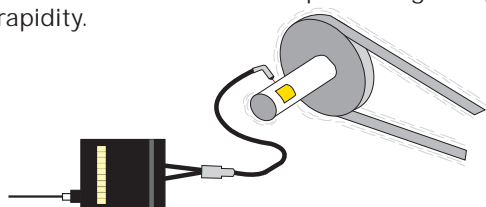
1. Detection of large objects.



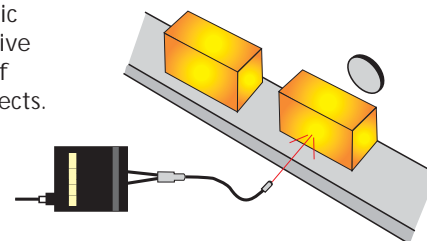
4. High performance retroreflective sensor for sensing a transparent glass or plastic product.



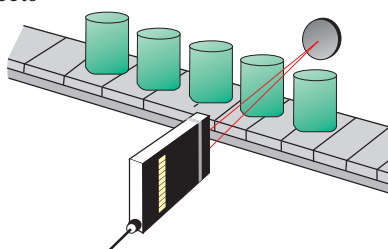
2. Detection of reflective tape moving at high rapidity.



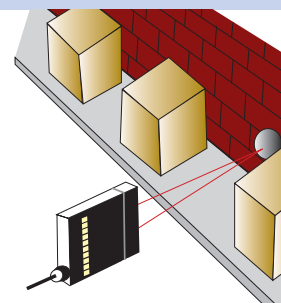
5. Fiber optic retroreflective detection of moving objects.



3. Detection of objects moving at high velocity.



6. Beam Break detection of objects at sensing sites where mounting space is limited.



# Beam Break Sensing

## Gap Sensors

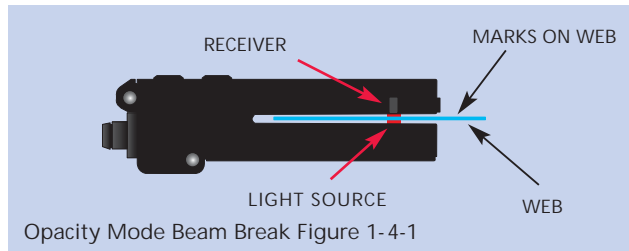
Gap sensors are an excellent choice to sense a distinguishing change or object on a continuous web or roll of materials. By using opacity mode sensing techniques that utilize a light source capable of penetrating through the web of materials, gap sensors can register slight contrasting light level changes and produce an output signal for a specific machine operation.

A significant advantage of opacity mode sensing with TRI-TRONICS gap sensors is that end users do not need to be concerned with web flutter or ambient light, including strobe flashes.

Depending on what you are trying to sense, opacity mode sensors can give you the desired output signal to perform machine functions. Typical applications include sensing labels on a roll, sensing registration marks on printed packaging material, and splice detection on continuous webs of material. Since opacity mode sensing distinguishes the light level change as light passes through a web of material, the web must be translucent or transparent. Most webs of packaging material such as film, metallized films, and paper do allow light to pass through. Opaque materials such as aluminum foil do not allow light to pass through and, therefore, cannot be used in opacity mode sensing.

## MARK•EYE®

The MARK•EYE® sensor is designed to see printed registration marks on most packaging materials on a continuous web. By detecting the contrasting light level difference between the background material and the registration mark on the web, the sensor's output signals to perform a machine function.

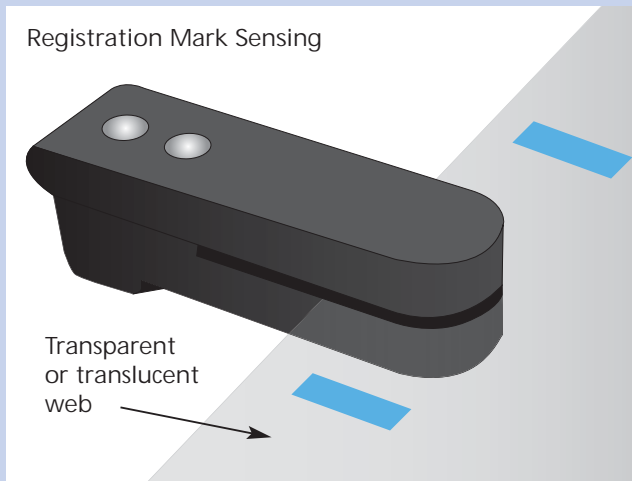


## LABEL•EYE®

The LABEL•EYE® sensor is designed specifically to sense a variety of adhesive labels on a continuous roll. It works by detecting the contrasting light level change that penetrates through the backing material of a web and a self-adhesive label. The function of the LABEL•EYE® is to look through the backing paper to detect the "gap" between the labels and signal the labeling machine to stop the dispensing mechanism before the label is completely dislodged from the backing material. With the next "up" label protruding off the end of the peeler plate, it is now perfectly positioned to be applied to the next product as it passes by on a conveyor.

## Opacity Mode

Registration Mark Sensing



Label Sensing



# Beam Make Sensing

## Optical Proximity Mode

Optical Proximity sensors contain both the light source and the receiver in one common housing. The light source lens shapes the light beam into a diverging column of light that, with distance, increases in width and decreases in intensity. A wide angle receiving lens is used to collect the reflected light beam off the surface of the object to be detected. (See Figure 1-5-1)

A bifurcated fiber optic light guide can also be utilized as the light passes through the fiber optic light guide. The light is reflected off the object and passes back through the fiber to the sensor's receiver.

It is often difficult, if not impossible, to access both sides of the detection path of objects moving past the sensing site. When this circumstance occurs, the Beam

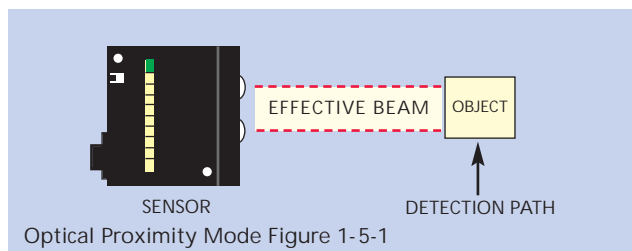
Make mode of sensing is the only choice. For example, when attempting to detect each item in a row of objects resting on a common conveyor belt, the proximity sensor is recommended. In this situation, the proximity sensor

must resolve the difference between the contrasting light levels reflecting off the object vs. light reflecting off the conveyor belt.

The suppression of light reflecting off shiny objects in the background can be enhanced by proper posi-

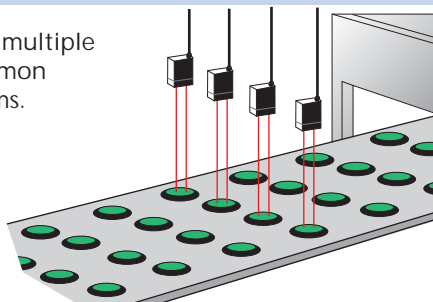
tioning of the sensor. If the angle of incidence to the reflected light beam is adjusted so that the light beam path does not return to the receiving lens, the proximity sensor will only respond to the light diffusing, or reflecting off the object itself.

Unfortunately, there are many situations when the intensity of the light reflected off the object is not much

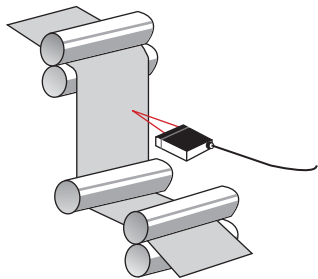


## Optical Proximity Mode

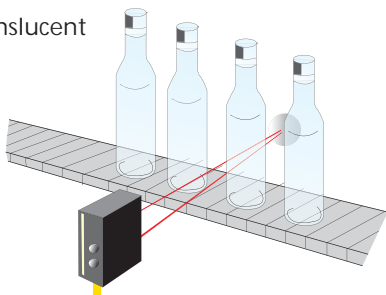
1. Detection of multiple objects on common conveyor systems.



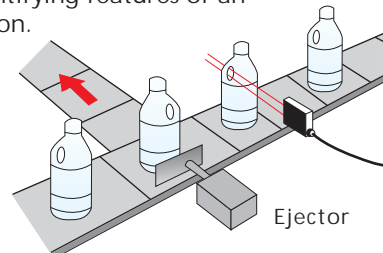
2. Detection of web material.



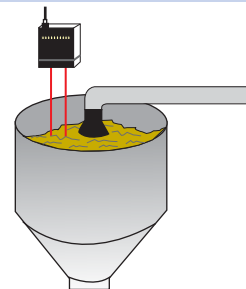
3. Detection of translucent objects.



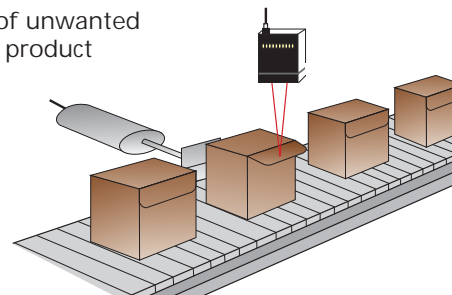
4. Detection of identifying features of an object for orientation.



5. Detection of the fill level of the contents of a container.

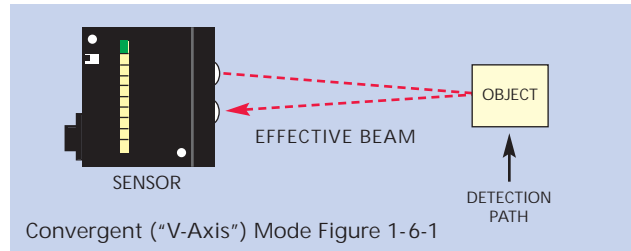


6. Detection of unwanted condition for product inspection task.



# Beam Make Sensing

different than the intensity of light reflected off background objects. In applications when the differential between these contrasting light levels is minimal, a high performance sensor equipped with high gain amplifiers and the contrast indicator are recommended. As a result of the diverging light beam, it is sometimes necessary for small objects to be as near as 1/8 inch to the receiving lens or fiber tip to be detected. Larger objects can be detected at a distance of up to 6 feet or more in this mode.



path that reflects off the surface of the object. However, the lensing system of a convergent (also referred to as "V-Axis") sensor converges the light beam into a small spot of light at a distance of a few inches, precisely at the receiving lens focal point. Using this technique provides an effective method of enhancing background suppression, while directing, by reflection, a very strong light beam on a direct path to the receiving lens. In addition to improving back-

ground suppression, convergent sensing is very useful for small parts detection and for detection of printed identification data.

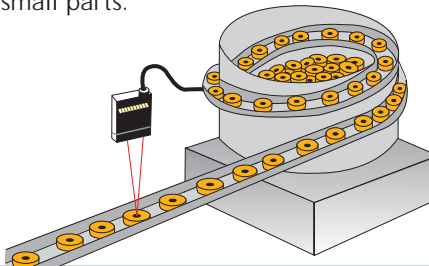
Fiberoptic light guides can also be used in a convergent mode for "V-Axis" sensing. Simply direct two fibers at the target in a "V" configuration and small parts or the contrasts of an object can be detected.

## Convergent ("V-Axis") Mode

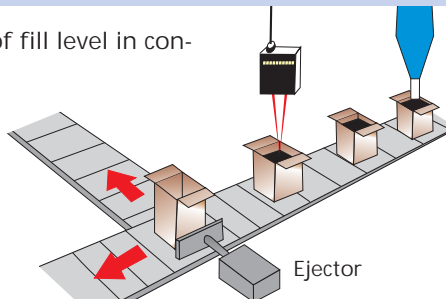
The convergent mode of Beam Make sensing is very similar to the proximity mode. The convergent beam sensor, like the proximity sensor, responds to a light beam

### Convergent Mode

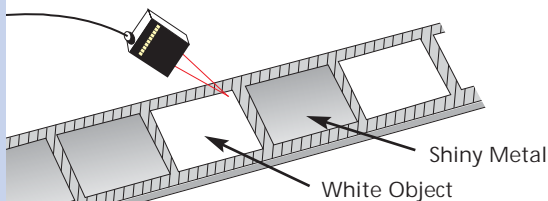
1. Detection of small parts.



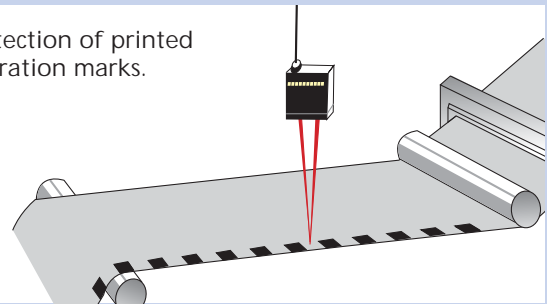
2. Detection of fill level in container.



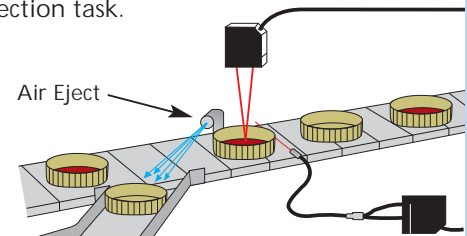
3. Detection of object when background light suppression is required.



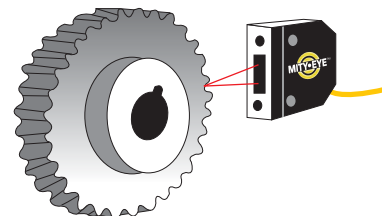
4. Detection of printed registration marks.



5. Detection of condition for product inspection task.



6. Detection of object moving at high speed.



# Color Perception for Detecting Registration Marks

## White LED Light Source

The White LED Light Source in our sensors is the best choice for detecting the widest variety of colored registration marks on today's packing material. White Light enhances performance when detecting dark-colored registration marks on dark-colored webs of materials. In addition, the COLORMARK II sensor is equipped with Red, Blue, White and Green LED light sources. These colors are useful in applications when the preferred White Light Source does not optimally perform; i.e., a White or Blue LED light source is recommended to detect pale yellow marks on a white background.

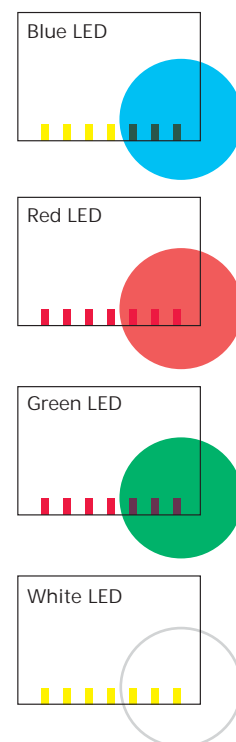
## Color Registration Mark Sensing

When detecting registration marks printed in a wide variety of colors on

packaging materials, we recommend white LED color light source for broad band color detection.

Imagine yourself viewing a printed red mark on white paper stock. The red mark looks dark in contrast to the white paper. Now, imagine placing a red transparent filter in front of your eye while trying to view that same red mark. The red mark now becomes difficult, if not impossible, to see. If the sensor is equipped with a red LED, the sensor would have the same problem. Now, imagine yourself viewing that same red mark through a green filter. The white background now appears bright green, but the red mark appears black or very dark. That's the contrast we are looking for!

Equipping the sensor with a green LED provides the sensor with the same advantage as the green filter did for your eye. Now, the red mark provides more



# Color Perception

than adequate response to the contrasting light reflecting off the white background.

## Opacity Mode Sensing

The MARK•EYE® offers an excellent solution for opacity mode sensing. It is a slot sensor optimized to see printed registration marks on transparent, some translucent, and metallized film on a continuous web of materials. Since the MARK•EYE® operates in the opacity sensing mode, the color of the registration mark simply doesn't matter.

## Optical Proximity Mode

The MARK•EYE® has been designed to detect the widest variety of color marks on the widest variety of web colors. It is optimized for high-speed detection of registration marks on opaque materials.

When another color of LED is desired, the COLOR-MARK II is an excellent choice. With the Red, Blue, Green, and White LEDs, seeing the registration mark has never been easier.

## Other Color Perception Tasks

The SMARTEYE® MARK II Series or EZ-PRO sensors are extremely useful in object sensing tasks when a difference in color is the only distinguishable feature. An example of an application where color perception is extremely useful in object sensing is identifying the contents of a container by the mere color of its cap. Please note that not all similar shades of the same color can be resolved; however, many can.

TRI-TRONICS sensors, designed for color perception, are all equipped with high gain amplifiers and the Contrast Indicator. They are capable of sensing differences in the color of objects introduced into the light beam path. The resulting signal level deviation is then amplified to a useful level and displayed on the 10 LED



Contrast Indicator. Whenever a color perception task is presented to a SMARTEYE® MARK II or EZ-PRO sensor, the Contrast Indicator eliminates all the guesswork.

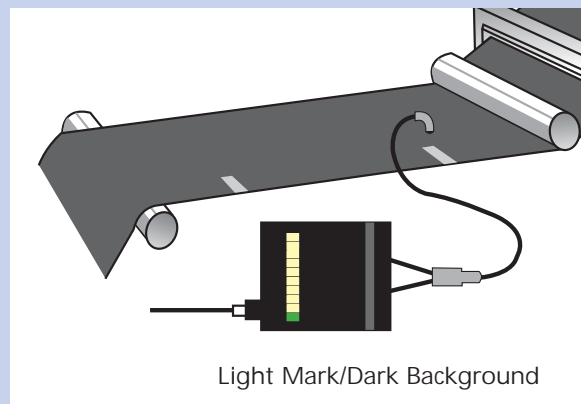
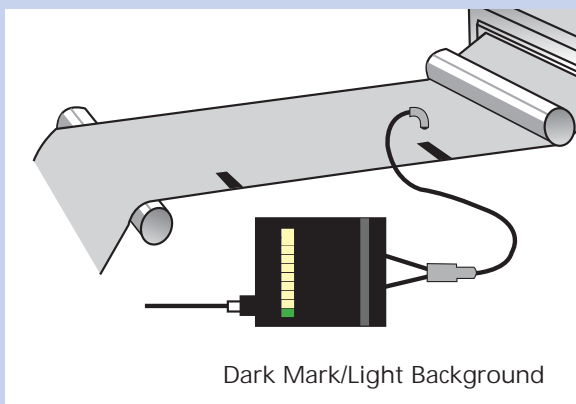


## Choosing the Correct LED Color

Preferred color perception of the sensor is controlled by the color of the LED light source.

Solid-state light emitting diodes are available in several different colors, such as white, red, green, blue, and infrared. Variable "shades" of colored visible light emitting diodes (LEDs) provide an extended choice for the light source of a pulsed photoelectric sensor. Selecting a color for the LED light source provides the same advantage as choosing a very selective colored filter for narrowing the response of the photoelectric sensor to a specific color. Narrowing the response of a photoelectric sensor to a specific color provides obvious advantages when color perception is required.

Please note that when operating in the Beam Make, proximity mode of sensing, a WHITE LED light source is the best choice for detecting dark colored objects.



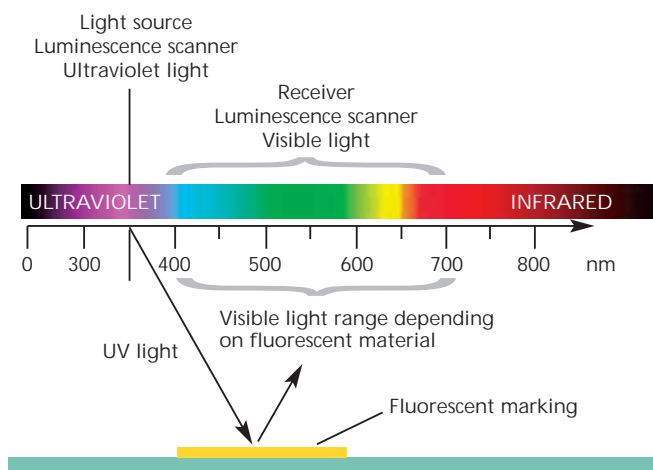
# Luminescence Sensing

## Luminescence Sensor

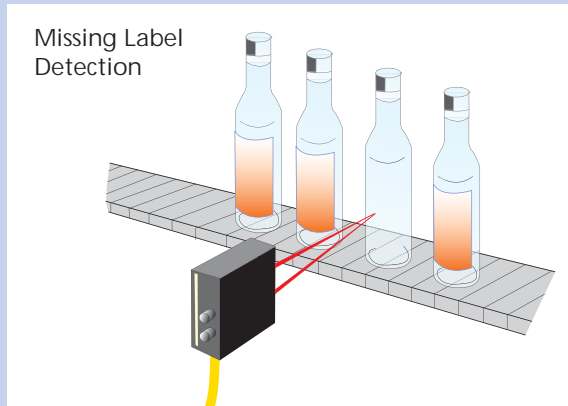
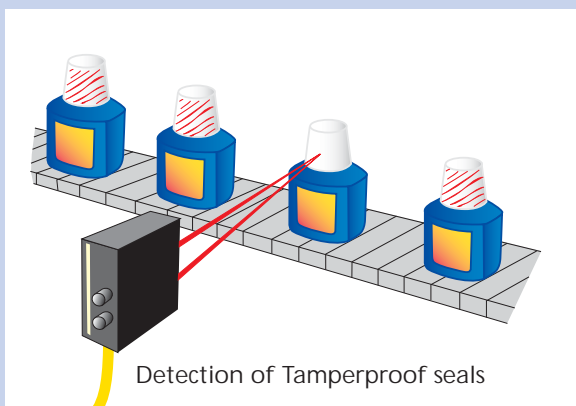
The SMARTEYE® *STEALTH-UV* sensor is a special purpose sensor designed to detect the presence of invisible fluorescent materials contained in special chalks, inks, paint, greases, glue, and optical brighteners found in labels, paper, tape, string, etc. The sensor contains an ultraviolet (UV) solid-state light source that is used to excite the luminescent materials to fluoresce in the visible range. The sensor's detector then responds to the visible fluorescing light. When the received fluorescing light level, as displayed on the Contrast Indicator, reaches a level of "4" or above, the NPN and PNP output transistors will switch to the opposite state.

Typical Luminescence Sensor Applications:

- Detection of tamperproof seals
- Clear label detection
- Detection of invisible registration marks
- Product orientation
- Verification of presence of adhesives
- Verification of pull tabs on packages
- Tape or splice detection of web
- Verification of glue on paper, plastic, or transparent materials
- Flaw detection using chalk or invisible marks on lumber/wood products
- Detection of presence of a critical component in a complex assembly
- Thread break detection



Verification of seals



# Range

The sensing range specification provided by sensor manufacturers is typically the maximum absolute sensing range under ideal circumstances.

In the opposed mode of sensing, maximum range is defined as the absolute maximum distance allowable between the light source and the receiver.

In the retroreflective mode of sensing, it is the absolute maximum distance between the sensor and the prismatic reflector.

In the proximity mode of sensing, the maximum range is the absolute maximum distance between the sensor and the sensed object.

However, these maximum sensing range specifications are for reference only. That is because these range specifications are taken under ideal conditions, with clean lenses and in very clean environments. These conditions are not found in the vast majority of industrial applications.

Many manufacturers supply "excess gain" charts that plot range vs. signal strength obtained above the necessary level to trip the output of the sensor. These charts are plotted with the gain adjustments at maximum.

In the Beam Break mode, the target/object, is larger

than the effective light beam and is always opaque.

When operating in the retroreflective mode, there is no way to obtain the effect of light reflecting off the sensed object.

In the Beam Make mode, the object is larger than the effective light beam, is perfectly flat, and has a 90% reflective white surface. In addition, in the Beam Make mode, there is no way to obtain the effect of light reflecting off background objects from excess gain charts.

In summary, excess gain charts totally ignore signal strength generated by the Dark State condition.

TRI-TRONICS unique Contrast Indicator™ provides actual signal strength indications that provide for perfect alignment by ascertaining actual response to the intensity of the received light. TRI-TRONICS sensors equipped with Contrast Indicators provide an instantaneous real time indication of the received light intensity at any range.

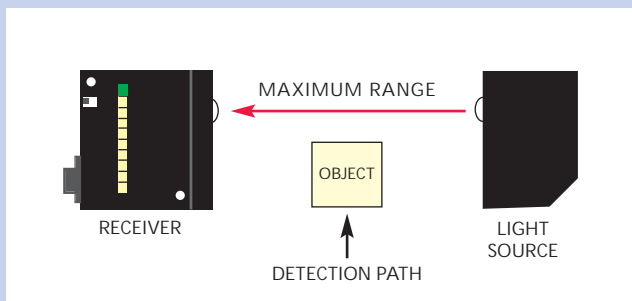
Contrast signal deviation charts are available on all sensors equipped with the Contrast Indicator™. These charts are extremely helpful in determining if the sensor you have selected will adequately perform your particular

## Guidelines for Determining Useful Range

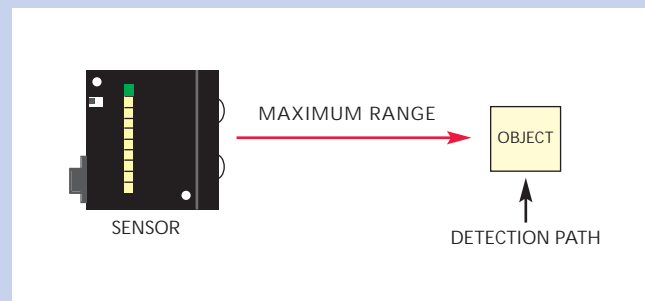
% of Range Decrease

Sensing Environment	Opposed	Retroreflective	Proximity
Clean	-5%	-10%	-10%
Slightly Dirty	-10%	-15%	-25%
Dirty	-20%	-30%	-50%
Very Dirty	-40%	-60%	-75%

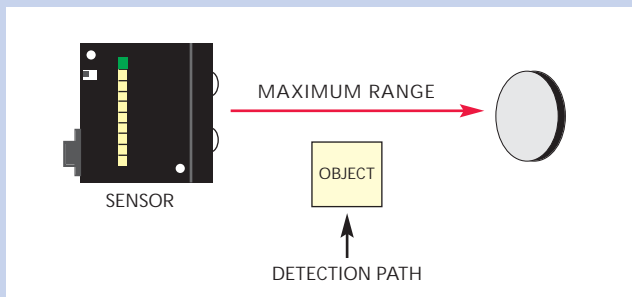
Maximum Range Opposed Mode



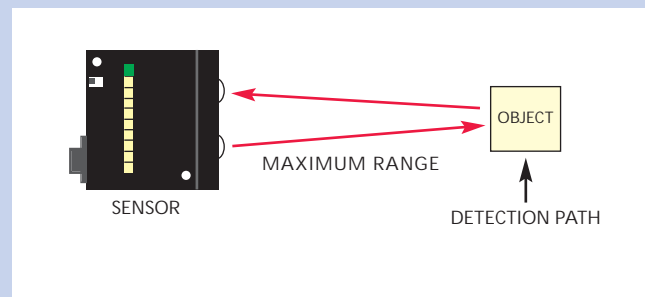
Maximum Range Proximity Mode



Maximum Range Retroreflective Mode



Maximum Range Convergent (V-Axis) Mode



# Range

sensing task at the desired range. Simply reference the amount of contrast deviation required to perform the sensing task in your environment, and compare it to the performance chart of the sensor you have selected to determine if the sensing range is adequate.

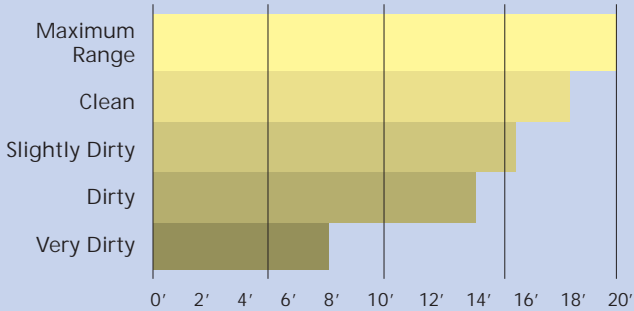
For TRI-TRONICS sensors not equipped with Contrast Indicators, range guidelines charts are available that indicate recommended maximum sensing ranges. To estimate useful range in your environment, simply decrease the specified maximum range by the percentage indicated in the following table.

### Guideline for Determining Useful Range

Sensing Environment	Percentage of Decrease		
	Opposed	Retroreflective	Proximity
Clean	-5%	-10%	-10%
Slightly Dirty	-10%	-15%	-25%
Dirty	-20%	-30%	-50%
Very Dirty	-40%	-60%	-75%



From clean to dirty lens



Example: Model MDIR4 (Retroreflective)

### Environmental Useful Range

If the maximum range of a retroreflective sensor is rated at 20 feet and your sensing site environment is dirty, the specified maximum range would decrease by 30% to a useful range of 14 feet.

## Environmental Considerations

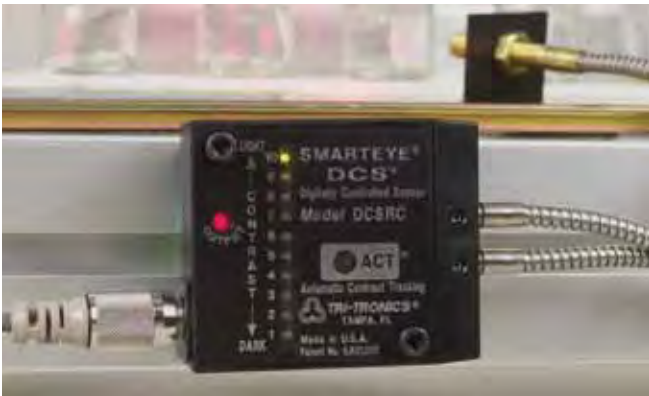
When selecting the appropriate TRI-TRONICS sensor to fit your application, sensing site environmental conditions should always be considered. All TRI-TRONICS products are designed into enclosures or housings that provide varying degrees of protection against special environmental conditions. The accompanying table lists the NEMA and IEC/IP Standards that apply to individual TRI-TRONICS sensors and control enclosures.

Consult factory for RoHS compliance.

### TRI-TRONICS Product Enclosure Ratings for Non-Hazardous Locations

PRODUCT FAMILY	NEMA	IEC/IP
CLASSIC SMARTEYE	4X, 6P	IP67
COLORMARK II	4X, 6P	IP67
EZ-PRO	4X, 6P	IP67
EZ-EYE	4	IP67
LABEL•EYE	4	IP67
MARK•EYE	4	IP67
MARKEYE PRO	4X, 6P	IP67
MINI-EYE	4X	IP66
MITY•EYE	4X	IP67
MULTI-MATE Controls	1	IP30
PIC Series Controls	1	IP30
RETROSMART	4	IP66
SEPS Power Supplies	1	IP30
SMART EYE DCS	4X, 6P	IP67
SMART EYE MARK II	4X, 6P	IP67
SMART EYE MARK III	4X, 6P	IP67
SMART EYE PRO	4X, 6P	IP67
SMART EYE STEALTH-UV	4	IP66
TINY-EYE	4X, 6P	IP67
U.S. EYE	1	IP20

See Environmental Ratings, Data Section



# Contrast Indicator™ *Guaranteed Performance*

## Contrast Indicator™ Guarantees Performance

By viewing the Contrast Indicator readings during installation, the position that generates the largest amount of contrast deviation can be determined. Maximizing contrast deviation in any sensing application results in the guarantee of maximum performance and reliability.

## Contrast Indicator™ Verifies Performance

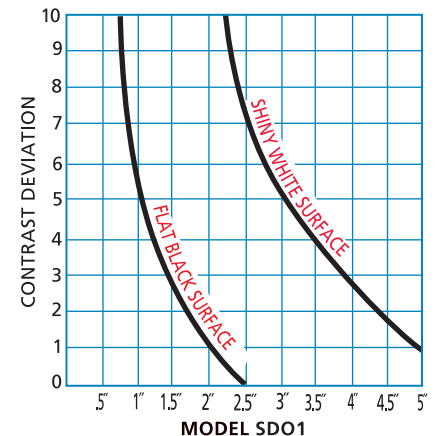
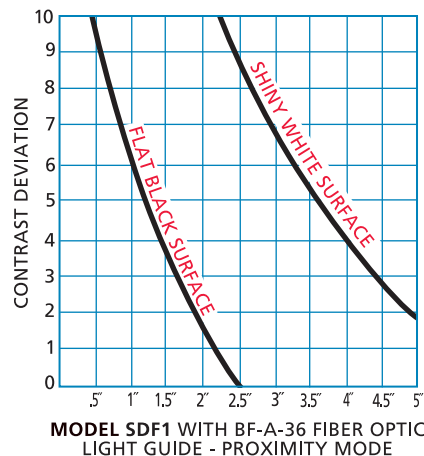
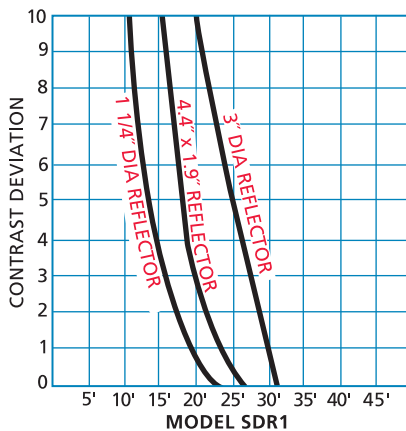
Performance of any SMARTEYE® can be diagnosed at the sensing site by observing contrast deviation as displayed on the Contrast Indicator. To ascertain deviation, simply subtract the lowest (Dark State) reading from the highest (Light State) reading and compare the resulting number to the contrast rating system below.

### CONTRAST RATINGS

CONTRAST DEVIATION			RATING	PERFORMANCE COMMENTS
5 Bar	8 Bar	10 Bar		
1	1 – 2	1 – 2	Poor	Insufficient contrast to adequately perform sensing task.
2	3	3 – 4	Fair	Adequate contrast when conditions can be repeated and when periodic adjustments are acceptable.
3	4	5 – 6	Good	Generally enough contrast to adequately perform most sensing tasks.
4	5 – 6	7 – 8	Very Good	Sufficient contrast to easily perform most sensing tasks.
5	7 – 8	9 – 10	Excellent	More than acceptable contrast which provides a very large operating margin.

## Contrast Performance Charts Verify Sensing Range

These charts are extremely helpful in determining if the SMARTEYE® you selected will adequately perform the sensing task at the desired range. Simply reference the amount of contrast deviation required to perform the sensing task in your environment and compare to the performance chart of the SMARTEYE® you have selected to determine if the sensing range is adequate. Shown below are typical performance charts on (3) Model SD SMARTEYE® Sensors.



# Optical Block Selection

Interchangeable optical blocks provide universal application to sensors in any sensing application. Select the sensor first, then choose the optical block that matches the spot size and target.

CLASSIC SMARTEYE®  
SMARTEYE® MARK II  
COLORMARK™ II  
SMARTEYE® DCS™

SMARTEYE® PRO™  
SMARTEYE® EZ-PRO™  
OPTI•EYE™  
MITY•EYE™  
TINY•EYE™  
EZ-EYE™  
MARKEYE®-PRO

## Proximity Mode Sensing

Wide beam optics useful for short-range sensing of transparent, translucent, or irregular shaped shiny objects.

O2

O4

Narrow beam optics useful in long-range sensing of medium to large size objects.

O1, O1G

O5

Adapts sensors to glass fiberoptic light guides.

F1

F4

Adapts sensors to plastic fiberoptic light guides.

–

F5, F6

## Retroreflective Mode Sensing

Very narrow beam optics designed to sense reflectors or reflective materials at long range. Designed for Beam Break sensing.

R1

R4

Polarized to reduce response to "hot spot" glare from shiny surface of detected object. Use with red or blue light source.

–

R5

Adapts sensors to glass fiberoptic light guides.

F1

F4

Adapts sensors to plastic fiberoptic light guides.

–

F5, F6

## Convergent Mode Sensing

Narrow beam optics that focus at a sensing range of 1". Useful for sensing small parts or registration marks. Also useful for proximity sensing (range of 1" to 5") to minimize response to reflected light from background objects.

V1, V1G

V4, V4A

Narrow beam optics that focus at a sensing range of 1.5". Useful for sensing small parts. Also useful for proximity sensing (range of 1.5" to 8") to minimize response to reflected light from background objects.

–

V6

Narrow beam optics that focus at a sensing range of .5". Useful for sensing small parts or registration marks. Also useful for proximity sensing (range of .25" to 5") to minimize response to reflected light from background objects.

–

V8



# Fiberoptic Light Guides

When you shine a flashlight into one end of either a flexible plastic or glass fiberoptic light guide, you will see light shining out the other end. The ability to guide light from the sensor to the target provides many advantages in photoelectric sensing.

Fiberoptic Light Guides are flexible and small enough to fit into difficult sensing areas. This allows the sensor to be located in a more convenient location—out of harm's way. Fibers are resistant to high temperatures, vibration, condensation, and corrosion.

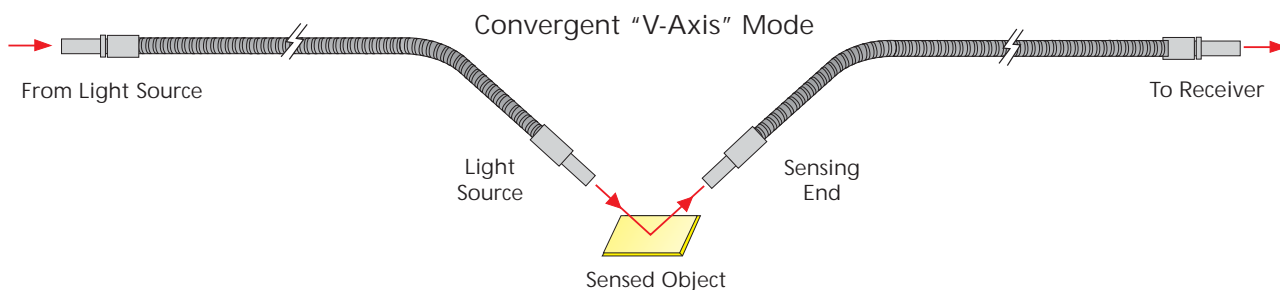
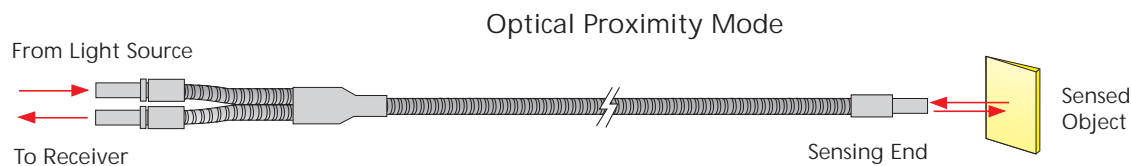
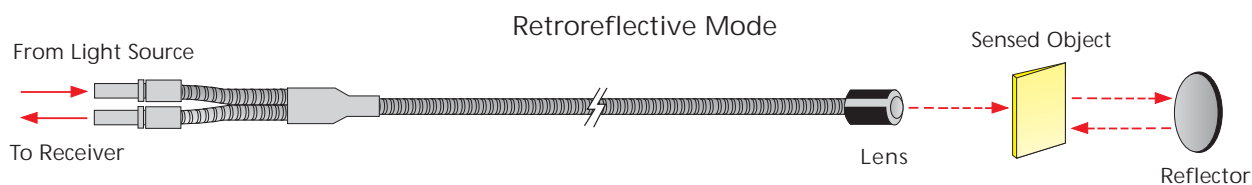
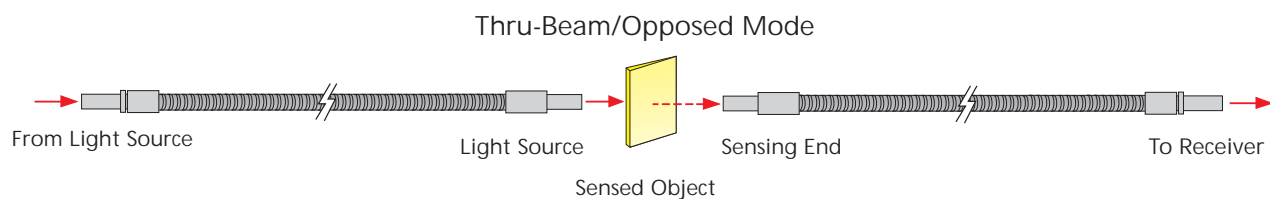
One of the main advantages of glass fiberoptic light guides is that they can be sized and shaped to provide an

optical advantage. When fiberoptic light guides are utilized, they become the optics of the sensing system.

At the sensing site, the size and shape of the fiber optic bundle carrying the light controls the size and shape of the transmitted light beam. The size and shape of the fiberoptic tip controls the effective viewing area of the sensing system.

Lenses are available to gain optical advantage to the sensing tasks.

Our Miniature Glass Fiber Optic Light Guides combine superior high-color resolution of glass fibers with the size and flexibility of plastic fibers. The tighter bend radius allows you to reach more areas with ease.



# Response Time/Operating Speed

Another very important factor in the selection of a photoelectric sensor is the sensor's ability to resolve input events occurring at rapid rates. Unfortunately, response time specifications provided by some photoelectric sensor manufacturers are sometimes vague or, at best, difficult to interpret. It should be noted that there is a difference between response time and operating speed.

Response Time is the length of time it takes for the output of the sensor to switch when a change from the lightest state to the darkest state (or vice versa) occurs. This can be important when attempting to locate the exact position of an object moving at a high velocity.

Operating Speed is the maximum output switching rate the sensor can achieve. This rating is usually expressed by the maximum rate of input events that can be resolved under set conditions.

These conditions generally involve input events that

are equally spaced apart, i.e., the length of time the sensor will be in the Dark State condition is equal to the length of time in the Light State condition. This is referred to as a 50-50 duty cycle. If the duty cycle of the input event is other than 50-50, attention should focus on the minimum duration of time the input event will spend in either the Light State or the Dark State condition.

The shortest duration of time spent in either state should then be compared with the minimum Light State/Dark State response times as stipulated in the sensor's specifications.

A word to the wise: Beware, you cannot expect the sensor to achieve the specified minimum response time or maximum operating speeds under all sensing conditions without making some adjustments to either the gain or offset settings.

## Speed Conversion Table

Ft/Min	In/Min	In/Sec	Sec/In	Ft/Min	In/Min	In/Sec	Sec/In
1	12	.2	5.000	60	720	12	.0833
2	24	.4	2.500	70	840	14	.0714
3	36	.6	1.667	80	960	16	.0625
4	48	.8	1.250	90	1,080	18	.0556
5	60	1.0	1.000	100	1,200	20	.0500
6	72	1.2	.833	125	1,500	25	.0400
7	84	1.4	.714	150	1,800	30	.0333
8	96	1.6	.625	175	2,100	35	.0286
9	108	1.8	.556	200	2,400	40	.0250
10	120	2.0	.500	225	2,700	45	.0222
11	132	2.2	.455	250	3,000	50	.0200
12	144	2.4	.417	275	3,300	55	.0182
13	156	2.6	.385	300	3,600	60	.0167
14	168	2.8	.357	350	4,200	70	.0143
15	180	3.0	.333	400	4,800	80	.0125
16	192	3.2	.313	450	5,400	90	.0111
17	204	3.4	.294	500	6,000	100	.0100
18	216	3.6	.278	600	7,200	120	.0083
19	228	3.8	.263	700	8,400	140	.0071
20	240	4.0	.250	800	9,600	160	.0063
25	300	5.0	.200	900	10,800	180	.0056
30	360	6.0	.167	1,000	12,000	200	.0050
35	420	7.0	.143	1,500	18,000	300	.0033
40	480	8.0	.125	2,000	24,000	400	.0025
45	540	9.0	.111	3,000	36,000	600	.0017
50	600	10.0	.100	5,000	60,000	1,000	.0010

Example: Determine the time a .25-inch registration mark remains totally in view of a sensor when traveling at 300 feet/min. and the sensor's effective beam width is .062 inch.

Answer: .25-inch mark width – .062-inch beam width = .188-inch travel distance. Using the table, a 1-inch travel distance at 300 feet/min. = .0167 sec/in. .188 inch x .0167 sec/in. = 3 milliseconds.



**Local or Remote One-Touch AUTOSET™  
Automatic Adjusting Options**





The **SMARTEYE® EZ-PRO™** is a high performance, automatic photoelectric sensor that can be adjusted by a *single push of a button*. As a result, there is no guess work on the part of the operator. Now you can throw away the screwdriver and the manual!

### The EZ-PRO™ AUTOSET™ Adjustment Procedure is as simple as it gets.

1. Establish one of the following conditions:
  - **Proximity** — Reflect light off object.
  - **Beam Break** — Remove object from light beam path.
2. Depress either yellow or blue button for three seconds.

That's all there is to it! From that point on, the sensor will automatically maintain a perfect setting, thanks to the dynamic Automatic Contrast Tracking System (ACT™). The **EZ-PRO™** AUTOSET™ routine can also be implemented from a momentary remote switch. (i.e. push-button or touch screen). The **EZ-PRO™** is equipped with a Contrast Indicator™ as well as an Action Alert diagnostic indicator that allows the operator to visually substantiate performance. When the lock feature is enabled (see advanced features), the **EZ-PRO™** sensor is tamperproof. Now, the sensor will provide you with the automatic, hassle-free performance that you expect from a **SMARTEYE®**.



# Features

## ACT™ AUTOMATIC CONTRAST TRACKING

ACT™ automatically adjusts the sensor as conditions change. This can include dirty or damaged lenses, reflectors, fiberoptics or LED light source, as well as thermal drift, and target variations such as position, orientation, or color. It can also compensate for signal shift or deterioration caused by high-speed input events. The **EZ-PRO™** continues to operate requiring far less maintenance than other sensors, making it **the choice** in tough sensing applications.

## AGS™ AUTOMATIC GAIN SELECT

This unique feature provides automatic digital selection of the amplifier gain based upon your application requirements.

## AUTOSET™ ADJUSTMENT

The AUTOSET™ adjustment routine only requires one finger to push one button one time! Even in a dynamic operating condition, with ongoing input events, all you have to do is push a button for a perfect setting.

## EDR®

Another unique feature, the EDR (Enhanced Dynamic Range) circuit is digitally controlled. It prevents dark state saturation and expands the operating range without reducing amplifier gain.

## ACTION ALERT™ INDICATOR LED

This indicator provides an early warning to prevent marginal performance when the sensor can no longer provide full contrast deviation as displayed on the Contrast Indicator.

## REMOTE AUTOSET™

Remotely adjust the sensor from a push button momentary switch or a touch screen to PLC instantaneously. The AUTOSET™ routine can occur during static or dynamic operating conditions.

## 5-LED DUAL FUNCTION INDICATOR AND CONTRAST INDICATOR™

Provides “at-a-glance” performance data during both setup and operation.

## STATUS INDICATOR

Displays status of 3 selectable functions: Lock, Auto Track, and Timer; 10ms, 25ms, and 50ms.

## VERSATILITY

Choice of ten “quick change” optical blocks allows one sensor to be used in the proximity, convergent, retroreflective, polarized retroreflective, fiberoptic applications.

## LED LIGHT SOURCES

Choice of four LED light sources —infrared, red, blue, and white light.

## CONNECTIONS

Built-in connector for use with quick disconnect cable or shielded 6' (1.80 m) cable.

## MOUNTING OPTIONS

Built-in DIN Rail “snap-on” design, thru-hole, or bracket mount.

## DUAL-FUNCTION BAR GRAPH

Primary Function: *Contrast Indicator*  
Secondary Function: *Status Indicator of Five Selectable Options*

## FIVE SELECTABLE OPTIONS

- #5 LOCK – for tamperproof operation.
- #4 AUTO TRAC™ – Automatic Contrast Tracking for perfect setting.
- #3 10 millisecond pulse stretcher/off delay.
- #2 25 millisecond pulse stretcher/off delay.
- #1 50 millisecond pulse stretcher/off delay.

## OPTION STATUS / MODE SELECT

Push both buttons for 3 seconds to switch bar graph display to status indicator of selectable options

## OPTION STATUS MODE INDICATOR

## OUTPUT STATUS INDICATOR

When illuminated, Option Status Indicator is enabled

## MARGINAL PERFORMANCE INDICATOR

## INTERCHANGEABLE OPTICAL BLOCKS

Choice of 10 Optical Blocks - O4, O5, R4, R5, F4, F5, V4, V4A, V6, V8

## OPTIONAL TIMER

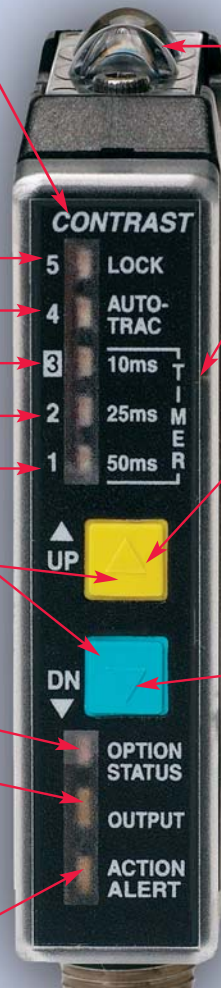
10, 25, or 50 millisecond pulse stretcher / “OFF” delay

## YELLOW PUSH BUTTON - 3 Functions

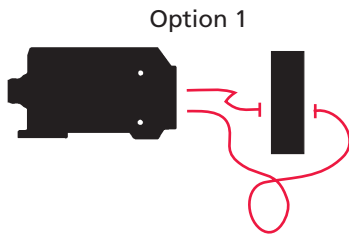
1. Manual “UP” adjustment
2. Light state AUTOSET™ with light “ON” output
3. Toggle selected option to opposite state and return to normal operation

## BLUE PUSH BUTTON - 3 Functions

1. Manual “DOWN” adjustment
2. Light state AUTOSET™ with dark “ON” output
3. Step to desired function to be altered when in option status mode



## Preferred Mode: Beam Break



Fiberoptic opposed mode is best choice for detecting any opaque object.

**Sensor:** Model EZPI/EZPIC with F4 Optical Block (IR lightsource)

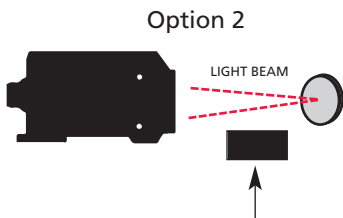
**Cable:** Shielded cable w/connector Model GSEC-6 (6 ft.) or GSEC-15 (15 ft.)

**Fiberoptic Light Guides:** Model F-A-36T (2 Required)

**NOTE:** Select smaller fiber bundle for small part detection. (See Fiberoptic Section)

**Sensing Range:** Up to 16 in.

**Accessories:** Two Model UAC-15 lenses, extends sensing range to over 20 ft.  
Mounting bracket, Model SEB-3, FMB-1



Retroreflective mode. Use with reflector to detect medium to large size opaque objects.

**NOTE:** Not recommended for detecting highly reflective objects.

**Sensor:** Model EZPI/EZPIC with R4 Optical Block (IR light source)

**Cable:** Shielded cable w/connector Model GSEC-6 (6 ft) or GSEC-15 (15 ft.)

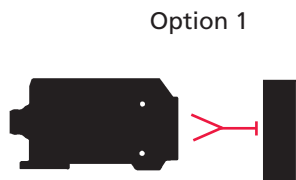
**Reflector:** Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted. (See Accessories Section for complete listing of reflectors.)

**Sensing Range:** Up to 20 ft.

**Accessories:** Mounting bracket, Model SEB-3

## Alternate Mode: Beam Make (Proximity)

**NOTE:** Consider proximity mode when installation sensing site conditions preclude using the preferred Beam Break mode.



Fiberoptic proximity is used to detect medium to large flat-sided opaque objects.

**Sensor:** Model EZPI/EZPIC with F4 Optical Block (IR light source)

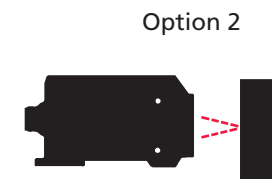
**Cable:** Shielded cable w/connector Model GSEC-6 (6ft.) or GSEC-15 (15ft.)

**Fiberoptic Light Guides:** Model BF-A-36T

**NOTE:** Select smaller fiber bundle for small part detection. (See Fiberoptic Section)

**Sensing Range:** Up to 6 in.

**Accessories:** Model UAC-15 lens. Use to extend sensing range up to 1 ft. Mounting bracket, Model SEB-3, FMB-1



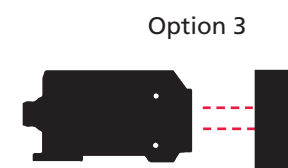
Convergent/proximity mode is useful to detect opaque objects when there is little (if any) gap between objects.

**Sensor:** Model EZPI/EZPIC with V6 Optical Block (IR light source)

**Cable:** Shielded cable w/connector Model GSEC-6 (6 ft.) or GSEC-15 (15 ft.)

**Sensing Range:** From 1.5 to 8 in.

**Accessories:** Mounting bracket, Model SEB-3



Proximity (divergent beam) mode sensing is useful in detecting large size opaque objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.

**Sensor:** Model EZPI/EZPIC with O5 Optical Block (IR light source)

**Cable:** Shielded cable w/connector Model GSEC-6 (6 ft.) or GSEC-15 (15 ft.)

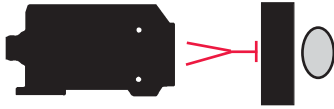
**Sensing Range:** From 1 to 5 ft.

**Accessories:** Mounting bracket, Model SEB-3



## Preferred Mode: Retroreflective Beam Break

Option 1



Fiberoptic retroreflective is the best choice for detecting empty transparent or translucent objects. The **SMARTEYE® EZ-PRO** featuring a unique blue LED light source is recommended for detecting transparent or translucent plastic or glass objects. A red light source is recommended when detecting translucent (non-transparent) objects only.

**Sensor:** Model EZPB/EZPBC with F4 Block (Blue light source) or Model EZPR/EZPRC with F4 Block (Red light source)

**Cable:** Shielded cable w/connector Model GSEC-6 (6ft.) or GSEC-15 (15ft.)

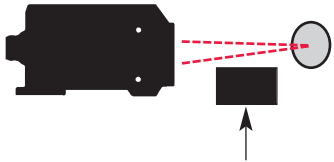
**Fiberoptic Light Guides:** Model BF-A-36T

**Reflector:** Model 78P, plastic 4.4 in. X 1.9 in, screw mounted

**Sensing Range:** Up to 1 ft.

**Accessories:** Model UAC-15 lens. Use to extend sensing range from 1 ft. maximum without lens to over 3 ft. with lens. Mounting bracket, Model SEB-3, FMB-1

Option 2



Retroreflective (R4 optical block) is a good choice for detecting medium to large size empty transparent or translucent objects. The **SMARTEYE® EZ-PRO** featuring a unique blue LED light source is recommended for detecting transparent or translucent plastic or glass objects. A red light source is recommended when detecting translucent (non-transparent) objects only.

**Sensor:** Model EZPB/EZPBC with R4 Block (Blue light source) or Model EZPR/EZPRC with R4 Block (Red light source)

**Cable:** Shielded cable w/connector Model GSEC-6 (6ft.) or GSEC-15 (15ft.)

**Reflector:** Model 78P, plastic 4.4 in. X 1.9 in., screw mounted.

**Sensing Range:** Up to 5 ft.

**Accessories:** Mounting bracket, Model SEB-3

## Alternate Mode: Beam Make (Proximity)

**NOTE:** Consider proximity mode when translucent/transparent objects are containers filled with clear liquid or when site conditions preclude using the preferred retroreflective Beam Break mode.

Option 1



Fiberoptic proximity mode is useful to detect transparent/translucent objects.

**Sensor:** Model EZPR/EZPRC with F4 Block (Red light source)

**Cable:** Shielded cable w/connector Model GSEC-6 (6 ft.) or GSEC-15 (15 ft.)

**Fiberoptic Light Guides:** Model BF-A-36T

**NOTE:** Select smaller fiber bundle for small part detection. (See Fiberoptic Section)

**Sensing Range:** Up to 4 in.

**Accessories:** Model UAC-15 lens. Use to extend sensing range up to 1 ft. Mounting bracket, Model SEB-3, FMB-1

Option 2



Convergent/proximity mode is useful to detect most transparent/translucent objects when there is little (if any) gap between objects.

**Sensor:** Model EZPR/EZPRC with V6 Block (Red light source)

**Cable:** Shielded cable w/connector Model GSEC-6 (6 ft.) or GSEC-15 (15 ft.)

**Sensing Range:** From 1 to 4 in

**Accessories:** Mounting bracket, Model SEB-3

Option 3



Proximity (divergent beam) mode sensing is useful in detecting some large size translucent/transparent objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.

**Sensor:** Model EZPR/EZPRC with O5 Block (Red light source)

**Cable:** Shielded cable w/connector Model GSEC-6 (6 ft.) or GSEC-15 (15 ft.)

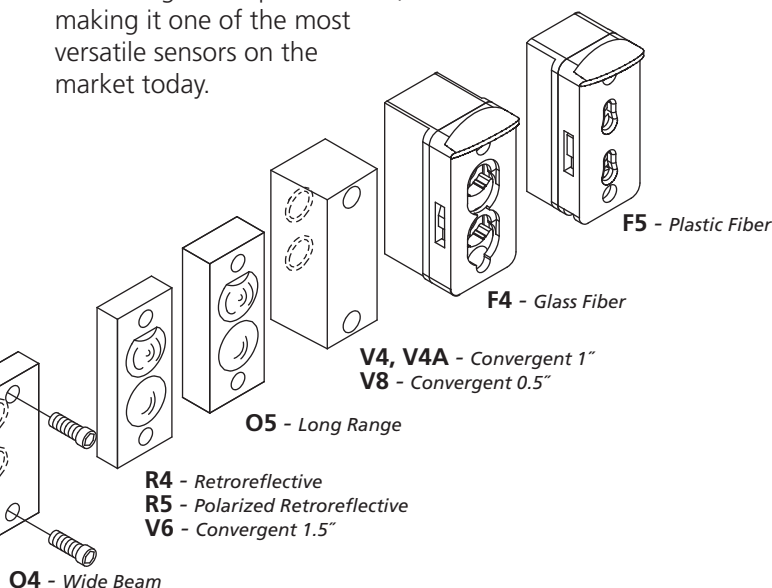
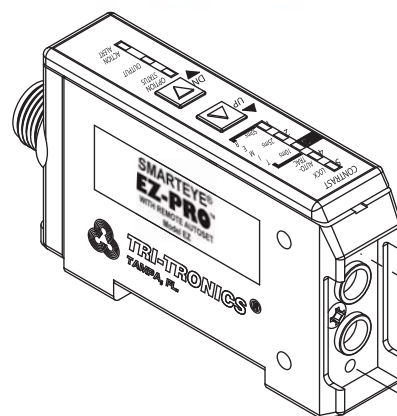
**Sensing Range:** From 1 to 4 ft.

**Accessories:** Mounting bracket, Model SEB-3

# Optical Block Selection



The **SMARTEYE® EZ-PRO™** gives you a choice of 10 interchangeable optical blocks, making it one of the most versatile sensors on the market today.



**O4 and O5**  
Proximity Sensing

**V4, V4A, V6, and V8**  
Convergent Sensing

**R4 and R5**  
Retroreflective Sensing

**F4**  
Glass Fiberoptic Sensing

**F5**  
Plastic Fiberoptic Sensing

## How To Specify:

1. Select Sensor light source required:  
I = Infrared  
R = Red  
B = Blue  
WL = White
2. Select Connector required:  
Blank = Cable  
C = Connector
3. Select Optical Block based on mode of operation required.

Example: **EZPRC F4**

EZ-PRO   Red   Connector Model   Fiberoptic optical block

## Sensing Range Guidelines

Convergent / Proximity / Retroreflective					Glass Fiberoptics					Plastic Fiberoptics		
OPTICAL BLOCKS	IR	RED	BLUE	WHITE	OPTICAL BLOCKS	IR	RED	BLUE	WHITE	OPTICAL BLOCKS	RED	WHITE
V4, V4A	1 in.	1 in.	1 in.	1 in.	Opposed Mode					Opposed Mode		
V6	1.5 in.	1.5 in.	1.5 in.	1.5 in.	F4	3 ft.	1 ft.	8 in.	5 in.	F5	9 in.	2 in.
V8	0.5 in.	0.5 in.	0.5 in.	0.5 in.	F4 w/lens	20+ ft.	20+ ft.	12 ft.	9 ft.	F5 w/lens	6 ft.	2 ft.
O4	18 in.	11 in.	4 in.	3 in.	Proximity Mode					F5 w/right angle lens	3 ft.	1 ft.
O5	4 ft.	3 ft.	1.5 ft.	12 in.	Proximity Mode					Proximity Mode		
R4	20+ ft.	18+ ft.	6 ft.	5 ft.	F4	7 in.	5 in.	1 in.	1 in.	F5	7 in.	5 in.
R5	N/A	7 ft.	4 ft.	3 ft.	F4 w/lens	1 ft.	1 ft.	N/A	6 in.	F5 w/lens	1 ft.	1 ft.

NOTE: Proximity test utilized a 90% reflective white target. Retroreflective tests utilized a 3" diam. round reflector, Model AR-3

NOTE: Range tests utilized a .125" diam. fiber bundle

NOTE: Range tests utilized a .040" diam. fiber

# Light Source Guidelines

<p><b>INVISIBLE INFRARED LIGHT SOURCE (880 nm)</b></p> <ul style="list-style-type: none"> <li>A. Best choice in most opaque object sensing tasks</li> <li>B. Provides longest possible sensing range in either Beam Make or Beam Break sensing modes</li> <li>C. Best choice in hostile environments; useful in penetrating lens contamination</li> <li>D. Preferred for use with small glass fiberoptic light guides Note: Do not use IR light with plastic fiberoptic light guides</li> <li>E. Preferred when sensing dark colored objects in the proximity (Beam Make) mode, i.e., black, blue, green, etc.</li> <li>F. Useful in penetrating containers for verification of contents; also useful in detecting overlapped splices in dense materials</li> <li>G. Color perception; tends to favor blue colored objects</li> </ul>	<p><b>RED LIGHT SOURCE (660 nm)</b></p> <ul style="list-style-type: none"> <li>A. Best choice for use with plastic fiberoptic light guides</li> <li>B. Useful when sensing translucent objects in proximity (Beam Make) mode</li> <li>C. Useful when sensing transparent objects in fiberoptic retroreflective (Beam Break) mode</li> <li>D. Can be polarized for retroreflective (Beam Break) sensing to reduce proxing on shiny objects</li> <li>E. Opposed fiberoptic light guides can be polarized for sensing some translucent plastic containers; consult factory for details</li> <li>F. Used as red filter for color perception advantages</li> </ul>
<p><b>BLUE LIGHT SOURCE (480 nm)</b></p> <ul style="list-style-type: none"> <li>A. Useful for detecting translucent, transparent, plastic, or glass objects in the retroreflective mode when using the R4 optical block</li> <li>B. Used as blue filter for color perception advantages, i.e. resolving yellow vs. white colored objects or printed registration marks</li> </ul>	<p><b>WHITE LIGHT SOURCE</b> (Broadband Color Spectrum)</p> <ul style="list-style-type: none"> <li>A. Best choice for detecting all printed registration marks on packaging material</li> <li>B. Recommended for detecting dark colored objects in the proximity (Beam Make) mode</li> <li>C. Best choice for sorting colored objects</li> </ul>

## Accessories

### Micro Cable Selection Guide, 5-wire M12



**GSEC-6**  
6' (1.8 m) Shielded cable



**GSEC-15**  
15' (4.6 m) Shielded cable



**GSEC-25**  
25' (7.62 m) Shielded cable

**GSEC-2MU**  
6.5' (2.0 m) Low-cost, unshielded

**GSEC-5MU**  
16.4' (5.0 m) Low-cost, unshielded

**GRSEC-6**  
6' (1.8 m) Right angle shielded cable

**GRSEC-15**  
15' (4.6 m) Right angle shielded cable

**GRSEC-25**  
25' (7.62 m) Right angle shielded cable



**FMB-1** (8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket



**SEB-3**  
Stainless "L" Bracket



**FMB-2** (5.1 mm diam.)  
**FMB-3** (3.1 mm diam.)  
Miniature Glass or Plastic  
Fiberoptic Mounting  
Brackets



**LK-4**  
Lens Kit  
(See Optical Blocks  
Accessories for contents)

# Specifications

## SUPPLY VOLTAGE

- 10 to 30 VDC
- Polarity Protected

## CURRENT REQUIREMENTS

- 45 mA (exclusive of load)

## OUTPUT TRANSISTORS

- (1) NPN and (1) PNP sensor output transistor
- Sensor outputs can sink or source up to 150 mA (current limited)
- All outputs are continuously short circuit protected

## REMOTE AUTOSET™ INPUT

- Opto isolated sinking input (10 mA)

## RESPONSE TIME

- Light/Dark state response = 300 microseconds

## LED LIGHT SOURCE

- Infrared = 880 nm, Red = 660 nm, Blue = 480 nm, White = Broadband Color Spectrum
- Pulse modulated

## PUSH BUTTON CONTROL

- Yellow/Blue – AUTOSET™
- Manual Adjustments
- Set status of 3 options: 5) Lock, 4) Auto-Trac, 3) Timers: 10 ms, 25 ms, 50 ms

## HYSTERESIS

- "Factory-set" for high resolution – less than one bar on the Contrast Indicator

## LIGHT IMMUNITY

- Responds to sensor's pulsed modulated light source, resulting in high immunity to most ambient light, including indirect sunlight or strobes

## DIAGNOSTIC INDICATORS

- 5-LED bar graph functions in one of two modes:
  1. Contrast Indicator – displays scaled reading of sensor's response to contrasting light levels (light to dark)
  2. Status Indicator – Displays status of 5 selectable options
- Red LED output indicator = Illuminates when the sensor's output transistors are "on." NOTE: If Output LED flashes, a short circuit condition exists
- Amber LED = Illuminates when in the options select mode
- Yellow LED = Illuminates when action alert is activated. Also indicates when ACT™ adjusts sensor



## AMBIENT TEMPERATURE

- - 40°C to 70°C (- 40°F to 158°F)

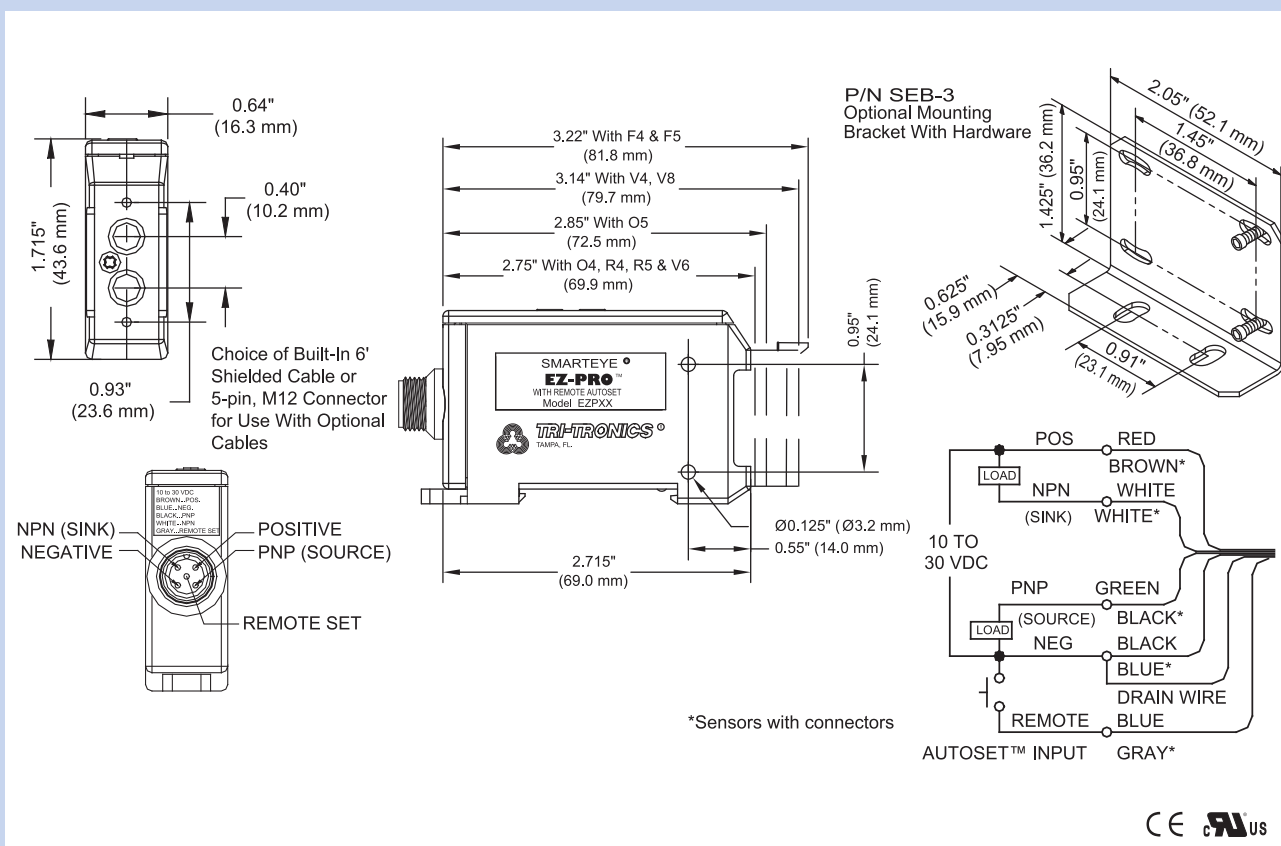
## RUGGED CONSTRUCTION

- Chemical resistant, high impact polycarbonate housing
- Waterproof ratings: NEMA 4X, 6P and IP67
- Conforms to heavy industry grade CE requirements

Product subject to change without notice. Consult Factory for RoHS Compliance.

## Connections and Dimensions

## SMARTEYE® EZ-PRO® PHOTOELECTRIC SENSOR





One-Touch Setup  
Automatic, Self-Adjusting  
Light State or Dark State Setup



*Action Alert*



*Remote AUTOSET™*

# Automatic, Self-Adjusting *From Clean to Dirty...It Keeps On Working!*

**SMARTEYE® PRO**

**SMARTEYE® PRO  
REMOTE**



## From Clean To Dirty Lens

The SMARTEYE® PRO is not a teach mode sensor; it is an automatic sensor. It is a high performance photoelectric sensor that, after the initial set-up, can be adjusted by a single push of a button, (either on the sensor or at a remote location). As a result, there is no guesswork on the part of the operator. Now you can throw away the screwdriver!

After selecting the features of your application requirements, the SMARTEYE® PRO sensor is ready to be adjusted. Simply put the target in front of the sensor (proximity mode) and push the AUTOSET™ button. From that point on,

the sensor will automatically maintain a perfect setting, thanks to the dynamic ACT™ (Automatic Contrast Tracking) system. The SPB Series Sensors are also equipped with a 5-LED Contrast Indicator™ as well as an Action Alert™ diagnostic tool that allows the operator to visually substantiate performance. The RSP Series Sensors feature a remote auto-set input. When the lock feature is enabled, the SMARTEYE® PRO sensor is tamperproof. Now the sensor will provide you with the hassle-free performance that you expect from a SMARTEYE®.

## Space-saving Multiple Sensor Mounting Design



### Five Selectable Options:

- 5 LOCK  
– for tamperproof operation
- 4 AUTOSET™  
– set up in Light or Dark state
- 3 OUTPUT STATE  
– indicates Light or Dark State output
- 2 ACT™  
– automatic Contrast Tracking for perfect setting
- 1 TIMER  
– 10 ms pulse stretcher timer function



# Features

## ACT™ AUTOMATIC CONTRAST TRACKING

ACT™ automatically adjusts the sensor as conditions change. This can include dirty or damaged lenses or reflectors, damaged fiberoptics, LED light source or thermal drift, and target variations such as position, orientation, or color. It can also compensate for signal shift or deterioration caused by high-speed input events. The SMARTEYE®-PRO continues to operate requiring far less maintenance than other sensors, making it the choice in tough sensing applications.

## AGS™ AUTOMATIC GAIN SELECT

This unique feature provides automatic digital selection of the amplifier gain based upon your application requirements.

## QUICKSET™ ADJUSTMENT

This two-step procedure is easy to perform and requires no expertise whatsoever.

1. Establish one of the following conditions: Proximity Mode – Reflect light off object. Beam Break – Remove object from light beam path.
2. Depress the red and green button simultaneously for three seconds.

## AUTOSET™ ADJUSTMENT

The AUTOSET™ adjustment routine only requires one finger to push one button one time! Even in a dynamic operating condition, with ongoing input events, all you have to do is push a button for a perfect setting.

## EDR (Pat. No. 5,621,205)

Another unique feature, the EDR (Enhanced Dynamic Range) circuit is digitally controlled. It prevents dark state saturation and expands the operating range without reducing amplifier gain.

## ACTION ALERT™ INDICATOR LED

This indicator provides an early warning to prevent marginal performance, when the sensor can no longer provide full contrast deviation as displayed on the Contrast Indicator.

## REMOTE AUTOSET™ (RSP Series)

Remotely adjust the sensor from a push button, momentary switch or a touch screen to PLC instantaneously. The AUTOSET™ routine can occur during static or dynamic operating conditions.

## 5-LED DUAL FUNCTION INDICATOR CONTRAST INDICATOR™

Provides “at-a-glance” performance data during both setup and operation.

## STATUS INDICATOR

Displays status of 5 selectable functions: Lock, AUTOSET™, and Light/Dark, AUTO-TRACK and Timer.

## VERSATILITY

Choice of nine “quick change” optical blocks allows use in the proximity, convergent, retroreflective, polarized retroreflective, fiberoptic, or gap sensing modes.

## LED LIGHT SOURCES

Choice of four LED light sources – invisible infrared, red, blue, and white light.

## CONNECTIONS

Built-in connector for use with quick disconnect cable or shielded 6' (1.80 m) cable.

## TIMER

10 ms pulse stretcher/off delay.

### DUAL-FUNCTION BAR GRAPH

Primary Function: *Contrast Indicator*  
Secondary Function: *Status Indicator of Five Selectable Options*

### QUICKSET

1. Establish one of the following conditions  
Proximity - Reflect light off an object  
Beam Break - Remove object from light beam path
2. AUTOSET™ to preset level with LOCK FUNCTION OFF (Hold for three seconds)
3. Depress both green and red buttons simultaneously for three seconds.

### OPTION STATUS / MODE SELECT

### OUTPUT STATUS INDICATOR

When illuminated, Option Status Indicator is enabled

### MARGINAL PERFORMANCE INDICATOR

### INTERCHANGEABLE OPTICAL BLOCKS

Choice of 10 Optical Blocks - O4, O5, R4, R5, F4, F6, V4, V4A, V6, V8

### OPTIONAL 10 ms TIMER

### THREE FUNCTION SWITCH

1. “UP” adjust in Normal Operating Mode with LOCK FUNCTION OFF
2. AUTOSET™ to preset level with LOCK FUNCTION OFF (hold for three seconds)
3. Toggle selected option to OPPOSITE STATE and return to normal operation

### THREE FUNCTION SWITCH

1. “DOWN” adjust in normal operating mode with LOCK FUNCTION OFF
  2. OPTION STATUS MODE (Hold for three seconds)
  3. Step to desired function to be altered
- NOTE: If required, use Green (UP) and Red (DOWN) buttons to tweak adjustment

NOTE: Model SPB includes visual LED and PNP output. Model RSP includes visual LED only.



# Light Source Guidelines



<p><b>INVISIBLE INFRARED LIGHT SOURCE (880 nm)</b></p> <ul style="list-style-type: none"> <li>A. Best choice in most opaque object sensing tasks</li> <li>B. Provides longest possible sensing range in either Beam Make or Beam Break sensing modes</li> <li>C. Best choice in hostile environments; useful in penetrating lens contamination</li> <li>D. Preferred for use with small glass fiberoptic light guides Note: Do not use IR light with plastic fiberoptic light guides</li> <li>E. Preferred when sensing dark colored objects in the proximity (Beam Make) mode, i.e., black, blue, green, etc.</li> <li>F. Useful in penetrating containers for verification of contents; also useful in detecting overlapped splices in dense materials</li> <li>G. Color perception; tends to favor blue colored objects</li> </ul>	<p><b>RED LIGHT SOURCE (660 nm)</b></p> <ul style="list-style-type: none"> <li>A. Best choice for use with plastic fiberoptic light guides</li> <li>B. Useful when sensing translucent objects in proximity (Beam Make) mode</li> <li>C. Useful when sensing transparent objects in fiberoptic retroreflective (Beam Break) mode</li> <li>D. Can be polarized for retroreflective (Beam Break) sensing to reduce proxing on shiny objects</li> <li>E. Opposed fiberoptic light guides can be polarized for sensing some translucent plastic containers (consult factory for details)</li> <li>F. Used as red filter for color perception advantages</li> </ul>
<p><b>BLUE LIGHT SOURCE (480 nm)</b></p> <ul style="list-style-type: none"> <li>A. Useful for detecting translucent, transparent, plastic, or glass objects in the retroreflective mode when using the R4 optical block</li> <li>B. Used as blue filter for color perception advantages, i.e., resolving yellow vs. white colored objects or printed registration marks</li> </ul>	<p><b>WHITE LIGHT SOURCE</b> (Broadband Color Spectrum)</p> <ul style="list-style-type: none"> <li>A. Best choice for detecting all printed registration marks on packaging material</li> <li>B. Recommended for detecting dark colored objects in the proximity (Beam Make) mode</li> <li>C. Best choice for sorting colored objects</li> </ul>

## Optical Block Selection

Interchangeable optical blocks provide for universal application of the SMARTEYE® PRO to any sensing application from large object sensing to finite sensing of small parts, registration mark detection, and product inspection tasks.



**Type O4**  
Proximity  
Wide beam optics useful for short-range sensing of transparent, translucent, or irregular shaped shiny objects.



**Type O5**  
Proximity  
Narrow beam optics useful in long-range sensing of medium to large size objects.



**Type R4**  
Retroreflective  
Very narrow beam optics designed to sense reflectors or reflective materials at long range. Designed for Beam Break sensing.



**Type R5**  
Polarized  
Anti-Glare Retroreflective  
Polarized to reduce response to "hot spot" glare from shiny surface of detected object. Use with red or blue light source.



**Type F4**  
Glass Fiberoptics  
Adapter for use with a wide variety of glass fiberoptic light guides for both the proximity and opposed sensing modes.



**Type V4, V4A**  
Convergent 1" "V" Axis  
Narrow beam optics that focus at a sensing range of 1". Useful for sensing small parts. Also useful for proximity sensing (range of 1" to 5") to minimize response to reflected light from background objects.



**Type V6**  
Convergent 1.5" "V" Axis  
Narrow beam optics that focus at a sensing range of 1.5". Useful for sensing small parts. Also useful for proximity sensing (range of 1.5" to 8") to minimize response to reflected light from background objects.



**Type V8**  
Convergent .5" "V" Axis  
Narrow beam optics that focus at a sensing range of .5". Useful for sensing small parts or registration color marks. Also useful for proximity sensing (range of .25" to 5") to minimize response to reflected light from background objects.



**Type F6**  
Plastic Fiberoptics  
Adapter for use with a wide variety of plastic fiberoptic light guides for both the proximity and opposed sensing modes.

# Sensing Range Guidelines

Convergent / Proximity / Retroreflective					Glass Fiber Optics					Plastic Fiber Optics		
OPTICAL BLOCKS	IR	RED	BLUE	WHITE	OPTICAL BLOCKS	IR	RED	BLUE	WHITE	OPTICAL BLOCKS	RED	WHITE
V4, V4A	1 in.	1 in.	1 in.	1 in.	Opposed Mode					Opposed Mode		
V6	1.5 in.	1.5 in.	1.5 in.	1.5 in.								
V8	0.5 in.	0.5 in.	0.5 in.	0.5 in.	F4	3 ft.	1 ft.	8 in.	5 in.	F6	9 in.	2 in.
O4	18 in.	11 in.	4 in.	3 in.	F4 w/lens	20+ ft.	20+ ft.	12 ft.	9 ft.	F6 w/lens	6 ft.	2 ft.
O5	4 ft.	3 ft.	1.5 ft.	12 in.	Proximity Mode					F6w/right angle lens	3 ft.	1 ft.
R4	20+ ft.	18+ ft.	6 ft.	5 ft.						Proximity Mode		
R5	N/A	7 ft.	4 ft.	3 ft.	F4	7 in.	5 in.	1 in.	1 in.			
					F4 w/lens	1 ft.	1 ft.	N/A	6 in.	F6 w/lens	1 ft.	1 ft.

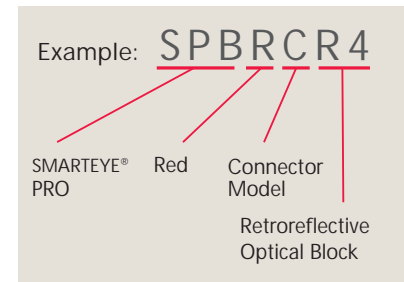
*NOTE: Proximity test utilized a 90% reflective white target. Retroreflective tests utilized a 3" diam. round reflector, Model AR-3*

*NOTE: Range tests utilized a .125" diam. fiber bundle*

*NOTE: Range tests utilized a .040" diam. fiber*

## How to Specify

1. Select Sensor Type (SPB or RSP)  
SPB – Includes Action Alert RSP – Includes Remote AUTOSET™
2. Select Sensor Light Source required: I = Infrared; R = Red; B = Blue; WL = White.
3. Select Connection required: Blank = Cable; C = Connector (RSP available with connector only)
4. Select Optical Block.



## Accessories

### Micro Cable Selection Guide, 5-wire M12



GSEC-6  
6' (1.8 m) Shielded cable



GSEC-15  
15' (4.6 m) Shielded cable



GSEC-25  
25' (7.62 m) Shielded cable



GSEC-2MU  
6.5' (2.0 m) Low-cost, unshielded

GSEC-5MU  
16.4' (5.0 m) Low-cost, unshielded

GRSEC-6  
6' (1.8 m) Right angle shielded cable

GRSEC-15  
15' (4.6 m) Right angle shielded cable

GRSEC-25  
25' (7.62 m) Right angle shielded cable

GX-25  
25' (7.62 m) extension cable



FMB-1 (8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket



SEB-3  
Stainless "L" Bracket



FMB-2 (5.1 mm diam.)  
FMB-3 (3.1 mm diam.)  
Miniature Glass or Plastic  
Fiberoptic Mounting  
Brackets



LK-4  
Lens Kit  
(See Optical Blocks Acces-  
sories for contents)

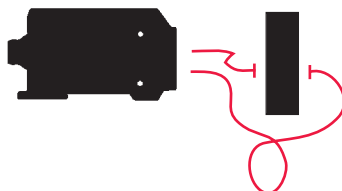
# Selection Guidelines *Opaque Object Sensing*



## Preferred Mode: Beam Break



Option 1



Fiber optic opposed mode is best choice for detecting any opaque object.

Sensor: Model SPBI/SPBIC/RSPIC with F4 Optical Block (IR lightsource)

Cable: Shielded cable w/connector Model GSEC-6 (6 ft.) or GSEC-15 (15 ft.)

Fiber optic Light Guides: Model F-A-36T (Two Required)

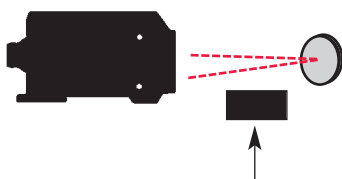
NOTE: Select smaller fiber bundle for small part detection. (See Fiber optic Section)

Sensing Range: Up to 16 in.

Accessories: Two Model UAC-15 lenses, extends sensing range to over 20 ft.

Mounting bracket: Model SEB-3, FMB-1

Option 2



Retroreflective mode. Use with reflector to detect medium to large size opaque objects

NOTE: Not recommended for detecting highly reflective objects.

Sensor: Model SPBI/SPBIC/RSPIC with R4 Optical Block (IR light source)

Cable: Shielded cable w/connector Model GSEC-6 (6 ft.) or GSEC-15 (15 ft.)

Reflector: Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted. (See Accessories Section for complete listing of reflectors)

Sensing Range: Up to 20 ft.

Accessories: Mounting bracket, Model SEB-3

## Alternate Mode: Beam Make (Proximity)

Fiber optic proximity is used to detect medium to large flat-sided opaque objects

Sensor: Model SPBI/SPBIC/RSPIC with F4 Optical Block (IR Light Source)

Cable: Shielded cable w/connector Model GSEC-6 (6ft.) or GSEC-15 (15ft.)

Fiber optic Light Guides: Model BF-A-36T

NOTE: Select smaller fiber bundle for small part detection. (See Fiber optic Section)

Sensing Range: Up to 6 in.

Accessories: Model UAC-15 lens. Use to extend sensing range up to 1 ft.

Mounting bracket: Model SEB-3, FMB-1

NOTE: Consider proximity mode when installation sensing site conditions preclude using the preferred Beam Break mode.

Option 1



Option 2



Convergent/proximity mode is useful to detect opaque objects when there is little (if any) gap between objects.

Sensor: Model SPBI/SPBIC/RSPIC with V6 Optical Block (IR light source)

Cable: Shielded cable w/connector Model GSEC-6 (6 ft.) or GSEC-15 (15 ft.)

Sensing Range: From 1.5 to 8 in.

Accessories: Mounting bracket, Model SEB-3

Option 3



Proximity (divergent beam) mode sensing is useful in detecting some large size opaque objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.

Sensor: Model SPBI/SPBIC/RSPIC with O5 Optical Block (IR light source)

Cable: Shielded cable w/connector Model GSEC-6 (6 ft.) or GSEC-15 (15 ft.)

Sensing Range: From 1 to 5 ft.

Accessories: Mounting bracket, Model SEB-3



## Preferred Mode: Retroreflective Beam Break



Option 1



Fiberoptic retroreflective is the best choice for detecting empty transparent or translucent objects. The SMARTEYE® PRO featuring a unique blue LED light source is recommended for detecting transparent or translucent plastic or glass objects. A red light source is recommended when detecting translucent (non-transparent) objects only.

Sensor: Model SPBB/SPBBC/RSPBC with F4 Block (Blue light source) or Model SPBR/SPBRC/RSPRC with F4 Block (Red light source)

Cable: Shielded cable w/connector Model GSEC-6 (6ft.) or GSEC-15 (15ft.)

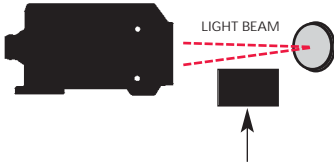
Fiberoptic Light Guides: Model BF-A-36T

Reflector: Model 78P, plastic 4.4 in. x 1.9 in, screw mounted

Sensing Range: Up to 1 ft.

Accessories: Model UAC-15 lens. Use to extend sensing range from 1 ft. maximum without lens to over 3 ft. with lens. Mounting bracket, Model SEB-3, FMB-1

Option 2



Retroreflective (R4 optical block) is a good choice for detecting medium to large size empty, transparent, or translucent objects. The SMARTEYE® PRO, featuring a unique blue LED light source, is recommended for detecting transparent or translucent plastic or glass objects. A red light source is recommended when detecting translucent (non-transparent) objects only.

Sensor: Model SPBB/SPBBC/RSPBC with R4 Block (Blue light source) or Model SPBR/SPBRC/RSPRC with R4 Block (Red light source)

Cable: Shielded cable w/connector Model GSEC-6 (6ft.) or GSEC-15 (15ft)

Reflector: Model 78P, plastic 4.4 in. X 1.9 in., screw mounted.

Sensing Range: Up to 5 ft.

Accessories: Mounting bracket, Model SEB-3

## Alternate Mode: Beam Make (Proximity)

Option 1



Fiberoptic proximity mode is useful to detect transparent/translucent objects.

Sensor: Model SPBR/SPBRC/RSPRC with F4 Block (Red light source)

Cable: Shielded cable w/connector Model GSEC-6 (6 ft.) or GSEC-15 (15 ft.)

Fiberoptic Light Guides: Model BF-A-36T

NOTE: Select smaller fiber bundle for small part detection. (See Fiberoptic Section)

Sensing Range: Up to 4 in.

Accessories: Model UAC-15 lens. Use to extend sensing range up to 1 ft.

Mounting bracket, Model SEB-3, FMB-1

NOTE: Consider proximity mode when translucent/transparent objects are containers filled with clear liquid or when site conditions preclude using the preferred retroreflective Beam Break mode.

Option 2



Convergent/proximity mode is useful to detect most transparent/translucent objects when there is little (if any) gap between objects.

Sensor: Model SPBR/SPBRC/RSPRC with V6 Block (Red light source)

Cable: Shielded cable w/connector Model GSEC-6 (6 ft.) or GSEC-15 (15 ft.)

Sensing Range: From 1 to 4 in

Accessories: Mounting bracket, Model SEB-3

Option 3



Proximity (divergent beam) mode sensing is useful in detecting some large size translucent/transparent objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.

Sensor: Model SPBB/SPBBC/RSPBC with O5 Block (Red light source)

Cable: Shielded cable w/connector Model GSEC-6 (6 ft.) or GSEC-15 (15 ft.)

Sensing Range: From 1 to 4 ft.

Accessories: Mounting bracket, Model SEB-3

# Specifications

SMARTEYE® PRO

SMARTEYE® PRO  
REMOTE

## SUPPLY VOLTAGE

- 10 to 30 VDC
- Polarity Protected

## CURRENT REQUIREMENTS

- 45 mA (exclusive of load)

## OUTPUT TRANSISTORS (Current Limited)

- (1) NPN and (1) PNP sensor output transistor
- (1) PNP Action Alert output transistor (SPB Series)
- Sensor outputs can sink or source up to 150 mA
- All outputs are continuously short circuit protected
- Action Alert PNP transistor source up to 75 mA (Action Alert available on SPB models only)

## REMOTE AUTOSET™ INPUT

- Opto isolated sinking input (10 mA) (RSP Series)

## RESPONSE TIME

- Light/Dark state response = 300 microseconds

## HYSTERESIS

- Set for high resolution – less than one bar on the Contrast Indicator

## LED LIGHT SOURCE

- Options:
  - A. Infrared = 880 nm,
  - B. Red = 660 nm,
  - C. Blue = 480 nm,
  - D. White = Broadband spectrum
- Pulse modulated

## PUSH BUTTON CONTROL

- Automatic set-up routines, i.e., QuickSet™/AUTOSET™
- Manual Adjustments
- Set status of five options: LOCK, AUTOSET, LT/DK ON, AUTOTRAC, and 10 ms TIMER

## LIGHT IMMUNITY

- Responds to sensor's pulse modulated light source, resulting in high immunity to most ambient light, including indirect sunlight

## AMBIENT TEMPERATURE

- - 40°C to 70°C (- 40°F to 158°F)

## RUGGED CONSTRUCTION

- Chemical resistant, high-impact polycarbonate housing
- Waterproof ratings: NEMA 6 and IP67
- Conforms to heavy industry grade CE requirements



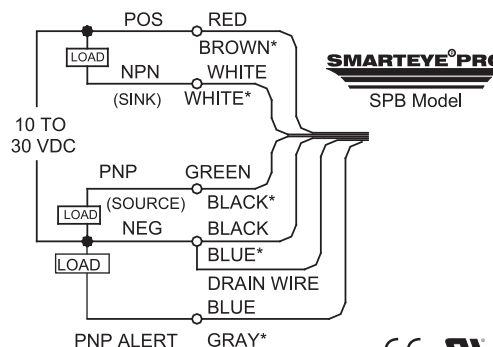
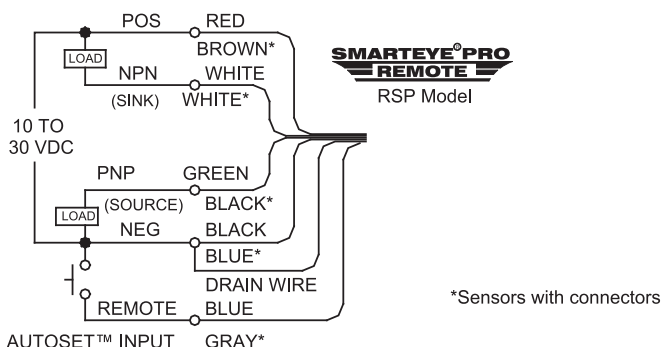
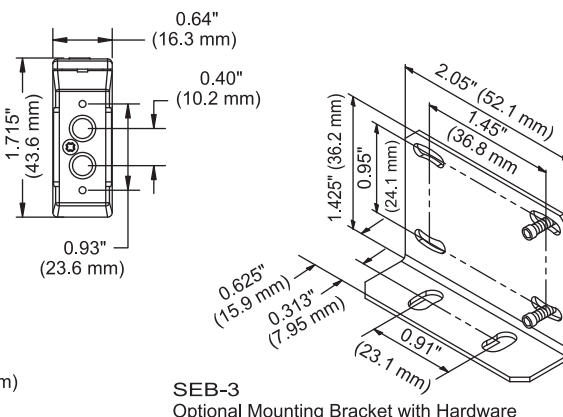
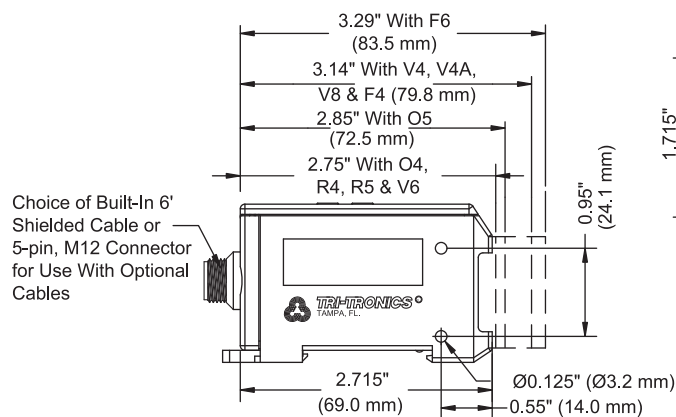
## INDICATORS

- 5-LED Bar graph functions in one of two modes:
  1. Contrast Indicator – Displays scaled reading of sensor's response to contrasting light levels (light to dark)
  2. Status Indicator – Displays status of 5 selectable options
- Red LED output indicator – Illuminates when the sensor's output transistors are "on." NOTE: If Output LED flashes, a short circuit condition exists
- Amber LED – Illuminates when in the options select mode
- Yellow LED – Illuminates when action alert is activated. Also indicates when ACT™ adjusts sensor

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions

## SMARTEYE® PRO PHOTOELECTRIC SENSOR



\*Sensors with connectors

CE US



Enhanced Dynamic Range  
Very High Speed, High Resolution



# The Performance Standard *High Speed, High Resolution*



*Featuring the patented EDR® —  
Enhanced Dynamic Range*

The SMARTEYE® MARK II sensor is TRI-TRONICS' most popular photoelectric sensor. The SMARTEYE MARK II features extremely high gain combined with very high speed. These high performance sensors were designed to resolve the most difficult sensing tasks...the hallmark of all TRI-TRONICS SMARTEYE sensors. In addition to superior high gain/high speed, the SMARTEYE MARK II is equipped with many new improvements.

Among the many features included in the design of the SMARTEYE MARK II, none is more important than



the addition of the EDR® circuit. Now, thanks to the addition of EDR® (Enhanced Dynamic Range), the dynamic operating range has been extended and background suppression has been enhanced.

Also included in the design of the new SMARTEYE MARK II are all of the proven features included in all SMARTEYE sensors, including our famous Contrast Indicator. Without question, the SMARTEYE MARK II sets a "new standard of performance" in photoelectric sensing. When the sensing task involves resolving critical identifying features such as size, texture, distance, opacity, depth, or color, the SMARTEYE MARK II will give you that extra measure of performance that is often required to ensure proper operation. Marginal performance cannot be tolerated when the entire operation of an automated machine process relies on the ability of a photoelectric sensor to perform its sensing task.

## CONTRAST INDICATOR™

The Contrast Indicator displays a scale reading of the level of light received by the sensor's photo detector. The more light received, the higher the reading. The less light received, the lower the reading.

Contrast is a comparison of the lightest state reading versus the darkest state reading. The sensing task of any digital (switching) photoelectric sensor is to resolve the difference between these two light levels and switch the output accordingly. The SMARTEYE® switches its output when the light level passes the midscale reading of "5".

## FIBEROPTIC LIGHT GUIDES

Flexible fiberoptic light guides are available in sizes small enough to fit into your tightest job sensing sites. There are models for inaccessible places, detection of extremely small parts, and high-vibration locations, plus straight light guides for thru-beam and bifurcated light guides for proximity sensing. Refer to Section 3 for details.

### SMARTEYE® MARK II Features:

Patent No. 5,621,205

- Very fast response time (50 microseconds) and operating speed while maintaining extremely high gain on all models
- Unique Enhanced Dynamic Range indicator
- Seven Interchangeable optical blocks
- Clutched offset adjustment
- Operational from 12 to 24 VDC...(polarity protected)
- Choice of models with infrared, red, white, or blue LED light source provides unique color perception, i.e., yellow vs. white
- 10-LED CONTRAST INDICATOR provides "at a glance" performance data during state set up as well as during dynamic conditions when input events are ongoing
- Built-in connector
- Waterproof housing complies with NEMA 4X, 6P, and IP67
- Both NPN and PNP Output transistors
- Short circuit protection for output transistors
- Light On/Dark on selector switch
- Anti-pulsing protection on power up

# EDR® *Enhanced Dynamic Range*

(Patent No. 5,621,205)

The EDR® circuit extends the dynamic operating range to provide unequalled performance at very bright light levels.

## Eliminates Saturation

Every photoelectric sensor has a saturation point – a point at which any further increase in received light level to its detector (from its own pulsing LED light source) will not result in any further internal signal level increase. This is apparent on the SMARTEYE's Contrast Indicator. For example, in an object sensing task, if the background (i.e., white conveyor belt) is reflecting enough light back to the sensor's detector to reach the sensor's saturation level, the arrival of an object (such as a cookie) will not result in any signal level increase as displayed on the Contrast Indicator. This undesirable condition is referred to as saturation. To avoid saturation and enhance background suppression, the EDR circuit monitors the offset adjustment during setup to determine when the sensor's operating level is approaching the sensor's light level saturation point. Before saturation occurs, the EDR circuit adjusts the sensor in such a unique manner so as to prevent saturation and extends the overall dynamic range of the SMARTEYE® MARK II sensor.

## Proximity Sensing Mode Advantages

Another performance benefit provided by the EDR circuit when operating in the proximity mode is that the SMARTEYE® MARK II does not typically require the use of convergent or triangulating optics to resolve objects resting on shiny or highly reflective backgrounds. Instead, the optics can be divergent, allowing a wider field of view. The larger the area in view of the sensor's optics,

the greater the contrast deviation. Convergent or triangulating optics results in pinpoint spots of light. These optical sensing methods can result in falsely switching the sensor's output by responding to minute surface variations or imperfections. A wider field of view offered by divergent optics (i.e., wide angle proximity lens or large bundle fiberoptic guides) allows the SMARTEYE® MARK II to overlook most minor surface irregularities.

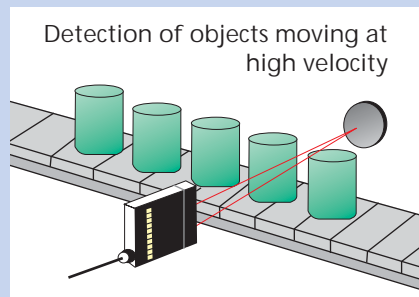
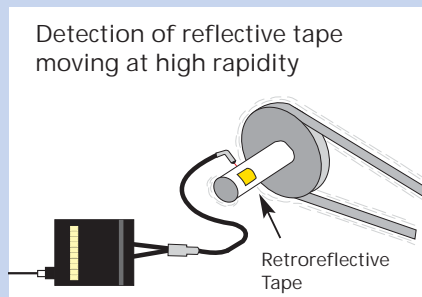
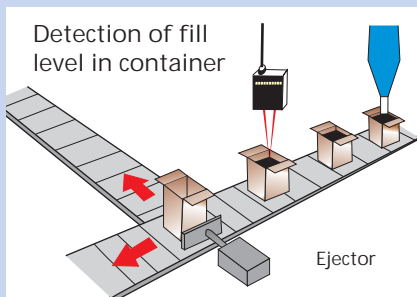
## Beam Break Sensing Mode Advantages

When operating in the Beam Break (opposed) mode of sensing, the EDR circuit once again prevents saturation. This is particularly advantageous when attempting to detect the presence of splices, overlapping materials, container contents, or adhesive labels on backing materials. Saturation can easily occur particularly when the materials involved are translucent or transparent. *Example:* In label detection, if the intensity of light penetrating through the label has reached the saturation level of the sensor, the arrival of the gap between labels will not increase the signal level as displayed on the Contrast Indicator. If this is allowed to occur, detection of the label is impossible. The new EDR circuit built into the SMARTEYE® MARK II prevents this from occurring by compensating during the setup procedure to prevent saturation.

### EDR® Benefits:

- Extends dynamic operating range to include high light level operation without reducing amplifier gain
- Eliminates saturation, important for both Beam Make or Beam Break sensing modes
- Enhances background suppression
- When operating in the proximity mode, allows use of divergent, wide beam optics to increase contrast deviation and reduce the possibility of false response to minute surface irregularities or variations in position

## Typical Applications

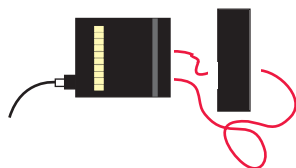


# Selection Guidelines *Opaque Object Sensing*



## Preferred Mode: Beam Break

Option 1



Fiberoptic opposed mode is best choice for detecting any opaque object

Sensor: Model SEIF1 (IR Light Source)

Cable: Shielded cable w/connector Model SEC-6 (6 ft.), SEC-15 (15 ft.), or SEC-25 (25 ft.)

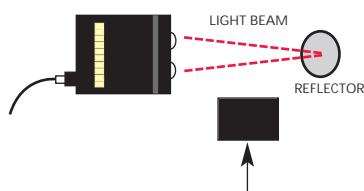
Fiberoptic Light Guides: (2) Model F-A-36T

Sensing Range: Up to 3 ft

Accessories: (2) Model UAC-15 lenses, extends sensing range to over 20 ft., Mounting bracket, Model SEB-1, FMB-1

NOTE: Select smaller fiber bundle for small part detection. (See Fiberoptic Section)

Option 2



Retroreflective mode. Use with reflector to detect medium to large size opaque objects

Sensor: Model SERR1 (Red Light Source)

Cable: Shielded cable w/connector Model SEC-6 (6 ft) or SEC-15 (15 ft.)

Reflector: Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted. (See Accessories Section for complete listing of reflectors)

Sensing Range: Up to 25 ft.

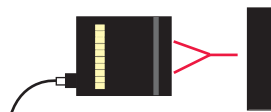
Accessories: Mounting bracket, Model SEB-1

NOTE: Not recommended for detecting highly reflective objects

## Alternate Mode: Beam Make (Proximity)

NOTE: Consider proximity mode when installation sensing site conditions preclude using the preferred Beam Break mode.

Option 1



Fiberoptic proximity is used to detect medium to large flat sided opaque objects

Sensor: Model SEIF1 (IR Light Source)

Cable: Shielded cable w/connector Model SEC-6 6ft.) or SEC-15 (15ft.)

Fiberoptic Light Guides: Model BF-A-36T

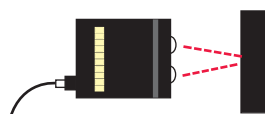
Sensing Range: Up to 4 in.

Accessories: (1) Model UAC-15 lens. Use to extend sensing range up to 1 ft.

Mounting bracket, Model SEB-1, FMB-1

NOTE: Select smaller fiber bundle for small part detection. (See Fiber Optic Section)

Option 2



Convergent/proximity mode is useful to detect opaque objects when there is little (if any) gap between objects.

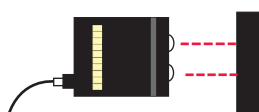
Sensor: Model SEIV1 (IR Light Source)

Cable: Shielded cable w/connector Model SEC-6 (6 ft.) or SEC-15 (15 ft.)

Sensing Range: From 1 to 4 in.

Accessories: Mounting bracket, Model SEB-1

Option 3



Proximity (divergent beam) mode sensing is useful in detecting some large size opaque objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.

Sensor: Model SEIO1 (IR Light Source)

Cable: Shielded cable w/connector Model SEC-6 (6 ft.) or SEC-15 (15 ft.)

Sensing Range: From 6 in. to 5 ft.

Accessories: Mounting bracket, Model SEB-1



## Preferred Mode: Retroreflective Beam Break

Option 1



Fiberoptic retroreflective is the best choice for detecting empty transparent or translucent objects. The SMARTEYE® MARK II featuring a unique blue LED light source is recommended for detecting transparent or translucent plastic or glass objects. A red light source is recommended when detecting translucent (non-transparent) objects only.

Sensor: Model SEBF1 (Blue Light Source) or Model SERF1 (Red Light Source)

Cable: Shielded cable w/connector Model SEC-6 (6ft.) or SEC-15 (15ft.)

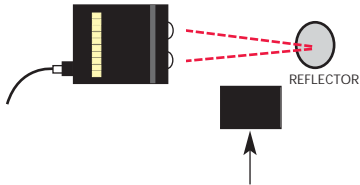
Fiberoptic Light Guides: Model BF-A-36T

Reflector: Model 78P, plastic 4-4 in. X 1.9 in, screw mounted

Sensing Range: Up to 1 ft.

Accessories: (1) Model UAC-15 lens. Use to extend sensing range from 1 ft. maximum without lens to over 3 ft. with lens. Mounting bracket, Model SEB-1, FMB-1

Option 2



Retroreflective (R1 optical block) is a good choice for detecting medium to large size empty transparent or translucent objects. The SMARTEYE® MARK II featuring a unique blue LED light source is recommended for detecting transparent or translucent plastic or glass objects. A red light source is recommended when detecting *translucent* (non-transparent) objects only.

Sensor: Model SEBR1 (Blue Light Source) or Model SERR1 (Red Light Source)

Cable: Shielded cable w/connector Model SEC-6 (6ft.) or SEC-15 (15ft)

Reflector: Model 78P, plastic 4.4 in. X 1.9 in., screw mounted

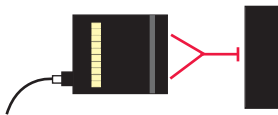
Sensing Range: Up to 5ft.

Accessories: Mounting bracket, Model SEB-1

## Alternate Mode: Beam Make (Proximity)

NOTE: Consider proximity mode when translucent/transparent objects are containers filled with clear liquid or when site conditions preclude using the preferred retroreflective Beam Break mode.

Option 1



Fiberoptic proximity mode is useful to detect transparent/translucent objects.

Sensor: Model SERF1 (Red light source)

Cable: Shielded cable w/connector Model SEC-6 (6 ft.) or SEC-15 (15 ft.)

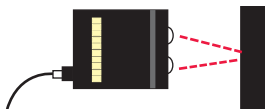
Fiberoptic Light Guides: Model BF-A-36T

NOTE: Select smaller fiber bundle for small part detection. (See Fiberoptic Section)

Sensing Range: Up to 4 in.

Accessories: (1) Model UAC-15 lens. Use to extend sensing range up to 1 ft., Mounting bracket, Model SEB-1, FMB-1

Option 2



Convergent/proximity mode is useful to detect most transparent/translucent objects when there is little (if any) gap between objects.

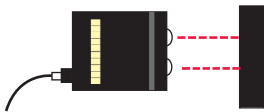
Sensor: Model SERV1 (Red Light Source)

Cable: Shielded cable w/connector Model SEC-6 (6 ft.) or SEC-15 (15 ft.)

Sensing Range: From 1 to 4 in

Accessories: Mounting bracket, Model SEB-1

Option 3



Proximity (divergent beam) mode sensing is useful in detecting some large size translucent/transparent objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.

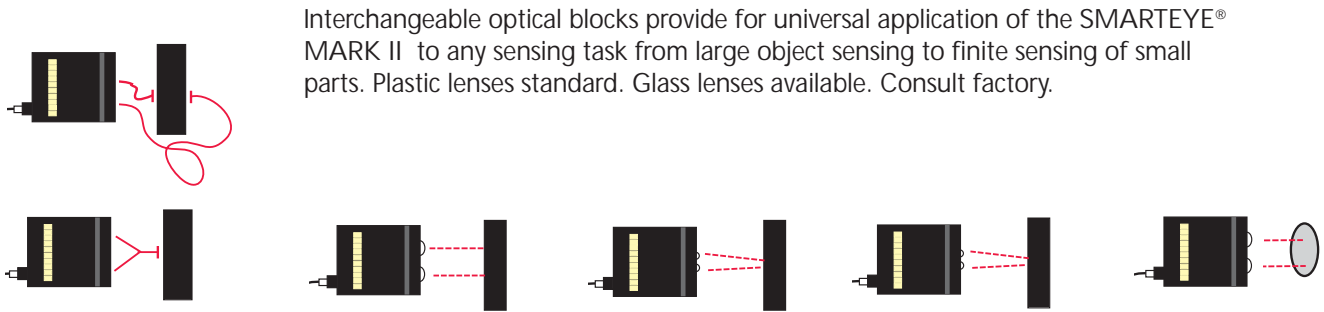
Sensor: Model SERO1 (Red Light Source)

Cable: Shielded cable w/connector Model SEC-6 (6 ft.) or SEC-15 (15 ft.)

Sensing Range: From 6 in. to 4 ft.

Accessories: Mounting bracket, Model SEB-1

# Optical Block Selection



Interchangeable optical blocks provide for universal application of the SMARTEYE® MARK II to any sensing task from large object sensing to finite sensing of small parts. Plastic lenses standard. Glass lenses available. Consult factory.



**Type F1**  
Fiberoptic Adapter  
Type F1 adapts MARK II to any standard fiber optic light guide with .187" O.D. tips. The light guide is inserted and held in place with set screws. See Section 3 for selection.



**Type O1, O1G (Glass)**  
Medium to Long Range Proximity  
Type O1, O1G (glass) adapts the MARK II to the optical proximity mode of sensing. Range is dependent on size, shape, surface reflectivity of the object to be detected.



**Type O2**  
Short Range Proximity  
Type O2 also adapts the MARK II to the optical proximity mode of sensing, but on a sharp "V" axis to control depth of view. Range is dependent on model of the MARK II selected.



**Type V1, V1G (Glass)**  
Focused Lens "V" Axis  
Type V1, V1G (Glass) is for direct lens "V" axis sensing at close ranges. Used for small part or precise leading edge sensing. Range is dependent on model of the MARK II selected.



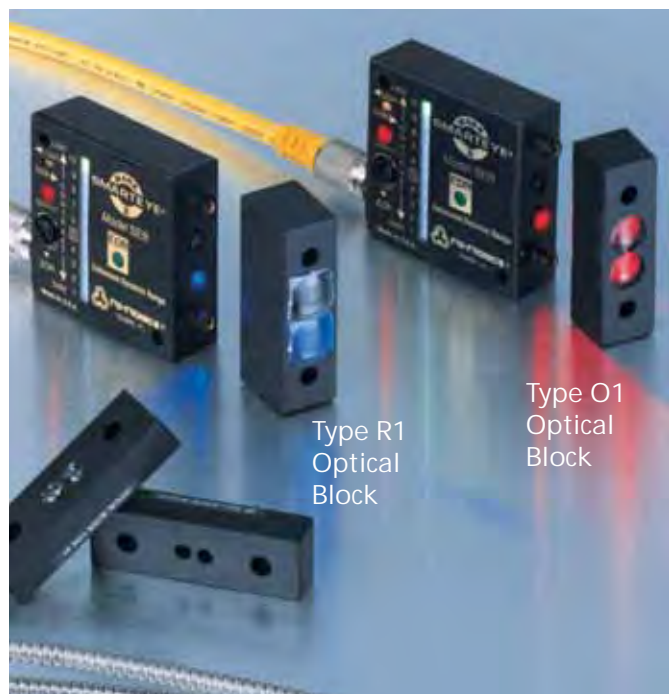
**Type R1**  
Retroreflective  
Type R1 turns the MARK II into a retroreflective sensor. Range is dependent on model of the MARK II selected and size of reflectors.

## Sensing Range Guidelines

Optical Blocks	IR	RED	BLUE	WHITE
O1, O1G	6 ft.	5.5 ft.	N/A	N/A
O2	3.5 in.	3.5 in.	2 in.	1.5 in.
V1, V1G	4 in.	4 in.	2.25 in.	2 in.
R1	35 ft.	30 ft.	10 ft.	N/A
F1 (Prox)	5.5 in.	4.5 in.	1 in.	0.5 in.
F1 (Prox w/lens)	1.5 ft.	14 in.	5 in.	2 in.
F1 Opposed	3.5 ft.	1.5 ft.	6 in.	1.75 in.
F1 Opposed w/lens	20+ ft.	20+ ft.	6.5 ft.	6.5 ft.

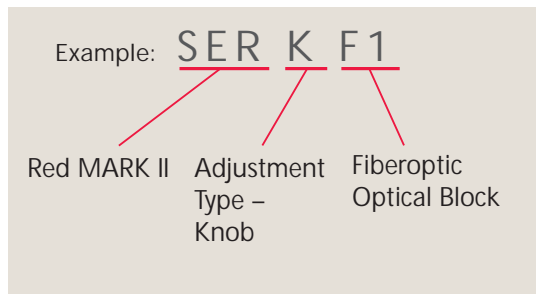
### NOTES:

- For more Information on useful range, see Fundamentals, Section 1.
- PROXIMITY tests utilized a 90% reflective target.
- RETROREFLECTIVE tests utilized a 3 in. diam. reflector Model AR3
- FIBER OPTIC tests utilized .125 in. diam. fiber bundles. Model UAC-15 Lens was used as indicated.



# How to Specify

1. Select Sensor Model based on light source required  
SEI = Infrared  
SER = Red  
SEB = Blue  
SEWL = White
2. Select adjustment type  
Blank = Potentiometer adjust  
K = Knob
3. Select Optical Block based on mode of sensing required



## Accessories

### Micro Cable Selection Guide, 4-wire M12

	<b>Yellow Shielded Cable Assemblies</b>
	SEC-6 6' (1.8 m) cable with connector
	SEC-15 15' (4.6 m) cable with connector
	SEC-25 25' (7.62 m) cable with connector
	RSEC-6 6' (1.8 m) cable / right angle conn.
	RSEC-15 15' (4.6 m) cable / right angle conn.
	RSEC-25 25' (7.62 m) cable / right angle conn.
	<b>Black Shielded Cable Assemblies (Lightweight)</b>
	BSEC-6 6' (1.8 m) cable with connector
	BSEC-15 15' (4.6 m) cable with connector
	BSEC-25 25' (7.62 m) cable with connector
	BRSEC-6 6' (1.8 m) cable / right angle conn.
	BRSEC-15 15' (4.6 m) cable / right angle conn.
	BRSEC-25 25' (7.62 m) cable / right angle conn.
	<b>Grey Unshielded Cable Assemblies</b>
	BX-10 10' (3.1 m) Extension cable
	BX-25 25' (7.62 m) Extension cable
	GSEC-2MU 6.5' (2.0 m) Low-cost
	GSEC-5MU 16.4' (5.0 m) Low-cost



FMB-1 (8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket



SEB-1  
Stainless "L" Bracket



FMB-2 (5.1 mm diam.)  
FMB-3 (3.1 mm diam.)  
Miniature Glass or Plastic  
Fiberoptic Mounting  
Brackets

# Specifications



## SUPPLY VOLTAGE

- 12 to 24 VDC
- Polarity Protected

## CURRENT REQUIREMENTS

- 85 mA (exclusive of load)

## OUTPUT TRANSISTORS

- (1) NPN and (1) PNP Output transistor:
- NPN: Sink up to 150 mA
- PNP: Source up to 150 mA
- Momentary short circuit protected
- Outputs protected from pulsing during power up
- Light/dark switch determines Output Status:  
Light = Light "ON" operate  
Dark = Dark "ON" operate

## RESPONSE TIME

- Minimum duration of input event
- Light state response = 50 microseconds
- Dark state response = 140 microseconds
- Leading edge Variation less than 20 microseconds

## HYSTERESIS

- Less than 400 millivolts for maximum sensitivity and resolution



## LED LIGHT SOURCE

- Pulse modulation rate 45 KHZ
- Choice of color:  
A. Infrared = 880nm  
B. Red = 660nm  
C. White = Broadband Color Spectrum  
D. Blue = 480nm

## LIGHT IMMUNITY

- Responds to sensor's pulsed modulated light source
- Immune to most ambient light

## OFFSET/EDR® ADJUSTMENT

- Sets initial level on CONTRAST INDICATOR in relation to mid-scale switch point of 5 – functions as sensitivity adjustment
- Controls Enhanced Dynamic Range circuit (EDR™) which functions to avoid saturation

## INDICATORS

- **OUTPUT INDICATOR** - RED LED illuminates and the NPN or PNP outputs switch to the opposite state when returned light level exceeds "5" on the CONTRAST INDICATOR
- **EDR™ INDICATOR** - Intensity of GREEN LED provides indication of where in the dynamic operating range the offset, EDR™ adjustment has been set
- **FULLY LIT**: Operating near saturation
- **OFF**: Operating near maximum sensing range
- **CONTRAST INDICATOR** – Displays scaled reading of sensor's response to contrasting light levels (light vs. dark) on a 10 bar LED display

## AMBIENT TEMPERATURE

- - 40°C to 70°C (- 40°F to 158°F)

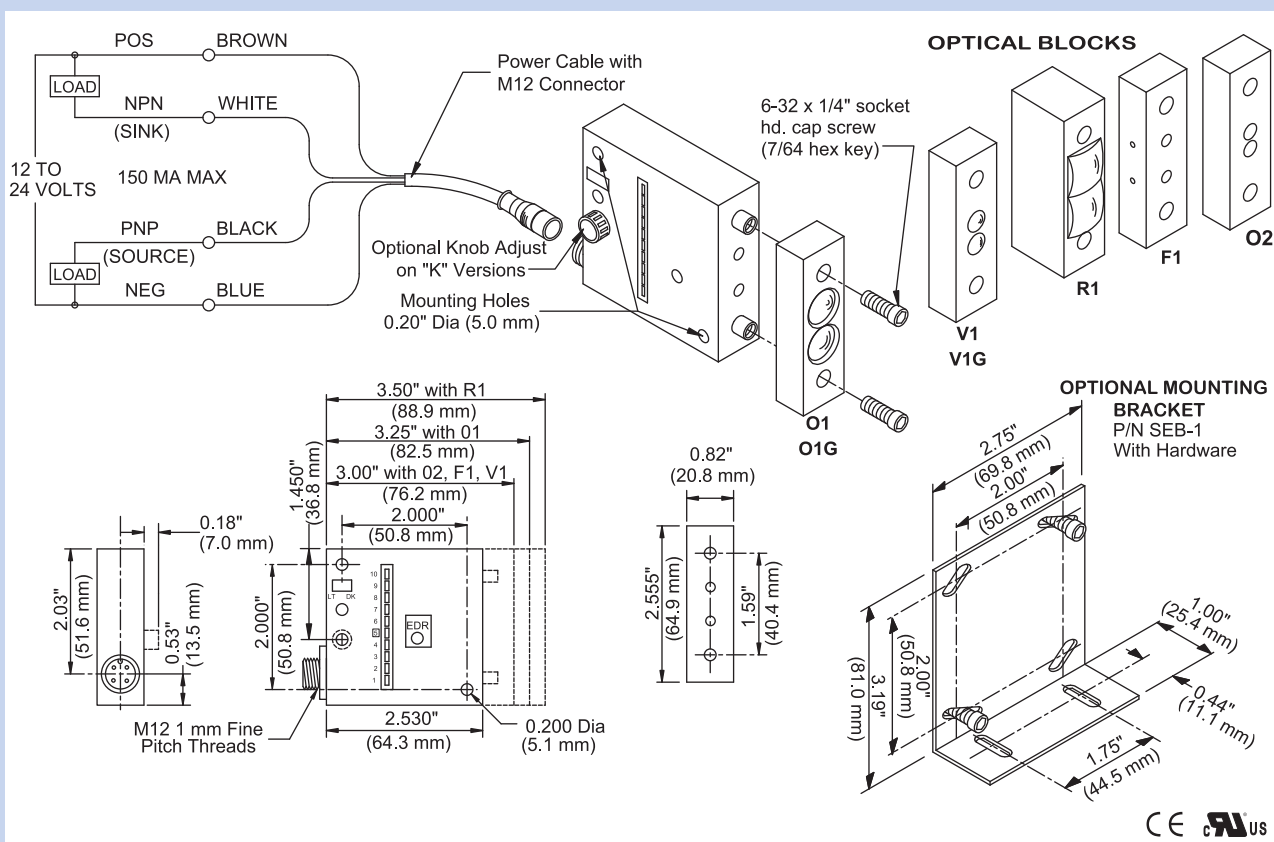
## RUGGED CONSTRUCTION

- Chemical resistant, high impact polycarbonate housing
- Waterproof, NEMA 4X, 6P and IP67 enclosure ratings
- Epoxy encapsulated for mechanical strength

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions

## SMARTEYE® MARK II PHOTOELECTRIC SENSOR





Miniature, High Performance  
DIN Rail Mountable



# World-Class Versatility *Miniature High Performance Sensor*

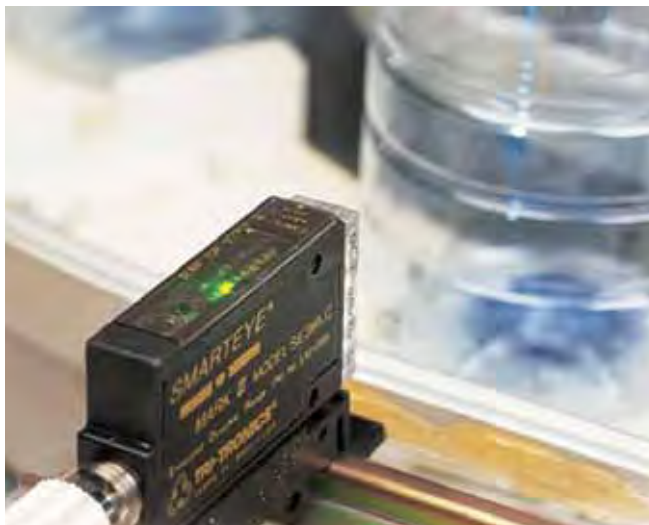


The SMARTEYE® MARK III is the “first” high performance photoelectric sensor in a miniature size that you can use anywhere...for any task...including your toughest industrial sensing applications. The SMARTEYE MARK III is loaded with features and benefits, never before offered in a miniature sensor, including extremely high gain and high speed of response (50 microseconds). High gain enables the sensor to resolve the most difficult low contrast sensing tasks. High speed response provides resolution of the exact position of objects traveling at high speeds.

You can easily optimize the SMARTEYE MARK III to conform to your particular sensing task because of its unique modular construction.

## QUICK-CHANGE OPTICAL BLOCK LENSES

You can choose from a wide variety of blocks to operate in the proximity, convergent, retroreflective, or fiberoptic sensing mode. A newly designed sensing model F5 fiberoptic block enhances performance when using plastic fiberoptic light guides. These inexpensive, interchangeable optical blocks reduce the inventory burden of replacement parts and eliminate the need for discarding a complete sensor in the event of damage to the optical block.



## LED LIGHT SOURCES

When color perception is a requirement to perform your sensing task, you can select the correct LED light source from one of our available colors...Infrared, Red, Blue, or White. For example, select the invisible IR light source for long-range sensing or hostile environments. Select the RED light source for use with plastic fibers. Select the BLUE light source for use in the retroreflective mode to detect translucent or transparent plastic or glass objects. Select the WHITE light source for detecting registration marks or for providing color perception advantages.

Always remember that selecting the proper color of LED Light Source is important in even the simplest object sensing tasks...particularly in the proximity mode.

## 10-LED CONTRAST INDICATOR™

The Contrast Indicator provides “at-a-glance” analysis of the sensor’s response to light state vs. dark sensing conditions. This device is not only useful in static conditions for alignment purposes, but is also functional during dynamic conditions when input events are ongoing.

# EDR<sup>®</sup> Enhanced Dynamic Range

(Patent No. 5,621,205)

## OFFSET/EDR<sup>®</sup> ADJUSTMENT (Patent No. 5,621,205)

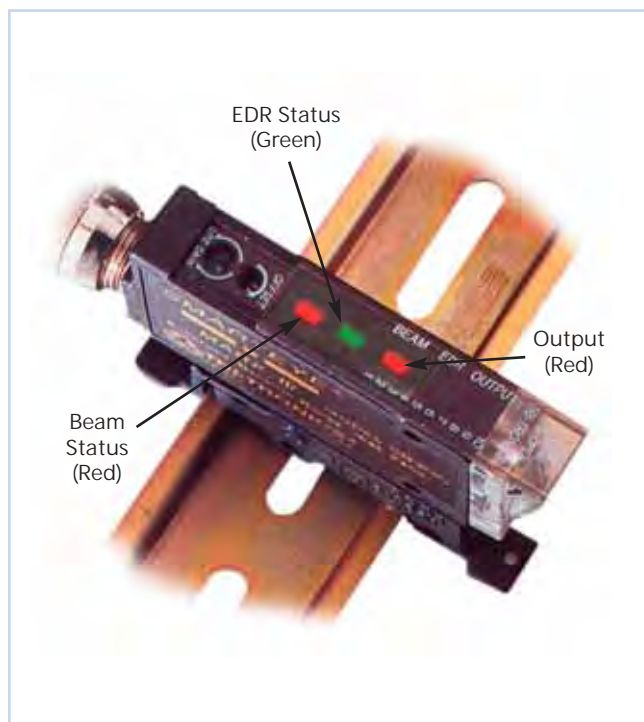
With the Offset/EDR<sup>®</sup> adjustment feature, the SMARTEYE MARK III sensor can resolve very low contrast sensing tasks over a wider range of light intensities, including proper operation at high light levels. In addition, EDR improves background suppression.

Please note that as the OFFSET/ EDR<sup>®</sup> adjustment is rotated in the counterclockwise direction, the green EDR indicator LED will begin to turn on and glow dimly. As the counter clockwise rotation proceeds, the intensity of the EDR<sup>®</sup> indicator will continue to increase. This indicator provides the installer an idea of just where in the overall dynamic operating range of the sensor the OFFSET/EDR<sup>®</sup> adjustment has been set. For example, if after adjustment to obtain maximum contrast deviation the OFFSET/ EDR<sup>®</sup> is "off," the sensor is operating under very low received light conditions. If the EDR<sup>®</sup> indicator is fully lit, the sensor is operating under very high received light conditions. The concept of how to interpret the green EDR<sup>®</sup> indicator is simple – after adjustment this indicator should not be fully lit or completely off. Anywhere in between indicates that the sensor is operating within its dynamic operating range.

EDR Indicator Status	Sensing Condition	Performance Enhancement
OFF	Operating near maximum sensing range	A. Move closer to target (proximity mode)
		B. Use larger diameter fiber optic light guides
		C. Use accessory lens
		D. Decrease sensing range
FULLY LIT	Operating near saturation	A. Move away from target (proximity mode)
		B. Increase sensing range (Beam Break mode)
		C. Downsize diameter of fiber optic

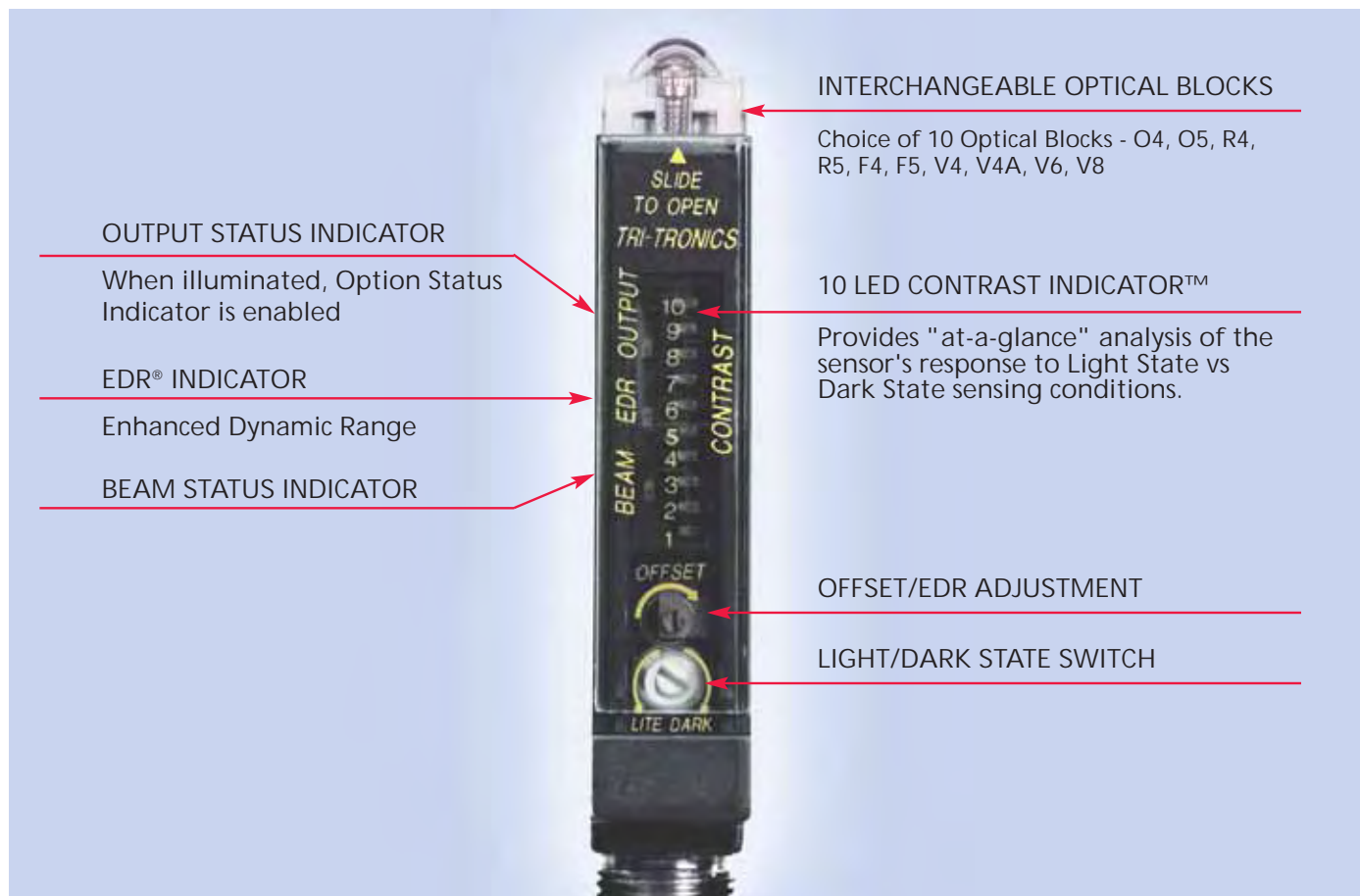
The suggested performance enhancements as listed above will ensure that contrast deviation response has been maximized.

**SMARTEYE<sup>®</sup>**  
**MARK III**



# Light Source Guidelines

<p><b>INVISIBLE INFRARED LIGHT SOURCE (880 nm)</b></p> <ul style="list-style-type: none"> <li>A. Best choice in most opaque object sensing tasks</li> <li>B. Provides longest possible sensing range in either Beam Make or Beam Break sensing modes</li> <li>C. Best choice in hostile environments; useful in penetrating lens contamination</li> <li>D. Preferred for use with small glass fiberoptic light guides Note: Do not use IR light with plastic fiberoptic light guides</li> <li>E. Preferred when sensing dark colored objects in the proximity (Beam Make) mode, i.e., black, blue, green, etc.</li> <li>F. Useful in penetrating containers for verification of contents; also useful in detecting overlapped splices in dense materials</li> <li>G. Color perception; tends to favor blue colored objects</li> </ul>	<p><b>RED LIGHT SOURCE (660 nm)</b></p> <ul style="list-style-type: none"> <li>A. Best choice for use with plastic fiberoptic light guides</li> <li>B. Useful when sensing translucent objects in proximity (Beam Make) mode</li> <li>C. Useful when sensing transparent objects in fiber optic retroreflective (Beam Break) mode</li> <li>D. Can be polarized for retroreflective (Beam Break) sensing to reduce proxing on shiny objects</li> <li>E. Opposed fiberoptic light guides can be polarized for sensing some translucent plastic containers; consult factory for details</li> <li>F. Used as red filter for color perception advantages</li> </ul>
<p><b>BLUE LIGHT SOURCE (480 nm)</b></p> <ul style="list-style-type: none"> <li>A. Useful for detecting translucent, transparent, plastic, or glass objects in the retroreflective mode when using the R4 optical block</li> <li>B. Used as blue filter for color perception advantages, i.e., resolving yellow vs. white colored objects or printed registration marks</li> </ul>	<p><b>WHITE LIGHT SOURCE</b> (Broadband Color Spectrum)</p> <ul style="list-style-type: none"> <li>A. Best choice for detecting all printed registration marks on packaging material</li> <li>B. Recommended for detecting dark colored objects in the proximity (Beam Make) mode</li> <li>C. Best choice for sorting colored objects</li> </ul>





## Preferred Mode: Beam Break

Fiberoptic opposed mode is best choice for detecting any opaque object.

Sensor: Model SE3I/SE3IC with F4 Optical Block (IR Light Source)

Cable: Shielded cable w/connector Model SEC-6/BSEC-6 (6 ft.) or SEC-15/BSEC-15 (15 ft.)

Fiberoptic Light Guides: Model F-A-36T (two required)

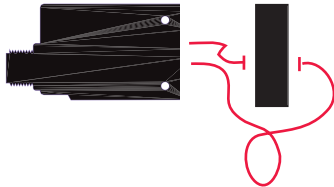
Sensing Range: Up to 16 in.

Accessories: (2) Model UAC-15 lenses, extends sensing range to over 20 ft.

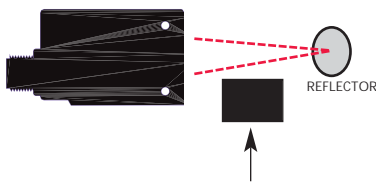
Mounting bracket: Model SEB-3, FMB-1

NOTE: Select smaller fiber bundle for small part detection. (See Fiberoptic Section)

Option 1



Option 2



Retroreflective mode. Use with reflector to detect medium to large size opaque objects.

Sensor: Model SE3I/SE3IC with R4 Optical Block (IR Light Source)

Cable: Shielded cable w/connector Model SEC-6/BSEC-6 (6 ft) or SEC-15/BSEC-15 (15 ft.)

Reflector: Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted. (See Accessories

Section for complete listing of reflectors.)

Sensing Range: Up to 20 ft.

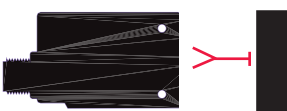
Accessories: Mounting bracket, Model SEB-3

NOTE: Not recommended for detecting highly reflective objects.

## Alternate Mode: Beam Make (Proximity)

NOTE: Consider proximity mode when installation sensing site conditions preclude using the preferred Beam Break mode.

Option 1



Fiberoptic proximity is used to detect medium to large flat sided opaque objects.

Sensor: Model SE3I/SE3IC with F4 Optical Block (IR Light Source)

Cable: Shielded cable w/connector Model SEC-6/BSEC-6 (6 ft.) or SEC-15/BSEC-15 (15 ft.)

Fiberoptic Light Guides: Model BF-A-36T

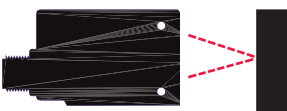
Sensing Range: Up to 6 in.

Accessories: Model UAC-15 lens. Use to extend sensing range up to 1 ft.

Mounting bracket: Model SEB-3, FMB-1

NOTE: Select smaller fiber bundle for small part detection. (See Fiberoptic Section)

Option 2



Convergent/proximity mode is useful to detect opaque objects when there is little (if any) gap between objects.

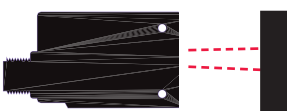
Sensor: Model SE3I/SE3IC with V6 Optical Block (IR Light Source)

Cable: Shielded cable w/connector Model SEC-6/BSEC-6 (6 ft.) or SEC-15/BSEC-15 (15 ft.)

Sensing Range: From 1.5 to 8 in.

Accessories: Mounting bracket, Model SEB-3

Option 3



Proximity (divergent beam) mode sensing is useful in detecting some large size opaque objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.

Sensor: Model SE3I/SE3IC with O5 Optical Block (IR Light Source)

Cable: Shielded cable w/connector Model SEC-6/BSEC-6 (6 ft.) or SEC-15/BSEC-15 (15 ft.)

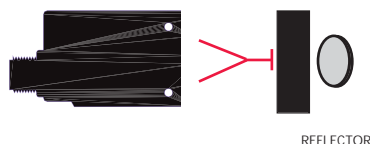
Sensing Range: From 1 to 5 ft.

Accessories: Mounting bracket, Model SEB-3

# Selection Guidelines *Translucent/Transparent Object Sensing*



Option 1



## Preferred Mode: Retroreflective Beam Break

Fiberoptic retroreflective is the best choice for detecting empty transparent or translucent objects. The SMARTEYE® MARK III featuring a unique Blue LED Light Source is recommended for detecting transparent or translucent plastic or glass objects. A Red Light Source is recommended when detecting translucent (non-transparent) objects only.

Sensor: Model SE3B/SE3BC with F4 Block (Blue Light Source) or Model SE3R/SE3RC with F4 Block (Red Light Source)

Cable: Shielded cable w/connector Model SEC-6/BSEC-6 (6ft.) or SEC-15/BSEC-15 (15ft.)

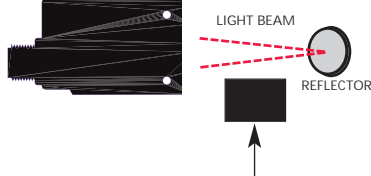
Fiberoptic Light Guides: Model BF-A-36T

Reflector: Model 78P, plastic 4.4 in. X 1.9 in, screw mounted

Sensing Range: Up to 1 ft.

Accessories: Model UAC-15 lens. Use to extend sensing range from 1 ft. maximum without lens to over 3 ft. with lens. Mounting bracket, Model SEB-3, FMB-1

Option 2



Retroreflective (R4 optical block) is a good choice for detecting medium to large size empty transparent or translucent objects. The SMARTEYE® MARK III featuring a unique Blue LED Light Source is recommended for detecting transparent or translucent plastic or glass objects. A Red Light Source is recommended when detecting translucent (non-transparent) objects only.

Sensor: Model SE3B/SE3BC with R4 Block (Blue Light Source) or Model SE3R/SE3RC with R4 Block (Red Light Source)

Cable: Shielded cable w/connector Model SEC-6/BSEC-6 (6ft.) or SEC-15/BSEC-15 (15ft.)

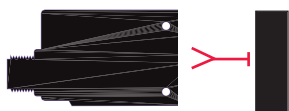
Reflector: Model 78P, plastic 4.4 in. X 1.9 in., screw mounted.

Sensing Range: Up to 5 ft.

Accessories: Mounting bracket, Model SEB-3

## Alternate Mode: Beam Make (Proximity)

Option 1



NOTE: Consider proximity mode when translucent/transparent objects filled with clear liquid or when site conditions preclude using the preferred retroreflective Beam Break mode.

Fiberoptic proximity mode is useful to detect transparent/translucent objects.

Sensor: Model SE3R/SE3RC with F4 Block (Red Light Source)

Cable: Shielded cable w/connector Model SEC-6/BSEC-6 (6ft.) or SEC-15/BSEC-15 (15 ft.)

Fiberoptic Light Guides: Model BF-A-36T

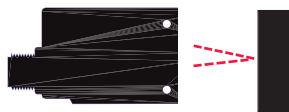
Sensing Range: Up to 4 in.

Accessories: Model UAC-15 lens. Use to extend sensing range up to 1 ft.

Mounting bracket, Model SEB-3, FMB-1

NOTE: Select smaller fiber bundle for small part detection. (See Fiberoptic Section)

Option 2



Convergent/proximity mode is useful to detect most transparent/translucent objects when there is little (if any) gap between objects.

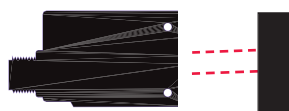
Sensor: Model SE3R/SE3RC with V6 Block (Red Light Source)

Cable: Shielded cable w/connector Model SEC-6/BSEC-6 (6ft.) or SEC-15/BSEC-15 (15 ft.)

Sensing Range: From 1 to 4 in

Accessories: Mounting bracket, Model SEB-3

Option 3



Proximity (divergent beam) mode sensing is useful in detecting some large size translucent/transparent objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.

Sensor: Model SE3R/SE3RC with O5 Block (Red Light Source)

Cable: Shielded cable w/connector Model SEC-6/BSEC-6 (6ft.) or SEC-15/BSEC-15 (15 ft.)

Sensing Range: From 1 to 4 ft.

Accessories: Mounting bracket, Model SEB-3

# Optical Block Selection

Interchangeable optical blocks provide for universal application of the SMARTEYE® MARK III to any sensing applications from large object sensing to finite sensing of small parts, registration mark detection and product inspection tasks.



**Type O4**  
Proximity  
Wide beam optics useful for short-range sensing of transparent, translucent, or irregular shaped shiny objects.



**Type O5**  
Proximity  
Narrow beam optics useful in long-range sensing of medium to large size objects.



**Type R4**  
Retroreflective  
Very narrow beam optics designed to sense reflectors or reflective materials at long range. Designed for Beam Break sensing.



**Type R5**  
Polarized  
Anti-Glare  
Retroreflective  
Polarized to reduce response to "hot spot" glare from shiny surface of detected object. Use with red or blue light source.



**Type V4, V4A**  
Convergent  
1" "V" Axis  
Narrow beam optics that focus at a sensing range of 1". Useful for sensing small parts. Also useful for proximity sensing (range of 1" to 5") to minimize response to reflected light from background objects.



**Type V6**  
Convergent  
1.5" "V" Axis  
Narrow beam optics that focus at a sensing range of 1.5". Useful for sensing small parts. Also useful for proximity sensing (range of 1.5" to 8") to minimize response to reflected light from background objects.



**Type V8**  
Convergent  
.5" "V" Axis  
Narrow beam optics that focus at a sensing range of .5". Useful for sensing small parts or registration color marks. Also useful for proximity sensing (range of .25" to 5") to minimize response to reflected light from background objects.



**Type F4**  
Glass Fiberoptics  
Adapts MARK III for use with a wide variety of glass fiberoptic light guides for both the proximity and opposed sensing modes.



**Type F5**  
Plastic Fiberoptics  
Adapts MARK III for use with a wide variety of plastic fiberoptic light guides for both the proximity and opposed sensing modes.

## Sensing Range Guidelines

Convergent / Proximity / Retroreflective					Glass Fiber Optics					Plastic Fiber Optics		
OPTICAL BLOCKS	IR	RED	BLUE	WHITE	OPTICAL BLOCKS	IR	RED	BLUE	WHITE	OPTICAL BLOCKS	RED	WHITE
V4, V4A	1 in.	1 in.	1 in.	1 in.	Opposed Mode					Opposed Mode		
V6	1.5 in.	1.5 in.	1.5 in.	1.5 in.	F4	3 ft.	1 ft.	8 in.	5 in.	F5	9 in.	2 in.
V8	0.5 in.	0.5 in.	0.5 in.	0.5 in.	F4 w/lens	20+ ft.	20+ ft.	12 ft.	9 ft.	F5 w/lens	6 ft.	2 ft.
O4	18 in.	11 in.	4 in.	3 in.	Proximity Mode					F5 w/right angle lens	3 ft.	1 ft.
O5	4 ft.	3 ft.	1.5 ft.	12 in.						Proximity Mode		
R4	20+ ft.	18+ ft.	6 ft.	5 ft.						F5	7 in.	5 in.
R5	N/A	7 ft.	4 ft.	3 ft.						F5 w/lens	1 ft.	1 ft.
NOTE: Proximity test utilized a 90% reflective white target. Retroreflective tests utilized a 3" diam. round reflector, Model AR-3					NOTE: Range tests utilized a .125" diam. fiber bundle					NOTE: Range tests utilized a .040" diam. fiber		

# How to Specify




1. Select Sensor Model based on light source required  
 SE3I = Infrared  
 SE3R = Red  
 SE3B = Blue  
 SE3WL = White
2. Select Optical Block based on mode of operation

NOTE: DRB-1 Bracket included

## Accessories



### Micro Cable Selection Guide, 4-wire, M12

#### Yellow Shielded Cable Assemblies



	SEC-6 6' (1.8 m) cable with connector
	SEC-15 15' (4.6 m) cable with connector
	SEC-25 25' (7.62 m) cable with connector
	RSEC-6 6' (1.8 m) cable / right angle conn.
	RSEC-15 15' (4.6 m) cable / right angle conn.
	RSEC-25 25' (7.62 m) cable / right angle conn.

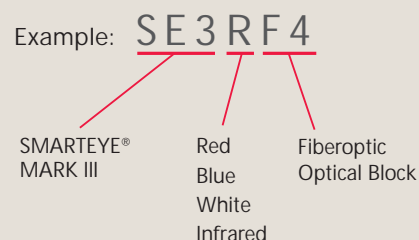
#### Black Shielded Cable Assemblies (Lightweight)

	BSEC-6 6' (1.8 m) cable with connector
	BSEC-15 15' (4.6 m) cable with connector
	BSEC-25 25' (7.62 m) cable with connector
	BRSEC-6 6' (1.8 m) cable / right angle conn.
	BRSEC-15 15' (4.6 m) cable / right angle conn.
	BRSEC-25 25' (7.62 m) cable / right angle conn.

	BX-10 10' (3.1 m) Extension cable
	BX-25 25' (7.62 m) Extension cable

#### Grey Unshielded Cable Assemblies

	GSEC-2MU 6.5' (2.0 m) Low-cost
	GSEC-5MU 16.4' (5.0 m) Low-cost



SEB-3  
Stainless "L" Bracket



TA-18  
18mm Adapter



DRB-1  
Bracket



FMB-1 (8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket



MB-18  
18mm Bracket



FMB-2 (5.1 mm diam.)  
FMB-3 (3.1 mm diam.)  
Miniature Glass or Plastic  
Fiberoptic Mounting  
Brackets

# Specifications



## SUPPLY VOLTAGE

- 12 to 30 VDC
- Polarity Protected

## CURRENT REQUIREMENTS

- 85 mA (exclusive of load)

## OUTPUT TRANSISTORS

- (1) NPN and (1) PNP output transistor:  
NPN: Sink up to 150 mA  
PNP: Source up to 150 mA
- Momentary short circuit protected
- Outputs protected from pulsing during power up
- Light/Dark switch determines output status:  
Light = Light "ON" operate  
Dark = Dark "ON" operate

## RESPONSE TIME

- Minimum duration of input event:  
Light state response = 50 microseconds  
Dark state response = 140 microseconds
- Leading edge variation less than 20 microseconds

## LIGHT IMMUNITY

- Responds to sensor's pulsed modulated light source – resulting in high immunity to most ambient light, including sunlight

## HYSTERESIS

- Less than 400 millivolts for maximum sensitivity and resolution

## LED LIGHT SOURCE

- Pulse modulation rate 36 KHZ.
- Choice of color: A. Infrared = 880 nm  
B. Red = 660 nm C. Blue = 480 nm  
D. White = Broadband Spectrum

## INDICATORS

- OUTPUT INDICATOR – RED LED illuminates when the output transistors are in the "ON" state as determined by the position of the Light/Dark switch
- BEAM STATUS INDICATOR – RED LED illuminates when returned light level exceeds "5" on the CONTRAST INDICATOR
- EDR® INDICATOR – Intensity of GREEN LED provides indication of where in the dynamic operating range the offset/EDR® adjustment has been set
- CONTRAST INDICATOR™ – Displays scaled reading of sensor's response to contrasting light levels (light vs. dark) on a 10 bar LED display



## OFFSET/EDR® ADJUSTMENT\*

- Sets initial level on the CONTRAST INDICATOR™ in relation to mid-scale switch point of 5 – functions as sensitivity adjustment
- Controls Enhanced Dynamic Range circuit (EDR®) which functions to avoid saturation

## AMBIENT TEMPERATURE

- -40°C to +70°C (-40°F to 158°F)

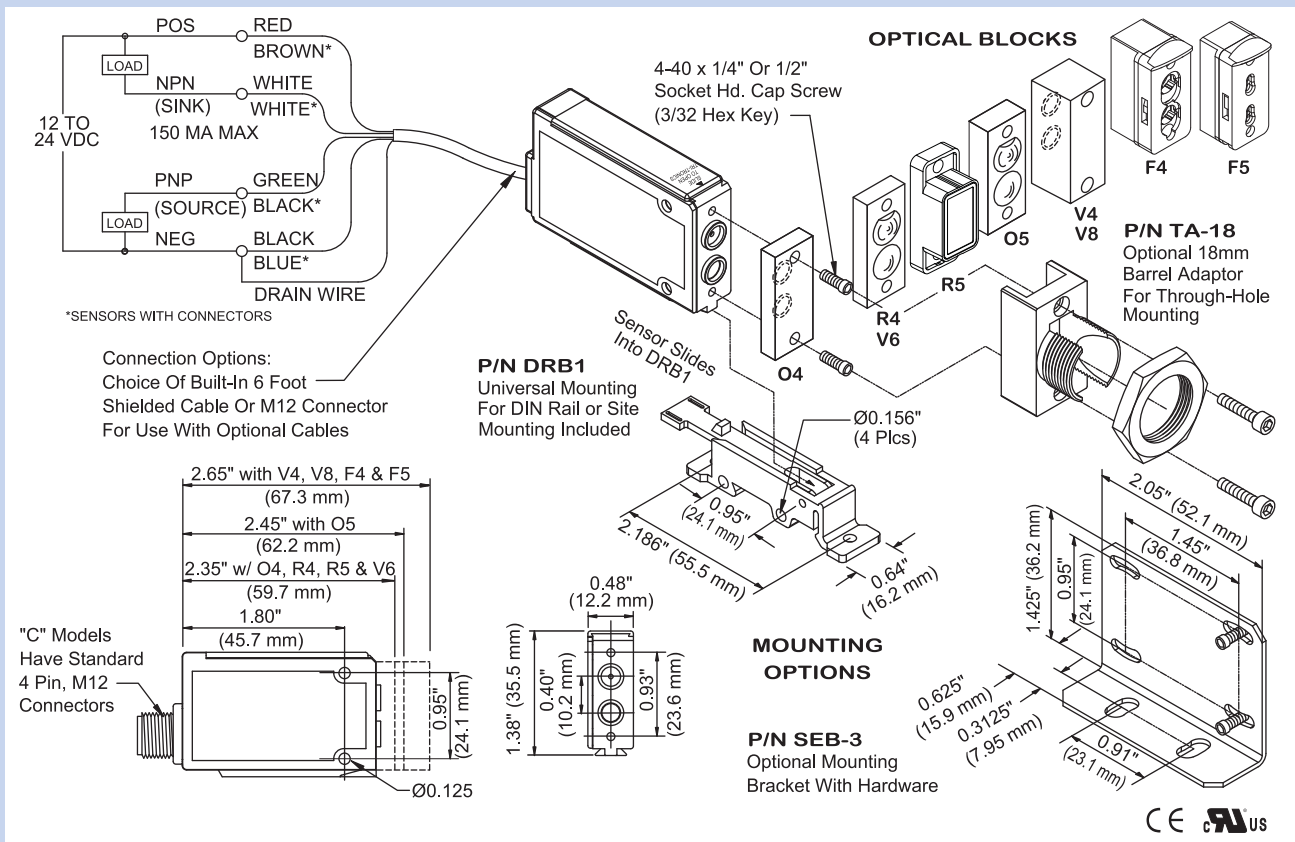
## RUGGED CONSTRUCTION

- Chemical resistant housing
- Rated NEMA 4X, 6P and IP67
- Epoxy encapsulated for mechanical strength.

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions

## SMARTEYE® MARK III PHOTOELECTRIC SENSOR





High Resolution  
High Speed



CLASSIC



Since introducing the SMARTEYE® line, these unique pulse modulated Photoelectric Sensors have successfully performed hundreds of intricate “low contrast” sensing tasks in critical material handling and automation applications—including product inspection tasks where even \$5,000 and \$10,000 vision systems couldn’t do the job!

In fact, the versatile SMARTEYE® has set a new “standard of performance” in the photoelectric sensing of size, texture, distance, opacity, depth and even color. With SMARTEYE®, there is no question whether it will perform the task, because SMARTEYE® will do the job with “performance to spare.”

High-speed response, high sensitivity, and long-range capabilities, combined with the unique CONTRAST INDICATOR™ give you a sensor that you can depend on—a sensor that eliminates marginal performance—and all at an affordable price!

## Contrast Indicator

The CONTRAST INDICATOR displays a scaled reading of the level of light received by the sensor’s photo detector. The more light received, the higher the reading. The less light received, the lower the reading.

Contrast is a comparison of the lightest state reading vs. the darkest state reading. The sensing task of any digital (switching) photoelectric sensor is to resolve the difference between these two light levels and switch the output accordingly. The SMARTEYE® switches its output when the light level passes the midscale reading of “5”.

## Fiberoptic Light Guides

Flexible fiberoptic light guides are available in sizes

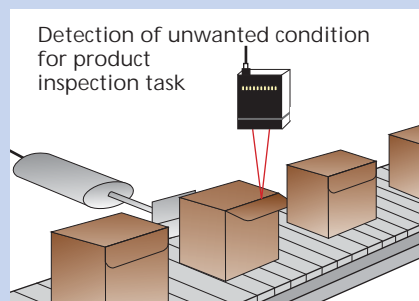
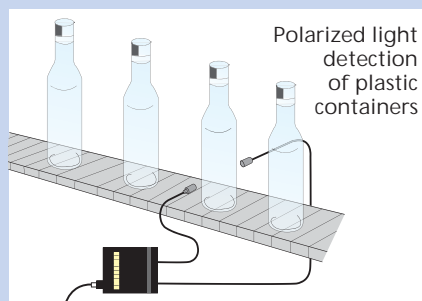
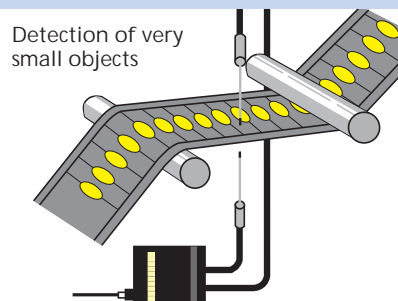


small enough to fit into your toughest job sensing sites, in models for inaccessible places and detection of extremely small parts, for high temperature applications, corrosive environments, or high-vibration locations, as well as straight light guides for Beam Break and bifurcated light guides for proximity sensing.

## Features

- Unique CONTRAST INDICATOR™ allows easy setup for optimum performance and displays actual performance during operation
- High-speed models: 500 microseconds Beam Make or Beam Break. Excellent resolution and high-speed response. Recommended for most sensing tasks
- High-gain models: 1.5 milliseconds Beam Make or Beam Break. Highest resolution. Recommended for “very low” contrast tasks
- Very high-speed models: 100 microseconds Beam Make or Beam Break. Good resolution with very high-speed response. Recommended for use when speed of response is critical
- Pulse-modulated for high immunity to ambient light
- Unique interchangeable optical block design
- Digital (switching) NPN or PNP output transistor models available
- Analog (DC proportional) output models available
- Light source selection: infrared, high intensity, red, (vis-

## Typical Applications



Switching Models			DC Proportional Models (Analog)	Performance	Light Source
NPN	(Digital)	PNP			
SD		PSD	SA	High Speed, 500 $\mu$ s	Infrared
SDL		PSDL	SAL	High Gain, 1.5 ms	Infrared
VSD		PVSD	-	Very High Speed, 100 $\mu$ s	Infrared
SDR		PSDR	SAR	High Speed, 500 $\mu$ s	Red
SDLR		PSDLR	SALR	High Gain, 1.5 ms	Red
SDLG		PSDLG	-	High Gain, 1.5 ms	Green
HSD		PHSD	-	High Speed, 500 $\mu$ s	High Intensity IR
HSDL		PHSDL	-	High Gain, 1.5 ms	High Intensity IR
-	-	-	SAQ	Near Linear Output/Opposed Mode	Infrared
-	-	-	HSAQ	Near Linear Output/Proximity Mode	High Intensity IR

NOTE: NPN models shown. To order PNP Current Sourcing outputs, add prefix "P" to model number.

## PERFORMANCE

### High Speed Models: SD, PSD

(recommended for most sensing tasks)

Excellent resolution and high-speed response. 500  $\mu$ s Beam Make or Beam Break. Maximum input events per second = 1000. Optimized to provide a balance between high speed of response and performance to match moderate to low-contrast applications typically found in high-speed automation.

### High Gain Models: HSD, PHSD

(recommended for very low contrast applications)

Highest resolution. 1.5 ms Beam Make or Beam Break. Maximum input events per second = 333. High amplification enables sensor to respond to very low contrast applications found in the more difficult sensing tasks. High gain is often necessary in SMARTEYE®s used to perform product inspection or orientation sensing tasks.

### Very High Speed Models: VSD, PVSD

(recommended only when high-speed sensing is critical)

Good resolution and very high-speed response. 100  $\mu$ s Beam Make or Beam Break. Maximum input events per second = 5000. Optimized to provide very high speed response while maintaining the necessary performance levels required in high velocity/high speed sensing.

## LIGHT SOURCE SELECTION

### Infrared Light Source

Invisible light – recommended in opaque object sensing applications. Infrared LED light source provides long-range sensing in either Beam Make or Beam Break modes. Infrared light maximizes the sensor's ability to penetrate contamination found in harsh environments.

### High Intensity Infrared Light Source

Invisible light for maximum possible range in either Beam Make or Beam Break sensing modes. Provides maximum penetration for use in harsh environments. Also works well with the small diameter fiberoptic light guides. NOTE: Not recommended for use in close-up sensing or for use in most low contrast applications.

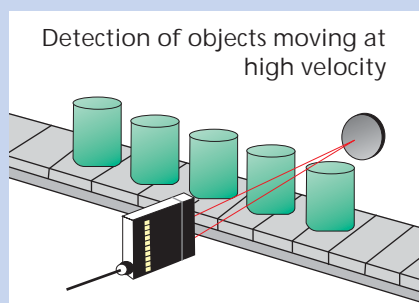
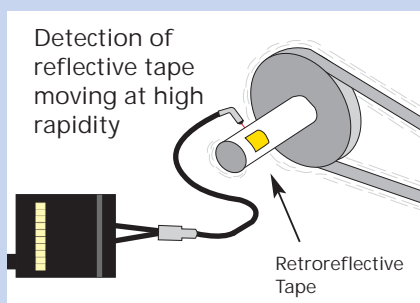
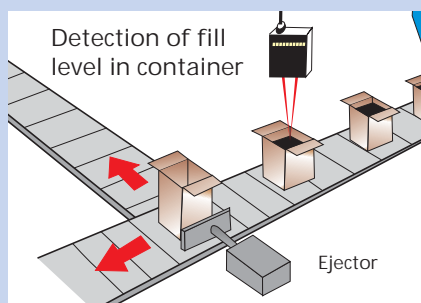
### Red (Visible) Light Source

Visible red LED light source recommended for sensing transparent/translucent objects. Outperforms infrared light in many moderate to low contrast applications. Also recommended for use with plastic fiberoptic light guides.

### Green (Visible) Light Source

Recommended for use only in applications where the color green provides an obvious advantage. An example would be sensing a light colored red/pink object on a white background. Also has been used in film processing applications when red or infrared light can cause damage to sensitive film.

## Typical Applications

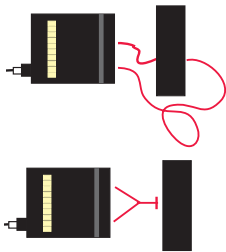


# Optical Block Selection

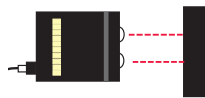
Interchangeable optical blocks provide for universal application of the SMARTEYE® CLASSIC to any sensing task from large object sensing to finite sensing of small parts. Plastic lenses standard. Glass lenses available. Consult factory.



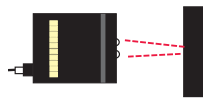
**Type F1**  
Fiberoptic Adapter  
Type F1 adapts SMARTEYE® CLASSIC to any standard fiberoptic light guide with .187" O.D. tips. The light guide is inserted and held in place with set screws. See Fiberoptic Light Guides Section for selection.



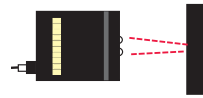
**Type O1, O1G**  
(Glass)  
Medium to Long Range Proximity  
Type O1, O1G (Glass) adapts the SMARTEYE® CLASSIC to the optical proximity mode of sensing. Range is dependent on size, shape, surface reflectivity of the object to be detected.



**Type O2**  
Short Range Proximity  
Type O2 also adapts the SMARTEYE® CLASSIC to the optical proximity mode of sensing, but on a sharp "V" axis to control depth of view. Range is dependent on model of The SMARTEYE® CLASSIC selected.



**Type V1, V1G**  
(Glass)  
Focused Lens  
"V" Axis  
Type V1, V1G (Glass) is for direct lens "V" axis sensing at close ranges. Used for small part or precise leading edge sensing. Range is dependent on model of the SMARTEYE® CLASSIC selected.



**Type R1**  
Retroreflective  
Type R1 turns the SMARTEYE® CLASSIC into a retroreflective sensor. Range is dependent on model the SMARTEYE® CLASSIC selected and size of reflectors.



## Sensing Range Guidelines

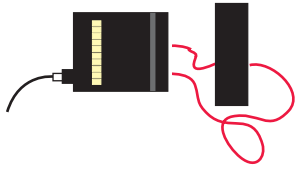
SMARTEYE® CLASSIC DIGITAL (SWITCHING) MODELS

Optical Blocks	SD	SDL	VSD	SDR	SDLR	SDLG	HSD	HSDL
O1, O1G	3 ft.	4 ft.	2 ft.	1 1/2 ft.	2 1/2 ft.	N/A	5 ft.	6 ft.
O2	4 1/2 in.	5 1/2 in.	3 in.	1 3/4 in.	2 1/4 in.	N/A	5 1/2 in.	7 in.
V1, V1G	3 in.	4 1/2 in.	2 1/2 in.	2 1/4 in.	3 in.	3/4 in.	4 3/4 in.	7 in.
R1	20 ft.	30 ft.	16 ft.	12 ft.	30 ft.	N/A	32 ft.	35 ft.
F1 (Prox)	3 1/2 in.	5 in.	2 in.	3 in.	4 1/2 in.	1/4 in.	5 1/2 in.	6 1/2 in.
F1 (Prox w/lens)	7 in.	10 in.	6 in.	10 in.	9 in.	N/A	10 in.	NOT RECOMMENDED
F1 Opposed	32 in.	48 in.	28 in.	6 in.	12 in.	2 3/4 in.	54 in.	66 in.
F1 Opposed w/lens	16 ft.	20 ft. +	14 ft.	11 ft.	13 1/2 ft.	3 ft.	20 ft. +	20 ft. +

### NOTES:

- For more Information on useful range, see Fundamentals, Section 1.
- PROXIMITY tests utilized a 90% reflective target.
- RETROREFLECTIVE tests utilized a 3 in. diam. reflector Model AR3
- FIBEROPTIC tests utilized .125 in. diam. fiber bundles. Model UAC-15 Lens was used as indicated.

Option 1



## Preferred Mode: Beam Break

Fiberoptic opposed mode is best choice for detecting any opaque object.

Sensor: Model SDF1 (IR Light Source)

Fiberoptic Light Guides: (2) Model F-A-36T

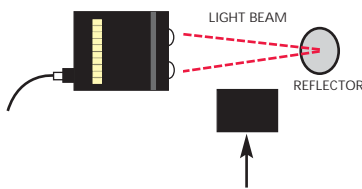
Sensing Range: Up to 3.2 in.

Accessories: (2) Model UAC-15 lenses, extends sensing range up to 15 ft.

Mounting bracket, Model SEB-1, FMB-1

NOTE: Select smaller fiber bundle for small part detection. (See Fiberoptic Section)

Option 2



Retroreflective mode. Use with reflector to detect medium to large size opaque objects.

Sensor: Model SDRR1 (Red Light Source)

Reflector: Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted. (See Accessories

Section for complete listing of reflectors)

Sensing Range: Up to 20 ft.

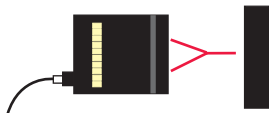
Accessories: Mounting bracket, Model SEB-1

NOTE: Not recommended for detecting highly reflective objects.

## Alternate Mode: Beam Make (Proximity)

NOTE: Consider proximity mode when installation sensing site conditions preclude using the preferred Beam Break mode.

Option 1



Fiberoptic proximity is used to detect medium to large flat sided opaque objects.

Sensor: Model SDF1 (IR Light Source)

Fiberoptic Light Guides: Model BF-A-36T

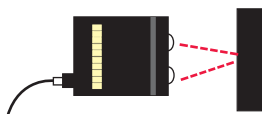
Sensing Range: Up to 3.5 in.

Accessories: (1) Model UAC-15 lens. Use to extend sensing range up to 7 in.

Mounting bracket, Model SEB-1, FMB-1

NOTE: Select smaller fiber bundle for small part detection. (See Fiberoptic Section)

Option 2



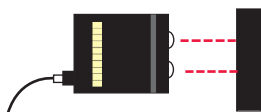
Convergent/proximity mode is useful to detect opaque objects when there is little (if any) gap between objects.

Sensor: Model SDV1 (IR Light Source)

Sensing Range: From 1/2 to 3 in.

Accessories: Mounting bracket, Model SEB-1

Option 3



Proximity (divergent beam) mode sensing is useful in detecting some large size opaque objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.

Sensor: Model SD01 (IR Light Source)

Sensing Range: From 1/2 to 3 ft.

Accessories: Mounting bracket, Model SEB-1



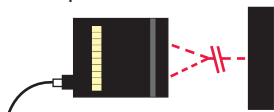
## Preferred Mode: Retroreflective Beam Break

NOTE: The *Preferred Sensor* is the SMARTEYE® EZ-PRO Model EZPRF1, EZPBF1 or EZPRCF4 with a BF-A-36T fiber and a 78P reflector. (Refer to SMARTEYE® EZ-PRO Selection Guidelines, for details)

## Alternate Mode: Beam Make (Proximity)

NOTE: Consider proximity mode when translucent/transparent objects/containers are filled with clear liquid or when site conditions preclude using the preferred retroreflective Beam Break mode.

Option 1.



Fiberoptic proximity mode is useful to detect transparent/translucent objects.

Sensor: Model SDLRF1 (Red Light Source)

Fiberoptic Light Guides: Model BF-A-36T

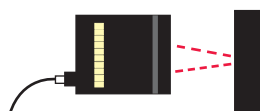
Sensing Range: Up to 4.5 in.

Accessories: (1) Model UAC-15 lens. Use to extend sensing range up to 9 in.

Mounting bracket, Model SEB-1, FMB-1

NOTE: Select smaller fiber bundle for small part detection. (See Fiberoptic Section)

Option 2.



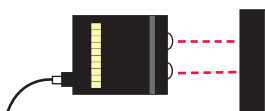
Convergent/proximity mode is useful to detect most transparent/translucent objects when there is little (if any) gap between objects.

Sensor: Model SDLV1 (Red Light Source)

Sensing Range: From 1/2 in. to 3 in.

Accessories: Mounting bracket, Model SEB-1

Option 3.



Proximity (divergent beam) mode sensing is useful in detecting some large size translucent/transparent objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.

Sensor: Model SDLR01 (Red Light Source)

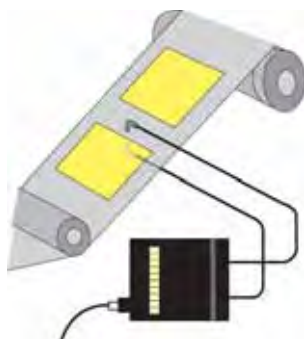
Sensing Range: From 1/2 in. to 2.5 ft.

Accessories: Mounting bracket, Model SEB-1

## LABEL SENSING:

## Alternate Mode: Fiberoptic Opacity (Thru-Beam)

Alternate Mode:



Best method to detect self-adhesive labels on backing material.

Sensor: Model SDF1 (IR Light Source)

Fiberoptic Light Guides: (2) Model F-A-36T

Sensing Range: From 1/2 in. to 2 in.

Accessories: Mounting bracket, Model SEB-1, FMB-1

NOTE: It is not necessary to use smaller fibers for this application. However, many optional sensing tip configurations are available that may provide an improved mechanical fit for your sensing site conditions.

See LABEL•EYE® for preferred method of sensing.

# How to Specify

1. Select Sensor Model based on LED light source and output required

## NPN Output

HSDL	High Gain, High Intensity IR
HSD	High Speed, High Intensity IR
SDL	High Gain IR
SD	High Speed IR
VSD	Very High Speed IR
SDLR	High Gain Red
SDR	High Speed Red

## PNP Output

PHSDL	High Gain, High Intensity IR
PHSD	High Speed, High Intensity IR
PSDL	High Gain IR
PSD	High Speed IR
PVSD	Very High Speed IR
PSDLR	High Gain Red
PSDR	High Speed Red

## Analog Output

SAL	High Gain IR
SA	High Speed IR
SALR	High Gain Red
SAR	High Speed Red
HSAQ	Near Linear High Intensity IR
SAQ	Near Linear High Intensity IR

2. Select Optical Block based on mode of operation required

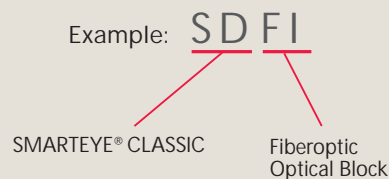
F 1 = Fiberoptic

O1, O1G = Medium to Long Range Proximity

O2 = Short Range proximity

V1, V1G = Focused V-Axis Lens (not available on Analog Sensors)

R1 = Retroreflective (not available on Analog Sensors)



FMB-1 (8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket



SEB-1  
Stainless "L" Bracket



FMB-2 (5.1 mm diam.)  
FMB-3 (3.1 mm diam.)  
Miniature Glass or Plastic  
Fiberoptic Mounting  
Brackets

# Specifications



## SUPPLY VOLTAGE

- 12 to 24 VDC
- Polarity protected

## CURRENT REQUIREMENTS

- 75 mA (exclusive of load)

## OUTPUTS

Digital (Switching)

- Models with complementary NPN output transistors sink up to 100 mA @ 40 VDC max
- Models with complementary PNP output transistors source up to 100 mA @ 40 VDC max
- Zener protected against voltage spikes

Analog (DC Proportional)

- Output swings from 0 up to 3 volts less than supply voltage with RL greater than 10K ohms

Models SAQ and HSAQ

- Approximates near linear output

## HYSTERESIS

- 400 millivolts for maximum sensitivity and resolution

## LED LIGHT SOURCE WAVELENGTH

- Infrared = 880 nm
- Red = 660 nm
- Green = 550 nm

## RESPONSE TIME

- Minimum duration of input event—Beam Make or Beam Break

High Speed Models = 500 microseconds, 1000 input events per second

High Gain Models = 1.5 milliseconds, 333 input events per second

Very High Speed Models = 100 microseconds, 5000 input events per second

Analog Models = Speed of response represents rise time output from 10% to 90% of voltage swing

## LIGHT IMMUNITY

- Pulse modulated to provide extremely high immunity to ambient light—including sunlight

## AMBIENT TEMPERATURE

- -40°C to 70°C (-40°F to 158°F)

## RUGGED CONSTRUCTION

- Chemical resistant, high impact poly carbonate housing
- Epoxy encapsulated for mechanical stability
- Waterproof, ratings: NEMA 4X, 6P and IP67



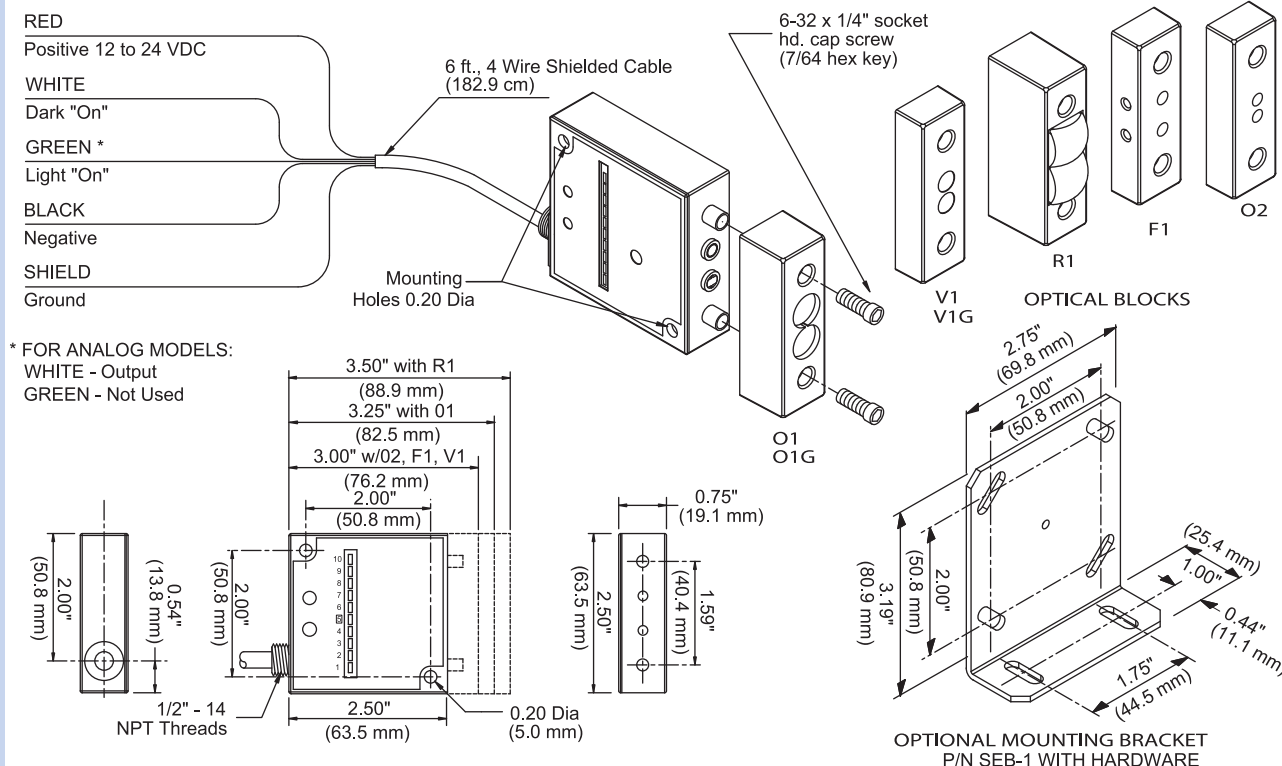
## ADJUSTMENTS AND INDICATORS

- OFFSET – Sets initial level in relation to switch point of "5" on CONTRAST INDICATOR—also functions as a sensitivity adjustment
- OUTPUT INDICATOR – LED illuminates and output switches when returned light level exceeds "5" on CONTRAST INDICATOR
- CONTRAST INDICATOR – Displays scaled reading of contrasting light levels (light vs. dark) on a 10-bar LED display
- ANALOG MODELS – Gain sets amplification level to light /dark differential

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions

## SMARTEYE® CLASSIC





Economical DIN Rail Mount Sensor  
Changeable Optical Blocks

**OPTI-EYE®**



OPTI-EYE® Photoelectric Sensors are high performance and versatile when applied to tough industrial sensing tasks. This sensor provides a combination of high gain and high speed of response (500 microseconds). High gain enables the sensor to resolve low contrast sensing tasks. High speed response provides resolution of the exact position of objects traveling at high speed.

#### OPERATING MODE OPTIONS:

Choice of nine "quick change" optical blocks allows use in the proximity, convergent, retroreflective, polarized retroreflective or fiberoptic sensing modes.

#### LED LIGHT SOURCE OPTIONS:

Choice of two LED light sources. Use the invisible IR light source for long range sensing or hostile environments. Use the visible RED light source for use with plastic fibers or for polarized retroreflective sensing.

#### CONNECTION OPTIONS:

Choice of built-in 6 foot shielded cable or connector for use with optional cables.

#### MOUNTING OPTIONS:

Choice of five mounting methods including DIN rail, through-hole and bracket mount.

#### OPTICAL BLOCK OPTIONS:

OPTI-EYE®'s unique lensed optical blocks are molded of solid optical grade, high-impact plastic. This innovative concept helps to prevent condensation or fog build-up on the inside of the lens. Multiple varieties of optical blocks are available for operating the OPTI-EYE®



# OPTI-EYE®

in either the retroreflective, polarized (non-glare), proximity, opposed, fiberoptic, or convergent sensing modes. A simple change of the optical block can be very useful in determining the best sensing mode for use in your specific sensing task. These inexpensive, interchangeable optical blocks reduce the inventory burden of replacement parts and eliminate the need for discarding a complete sensor in the case of damage to the optical block.

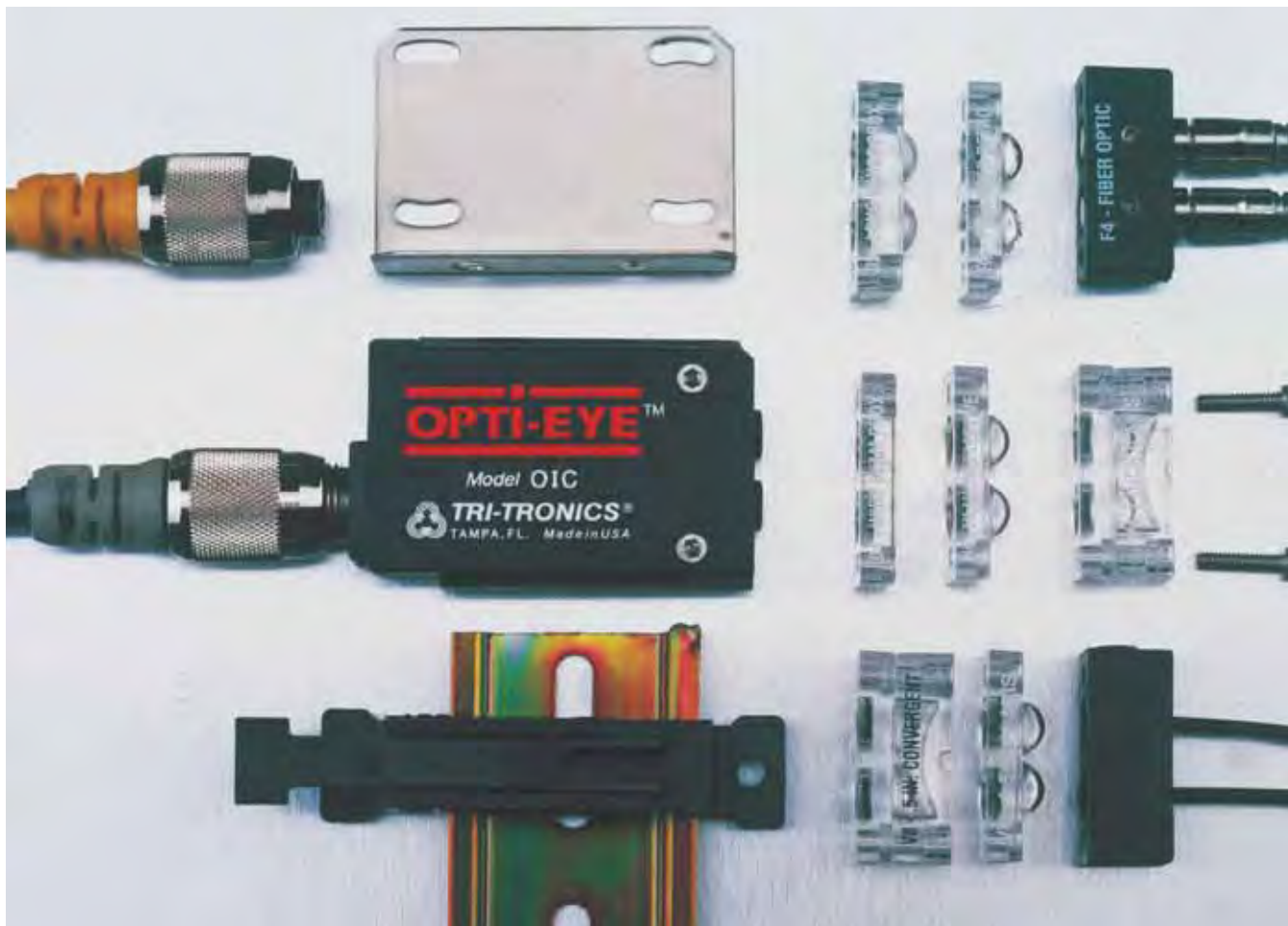
OPTI-EYE® offers many unique features including a range adjustment (light source intensity) and three LED setup indicators. The range adjustment allows operation over a wide dynamic range. The green LED indicator illuminates when the received light level exceeds the sensor's light state switch point.

The yellow LED indicator displays the intensity of the sensor's light source. This indicator provides the installer an idea of where in the overall dynamic operating range the adjustment has been set. This is particularly impor-

tant when using the invisible IR light source. The red LED illuminates when the output transistors are in the "on" status. Now you can set up and adjust the sensor as easily as monitoring the status of three LED indicators.

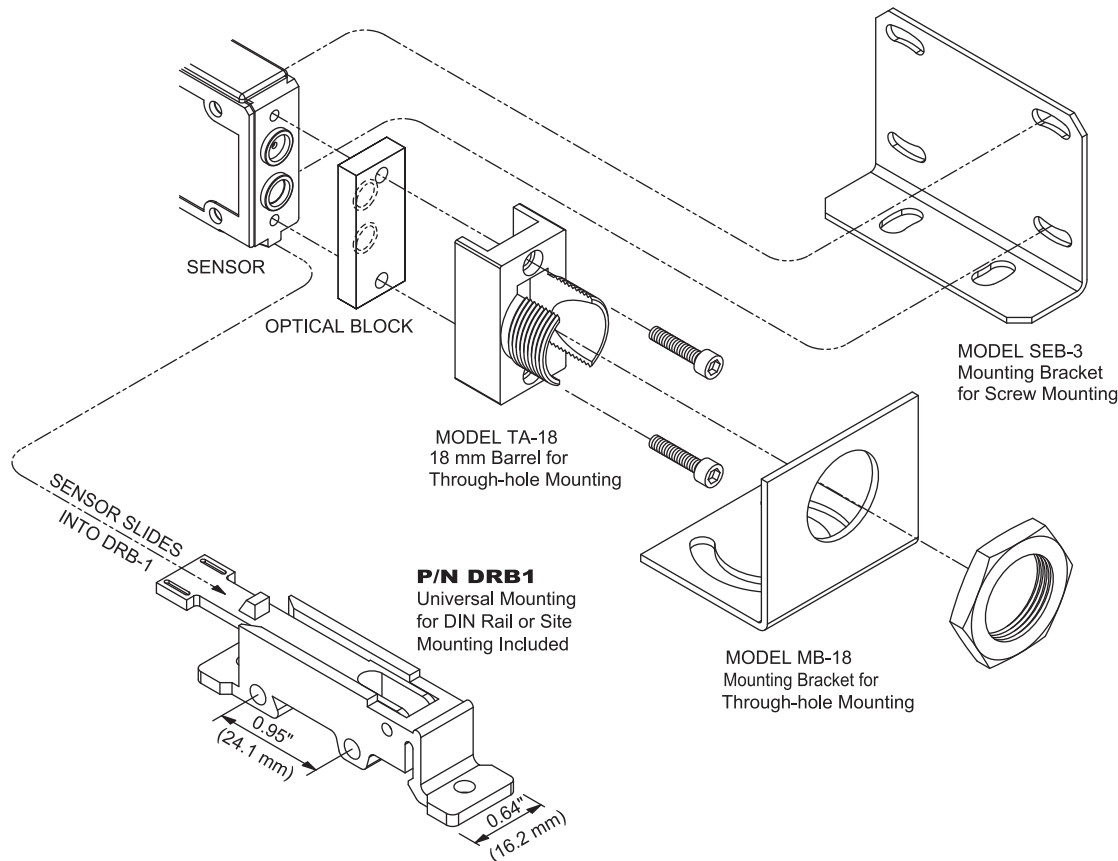


## OPTI-EYE® is a complete modular system



## Five Unique Mounting Options:

1. Snap Mount onto a DIN rail with Universal Bracket Model DRB-1
2. Screw mount at sensing site with Universal Bracket Model DRB-1
3. Through-hole mount with optional 18mm Threaded Barrel Adapter Model TA-18
4. Screw mount with optional "L" Shaped Stainless Steel Bracket Model SEB-3
5. Screw mount directly to the machine



## Light Source Guidelines

### INVISIBLE INFRARED LIGHT SOURCE (880 nm)

- A. Best choice in most opaque object sensing tasks.
- B. Provides longest possible sensing range in either Beam Make or Beam Break sensing modes.
- C. Best choice in hostile environments. Useful in penetrating lens contamination.
- D. Preferred for use with small glass fiberoptic light guides. Note: Do not use IR light with plastic fiberoptic light guides.
- E. Preferred when sensing dark colored objects in the proximity (Beam Make) mode. i.e. black, blue, green, etc.
- F. Useful in penetrating containers for verification of contents. Also useful in detecting overlapped splices in dense materials.
- G. Color perception; tends to favor blue colored objects.

### RED LIGHT SOURCE (660 nm)

- A. Best choice for use with plastic fiberoptic light guides.
- B. Useful when sensing translucent objects in proximity (Beam Make) mode.
- C. Useful when sensing transparent objects in fiberoptic retroreflective (Beam Break) mode.
- D. Can be polarized for retroreflective (Beam Break) sensing to reduce proying on shiny objects.
- E. Opposed fiberoptic light guides can be polarized for sensing some translucent plastic containers. Consult factory for details.
- F. Used as red filter for color perception advantages.

# Optical Block Selection

Interchangeable optical blocks provide for universal application of the OPTI-EYE® to any sensing applications from large object sensing to finite sensing of small parts, registration mark detection, and product inspection tasks.



OPTI-EYE®

2

General Application Photoelectric Sensors



**Type O4**  
Proximity  
Wide beam optics useful for short-range sensing of transparent, translucent or irregular shaped shiny objects.



**Type O5**  
Proximity  
Narrow beam optics useful in long-range sensing of medium to large size objects.



**Type R4**  
Retroreflective  
Very narrow beam optics designed to sense reflectors or reflective materials at long range. Designed for Beam Break sensing.



**Type R5**  
Polarized  
Anti-Glare  
Retroreflective  
Polarized to reduce response to "hot spot" glare from shiny surface of detected object. Use with red light source.



**Type V4, V4A**  
Convergent  
1" "V" Axis  
Narrow beam optics that focus at a sensing range of 1". Useful for sensing small parts. Also useful for proximity sensing (range of 1" to 5") to minimize response to reflected light from background objects.



**Type V6**  
Convergent  
1.5" "V" Axis  
Narrow beam optics that focus at a sensing range of 1.5". Useful for sensing small parts. Also useful for proximity sensing (range of 1.5" to 8") to minimize response to reflected light from background objects.



**Type V8**  
Convergent  
.5" "V" Axis  
Narrow beam optics that focus at a sensing range of .5". Useful for sensing small parts or registration color marks. Also useful for proximity sensing (range of .25" to 5") to minimize response to reflected light from background objects.



**Type F4**  
Glass Fiber Optics  
Adapts OPTI-EYE® for use with a wide variety of glass fiberoptic light guides for both the proximity and opposed sensing modes.



**Type F5**  
Plastic Fiber Optics  
Adapts OPTI-EYE® for use with a wide variety of plastic fiberoptic light guides for both the proximity and opposed sensing modes.

## Sensing Range Guidelines

Convergent / Proximity / Retroreflective		
OPTICAL BLOCKS	IR	RED
V4, V4A	1 in.	1 in.
V6	1.5 in.	1.5 in.
V8	0.5 in.	0.5 in.
O4	5 in.	2.5 in.
O5	3 ft.	1.5 ft.
R4	20+ ft.	18 ft.
R5	N/A	10 ft.

NOTE: Proximity test utilized a 90% reflective white target. Retroreflective tests utilized a 3" diam. round reflector, Model AR-3

Glass fiberoptics		
OPTICAL BLOCKS	IR	RED
Opposed Mode		
F4	8 in.	4 in.
F4 w/lens	20 ft.	18 ft.
Proximity Mode		
F4	3 in.	1.25 in.
F4 w/lens	6 in.	3 in.

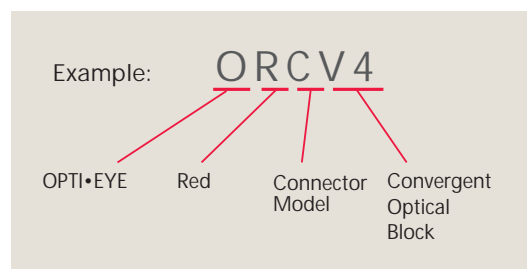
NOTE: Range tests utilized a .125" diam. fiber bundle

Plastic fiberoptics		
OPTICAL BLOCKS	IR	RED
Opposed Mode		
F5	N/A	2 in.
F5 w/lens	N/A	2 ft.
F5 w/right angle lens	N/A	1 ft.
Proximity Mode		
F5	N/A	5 in.
F5 w/lens	N/A	1 ft.

NOTE: Range tests utilized a .040" diam. fiber

# How To Specify

1. Select Sensor Model.
2. Select Sensor light source required:  
I = Infrared; R = Red
3. Select Connector required:  
Blank = Cable; C = Connector
4. Select Optical Block based on mode of operation required.



## Accessories

### Micro Cable Selection Guide, 4-wire, M12

	<b>Yellow Shielded Cable Assemblies</b>
	SEC-6 6' (1.8 m) cable with connector
	SEC-15 15' (4.6 m) cable with connector
	SEC-25 25' (7.62 m) cable with connector
	RSEC-6 6' (1.8 m) cable / right angle conn.
	RSEC-15 15' (4.6 m) cable / right angle conn.
	RSEC-25 25' (7.62 m) cable / right angle conn.
	<b>Black Shielded Cable Assemblies (Lightweight)</b>
	BSEC-6 6' (1.8 m) cable with connector
	BSEC-15 15' (4.6 m) cable with connector
	BSEC-25 25' (7.62 m) cable with connector
	BRSEC-6 6' (1.8 m) cable / right angle conn.
	BRSEC-15 15' (4.6 m) cable / right angle conn.
	BRSEC-25 25' (7.62 m) cable / right angle conn.
	BX-10 10' (3.1 m) Extension cable
	BX-25 25' (7.62 m) Extension cable
	<b>Grey Unshielded Cable Assemblies</b>
	GSEC-2MU 6.5' (2.0 m) Low-cost
	GSEC-5MU 16.4' (5.0 m) Low-cost

**OPTI-EYE®**



FMB-1 (8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket



FMB-2 (5.1 mm diam.)  
FMB-3 (3.1 mm diam.)  
Miniature Glass or Plastic  
Fiberoptic Mounting  
Brackets



LK-4  
Lens Kit  
(See Optical Blocks  
Accessories for contents)



SEB-3  
Stainless "L" Bracket



TA-18  
18mm Adapter



MB-18  
Mounting Bracket



DRB-1  
Bracket

#### **IMPORTANT:**

To reduce the possibility of electrical interference, use TRI-TRONICS molded plug/shielded cable assembly

# Specifications

**OPTI-EYE®**

## SUPPLY VOLTAGE

- 12 to 24 VDC
- Polarity Protected

## CURRENT REQUIREMENTS

- 60 mA (exclusive of load)

## OUTPUT TRANSISTORS

- (1) NPN and (1) PNP output transistors:  
NPN: Sink up to 150 mA  
PNP: Source up to 150 mA
- Momentary short circuit protected
- Outputs protected from pulsing during power up
- Light/Dark switch determines output status:  
LT = Light "ON" operate  
DK = Dark "ON" operate

## RESPONSE TIME

- Minimum duration of input event:  
500 microseconds

## HYSTERESIS

- Set for Medium-to-Low contrast application

## LED LIGHT SOURCE

- Choice of color: Infrared = 880 nm  
or Visible Red = 660 nm

## LIGHT IMMUNITY

- Responds to sensor's pulse modulated  
light source – immune to most ambient light

## RANGE ADJUSTMENT

- 15 turn Light Source Intensity control

## AMBIENT TEMPERATURE

- -40°C to 70°C (-40°F to 158°F)



## INDICATORS

### • OUTPUT INDICATOR

RED LED illuminates when the output transistors are in the "ON" state as determined by the Light/Dark switch

### • BEAM STATUS INDICATOR

GREEN LED illuminates when received light level exceeds the sensor's light state switch point

### • LIGHT SOURCE INTENSITY INDICATOR

YELLOW LED illuminates proportionally to the Light Source intensity as determined by the Range adjustment

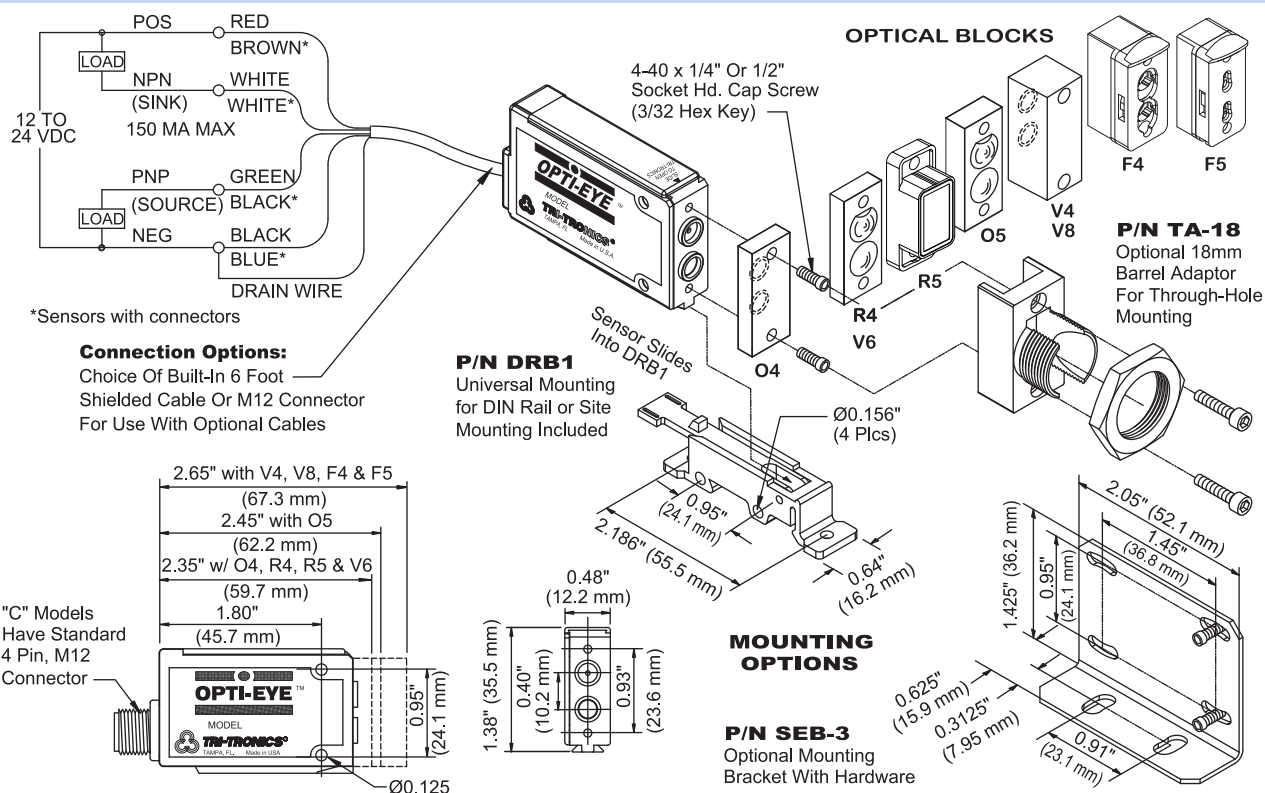
## RUGGED CONSTRUCTION

- Chemical resistant housing
- Waterproof, ratings, NEMA 4X, 6P and IP67
- Epoxy encapsulated for mechanical strength

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions

## OPTI-EYE® PHOTOELECTRIC SENSOR





Affordable  
All-Purpose  
EZ To Use



# Miniature Push-Button Photoelectric Sensor



EZ-EYE™

2

General Application Photoelectric Sensors

- Object Detection
- Web Break Detection
- Counting
- Inspection
- Orientation and much more...



**EZ-EYE™** miniature photoelectric sensors fulfill the need for an affordable, push-button sensor that is EZ to align and EZ to adjust. Optimized for machine control automation, the setup is easy with the unique one-touch AUTOSET™ routine. Simply place the sensor in the Light State condition and push the button once for a perfect setting. That's all there is to it!

**Push-Button Adjustment:** EZ to select higher excess gain... just tap the button twice to increase the excess gain (sensitivity). **Note:** Initiating the AUTOSET™ routine followed by tapping the button emulates a screwdriver adjustment.

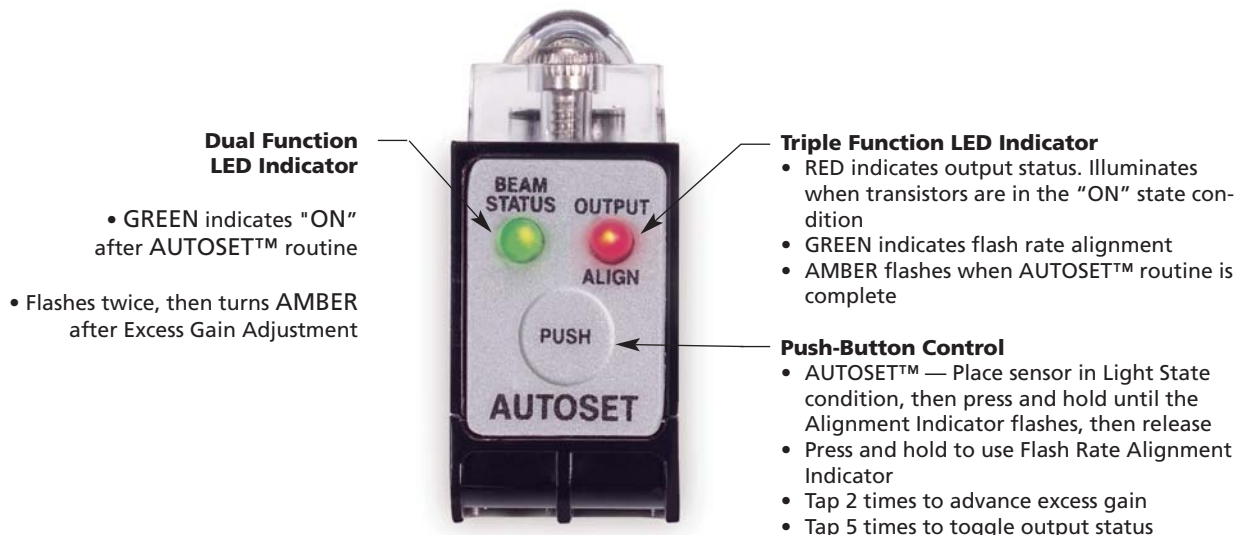
**Optical Block Options:** Unique lensed optical blocks are molded of solid, optical-grade, high-impact plastic. This innovative concept helps to prevent condensation on the inside of the lens. Ten varieties of optical blocks are available for operating the EZ-EYE, such as retroreflective, polarized retroreflective, proximity, fiberoptic or convergent sensing modes. A simple change of the optical block can be very useful in determining the best sensing mode for your specific sensing task. These inexpensive, interchangeable optical blocks eliminate the need for discarding a complete sensor in the case of damage to the optical block.

The **EZ-EYE™** photoelectric sensor by TRI-TRONICS® fulfills the need for an affordable, push-button sensor that is EZ to align and EZ to adjust.



## FEATURES & BENEFITS

- EZ to adjust...AUTOSET™ routine requires a single push of a button.
- EZ to align...Flash Rate Indicator monitors received light intensity.
- EZ to select higher excess gain...tap the button twice to increase excess gain (sensitivity).  
**Note:** Initiating the AUTOSET™ routine followed by tapping the button emulates a screwdriver adjustment.
- EZ to select sensing mode...choose from ten completely interchangeable optical blocks.
- EZ-EYE™ sensors are available with either infrared (IR) or red LED light sources.
- EZ EYE™ sensors are equipped with both NPN and PNP output transistors.
- Power supply requirements: 10 to 24 VDC.
- Responds to sensor's pulsed modulated light source... resulting in high immunity to most ambient light, including strobes.



## LIGHT SOURCE GUIDELINES

### INVISIBLE INFRARED LIGHT SOURCE (880 nm)

- A. Best choice in most opaque object sensing tasks.
- B. Provides longest possible sensing range in either Beam Make or Beam Break sensing modes.
- C. Best choice in hostile environments. Useful in penetrating lens contamination.
- D. Preferred for use with small glass fiberoptic light guides.  
 Note: Do not use IR light with plastic fiberoptic light guides.
- E. Preferred when sensing dark colored objects in the proximity (Beam Make) mode, i.e., black, blue, green, etc.
- F. Useful in penetrating containers for verification of contents. Also useful in detecting overlapped splices in dense materials.

### RED LIGHT SOURCE (660 nm)

- A. Best choice for use with plastic fiberoptic light guides.
- B. Useful when sensing translucent or transparent objects in proximity (Beam Make) mode.
- C. Can be polarized for retroreflective (Beam Break) sensing to reduce proxing on shiny objects.
- D. Opposed fiberoptic light guides can be polarized for sensing some translucent plastic containers. Consult factory for details.

## OPTICAL BLOCK SELECTION

Interchangeable optical blocks provide for universal application of the **EZ-EYE™** to any sensing application from large object sensing to finite sensing of small parts and product inspection tasks.



**Type O4  
Proximity**

Wide beam optics useful for short-range sensing of transparent, translucent or irregular shaped shiny objects.



**Type O5  
Proximity**

Narrow beam optics useful in long-range sensing of medium to large size objects.



**Type R4  
Retroreflective**

Very narrow beam optics designed to sense reflectors or reflective materials at long range. Designed for Beam Break sensing.



**Type R5  
Polarized  
Anti-Glare  
Retroreflective**

Polarized to reduce response to "hot spot" glare from shiny surface of detected object. Use with red light source.



**Type V4  
Convergent  
1" "V" Axis**

Narrow beam optics that focus at a sensing range of 1". Useful for sensing small parts. Also useful for proximity sensing (range of 1" to 5") to minimize response to reflected light from background objects.



**Type V6  
Convergent  
1.5" "V" Axis**

Narrow beam optics that focus at a sensing range of 1.5". Useful for sensing small parts. Also useful for proximity sensing (range of 1.5" to 8") to minimize response to reflected light from background objects.



**Type V8  
Convergent  
.5" "V" Axis**

Narrow beam optics that focus at a sensing range of .5". Useful for sensing small parts. Also useful for proximity sensing (range of .25" to 5") to minimize response to reflected light from background objects.



**Type F4  
Glass Fiberoptics**

Adapts for use with a wide variety of glass fiberoptic light guides (.187 O.D.) for both the proximity and opposed sensing modes.



**Type F5  
Plastic Fiberoptics**

Adapts for use with a wide variety of plastic fiberoptic light guides (.090 O.D.) for both the proximity and opposed sensing modes.

## RANGE GUIDELINES

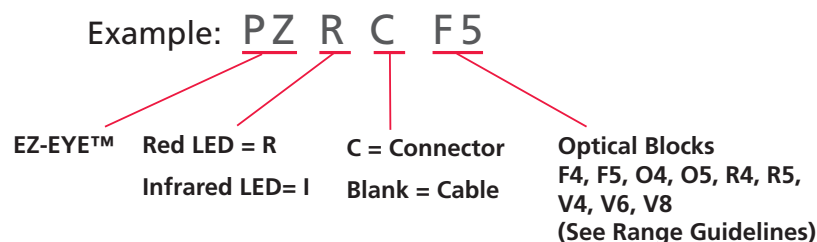
OPTICAL BLOCKS	PZI	PZR
	Infrared LED	Red LED
O4 Proximity	5" (127 mm)	2.0" (51 mm)
O5 Proximity	3' (914 mm)	16" (406 mm)
R4 Retroreflective	40' (12.0 m)	20' (6.09 m)
R5 Polarized Retro.	N/A	12' (3.6 m)
V4	1" (25.4 mm)	1" (25.4 mm)
V6 Convergent	1.5" (38 mm)	1.5" (38 mm)
V8 Convergent	.5" (12.7 mm)	.5" (12.7 mm)

GLASS FIBEROPTICS	PZI	PZR
	Infrared LED	Red LED
<b>Type F4, .125" diam. (3.175 mm)</b>		
Proximity	2.5" (63.5 mm)	1.25" (31.75 mm)
Proximity w/ UAC-15	5" (127 mm)	6" (152.4 mm)
Opposed	7" (178 mm)	3.5" (88.9 mm)
Opposed w/ UAC-15	10' (3.048 m)	5' (1.524 m)

<b>PLASTIC FIBEROPTICS Type F5, .040" diam. (1.016 mm)</b>		
Proximity	N/A	1" (25.4 mm)
Opposed	N/A	4.5" (114.3 mm)
Opposed w/ GLA-2 Lens	N/A	10' (3.048 m)

**NOTE:** All proximity tests utilized a 90% reflective, white target.  
All retroreflective tests utilized model AR6151 high-performance reflector.

## HOW TO SPECIFY



## ACCESSORIES

### 4-Wire Nano Cable, M8



**GEC-6**  
6' (1.8 m) cable with connector



**GEC-15**  
15' (4.6 m) cable with connector



**GEC-25**  
25' (7.6 m) cable with connector

**RGEC-6**  
6' (1.8 m) cable / right angle conn.

**RGEC-15**  
15' (4.6 m) cable / right angle conn.

**GEX-9**  
9' (2.7 m) extension cable



**EEB-1**  
Vertical Stainless  
Bracket Assembly



**EEB-2**  
Horizontal  
Bracket Assembly



**FMB-1** (8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket

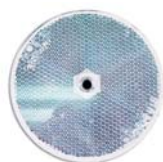


**LK-4**  
Lens Kit  
(See Optical Blocks  
Accessories for contents)

### Screw Mount Reflectors



**78P**  
4.4" x 1.9"  
(111.7 mm x 48.3 mm)



**AR3**  
3" diam.  
(76.2 mm diam.)

### Optional Prismatic High-Performance Reflectors NEMA 4, IP67



**AR6151**  
**AR6151G**  
(Chemical Resistant  
Glass Cover)  
2.4" x 2.0"  
(61 x 51 mm)



**AR4060**  
1.6" x 2.36"  
(40.5 x 60 mm)



**AR46**  
1.8" diam.  
(46 mm diam.)  
Glue Mount



**FMB-2** (5.1 mm diam.)  
**FMB-3** (3.1 mm diam.)  
Miniature Glass or  
Plastic Fiberoptic  
Mounting Brackets



Go to  
**ttco.com**  
for  
**fiberoptic  
light guide  
selections**

# Specifications



## SUPPLY VOLTAGE

- 10 to 24 VDC
- Polarity Protected

## CURRENT REQUIREMENTS

- 50 mA (exclusive of load)

## OUTPUT TRANSISTORS

- (1) NPN and (1) PNP sensor output transistor
- Sensor's output can sink or source up to 150 mA (current limited)
- Outputs are continuously short-circuit protected

## RESPONSE TIME

- Light State response = 500 microseconds
- Dark State response = 500 microseconds

## LED LIGHT SOURCE

- Red = 660 nm
- Infrared = 880 nm
- Pulse Modulated

## PUSH BUTTON CONTROL

- AUTOSET™ Routine: Push and release with sensor in "light" state
- Excess Gain Adjustment: Tap twice to step to higher excess gain
- Push and hold to activate Flash Rate Alignment Indicator
- Light /Dark "ON" selection: Tap 5 times to toggle

## RANGE

- Dependent on optical block (see range guidelines)

## HYSTERESIS

- Approximately 15% of signal

## LIGHT IMMUNITY

- Responds to sensor's pulse-modulated light source, resulting in high immunity to most ambient light, including high intensity strobes.

## DIAGNOSTIC INDICATORS

- Dual Red/Green LED  
Red = Output Status NOTE: If Output LED flashes, a short circuit condition exists.  
Green = Flash Rate Alignment Indicator
- Dual Green/Amber LED  
Green = "ON" After AUTOSET™ Routine  
Amber = "ON" After Excess Gain Adjustment

## AMBIENT TEMPERATURE

- -40° to 70°C (-40° to 158° F)

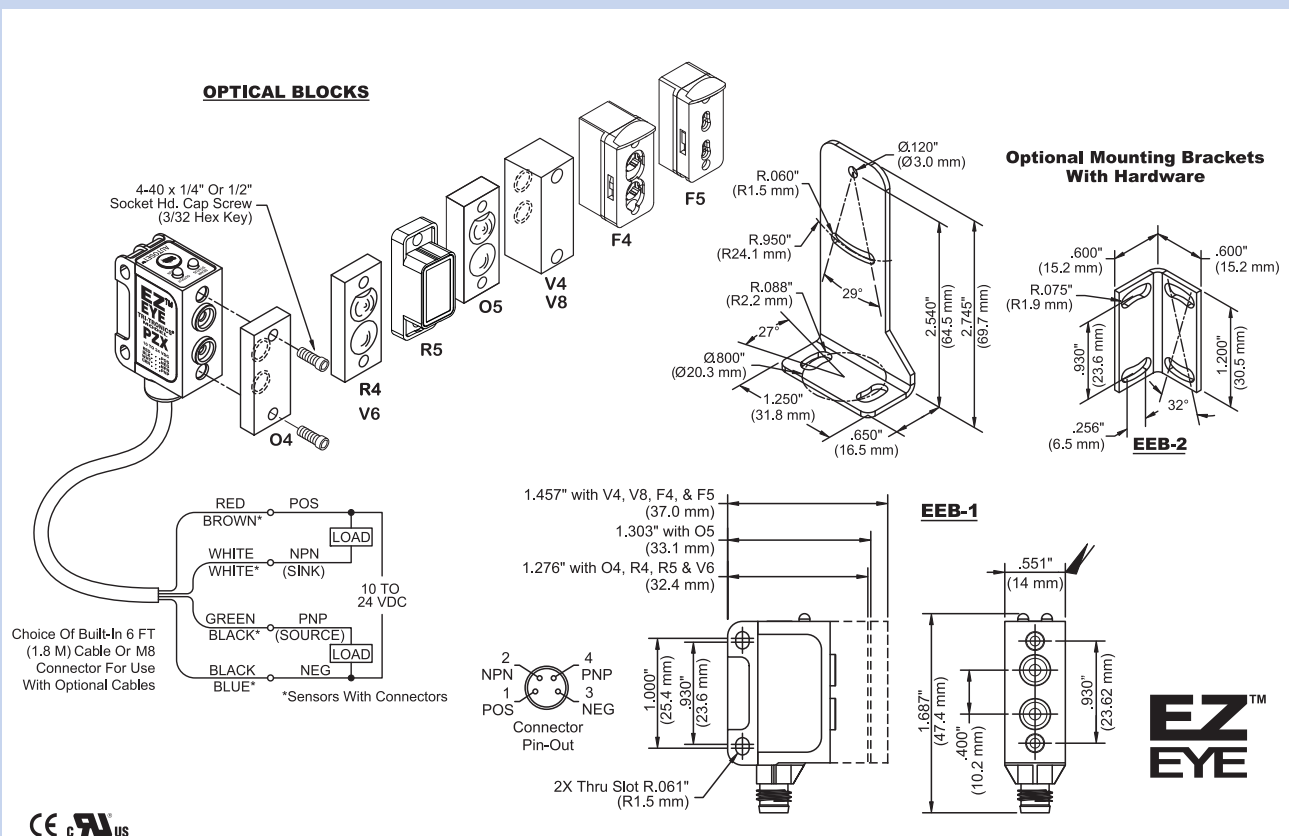
## RUGGED CONSTRUCTION

- Chemical resistant, high impact polycarbonate housing
- Waterproof ratings: NEMA 4, IP67
- Conforms to heavy industry grade CE requirements

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions

## EZ-EYE™ PHOTOELECTRIC SENSOR



**NEW!**



**"Small, Rugged and Powerful...  
yet Low in Price"**

**MINI-EYE™**

# Miniature Sensor

## MINI-EYE™

**"Small, Rugged and Powerful...  
yet Low in Price"**

The **TRI-TRONICS MINI-EYE™** photoelectric sensors are designed to be low in cost and high in value. The sensors are waterproof and are enclosed in a high-impact plastic housing.

**Thru-Beam Models** utilize a separate light source and receiver for "Beam Make" or "Beam Break" sensing. Recommended for long-range sensing or for use in environments where dust or dirt buildup may cover the lens.

The sensors provide a very narrow beam path from the light source to the receiver and are perfect for sensing small gaps or precise sensing tasks, which is critical when attempting to resolve the exact location of passing objects. The light source requires a simple 2-wire connection and functions independently of other receivers.

**Retroreflective Models** operate in either the "Beam Make" or "Beam Break" sensing mode and are designed to be used with a prismatic reflector. Detection occurs when the light beam is broken by a passing target or object. The visible, red, polarized model helps to prevent "proxing" or responding to undesirable light reflecting from shiny objects, such as cans, glass and clear plastic. The invisible, infrared light source model is rec-

**Our Lowest Cost Sensor that outperforms anything in its price range!**

### Applications:

- Presence/Absence Detection
- Material Handling
- Counting
- Sorting
- Orientation
- Web Break Detection

ommended for long-range sensing.

**Proximity Models** are designed for close range sensing tasks and operate by detecting the reflected light from targeted objects. The red LED light source is recommended for detecting transparent objects, such as clear glass or plastic bottles. The invisible infrared LED light source is recommended for general purpose sensing tasks.

All **MINI-EYE™** sensors are available with a quick disconnect M8 4-PIN connector or a potted 6' (1.8 m) 4-wire cable, and with a red or infrared LED light source. They are easy to set up and can operate in either the light "ON" or dark "ON" mode. For light "ON" operation, connect the white wire to negative and for dark "ON" operation, simply connect the white wire to positive.

Hands down, the **MINI-EYE** is a tough little sensor that outperforms anything in its price range!

# Features

- Standard and 18 mm mounting models
- Laser, thru-beam models
- Sensors are available with either infrared (IR) or red LED light source, and either NPN or PNP output transistor
- Fixed Optics - Proximity, Retroreflective, Polarized Retroreflective, and Thru-Beam
- Selectable Light "ON" or dark "ON" operation
- High immunity to ambient light and strobes
- Waterproof with high-impact housing
- High Speed — 600  $\mu$ s; 1.1 ms (opposed mode)
- Potted 6' 4-wire cable or M8 4-PIN connector
- Operates between 10 to 30 VDC  
(5-volt models available – consult factory for details)
- Reverse polarity protection
- Short circuit protection
- Power-up output suppression
- EMC tested

## Light Source Guidelines

### INVISIBLE INFRARED LIGHT SOURCE (850 nm)

- A. Best choice in most opaque object sensing tasks
- B. Provides longest possible sensing range in either Beam Make or Beam Break sensing modes
- C. Best choice in hostile environments; useful in penetrating lens contamination
- D. Preferred when sensing dark colored objects in the proximity (Beam Make) mode, i.e., black, blue, green, etc.

### RED LED LIGHT SOURCE (633 nm)

- A. Useful when sensing translucent objects in proximity (Beam Make) mode
- B. Can be polarized for retroreflective (Beam Break) sensing to reduce proying on shiny objects
- C. Visible red LED allows for easy alignment

*NOTE: Red, laser light source, 650 nm, Class 1*

# Fine Tuning Adjustment



18 mm Mounting

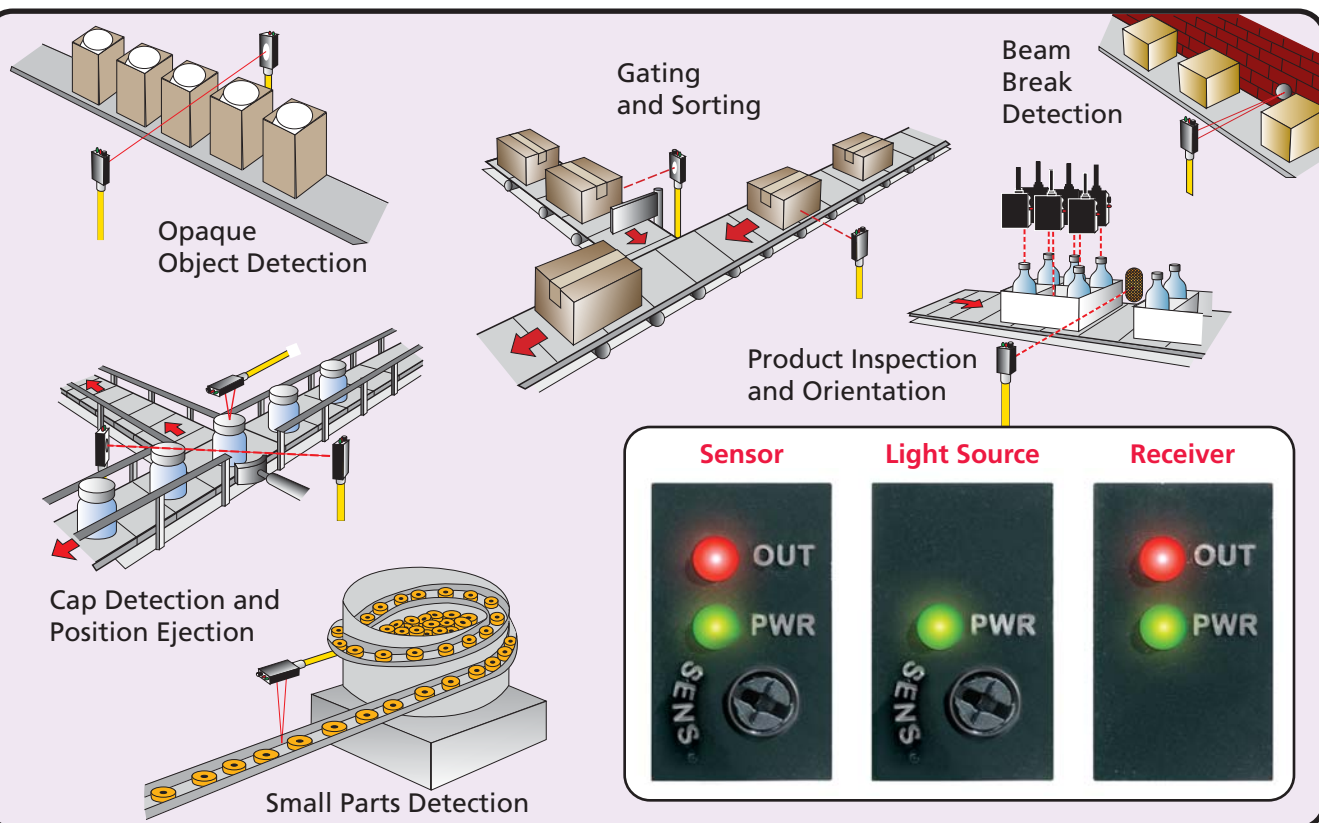
Gain (Sensitivity)  
Screwdriver Adjustment  
(Adjustment N/A on Receiver models)

Power "ON" Indicator  
GREEN LED

Output Status Indicator  
RED LED  
(N/A on Light Source models)



## Typical Applications



# Selection Guidelines

HOW TO SPECIFY				
MODELS		DESCRIPTION	RANGE	
STANDARD	18 mm	SHORT RANGE PROXIMITY	STANDARD	18 mm
MIVC	MIVC-18	IR, NPN, Connector	6" (152.4 mm)	6" (152.4 mm)
MIV	MIV-18	IR, NPN, Cabled	6" (152.4 mm)	6" (152.4 mm)
MRVC	MRVC-18	Red, NPN, Connector	4" (101.6 mm)	4" (101.6 mm)
MRV	MRV-18	Red, NPN, Cabled	4" (101.6 mm)	4" (101.6 mm)
PMIVC	PMIVC-18	IR, PNP, Connector	6" (152.4 mm)	6" (152.4 mm)
PMIV	PMIV-18	IR, PNP, Cabled	6" (152.4 mm)	6" (152.4 mm)
PMRVC	PMRVC-18	Red, PNP, Connector	4" (101.6 mm)	4" (101.6 mm)
PMRV	PMRV-18	Red, PNP, Cabled	4" (101.6 mm)	4" (101.6 mm)
LONG RANGE PROXIMITY				
MIPC	MIPC-18	IR, NPN, Connector	24" (609.6 mm)	24" (609.6 mm)
MIP	MIP-18	IR, NPN, Cabled	24" (609.6 mm)	24" (609.6 mm)
MRPC	MRPC-18	Red, NPN, Connector	16" (406.4 mm)	11" (279.4 mm)
MRP	MRP-18	Red, NPN, Cabled	16" (406.4 mm)	11" (279.4 mm)
PMIPC	PMIPC-18	IR, PNP, Connector	24" (609.6 mm)	24" (609.6 mm)
PMIP	PMIP-18	IR, PNP, Cabled	24" (609.6 mm)	24" (609.6 mm)
PMRPC	PMRPC-18	Red, PNP, Connector	16" (406.4 mm)	11" (279.4 mm)
PMRP	PMRP-18	Red, PNP, Cabled	16" (406.4 mm)	11" (279.4 mm)
RETROREFLECTIVE				
MIRC	MIRC-18	IR, NPN, Connector	7' (2.1 m)	25' (7.6 m), 45' (13.6 m)*
MIR	MIR-18	IR, NPN, Cabled	7' (2.1 m)	25' (7.6 m), 45' (13.6 m)*
MRRC	MRRC-18	Red, Polarized, NPN, Connector	8' (2.4 m)	8' (2.4 m)
MRR	MRR-18	Red, Polarized, NPN, Cabled	8' (2.4 m)	8' (2.4 m)
PMIRC	PMIRC-18	IR, PNP, Connector	7' (2.1 m)	25' (7.6 m), 45' (13.6 m)*
PMIR	PMIR-18	IR, PNP, Cabled	7' (2.1 m)	25' (7.6 m), 45' (13.6 m)*
PMRRC	PMRRC-18	Red, Polarized, PNP, Connector	8' (2.4 m)	8' (2.4 m)
PMRR	PMRR-18	Red, Polarized, PNP, Cabled	8' (2.4 m)	8' (2.4 m)
THRU-BEAM				
LIGHT SOURCE				
MLSIC	MLSIC-18	Infrared, Connector	65' (20 m)	65' (20 m)
MLSI	MLSI-18	Infrared, Cabled	65' (20 m)	65' (20 m)
MLSRC	MLSRC-18	Red, Connector	15' (4.6 m)	15' (4.6 m)
MLSR	MLSR-18	Red, Cabled	15' (4.6 m)	15' (4.6 m)
RECEIVERS				
MRC	MRC-18	NPN, Connector	DEPENDENT ON LIGHT SOURCE	
MR	MR-18	NPN, Cabled		
PMRC	PMRC-18	PNP, Connector		
PMR	PMR-18	PNP, Cabled		
LASER THRU-BEAM				
LIGHT SOURCE				
MLZRC	MLZRC-18	Red, Connector	200' (61 m)	200' (61 m)
MLZR	MLZR-18	Red, Cabled	200' (61 m)	200' (61 m)
RECEIVERS				
MLRC	MLRC-18	NPN, Connector		
MLR	MLR-18	NPN, Cabled		
PMLRC	PMLRC-18	PNP, Connector		
PMLR	PMLR-18	PNP, Cabled		

**New!**



NOTE: Retroreflective sensors equipped with a red light source are polarized to prevent proxing off shiny objects. Proximity test utilized a 90% reflective white target. Retroreflective tests utilized a 3" diam., round reflector, Model AR3.

NOTE: Receivers can be used with either IR or Red Light Sources.

\*AR82 High performance reflector.

# Accessories

## 4-Wire Nano Cable, M8



**GEC-6**  
6' (1.8 m) cable with connector



**GEC-15**  
15' (4.6 m) cable with connector



**GEC-25**  
25' (7.6 m) cable with connector

**RGEC-6**  
6' (1.8 m) cable / right angle conn.

**RGEC-15**  
15' (4.6 m) cable / right angle conn.

**GEX-9**  
9' (2.7 m) extension cable

Standard  
Mounting



18 mm  
Mounting

## Screw Mount Reflectors



**78P**  
4.4 in. x 1.9 in.



**AR3**  
3 in. Diameter



**AR4060**  
1.6" x 2.36"  
40.5 x 60 mm



**AR6151**  
**AR6151G**  
(Chemical Resistant  
Glass Cover)  
2.4" x 2.0"  
(61 x 51 mm)



**AR-46**  
1.8" diameter  
46 mm diameter  
Glue Mount

## Prismatic High-Performance Reflectors

## Optional Mounting Brackets



**MB-18**  
Mounting Bracket  
(for 18 mm  
mounting models)



**MIB-1**  
Stainless Bracket  
Assembly



**MIB-2**  
Stainless Bracket  
Assembly



**MIB-3 (Standard)**  
**MIB-4 (18 mm)**  
Stainless Laser Light  
Source Bracket

# Specifications

## SUPPLY VOLTAGE

- 10 to 30 VDC
- Polarity protected
- Note: 5 VDC +/- 10%

## CURRENT REQUIREMENTS

- 30mA (exclusive of load)
- OUTPUT TRANSISTORS (CURRENT LIMITED)
- NPN: Sink up to 100mA
- PNP: Source up to 100mA
- All outputs are continuously short circuit protected

## RESPONSE TIME

- Light State response = 600µs (1,100µs, Thru-Beam)
- Dark State response = 600µs (1,100µs, Thru-Beam)

## LIGHT SOURCE

- LED, Red = 660 nm
- LED, Infrared = 880 nm
- Pulse Modulated
- Laser, Red = 650 nm, Class 1

## LIGHT/DARK "ON" OPERATION

- Light "ON" achieved by connecting white wire to negative lead
- Dark "ON" achieved by connecting white wire to positive lead

## RANGE

- Dependent on model, see Selection Guidelines
- Note: 5 VDC models, range reduced by 10%

## HYSTERESIS

- Approximately 20% of signal

## LIGHT IMMUNITY

- Responds to sensor's pulse-modulated light source, resulting in high immunity to most ambient light, including high intensity strobes

## DIAGNOSTIC INDICATORS

- Red LED = Output Status
- Green LED = Power "ON"

## AMBIENT TEMPERATURE

- -40°C to 70°C (-40°F to 158°F)

## MINI-EYE™

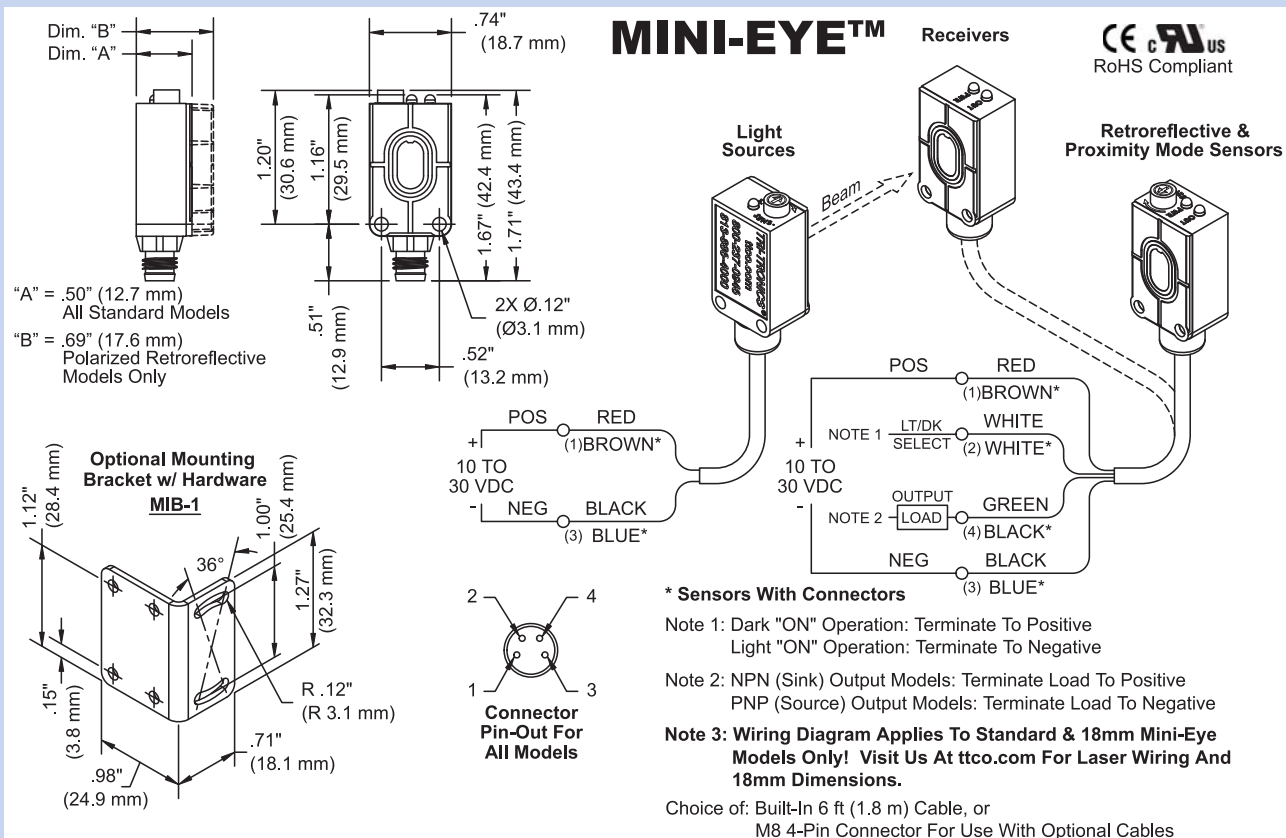


## RUGGED CONSTRUCTION

- Chemical resistant, high-impact polycarbonate housing
- Waterproof ratings: NEMA 4X, IP66

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions





## AC & DC Miniature Sensors Changeable Optical Blocks





## *Designed for Trouble-Free Operation*

Many design features have been incorporated into the **MITY•EYE®** to prevent mechanical or electrical damage and to provide trouble-free operation. The sensitivity pot is protected with a clutch to prevent damage from over-travel. The entire sensor is epoxy-encapsulated to ensure mechanical strength. The case itself is rugged and watertight.

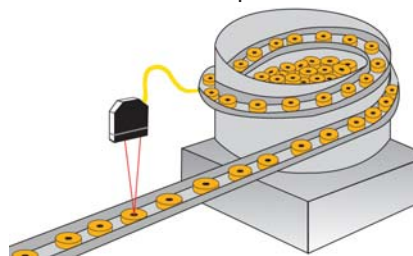
To prevent electrical mishaps, the optically isolated AC solid state switch is protected by an MOV (Metal Oxide Varistor). In addition, the AC switch turns on synchronously at near zero volts which helps to prevent electrical line noise generated by hard relay contacts or inductive loads.

**MITY•EYE's** unique lensed optical blocks are molded of solid optical grade, high-impact plastic. This innovative concept helps to prevent condensation or fog buildup on the inside of the lens. Multiple varieties of optical blocks are available for operating the **MITY•EYE®** in either the retroreflective, polarized (non-glare), proximity, fiberoptic, or convergent sensing modes. A simple change of the optical block can be very useful in determining the best sensing mode for use in your specific sensing task. These inexpensive, interchangeable optical blocks reduce the inventory burden of replacement parts and eliminate the need for discarding a complete sensor in the case of damage to the optical block.

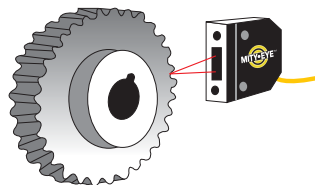


### *Typical Applications*

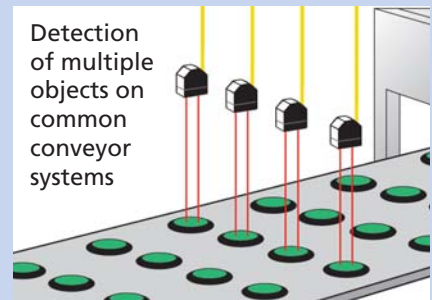
Detection of small parts



Detection of object moving at high speed



Detection of multiple objects on common conveyor systems





## Features

- 500  $\mu$ s Speed of Response
- Totally interchangeable high-impact optical blocks
- Rugged, watertight case
- Selection of red, infrared, or high-intensity red light sources
- Designed to meet or exceed testing laboratory standards
- Convenient “pop-open” hinged control access panel reveals:
  - 4-turn clutched sensitivity adjustment
  - 2-position light/dark switch
- “Extra bright” LED output indicator
- Protected from output chatter/pulsing on power-up
- Operational from:
  - DC models: 10 to 30 VDC
  - AC models: 24 to 240 VAC
- Reverse polarity protection
- One NPN sinking output and one PNP sourcing output (status determined by light/dark switch)
- Output transistor short circuit protection
- Selector switch to determine output status
- Optional micro quick-change connector

Both the light/dark switch and sensitivity adjustment are located behind a clear plastic cover. The panel is made watertight by the use of an “O” ring seal, and its cover is permanently captured by a hinge – no lost screw or cover to worry about! The light/dark switch is a 2-position slide switch that is easily viewable through the clear cover.

The 4-turn sensitivity adjustment was selected over conventional 10 or 15-turn types because it is faster and easier to operate.

The “extra bright” red LED Output indicator is located to the side on a slanted panel so that the indicator can be easily viewed from a wide angle.

**MITY•EYE®** Photoelectric Sensors are designed to provide you with features and benefits of large, expensive sensors ... in a truly miniature package at an affordable price. With features like high speed of response, totally interchangeable optical blocks (including non-glare, polarized retroreflective), and selection of AC or DC-powered models, you can use **MITY•EYE®** in nearly all of your automation sensing tasks. Best of all, you’ll get high quality and unequalled performance in a miniature photoelectric sensor.





## Type O4 Proximity

Wide beam optics useful for short-range sensing of transparent, translucent or irregular shaped shiny objects.



## Type O5 Proximity

Narrow beam optics useful in long-range sensing of medium to large size objects.



## Type R4 Retroreflective

Very narrow beam optics designed to sense reflectors or reflective materials at long range. Designed for Beam Break sensing.



## Type R5 Polarized Anti-Glare Retroreflective

Polarized to reduce response to "hot spot" glare from shiny surface of detected object. Use with red or blue light source.



## Type F4 Glass Fiber Optics

Adapts MITY•EYE® for use with a wide variety of glass fiberoptic light guides for both the proximity and opposed sensing modes.



## Type V4 Convergent 1" "V" Axis

Narrow beam optics that focus at a sensing range of 1". Useful for sensing small parts. Also useful for proximity sensing (range of 1" to 5") to minimize response to reflected light from background objects.



## Type V6 Convergent 1.5" "V" Axis

Narrow beam optics that focus at a sensing range of 1.5". Useful for sensing small parts. Also useful for proximity sensing (range of 1.5" to 8") to minimize response to reflected light from background objects.



## Type V8 Convergent .5" "V" Axis

Narrow beam optics that focus at a sensing range of .5". Useful for sensing small parts or registration color marks. Also useful for proximity sensing (range of .25" to 5") to minimize response to reflected light from background objects.



## Type F5 Plastic Fiber Optics

Adapts MITY•EYE® for use with a wide variety of plastic fiberoptic light guides for both the proximity and opposed sensing modes.

## Sensing Range Guidelines

### MITY•EYE® Models

Optical Blocks	IR	RED	HI INT RED
O4 Proximity	2 in.	1 in.	2 in.
O5 Proximity	18 in.	9 in.	18 in.
R4 Retroreflective	20 ft.	16 ft.	N/A
R5 Polarized Retro	N/A	17 ft.	12 ft.
V4 Convergent	1 in.	1 in.	1 in.
V6 Convergent	1.5 in.	1.5 in.	1.5 in.
V8 Convergent	.5 in.	.5 in.	.5 in.
<b>Glass Fiberoptics</b>			
F4 Proximity	1.5 in.	.5 in.	1 in.
F4 Proximity w UAC-15 lens	8 in.	N/A	6 in.
F4 Opposed	3.5 in.	2.5 in.	3 in.
F4 Opposed w UAC-15 lens	15 ft.	8 ft.	15 ft.
<b>Plastic Fiberoptics</b>			
F5 Proximity	N/A	N/A	1/2 in.
F5 Opposed	N/A	1 in.	2 in.
F5 Opposed w HLA-1 lens	N/A	3.5 ft.	4.5 ft.

MITY•EYE® Sensors offer a selection of either Infrared (invisible), Red (visible), or High Intensity Red (visible) light sources.

**Infrared** – invisible light source recommended for opaque object sensing. The IR LED provides long-range sensing capabilities and maximizes the ability to penetrate contaminated lenses.

**Red** – visible red light source recommended for sensing transparent/translucent objects and for use with the polarized retroreflective lens.

**High Intensity Red** – recommended for long-range proximity sensing and for use with plastic fiberoptic light guides.

NOTES: Proximity test utilized a 90% reflective white target. Retroreflective tests utilized a 3" diam. round reflector, Model AR-3. Range tests utilized a .125" diam. glass fiber bundle or .040" diam. plastic fiber.

# How To Specify

1. Select sensor model based on light source required

## DC POWERED

MDI = Infrared

MDHR = High Intensity RED

MDR = Red

## AC POWERED

MAI = Infrared

MAHR = High Intensity RED

MAR = Red

2. Select Connection

Blank = Cable

C = Connector

## NOTE:

**CAC15 power cable for AC MITY•EYE® ONLY**

3. Select Optical Block based on mode of operation required.

04 = Short Range Proximity

05 = Long Range Proximity

R4 = Retroreflective

R5 = Polarized Retroreflective

V4 = 1.0" V-Axis

V6 = 1.5" V-Axis

V8 = 0.5" V Axis

F4 = Fiberoptic

F5 = Plastic fiberoptic

Example: **MDHR C F4**

MITY•EYE DC High Intensity RED      Connector Model      Fiberoptic Optical Block



**AC & DC  
Miniature Sensors**

## Accessories



**FMB-1** (8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket



**FMB-2** (5.1 mm diam.)  
**FMB-3** (3.1 mm diam.)  
Miniature Glass or Plas-  
tic Fiberoptic Mounting  
Brackets



**TA-18**  
18mm Adapter



**CAC15**  
Custom, AC only, 5-Wire  
MITY•EYE® Cable,  
15' (4.6 m)



**LK-4**  
Lens Kit  
(See Optical Blocks  
Accessories for contents)



**MEB-1**  
Mounting Bracket



**MB-18**  
Mounting Bracket



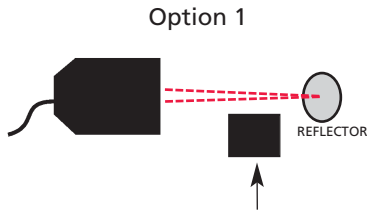
**DC MITY•EYE® Cable**  
4-wire, M12

**SEC-2MU**  
6.5' (2.0 m) Low-cost

**SEC-5MU**  
16.4' (5.0 m) Low-cost

### Opaque Object Sensing

#### Preferred Mode: Beam Break



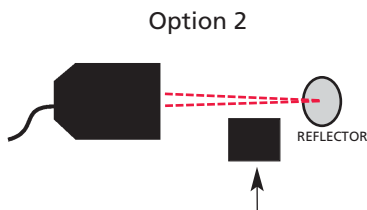
Polarized retroreflective mode is a cost effective mode to detect medium to large size shiny or non-shiny opaque objects. Use with reflector.

**Sensor:** Model MDRR5 (with red light source and 6 ft. cable) or MDRCR5 (with inline connector...requires mating cable Model SEC-5MU).

**Reflector:** Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted. (See Accessories Section for complete listing of reflectors.)

**Sensing range:** Up to 6 ft. (Dependent on size of reflector)

**Accessories:** Mounting bracket, Model MEB-1



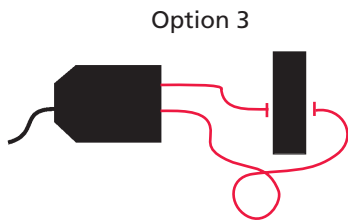
Retroreflective is a cost effective mode to detect medium to large size non-shiny opaque objects. Longer sensing range than polarized mode. Use with reflector.

**Sensor:** Model MDIR4 (with infrared light source and 6 ft. cable) or MDICR4 (with inline connector requires mating cable Model SEC-5MU).

**Reflector:** Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted. (See Accessories Section for complete listing of reflectors.)

**Sensing range:** Up to 18 ft. (Dependent on size of reflector)

**Accessories:** Mounting bracket, Model MEB-1



Fiberoptic opposed mode is excellent choice for detecting any opaque object, particularly in a hostile sensing environment.

**Sensor:** Model MDIF4 (with infrared light source and 6 ft. cable) or MDICF4 (with inline connector...requires mating cable Model SEC-5MU).

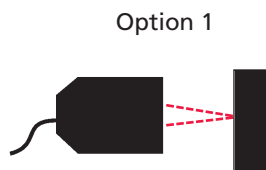
**Fiberoptic light guides:** (2) Model F-A-36T

**NOTE:** Select smaller fiber bundle for small part detection (See Fiberoptic Section)

**Sensing range:** Up to 3 in. without lens. Up to 15ft. with (2) UAC-15 lenses

**Accessories:** (2) Model UAC-15 or (2) UAC-5 Lenses Mounting bracket, Model MEB-1, FMB-1

#### Alternate Mode: Beam Make (Proximity)



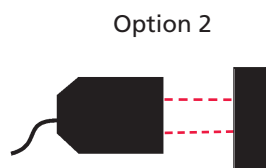
**NOTE:** Consider proximity mode when installation sensing site conditions preclude using the preferred Beam Break mode.

Convergent/proximity mode is useful to detect a wide variety of opaque objects when there is little (if any) space between objects.

**Sensor:** Model MDIV6 (infrared light source and 6 ft. cable) or MDICV6 (with inline connector requires mating cable Model SEC-5MU).

**Sensing range:** From .75 in. to 4 in.

**Accessories:** Mounting bracket, Model MEB-1

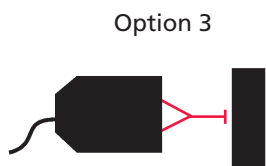


Divergent/proximity mode sensing is useful in detecting medium to large size objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.

**Sensor:** Model MD105 (infrared light source and 6 ft. cable) or MDIC05 (with inline connector...requires mating cable Model SEC-5MU).

**Sensing range:** Up to 1.5 ft.

**Accessories:** Mounting bracket, Model MEB-1



Fiberoptic proximity is useful to detect any opaque object in hostile environments.

**Sensor:** Model MDIF4 (with infrared light source and 6 ft. cable) or MDICF4 (with inline connector...requires mating cable Model SEC-5MU).

**Fiberoptic light guide:** Model BF-A-36T

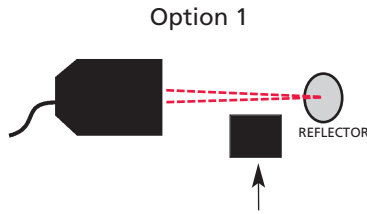
**NOTE:** Select smaller fiber bundle for small part detection. (See Fiberoptic Section)

**Sensing range:** Up to 1.5 in. without lens. Up to 8 in. with UAC-15 lens

**Accessories:** Mounting bracket Model MEB-1, FMB-1. Model UAC-15 lens

## Translucent Object Sensing

### Preferred Mode: Beam Break



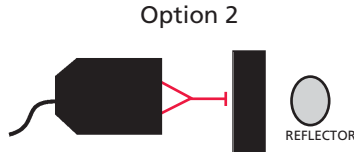
Polarized retroreflective mode

**Sensor:** Model MDRF4 (with red light source and 6 ft. cable) or MDRCR5 (with inline connector... requires mating cable Model SEC-5MU)

**Reflector:** Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted

**Sensing range:** Up to 6 ft. (dependent on size of reflector)

**Accessories:** Mounting bracket, Model MEB-1



Fiberoptic retroreflective mode

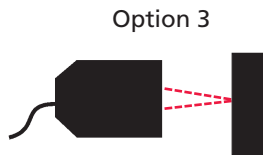
**Sensor:** Modes MDRF4 (with red light source and 6 ft. cable) or MDRCF4 (with inline connector...requires mating cable Model SEC-5MU)

**Fiberoptic light guide:** Model BF-A-36T

**Reflector:** Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted.

**Sensing range:** Up to 4 ft. without lens. Up to 8 ft. with UAC-15 lens

**Accessories:** Mounting bracket, Model MEB-1, FMB-1. UAC-15 lens



### Alternate Mode: Beam Make (Convergent/proximity)

**Sensor:** Model MDRV6 (with red light source and 6 ft. cable) or MDRCV6 (with inline connector...requires mating cable Model SEC-5MU)

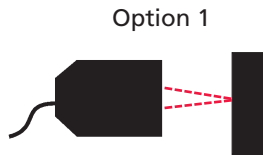
**Sensing range:** Up to 3 in. dependent on size, shape and color

**Accessories:** Mounting bracket, Model MEB-1

## Transparent Object Sensing

**NOTE:** Totally transparent objects can be very difficult to detect. A high performance sensor may be required. See **RETROSMART®** section for details.

### Preferred Mode: Beam Make (Convergent/proximity)



**Sensor:** Model MDRV6 (with red light source and 6 ft. cable) or MDRCV6 (with in-line connector...requires mating cable Model SEC-5MU)

**Sensing range:** Up to 2 in. dependent on size, shape and color

**Accessories:** Mounting bracket, Model MEB-1

## POWER REQUIREMENTS

- 10 TO 30 VDC @ 35mA (reverse polarity protected)

## OUTPUT DEVICES

- Provide both NPN and PNP open collector output transistors capable of sinking or sourcing up to 150 mA continuous
- Short circuit protected
- Zener Diode protected to 36 volts
- Protected against false chattering/pulsing during power up

## RESPONSE TIME

- 500 microseconds (light or dark)

## LIGHT IMMUNITY

- Pulse modulated to provide extremely high immunity to ambient light

## SENSING RANGE

- Range determined by model type, mode of sensing, and optical block type as selected. See Range Chart for details

## ADJUSTMENTS/INDICATORS

- 4-turn clutched sensitivity adjustment
- 2-position light "on" / dark "on" selection switch
- Red LED indicator energizes when light beam is established

## AMBIENT TEMPERATURE

- -20°C to 70°C (-20°F to 158°F)

## RUGGED CONSTRUCTION

- Chemical resistant case, "O" ring sealed to provide moisture protection
- Epoxy encapsulated for mechanical stability
- NEMA 4X, 6P and IP67



## LED LIGHT SOURCE WAVELENGTH

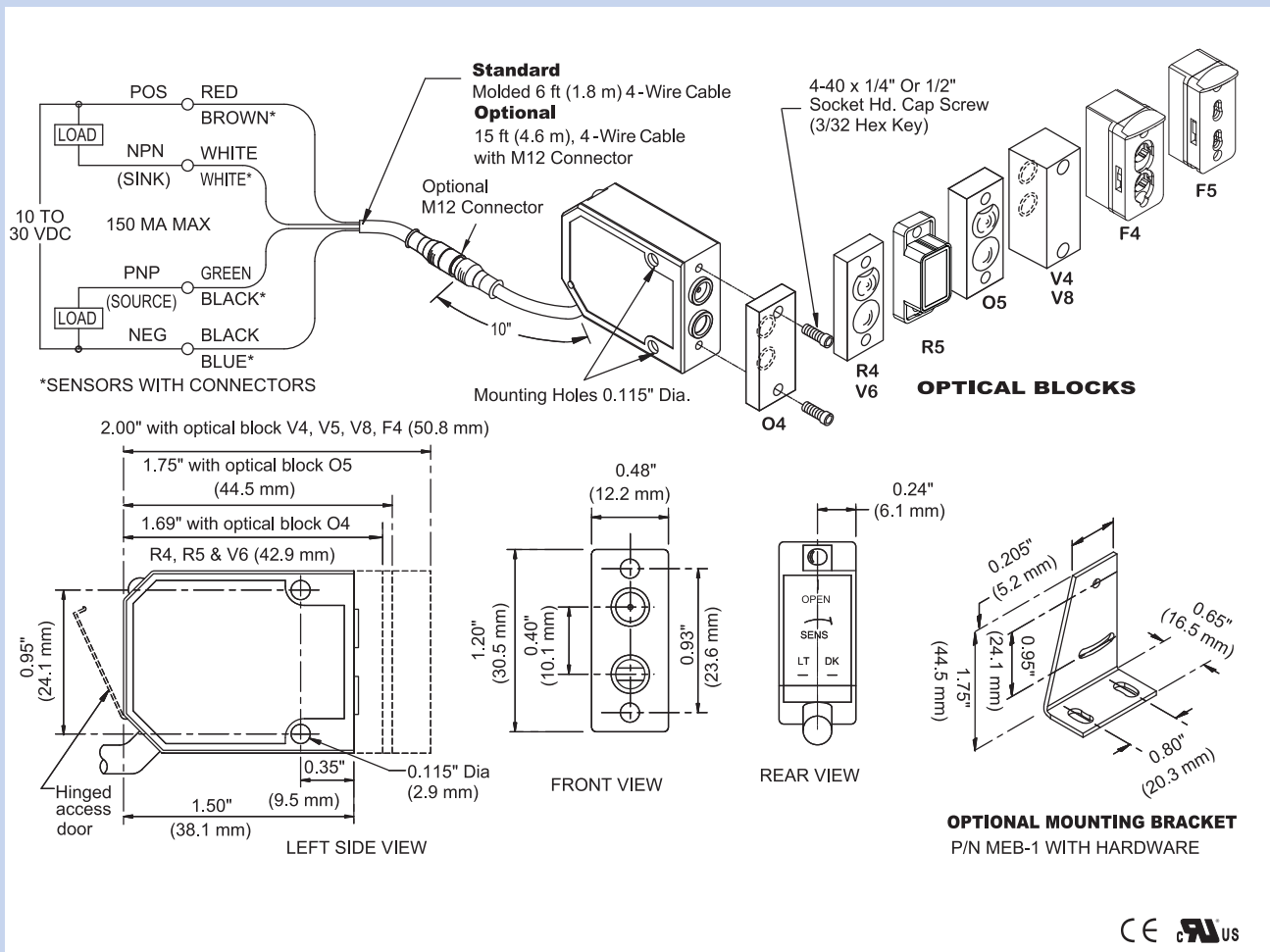
- Infrared = 880 nm
- Red = 660 nm
- High Intensity Red = 650 nm

**NOTE:** DC Mity•Eye with 10" Pigtail is designed to be used with our 4-Wire M12 Power Cable.

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

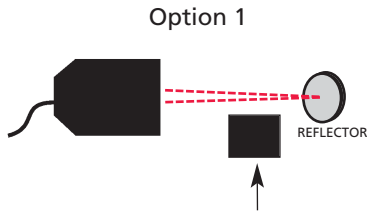
## Connections and Dimensions

## DC MITY•EYE®



## Opaque Object Sensing

### Preferred Mode: Beam Break



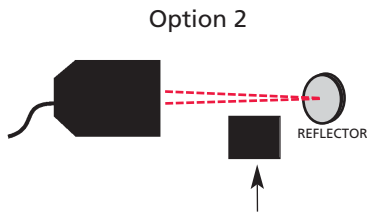
Polarized retroreflective mode is a cost effective mode to detect medium to large size shiny or non-shiny opaque objects. Use with reflector.

**Sensor:** Model MARR5 (with red light source and 6 ft. cable) or MARCR5 (with inline connector...requires mating cable Model CAC15)

**Reflector:** Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted. (See Accessories Section for complete listing of reflectors.)

**Sensing range:** Up to 6 ft. (Dependent on size of reflector)

**Accessories:** Mounting bracket, Model MEB-1



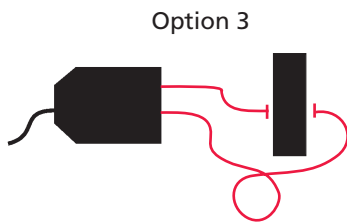
Retroreflective is a cost effective mode to detect medium to large size non-shiny opaque objects. Longer sensing range than polarized mode. Use with reflector.

**Sensor:** Model MAIR4 (with infrared light source and 6 ft. cable) or MARCR4 (with inline connector requires mating cable Model CAC15).

**Reflector:** Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted. (See Accessories Section for complete listing of reflectors.)

**Sensing range:** Up to 18 ft. (Range is dependent on size of reflector)

**Accessories:** Mounting bracket, Model MEB-1



Fiberoptic opposed mode is excellent choice for detecting any opaque object... particularly in a hostile sensing environment.

**Sensor:** Model MAIF4 (with infrared light source and 6 ft. cable) or MAICF4 (with inline connector...requires mating cable Model CAC15)

**Fiberoptic light guides:** (2) Model F-A-36T

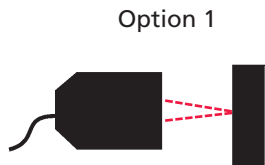
**NOTE:** Select smaller fiber bundle for small part detection (See Fiberoptic Section)

**Sensing range:** Up to 3 in. without lens. Up to 15ft. with (2) UAC-15 lenses

**Accessories:** (2) Model UAC-15 or (2) UAC-5 Lenses, Mounting bracket, Model MEB-1, FMB-1

### Alternate Mode: Beam Make (Proximity)

**NOTE:** Consider proximity mode when installation sensing site conditions preclude using the preferred Beam Break mode.

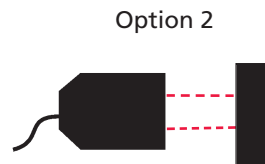


Convergent/proximity mode is useful to detect a wide variety of opaque objects when there is little (if any) space between objects.

**Sensor:** Model MAIV6 (infrared light source and 6 ft. cable) or MAICV6 (with inline connector requires mating cable Model CAC15)

**Sensing range:** From .75 in. to 4 in. (Dependent upon size, shape, color and surface reflectivity.)

**Accessories:** Mounting bracket, Model MEB-1

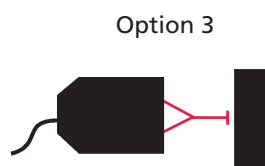


Divergent/proximity mode sensing is useful in detecting medium to large size objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.

**Sensor:** Model MAIO5 (infrared light source and 6 ft. cable) or MAICO5 (with inline connector...requires mating cable Model CAC15 )

**Sensing range:** Up to 1.5 ft.

**Accessories:** Mounting bracket, Model MEB-1



Fiberoptic proximity is useful to detect any opaque object in hostile environments.

**Sensor:** Model MAIF4 (with infrared light source and 6 ft. cable) or MAICF4 (with inline connector...requires mating cable Model CAC15)

**Fiberoptic light guide:** Model BF-A-36T

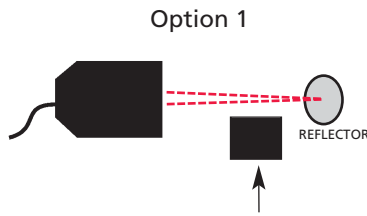
**NOTE:** Select smaller fiber bundle for small part detection. (See Fiberoptic Section.)

**Sensing range:** Up to 1.5 in. without lens. Up to 8 in. with UAC-15 lens (dependent upon size, shape, color, and surface reflectivity.)

**Accessories:** Mounting bracket Model MEB-1, FMB-1. Model UAC-15 lens

### Translucent Object Sensing

#### Preferred Mode: Beam Break



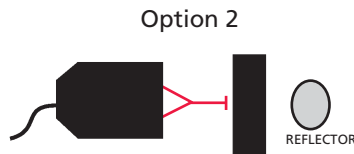
Polarized retroreflective mode

**Sensor:** Model MARR5 (with red light source and 6 ft. cable) or, MARCR5 (with inline connector requires mating cable Model CAC15)

**Reflector:** Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted

**Sensing range:** Up to 6 ft. (dependent on size of reflector)

**Accessories:** Mounting bracket, Model MEB-1



Fiber optic retroreflective mode

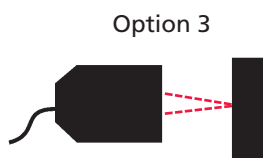
**Sensor:** Model MARF4 (with red light source and 6 ft. cable) or, MARCF4 (with in-line connector...requires mating cable Model CAC15)

**Fiber optic light guide:** Model BF-A-36T

**Reflector:** Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted.

**Sensing range:** Up to 4ft. without lens. Up to 8 ft. with UAC-15 lens

**Accessories:** Mounting bracket, Model MEB-1, FMB-1. Model UAC-15 lens



#### Alternate Mode: Beam Make (Convergent/proximity)

**Sensor:** Model MARV6 (with red light source and 6 ft. cable) or, MARCV6 (with in-line connector...requires mating cable Model CAC15)

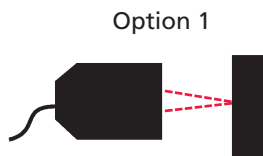
**Sensing range:** Up to 3 in. dependent on size, shape and color

**Accessories:** Mounting bracket, Model MEB-1

### Transparent Object Sensing

**NOTE:** Totally transparent objects can be very difficult to detect. A high performance sensor may be required. See **RETROSMART®** section for details.

#### Preferred Mode: Beam Make (Convergent/proximity)



**Sensor:** Model MARV6 (with red light source and 6 ft. cable) or, MARCV6 (with in-line connector...requires mating cable Model CAC15)

**Sensing range:** Up to 2 in. dependent on size, shape and color

**Accessories:** Mounting bracket, Model MEB-1

### POWER REQUIREMENTS

- 24 TO 240 VAC

### OUTPUT DEVICES, AC MODELS

- 2-wire isolated solid state triac rated at 500 mA rms continuous
- MOV protected
- Switches "On" and "Off" synchronously at near zero volts
- "Off" state leakage less than 1 mA

### RESPONSE TIME

- 4 milliseconds

### LIGHT IMMUNITY

- Pulse modulated to provide extremely high immunity to ambient light

### SENSING RANGE

- Range determined by model type, mode of sensing, and optical block type as selected. See Range Chart for details

### ADJUSTMENTS/INDICATORS

- 4-turn clutched sensitivity adjustment
- 2-position light "on"/dark "on" selection switch
- Red LED indicator energizes when light beam is established

### AMBIENT TEMPERATURE

- -20°C to 70°C (-20°F to 158°F)

### RUGGED CONSTRUCTION

- Chemical resistant case, "O" ring sealed to provide moisture protection
- Epoxy encapsulated for mechanical stability
- NEMA 4X, 6P and IP67

### LED LIGHT SOURCE WAVELENGTH

- Infrared = 880 nm
- Red = 660 nm
- High Intensity Red = 650 nm

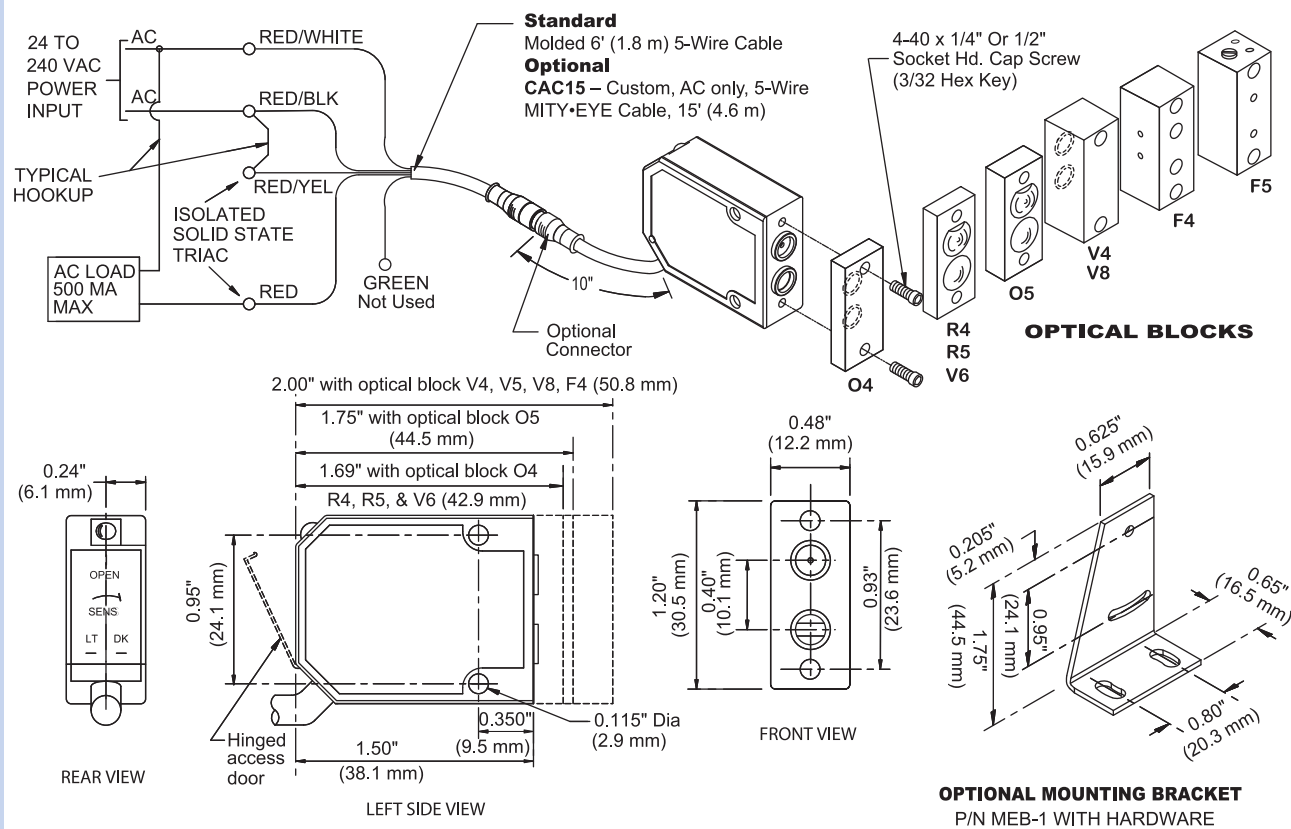


**NOTE:** AC Mity•Eye with 10" Pigtail is designed to be used with the CAC15 Power Cable.

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions

## AC MITY-EYE®





Our Miniature, Tamperproof Sensor



# Miniature DC-Powered Sensors *Small and Economical*

TINY-EYE®

2

General Application Photoelectric Sensors



The TINY-EYE® Miniature Photoelectric Sensor “unlocks the door” to big cost savings with its ability to perform many industrial sensing tasks. Changing the lens changes the sensing mode. TINY-EYE® utilizes our “quick-change” optical blocks, allowing the TINY-EYE® to be used in multiple sensing modes.

## Interchangeable Optical Blocks

TINY-EYE®'s unique lensed optical blocks are molded of solid optical grade, high-impact plastic. This innovation concept helps to prevent condensation or fog buildup on the inside of the lens. Multiple varieties of optical blocks are available for operating the TINY-EYE® in either the retroreflective, polarized (non-glare), proximity, opposed, fiberoptic, or convergent sensing modes. A simple change of the optical block can be very useful in determining the best sensing mode for use in your specific sensing task. These inexpensive, interchangeable optical blocks reduce the inventory burden of replacement parts and eliminate the need for discarding a complete sensor in the case of damage to the optical block.

## BIG PERFORMANCE

- 500  $\mu$ sec Speed of Response
- 10 to 30 VDC Operating Voltage (5 VDC Operating Voltage available Consult Factory)
- Pulse Modulated
- Reverse Polarity Protected
- Both NPN and PNP Outputs
- Red or Infrared Light Sources
- Step-Function Remote Sensitivity Adjustment
- Rugged and Waterproof

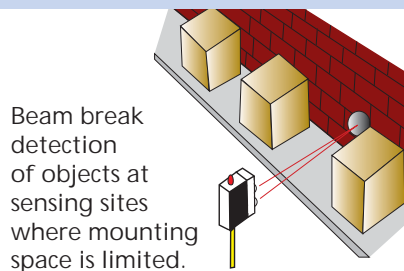
## BIG CAPABILITY

- Wide Beam Proximity
- Long Range Proximity
- One or Two Inch Convergent
- Retroreflective
- Polarized Retroreflective
- Opposed (Separate Light Source/Receiver)
- Fiber Optics

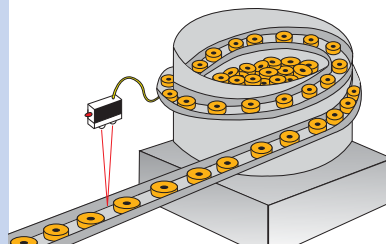
## Tamperproof, Trouble-Free Operation

Many design features have been incorporated into the TINY-EYE® to prevent mechanical or electrical damage, and to provide trouble-free operation. The rugged case is molded of high-impact polycarbonate. To prevent electrical mishaps, the sensors are protected from reverse polarity.

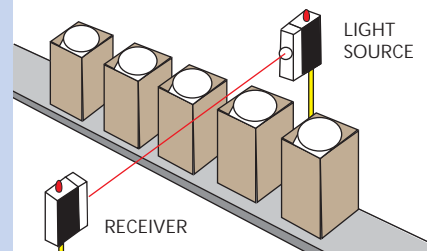
## Typical Applications



Detection of small parts.

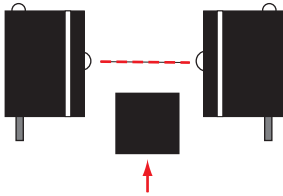


Detection of opaque objects.

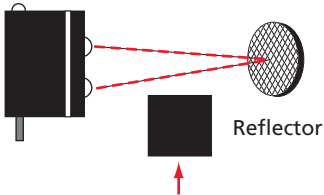




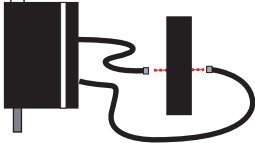
Option 1:



Option 2:



Option 3:



## OPAQUE OBJECT SENSING

### Preferred Mode: Beam Break

Opposed mode, uses separate light source/receiver. Provides long range sensing. Best choice for use in hostile environments.

Sensor: Model STIT4 Light source (infrared)

Model RTL4 Light "on" receiver or RTDT4 Dark "on" receiver.

Range: In excess of 20 ft.

Accessories: Model TEB-1 (vertical mount) or TEB-2 (horizontal mount) bracket.

Polarized retroreflective mode is a cost effective mode to detect medium to large size shiny or non-shiny opaque objects. Use with reflector.

Sensor: Model TRLR5, Light "on" output. (red light source) or TRDR5 Dark "on" output.

Reflector: Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted.

Sensing range: Up to 10 ft. (Dependent on size of reflector).

Accessories: Model TEB-1 (vertical mount) or TEB-2 (horizontal mount) bracket.

Fiberoptic opposed mode is useful to detect any opaque object in hostile environment.

Sensor: Model TILF4, Light "on" operate (red light source) or TIDF4, Dark "on" operate.

Fiberoptic light guides: Model F-A-36T (use smaller fiber for smaller parts).

Sensing range: Up to 6 in. without lens. Up to 15 ft. with (2) UAC-15 lenses

Accessories: Model TEB-1 (vertical mount) or TEB-2 (horizontal mount) bracket.

## TRANSLUCENT OBJECT SENSING

### Preferred Mode: Beam Break

Polarized retroreflective mode.

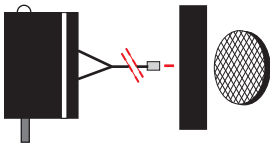
Sensor: Model TRLR5, Light "on" operate (red light source) or TRDR5, Dark "on"

Reflector: Model 78P, Plastic, 4.4 in. x 1.9 in. screw mounted.

Sensing range: Up to 10 ft. (dependent on size of reflector)

Accessories: Model TEB-1 (vertical mount) or TEB-2 (horizontal mount) bracket.

Option 2:



Fiberoptic retroreflective mode.

Sensor: Model TRLF4, Light "on" operate (red light source) or TRDF4, Dark "on"

Fiberoptic light guide: Model BF-A-36T

Reflector: Model 78P, Plastic, 4.4 in. x 1.9 in. screw mounted

Sensing range: Up to 4 ft. without lens. Up to 8 ft. with UAC-15 lens.

Accessories: Model TEB-1 (vertical mount) or TEB-2 (horizontal mount) bracket.

### Alternate Mode: Beam Make

Sensor: Model TRLV6, Light "on" operate (red light source) or TRDV6, Dark "on".

Sensing range: Up to 3 in. (dependent on size, shape and color).

Accessories: Model TEB-1 (vertical mount) or TEB-2 (horizontal mount) bracket.

# Optical Block Selection

Interchangeable optical blocks provide for universal application of the TINY•EYE® to any sensing applications from large object sensing to finite sensing of small parts, registration mark detection and product inspection tasks.



TINY•EYE®



**Type O4**  
Proximity  
Wide beam optics useful for short-range sensing of transparent, translucent, or irregular shaped shiny objects.



**Type O5**  
Proximity  
Narrow beam optics useful in long-range sensing of medium to large size objects.



**Type R4**  
Retroreflective  
Very narrow beam optics designed to sense reflectors or reflective materials at long range. Designed for Beam Break sensing.



**Type R5**  
Polarized Anti-Glare Retroreflective  
Polarized to reduce response to "hot spot" glare from shiny surface of detected object. Use with red or blue light source.



**Type V4, V4A**  
Convergent 1" "V" Axis  
Narrow beam optics that focus at a sensing range of 1". Useful for sensing small parts. Also useful for proximity sensing (range of 1" to 5") to minimize response to reflected light from background objects.



**Type V6**  
Convergent 1.5" "V" Axis  
Narrow beam optics that focus at a sensing range of 1.5". Useful for sensing small parts. Also useful for proximity sensing (range of 1.5" to 8") to minimize response to reflected light from background objects.



**Type V8**  
Convergent .5" "V" Axis  
Narrow beam optics that focus at a sensing range of .5". Useful for sensing small parts or registration color marks. Also useful for proximity sensing (range of .25" to 5") to minimize response to reflected light from background objects.



**Type F4**  
Glass Fiber Optics Adapter for use with a wide variety of glass fiberoptic light guides for both the proximity and opposed sensing modes.



**Type F5**  
Plastic Fiber Optics Adapter for use with a wide variety of plastic fiberoptic light guides for both the proximity and opposed sensing modes.



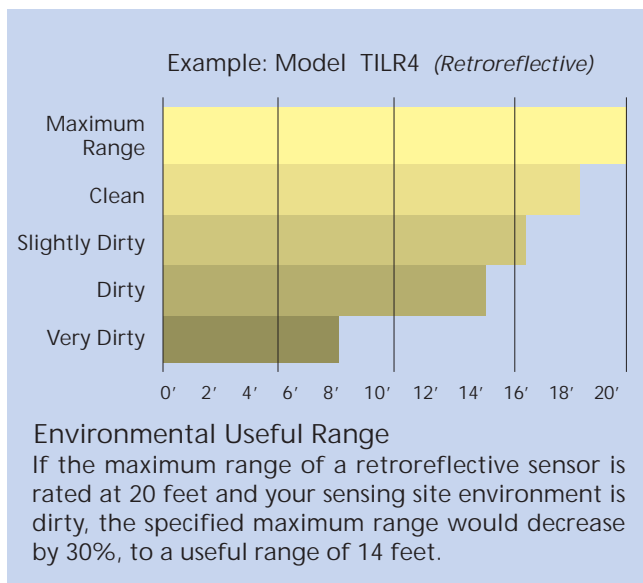
**Type T-4 Opposed Optical Blocks**  
Uses separate Light Source/Receiver. Designed for extra long-range sensing.

## Light Source Selection

TINY•EYE® Sensors offer a selection of either Infrared (invisible), or High Intensity Red (visible) light sources.

**Infrared** – Invisible light source recommended for opaque object sensing. The IR LED provides long-range sensing capabilities and maximizes the ability to penetrate contaminated lenses.

**High Intensity Red** – recommended for long-range proximity sensing and for use with plastic fiberoptic light guides.



# How to Specify

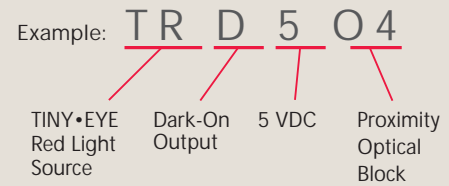
## Thru-Beam Light Source Receiver Models

1. Select Light Source Model based on light source required:  
STIT4 = Infrared Light Source; STRT4 = Red Light Source
2. Select Receiver Model based on light source required:  
RTL4 = Light-On Receiver; RTDT4 = Dark-On Receiver

Example: Light Source STIT4; Receiver RTL4

## Sensor Models

1. Select Sensor Model based on light source required:  
TI = Infrared Light Source; TR = Red Light Source
2. Select Dark/Light Output  
D = Dark-On Output; L = Light-On Output
3. Select Operational Voltage: Blank = 10 – 30 VDC, 5 = 5 VDC
4. Select Optical Block based on mode of operation required.



## Range Guidelines

OPTICAL BLOCK TYPES	TINY-EYE® MODELS	
	TIL/TID (Infrared)	TRL/TRD (Red)

O4 Proximity	2 in.	1.5 in.
O5 Proximity	18 in.	16 in.
R4 Retroreflective	20 ft.	20 ft.
R5 Polarized Retroreflective	N/A	7 ft.
V4, V4A Convergent	1 in.	1 in.
V6 Convergent	1-1/2 in.	1-1/2 in.
V8 Convergent	.5 in.	.5 in.

Type F4 with .125 in. diam. Glass Fiberoptic Bundle

Proximity	1-1/2 in.	1 in.
Proximity w/ UAC-15 Lens	8 in.	6 in.
Opposed	6 in.	3 in.
Opposed w/ UAC-15 Lens	15 ft.	15 ft.

Type F5 with .040 in. diam. Plastic Fiberoptics

Proximity	N/A	1/2 in.
Opposed	N/A	2 in.
Opposed w/ HLA-1 Lens	N/A	4 ft.

Type T4 Opposed Mode – Light Source/Receiver

Light Source	Receiver	Max. Range
STIT4	RTL4	25 ft.
STIT4	RTDT4	25 ft.
STRT4	RTL4	20 ft.
STRT4	RTDT4	20 ft.

### NOTES:

- PROXIMITY tests utilizes a 90% reflective white target.
- RETROREFLECTIVE tests utilizes a 3' diam. round reflector Model AR-3.
- \*Maximum ranges at 24 VDC. (Varies with supply voltage)

## POWER REQUIREMENTS

- Sensors 10 - 30 VDC @ 35 mA Max
- Receivers 10 - 30 VDC @ 15 mA Max
- Light Source 10- 30 VDC @ 20 mA Max
- NOTE: All devices equipped with reverse polarity protection

## OUTPUT TRANSISTORS (SENSORS/ RECEIVERS)

- NPN (1) and PNP (1) Output Transistors provided
- NPN: Sink up to 100 mA
- PNP: Source up to 100 mA

## RESPONSE TIME: (SENSORS/RECEIVERS)

500 microseconds (light or dark)

## LIGHT IMMUNITY: (SENSORS/RECEIVERS)

Pulse modulated to provide extremely high immunity to ambient light

## SENSING RANGE:

Sensing range determined by model type, mode of sensing, optical block selected, and supply voltage

## SENSITIVITY/RANGE ADJUSTMENT:

Adjusting light source intensity by termination of designated wire lead (Blue for Sensors/Green for Light Sources) determines sensitivity/range setting  
Maximum Range - connect wire lead to POSITIVE. (24 VDC Supply)  
Mid-Range - no connection required. (12 - 24 VDC Supply)  
Low Range - connect wire lead to NEGATIVE. (12 - 24 VDC Supply)  
NOTE: Continuous adjustment can be accomplished by connecting the wire lead to a remote potentiometer. Consult factory

## AMBIENT TEMPERATURE:

- -30°C to 70°C (-22°F to 158°F)

## RUGGED CONSTRUCTION:

- High impact polycarbonate housing
- Waterproof, NEMA 4X, 6P and IP67
- Encapsulated for mechanical strength

## LED LIGHT SOURCE WAVELENGTH:

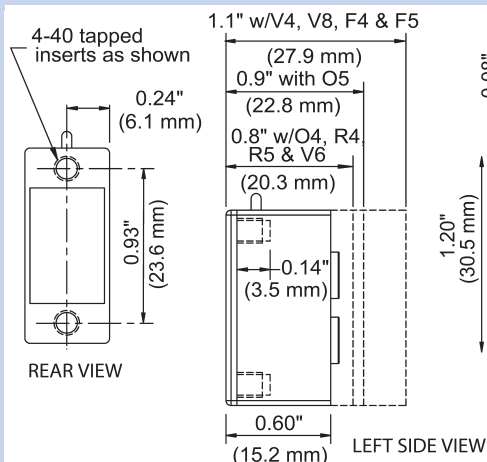
- Infrared = 880 nm
- High intensity red = 660 nm

## Accessories See Dimensions drawing

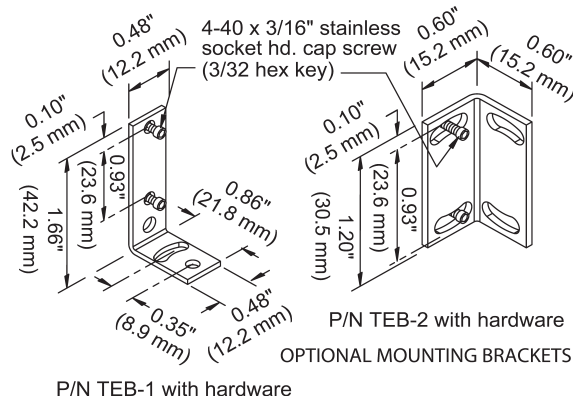
Model Description

TEB-1	Vertical mount Tiny-Eye Mounting Bracket
TEB-2	Horizontal Mount Tiny-Eye Mounting Bracket

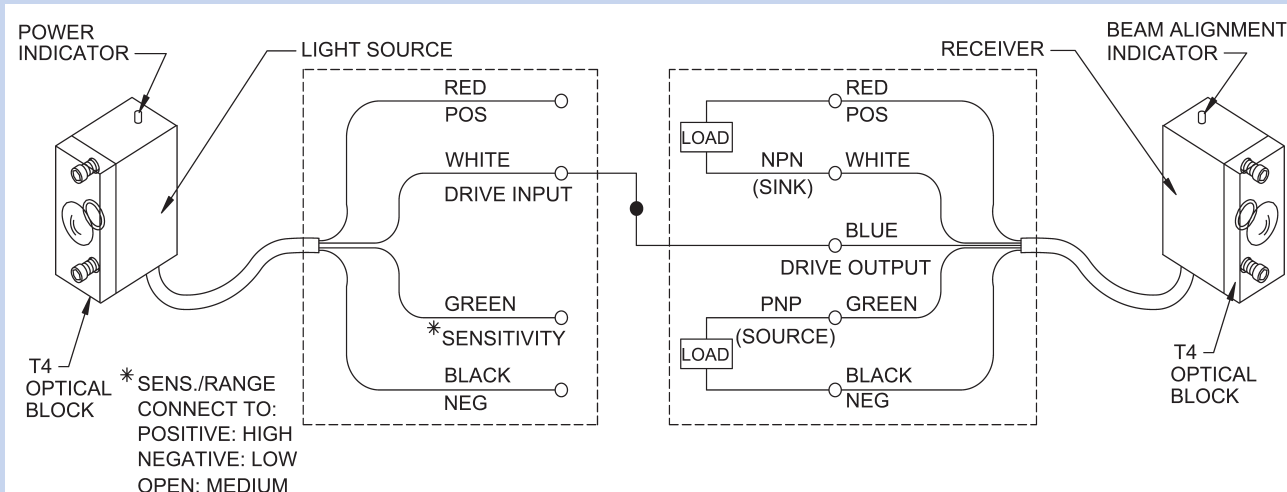
## Dimensions



## TINY-EYE® SENSOR MODELS

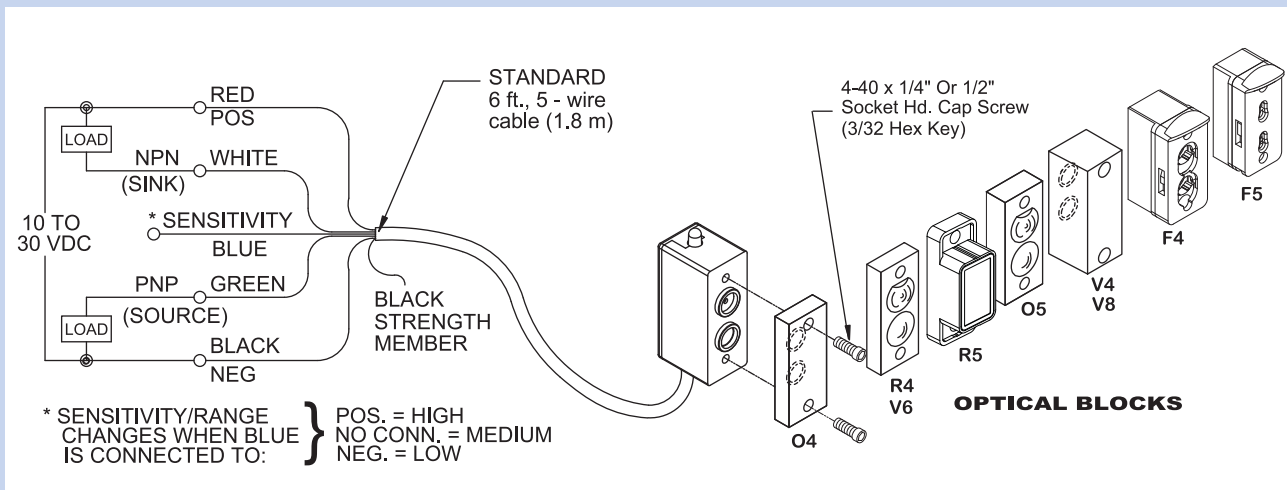


## Connections TINY-EYE® LIGHT SOURCE / RECEIVER MODELS - OPPOSED MODE



## Connections

## ALL TINY-EYE® SENSOR MODELS





AC/DC Sensor with Timer,  
Relay or Triac Output Options

U.S. EYE®

U.S. EYE® Photoelectric Sensors were designed and built by TRI-TRONICS to answer the demand for economical, high-performance sensors with U.S. quality—backed by U.S. service! They are available with a unique Contrast Indicator for difficult sensing tasks and without the Contrast Indicator for simple tasks at an even lower cost.

## Function modes available:

- ON/OFF – output relay switches for duration of input.
- Type T1, delay timer – offers two options using light/dark switch:
  - a) “ON” delay for product jam or backup detection.
  - b) “OFF” delay for product void detection.
- Type T2, “one-shot” timer – may be used for short, momentary output pulse or in the “triggerable” mode for “stop motion” detection. (See Timing Sequence Data Charts.)

## Contrast Indicator™ Models

The Contrast Indicator displays a scaled reading of the level of light received by the sensor's photo detector. The more light received, the higher the reading. The less light received, the lower the reading. Contrast is a comparison of the lightest state reading vs. the darkest state reading. The sensing task of any photoelectric sensor is to resolve the difference between these two light levels and switch the output accordingly. The U.S. EYE® switches its output when the light level passes the mid-scale reading of “5.” Refer to section 1 for details.

## Fiberoptic Models

Flexible fiberoptic light guides are available in sizes small enough to fit into your toughest job sensing sites, with models designed for inaccessible places, detection of extremely small parts, high temperature applications, corrosive environments, or high vibration locations, as well as straight light guides for Beam Break and bifurcated light guides for proximity sensing.

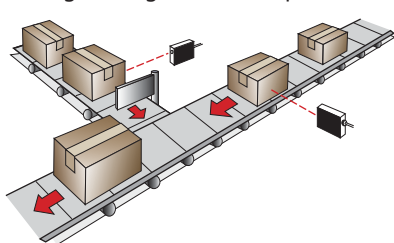


## Features

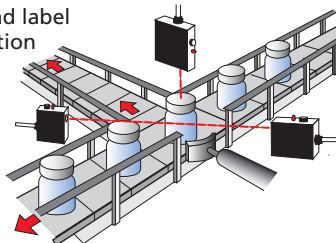
- Easy installation – includes all accessories, mounting bracket, reflector, and hardware
- Thru-beam models include both light source and receiver
- All models operate on AC or DC from 24 to 130 volts; relay or triac outputs
- Output relay contacts are rated at 5 amps
- High-speed response – limited by the output relay itself. 7 ms Beam Make or Beam Break
- Fiberoptic models available with infrared or red LED light sources
- All models equipped with sensitivity adjustments
- All models have red LED indicator showing status of output relay
- All models have green LED beam status indicator for easy alignment
- High-impact plastic case is dirt and moisture sealed
- Switching power supply eliminates failures often caused by power line transients

## Typical Applications

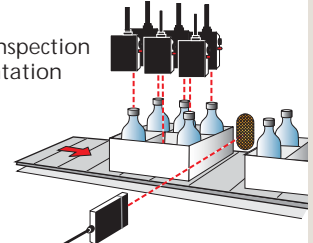
Gating, sorting, and seal inspection



Cap and label inspection



Product inspection and orientation





On or Off  
Delay  
Switch

With Contrast Indicator	Without Contrast Indicator	Light Source	Max Range	Speed of Response	Output Information
<b>Beam Break Mode Retroreflective (Models Include 78P Reflector)</b>					
UCR-A	UR-A	Infrared	15 ft.	7 ms	On/Off Relay
TUCR-A	TUR-A	Infrared	15 ft.	8 ms	On/Off Triac
UCR-AT1	UR-AT1	Infrared	15 ft.	7 ms	On or Off Delay
UCR-AT2	UR-AT2	Infrared	15 ft.	7 ms	One-Shot Motion

## Beam Break Opposed Mode (Models Include Both Light Source and Receiver)

UCT-A	UT-A	Infrared	75 ft.	7 ms	On/Off Relay
UCT-AT1	UT-AT1	Infrared	75 ft.	7 ms	On or Off Delay
UCT-AT2	UT-AT2	Infrared	75 ft.	7 ms	One-Shot Motion

Receiver Replacements		Light Source Replacements	
W Contrast Indicator	W/O Contrast Indicator		
UCT-A	UT-AR	UT	order replacements separately
UCT-AT1	UT-AT1R	UT	order replacements separately
UCT-AT2	UT-AT2R	UT	order replacements separately

## Beam Make Mode Proximity Diffused Beam

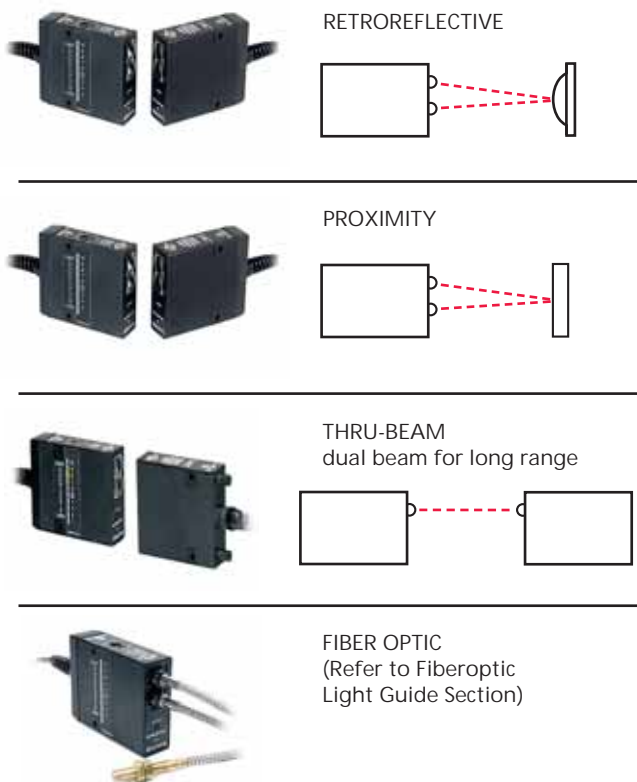
UCD-A	UD-A	Infrared	3 ft.	7 ms	On/Off Relay
TUCD-A	TUD-A	Infrared	3 ft.	8 ms	On/Off Triac
UCD-AT1	UD-AT1	Infrared	3 ft.	7 ms	On or Off Delay
UCD-AT2	UD-AT2	Infrared	3 ft.	7 ms	One-Shot Motion

## Fiberoptic Mode

With Contrast Indicator	Without Contrast Indicator	Light Source	Opposed Range*		Proximity Range*		Speed of Response	Output Information
			With Lens	W/O Lens	With Lens	W/O Lens		
UCF-A	UF-A	Infrared	12 ft.	2 ft.	4 in.	2.5 in.	7 ms	On/Off Relay
TUCF-A	TUF-A	Infrared	12 ft.	2 ft.	4 in.	2.5 in.	8 ms	On/Off Triac
UCF-AT1	UF-AT1	Infrared	12 ft.	2 ft.	4 in.	2.5 in.	7 ms	On or Off Delay
UCF-AT2	UF-AT2	Infrared	12 ft.	2 ft.	4 in.	2.5 in.	7 ms	One-Shot Motion
UCFR-A	UFR-A	Red	6 ft.	8 in.	4 in.	1 in.	7 ms	On/Off Relay
UCFR-AT1	UFR-AT1	Red	6 ft.	8 in.	4 in.	1 in.	7 ms	On or Off Delay
UCFR-AT2	UFR-AT2	Red	6 ft.	8 in.	4 in.	1 in.	7 ms	One-Shot Motion

### NOTES:

- FIBER OPTIC range tests utilized .125 in. diameter fiber bundles and UAC-15 lenses as indicated.
- PROXIMITY tests utilized a 90% Reflective target. RETROREFLECTIVE tests utilized a 78P reflector.



Operating Range: 24 to 130 VAC or VDC

Power Consumption: 2 VA

Temperature Range: -10°C to + 50°C (14°F to 122°F)

Output:

- SPDT Relay Models: 5 amps @ 120 VAC

Normally de-energized before input occurs.

- Isolated Solid State TRIAC Models: 1 amp at 50°C

Response Time: Relax: 7 ms light or dark TRIAC: 8 ms

Timer Range: 0.1 to 15 seconds

Contrast Indicator Models: Displays a 10 bar LED scaled reading of contrasting light level

LED Light Source Wavelength: Infrared (880 nm), Red (660 nm)

Sensitivity Adjustment: Provided on all models

Beam Status Indicator: (Green LED) "ON" when beam is established

Output Indicator: (Red LED) Follows status of output relay

Cabling: 6' standard, 5-conductor

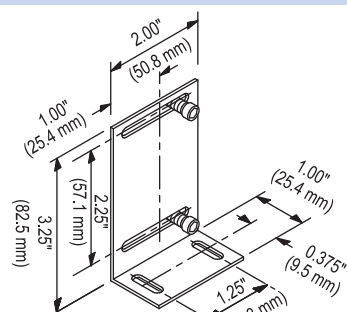
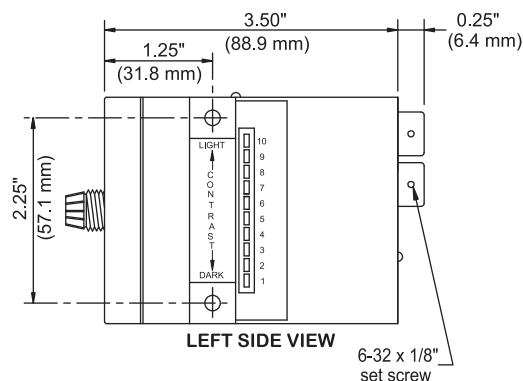
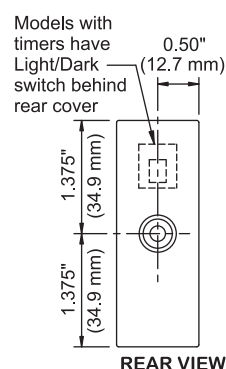
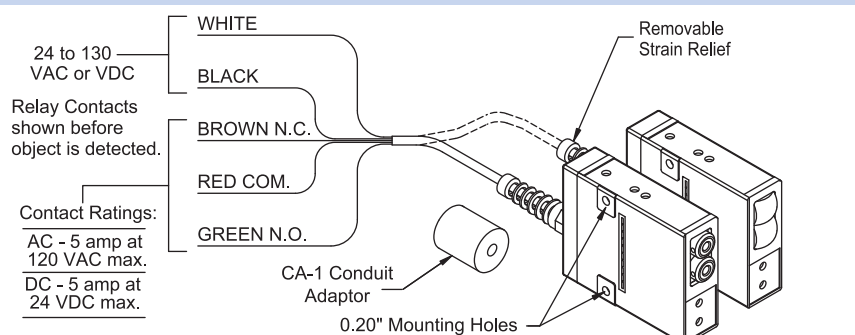
## Accessories

Model #	Miscellaneous
CA-1	1/2 in. Conduit Adaptor
FSR-1	Flexible Strain Relief
UMB-1	U.S. Eye Bracket
USB-1	U.S. Eye Sub-Bracket

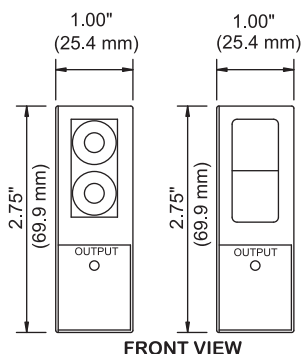
Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions

## U.S. EYE



**OPTIONAL MOUNTING BRACKET**  
MODEL UMB-1 WITH HARDWARE



**U. S. EYE™ PHOTOELECTRIC SENSOR**  
(WITH MECHANICAL RELAY or TRIAC OUTPUT)  
ALL DIMENSIONS IN BRACKETS ARE METRIC

**NEW!**



High Performance Clear Object Sensor

**RETROSMART®**

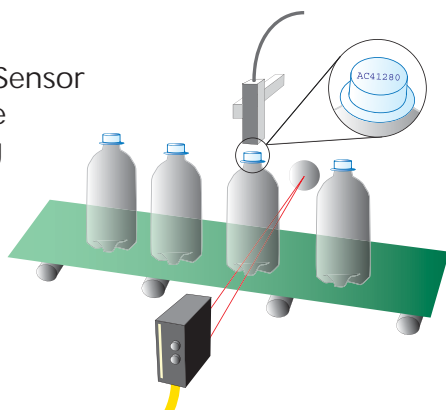
# Dependable Detection of Clear and Shiny Objects

## RETROSMART®

- No Proxing On Shiny Objects
- Detection of transparent PET and glass containers...full or empty
- Detection of Shiny Objects at High Velocity
- Leading Edge Detection of Irregular objects



Trigger Sensor  
for Code  
Marking



The *TRI-TRONICS*® *RETROSMART*® retroreflective sensor is optimized to detect translucent/transparent containers and shiny objects. You can depend on the *RETROSMART*® sensor's ability to reliably sense any object, regardless of the size or shape, from the leading edge to the trailing edge without false signals, a requirement when the sensing task involves monitoring a conveyor line for jam detection. The sensor's red, narrow light beam assures accuracy in detecting the leading edge of any product to trigger the response, such as filling, capping, labeling, and coding.

Many of today's industrial control functions require a sensor that can provide dependable detection of position or presence of transparent containers. The *RETROSMART*® will provide a single, non-chattering output for each transparent container that passes by, independent of size, shape, empty, or full.

Imagine...just point the *RETROSMART*® sensor's red, narrow light beam at the reflector and push the *AUTOSET*™ button one time. Now sit back and watch the sensor flawlessly detect any size PET bottle filled with water, with no need to worry about burnthrough or double signals. When the efficiency of an entire production line depends on the performance of a photoelectric sensor, the *RETROSMART*® is the smart choice.

## HIGH IMMUNITY TO ALL AMBIENT LIGHT, INCLUDING STROBES

### FEATURES AND BENEFITS:

- Designed specifically to detect transparent/translucent plastic or glass containers, as well as shiny metal cans.
- Operates in the retroreflective (beam break) sensing mode, using a high performance reflector (AR6151 reflector included with sensor).
- Optimum range (distance to reflector) 6 in. to 8 ft. (15.24 cm to 2.4 m).
- AUTOSET™ setup routine requires a single push of a button with the reflector in view.
- Remote AUTOSET™ feature allows the sensor to be adjusted from a remote location.
- LST (Light State Tracking) establishes and automatically maintains a level “8” on the Contrast Indicator as input events are ongoing.
- Lock disables buttons for tamperproof operation.
- Light “ON” /Dark “ON” selection: depress the LT/DK button to toggle the output status.
- 8 LED Contrast Indicator provides “at a glance” performance data during both setup and operation.



#### CONTRAST INDICATOR

##### CONTRAST INDICATOR BAR 8

Remains illuminated when Light State signal strength is 8 or above

##### SWITCH POINT BAR 4

Sensor outputs toggle or switch to opposite state when the signal level passes above or below 4

##### CONTRAST INDICATOR BAR 1

Extinguishes when Light State signal strength is below 1

##### PUSH BUTTON – 3 FUNCTIONS

1. LST (Light State Tracking)  
Depress and hold for 6 seconds to toggle
2. Light/Dark Output Status  
Depress and release after 2 seconds to toggle
3. Manual Down Adjust  
Tap and release for less than 1/4 second



#### LOCK INDICATOR

Illuminates when buttons are disabled  
Depress both buttons for 2 seconds to toggle

#### LST INDICATOR

(Light State Tracking)  
Illuminates when LST is enabled

#### OUTPUT STATUS INDICATOR

When illuminated, Option Status Indicator is enabled

#### PUSH BUTTON – 2 FUNCTIONS

1. AUTOSET™  
Depress for 1 second to initiate Light State AUTOSET™ routine
2. Manual UP Adjust  
Tap and release for less than 1/4 second LOCK INDICATOR



### HOW IT WORKS!

The **RETROSMART**® sensor is equipped with a pinpoint source of red, visible light that transmits a concentrated, narrow beam. When the beam is directed toward our high quality corner cube reflector (AR6151, included with each sensor), a thru-beam is established. Any object that comes between the sensor and the reflector will break the beam, signaling an output.

### SENSING ADVANTAGE

With the **RETROSMART**® there is no need to be concerned with air currents, convection heat, humidity, or irregular shaped objects. It has high performance with a sensing range of 8' and a 500 microsecond response time.

### UNIQUE FEATURES:

#### ■ AUTOSET™ ADJUSTMENT

The AUTOSET™ adjustment routine only requires the push of one button, one time! All you have to do is aim the sensor at the reflector and push the button for a perfect setting.

#### ■ REMOTE AUTOSET™

To remotely AUTOSET™ the sensor, apply a momentary contact closure from the AUTOSET™ input wire to negative, as shown in the wiring diagram. A remote AUTOSET™ command will duplicate the last manual AUTOSET™.

#### ■ AGS™ AUTOMATIC GAIN SELECT

This unique feature provides automatic digital selection of amplifier gain based upon your sensing requirements.

#### ■ LST™ (LIGHT STATE TRACKING)

When enabled, the sensor will continually adjust to the perfect setting of "8" on the Contrast Indicator. Just set it and forget it.



*Detection of transparent PET and glass containers...full or empty.*



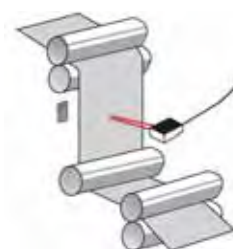
*Detection of shiny objects at high velocity.*



*Leading edge detection of irregularly shaped objects without false signals.*

### Clear Detection Applications

- Shrink-wrap
- Double Sheet
- Splice



*Recommended for wraparound machinery and material handling; does not prox when looking through site glass up to 8' (5.5m) range.*

## HOW TO SPECIFY

### RETROSMART® SENSORS

- RSR-1 Includes 6' cable (1.8 m) & AR6151 reflector
- RSR-1G Includes chemical resistant glass window, 6' cable (1.8 m) & AR6151G reflector
- RSRC-1 Includes 5-PIN 6" pigtail connector & AR6151 reflector (Accessory Cable required)
- RSRC-1G Includes chemical resistant glass window, 5-PIN 6" pigtail connector & AR6151G reflector (Accessory Cable required)



HIGH PERFORMANCE REFLECTOR  
INCLUDED WITH EACH SENSOR

AR6151

AR6151G  
(Chemical Resistant  
Glass Cover)



## ACCESSORIES

### CABLE CONNECTION

5-Wire Shielded MicroCable, M-12



GSEC-6  
6' (1.8 m) cable with connector

GSEC-15  
15' (4.6 m) cable with connector

GSEC-25  
25' (7.62 m) cable with connector



GRSEC-6  
6' (1.8 m) cable/right angle connector

GRSEC-15  
15' (4.6 m) cable/right angle connector

GRSEC-25  
25' (7.6 m) cable/right angle connector



GPSEC-15  
15' (4.6 m) non-metallic shell

5-Wire Unshielded Cable, M-12, Low Cost



GSEC-2MU  
5.5' (2.0 m)  
cable with connector

GSEC-5MU  
16.4' (5.0 m)  
cable with connector

5-Wire Extension Cable, M-12



GX-25  
25' (7.6 m) extension cable

### OPTIONAL STAINLESS MOUNTING BRACKET ASSEMBLY



SEB-4

Note: Rigid mounting of sensor and reflector required.

Optional Prismatic  
High-Performance Reflectors  
NEMA 4, IP67

Screw Mount

Glue Mount



AR4060  
1.6" x 2.36"  
(40.5 x 60 mm)



AR46  
1.8" diam.  
(46 mm diam.)



AR6151  
2.4" x 2.0" (61 x 51 mm)

AR6151G (Chemical Resistant Glass Cover)  
2.4" x 2.0" (61 x 51 mm)

Economical Reflective Discs  
with Adhesive Backing

PRD1  
1" x .03" (25 mm x .75 mm)

PRD2  
2" x .03" (50 mm x .75 mm)



# Specifications

## SUPPLY VOLTAGE

- 10 to 30 VDC
- Polarity Protected

## CURRENT REQUIREMENTS

- 50 mA (exclusive of load)

## OUTPUT TRANSISTORS

- (1) NPN and (1) PNP output transistor:  
NPN: Sink up to 150 mA  
PNP: Source up to 150 mA
- Continuous short-circuit protection
- Outputs protected from pulsing during power up

## REMOTE AUTOSET™ INPUT

- Opto-isolated momentary sinking input (10 mA)

## RESPONSE TIME

- Light State response = 500 microseconds
- Dark State response = 500 microseconds

## LED LIGHT SOURCE

- Red 660 nm
- Pulse Modulated

## PUSH BUTTON CONTROL

- "One-Touch" AUTOSET™ push-button setup
- Tweak adjustments with "up" or "down" buttons
- LST™ (Light State Tracking) Enable/Disable
- Light "ON"/Dark "ON" selection

## RANGE

- Optimum from 6 in. to 8 ft.  
(15.24 cm to 2.4 m) distance to the AR6151 reflector

## HYSTERESIS

- Two bars as displayed on  
Contrast Indicator  
Light State Switch = 5  
Dark State Switch = 3

## LIGHT IMMUNITY

- Responds to sensor's pulse-modulated light source, resulting in high immunity to most ambient light, including high intensity strobes

## DIAGNOSTIC INDICATORS

- Contrast Indicator-Display scaled reading of sensor's response to contrasting light levels (light vs. dark) on an 8-bar LED display
- Red LED "LOCK" Indicator
- Green LED LST (Light State Tracking)
- Red Output Status Indicator NOTE: If Output LED flashes, a short circuit condition exists.

## AMBIENT TEMPERATURE

- -40° to 70° C (-40° to 158° F)

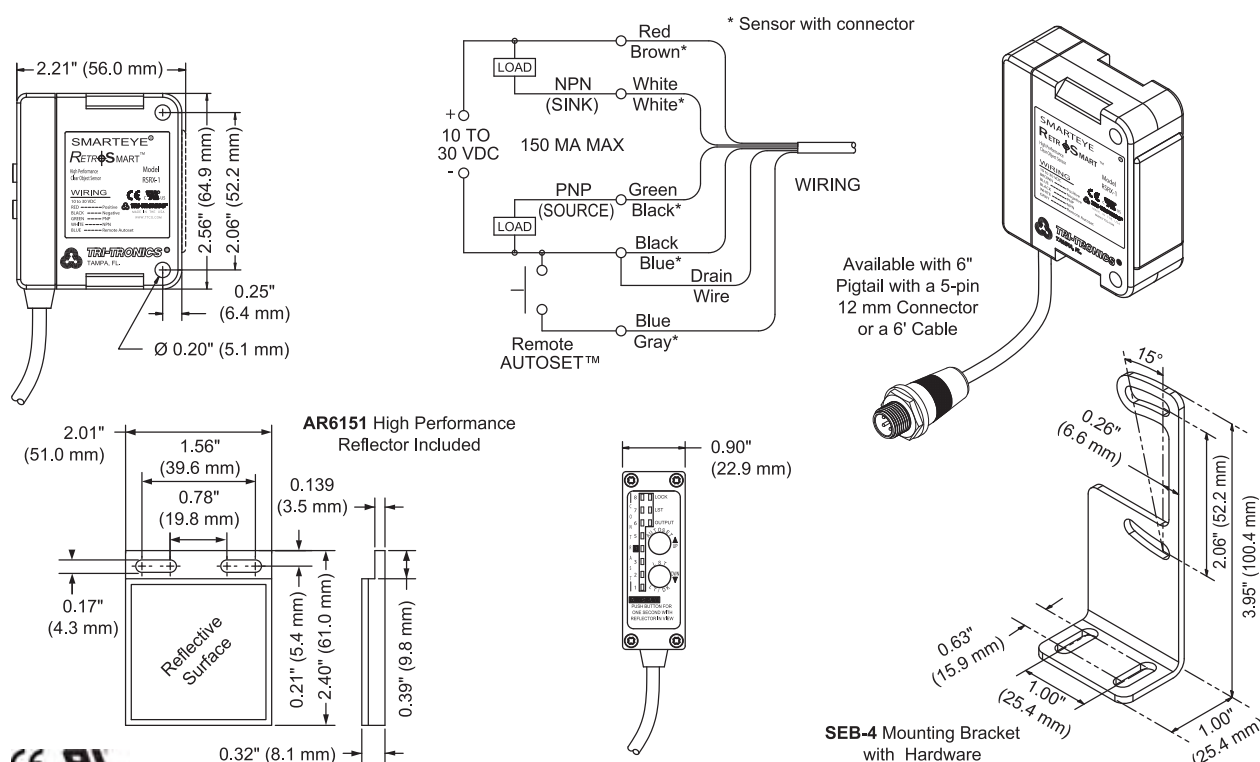
## RUGGED CONSTRUCTION

- Chemical resistant, high-impact polycarbonate housing
- Waterproof ratings: NEMA 4, IP66

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions

## SMARTEYE® RETROSMART®





Detects the Presence of Invisible Fluorescent Materials



Digital Models  
Analog Models  
Fiberoptic Options  
Up to 24" Range  
AUTOSET™ Adjustment

SMARTEYE®





## The SMARTEYE® STEALTH-UV™ Luminescence Sensor

The SMARTEYE® STEALTH-UV sensor is a special purpose sensor designed to detect the presence of invisible fluorescent materials contained in or added to chalks, inks, paint, greases, glue, or optical brighteners found in labels, paper, tape, string, etc. The sensor contains an ultraviolet (UV) solid state light source that is used to excite the luminescent materials to fluoresce in the visible range. The sensor's detector then responds to the visible fluorescing light. When the received fluorescing light level (displayed on the Contrast Indicator) reaches a level of "4" or above, the NPN and PNP output transistors will switch to the opposite state.



## Typical Applications

- Detection of clear tamperproof seals
- Label verification on containers
- Detection of invisible registration marks for printing, cutting, positioning
- Registering UV adhesives on clear labels
- Triggering on inkjet printed marks for product identification or insertion
- Thread break detection
- Continuous web splice detection
- Detecting marks (chalk) for grading or sorting, such as lumber, hardwood, and tile products
- Orientation of products
- Detecting the presence of a critical component in a complex assembly
- Seeing UV threads in carpets for cutting or positioning
- Detection of cellophane tape or adhesives on cardboard cartons or boxes
- Verification of pull tabs on packages
- Verifying the presence of lubricants, such as oil or grease, or identifying oil leaks
- Product Inspection/Verification:
  - Amount of glue/adhesives on paper, plastics, envelopes, and transparent materials
  - Detecting LOCTITE P/N 24221 on machine threads or bolts
  - Verifying that products are inserted into packages, such as coupons into cake mixes, or pamphlets into pharmaceutical products
  - Label verification on bottles (white label on a white plastic bottle)



# The SMARTEYE® STEALTH-UV™ Advantage

The *STEALTH-UV* operates in the ultraviolet region where there is little interference from other light sources. The *STEALTH-UV* responds to the ultraviolet (UV) fluorescent regions found in many man-made and natural materials. Another advantage is that, unlike most UV light, the *STEALTH-UV* can use our standard glass fiberoptic light guides.



Glass Fiberoptic Light Guides

SMARTEYE® STEALTH-UV™ — High immunity to all ambient light, including strobes

## Features

### CONTRAST INDICATOR™

Provides “at-a-glance” performance data, both statically and dynamically.

### OPTIMIZED GAIN ADJUSTMENT

This unique feature provides automatic digital selection of amplifier gain based upon your sensing requirements.

### AUTOSET™ ADJUSTMENT

The AUTOSET™ adjustment routine only requires the push of one button, one time! Simply place the UV target in view and press the AUTOSET™ button for 1/2 second.

### TIMER

When the “OFF” delay pulse stretcher is enabled, the output duration is extended by 15 milliseconds. Enabling the Timer allows ample time for the controller to respond to short duration input events.

### HIGH SPEED

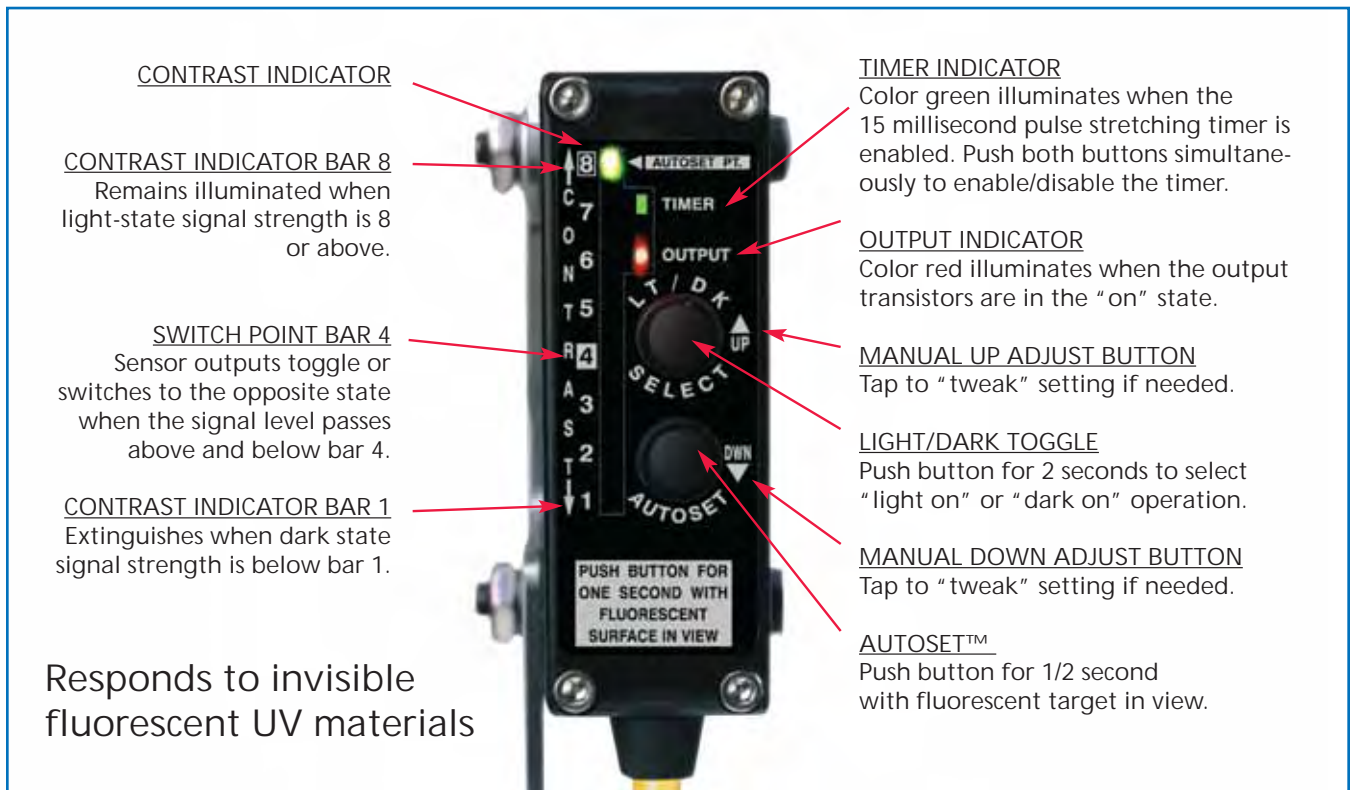
Detection varies with model selection. See *Specifications* for details.

### CONNECTIONS

Built-in 4-pin 12 mm 6" (152.4 mm) male micro connector (M-12)

### MOUNTING OPTIONS

Through-hole or bracket mount.



## How To Specify:



Analog Output Available  
Spring '07

### Coaxial

#### UVS-1 / UVS-1A (Analog Output)

Focal Distance 0.50" (12.7 mm)  
Spot Size 0.067" (1.7 mm)  
Usable Range 0 to 5.0" (0 to 127 mm)  
Response Time 200 microseconds

#### UVS-2 / UVS-2A (Analog Output)

Focal Distance 1.0" (25.4 mm)  
Spot Size 0.086" (2.2 mm)  
Usable Range 0 to 7.5" (0 to 190.5 mm)  
Response Time 200 microseconds

#### UVS-3 / UVS-3A (Analog Output)

Focal Distance 2.0" (50.8 mm)  
Spot Size 0.128" (3.25 mm)  
Usable Range 0 to 10.0" (0 to 254 mm)  
Response Time 200 microseconds

#### UVS-4 / UVS-4A (Analog Output)

Focal Distance 4.0" (101.6 mm)  
Spot Size 0.16" (4.1 mm)  
Usable Range 0 to 13.0" (0 to 330 mm)  
Response Time 200 microseconds

### Convergent

#### UVS-5 / UVS-5A (Analog Output)

Focal Distance 8.0" (203 mm)  
Spot Size 1.0" (25.4 mm)  
Usable Range 2.0 to 24.0" (50.8 to 609.6 mm)  
Response Time 750 microseconds

### Fiberoptic

#### UVS-6 / UVS-6A (Analog Output)

Micro Polished Fiberoptic Light Guide  
BF-U-36TUV 0.156" Bundle Size (4.0 mm)  
Usable Range Up to 2.5" (63.5 mm)  
Response Time 350 microseconds

Note: For chemical resistant glass window, add "G" to model numbers. Examples: UVS-1G, UV-1AG

### Model/Range Guidelines

Optimal range is dependent upon fluorescent concentration, size, and surface reflectivity.

NOTE: Sensor selection should not be determined solely by range. It may be advisable to test multiple sensors or fiber optic light guide tip configurations to ensure optimum performance.

## Accessories

### Micro Cable Selection Guide 4-wire, M12



#### Yellow Shielded Cable Assemblies

SEC-6  
6' (1.8 m) cable with connector  
SEC-15  
15' (4.6 m) cable with connector  
SEC-25  
25' (7.62 m) cable with connector



#### Black Shielded Cable Assemblies (Lightweight)

BSEC-6  
6' (1.8 m) cable with connector  
BSEC-15  
15' (4.6 m) cable with connector  
BSEC-25  
25' (7.62 m) cable with connector



BX-10  
10' (3.1 m) Extension cable  
BX-25  
25' (7.62 m) Extension cable



#### Unshielded Cable Assemblies

SEC-2MU  
6.5' (2.0 m) Low-cost  
SEC-5MU  
16.4' (5.0 m) Low-cost



#### Suggested Fiberoptic Light Guides for Stealth UV:

BF-U-36TUV  
BF-A-36T  
BF-C-36



FMB-1 (8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket



SEB-4  
Stainless Stealth  
Mounting Bracket



FMB-2 (5.1 mm diam.)  
FMB-3 (3.1 mm diam.)  
Miniature Glass or Plastic  
Fiberoptic Mounting  
Brackets

# Specifications

## SUPPLY VOLTAGE

- 10 to 30 VDC
- Polarity Protected

## CURRENT REQUIREMENTS

- UVS-1, UVS-2, UVS-3 & UVS-4: 50 mA
- UVS-5 & UVS-6: 65 mA (exclusive of load)

## TRANSISTOR OUTPUT

- (1) NPN and (1) PNP output transistor:  
NPN: Sink up to 150 mA  
PNP: Source up to 150 mA
- Continuous short circuit protected
- Outputs protected from pulsing during power up

## ANALOG OUTPUT

- 4 – 20 mA (Consult factory for specifications)

## RESPONSE TIME

- Varies by sensor model

## AMBIENT TEMPERATURE

- - 40°C to +70°C (- 40°F to 158°F)

## LIGHT IMMUNITY

- Responds to sensor's pulse modulated light source, resulting in high immunity to most ambient light and strobes, including indirect sunlight

## RUGGED CONSTRUCTION

- Chemical resistant high impact polycarbonate housing, acrylic lens cover
- Industry Ratings: NEMA 4, IP67

## PUSH BUTTON CONTROL

- "One-Touch" AUTOSET™ push-button setup
- Tweak adjustments with "up" or "down" buttons
- Selection of Light/Dark operation
- Enable/Disable pulse stretcher

## HYSTERESIS

- 2 bars as displayed on Contrast Indicator:  
Light State switch = 5  
Dark State Switch = 3

## DIAGNOSTIC INDICATORS

- Contrast Indicator – Display scaled reading of sensor's response to contrasting light levels (light vs. dark) on an 8 bar LED display
- RED LED OUTPUT INDICATOR Illuminates when the sensor's output transistors are "on" NOTE: If Output LED flashes, a short circuit condition exists
- GREEN LED TIMER INDICATOR Illuminates when the 15 millisecond pulse stretcher timer is enabled

## LIGHT SOURCE

- UV LED, 375 nm Wavelength

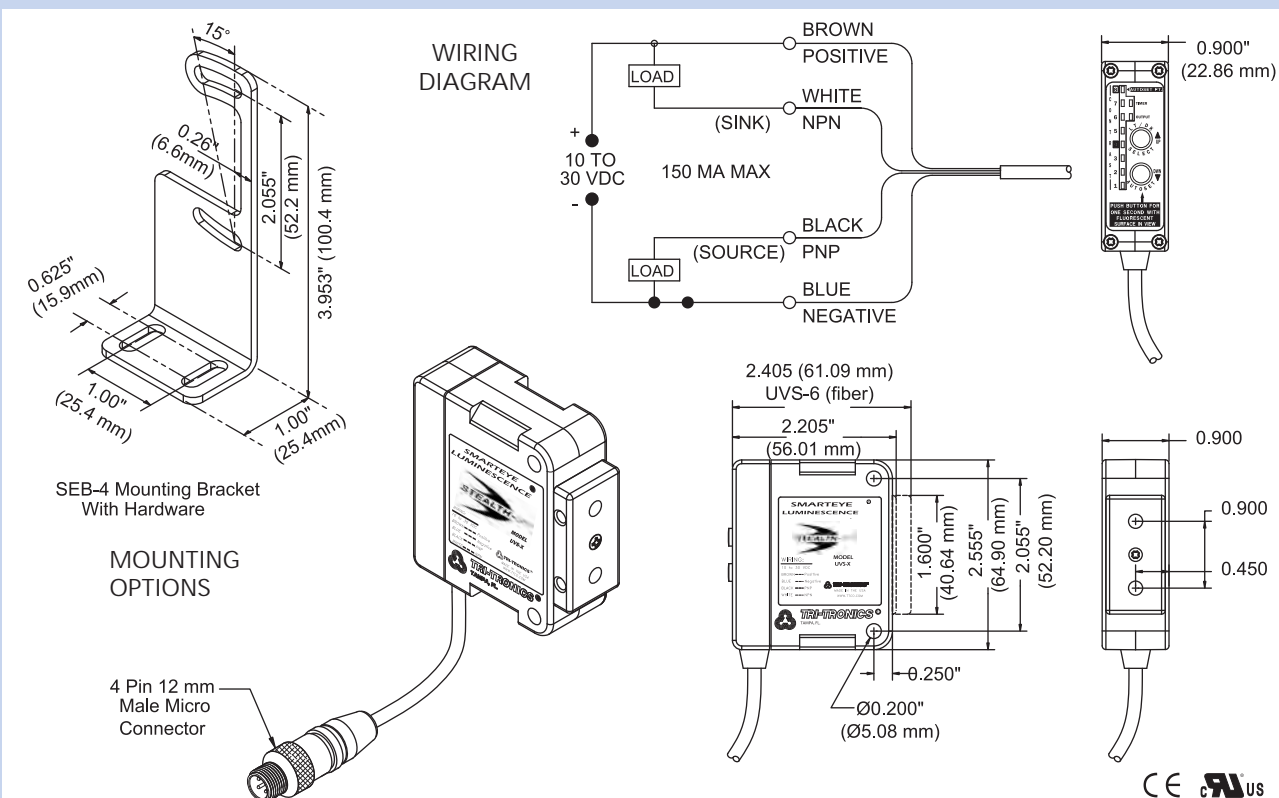


Verification of Tamperproof Seals or Labels

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions

## SMARTEYE® STEALTH-UV™





Remote Digitally Controlled Sensor  
Highest Resolution of Any Model



DCS®

# SMARTEYE® DCS®

DIGITALLY CONTROLLED  
SMARTEYE® SENSOR

## Solve Your Sensing Problems

- Icons Simplify Setup
- Unlimited Product Memory Settings
- Graphical Performance Monitor
- Configurable Performance Options
- Multiple Timer Options
- Tamperproof

Many of today's photoelectric sensors are equipped with limited features that are both confusing and difficult to control. The operator can find it difficult to implement even a simple setup procedure or monitor the diagnostic indicators. By combining the power of the computer with the SMARTEYE® DCS® sensor, setup procedures are simplified, performance options are easily configured, and the operator is provided a unique, graphic display.

Without a doubt, the SMARTEYE® DCS® (Digitally Controlled Sensor) is equipped with the greatest variety



(Patent No. 6,950,778)

of performance enhancing options ever offered in a single photoelectric sensor. Because this sensor offers so many features and benefits, it would be easy to assume that it would be difficult for a machine operator to adjust. Frankly, the opposite is true. While viewing a simple, easy-to-use graphic display, all that's required is for the operator to point and click on the specific icon depicting the sensing mode in use, i.e., Beam Make (proximity) or Beam Break (retroreflective or opposed). Another setup option is to go to the product memory screen to store or recall previous settings, based upon specific product descriptions.



After initiating the AUTOSSET™ routine, the operator has the option of monitoring the response of the sensor to contrasting light levels on either a bargraph contrast indicator or a unique oscilloscope-style Contrast Deviation Analyzer (Patent Pending). The analyzer charts the signal level deviation against the background of the dynamic range of the sensor while monitoring on-going events. Now the operator, while viewing the contrast analyzer on the screen, can

# SMARTEYE® DCS®

*From your Control Display Screen, you can...*

## ADJUST THE SENSOR

- A. Click on the icon depicting the sensing mode in use to initiate the automatic setup routine. (AUTOSET™)
- B. Recall prior settings from product memory. *NOTE:* Both the stored settings and the configured options will be instantly recalled.
- C. While viewing the oscilloscope-style Contrast Deviation Analyzer, the adjustments can be tweaked to obtain the setting that absolutely guarantees the most reliable performance.



## CONFIGURE THE SENSOR

The following options are automatically configured by using selectable icons or can be manually configured.

- A. ACT™ (Automatic Contrast Tracking)
- B. Response Time
- C. Hysteresis
- D. AUTOSET™ Mode
- E. AUTOSET™ Point
- F. Output Mode
- G. Adjustable Signal Conditioning Timer Options
  1. Signal Conditioning
    - a. Leading Edge Debounce
    - b. Trailing Edge Debounce
    - c. Blind/Inhibit Timer
  2. Motion Control Function (traditional On/Off delays)



## MONITOR THE SENSOR *(Unique to the Industry)*

- A. Indicators
  1. Contrast Indicator
  2. Output Status
  3. Dynamic Range
  4. RS-232 Communications Error
  5. Product Serial Number
  6. Sensor Change Indicator (sensor in use is not original sensor)
- B. Oscilloscope-Style Contrast Deviation Monitor (charts actual signal level response to input events)
  1. Screen number *one* displays signal level response while monitoring actual output switching
  2. Screen number *two* charts signal level deviation against the background of the dynamic range of the sensor



*While viewing the display, the operator can "tweak" the adjustment to obtain the most ideal setting that guarantees reliable sensing. In addition, the signal conditioning timers can be properly adjusted.*

The following options are automatically configured by using selectable icons, or they can be manually configured.

## ACT™

### AUTOMATIC CONTRAST TRACKING

ACT™ automatically adjusts the sensor as conditions change. This can include dirty lenses or reflectors, damaged fiberoptics or lenses, LED light source or thermal drift, and target variations such as position, orientation, or color. It can also compensate for signal shift or deterioration caused by high-speed input events. The DCS® continues to operate requiring far less maintenance than other sensors, making it *the choice* in tough sensing applications.

In applications where conventional photoelectric sensors require constant adjustments, the digitally controlled sensor is the answer. The ACT™ system is event driven, *i.e., the sensor monitors each input and makes appropriate adjustments*. This results in the truly unique ability of the sensor to track with gradual deterioration of contrasting light levels in dynamic conditions, while input events are ongoing.

Without question, the ACT™ system has proven to be extremely useful and should be activated as the default setting. It may be advantageous to turn the ACT™ off when performing product inspection or extremely low contrast sensing tasks.

## RESPONSE TIME

In general, it is advantageous to have a high speed of response from the sensor that triggers an electro-mechanical response required to perform a machine operation or function *i.e., drill it, cap it, fill it, label it, print it, etc.* As a result, the location of the performed operation remains consistent, independent of variations in the velocity of the moving target. Therefore, for the vast majority of applications, the 125-microsecond response time is your best choice and should be considered the default setting. However, in some situations it may be advisable to slow down the response time of the sensor to 500 microseconds. For example, when attempting to respond to printed registration marks on paper or “web” materials, you may elect to desensitize the sensor to avoid responding to minor surface blemishes that pass rapidly through the sensor’s light beam. Selecting a slower speed of response is also useful to prevent the sensor’s output from chattering due to extreme electrical noise.



## HYSTERESIS

The DCS® sensor has two switch point signal levels as displayed on the Contrast Indicator that determine when the output of the sensor will switch. When the signal level passes through the upper, or light state switch point, the sensor will switch to the light state condition. When the signal level drops below the dark state switch point, the output will switch to the dark state condition. The difference between the light state and dark state switch points defines the hysteresis of the sensor.

It is common for all photoelectric sensors to have a level of hysteresis to prevent the output of the sensor from inadvertently switching or “chattering” due to, for example, electrical interference or minute changes in the level of light received caused by vibrating objects partially in view of the sensor’s light beam. The DCS® sensor is unique in that two levels of hysteresis are available. The low *hysteresis* setting is from 4 to 6 (3 bars as displayed on the Contrast Indicator). This is generally more than enough to provide for clean output switch transitions and prevents an output response on both the leading edge and trailing edge of the passing object. The low setting should be considered the default setting.

The high hysteresis setting of 2 to 8 (7 bars as displayed on the Contrast Indicator) can be used in applications when there is severe vibration of the objects stopped in front of the sensor.



The Operator can tweak the adjustments from the monitor for any sensing purpose.

## AUTOSET™ MODE

### *The Light State AUTOSET™ Routine*

On command, it automatically adjusts the sensor to a light state set point slightly above 10 on the Contrast Indicator. Best choice when operating in the Proximity (reflected light) mode. Provides a near perfect adjustment that prevents the sensor from responding to objects in the background at the sensing site. NOTE: The light state AUTOSET™ routine is the best choice for both Beam Make (Proximity) or Beam Break (Retroreflective) sensing modes and should be considered the default setting.

### *The Dark State AUTOSET™ Routine*

On command, it automatically adjusts sensor to a dark state set point slightly below 1 (zero) on the Contrast Indicator. It can be useful to obtain the longest possible sensing range when operating in the Proximity (Beam Make) mode and can only be useful when there are no objects in the immediate background. Use with care.

## AUTOSET™ POINT

The level to which the sensor sets itself when an AUTOSET™ command is implemented. The automatic set point (Excess Gain) can be optimized to a high or low contrast sensing task. Therefore, we have built into the sensor two possible AUTOSET™ points, one for high contrast applications and one for low contrast applications. For general purpose sensing tasks, the high contrast AUTOSET™ switch point is the default setting.

## OUTPUT MODE

In the *Light "ON"* mode the output transistor will turn "ON" when the signal level is above the mid-scale switch point on the Contrast Indicator. When operating in the Proximity (Beam Make mode), the *Light "ON"* mode will result in the output transistor turning "ON" when the leading edge of the object moves into the sensor's light beam.

In the *Dark "ON"* mode the output transistor will turn "ON" when the signal level is below the mid-scale switch point on the Contrast Indicator. When operating in the Beam Break Mode (Opposed mode), the *Dark "ON"* mode will result in the output transistor turning "ON" when the leading edge of the object breaks the light beam.

## ADJUSTABLE SIGNAL CONDITIONING TIMER OPTIONS

### Timer #1

Leading edge "Debounce" timer can be selected to prevent the output from chattering as the leading edge of an object enters the sensor's effective light beam. NOTE: When in use, this timer will delay an output response for the adjustable timed period.

### Timer #2

"Blind" or "Inhibit" timer can be selected to prevent the output from returning to the non-detection state *during* an input event. This timer function can be used to ignore short duration response to undesired target or object conditions that can return the output to the non-detection state prior to the trailing edge clearing the sensor's light beam, *i.e. can be used to ignore a hole in the middle of an object as it passes through the sensor's light beam.*

### Timer #3

Trailing edge "Debounce" timer can be selected to prevent the output from chattering as the trailing edge of an object exits the sensor's effective light beam. NOTE: When in use, the output will be delayed from returning to the non-detection state for the adjustable time period after the trailing edge of the object has cleared the sensor's effective light beam.

## IMPORTANT:

When both of the Debounce timers are set to the same time duration, the sensor's response will be delayed and will be representative of the actual input duration.

# How to Specify

## 1. SELECT SENSOR

DCSIC Infrared  
DCSRC Red  
DCSWLC White

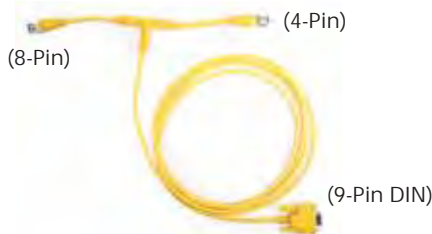
## 2. SELECT OPTICAL BLOCK

F1 Fiber Optic  
V1, V1G Convergent 2 – 4"  
R1 Retroreflective  
O1, O1G Long Range Proximity  
O2 Wide Beam Proximity

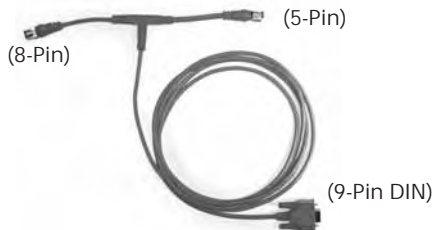
Example: **DCSRCF1**

DCS LED Color Connector Model Optical Block

## Accessories



TJC-2  
"T" Junction Splitter Cable,  
4-Pin Output



TJC-3  
"T" Junction Splitter Cable,  
5-Pin Output



DCS8-2M  
Cable, 8-wire, M12



004-0097  
EYEWARE CD  
(Free)



FMB-1 (8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket



FMB-2 (5.1 mm diam.)  
FMB-3 (3.1 mm diam.)  
Miniature Glass or Plastic  
Fiberoptic Mounting  
Brackets



SMARTEYE® DCS®



4-Wire, M12 (for TJC-2)  
BSEC-6  
6' (1.8 m) cable with connector



BSEC-15  
15' (4.6 m) cable with connector

BSEC-25  
25' (7.6 m) cable with connector

5-Wire, M12 (for TJC-3)  
GSEC-6  
6' (1.8 m) cable with connector  
GSEC-15  
15' (4.6 m) cable with connector  
GSEC-25  
25' (7.62 m) cable with connector

## Range Guidelines

### Convergent/Proximity/Retroreflective

OPTICAL BLOCKS	IR	RED	WHITE
O1, O1G	6 ft.	5.5 in.	N/A
O2	3.5 in.	3.5 in.	1.5 in.
V1, V1G	4 in.	4 in.	2 in.
R1	35 ft.	30 ft.	N/A

NOTE: Proximity test utilized a 90% reflective white target. Retro-reflective tests utilized a 3" diam. round reflector, Model AR-3

### Glass Fiberoptics Opposed Mode

F1	6 ft.	5.5 in.	N/A
F1 w/lens	20+ ft.	20+ ft.	9 ft.

### Glass Fiberoptics Proximity Mode

F1	6 in.	4.5 in.	1.75 in.
F1 w/lens	1 ft.	1 ft.	1 ft.

NOTE: Range tests utilized a .125" diam. fiberoptic bundle

# Specifications

## SUPPLY VOLTAGE:

- 10 to 16 VDC
- Polarity Protected

## CURRENT REQUIREMENTS:

- 65 mA (exclusive of load)

## OUTPUTS:

- (1) NPN and (1) PNP open collector output transistors
- Sensor outputs can sink or source up to 150 miliamps (current limited)
- All outputs are continuously short circuit protected

## COMMUNICATIONS PORT:

- RS-232 I/O
- Baud Rate 19.2k

## LED LIGHT SOURCE:

- Options: Infrared = 880nm, Red = 660nm, or White = Broadband Spectrum

## LIGHT IMMUNITY:

- Responds to sensor's pulsed modulated light source resulting in high immunity

## INDICATORS:

- Red LED output indicator illuminates when the sensor's output transistor is "ON", NOTE: If Output LED flashes, a short circuit condition exists.
- Yellow ACT™ indicator – illuminates when contrast deviation fails to rise above "8" in the light state condition or fails to go below "2" in the dark state condition. Indicates performance approaching marginal level.
- 10 LED Contrast Indicator – displays scaled readings of sensor's response to contrasting light levels (light vs. dark)

## AMBIENT TEMPERATURES:

- -40° C to +70° C (-40° F to +158° F)

## RUGGED CONSTRUCTION:

- Chemical resistant high impact polycarbonate plastic housing
- Waterproof rating: NEMA 4X, 6, IP-67
- Conforms to heavy industrial grade CE requirements



The DCS® Sensors are compatible with computers, PLC's, imbedded controllers, or any controlling device equipped with an RS-232 serial port.

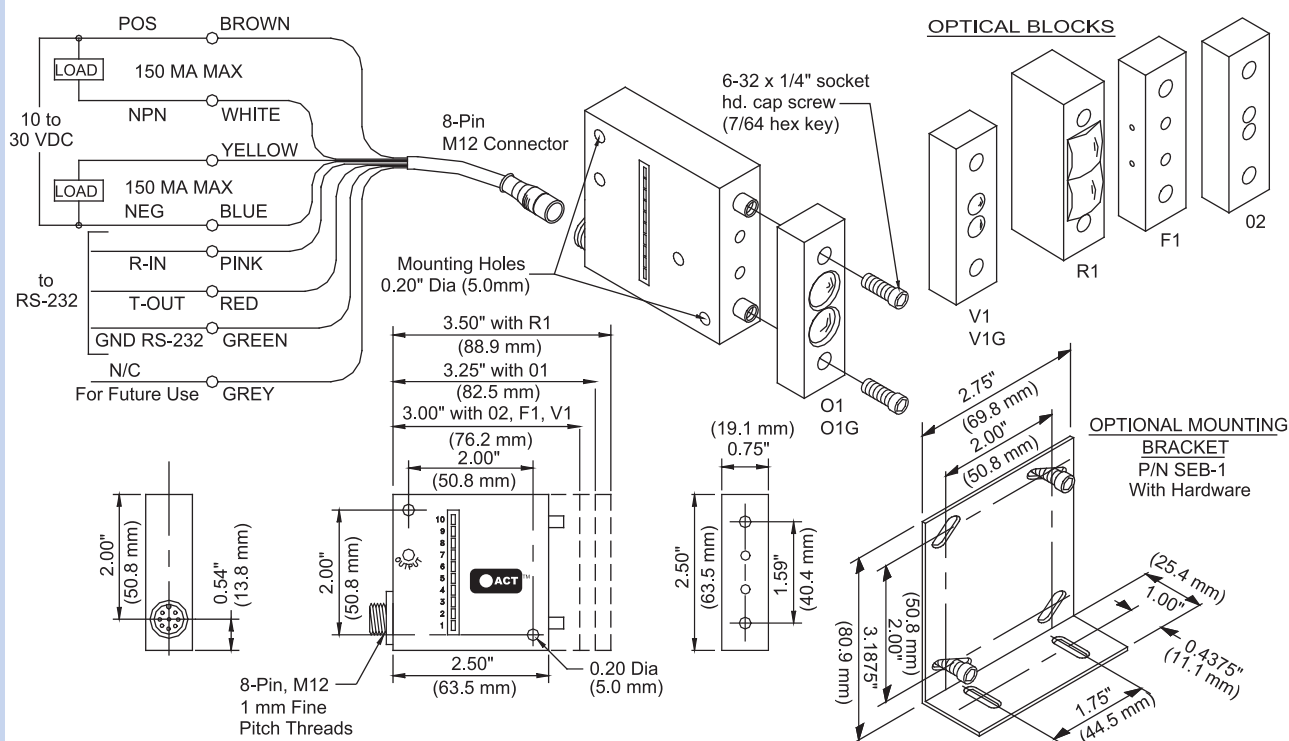
EYEWARE software and ASCII command set available online (free).

(Patent No. 6,950,778)

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions

## SMARTEYE® DCS®



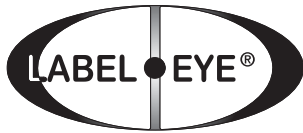
CE US



Optimized for Label Detection  
AUTOSET™ Setup  
Low Cost



# Opacity Mode Special Purpose Sensor

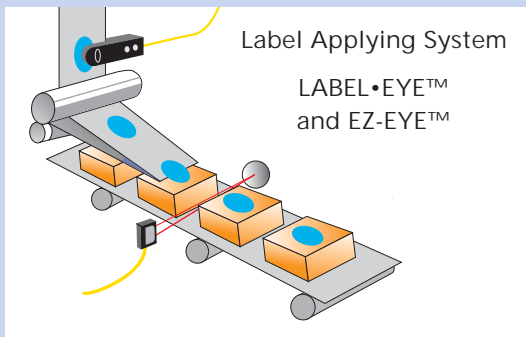


*Designed specifically for the detection of labels*

The LABEL•EYE® is a photoelectric sensor designed specifically to sense labels on a roll. Since the LABEL•EYE is an automatic one-touch sensor and not the conventional "teach mode" sensor, set-up is simple. Position the gap between the labels directly under the sensor's sight guide and push the AUTOSSETM button. The sensor does the rest, adjusting itself to the perfect setting. Sensing labels has never been easier.

## Other Possible Uses:

- Double sheet detection
- Envelope contents sensing
- Edge guiding
- Splice detection
- Label counting
- Unwinder, Rewinder
- Die cutter
- Label hot-printing
- Rotary die cutting and converting
- High speed dispensing



## The Label Applicator Process

The LABEL•EYE is a special purpose gap or slot sensor optimized to sense adhesive labels adhering to a roll of backing paper. The web of labels is directed from a "roll" across a peeler plate or around a sharp edge. As the web passes around the sharp edge of the peeler plate, the adhesive label dislodges from the backing material. The function of the LABEL•EYE is to look through the backing paper to detect the "gap" between the labels and signal the labeling machine to stop the dispensing mechanism before the label is completely dislodged from the backing material. With the next "up" label protruding off the end of the peeler plate, it is now perfectly positioned to be applied to the next product as it passes by on a conveyor.

The LABEL•EYE operates on 10 to 30 VDC and is pulse-modulated to prevent any problems from ambient light. Although designed for label detection, the LABEL•EYE can be useful in a variety of applications.



## SUPPLY VOLTAGE

- 10 to 30 VDC
- Polarity Protected

## CURRENT REQUIREMENTS

- 45 mA (exclusive of load)

## OUTPUT TRANSISTORS

- (1) NPN and (1) PNP output transistors
- Sensor outputs can sink or source up to 150 mA (current limit)
- All outputs are continuously short circuit protected

## RESPONSE TIME

- Light state response = 100 microseconds
- Dark state response = 100 microseconds

## LED LIGHT SOURCE

- High intensity red LED
- Pulse modulated

## PUSH BUTTON CONTROL

- Automatic setup routines based on web opacity

- One push button setup
- Pushing both buttons simultaneously inverts output

## HYSTERESIS

- Minimal hysteresis promotes the detection between the backing material and the label depending on the settings

## LIGHT IMMUNITY

- Responds to sensor's pulsed modulated light source, resulting in high immunity to most ambient light

## INDICATORS

- Green LED flashes when AUTOSET™ routine is activated and stays illuminated when AUTOSET™ is completed
- Red LED illuminates when sensor's output transistors are "ON". NOTE: The status of the output transistors can be inverted

by pushing both buttons simultaneously. If Output LED flashes, a short circuit condition exists.

## AMBIENT TEMPERATURE

- -40°C to 70°C (-40°F to 158°F)

## RUGGED CONSTRUCTION

- Chemical resistant high thermoplastic PPS housing
- Waterproof, ratings: NEMA 4 and IP66
- Conforms to heavy industry grade CE and UL requirements

## 4-Wire Nano Cable, M8

GEC-6  
6' (1.8 m) cable with connector

GEC-15  
15' (4.6 m) cable with connector

GEC-25  
25' (7.6 m) cable with connector

RGEC-6  
6' (1.8 m) cable / right angle conn.

RGEC-15  
15' (4.6 m) cable / right angle conn.

GEX-9  
9' (2.7 m) extension cable



NOTE: Red flashing LED — Short circuit condition exists  
Green flashing LED — No contrast through web

## How To Specify:

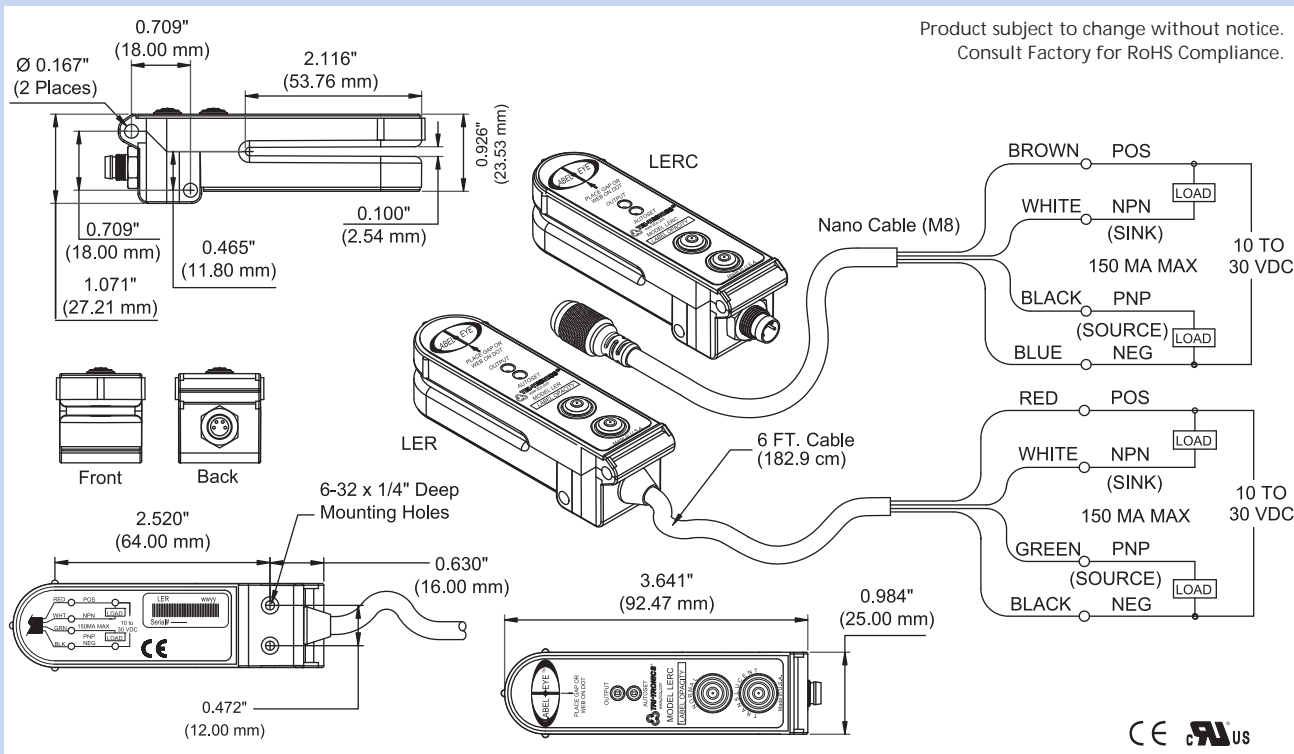
Example:

LER – Red LED, 4 conductor cable

LERC – Red LED, 4 pin Nano connector, M8

## Connections and Dimensions

LABEL•EYE®



## SPECIALTY APPLICATION PHOTOELECTRIC SENSORS



Extreme High-Intensity Sensors  
Thru-Beam and Fiberoptic  
Penetrates Many Packaging Materials  
for Content Verification



# High-Intensity Sensors

The Model HSLS-12 Super High Intensity Light Source has been added to the SLS Series product line. The Light Source emits 10 times the optical power, enabling it to easily penetrate cardboard or plastic containers. Applications include verification of container contents, proper fill levels or overlap splice detection of dense materials.

SMARTEYE® Light Sources and Receivers have been designed to perform Beam Break or thru-beam sensing tasks where the material or container is dense, the lens is subject to contamination buildup, or for long range sensing in harsh environments. A complete system includes a Dual LED High-Intensity Light Source and a Complementary Receiver.



*HIGH INTENSITY*

*Super High Intensity  
Light Source provides  
10X the Optical  
Power!*

## Features

- Unique CONTRAST INDICATOR™ allows easy set-up for optimum performance and displays actual performance during operation
- Dual LED high-intensity design
- Pulse modulated for high immunity to ambient light
- Complementary NPN or PNP output transistors
- 800 microseconds – Beam Make or Beam Break



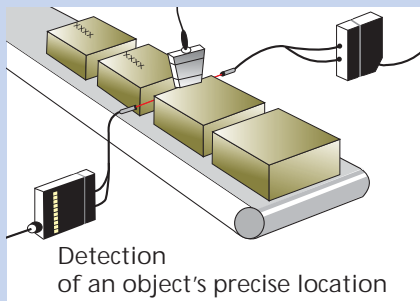
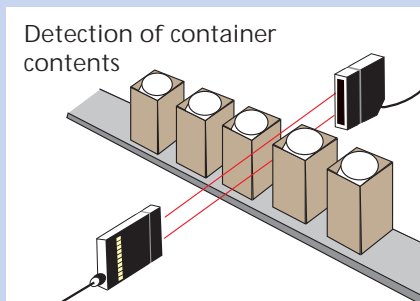
Sees through many packages

## Fiberoptic Light Guides

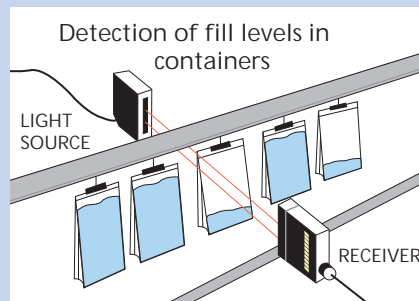
Flexible Fiberoptic Light Guides are available in sizes small enough to fit into your toughest job sensing sites, with models for inaccessible places, detection of extremely small parts, high temperature applications, corrosive environments, or high vibration locations, as well as straight light guides for opposed mode (Beam Make) and bifurcated light guides for proximity sensing.

## Typical Applications

Detection of container contents



Detection of fill levels in containers



# Model Selection & Specifications



## HIGH INTENSITY

### Receiver Specifications

#### SUPPLY VOLTAGE

- 12 to 24 VDC
- Polarity protected

#### CURRENT REQUIREMENTS

- 50 mA (exclusive of load)

#### OUTPUTS

- Complementary NPN or PNP output transistors sink/source up to 100 mA

#### RESPONSE TIME

- 800 microseconds – Beam Make or Beam Break

#### HYSTERESIS

- 400 millivolts – maximum sensitivity and resolution

#### LIGHT IMMUNITY

- Extremely high immunity to ambient light – sensor responds to pulse modulated light only

#### LED INDICATOR

- When the light level reaching the photodetector exceeds "5" on the Contrast Indicator, the output switch, and the output LED indicator illuminates

#### CONTRAST INDICATOR

- Displays the receiver's full and complete response to contrasting light levels (lightest state vs. darkest state) on the LED bar graph

#### AMBIENT TEMPERATURE/RH

- -40°C to 70°C (-40°F to 158°F)
- 95% relative humidity

#### RUGGED CONSTRUCTION

- High-impact plastic case is dirt and moisture sealed
- Epoxy encapsulated for mechanical stability

### High Power Light Source Specifications

#### SUPPLY VOLTAGE

- 12 to 24 VDC
- Polarity protected

#### CURRENT REQUIREMENTS

- Dual LED light source 65 mA
- HSLS-12 light source 70 mA

#### LED LIGHT SOURCE

- Infrared = 880 nm wavelength
- Model SLS, 2 LED's; Model HSLS-12, 10 LED's

#### AMBIENT TEMPERATURE/RH

- -40°C to 70°C (-40°F to 158°F)
- 95% relative humidity

#### RUGGED CONSTRUCTION

- High-impact plastic case is dirt and moisture sealed
- Epoxy encapsulated for mechanical stability



#### CONTAINER CONTENTS DETECTION

Dual LED Light Source Model SLS-1 and Dual Detector Receiver Model SR-1.

This basic system is used without optical blocks. It was designed for closeup thru-beam sensing through dense containers and materials. Applications include detecting the presence or absence of contents in plastic containers or cardboard boxes, detecting overlap splices in dense materials, etc.



#### LONG RANGE HARSH ENVIRONMENT PENETRATION

Dual LED Light Source Model SLS-2R1 and Dual Detector Receiver Model SR-2R1.

Type R1 Optical Block which allows the light source and receiver to be placed as far apart as 100'. This system is capable of penetrating severe contamination buildup on the lenses. Applications include detecting opaque objects under the most adverse conditions found in the lumber, paper, and steel industries.

# Model Selection, Specifications & Accessories



## FIBEROPTIC BEAM BREAK DETECTION

Dual LED Light Source Model SLS-2F1 and Dual Detector Receiver Model SR-2F1.

Type F1 allows the use of our fiber optic light guides. Utilizing a bifurcated light guide, the light energy available from the two LED light sources is used to create a very high intensity light beam. The Dual Detector receiver can be used with one bifurcated light guide and one or two straight light guides.



*HIGH INTENSITY*

## Accessories

Model #	Description
F1	Fiberoptic Optical Block
R1	Thru-Beam Optical Block
DCB-1	Light Source Mounting Bracket
SEB-1	Receiver Mounting Bracket; S.S.
CA-1	Conduit Adapter
FSR-1	Flexible Strain Relief
UAC-15	Threaded Long Range Lens

## How to Specify

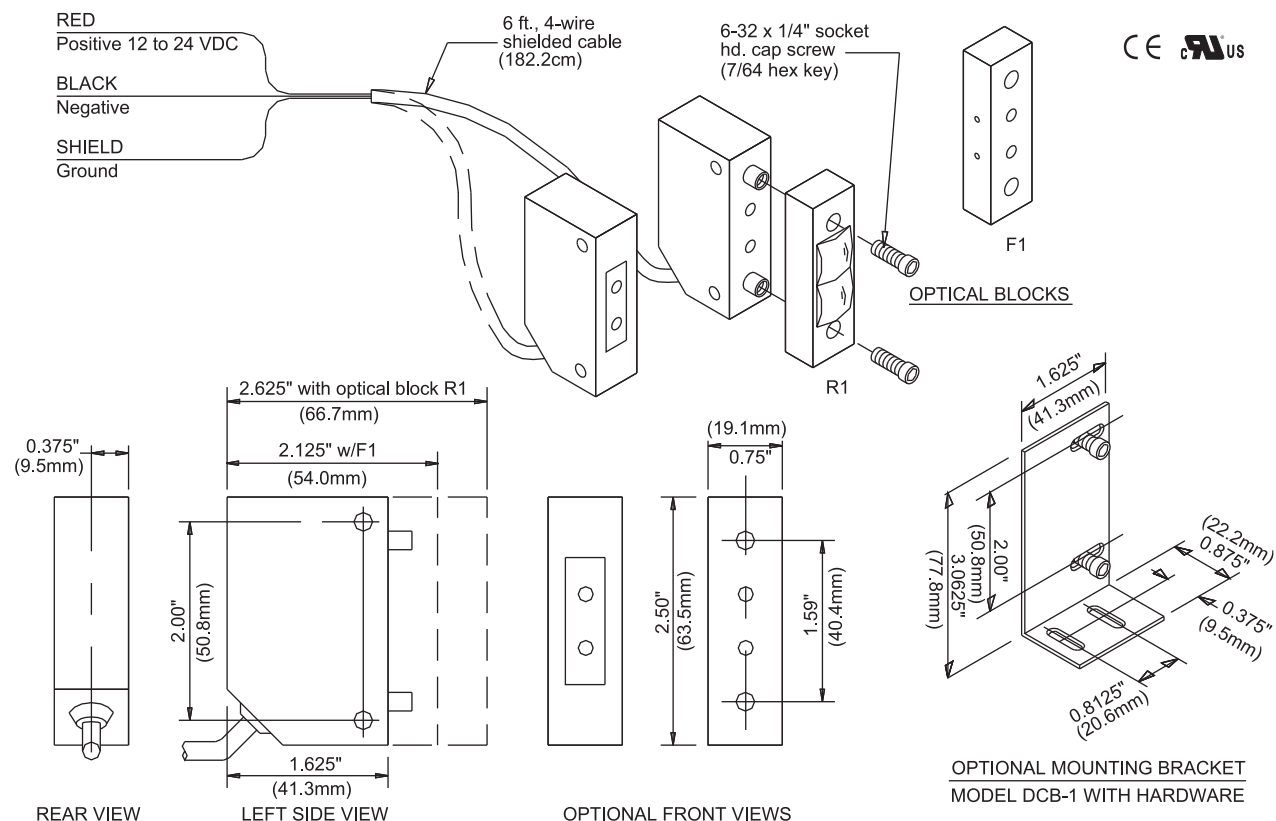
Light sources and receivers are not furnished in pairs and they must be ordered separately.

Light Source Model #	Receiver NPN Model #	Receiver PNP Model #	Range Guidelines	Applications
<b>High Intensity Light Sources</b>				
SLS-1	SR-1	PSR-1	Up to 12 in.	Short range, high power opacity sensing. Use in shortest range possible for maximum penetration.
SLS-2R1	SR-2R1	PSR-2R1	Up to 100 ft.	Long range, Beam Break object sensing.
SLS-2F1 (with fiberoptic light guide)	SR-2F1	PSR-2F1	Up to 3 ft. without lens	Short range fiberoptic Beam Break sensing.
			Up to 18 ft. with lenses	Long range fiberoptic Beam Break sensing. Using 2 UAC-15 lenses.
<b>Super High Intensity Light Sources</b>				
HSL-12	SR-1	PSR-1	35 ft.	10X Optical power. Verification of container contents, proper fill levels, or overlap splice detection of dense materials.

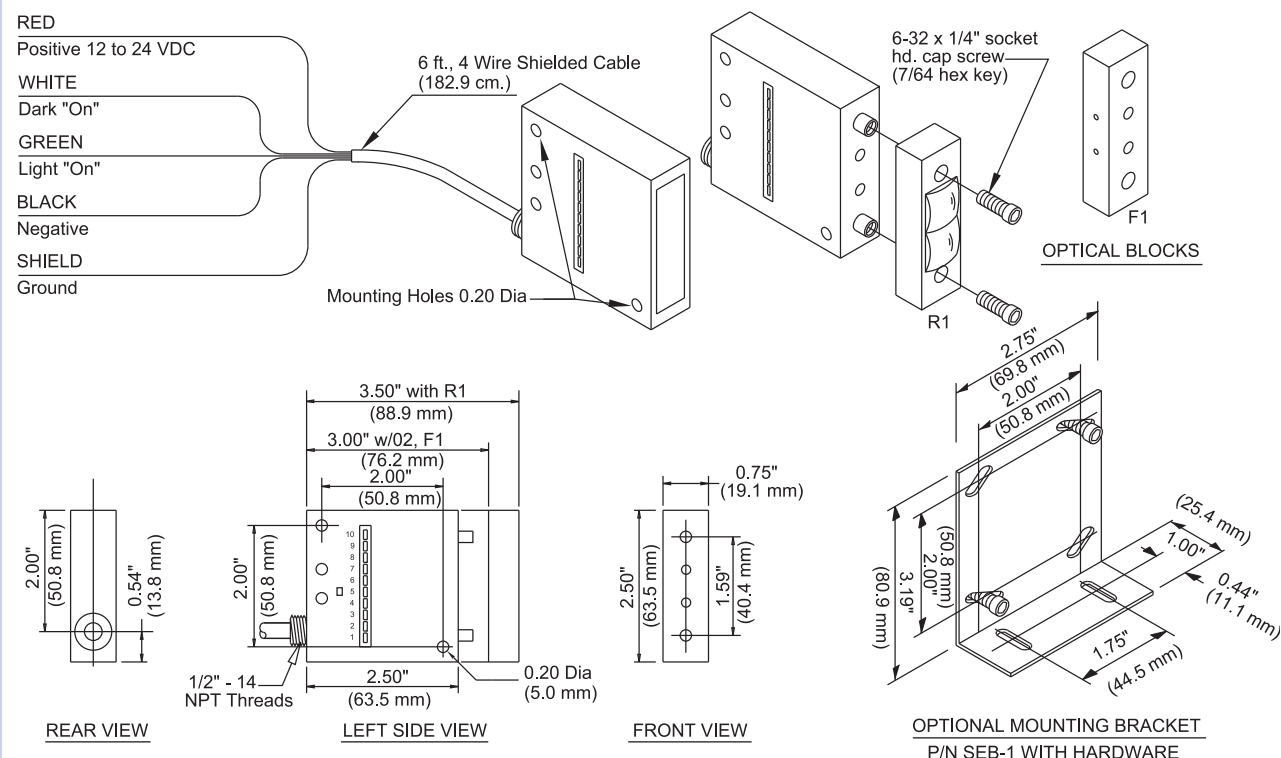
# High Intensity



## High Intensity Light Source/Receiver Models



## Dual Detector Receivers





High Resolution Registration Mark Sensor  
4 LED Color Option  
50 Microsecond Response Time



# High Resolution Registration Mark Sensors



## SMARTEYE® COLORMARK™ II Features:

- Built-in Connectors
- Waterproof Housings
- Clutch Knob Adjustment (Offset/EDR)
- Unique 10 LED Contrast Indicator
- Addition of EDR® "Enhanced Dynamic Range" – eliminates hot spot glare effects. Works on the shiniest materials, including foils.
- Optional Pulse Stretcher guarantees a minimum of 10 milliseconds output – ample time for visual LED verification and for the control to respond.
- Choice of light source – green, red, blue, or white.

TRI-TRONICS SMARTEYE® COLORMARK™ II Registration Mark Sensors now combine unique color perception ability with very high speed response. Many important features have been incorporated into the design to meet the increasing demand for precision registration control on today's higher speed packaging machinery.

The specific task of a photoelectric registration mark detector is to respond to printed registration marks on packaging material as they pass through the sensor's light beam. The output of the sensor must switch when the mark arrives precisely in position for the control function to occur. The resolution of the exact location of each passing registration mark is keynote to ensure that the initiation of the electromechanical response triggered by the sensor is in synchronization with the arrival of the mark.

The high speed (50 microseconds) response time of the SMARTEYE® COLORMARK™ II helps to ensure



that the point of detection of the sensed mark will not shift as the velocity of the moving web varies from slow startup to maximum velocity.

## COLOR REGISTRATION MARK SENSING

Color perception is a must for detecting registration marks printed in a wide variety of colors. Imagine viewing a printed red mark on white paper stock. Now, imagine placing a red transparent filter in front of your eye while trying to view that same red mark. The red mark now becomes difficult, if not impossible, to see. If the sensor was equipped with a red LED, it would have the same problem. Now, imagine viewing that same red mark through a green filter. The white background now appears bright green, but the red mark appears black or very dark. That's the contrast we are looking for. Equipping the sensor with a green LED light source provides the same advantages as the green filter did for your eye. Now, the red mark provides more than adequate response to the contrasting light reflecting off the white background. The SMARTEYE® COLORMARK™ II recommended for detecting the greatest variety of color of marks is equipped with a unique combination of white LED light source and photodetector. In addition, there are SMARTEYE® COLORMARK™ II sensors equipped with red, green or blue LED light sources that are useful in other applications when the preferred white light source fails to perform; i.e., a blue LED light source is recommended to detect pale yellow marks on a white background. Consult selection guidelines to help in specifying the correct SMARTEYE® COLORMARK™ II to fit your sensing requirements.

TRI-TRONICS CMS Series Sensors are easier to set up than conventional color sensors because of their unique built-in Contrast Indicator™. Examples of setup instructions for various materials are shown below.

## Opaque Material (Non-Foil)

1. Position fiberoptic light guide to view material looking straight down. (See Fig. 1)
2. Place background in view of fiberoptic light guide.
3. Adjust "offset" as follows...
  - A – For dark mark on light background, adjust for a reading of "10" on the Contrast Indicator with the background in view.
  - B – For light mark on dark background, adjust for a reading of "1" on the Contrast Indicator with the background in view.
4. Set light/dark switch in the position that turns the "mark" indicator off.
5. Move mark into view. Note the new contrast reading. If this reading has deviated from the initial reading by 4 to 5 bars or more, enough contrast exists for proper detection.

## Foil Material

1. Position fiberoptic light guide as follows:
  - A – For a black or dark mark on shiny foil, position light guide to view material looking straight down. (See Fig. 1)
  - B – For white or light mark on shiny foil, position light guide to view material looking on a 45° angle. (See Fig. 2)
2. Place mark in view of fiberoptic light guide.
3. Adjust "offset" as follows:
  - A – For black or dark mark on shiny foil, adjust for a reading of "1" when the black mark is in view.
  - B – For white or light mark on shiny foil, adjust for a reading of "10" when the white mark is in view.
4. Set light/dark switch in the position that turns the mark indicator "ON" when the mark is in view.
5. Move mark out of view. With the background in view, note the new contrast reading. If this reading has deviated from the initial reading by 4 to 5 bars or more, enough contrast exists for proper detection.



## Transparent Material

1. Position fiberoptic light guide to view material looking straight down.
2. Place background (transparent area) in view of fiberoptic light guide.
3. Adjust "offset" for a reading of 9 or 10 on the Contrast Indicator.
4. Set light/dark switch in the position that turns the mark indicator off.
5. Move the mark into view. Note the new contrast reading. If this reading has decreased or deviated from the initial reading by 6 to 8 bars or more, enough contrast exists for proper detection.

## Hints and Tips:

1. False tripping or erratic operation is usually caused by excessive web flutter, wrinkles or variations in material background color or marks. Minor adjustments of the "offset" can help to eliminate erratic operation.
2. If the surface of opaque (non-foil) material is extremely shiny, consider placing fiberoptic light guide into the 45° angle position. (See Fig. 2). The position that results in the maximum contrast deviation as displayed on the Contrast Indicator will give the most reliable performance.
3. A metal guide plate for the material to flow across provides several necessary advantages:
  - A – Helps to iron out wrinkles.
  - B – Helps to eliminate web flutter.
  - C – Provides shiny background when sensing marks on transparent material.

Fig. 1 Straight Position

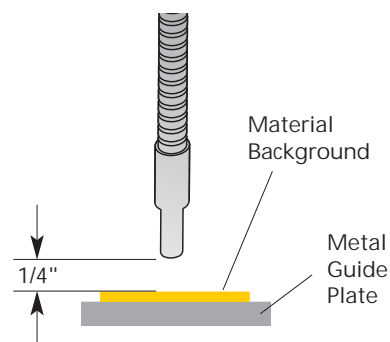
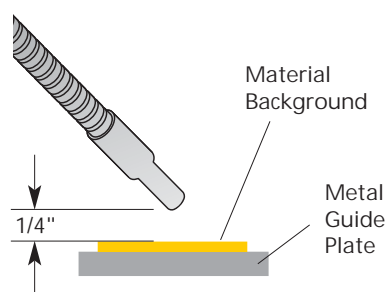


Fig. 2 45° Angle Position



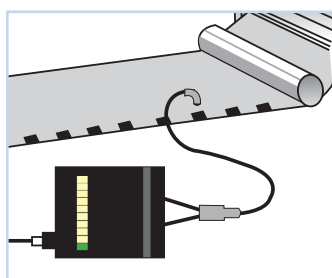
# Selection Guidelines



Fiberoptic Models



Lensed "V" Axis Models



## Preferred Mode: Fiberoptic Reflective (Proximity)

Based upon the characteristics of the web material, the printed mark and the sensing site conditions, the following guidelines will help to select the proper SMARTEYE® COLORMARK™ II to fit your sensing needs.

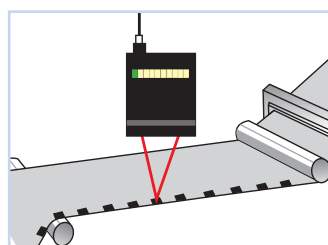
Sensor: Model CMSWL-1BF1 (with Pulse Stretcher) or Model CMSWL-2BF1 (w/o Pulse Stretcher). White Light Source.

Cable: Shielded cable w/connector. Right angle or straight mating connectors available.

Fiberoptic Light Guide: Model BF-A-36T (straight) or Model BF-A-36RT (right angle) as shown above. See Fiberoptic Light Guides section for availability in a wide variety of bundle sizes and shapes.

Sensing Range: From 1/4 to 3/8 in. Optional lenses can be used to extend sensing ranges.

Accessories: Mounting Bracket: Model SEB-1



## Alternate Mode (A): Convergent Beam "V" Axis

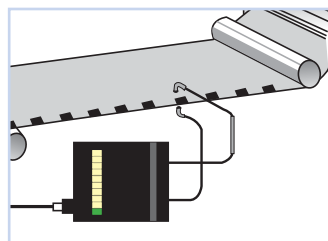
Optional choice to detect printed registration marks on opaque or translucent packaging materials.

Sensor: Model CMSWL-1BV1G (with Pulse Stretcher) or Model CMSWL-2BV1G (w/o Pulse Stretcher). White light source.

Cable: Shielded cable w/connector. Right angle or straight mating connector available.

Sensing Range: 1 in.

Accessories: Mounting Bracket: Model SEB-1



## Alternate Mode (B): Fiberoptic Thru-Beam

Good choice to detect printed registration marks on transparent packaging material.

Sensor: Model CMSWL-1BF1 (with Pulse Stretcher) or Model CMSWL-2BF1 (w/o Pulse Stretcher). White light source.

Cable: Shielded cable w/connector. Right angle or straight mating connectors available.

Fiberoptic Light Guide: Model (2) F-A-36T (straight) or Model (2) F-A-36RT (right angle).

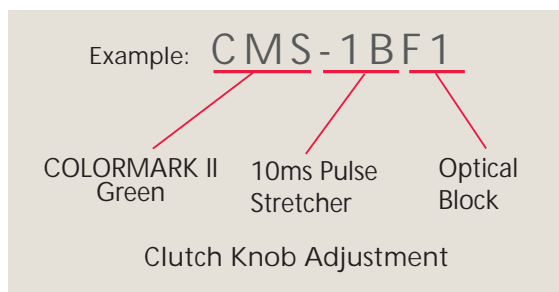
See Fiberoptic Light Guides section for availability in a wide variety of bundle sizes and shapes.

Sensing Range: Recommended 2 to 3 in.

Accessories: Mounting Bracket: Model SEB-1

# How to Specify

1. Select Sensor Model based on light source required  
 CMS = Green  
 CMSR = Red  
 CMSB = Blue  
 CMSWL = White
2. Select Pulse Stretcher  
 -1B = 10ms Pulse Stretcher  
 -2B = No Pulse Stretcher
3. Select Optical Block based on mode of operation required  
 F1= Fiberoptic  
     Range – 1/4" to 3/8" in Proximity Mode  
             1/2" to 3" in Opposed Mode  
 VIG = 1" V-Axis Glass Lens  
     Range – 1"



## Accessories

### Micro Cable Selection Guide, 4-wire, M12



#### Yellow Shielded Cable Assemblies

SEC-6  
6' (1.8 m) cable with connector

SEC-15  
15' (4.6 m) cable with connector

SEC-25  
25' (7.62 m) cable with connector



RSEC-6  
6' (1.8 m) cable / right angle conn.

RSEC-15  
15' (4.6 m) cable / right angle conn.

RSEC-25  
25' (7.62 m) cable / right angle conn.



#### Black Shielded Cable Assemblies (Lightweight)

BSEC-6  
6' (1.8 m) cable with connector

BSEC-15  
15' (4.6 m) cable with connector

BSEC-25  
25' (7.62 m) cable with connector



BRSEC-6  
6' (1.8 m) cable / right angle conn.

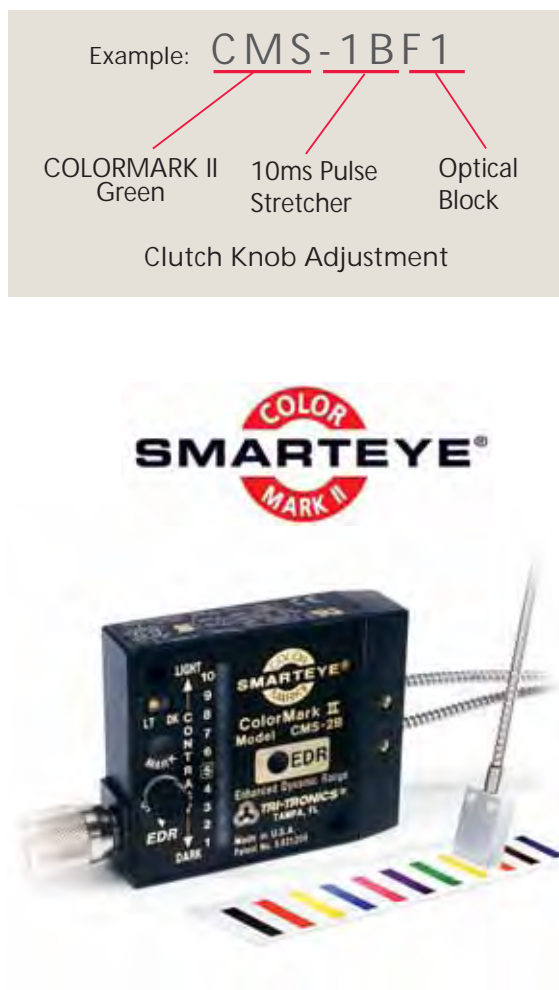
BRSEC-15  
15' (4.6 m) cable / right angle conn.

BRSEC-25  
25' (7.62 m) cable / right angle conn.



BX-10  
10' (3.1 m) Extension cable

BX-25  
25' (7.62 m) Extension cable



FMB-1 (8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket



SEB-1  
Stainless "L" Bracket



FMB-2 (5.1 mm diam.)  
FMB-3 (3.1 mm diam.)  
Miniature Glass or Plastic  
Fiberoptic Mounting  
Brackets



# Specifications



## SUPPLY VOLTAGE

- 12 TO 24 VDC
- Polarity Protected

## CURRENT REQUIREMENTS

- 85 mA (exclusive of load)

## OUTPUT TRANSISTOR

- (1) NPN and (1) PNP output transistor
- NPN: Sink up to 150 mA
- PNP: Source up to 150 mA
- Momentary short circuit protected
- Output transistors turn "ON" when mark is in view
- Anti-pulsing on power-up

## RESPONSE TIME

- Minimum duration of input event: 50 microseconds
- Light state response: 50 microseconds
- Dark state response: 140 microseconds
- Leading edge variation: less than 20 microseconds

## HYSTERESIS

- Less than 400 millivolts for maximum sensitivity and resolution

## LED LIGHT SOURCE

- Choice of color:
  - A. White - Broadband Spectrum (CMSWL)
  - B. Green - 550 nm (CMS)
  - C. Blue - 480 nm (CMSB)
  - D. Red - 660 nm (CMSR)

## LIGHT IMMUNITY

- Pulse modulated to provide extremely high immunity to ambient light

## PULSE STRETCHER TIMER (Optional)

- Provides minimum of 10 milliseconds output duration

## OFFSET/EDR® CLUTCH KNOB ADJUSTMENT

- Sets initial level on Contrast Indicator in relation to mid-scale switch point of 5 – functions as sensitivity adjustment
- Controls Enhanced Dynamic Range circuit (EDR®) which functions to avoid glare effect

## LIGHT/DARK SWITCH

- Dark position for dark mark; Light position for light mark

## INDICATORS

- OUTPUT INDICATOR - Red LED illuminates when output transistors are "ON"
- EDR INDICATOR – Intensity of Green LED provides indication of where in the dynamic operating range the offset / EDR adjustment has been set
- FULLY LIT: Operating near saturation
- OFF: Operating near maximum sensing range



- CONTRAST INDICATOR – Displays returned contrasting light levels (background vs. mark)

## AMBIENT TEMPERATURE

- -40°C to 70°C (-40°F to 158°F)

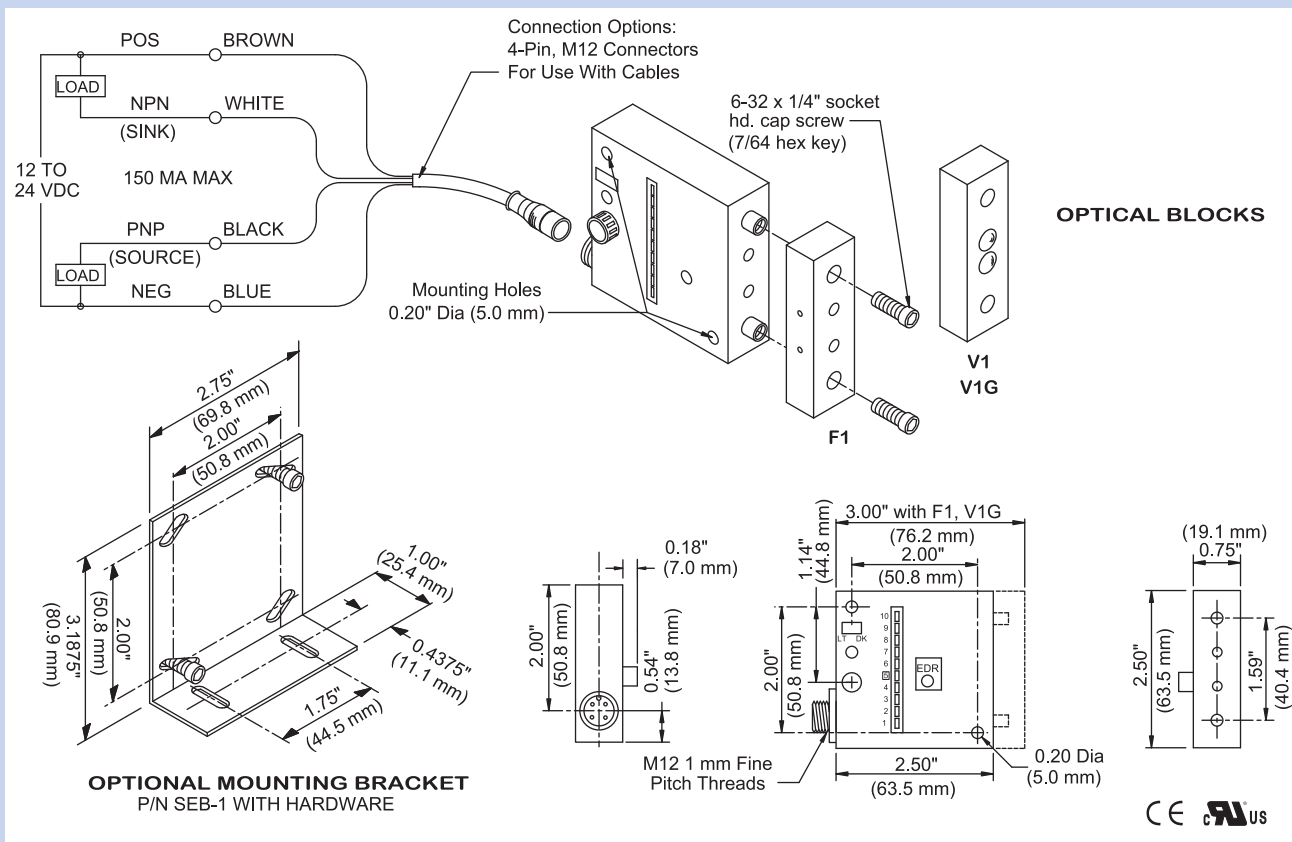
## RUGGED CONSTRUCTION

- Chemical resistant, high impact polycarbonate housing
- Waterproof, ratings: NEMA 4X, 6P and IP67
- Epoxy encapsulated for mechanical strength

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions

## SMARTEYE® COLORMARK™ II





Miniature High-Resolution Registration Mark Sensor  
White LED  
AUTOSET™  
Remote Setup Option

**MARK•EYE® PRO**

# High-Resolution Registration Mark Sensor

## MARK•EYE® PRO

- See any color mark on any background
- High immunity to all ambient light, including strobes
- 5 LED Contrast Indicator
- "One-touch" AUTOSET™ push-button setup
- Remote AUTOSET™ option
- Lens and fiberoptic light guide options



The MARK•EYE® PRO registration mark sensor was designed to detect printed registration marks on a continuous web. Optimized for high-speed color detection, seeing registration marks on form-fill-seal machinery has never been easier.

The MARK•EYE® PRO sensor was designed to deliver high-resolution performance by utilizing the broadband characteristics of a white light LED for detecting the greatest variety of color combinations on any color background. The "one-touch" AUTOSET™ routine can be accomplished by pushing the appropriate button on the sensor or from a remote push-button switch.

The MARK•EYE® PRO sensor was designed for both the apertured V-axis (V4A) lens or fiberoptic light guides. We recommend using glass fiberoptic light guides for detecting low contrast registration marks. Our *NEW* miniature glass fiberoptic light guides are excellent when you need a tight bend radius or for those hard-to-get-to locations.

Plastic light guides can also be used with this new sensor. A variety of fiberoptic accessory lenses can be used to enhance sensing performance.

Setup could not be easier with the "One-Touch AUTOSET™". Simply put the background in view and press the black button if the background is darker than the registration mark or press the white button if the background is lighter than the registration mark.

## AGS™ AUTOMATIC GAIN SELECT

This unique feature provides automatic digital selection of amplifier gain based upon your sensing requirements.

## AUTOSET™ ADJUSTMENT

The AUTOSET™ adjustment routine only requires the push of one button, one time! Even in a dynamic operating condition, with ongoing input events, all you have to do is push the button for a perfect setting.

## EDR®

Another unique feature is the digitally-controlled EDR (Enhanced Dynamic Range) circuit. It prevents dark state saturation and expands the operating range without reducing amplifier gain.

## REMOTE AUTOSET™

To remotely AUTOSET™ the sensor, apply a momentary contact closure from the AUTOSET™ input wire to negative as shown in the wiring diagram. A remote AUTOSET™ command will duplicate the last manual AUTOSET™.

## 5 LED DUAL FUNCTION INDICATOR

**Contrast Indicator™** – Provides “at-a-glance” performance data.

**Status Indicator** – Displays status of selectable features:

**Lock** – When this feature is enabled the sensor becomes tamperproof. Note: The remote AUTOSET™ is not affected by the lock.

**Output Invert** – Allows the sensor to be programmed for the output transistors to be “ON” or “OFF” when the registration mark comes into view.

**Timer** – When the “OFF” delay pulse stretcher is enabled, the output duration is extended by 10, 25, or 50 milliseconds (not additive). Enabling the Timer allows ample time for the controller to respond. The time durations of the gap between marks must be less than the selected delay.

## HIGH SPEED

175 microsecond response when detecting light or dark marks.

## CONNECTIONS

Built-in 12 mm connector or 6' cable.

## MOUNTING OPTIONS

Built-in DIN rail “Snap-On” design, through hole, or bracket mount.

## Dual Function Bar Graph

Primary function: Contrast Indicator  
Secondary function: Status Indicator of 5 selectable options

## 5 Selectable Options

- #5 LOCK – for tamperproof operation
- #4 Output Invert
- #3 10 ms pulse stretcher/“OFF” delay
- #2 25 ms pulse stretcher/“OFF” delay
- #1 50 ms pulse stretcher/“OFF” delay

## Option Status Mode Select

Push both buttons for 3 seconds to switch bargraph display to status indicator of selectable options

## Option Status Mode Indicator

Illuminates when in program mode

## Output Status Indicator

When illuminated, Option Status Indicator is enabled

## Lock Status Indicator

Illuminates when sensor controls are locked

## Interchangeable Optical Blocks

- Choice of 3 interchangeable optical blocks
1. F4 (Glass fiberoptic light guides)
  2. F5 (Plastic fiberoptic light guides)
  3. V4A (Apertured V-Axis Convergent lens)

## Optional Timer

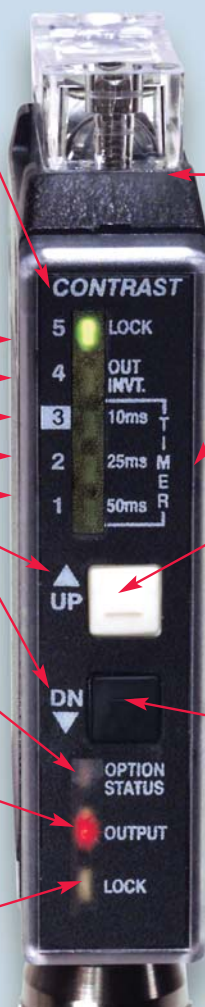
10, 25, or 50 millisecond pulse stretcher/“OFF” delay

## White Push-button - 3 functions

1. Manual “UP” adjustment
2. AUTOSET™ on “light” background
3. Toggle selected option to opposite state and return to normal operation

## Black Push-button - 3 functions

1. Manual “DOWN” adjustment
2. AUTOSET™ on “dark” background
3. When in Option Status Mode, tap to desired function to be altered.



# Setup Guide *Registration Mark Sensing Using Fiberoptic Light Guides*

**TRI-TRONICS MARK•EYE® PRO Series Sensors** are easier to set up than conventional color mark sensors because of their unique built-in **Contrast Indicator™**. Examples of setup instructions for various materials are shown below.

## Opaque Material (Non-Foil)

1. Position the fiberoptic light guide to view material looking straight down. (See Fig. 1)
2. Place background in view of fiberoptic light guide.
3. Adjust "offset" as follows...
  - A. For dark mark on light background, adjust for a reading of "5" on the Contrast Indicator with the background in view.
  - B. For light mark on dark background, adjust for a reading of "1" on the Contrast Indicator with the background in view.
4. Set light/dark switch in the position that turns the "mark" indicator off.
5. Move mark into view. Note the new contrast reading. If this reading has deviated from the initial reading by 2 to 3 bars or more, enough contrast exists for proper detection.

## Foil Material

1. Position fiberoptic light guide as follows:
  - A. For a black or dark mark on shiny foil, position light guide to view material looking straight down. (See Fig. 1)
  - B. For white or light mark on shiny foil, position light guide to view material looking on a 20° – 30° angle. (See Fig. 2)
2. Place mark in view of fiberoptic light guide.
3. Push appropriate Autoset™ button as follows:
  - A. For black or dark mark on shiny foil, adjust for a reading of "1" when the black mark in view.
  - B. For white or light mark on shiny foil, adjust for a reading of "5" when the white mark is in view.
4. Set light/dark switch in the desired output state.
5. Move mark out of view. With the background in view, note the new contrast reading. If this reading has deviated from the initial reading by 4 to 5 bars or more, enough contrast exists for proper detection.

## Transparent Material

1. Position fiberoptic light guide to view shiny back plate looking straight down without the mark in view.
2. Push white Autoset™ for a reading of 5 on the Contrast Indicator.
3. Set light/dark switch in the desired position.
4. Move the mark into view. Note the new contrast reading. If this reading has decreased or deviated from the initial reading by 4 to 5 bars or more, enough contrast exists for proper detection.

## Hints and Tips:

1. False tripping or erratic operation is usually caused by excessive web flutter, wrinkles, or variations in material background color or marks. Minor adjustments of the manual Up/Down adjustment can help to eliminate erratic operation.
2. If the surface of opaque (non-foil) material is extremely shiny, consider placing fiberoptic light guide in a slightly angled position. The position that results in the maximum contrast deviation as displayed on the Contrast Indicator will give the most reliable performance.
3. A metal guide plate for the material to flow across provides several necessary advantages:
  - A. Helps to iron out wrinkles.
  - B. Helps to eliminate web flutter.
  - C. Provides shiny background when sensing marks on transparent material.

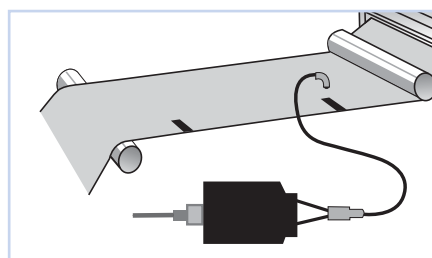


Fig. 1 Straight Position

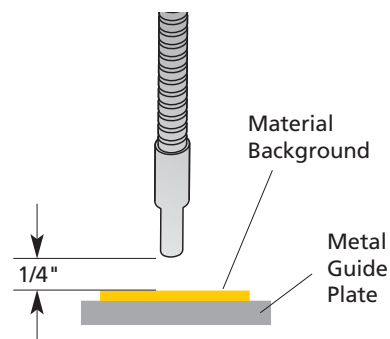
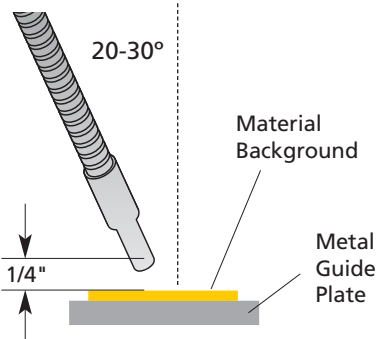


Fig. 2 20-30° Angle Position



# White Light Source

(Broadband Color Spectrum)

The "White Light" LED light source built into the **MARK•EYE® PRO** promotes easy detection of the largest variety of color marks printed on the largest variety of colored web materials. By combining a White LED light source, our **Contrast Indicator** and the "One-Push" AUTOSET™ setup, you have a winning combination of high performance with an easy to use sensor:

- The best choice for detecting printed registration marks on packaging materials
- The best choice for detecting pale yellow marks on white backgrounds

## How to Specify

**Model Description**

5-Conductor, Cable Attached:

MEP45WL 45  $\mu$ s Response Time, White LED

MEPWL 175  $\mu$ s Response Time, White LED

5-Pin Micro Connector (M12):

MEP45WLC 45  $\mu$ s Response Time, White LED

MEPWLC 175  $\mu$ s Response Time, White LED



1. Sensor model: MEP45, MEP
2. White light source: WL
3. Select Connector  
Blank = 6' Cable, C = Connector
4. Select Optical Block based on sensing mode:  
**F4** – Glass Fibers 0.25" (6.4 mm) to 0.50" (12.7 mm) range  
**V4A** – Apertured V-Axis 0.75" (19.1 mm) to 1.0" (25.4 mm) range  
**F5** – Plastic Fibers 0.25" (6.4 mm) range

### MARK•EYE® PRO

Example:

**MEP45WLCF4**

MARK•EYE®  
PRO

White  
LED

Connector  
Option

Fiberoptic  
Optical Block

## Hardware & Accessories

- Micro Cable Selection Guide, 5-wire, M12



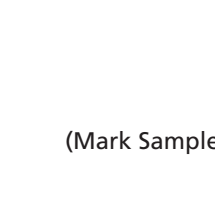
**GSEC-6**  
6' (1.8 m) Shielded cable



**GSEC-15**  
15' (4.6 m) Shielded cable



**GSEC-25**  
25' (7.62 m) Shielded cable



**GSEC-2MU**  
6.5' (2.0 m) Low-cost, unshielded



**GSEC-5MU**  
16.4' (5.0 m) Low-cost, unshielded



**GRSEC-6**  
6' (1.8 m) Right angle shielded cable



**GRSEC-15**  
15' (4.6 m) Right angle shielded cable



**GRSEC-25**  
25' (7.62 m) Right angle shielded cable

**GX-25**  
25' (7.62 m) extension cable



**FMB-1** (8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket



**SEB-3**  
Stainless "L" Bracket



**FMB-2** (5.1 mm diam.)  
**FMB-3** (3.1 mm diam.)  
Miniature Glass or Plastic  
Fiberoptic Mounting  
Brackets



**LK-4**  
Lens Kit  
(See Optical Blocks  
Accessories for contents)

(Mark Samples)



2-119

# Specifications

## SUPPLY VOLTAGE

- 10 to 30 VDC
- Polarity Protected

## CURRENT REQUIREMENTS

- 45 milliamps (exclusive of load)

## OUTPUT TRANSISTORS

- (1) NPN and (1) PNP sensor output transistors
- Outputs sink or source up to 150 milliamps (current limit)
- All outputs are continuously short circuit protected

## REMOTE AUTOSET™ INPUT

- Opto-isolated momentary sinking input (10 milliamps)

## RESPONSE TIME

- MEP45WL – Light/Dark = 45  $\mu$ s Repeatability = 13  $\mu$ s
- MEP – Light/Dark = 175  $\mu$ s

## LED LIGHT SOURCE

- White LED provides detection of registration marks of the widest variations of contrasting colors

## PUSH BUTTON CONTROL

- AUTOSET™
- Manual Adjustments
- Set status of 5 options: 5) Lock, 4) Output Invert, and Pulse Stretchers 3) 10ms, 2) 25ms, and 1) 50ms

## HYSTERESIS

- Set for high resolution ... less than one bar on the contrast indicator

## LIGHT IMMUNITY

- Responds to sensor's pulsed modulated light source ... immune to most ambient light and strobes, including indirect sunlight

## DIAGNOSTIC INDICATORS

- 5-LED Bargraph functions in one of two modes:
  1. Contrast Indicator... Displays scaled reading of sensor's response to contrasting light levels (light to dark)
  2. Status Indicator... Displays status of 5 selectable options
- Red LED output indicator ... Illuminates when the sensor's output transistors are "ON"
- NOTE: If Output LED flashes, a short circuit condition exists
- Amber LED...Illuminates when in the options select mode
- Yellow LED...Illuminates when Lock feature is activated

## AMBIENT TEMPERATURE

- -40°C to 70°C (-40°F to 158°F)

**MARK-EYE® PRO**



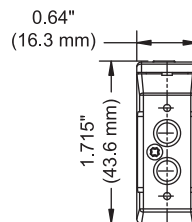
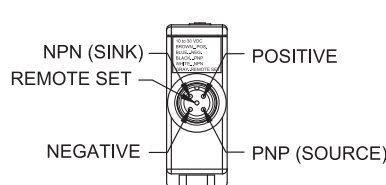
## RUGGED CONSTRUCTION

- Chemical resistant high impact polycarbonate housing
- Industry Ratings: NEMA 4X, 6P, IP67

Product subject to change without notice.  
Consult Factory for RoHS Compliance.

## Connections and Dimensions

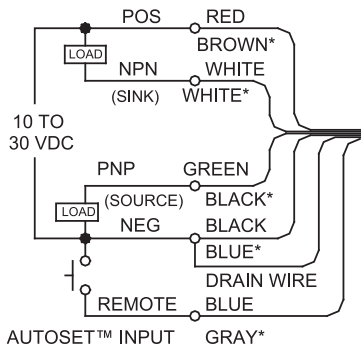
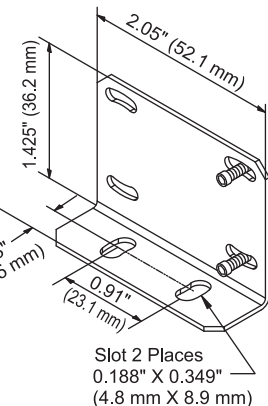
**MARK-EYE® PRO**



## MOUNTING OPTIONS

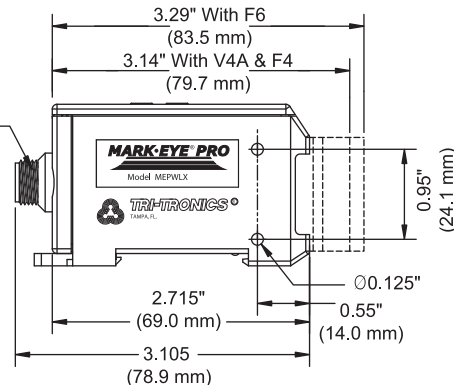
Direct mount to panel or bulkhead  
Din Rail  
Bracket (see below)

P/N SEB-3  
Optional Mounting  
Bracket With Hardware



\*SENSORS WITH CONNECTORS

"C" Models Have  
Standard 5 Pin,  
M12 Connector

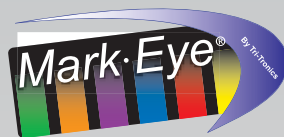


CE cUL US



Opacity Mode Registration Mark Gap Sensor

One-Touch AUTOSET™  
Remote Setup Option  
Low Cost



# Opacity Mode Registration Mark Gap Sensor



*White LED Light Source*

- Color mark registration detection on transparent and translucent material, including many metallized films and paper
- Single, one push-button setup
- Includes remote AUTOSET™
- Selectable 15 ms Pulse Stretcher

The Mark•Eye® is a registration mark sensor designed to see printed registration marks on most packaging materials on a continuous web. The “one-touch” setup enables the sensor to be adjusted with a single push of a button. There is no more guess work, making the operator's adjustment procedure easy!

The Mark•Eye® utilizes a white LED light source that is optimized to detect printed registration marks on translucent, transparent, and many metallized films and



paper. This sensor is particularly useful on form, fill, and seal machines. Note that most packaging materials (except foil) are translucent! Many of the translucent packaging materials that we have tested allow light to penetrate either the backing material or the registration mark. Because this sensor operates in the opacity sensing mode, the color of the registration mark simply doesn't matter!

Note: Marks as small as 1/16" wide by 1/4" long can be detected, dependent upon web opacity (contrast) and velocity.

The Mark•Eye® operates on 10 to 30 VDC and is pulse modulated to prevent any problems with ambient light. Its design incorporates a white LED light source directing a beam of light across the gap to the receiving lens of a photoelectric detector. In operation, the moving web of packaging material passes through the gap/slot. This sensor can detect registration marks in a wide variety of applications, as long as the size of the mark and velocity meets the capability of the sensor. When the intensity of the light beam transmitted through the web of material is altered by the presence of printed registration mark, the Mark•Eye® will switch its output accordingly.

Note: For metallized film that does not produce the desired response, we recommend sensing with a reflective mode sensor, such as the CMS Series or the Mark•Eye® Pro.

Setup: The Mark•Eye® is an automatic sensor...it is not a conventional “teach mode” sensor. As a result, all that is required to adjust the sensor is to place the web between the marks and push the appropriate AUTOSET™ button one time. The sensor will automatically adjust itself to a perfect setting. The Mark•Eye® will now sense the difference or contrast between the light level penetrating through the web, giving an output when the mark is in view. Provision for a remote AUTOSET™ switch is also provided.



# White Light Source

(Broadband Color Spectrum)

The "White Light" LED light source built into the Mark•Eye® promotes easy detection of the largest variety of color marks printed on the largest variety of colored web materials. By combining a White LED light source, our Contrast Indicator, and the one-push AUTOSET™ setup, you have a winning combination of high performance with an easy to use sensor:

- The best choice for detecting printed registration marks on packaging materials
- The best choice for detecting pale yellow marks on white backgrounds

## How to Specify

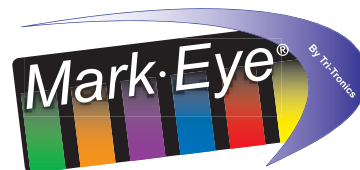
Example:

MEWL

White LED, 5-conductor, 6' (1.8 m) cable attached

MEWLC

White LED, 5-pin micro connector on a 6" pigtail (M12)



## Hardware & Accessories

Micro Cable Selection Guide, 5-wire, M12



GSEC-6  
6' (1.8 m) Shielded cable



GSEC-15  
15' (4.6 m) Shielded cable



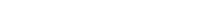
GSEC-25  
25' (7.62 m) Shielded cable



GSEC-2MU  
6.5' (2.0 m) Low-cost, unshielded



GSEC-5MU  
16.4' (5.0 m) Low-cost, unshielded



GRSEC-6  
6' (1.8 m) Right angle shielded cable



GRSEC-15  
15' (4.6 m) Right angle shielded cable



GRSEC-25  
25' (7.62 m) Right angle shielded cable



GX-25  
25' (7.62 m) extension cable



(Mark Samples)



2-123

## Registration Mark Photoelectric Sensors





## Fiberoptic Sensing Solutions

Standard Glass Fiberoptic Light Guides

Miniature Glass Fiberoptic Light Guides



Wider Selection of Plastic Fiberoptic Light Guides

Custom Tips and Lengths

# Fiberoptic Light Guides

Shine a flashlight into one end of either a flexible plastic or glass fiberoptic light guide and you will see light coming out of the other end. This ability to guide light from one place to another provides many advantages when applied to industrial photoelectric sensing.

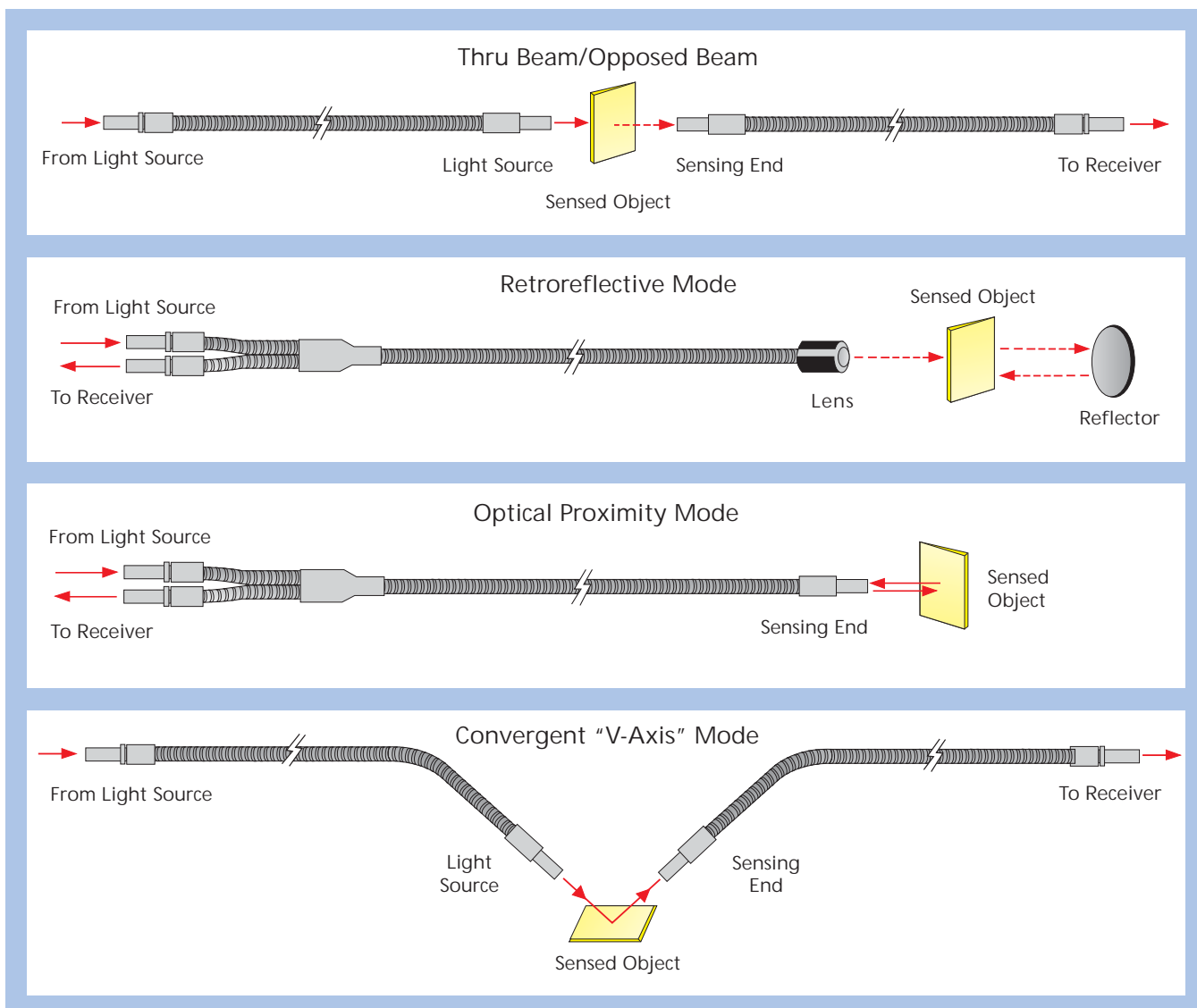
Fiberoptic Light Guides are flexible and small enough to fit into difficult sensing sites. This allows the sensor to be located in a more convenient, remote location — out of harm's way. Fibers are resistant to high temperatures, vibration, condensation, and corrosion.

One of the main advantages of glass fiberoptic light guides is that they can be sized

and shaped to provide optical advantages. When fiberoptic light guides are utilized, they become the optics of the sensing system.

At the sensing site, the size and shape of the fiberoptic bundle carrying the light controls the size and shape of the transmitted light beam. The size and shape of the fiberoptic bundle receiving the light beam controls the effective viewing area of the sensing system.

Lenses are available to provide additional control of the transmitted and received light beams. Both Beam Break and Beam Make sensing modes are adaptable to fiberoptic sensing.



# Fiberoptic Application *Hints & Tips*

## 1. USING STRAIGHT LIGHT GUIDES

Straight light guides are a bundle of glass fibers, with the same number of glass fibers on both ends.

### • Thru-Beam/Opposed Mode Sensing

Straight light guides are used in pairs. One light guide is used to transmit the light from the sensor's light source to the sensing site. Here the light beam is focused, or directed across the area the target is to be passing. The receiving light guide is located on the opposite side, aligned in position to receive the light beam. Then this light guide transmits the received light back to the sensor's photo detector. When a target or object passes through the light beam, the sensor responds to the absence of light and switches its output accordingly. This is called Beam Break, or thru-beam sensing. (Refer to illustrations)

### • Convergent "V" Axis Mode

At times thru-beam and proximity sensing won't work for a particular application. By using a pair of straight fibers directed at an object in a "V" configuration, a certain part of the object can be detected. (Refer to illustrations)

## 2. USING BIFURCATED LIGHT GUIDES

Bifurcated light guides start out as one bundle of glass fibers. This single bundle is then split into two separate bundles of fibers at the sensor end, and left as one randomly mixed bundle at the sensing end.

### • Beam Break Sensing or Retroreflective Mode

The sensing tip of the fiber is placed on one side of the detection path with a reflector on the other. The object passes between the fiber and the reflector, breaking the beam and switching the output of the sensor. (Refer to illustrations)

### • Beam Make Sensing or Proximity Mode

One half of the fiber transmits the light to the sensing site. The other half transmits the reflecting or diffusing light off the surface of the target back to the sensor's photodetector. This "proximity mode" sensing is used to sense nearby objects.

## 3. EXPLOSIVE ENVIRONMENTS

### WARNING

While fiberoptics are considered to be intrinsically safe, the sheathing is a hollow tube that could conceivably provide a flame path. Additionally, the photoelectric sensor must be placed into an approved enclosure.

## 4. LONG FIBERS

Glass fibers absorb 10% of the remaining light for each foot of glass the light travels; 15-foot fibers have brighter beams than 20-foot fibers, etc. Fibers can be ordered in longer lengths in 12-inch increments up to 30 feet.

## 5. ROUTING

Avoid sharp bends when routing light guides

around machines. A good minimum bend radius is approximately 10 times the jacket diameter.

## 6. WATERPROOF

Liquid inside the fiber's protective jacket will lower transmission. Use PVC mono coil jackets in wet locations.

## 7. REPAIRS

Fiberoptics must *never be cut or broken*. Never pull on a fiberoptic's protective jacket. They cannot be repaired or spliced. The tips cannot be bent unless specifically noted. They are filled with epoxy, and will break. Abrasion can scratch the face of the fiberoptic bundle and lower its performance.

## 8. CLEANING

Avoid dirt build-up on the bundle face. Clean with filtered air, soap and water, glass cleaners, toothbrushes, etc. Avoid abrasives.

## 9. FIBEROPTIC LIGHT GUIDES TEMPERATURE RATINGS

GLASS FIBERS (Type 304 stainless steel)

### Standard Fibers

Excess heat above the rated temperature damages the epoxy in the tips, or melts the PVC monocoil jacket.

#### • Flexible Stainless Steel Jacketing

Operating temperatures from -50°F to +525°F (-45°C to +275°C)

#### • PVC Monocoil Jacketing

Operating temperatures from -40°F to +220°F (-40°C to +105°C)

### High Temperature Fibers

On various tests our high temperature fiberoptics were subjected to temperatures above 500°C for ten hours, and they held their bonding elements without failure.

#### • Stainless Steel Jacketing (Type 304)

Operating temperatures from -50°F to +900°F (-45°C to +480°C)

## PLASTIC FIBERS

### PLASTIC FIBER OPTIC SPECIFICATIONS

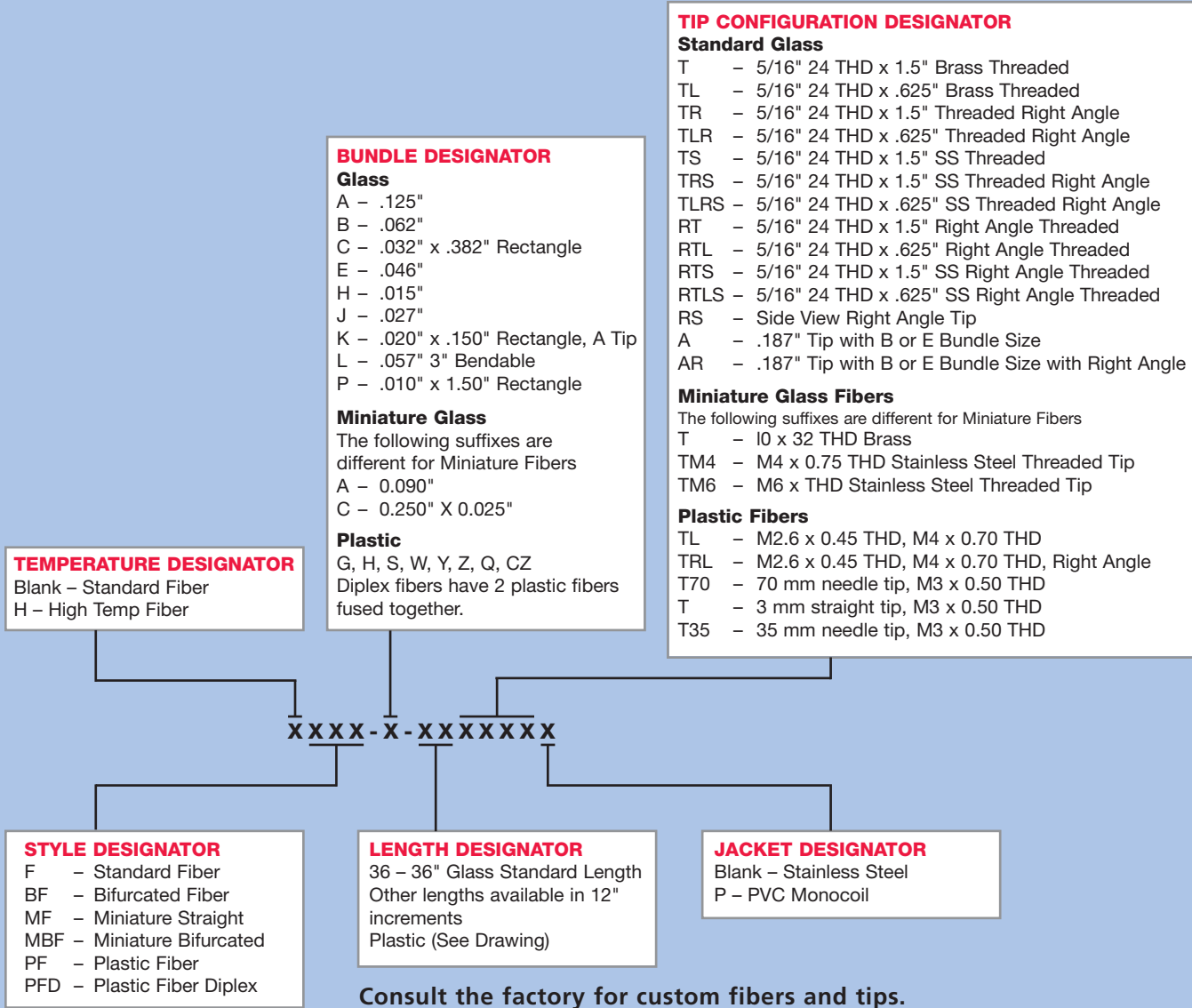
Operating Temperature	-40° to 80° C (-40° to 176° F)
Sensing Range	Dependent on Fiber & Sensor Combination
Construction	Optical Fiber: Acrylic Monofilament
	Protective Jacket: Black Polyethylene
	Threaded End Tips & Hardware: Nickel Plated Brass
Minimum Bend Radius	Probe End Tips: SUS Stainless Steel
	.47" (12 mm) for .020" (0.5 mm) Fibers
	.98" (25 mm) for .040" (1.0 mm) Fibers
Chemical Resistance	Core is made of acrylic. Avoid exposing core to acids and aggressive bases as well as solvents. Jacket of fiber will provide a degree of protection from most chemical environments.

# Fiberoptic Light Guides

1. Select mode of sensing best suited to your application, e.g., "straight light guide" for Beam Break/opposed mode sensing, or "bifurcated light guide" for Beam Make/proximity sensing.
2. Determine whether the standard size or the miniature fibers will work best.
3. Select "stainless steel armored cable" for most applications, including high temperatures, or "PVC jacketed monocoil" for wet applications.
4. Select fiberoptic bundle size and shape that optimize the viewing area and provide the greatest amount of contrast deviation as displayed on the CONTRAST INDICATOR.
5. Select the tip configuration that best fits the sensing needs, such as, right angle, straight, stainless or brass threaded (both 1.5" and .625" lengths), or side view.
6. Use the **Glass Fiberoptic Model Number Matrix** below to create the model number that matches your selected sensing mode, jacketing, fiberoptic bundle, size, and tip configuration.

## Plastic Fiberoptic Light Guides

Model numbers for plastic fibers do not fit this matrix. If you have a need for a plastic fiber, look through this section and determine the tip configuration and fiber you require. See drawings for plastic fiber bundle sizes.



This section lists only the most popular fiberoptic light guides. Many more configurations are also available directly from stock. Consult your local sales representative or the factory with your requirements.

# Fiberoptic Light Guides

## JACKETING FOR FIBEROPTIC LIGHT GUIDES



## Glass Fiber – Flexible Stainless Steel Armored Cables

Stainless steel armored cables (Type 304 Stainless) provide maximum protection against shock and abrasion. The interlocked metal hose is both flexible and strong. However, it is not waterproof, oil tight, or vapor proof. Standard operating temperatures from -50°F to 525°F (-45°C to 275°C) High temperature from -50°F to +900°F (-45°C to +480°C)



## Glass Fiber – PVC Jacketed Monocoil

PVC jacketed monocoil provides ample protection for most industrial applications. It is a flat-wound steel spring, forming a crush-proof flexible tube around the glass. PVC monocoil fibers are waterproof, oil tight, crush resistant, and very flexible. Operating temperatures from -40°F to 220°F (-40°C to 105°C) Not available in High Temperature. PVC Jacketed Monocoil (Add Suffix "P" to Model Numbers)



## Plastic Fiber – Fluorinated Polymer Jacket

Core – Polymethyl Methacrylate (ultra grade) with an allowable bending radius of >17mm. Plastic Fibers should be used only with visible light. Operating temperatures from -40°F to +185°F (-40°C to +85°C)

Note: Due to their light transmission properties, plastic fiberoptic light guides are recommended for use only with visible light sensors.

## CUSTOM FIBERS

Custom Fiberoptics are a TRI-TRONICS® specialty! In most cases, we can meet your "special requirements" for customized tip configurations, fiber bundle sizes, and cable lengths, all with quick delivery. All requests for custom fiber optic light guides must include a detailed drawing showing the critical tolerances before a quotation can be provided, to ensure construction requirements and tolerances are within TRI-TRONICS capabilities. Important: Custom fiber optic light guides are non-refundable and non-returnable. Suitability for purpose is not guaranteed.

## FIBEROPTIC ACCESSORIES

TRI-TRONICS carries a full line of Fiberoptic Accessories to complement your selection of fiberoptic light guides. See Accessories Section for details.



# Glass Single Light Guides

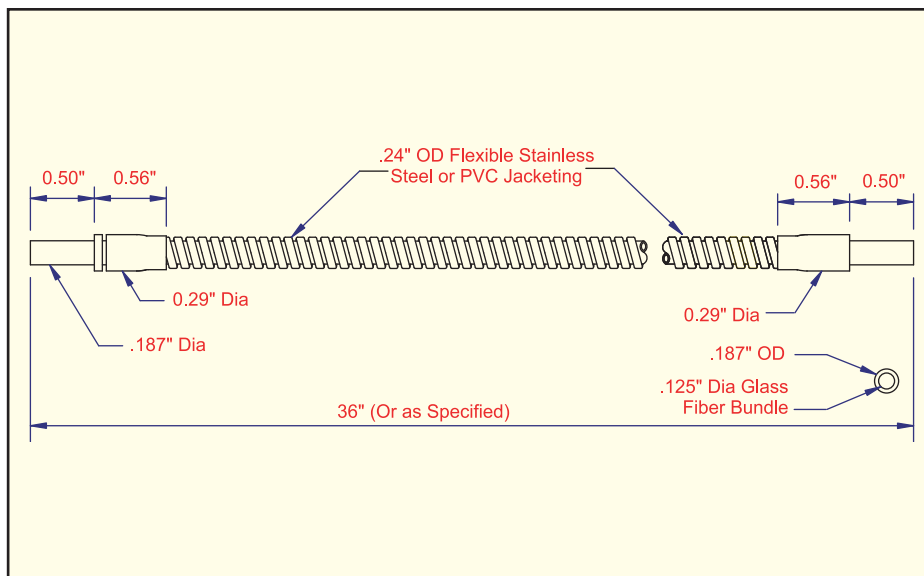
## Straight Barrel Tip Stainless Steel Jacket

MODEL	BUNDLE SIZE
F-A-36	.125"
F-B-36A	.062"
F-E-36A	.046"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
F-A-36P	.125"
F-B-36AP	.062"
F-E-36AP	.046"



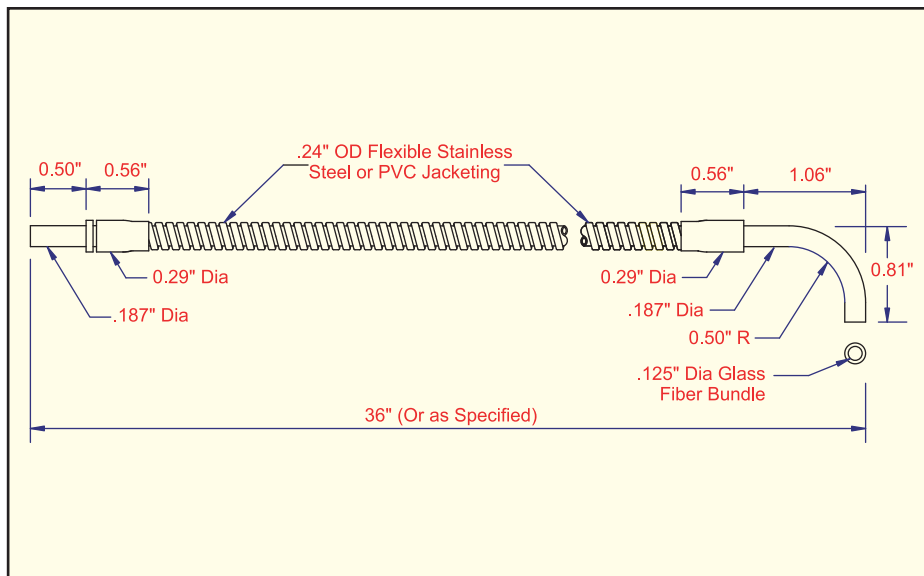
## Right AngleTip Stainless Steel Jacket

MODEL	BUNDLE SIZE
F-A-36R	.125"
F-B-36AR	.062"
F-E-36AR	.046"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
F-A-36RP	.125"
F-B-36ARP	.062"
F-E-36ARP	.046"



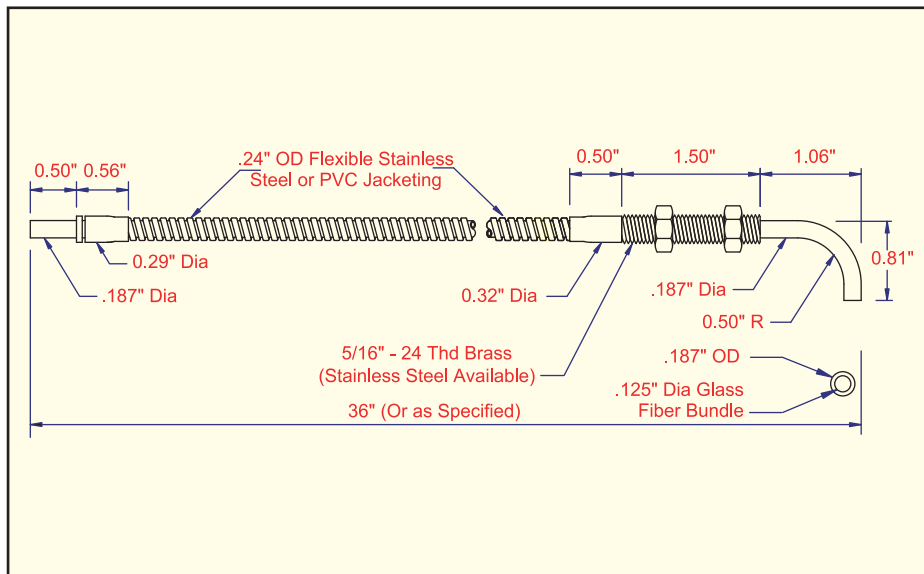
## Right Angle Tip, then Threaded Stainless Steel Jacket

MODEL	BUNDLE SIZE
F-A-36RT	.125"
F-B-36RT	.062"
F-E-36RT	.046"

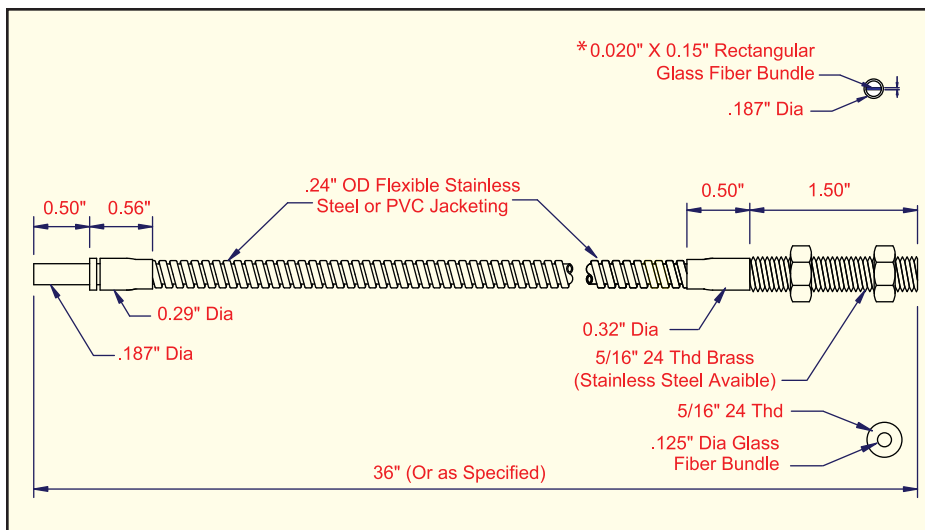


## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
F-A-36RTP	.125"
F-B-36RTP	.062"
F-E-36RTP	.046"



# Glass Single Light Guides



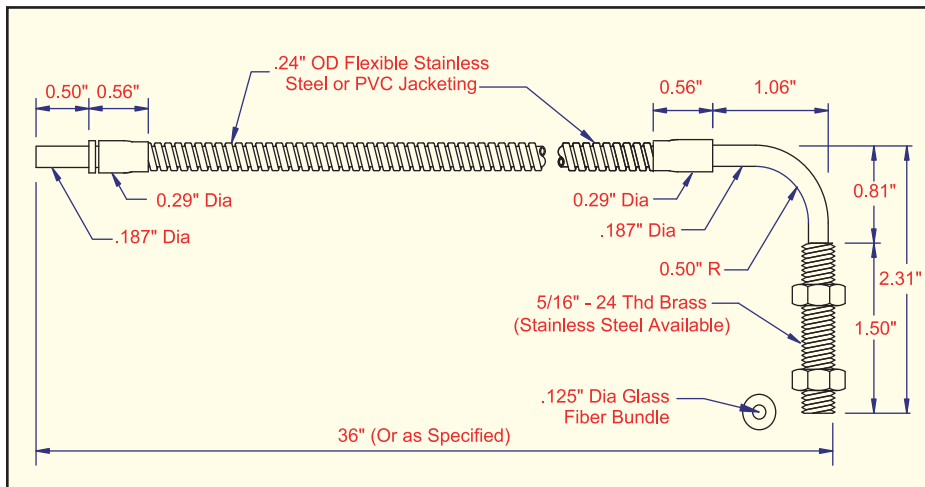
## Straight Threaded Tip Stainless Steel Jacket

MODEL	BUNDLE SIZE
F-A-36T	.125"
F-B-36T	.062"
F-E-36T	.046"
*F-K-36T	.020" x .15"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
F-A-36TP	.125"
F-B-36TP	.062"
F-E-36TP	.046"
*F-K-36TP	.020" x .15"



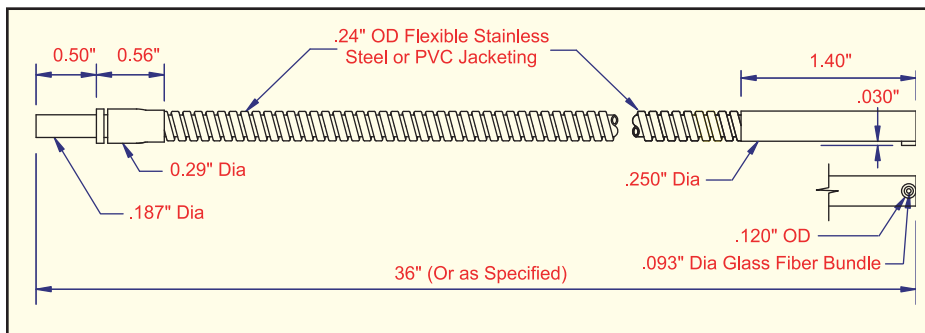
## Threaded Tip, then Right Angle Stainless Steel Jacket

MODEL	BUNDLE SIZE
F-A-36TR	.125"
F-B-36TR	.062"
F-E-36TR	.046"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
F-A-36TRP	.125"
F-B-36TRP	.062"
F-E-36TRP	.046"



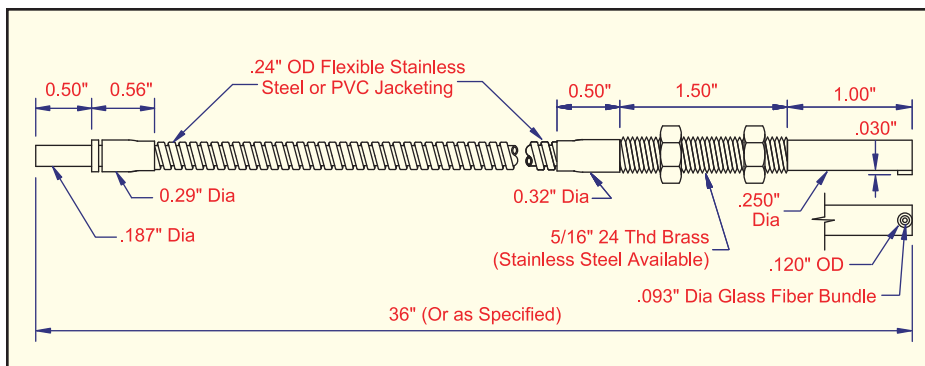
## Side View, Right Angle Tip Stainless Steel Jacket

MODEL	BUNDLE SIZE
F-A-36RS	.093"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
F-A-36RSP	.093"



## Side View, Right Angle Threaded Stainless Steel Jacket

MODEL	BUNDLE SIZE
F-A-36RST	.093"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
F-A-36RSTP	.093"



# Glass Single Light Guides

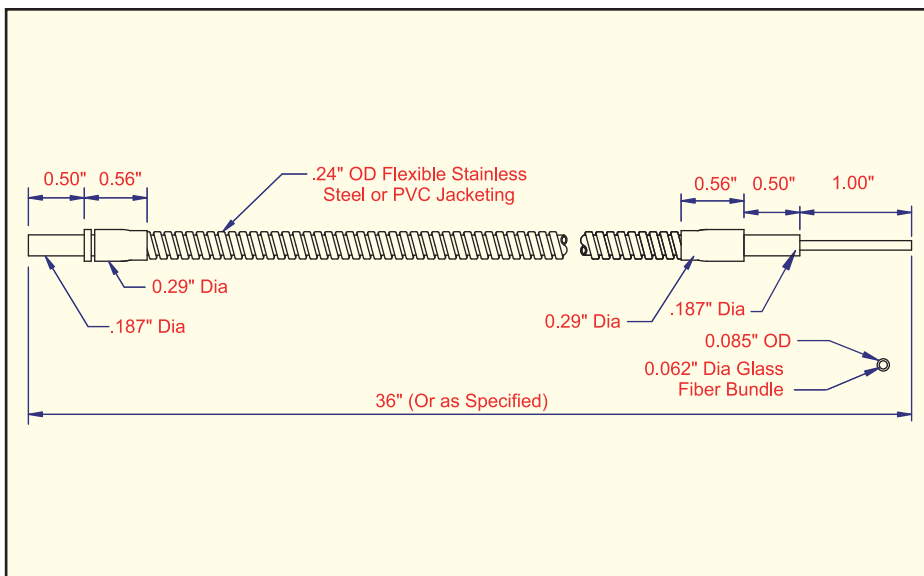
## Straight Needle Tip Stainless Steel Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
F-B-36	.062"



## PVC Monocoil Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
F-B-36P	.062"



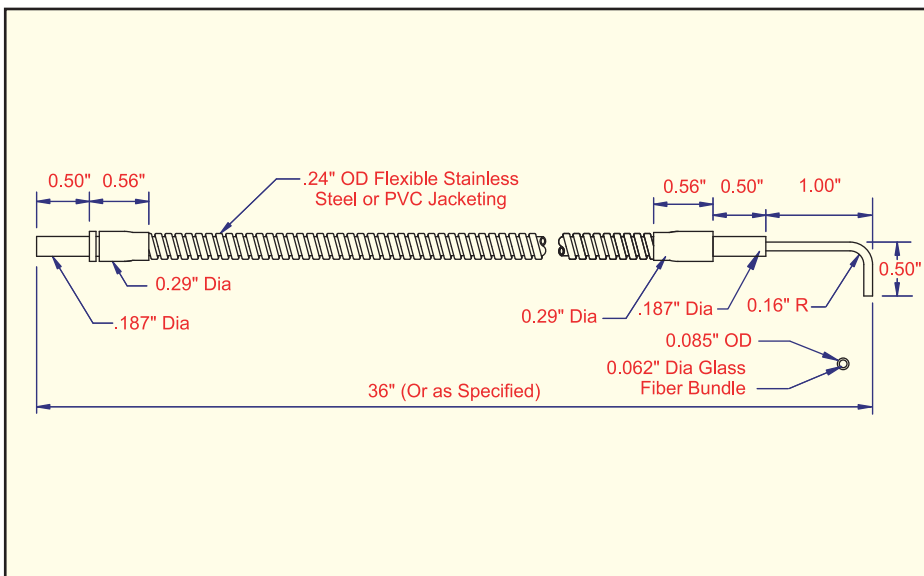
## Right Angle Needle Tip Stainless Steel Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
F-B-36R	.062"



## PVC Monocoil Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
F-B-36RP	.062"



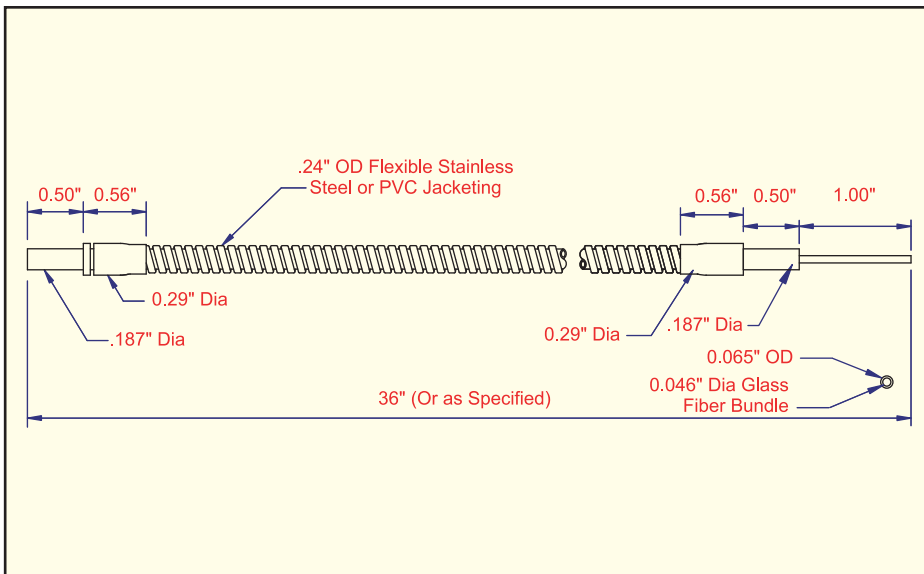
## Straight Needle Tip Stainless Steel Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
F-E-36	.046"

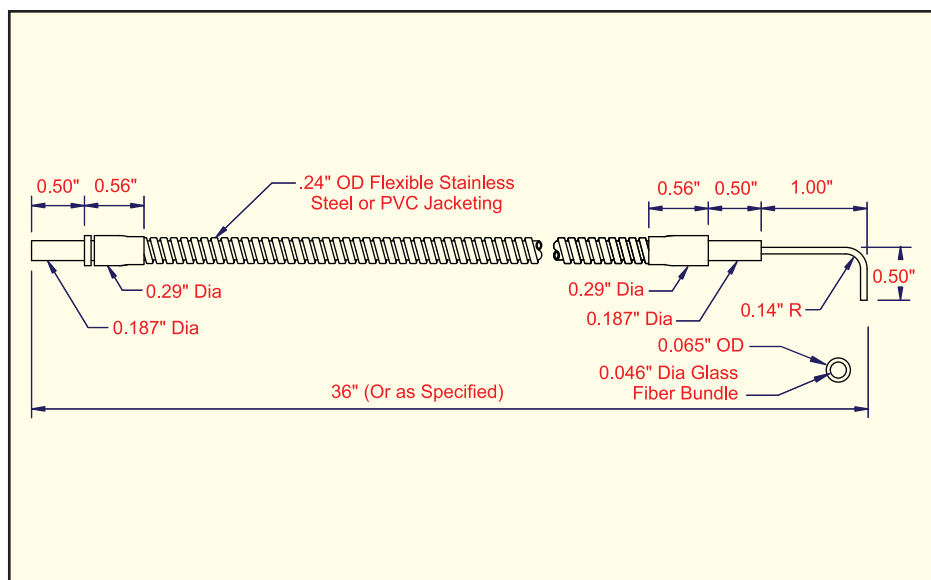


## PVC Monocoil Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
F-E-36P	.046"



# Glass Single Light Guides



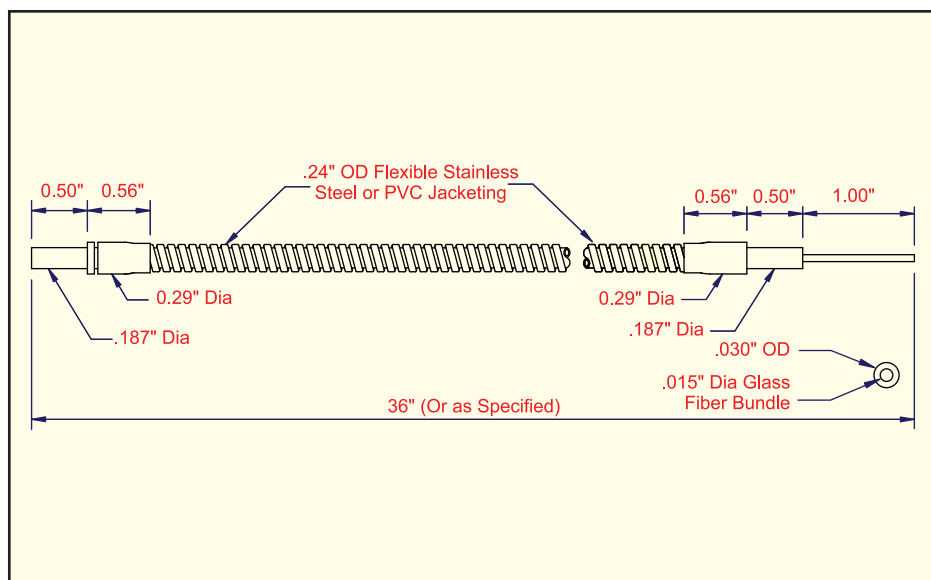
## Right Angle Needle Tip Stainless Steel Jacket

MODEL	BUNDLE SIZE
F-E-36R	.046"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
F-E-36P	.046"



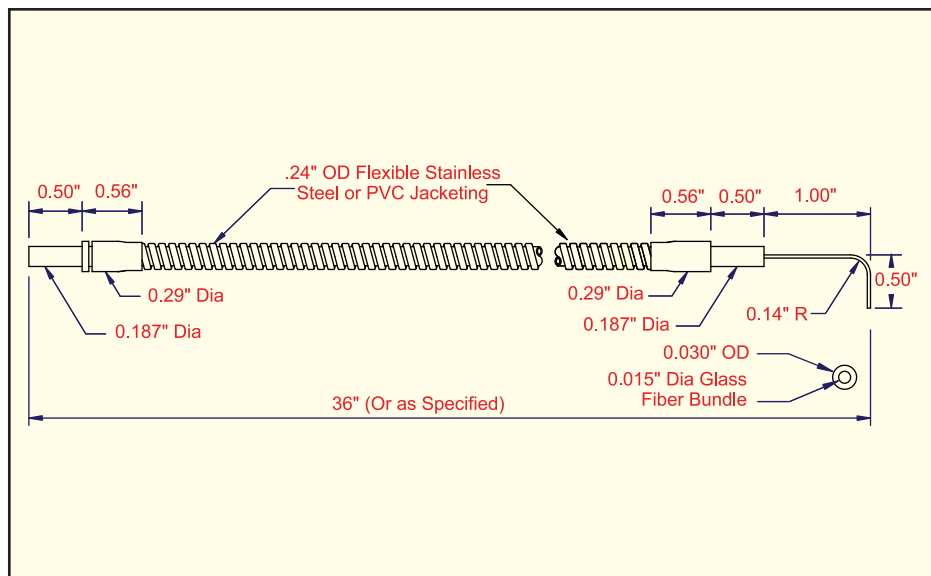
## Straight Needle Tip Stainless Steel Jacket

MODEL	BUNDLE SIZE
F-H-36	.015"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
F-H-36P	.015"



## Right Angle Needle Tip Stainless Steel Jacket

MODEL	BUNDLE SIZE
F-H-36R	.015"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
F-H-36RP	.015"

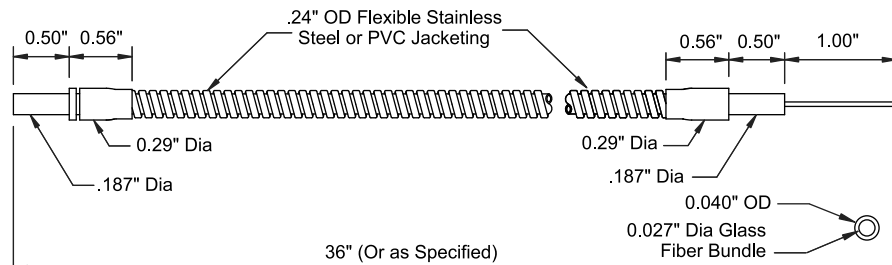
# Glass Single Light Guides

## Straight Needle Tip Stainless Steel Jacket

MODEL                      BUNDLE SIZE  
F-J-36                      .027"

## PVC Monocoil Jacket

MODEL                      BUNDLE SIZE  
F-J-36P                      .027"

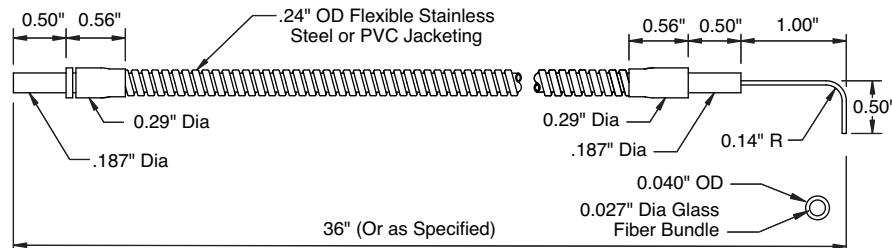


## Right Angle Needle Tip Stainless Steel Jacket

MODEL                      BUNDLE SIZE  
F-J-36R                      .027"

## PVC Monocoil Jacket

MODEL                      BUNDLE SIZE  
F-J-36RP                      .027"

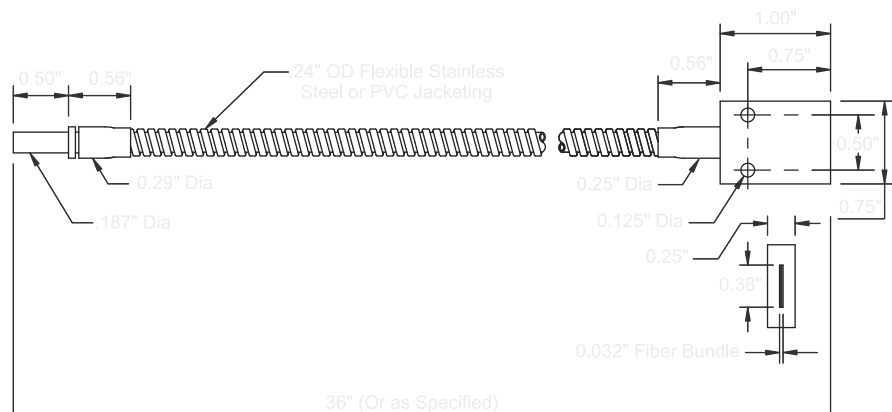


## Rectangular Flat Housing Stainless Steel Jacket

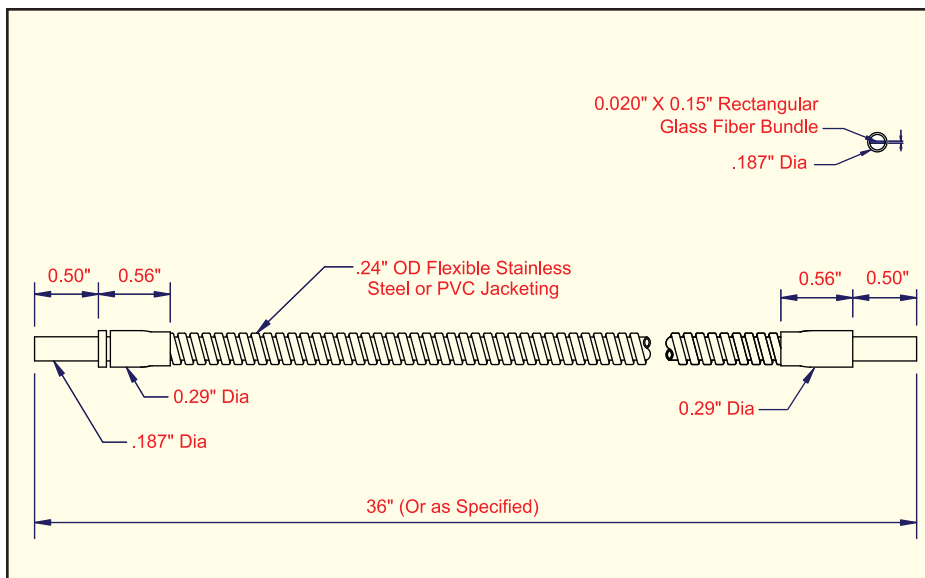
MODEL                      BUNDLE SIZE  
F-C-36                      .032" x .38"

## PVC Monocoil Jacket

MODEL                      BUNDLE SIZE  
F-C-36P                      .032" x .38"



# Glass Single Light Guides



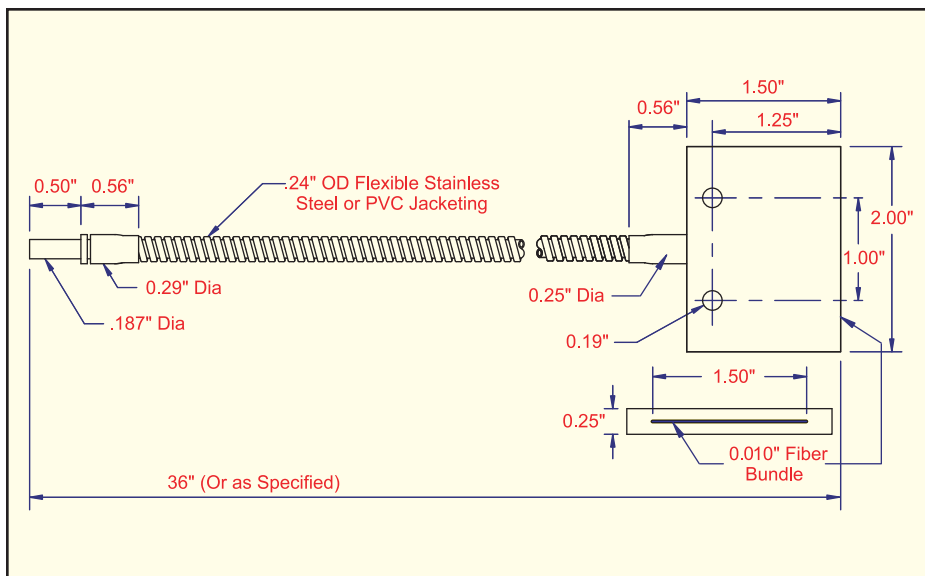
Rectangular Bundle Barrel Tip  
Stainless Steel Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
F-K-36	.020" x .15"



PVC Monocoil Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
F-K-36P	.020" x .15"



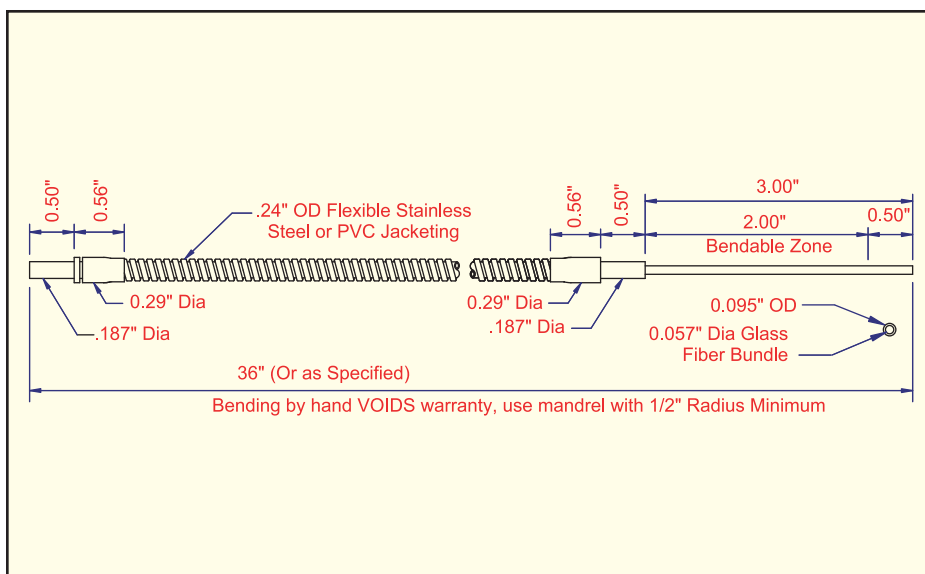
Rectangular 2" Flat Housing  
Stainless Steel Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
F-P-36	.010" x 1.50"



PVC Monocoil Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
F-P-36P	.010" x 1.50"



3" Long Bendable Tip  
Stainless Steel Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
F-L-36B	.057"



PVC Monocoil Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
F-L-36BP	.057"

# Glass Bifurcated Light Guides

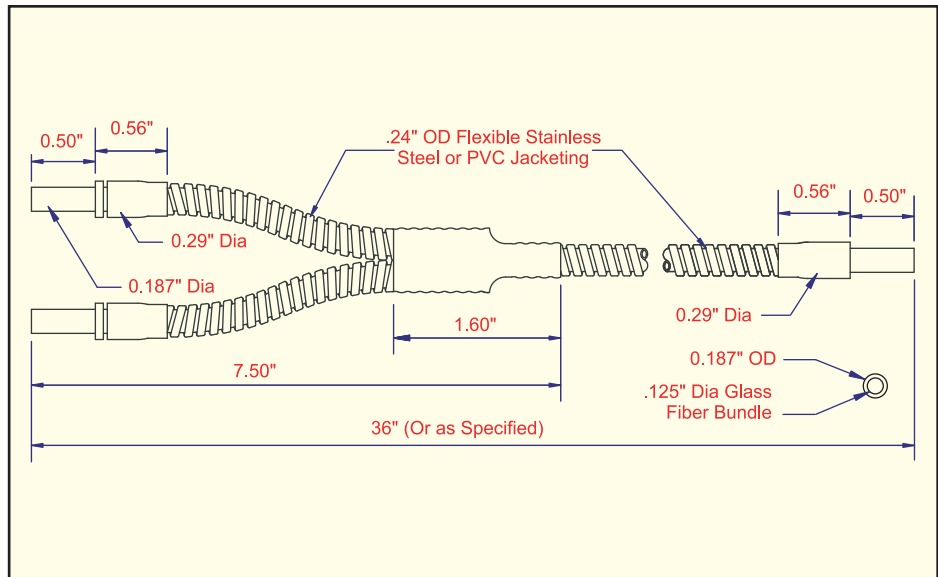
## Straight Barrel Tip Stainless Steel Jacket

MODEL	BUNDLE SIZE
BF-A-36	.125"
BF-B-36A	.062"
BF-E-36A	.046"
BF-J-36A	.027"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
BF-A-36P	.125"
BF-B-36AP	.062"
BF-E-36AP	.046"
BF-J-36AP	.027"



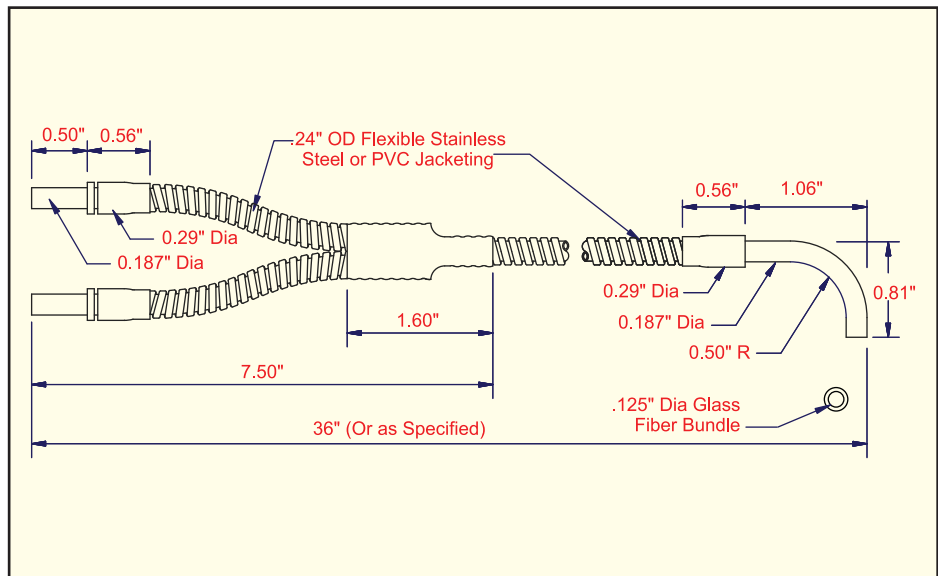
## Right Angle Tip Stainless Steel Jacket

MODEL	BUNDLE SIZE
BF-A-36R	.125"
BF-B-36AR	.062"
BF-E-36AR	.046"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
BF-A-36RP	.125"
BF-B-36ARP	.062"
BF-E-36ARP	.046"



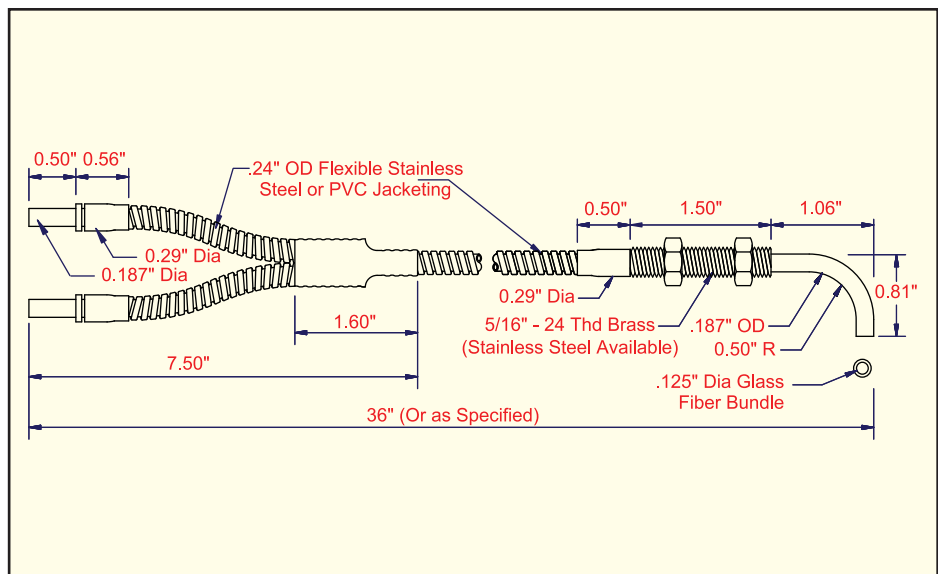
## Right Angle Tip, then Threaded Stainless Steel Jacket

MODEL	BUNDLE SIZE
BF-A-36RT	.125"
BF-B-36RT	.062"
BF-E-36RT	.046"

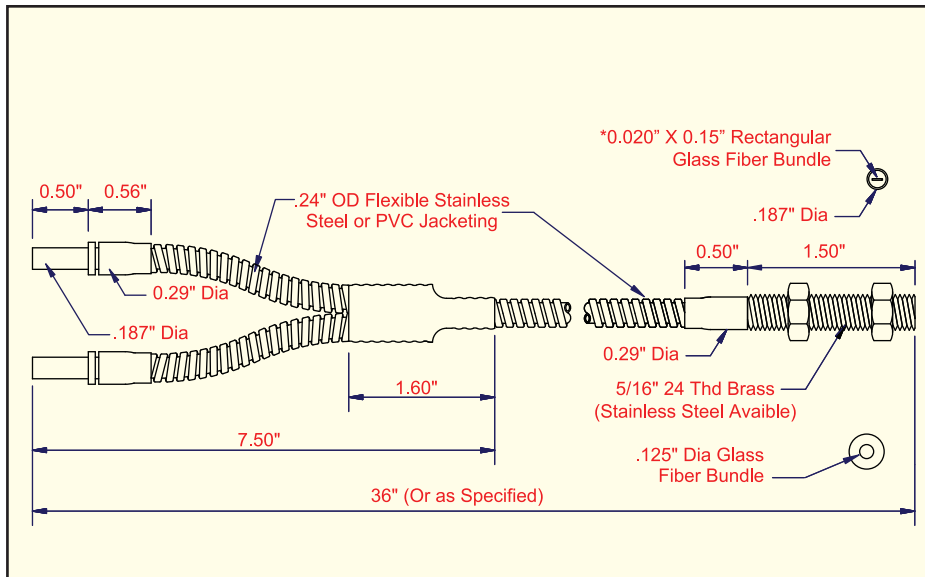


## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
BF-A-36RTP	.125"
BF-B-36RTP	.062"
BF-E-36RTP	.046"



# Glass Bifurcated Light Guides



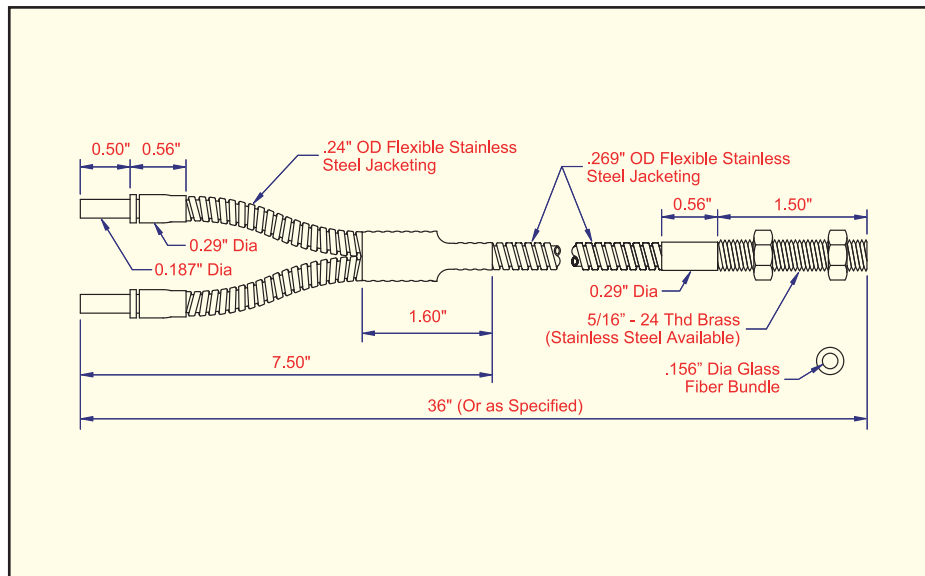
## Straight Threaded Tip Stainless Steel Jacket

MODEL	BUNDLE SIZE
BF-A-36T	.125"
BF-B-36T	.062"
BF-E-36T	.046"
BF-J-36T	.027"
* BF-K-36T	.020" x .15"



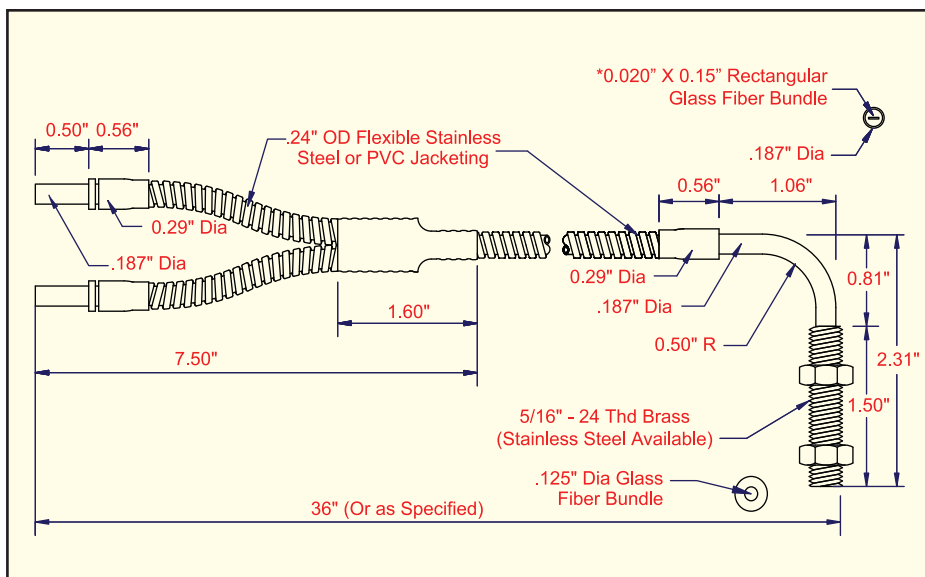
## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
BF-A-36TP	.125"
BF-B-36TP	.062"
BF-E-36TP	.046"
BF-J-36TP	.027"
* BF-K-36TP	.020" x .15"



## Straight Threaded Tip Stainless Steel Jacket Micro Polished for Superior Performance and Range

MODEL	BUNDLE SIZE
BF-U-36TUV	.156"



## Threaded Tip, then Right Angle Stainless Steel Jacket

MODEL	BUNDLE SIZE
BF-A-36TR	.125"
BF-B-36TR	.062"
BF-E-36TR	.046"
* BF-K-36TR	.020" x .15"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
BF-A-36TRP	.125"
BF-B-36TRP	.062"
BF-E-36TRP	.046"
* BF-K-36TRP	.020" x .15"

# Glass Bifurcated Light Guides

Side View, Right Angle Tip  
Stainless Steel Jacket

MODEL BUNDLE SIZE  
BF-A-36RS .093"

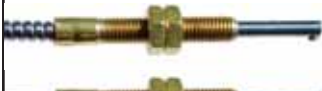


PVC Monocoil Jacket

MODEL BUNDLE SIZE  
BF-A-36RSP .093"

NEW! Side View, Right Angle  
Threaded, Stainless Steel Jacket

MODEL BUNDLE SIZE  
BF-A-36RST .093"



PVC Monocoil Jacket

MODEL BUNDLE SIZE  
BF-A-36RSTP .093"

Straight Needle Tip  
Stainless Steel Jacket

MODEL BUNDLE SIZE  
BF-B-36 .062"



PVC Monocoil Jacket

MODEL BUNDLE SIZE  
BF-B-36P .062"

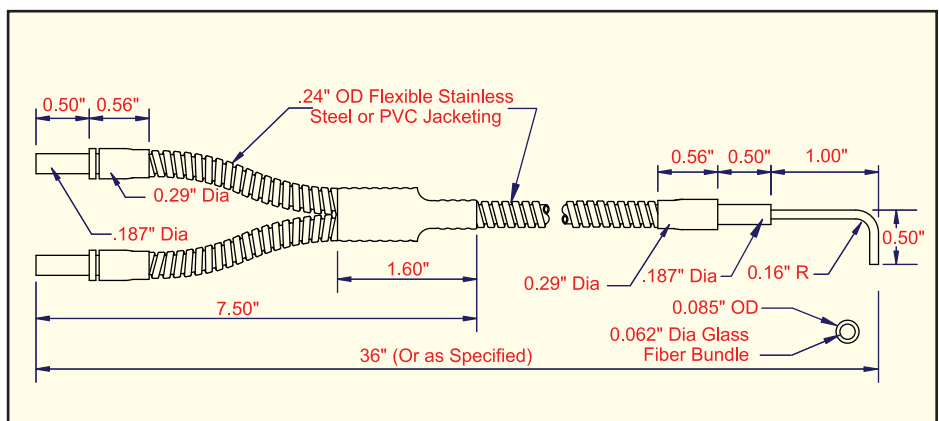
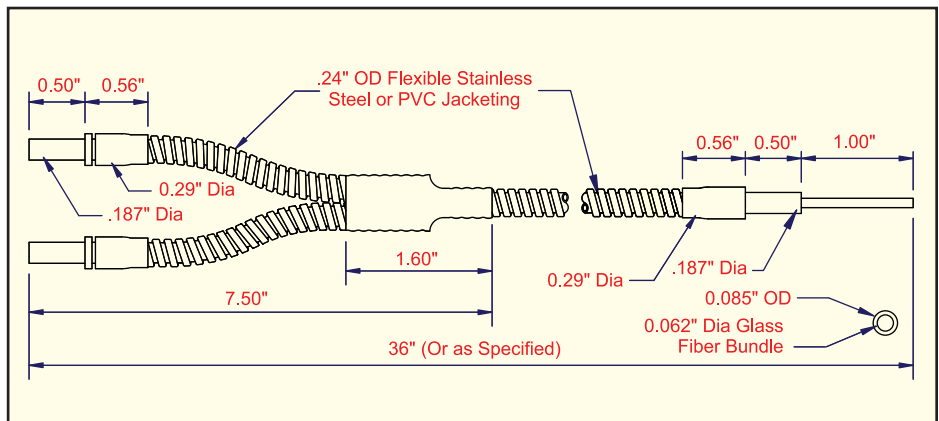
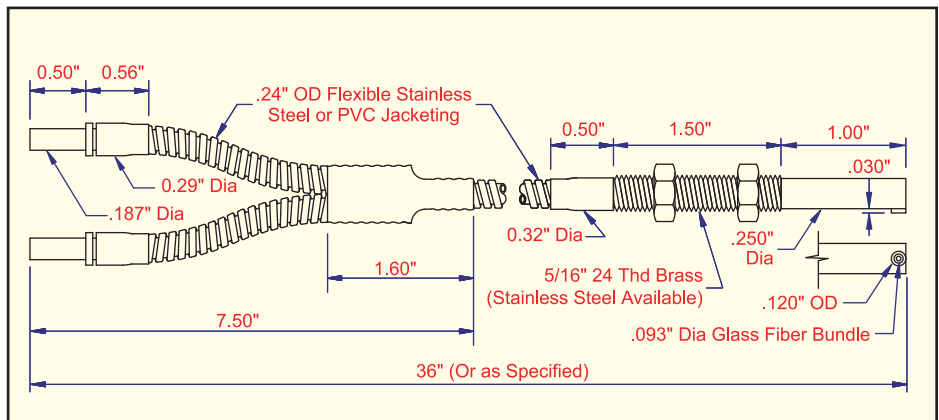
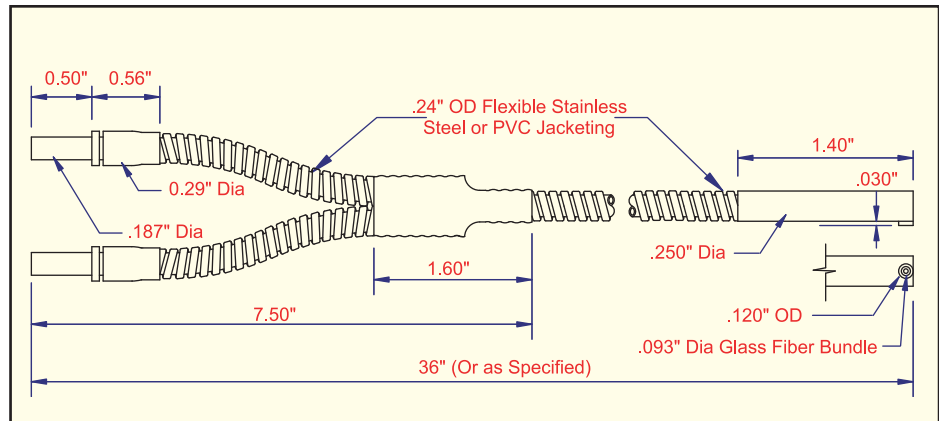
Right Angle Needle Tip  
Stainless Steel Jacket

MODEL BUNDLE SIZE  
BF-B-36R .062"

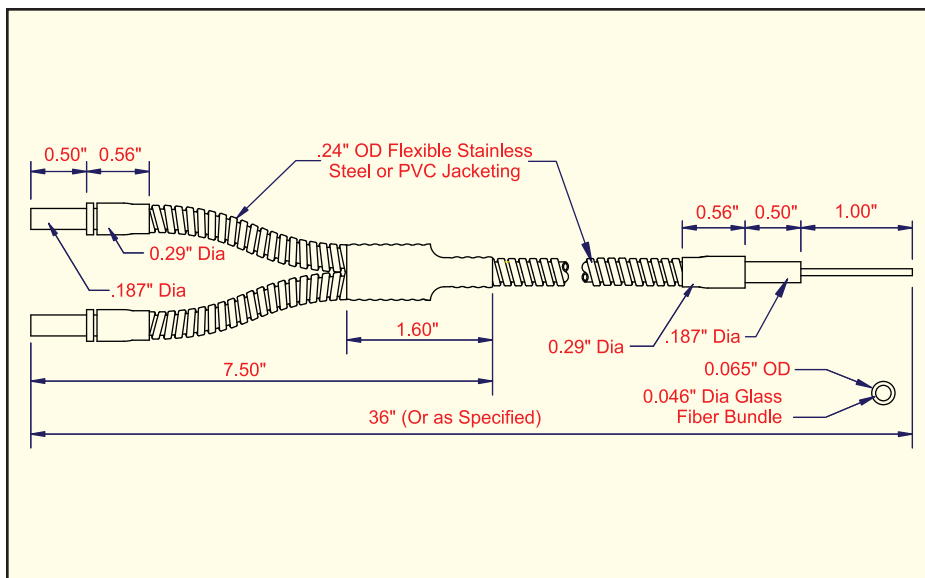


PVC Monocoil Jacket

MODEL BUNDLE SIZE  
BF-B-36RP .062"



# Glass Bifurcated Light Guides



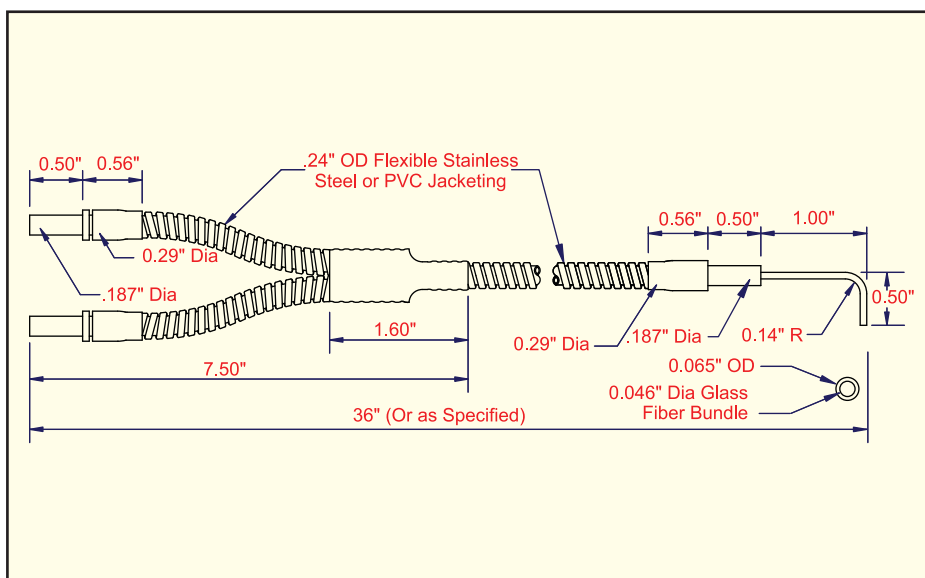
## Straight Needle Tip Stainless Steel Jacket

MODEL	BUNDLE SIZE
BF-E-36	.046"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
BF-E-36P	.046"



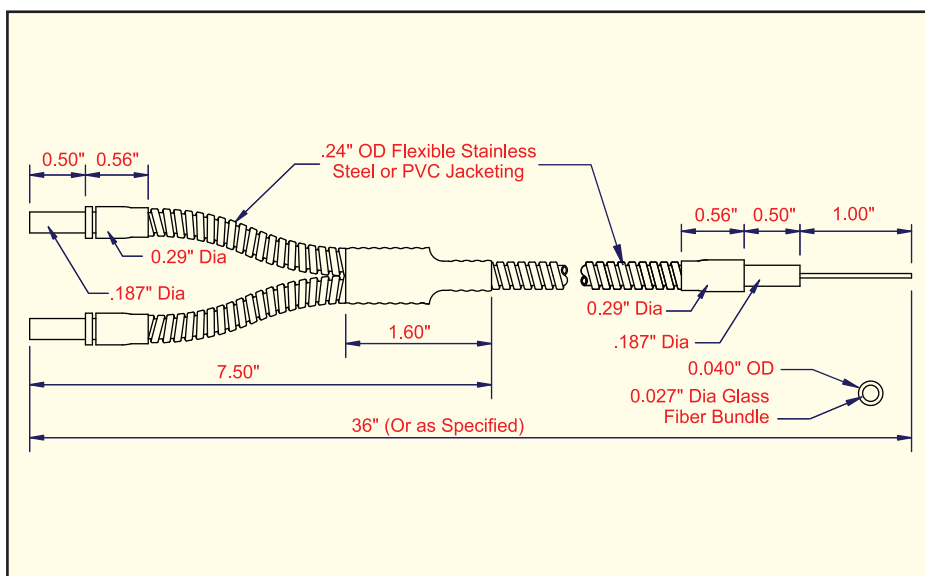
## Right Angle Needle Tip Stainless Steel Jacket

MODEL	BUNDLE SIZE
BF-E-36R	.046"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
BF-E-36RP	.046"



## Straight Needle Tip Stainless Steel Jacket

MODEL	BUNDLE SIZE
BF-J-36	.027"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
BF-J-36P	.027"

# Glass Bifurcated Light Guides

## Right Angle Needle Tip Stainless Steel Jacket

MODEL  
BF-J-36R

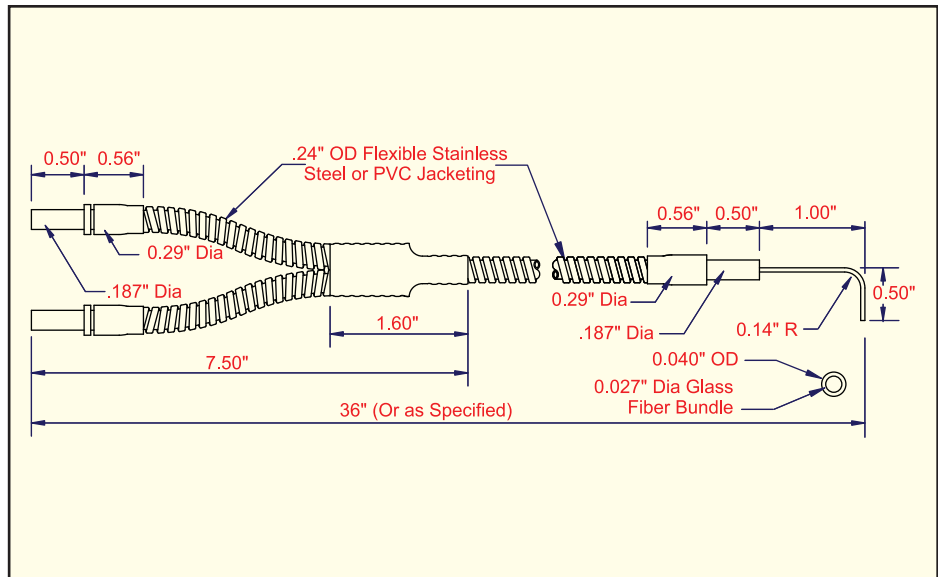
BUNDLE SIZE  
.027"



## PVC Monocoil Jacket

MODEL  
BF-J-36RP

BUNDLE SIZE  
.027"



## Rectangular Flat Housing Stainless Steel Jacket

MODEL  
BF-C-36

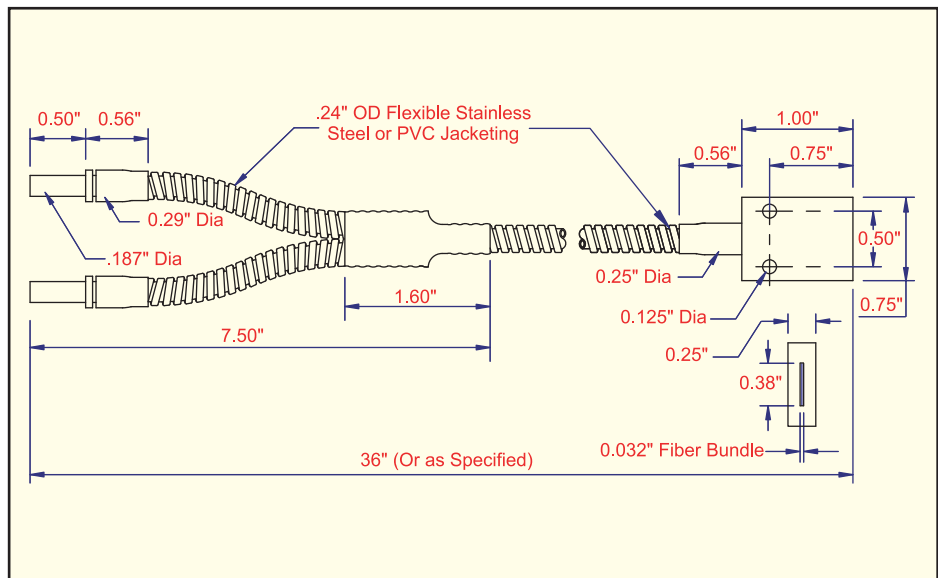
BUNDLE SIZE  
.032" x .38"



## PVC Monocoil Jacket

MODEL  
BF-C-36P

BUNDLE SIZE  
.032" x .38"



## Rectangular Bundle Barrel Tip Stainless Steel Jacket

MODEL  
BF-K-36

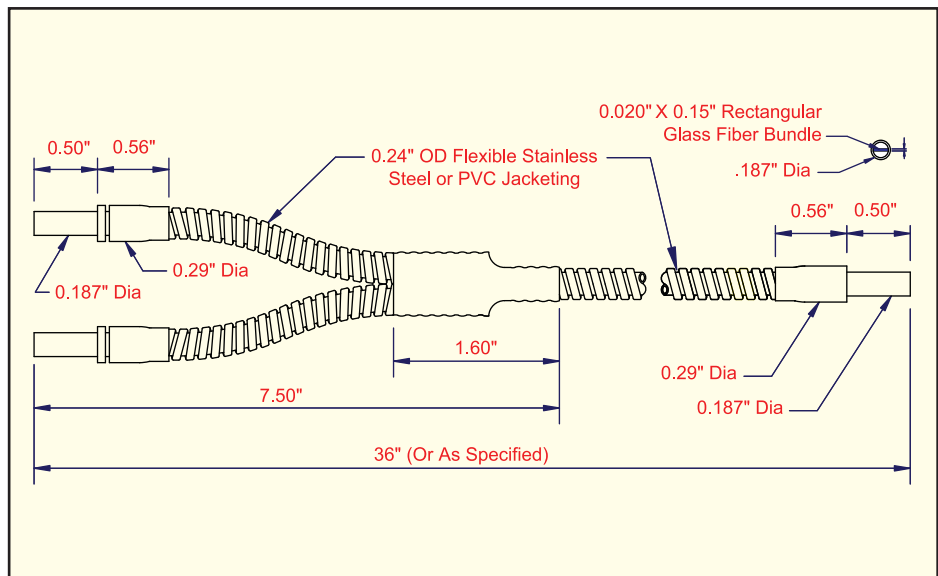
BUNDLE SIZE  
.020" x .15"



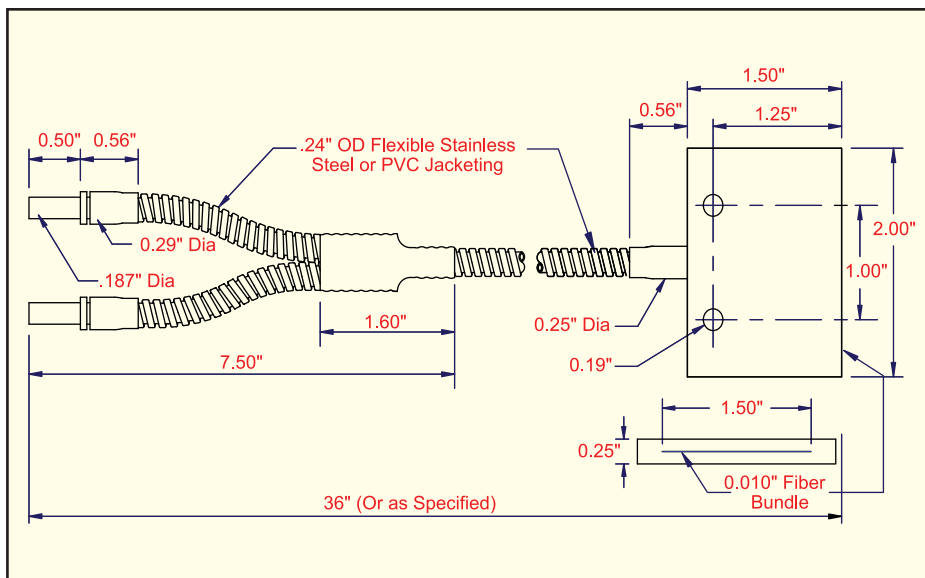
## PVC Monocoil Jacket

MODEL  
BF-K-36P

BUNDLE SIZE  
.020" x .15"



# Glass Bifurcated Light Guides



Rectangular, 2" Flat Housing  
Stainless Steel Jacket

MODEL  
BF-P-36

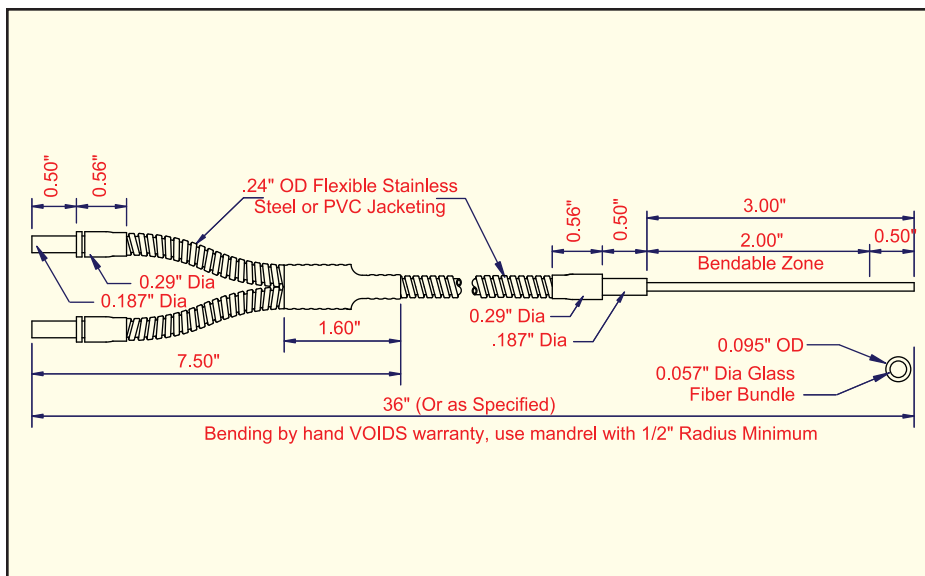
BUNDLE SIZE  
.010" x 1.50"



PVC Monocoil Jacket

MODEL  
BF-P-36P

BUNDLE SIZE  
.010" x 1.50"



3" Long Bendable Tip  
Stainless Steel Jacket

MODEL  
BF-L-36B

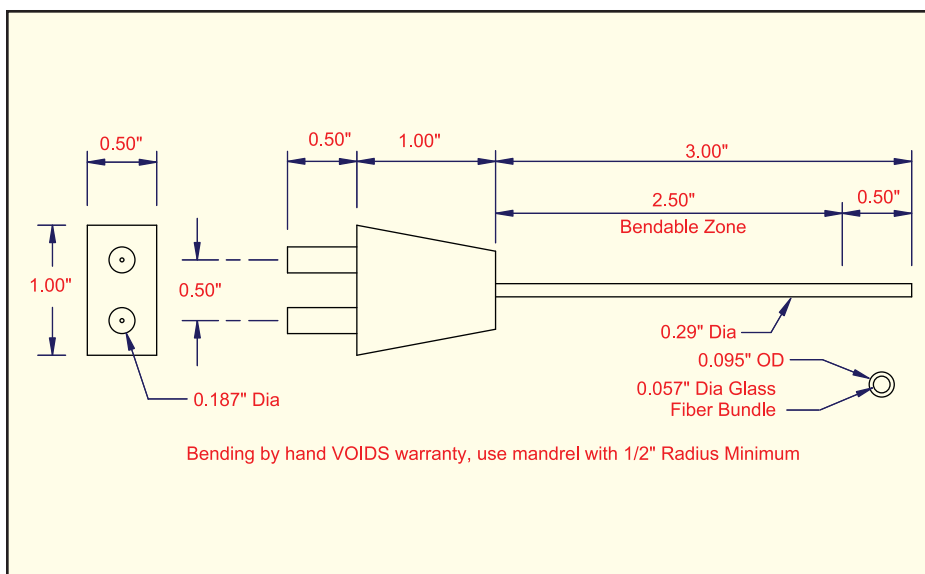
BUNDLE SIZE  
.057"



PVC Monocoil Jacket

MODEL  
BF-L-36BP

BUNDLE SIZE  
.057"



Sensor Adaptor  
Bendable 3" Tip  
For use with  
F1 Optical Block

MODEL  
BF-L-3B

BUNDLE SIZE  
.057"



# Miniature Glass Single Light Guides

Our **MINIATURE GLASS FIBEROPTIC LIGHT GUIDES** utilize the high performance and protection of glass fibers with the space saving flexibility of plastic fibers, plus a tighter bend radius. *Now there is nowhere we can't take you.*

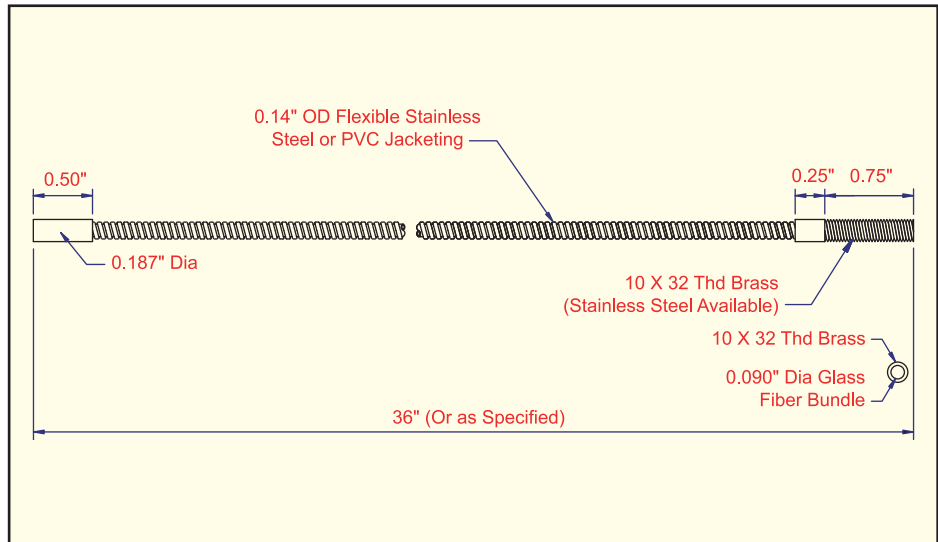
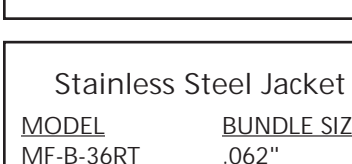
## Stainless Steel Jacket

MODEL	BUNDLE SIZE
MF-A-36T	.090"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
MF-B-36TP	.062"



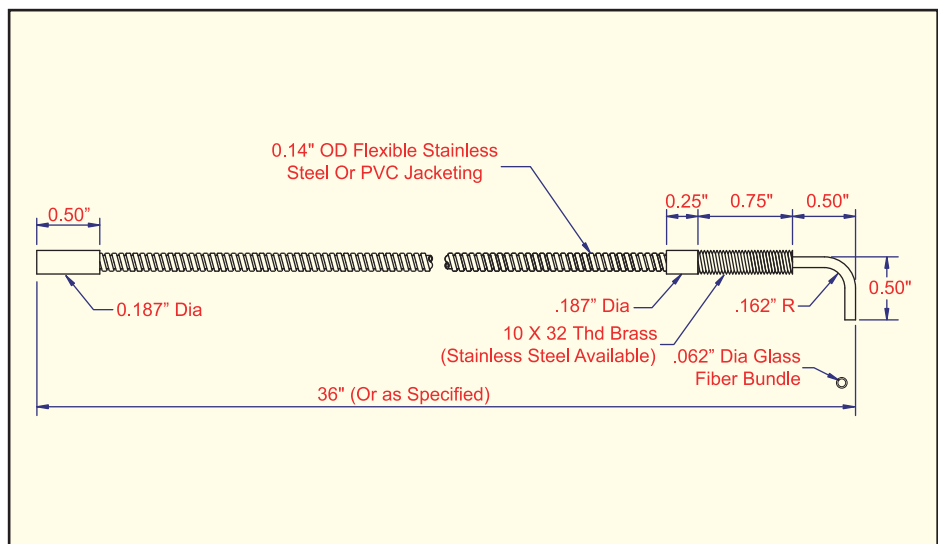
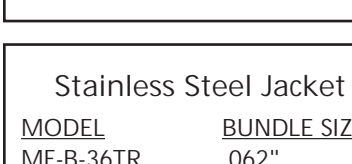
## Stainless Steel Jacket

MODEL	BUNDLE SIZE
MF-B-36RT	.062"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
MF-B-36RTP	.062"



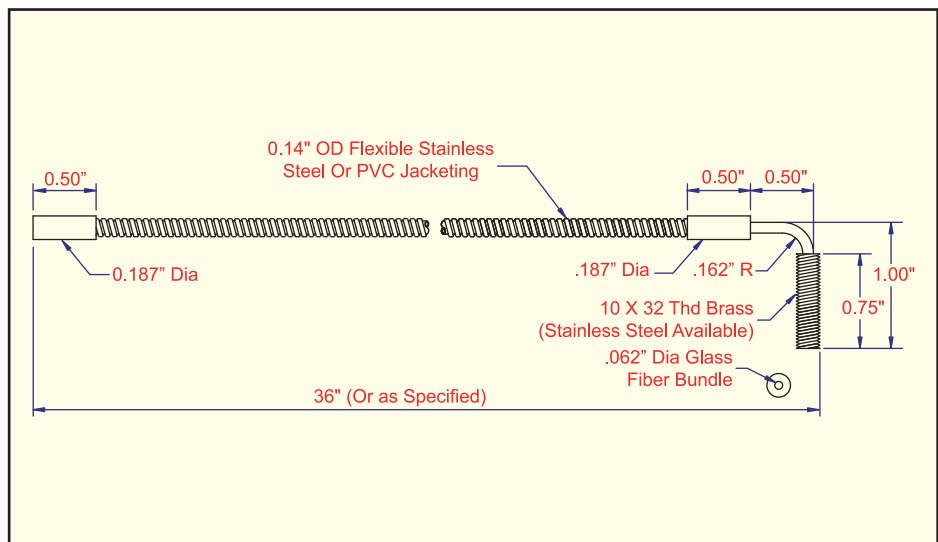
## Stainless Steel Jacket

MODEL	BUNDLE SIZE
MF-B-36TR	.062"

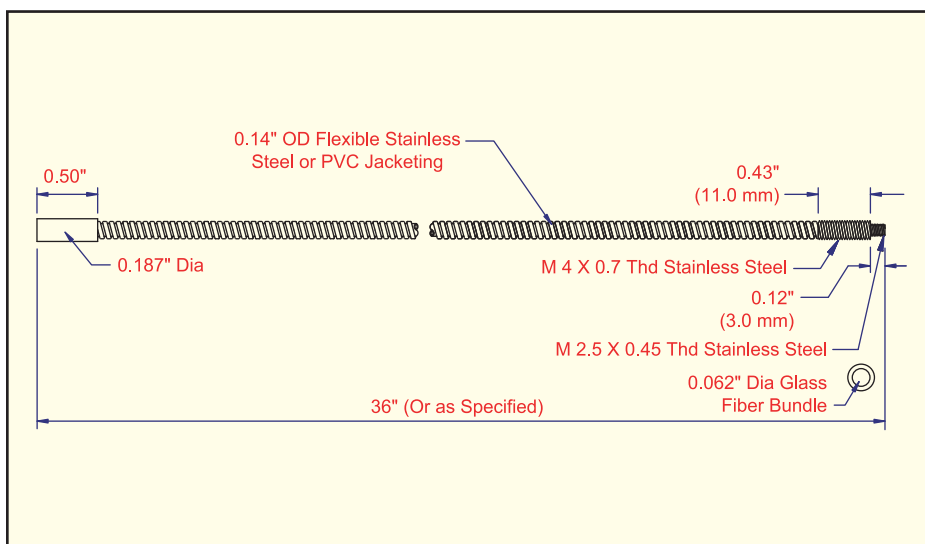
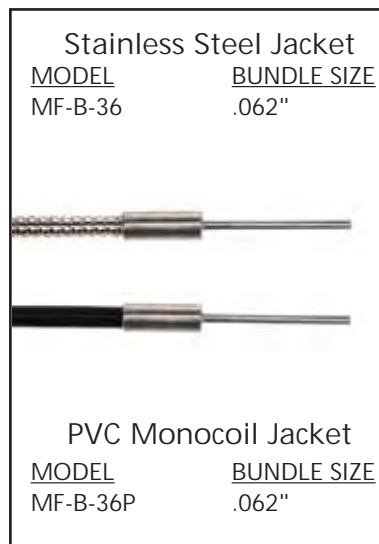
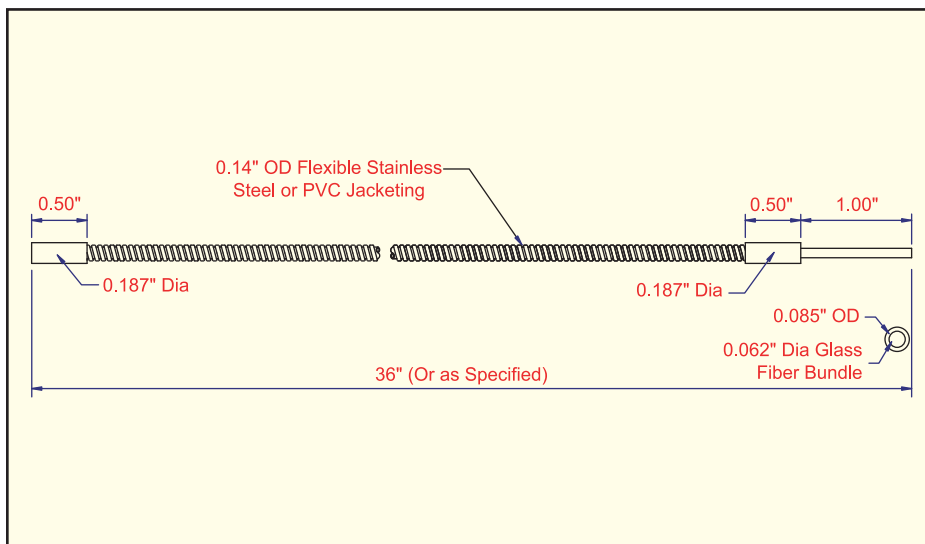
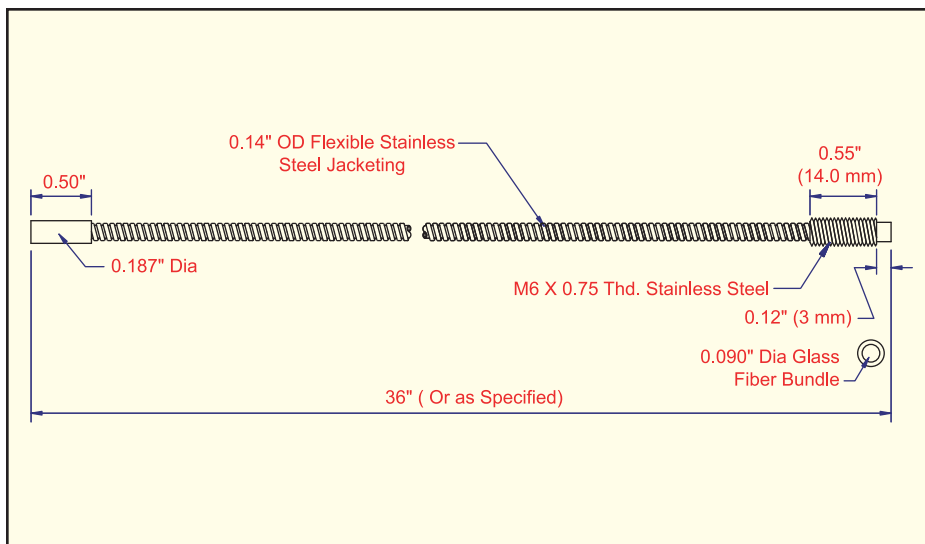


## PVC Monocoil Jacket

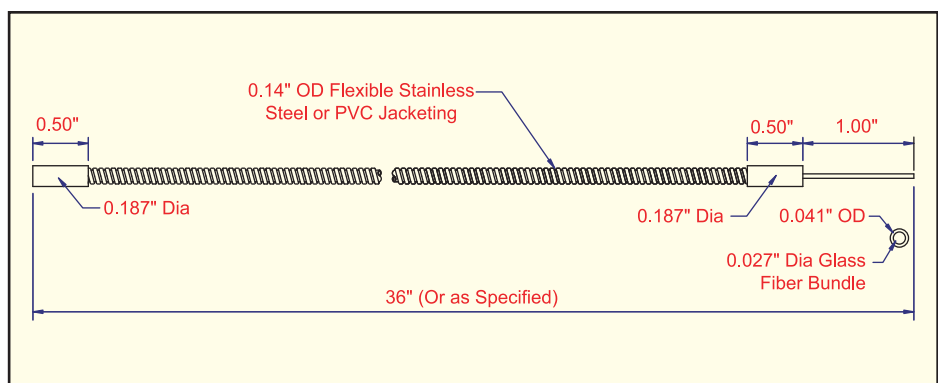
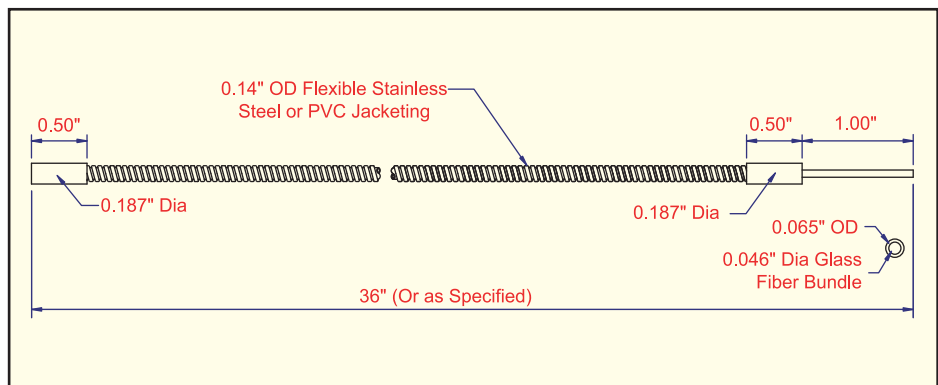
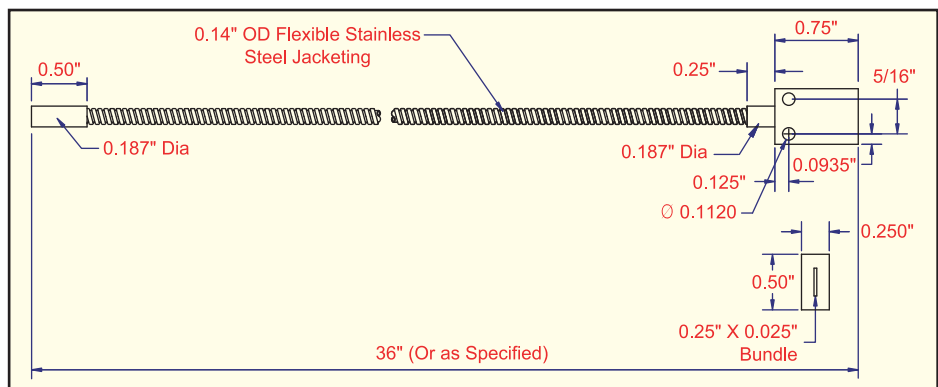
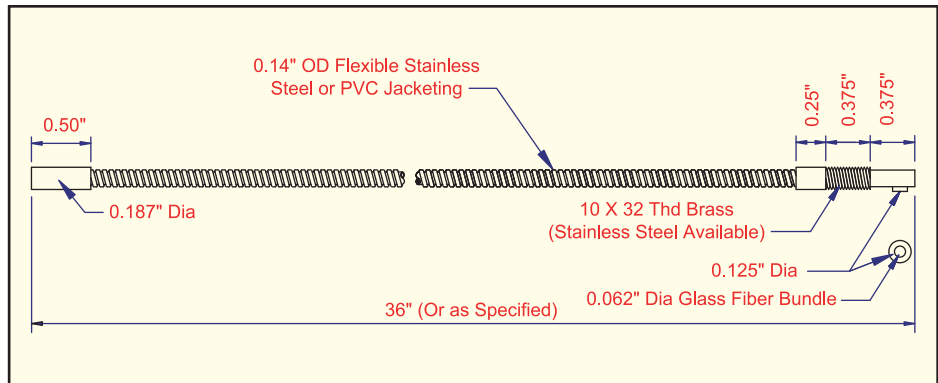
MODEL	BUNDLE SIZE
MF-B-36TRP	.062"



# Miniature Glass Single Light Guides

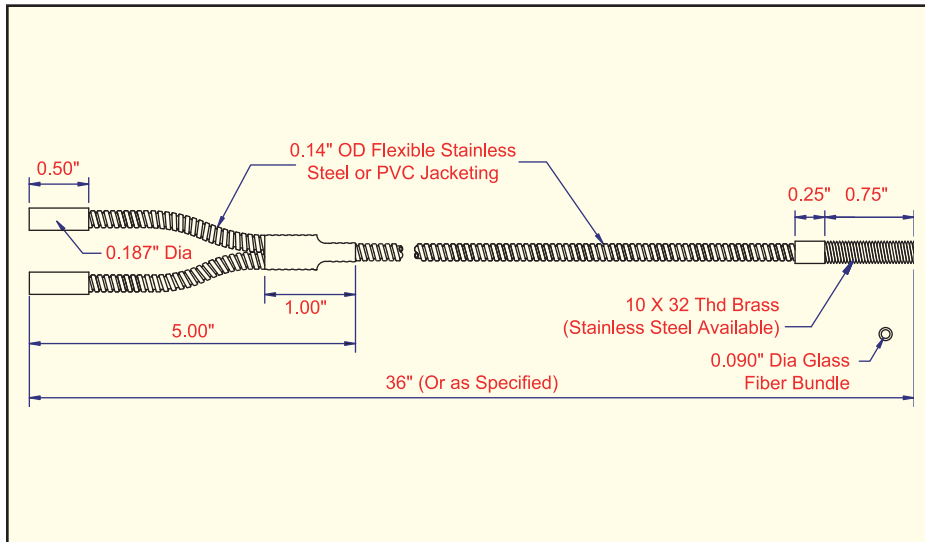


# Miniature Glass Single Light Guides



# Miniature Glass Bifurcated Light Guides

*FINALLY...* BIFURCATED FIBEROPTIC LIGHT GUIDES  
in a small package with the performance of glass



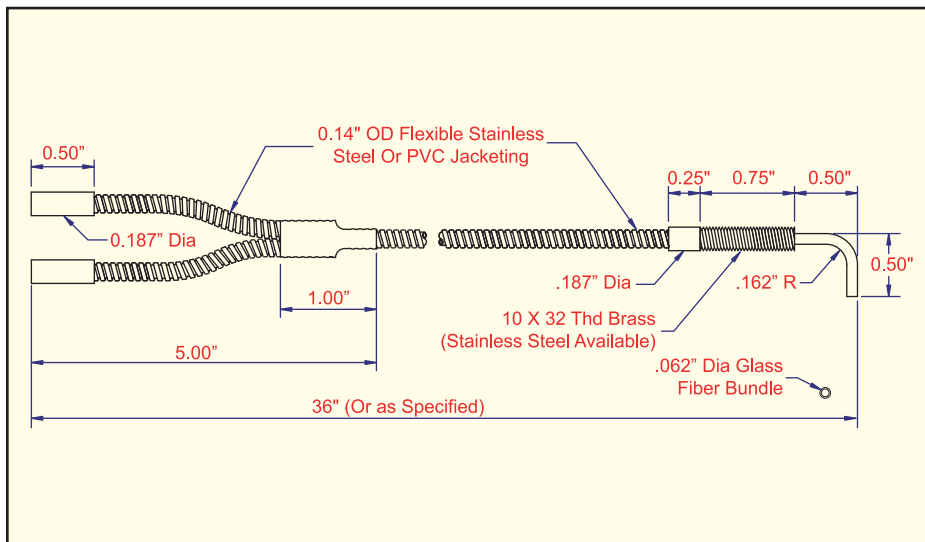
## Stainless Steel Jacket

MODEL	BUNDLE SIZE
MBF-A-36T	.090"
MBF-B-36T	.062"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
MBF-A-36TP	.090"
MBF-B-36TP	.062"



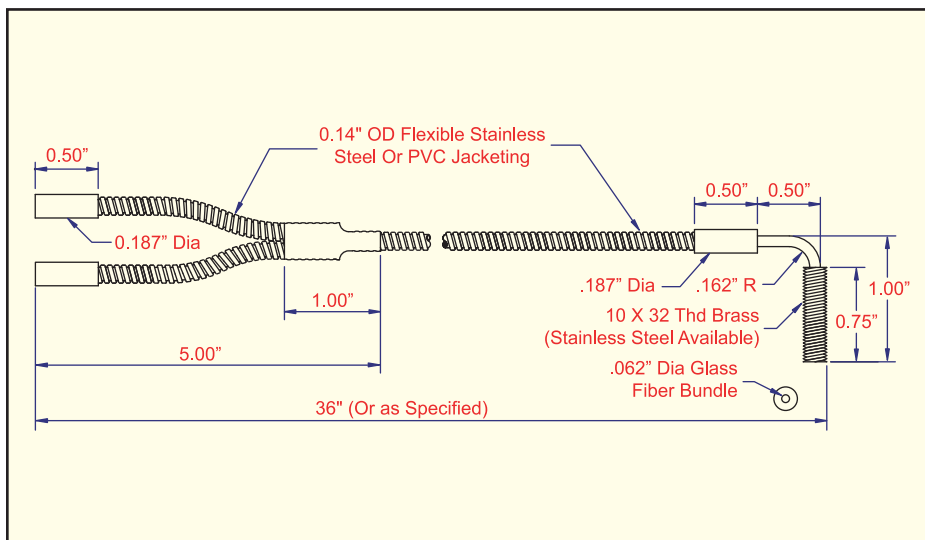
## Stainless Steel Jacket

MODEL	BUNDLE SIZE
MBF-B-36RT	.062"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
MBF-B-36RTP	.062"



## Stainless Steel Jacket

MODEL	BUNDLE SIZE
MBF-B-36TR	.062"



## PVC Monocoil Jacket

MODEL	BUNDLE SIZE
MBF-B-36TRP	.062"

# Miniature Glass Bifurcated Light Guides

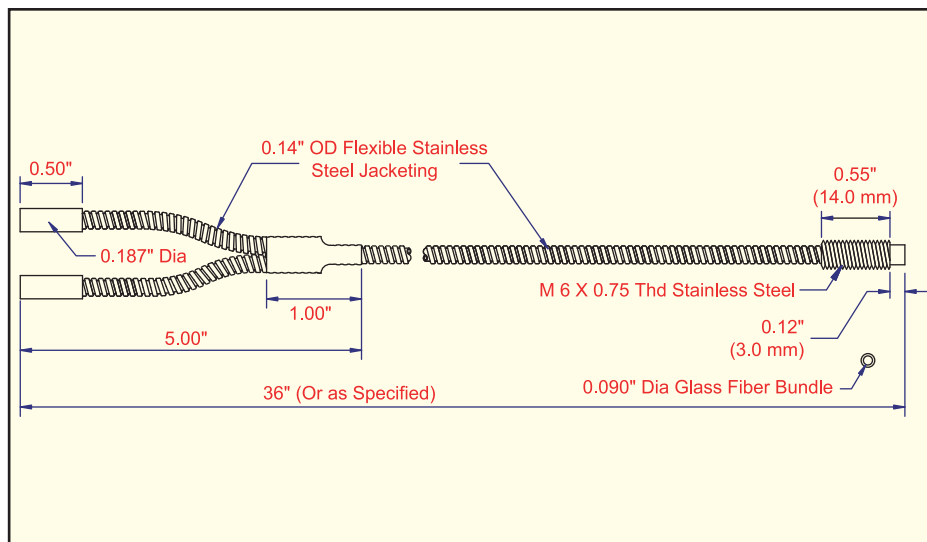
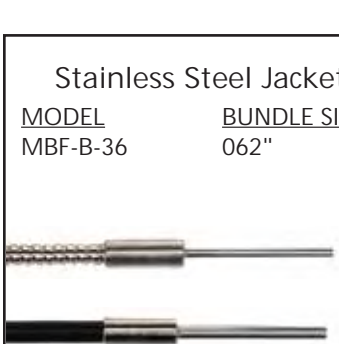
## Stainless Steel Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
MBF-A-36TM6	.090"



## PVC Monocoil Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
MBF-B-36TM6P	.062"



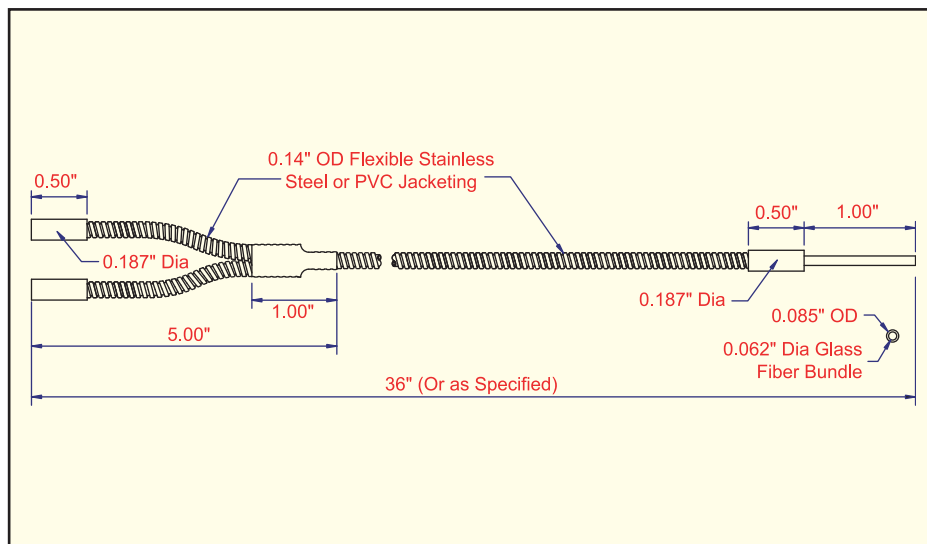
## Stainless Steel Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
MBF-B-36	062"



## PVC Monocoil Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
MBF-B-36P	062"



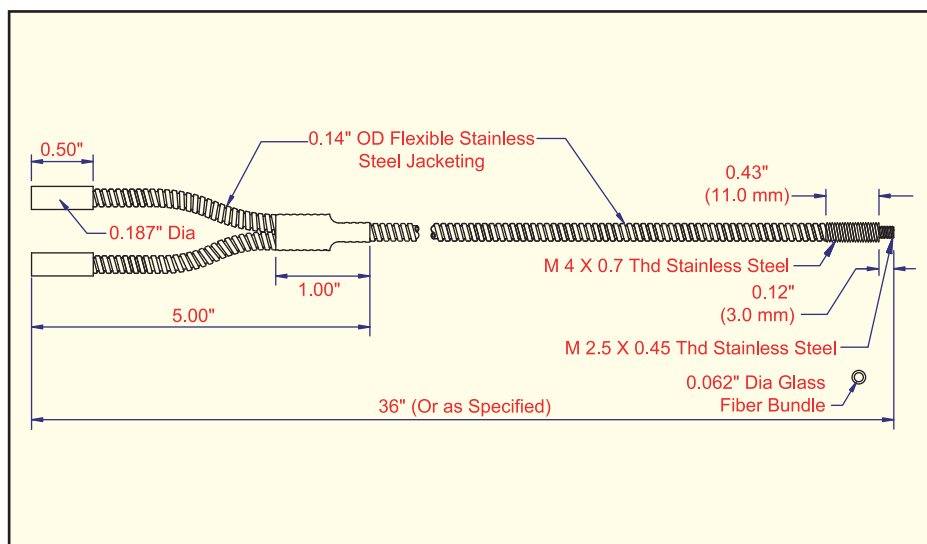
## Stainless Steel Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
MBF-B-36TM4	.062"

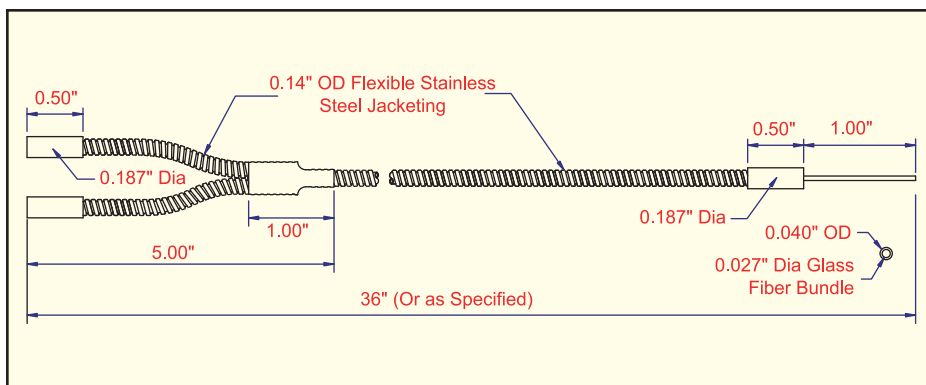
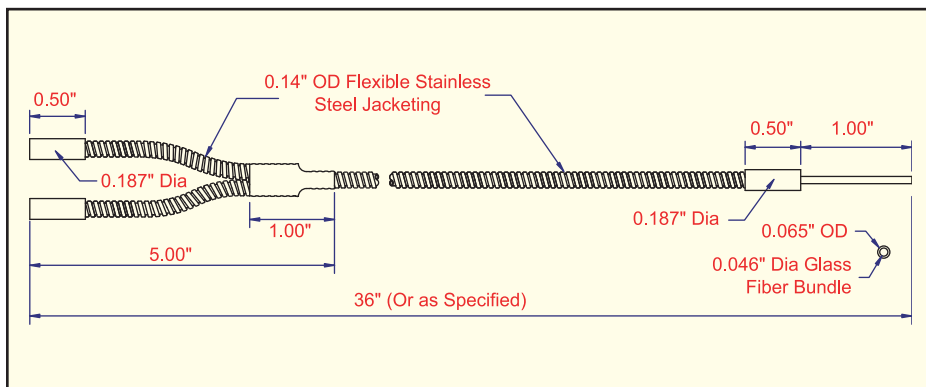
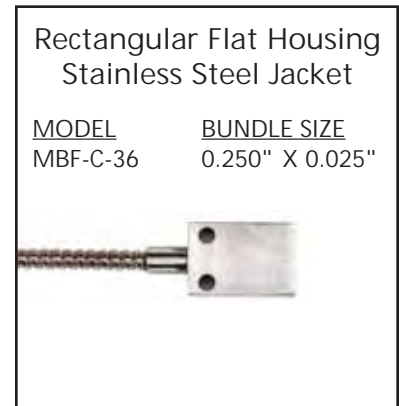
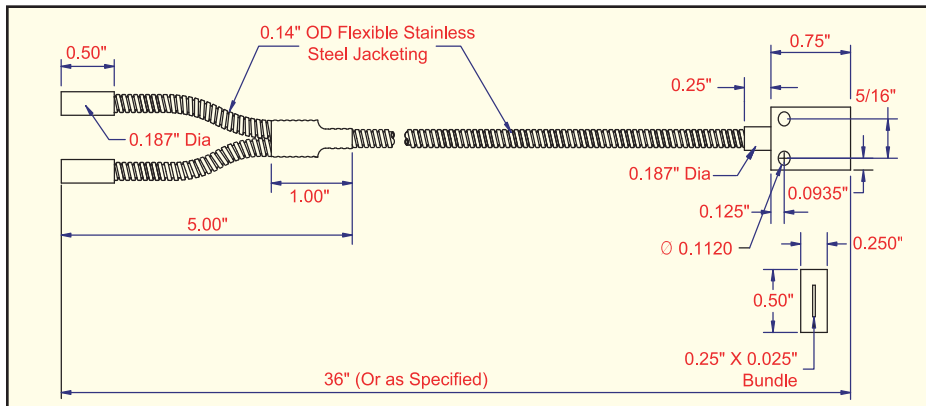
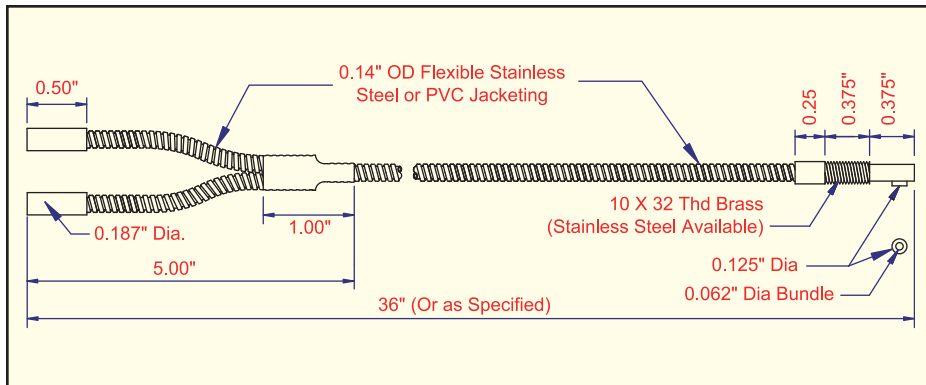


## PVC Monocoil Jacket

<u>MODEL</u>	<u>BUNDLE SIZE</u>
MBF-B-36TM4P	062"



# Miniature Glass Bifurcated Light Guides



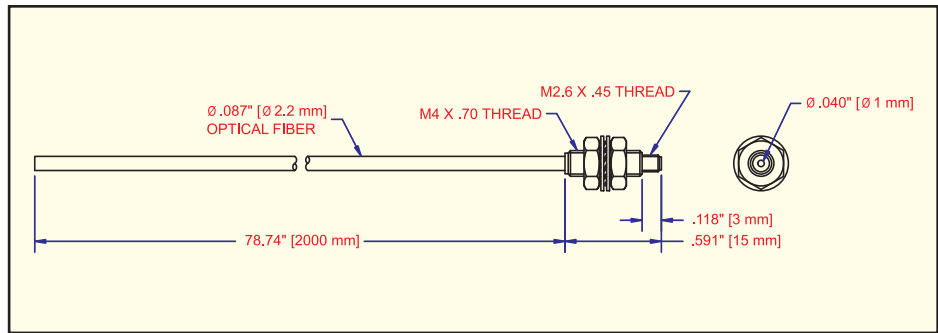
# Plastic Single Light Guides

**NEW!**

Two per package\*

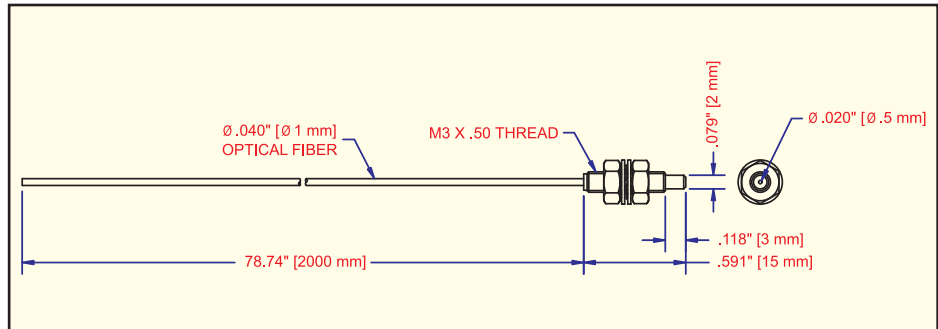
## Straight Threaded Tip

MODEL PF-Z-78TL BUNDLE SIZE .040"



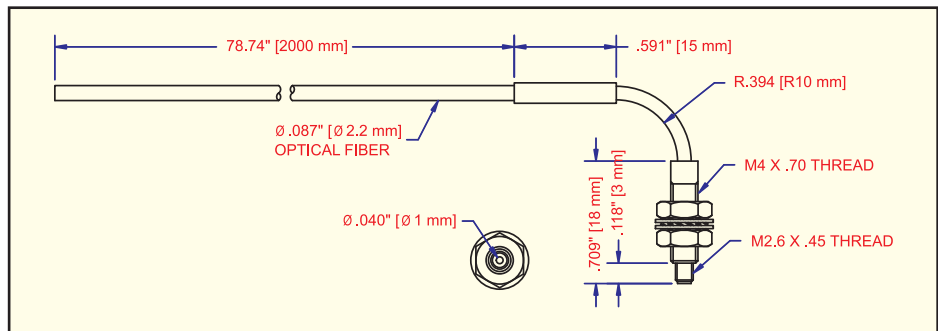
## Straight Threaded Tip

MODEL PF-Q-78T BUNDLE SIZE .020"



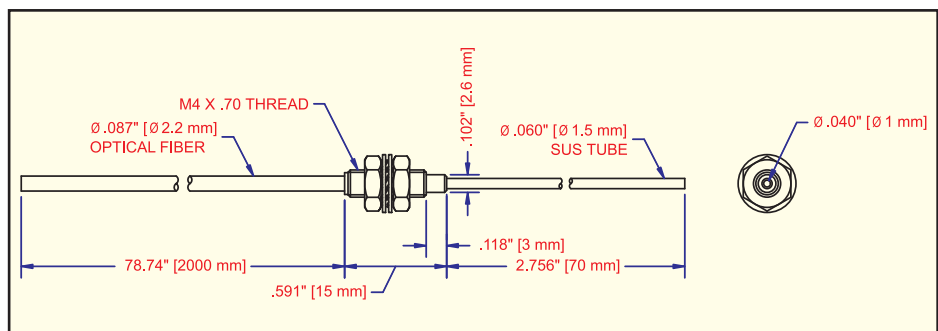
## Threaded Tip then Right Angle

MODEL PF-Z-78TRL BUNDLE SIZE .040"



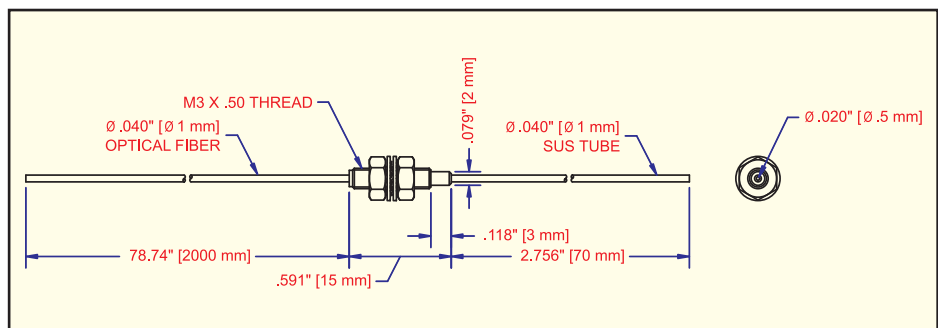
## Straight Threaded Needle Tip

MODEL PF-Z-78T70 BUNDLE SIZE .040"



## Straight Needle Tip with Threaded Mounting

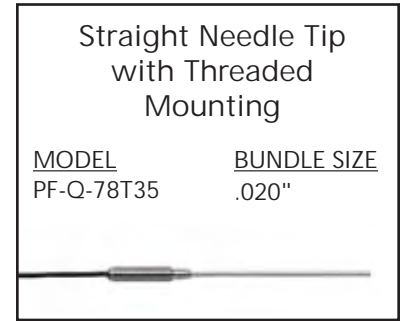
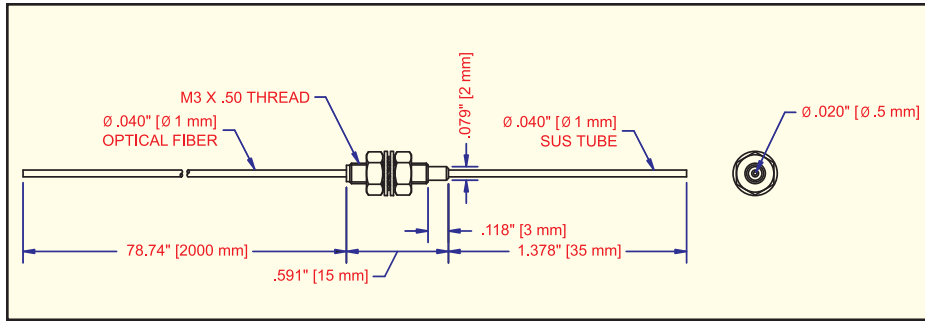
MODEL PF-Q-78T70 BUNDLE SIZE .020"



# Plastic Single Light Guides

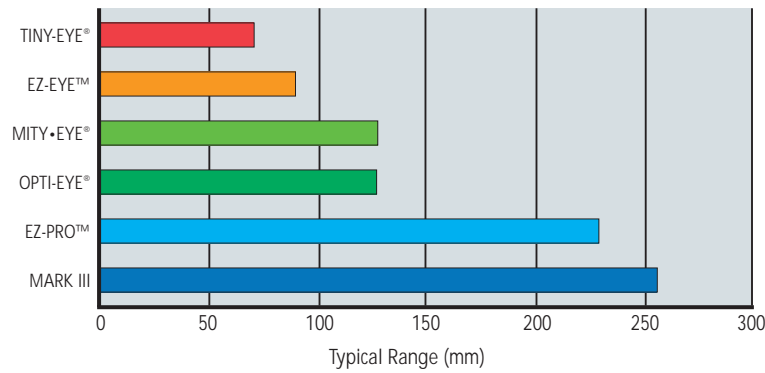
Two per package

**NEW!**

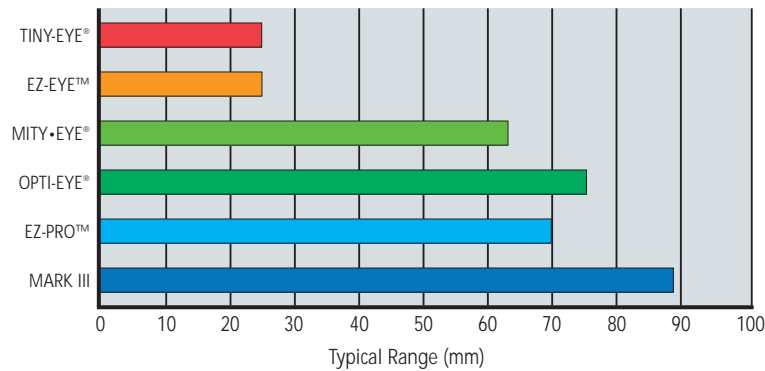


## Range Guidelines with Red LED

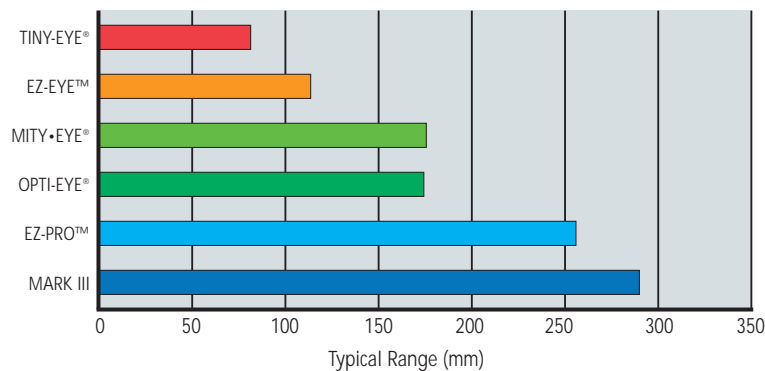
PF-Z-78TL, PF-Z-78T70



PF-Q-78T, PF-Q-78T35, PF-Q-78T70



PF-Z-78TRL

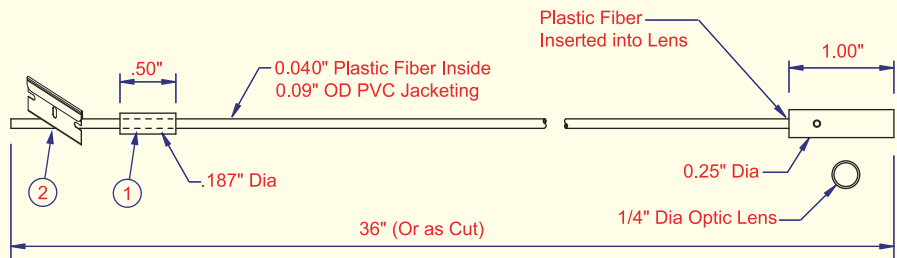


# Plastic Single Light Guides

One per package

## Slip-on Barrel Lens 1/4" x 1"

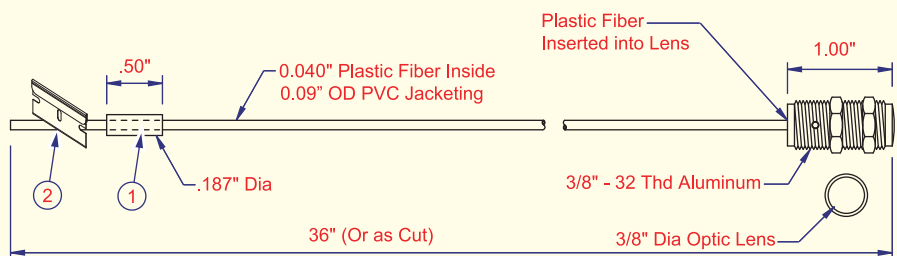
MODEL	BUNDLE SIZE
LF-G-36	.040"
	36" Cable Length
LF-G-72	.040"
	72" Cable Length



- 1 NFA-50 (Removable Nylon Fiber Optic Block Adaptor)
- 2 Fibers can be cut to length using the PFC-1  
Note: Cut Must Be Perpendicular to Fiber

## Slip-on Threaded Barrel Lens 3/8" x 1"

MODEL	BUNDLE SIZE
LF-H-36	.040"
	36" Cable Length
LF-H-72	.040"
	72" Cable Length



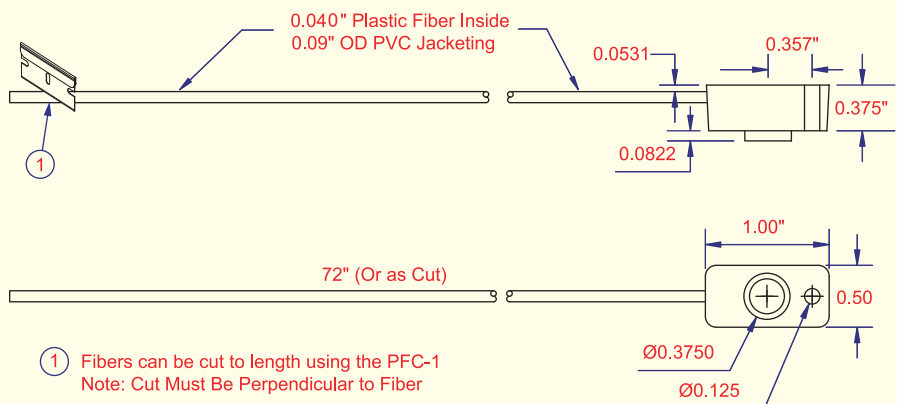
- 1 NFA-50 (Removable Nylon Fiber Optic Block Adaptor)
- 2 Fibers can be cut to length using the PFC-1  
Note: Cut Must Be Perpendicular to Fiber

## Plastic Fibers Right Angle



MODEL	BUNDLE SIZE
F-S-72R	.040"
F-S-120R	.040"

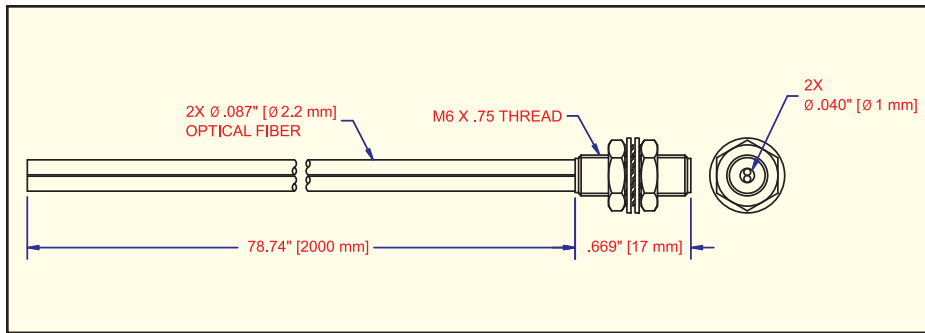
Low Cost, right angle plastic fiberoptic light guides offer the most reliable sensing mode for opaque objects. Wide beam simplifies alignment. 72" or 120" long cut-to-length fibers.



- 1 Fibers can be cut to length using the PFC-1  
Note: Cut Must Be Perpendicular to Fiber

# Plastic Diplex Light Guides

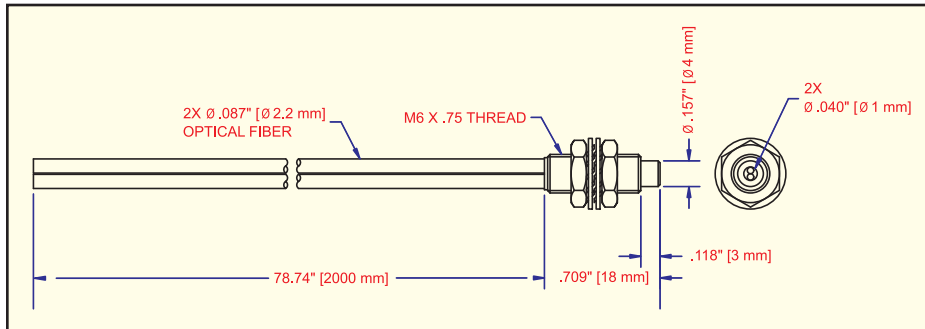
NEW!



## Threaded Tip

MODEL  
PFD-Z-78M6

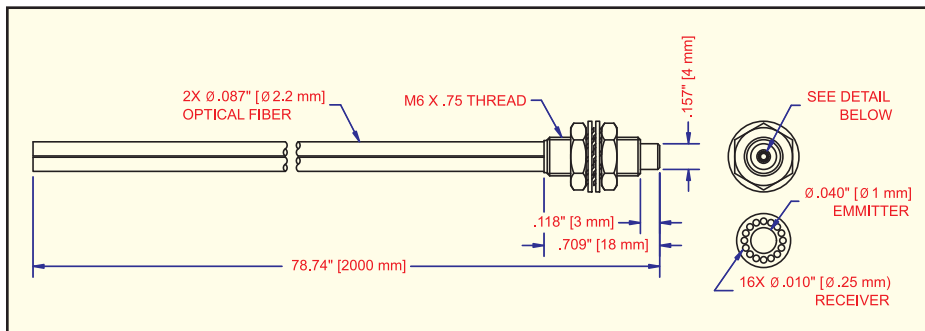
BUNDLE SIZE  
.040"



## Threaded Tip

MODEL  
PFD-Z-78M64

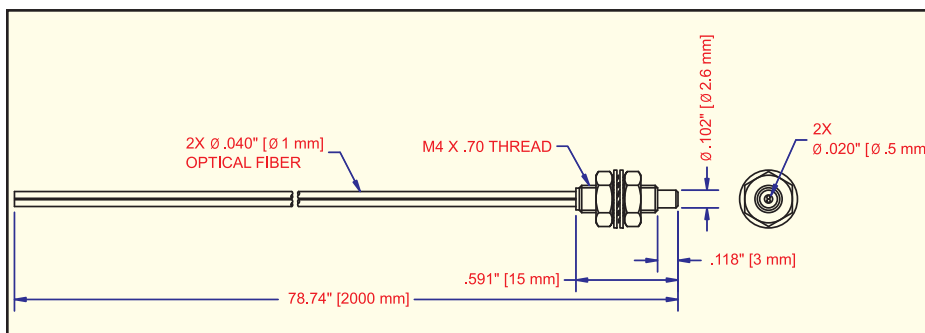
BUNDLE SIZE  
.040"



## Coaxial Threaded Tip

MODEL  
PFD-CZ-78T

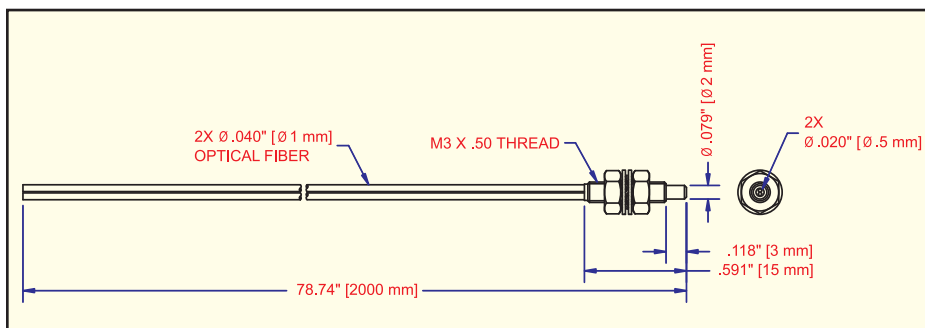
BUNDLE SIZE  
Emitter: .040"  
Receiver: .010"



## Threaded Tip

MODEL  
PFD-Q-78M4

BUNDLE SIZE  
.020"



## Threaded Tip

MODEL  
PFD-Q-78M3

BUNDLE SIZE  
.020"

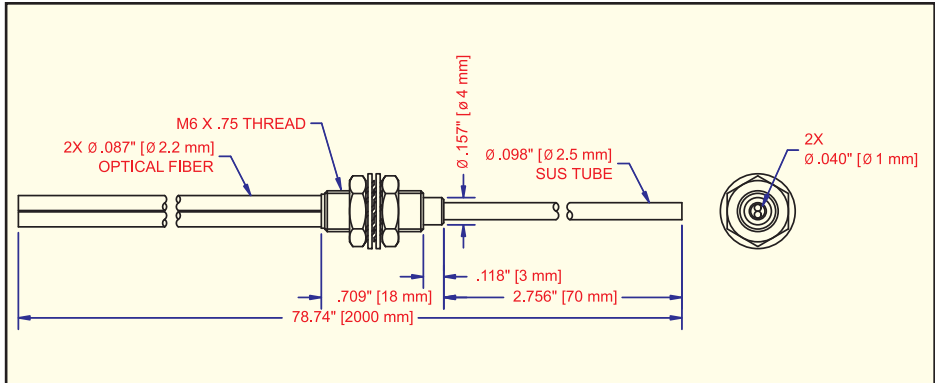


# Plastic Diplex Light Guides

NEW!

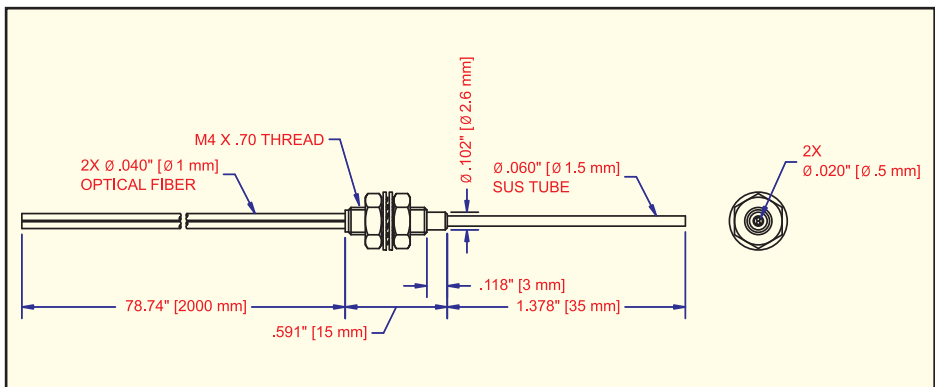
## Straight Needle Tip, Threaded

MODEL PFD-Z-78T70  
BUNDLE SIZE .040"



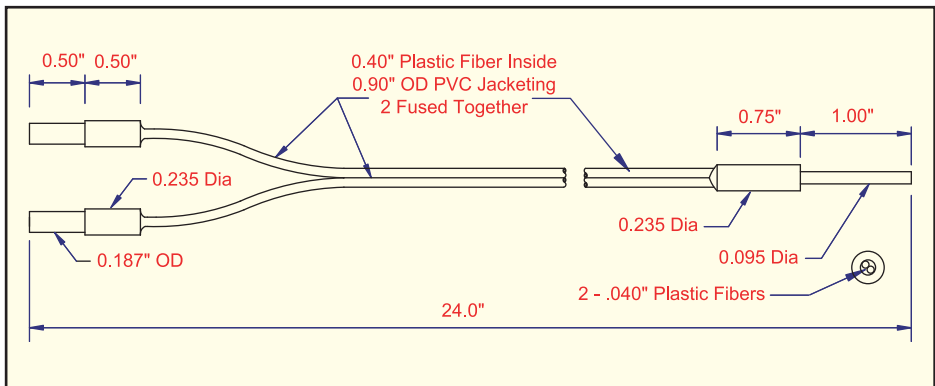
## Needle Tip with Threaded Mounting Diplex

MODEL PFD-Q-78T35  
BUNDLE SIZE .020"



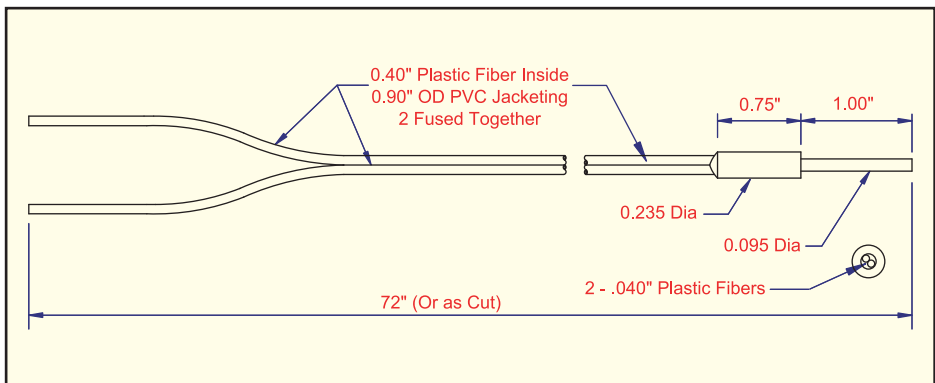
## Straight Needle Tip

MODEL BF-W-24PP  
BUNDLE SIZE .040"



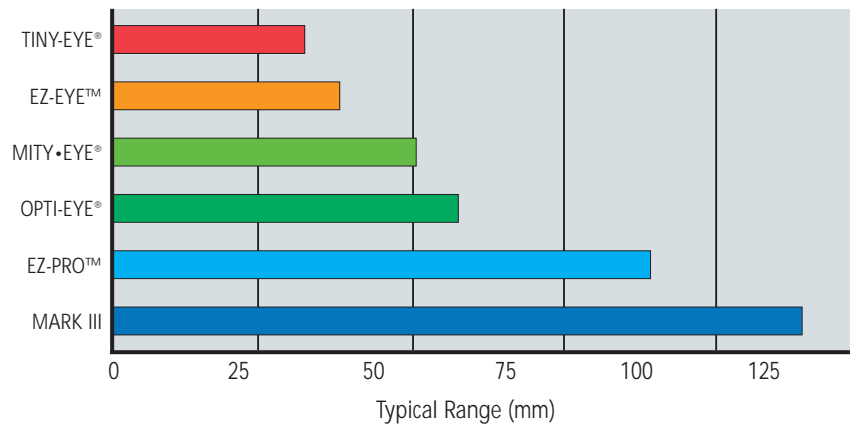
## Straight Needle Tip

MODEL BF-Y-72PPC  
BUNDLE SIZE .040"

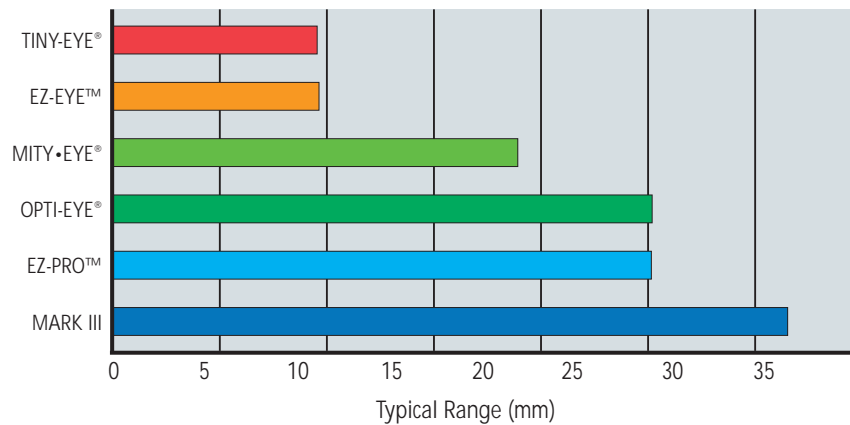


# Plastic Diplex Light Guides

PFD-Z-78M6, PFD-Z-78M64, PFD-Z-78T70, PFD-CZ-78T

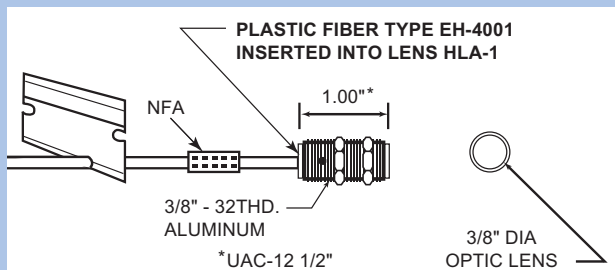


PFD-Q-78M3, PFD-Q-78M4, PFD-Q-78T35,

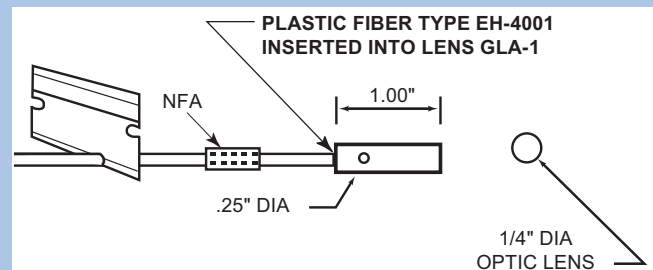


## INDIVIDUAL CUT-TO-LENGTH COMPONENTS

Plastic Fiber Cutter, model # PFC-1



Model No.	Description
EH-4001-25	25' of .040 Single Plastic Fiberoptic Cable
EH-4001-50	50' of .040 Single Plastic Fiberoptic Cable
EH-4001-100	100' of .040 Single Plastic Fiberoptic Cable
EH-4002-25	25' of 2-.040" Diplex Plastic Fiberoptic Cable
EH-4002-50	50' of 2-.040" Diplex Plastic Fiberoptic Cable
EH4002-100	100' of 2-.040" Diplex Plastic Fiberoptic Cable
PFC-1	Plastic Fiber Cutter
NFA-50	.5" Nylon Fiberoptic Adaptor, 50 pieces
NFA12-50	.25" Nylon Fiberoptic Adaptor, 50 pieces



# Examples of Custom Light Guides

Custom Fiberoptic tips and lengths BTO (built to order). Please consult factory.

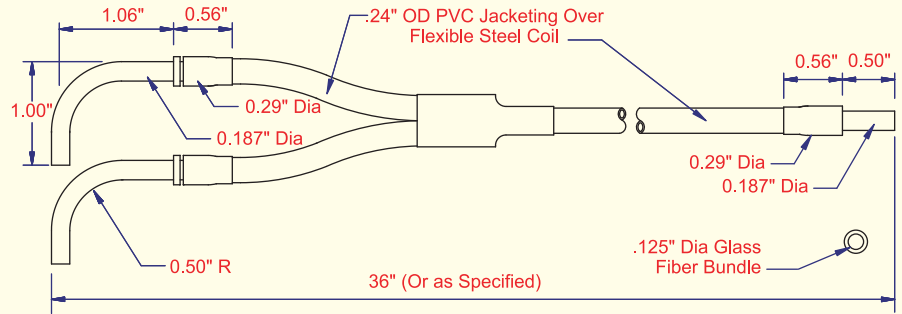
Straight Barrel Tip  
PVC Monocoil Jacket  
Low Profile

MODEL

BF-A-36X31

BUNDLE SIZE

.125"



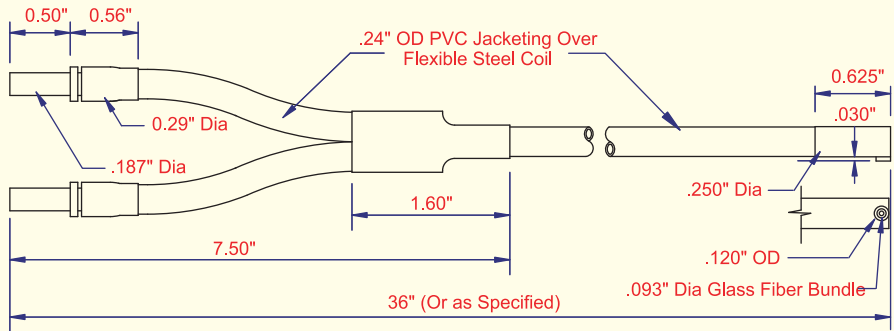
Side View Right  
Angle Short Tip  
PVC Monocoil Jacket

MODEL

BF-A-36X408

BUNDLE SIZE

.093"



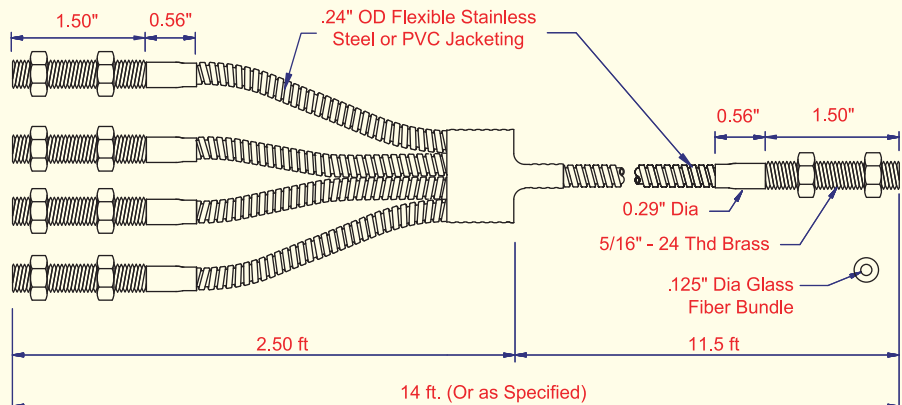
Straight Threaded Tip  
Stainless Steel Jacket  
Light Pipe

MODEL

F-A-168X448

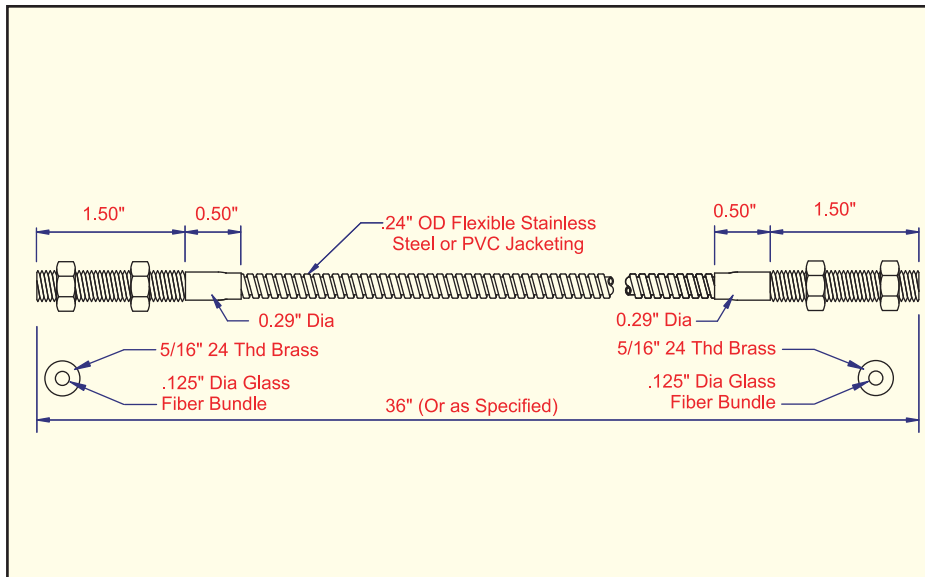
BUNDLE SIZE

.125"



# Examples of Custom Light Guides

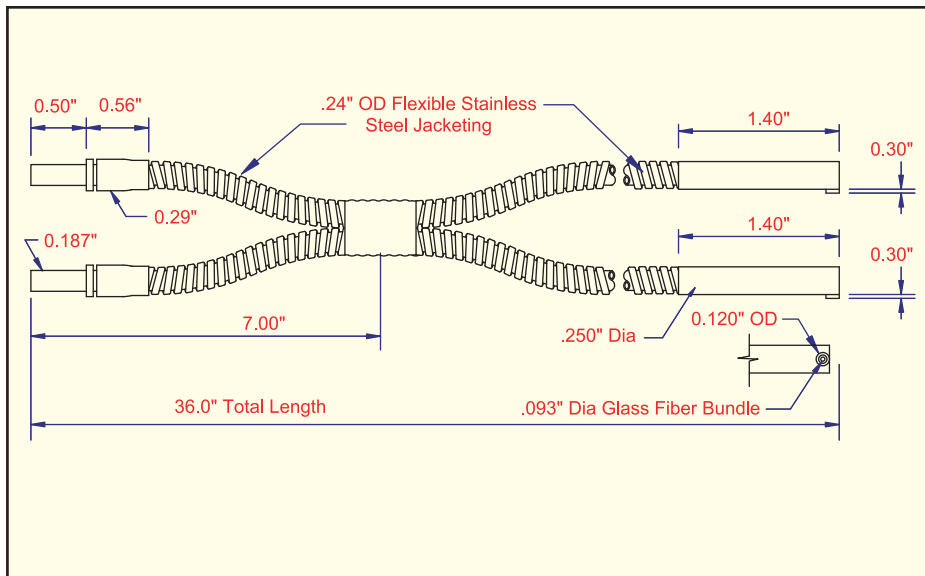
Custom Fiberoptic tips and lengths BTO (built to order). Please consult factory.



Straight Threaded Tip  
Light Pipe  
Stainless Steel Jacket

MODEL  
F-A-36X70

BUNDLE SIZE  
.125"

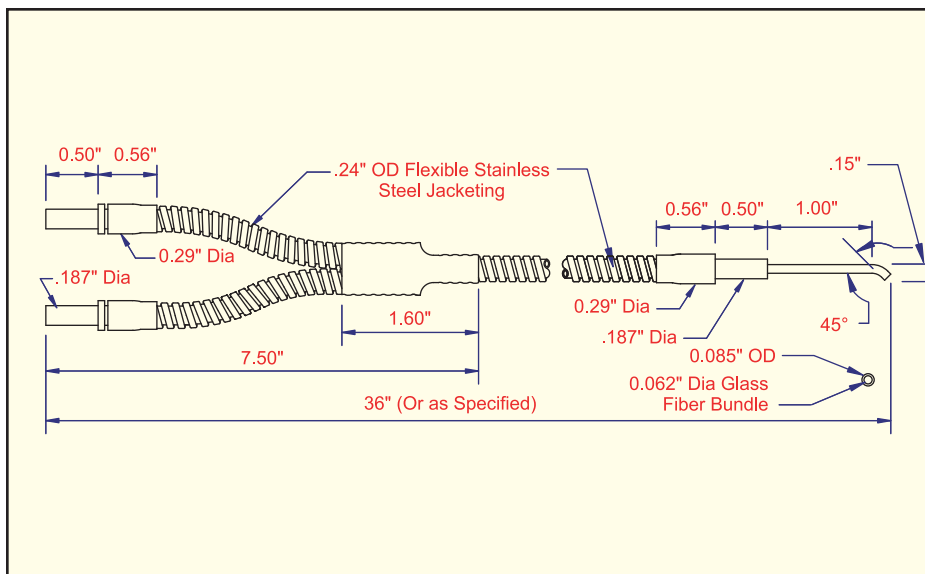


Side View Right Angle  
Dual Head Tip  
Stainless Steel Jacket

MODEL  
BF-A-36X107

BUNDLE SIZE  
.093"

Dual Head Tip



45° Short Curved Tip  
Stainless Steel Jacket

MODEL  
BF-B-36X397

BUNDLE SIZE  
.062"

Short Curved Tip

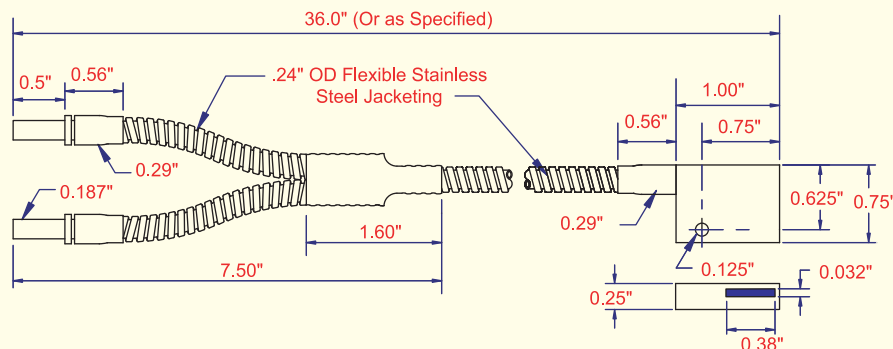
# Examples of Custom Light Guides

Custom Fiberoptic tips and lengths BTO (built to order). Please consult factory.

Right Angle "C" Fiber  
Stainless Steel Jacket

MODEL  
BF-C-36X374

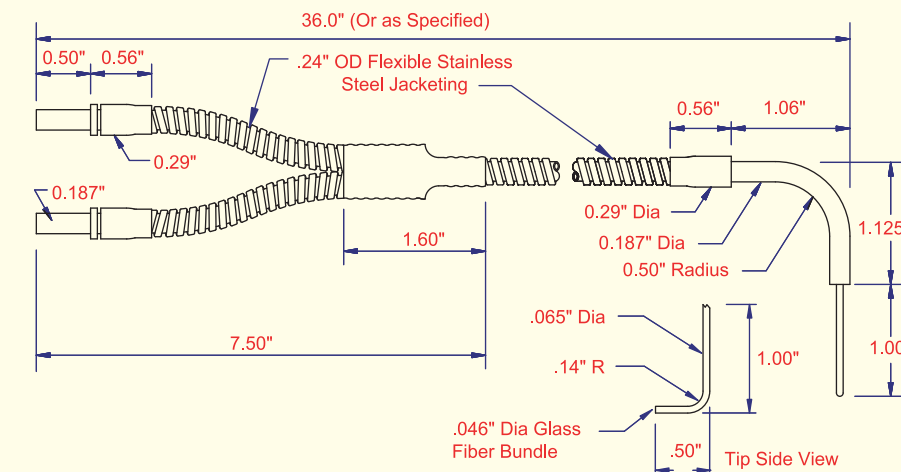
BUNDLE SIZE  
0.38" X 0.032"



Jig Fit Fiber  
Stainless Steel Jacket

MODEL  
BF-E-36X92

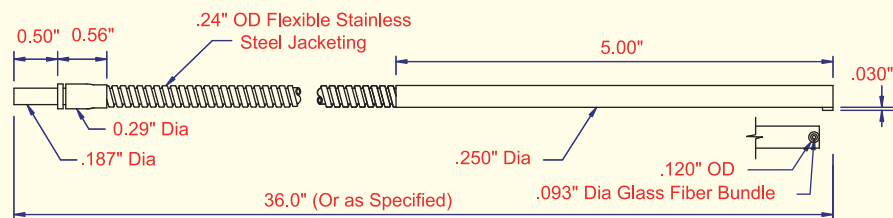
BUNDLE SIZE  
.046"



Jig Fit Fiber  
Stainless Steel Jacket

MODEL  
F-A-36X505

BUNDLE SIZE  
.093"



# Fiberoptic Lenses and Mounting Brackets

3

Fiberoptic Light Guides



**FMB-1**  
(8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket  
Use with Threaded Glass  
Fiberoptic



**FMB-2** (5.1 mm diam.)  
**FMB-3** (3.1 mm diam.)  
Miniature Glass or Plastic  
Fiberoptic Mounting  
Brackets



**FPA-1**  
Slip-on Polarizing Adaptor  
Lens (2 Required)  
Slips over end of  
Model F-A-36 Straight  
Light Guides only



**FPA-2**  
Friction Mount Polarizing  
Adaptor Lens (2 Required)  
Friction mounts onto  
F-A-36P Straight Light  
Guides only



**GLA-1**  
1/4" X 1"  
Slip-on Lens Assembly  
Slips on Model  
EH-4001 plastic fibers



**GLA-2**  
Long Range Lens  
for Through-Beam  
Use with M4 Tips



**HLA-1**  
3/8" X 1" Threaded  
Slip-on Lens Assembly  
Slips on Model EH-4001  
plastic fibers



**HLA-2**  
Spot Focus Lens for  
Diffused Beam  
Use with M6 Tips  
Focal Point .50" (12.7 mm)



**UAC-12**  
Slip-on Long Range Plastic  
Lens, Use on .187" O.D.  
straight or right angle  
fiber tip or .040" fiber



**UAC-15**  
Threaded Long Range Glass  
Lens, 2" Focal Point  
Fits any standard threaded  
tip Glass Fiberoptic  
Lg. 1 3/8" (35 mm)



**UAC-5**  
Threaded Spot Focus Plastic  
Lens, 1" Focal Point  
Fits any standard threaded  
tip Glass Fiberoptic  
Lg. 2" (51 mm)



**UAC-5G**  
Threaded Spot Focus Glass  
Lens, 1" Focal Point  
Fits any standard threaded  
tip Fiberoptic  
Lg. 2" (51 mm)



**NFA-50**  
.5" Nylon Fiberoptic Adaptor,  
50 pieces, Insert adapts F1 and F4  
optical blocks to all .040" diam.  
cut-to-length plastic fiberoptic  
light guides.



**NFA12-50**  
.25" Nylon Fiberoptic  
Adaptor, 50 pieces,  
Use to adapt UAC-12  
Lens to .040" diam.  
plastic fibers.



**PFC-1**  
Plastic Fiber Cutter

# Reflectors and Mounting Brackets

**NEW!**

## Standard Reflectivity

### Screw Mount



78P  
4.4" x 1.9"



AR3  
3" diam.

### Glue Mount



AR114  
1 1/4" diam.



AR158  
1 5/8" diam.



AR58  
5/8" diam.



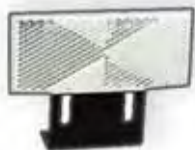
AR78  
7/8" diam.

### Self-Adhesive Mount



98S  
3.2" x 1.45"

## Reflector Mounting Brackets



RB-1  
Mounting kit includes  
98S Reflector and  
RB-2 Bracket



RB-2  
98S Reflector  
Mounting Bracket

## Prismatic High Performance Reflectors NEMA 4, IP67

These reflectors work with all retroreflective sensors, including the RetroSmart® (RSR) series.

### Acrylic



AR4060  
40.5 x 60 mm



AR6151  
AR6151G  
(Chemical Resistant Glass Cover)  
2.4" x 2.0", (61 x 51 mm)



AR82  
82.1 mm diam.



AR46  
46 mm diam.

### Flexible Acrylic, Self-Adhesive Mount



PRD1 Round Reflector  
1" (25 mm) diam.  
PRD2 Round Reflector  
2" (50 mm) diam.



SPR1 Square Reflector  
1 1/16" (27 mm)  
SPR2 Square Reflector  
2" (50.8 mm)

### Acrylic, Self-Adhesive Reflector Tape

Very thin – .03" (.76 mm)



- 2000X Square Reflector Tape 3" (76.2 mm)
- 2001X-1F Reflector Tape 1" x 12" (25.4 mm x 304.8 mm) 12" minimum
- 2001X-50F Reflector Tape 1" x 50' (25.4 mm x 15.2 m) 50' roll
- 2002X-1F Reflector Tape 2" x 12" (50.8 mm x 304.8 mm) 12" minimum
- 2002X-75F Reflector Tape 2" x 75' (50.8 mm x 22.8 m) 75' roll



## Control Modules

## SEPS™ Series

### DC Power Supply Control Modules

- Relay or TRIAC output models accept inputs from remote sensors
- Convert 120 VAC or 240 VAC to 24 VDC power
- One or two SPDT relays or one or two opto-isolated TRIAC models are available



## MULTI-MATE®

### Multi-Function Programmable Control Modules

- Program up to 25 functions
- Single or dual event models
- Dual outputs; TRIAC or NPN transistors
- Provides 24 VDC for remote sensor



## PIC™ Series

### Product Inspection Control Modules

- Provides 24 VDC for remote sensor
- Used for on-line product sorting and inspection systems
- Programmable outputs and timing functions
- Requires interrogate and inspection sensors



# SEPS™ Series Control Modules *DC Power Supply*

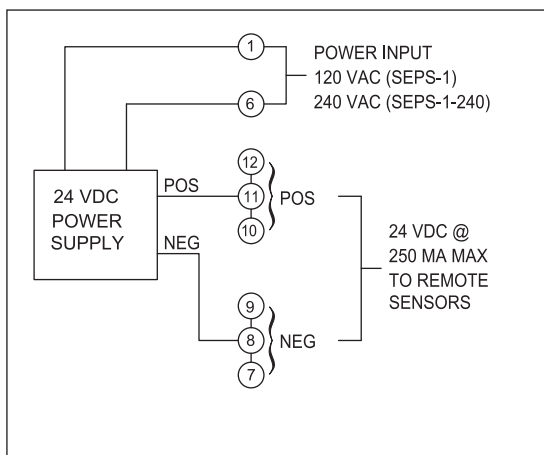
SEPS™ Series plug-in modules offer a convenient means of converting 120 VAC or 240 VAC power into 24 VDC unregulated power for use with TRI-TRONICS DC-powered sensors.

The original SEPS™ module was designed to supply only DC power to the sensors. New SEPS™ modules are available with the capability to convert NPN open collector transistor outputs from the sensor into conventional hard relay contact outputs or into solid state AC TRIAC outputs. *All modules supply 24 VDC to remote sensors.* Models are also available with either one or two relays, or one or two TRIACs.

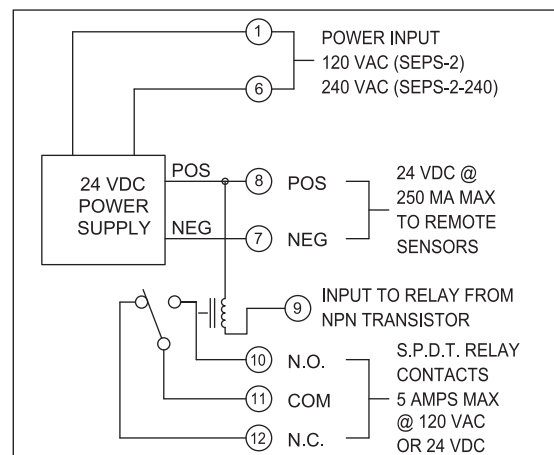
All inputs of the SEPS™ relay devices can be addressed by the outputs of independent sensors. These inputs can also be paralleled to accept the output of a single sensor to drive loads in unrelated circuits.

Feeding the complementary outputs of a remote sensor into the two separate inputs of the SEPS-5 dual output module emulates the action of a single-pole/double-throw solid state relay.

The number of sensors that can be simultaneously powered by a single SEPS power supply control module is dependent upon the total current draw of the sensor/sensors to be used. Example: Up to three SMART-EYE® sensors or up to eight MITY-EYE® sensors can be powered by a single SEPS™ module. Refer to the specifications of the specific sensor or sensors to be used in order to calculate total current requirements.

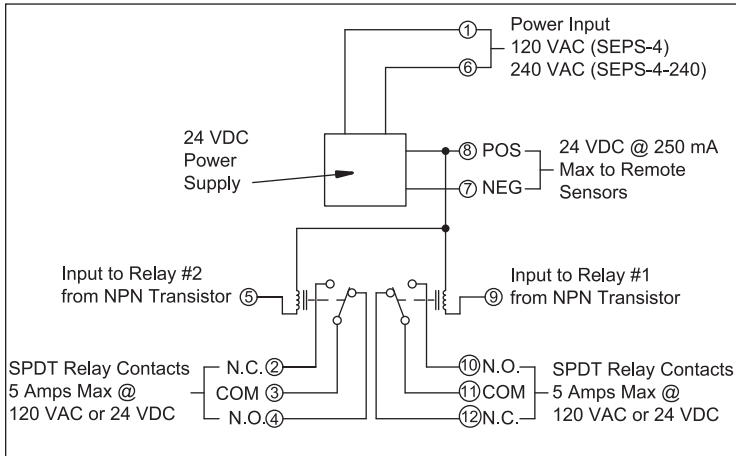


SEPS-1 & SEPS-1-240 Power Supply

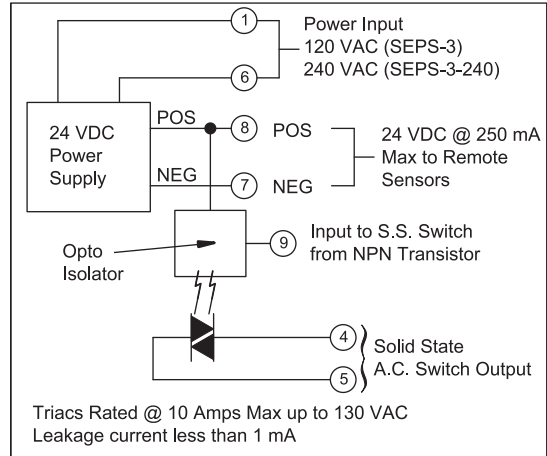


SEPS-2 & SEPS-2-240 Power Supply

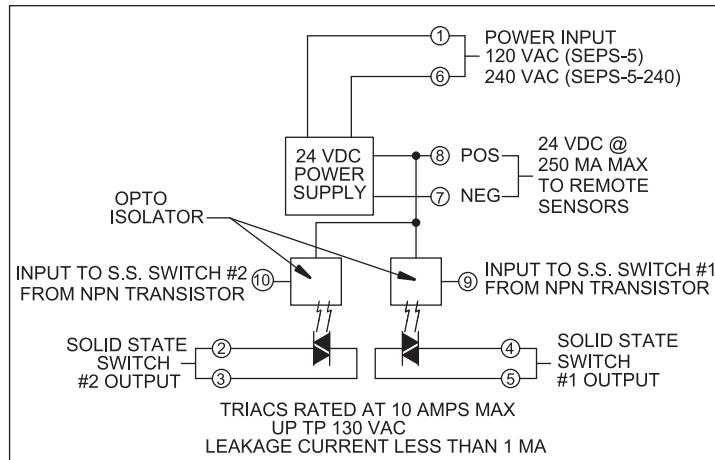
# SEPS™ Series Control Modules



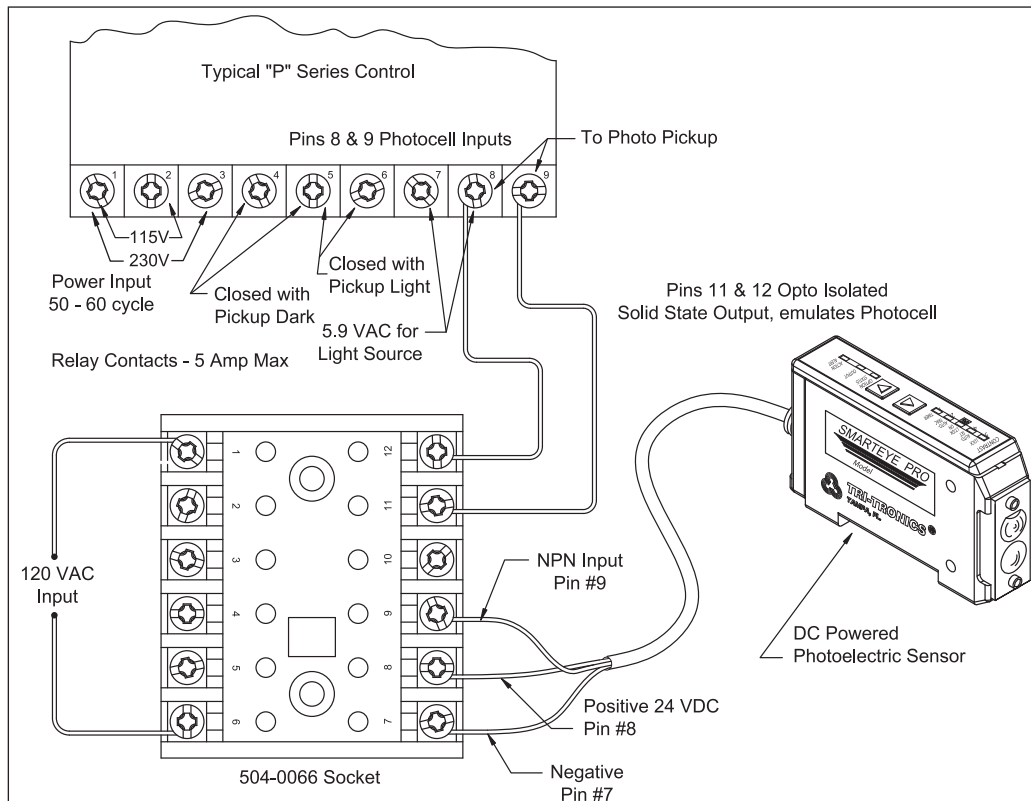
SEPS-3 & SEPS-3-240 Power Supply



SEPS-4 & SEPS-4-240 Power Supply



SEPS-5 & SEPS-5-240 Power Supply



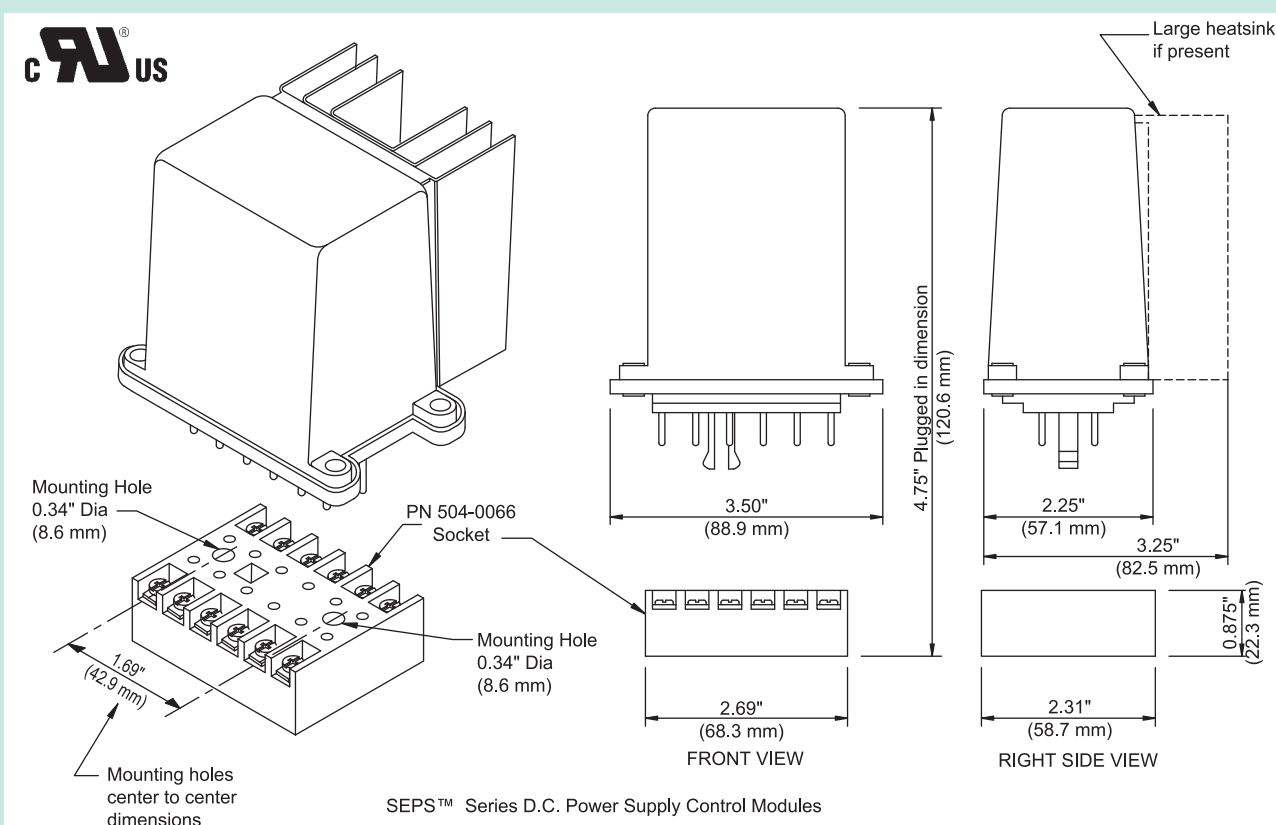
SEPS-6 & SEPS-6-240 Interface Module

# SEPS™ Series Control Modules *D.C. Power Supply*

Model #	Operating Voltage		Description
SEPS-1	120 VAC	50/60 HZ	Power Supply Only
SEPS-1-240	240 VAC	50/60 HZ	
SEPS-2	120 VAC	50/60 HZ	PS with (1) 5 amp AC or DC SPDT Relay
SEPS-2-240	240 VAC	50/60 HZ	
SEPS-3	120 VAC	50/60 HZ	PS with (2) 5 amp AC or DC SPDT Relay
SEPS-3-240	240 VAC	50/60 HZ	
SEPS-4	120 VAC	50/60 HZ	PS with (1) 10 amp Solid State AC Triac
SEPS-4-240	240 VAC	50/60 HZ	
SEPS-5	120 VAC	50/60 HZ	PS with (2) 10 amp Solid State AC Triac
SEPS-5-240	240 VAC	50/60 HZ	
SEPS-6	120 VAC	50/60 HZ	Provides DC Power to replacement sensor and interfaces output to photocell input of older Tri-Tronics Controls, such as P-Type chassis.
SEPS-6-240	240 VAC	50/60 HZ	

NOTE: Power Output Current Draw; 24 VDC / 250 mA - Consider total number of sensors being used and amount of current being drawn. Specify Socket Separately Model No. 504-0066

## Dimensions



## Features

- The simplicity of a plug-in module with the versatility of programming up to 25 functions.
- Available in both Single Event (Model PM-8100/8125) and Dual Event (Model PM-8200/8225) versions, both providing dual outputs.
- Gives you the unique capability of programming for one function now, then changing the program as your needs change.



MULTI-MATE  
Dual Function  
Models

MULTI-MATE  
Dual Function Models  
with high current  
output and  
heat sink

MULTI-MATE  
Single Function  
Models

MULTI-MATE® Control Modules provide users with the flexibility to program up to 25 functions. These unique controls are the perfect match for use with TRI-TRONICS DC-powered sensors. They combine the simplicity of plug-in controls with the versatility of programming a wide variety of functions.

MULTI-MATE® Control Modules are available in either single or dual function models. All models provide a heavy-duty AC solid state output switch (TRIAC) as well as an output from a NPN open collector transistor. The controls also provide 24 VDC power for the remote sensor. The input to the control can be from an

open collector transistor or a switch.

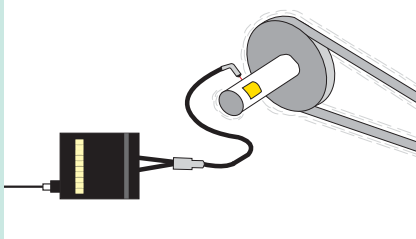
Event functions, timing ranges, and operating sequence are easily programmed using 8-position mini-dip switches, which are conveniently accessible through ports located on the front of the control. Switches 1 thru 5 program the function and 6 thru 8 set the timing range.

Many of the programmable timing/control functions are useful in monitoring product flow, i.e. "ON" delay, "OFF" delay, retriggerable one-shot/motion, etc. Additional programmable functions are useful to control and manipulate products through the manufacturing process, such as "LATCH," one shot, etc.

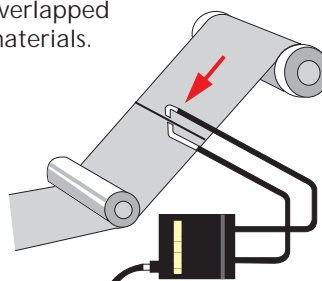
Some examples of applications where the timing and control functions provided by the MULTI-MATE® are extremely useful are:

- Jam detection
- Product void detection
- Motion detection
- Registration control
- Door control
- Over travel/limit/stop control
- Edge guide control
- Splice detection
- Product ejection monitor
- Batch counting
- Hopper level control
- Loop level control

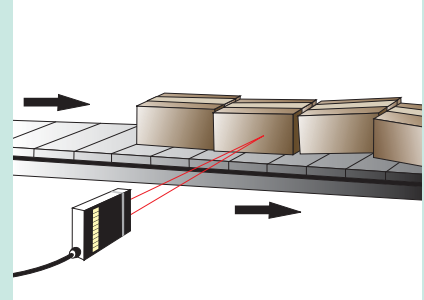
1. Detection of reflective tape moving at high rapidity.



2. Detection of splices or overlapped materials.



3. Jam detection



Single and Dual Event controls offer:

## *Dual Outputs:*

1. TRIAC (AC switch) — selection of medium-duty rated at 1/6 HP or heavy-duty rated up to 1/4 HP.
2. NPN grounded emitter open collector output transistor rated to 100 mA maximum.

NOTE:

24 VDC power supply provides power to all DC sensors.

## *A variety of programmable functions:*

Single Event Model PM-8100/8125:

- Motion (Retriggerable One-Shot)
- On-Delay
- Off-Delay
- One-Shot
- Latch

Dual Event Model PM-8200/8225:

25 programmable functions. These are the most common:

- On-Delay then Off-Delay
- One-Delay then One-Shot
- On-Delay then Latch
- Off-Delay then One-Shot
- Off-Delay then Latch
- One-Shot Input and One-Shot
- One-Shot (Delay) then One-Shot
- One-Shot (Delay) then Latch
- Motion then One-Shot
- Motion then Latch
- Latching Input then On-Delay
- Latching Input then One-Shot



## *Programming Simplicity*

Event functions are programmed by an 8-position mini-dip switch, easily accessible through a port at the front of the control. Switches 1-5 program the function; switches 6-8 set the maximum time limits as follows:

Switch #1 - Motion (Retriggerable One-Shot)

Switch #2 - Delay

Switch #3 - Latch

Switch #4 - Light/Dark

Switch #5 - Output Invert (N/A on first function of Dual Event Model PM-8200)

Switch #6\* - 1 second (Max. timing switch)

Switch #7\* - 5 seconds (Max. timing switch)

Switch #8\* - 15 seconds (Max. timing switch)

\*With Switches #6, #7 and #8 "OFF," maximum time would be 1/2 second if the adjustments on top of the controls are turned to maximum. If Switches, #6, #7 and #8 are in the "ON" position, the maximum time would be 21 seconds. Timers are additive.

NOTE: Time adjustments are not applicable in "Latching" functions.

## Programming



In the programming instructions below, it is assumed that:

1. Input from the sensor is normally "OFF" and the function is to occur on the leading edge of the input event. If this is not the case, simply reverse the position of Switch #4 (Light/Dark).
2. Output (TRIAC) is normally "OFF". If this is not the case, simply reverse the position of Switch #5 (Output Invert).

### Single Event (Model PM-8100 and PM-8125)

SEQUENCE*	PLACE LISTED SWITCHES TO >ON (ALL OTHERS OFF <)	CONTROL SEQUENCE*
"On" Delay	2,4	1
"Off" Delay	2,5	2
One-Shot	5	3
Motion Retriggerable One-Shot	1,5	4
Latch, Edge-Triggered	3,5	5

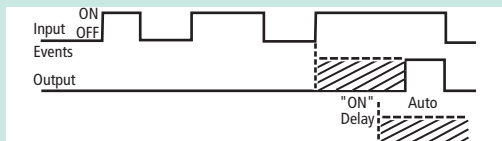


### Dual Event (Model PM-8200 and PM-8225)

	PLACE LISTED SWITCHES TO >ON (ALL OTHERS OFF <)	INPUT EVENT	OUTPUT EVENT	CONTROL SEQUENCE*
"On" Delay then "Off" Delay	2,4	2,4	2,5	6
"On" Delay then One-Shot	2,4	2,4	5	7
"On" Delay then Latch	2,4	2,4	3,5	8
"Off" Delay then One-Shot	2	2	5	9
"Off" Delay then Latch	2	2	3,5	10
One-Shot Triggers One-Shot	All "OFF"	All "OFF"	4,5	11
One-Shot (Delay) then One-Shot	All "OFF"	All "OFF"	5	12
One-Shot (Delay) then Latch	All "OFF"	All "OFF"	3,5	13
Motion then One-Shot	1	1	5	14
Motion then Latch	1	1	3,5	15
Latch then "On" Delay	3	3	2	16
Latch then One-Shot	3	3	4,5	17

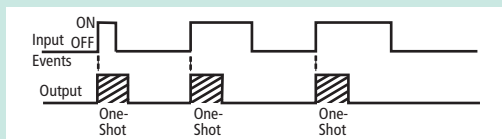
## Functional Control and Timing Sequence Data

1



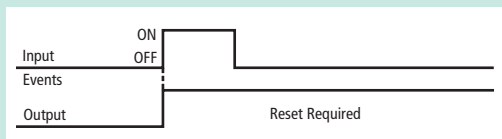
"ON" Delay

3



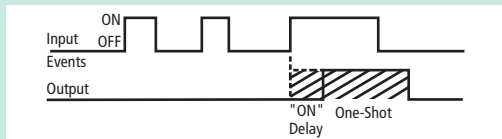
One-Shot

5



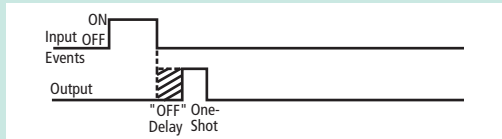
Latching, Edge Triggered

7



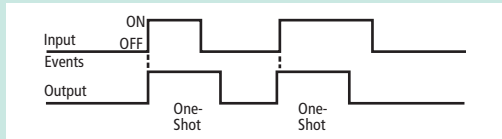
"ON" Delay, then One-Shot

9



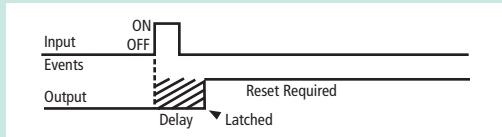
"OFF" Delay then One-Shot

11



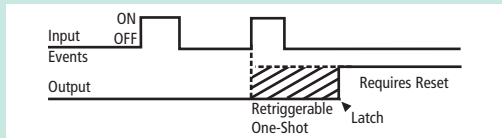
One-Shot Triggers One-Shot

13



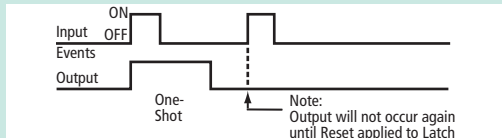
One-Shot Delay, then Latch

15



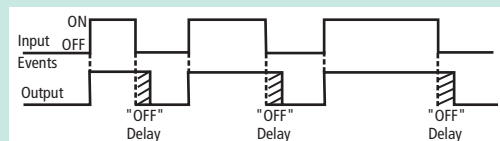
Stop Motion, then Latch

17



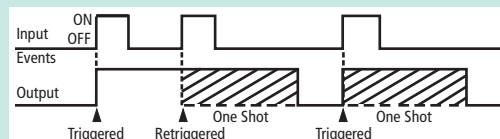
Latch, then One-Shot

2



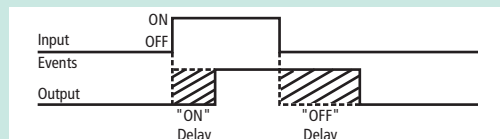
"OFF" Delay Pulse Stretcher

4



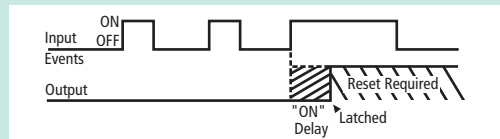
Motion Detection, Retriggerable One-Shot

6



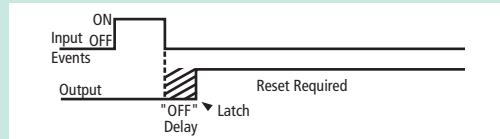
"ON" Delay then "OFF" Delay

8



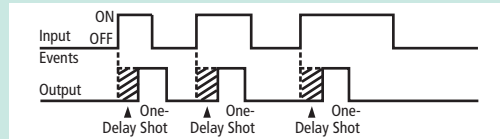
"ON" Delay then Latch

10



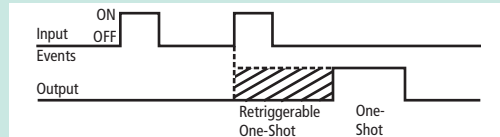
"OFF" Delay then Latch

12



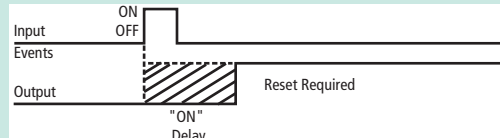
One-Shot Delay, then One-Shot

14



Stop Motion, then One-Shot

16



Latch then "ON" Delay

## Electrical Specifications

Input Power Requirements: Choice of 120 or 240 VAC  $\pm$  10%; 50-60 Hz models.

DC Power Output: 24 VDC Nominal @ 150 mA . (Unregulated) (Supplies power to DC sensor)

Output Relay: Models PM-8100/PM-8200 – Solid state AC relay. Triac rated at up to 1/6 HP motor load or 3.2 amp inductive load at 115 VAC.

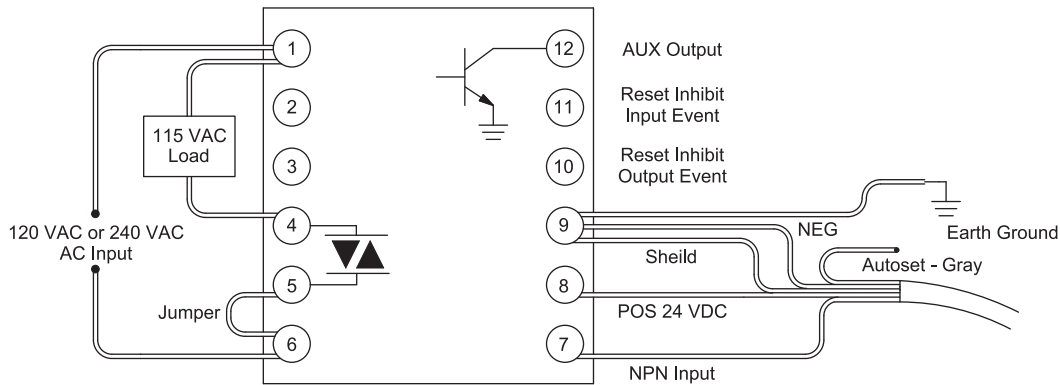
Models PM-8125/PM-8225 – Equipped with larger heat sink Triac rated up to 1/4 HP motor load or 5.4 amp inductive load at 115 VAC.

Output Transistor (Pin 12): NPN grounded emitter open collector output transistor rated at 100 mA maximum. Maximum voltage = 40 VDC.

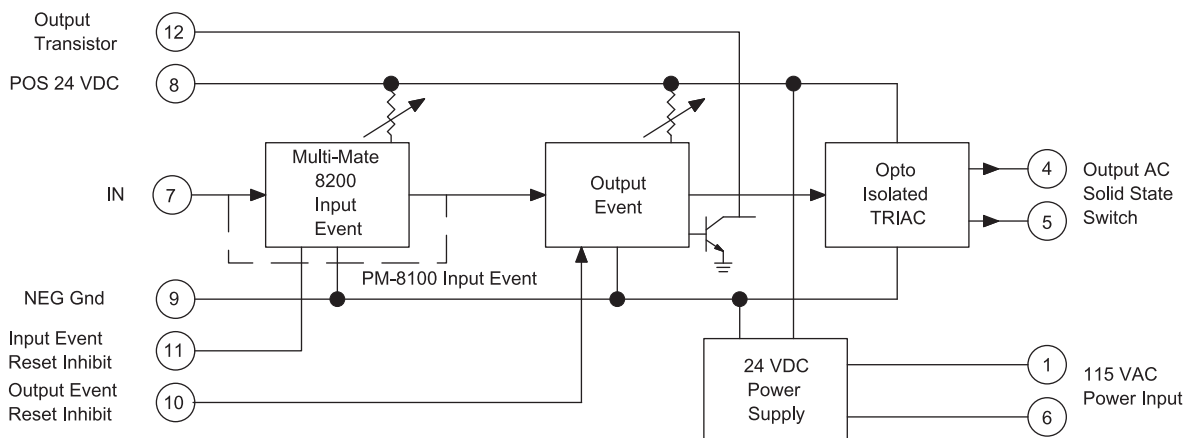
Input (Pin 7): Opto-isolated for high noise immunity. Accepts input from NPN open collector transistor or switch to ground. Responds to input durations as short as 100 microseconds.




Reset/Inhibit (Pin 10 or 11): Accepts input from NPN open collector transistor or switch to ground (Pin 9). Activated when Pin 9 is shorted to Pin 10 or 11.

## Typical Wiring Diagram



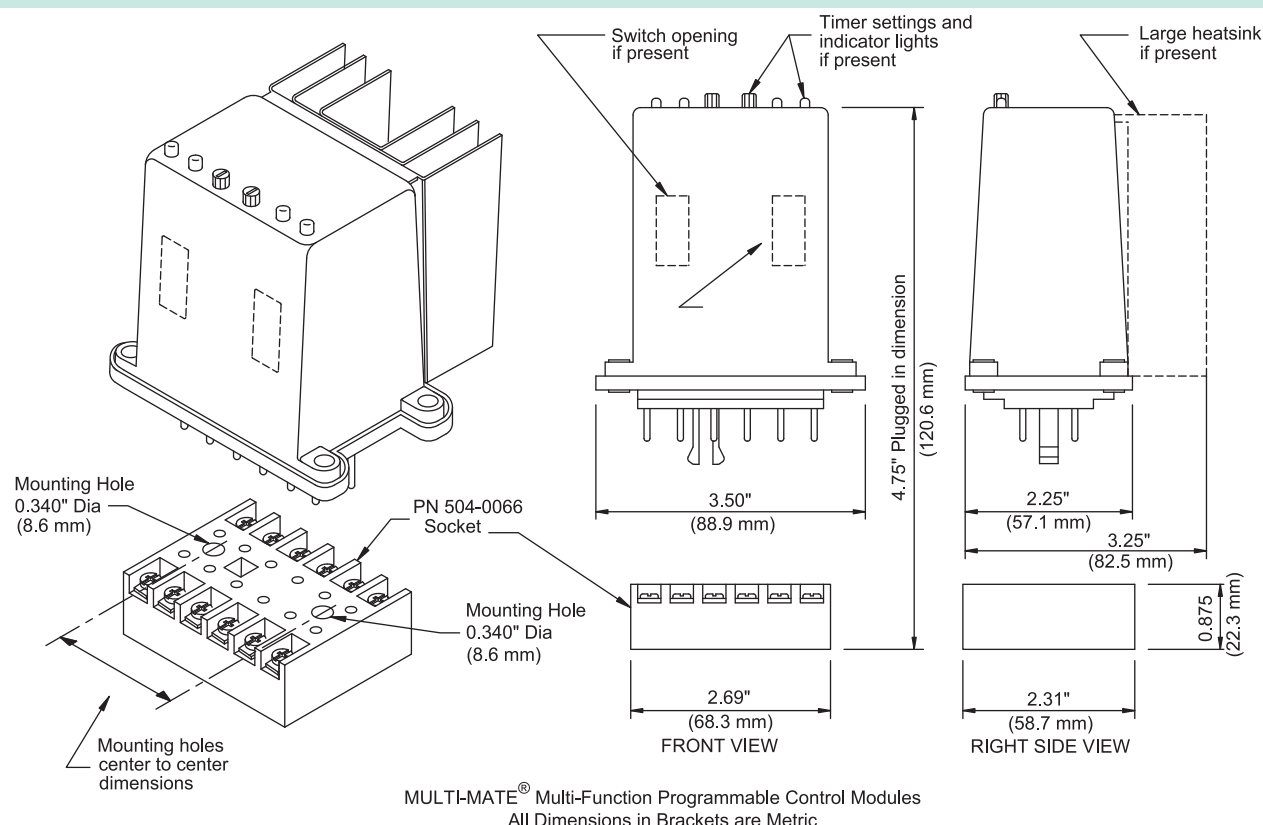
## Functional Block Diagram



Model	Power Output Current Draw	Operating Voltage	Description
PM-8100 	24V DC 150 mA	120V AC 50/60HZ	Single Function Programmable with Solid State AC Switch, 1/6 HP rated
PM-8100-240 	24V DC 150 mA	240V AC 50/60HZ	Single Function Programmable with Solid State AC Switch, 1/6 HP rated
PM-8125	24V DC 150mA	120VAC 50/60HZ	Single Function Programmable with Solid State AC Switch, 1/4 HP rated
PM-8125-240	24V DC 150 mA	240V AC 50/60HZ	Single Function Programmable with Solid State AC Switch, 1/4 HP rated
PM-8200 	24V DC 150 mA	120V AC 50/60HZ	Dual Function Programmable with Solid State AC Switch, 1/6 HP rated
PM-8200-240	24V DC 150 mA	240V AC 50/60HZ	Dual Function Programmable with Solid State AC Switch, 1/6 HP rated
PM-8225	24V DC 150 mA	120V AC 50/60HZ	Dual Function Programmable with Solid State AC Switch, 1/4 HP rated
PM-8225-240	24V DC 150 mA	240V AC 50/60HZ	Dual Function Programmable with Solid State AC Switch, 1/4 HP rated
504-0066			Plug-In Socket Sold Separately

NOTE: 1/6 HP Rating = 3.2 amp inductive load at 115 VAC, 1/4 HP Rating = 5.4 amp inductive load at 115 VAC

## Dimensions



## Description

The PIC™ Series Programmable Controls were designed to meet the demand for an easy-to-install and easy-to-use control for product sortation and inspection systems.

PIC™ Controls are used with a minimum of two DC-powered sensors. Any “product sensor” is used to detect the arrival of the product, and the “inspection sensor” (a SMART-EYE® or EZ-PRO®) is used to identify or inspect the product for the critical identifying features; e.g., variations in color, pattern, position, orientation, size, opacity, or surface reflectivity.

PIC™ controls supply 24 VDC power to both the product and inspection sensors. The control accepts inputs from NPN open collector transistor outputs of the remote sensors. Each input is opto-isolated to prevent problems with electrical noise and interference. The status of each input can be easily monitored via LED indicators located on the top of the control.

## Programming

PIC™ Controls can be programmed to provide one of two outputs—either an adjustable one-shot (momentary) output or a latching output – whenever it responds to the recognition of the identifying feature. An optional program allows for an output response whenever the identifying feature has not been identified or detected.

An adjustable delay can be programmed to provide time for the product to move out of view of the sensors to a position where an electro-mechanical device can be located to eject the product from the conveyor line.

The optional latching output can be used to shut the machine off until a manual reset command from a remote switch is applied to the reset input of the control.

The output of the PIC™ Control is from a heavy-duty solid state TRIAC Switch that is capable of directly driving AC loads.

An additional open collector NPN transistor output provides the capability to drive logic controls such as counters or PLCs. This output is ideal when the application requires counting either “bad” or “good” products.

## Operational Examples

The “product sensor” detects the arrival of the object or product to be inspected for the purpose of telling the control when to perform the inspection task. This sensor (also referred to as the “leading edge” sensor) generates an instantaneous “interrogate” or “look now” signal. It can be easily converted to a “trailing edge” sensor by simply switching to the sensor’s complementary output, making it the interrogate input; e.g., switch from white to green wire or vice versa.



The “inspection sensor” performs the actual inspection task, such as detecting the presence or absence of a top or lid of a container, the correct color of a lid, the presence or absence of a label, foil liner or handle, etc. The list of inspection tasks this system will perform is virtually endless.

Utilizing a TRI-TRONICS high-performance sensor with the PIC™ Control makes this a unique system that is capable of responding to color, opacity, reflectivity, pattern, position, size or orientation.

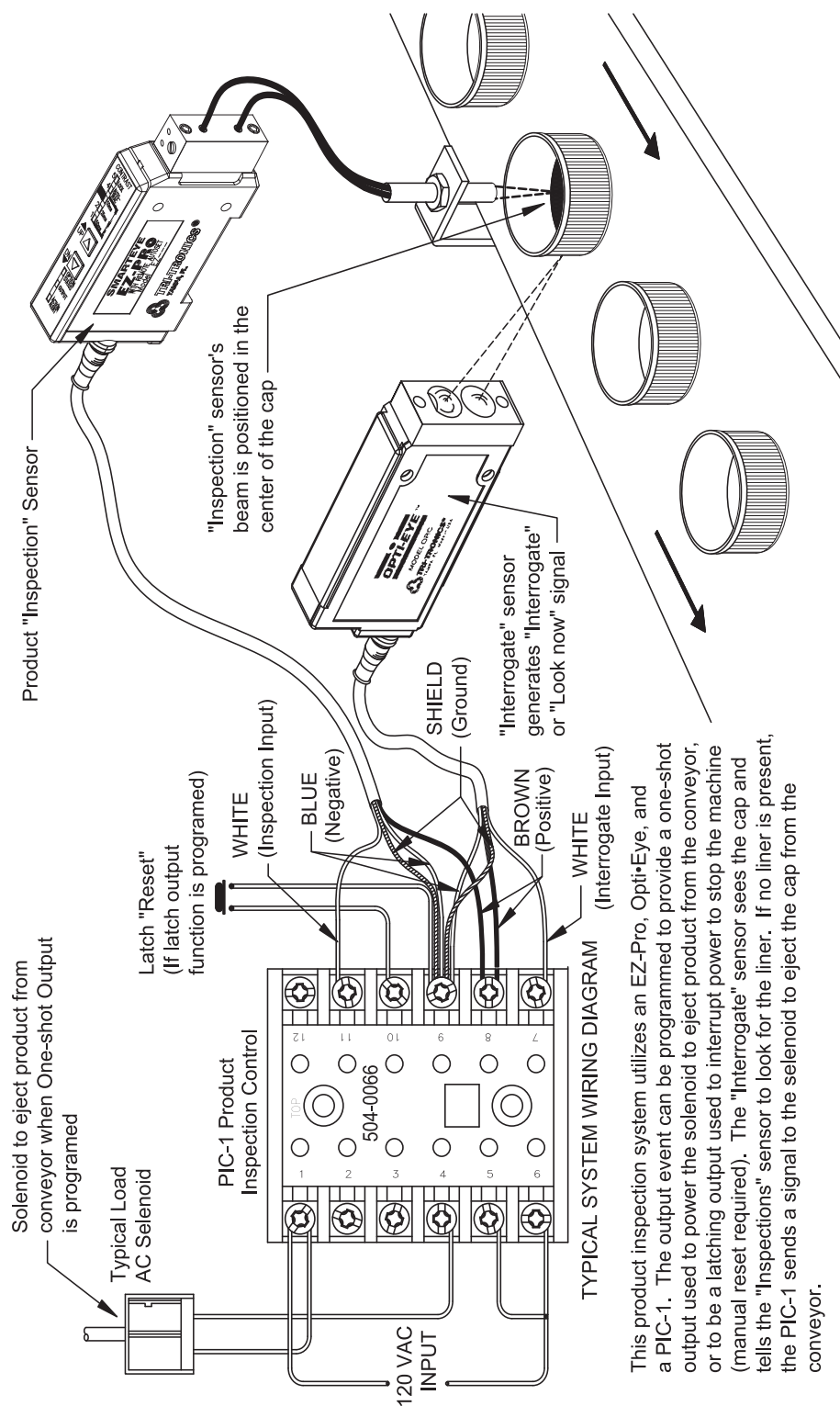
In some applications, more than one “inspection sensor” can be used in the control system by combining multiple outputs into one common input for “and/or” gating functions. Examples of where this capability is useful are in the detection of labels on both sides of a bottle or for inspection of a complex pattern.

For inspecting the bottle labels, one PIC™ Control is used with one “product sensor” and two “inspection sensors”.

For pattern recognition, one, two, or more SMART-EYE® sensors are used to view light/dark areas on complex patterns for specific identification purposes.

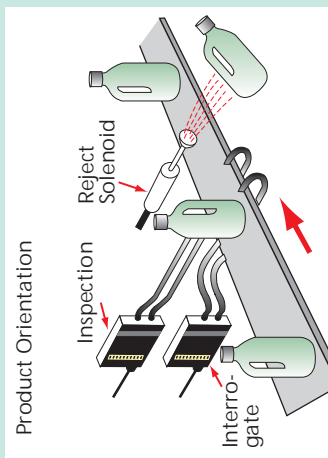
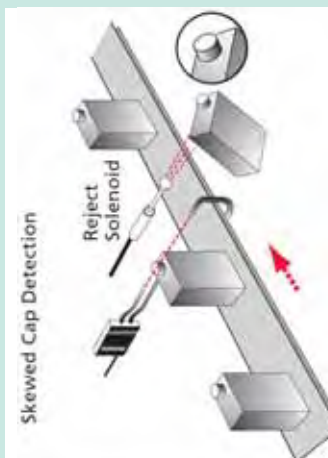
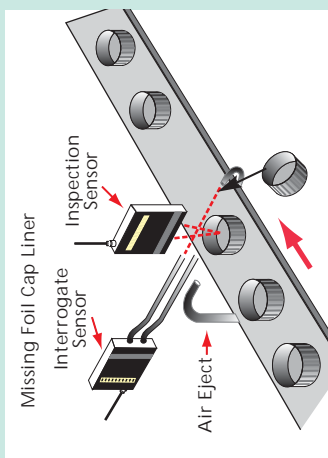
Contact your local Representative or the Factory for applications assistance.

# PIC-1™ PRODUCT INSPECTION CONTROL MISSING LINER DETECTOR, COLOR INSPECTION, CAP INSPECTION

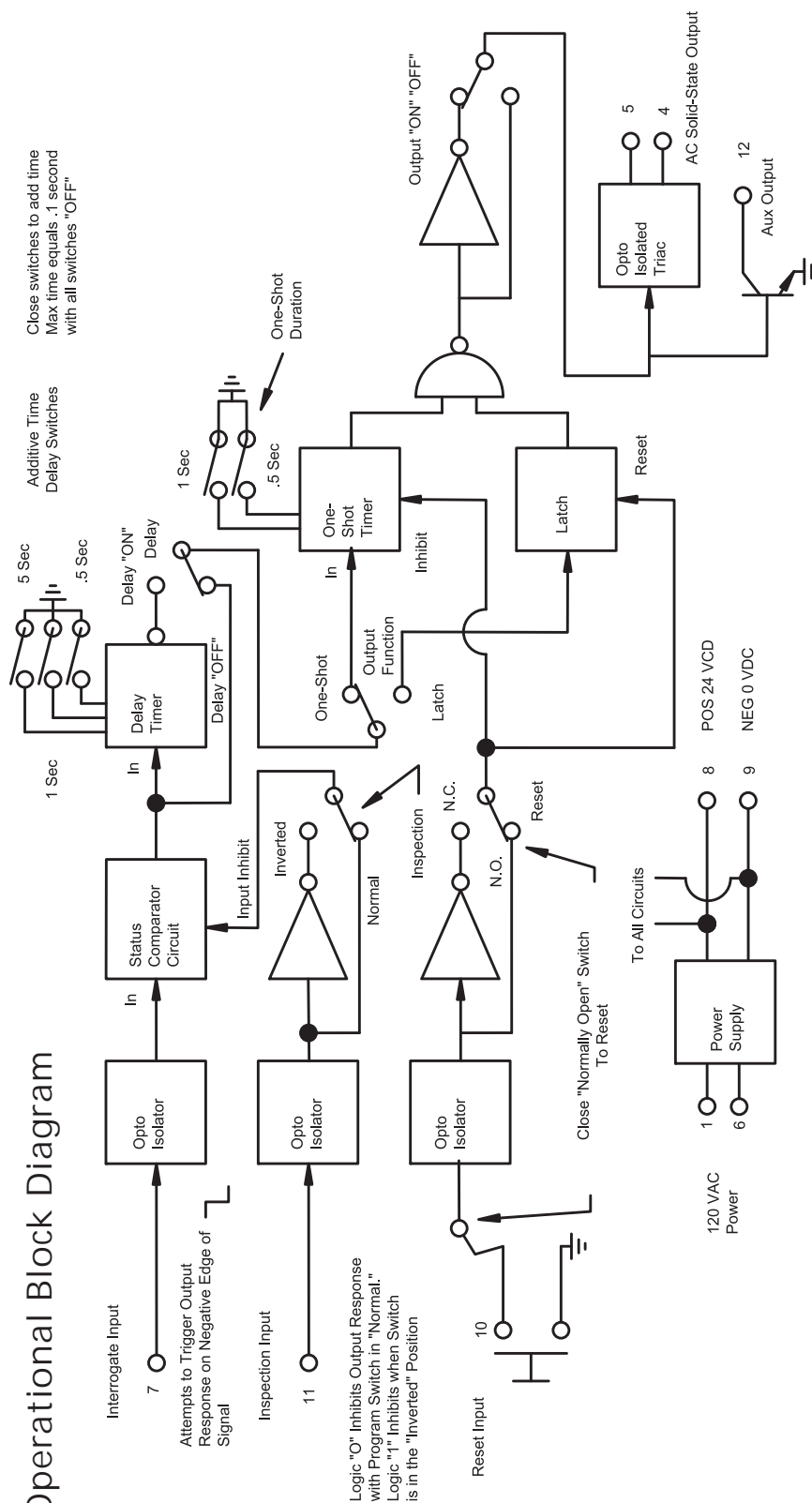


This product inspection system utilizes an EZ-Pro, Opti•Eye, and a PIC-1. The output event can be programmed to provide a one-shot output used to power the solenoid to eject product from the conveyor, or to be a latching output used to interrupt power to stop the machine (manual reset required). The "Interrogate" sensor sees the cap and tells the "Inspections" sensor to look for the liner. If no liner is present, the PIC-1 sends a signal to the solenoid to eject the cap from the conveyor.

## Typical Applications



## Operational Block Diagram



# PIC™ Series Control Modules *Product Inspection Control*

## Input Power requirements (Pins 1 and 6)

Model PIC-1: 120 VAC  
± 10%; 50-60 Hz  
Model PIC-1-240: 240  
VAC ± 10%; 50-60 Hz

## D.C. Power Output

(POS Pin 8, NEG Pin 9) -  
All Models  
24 VDC nominal @ 150  
mA (unregulated)

## Output Relay (pins 4 and 5)

Solid state AC relay  
drives up to 1/6 HP load  
or 3.2 amp inductive  
load at 115 VAC MOV  
protection provided.

## Output Transistor (Pin 12) - All Models

NPN grounded emitter  
open collector output  
transistor rated at  
100 mA maximum.

Maximum voltage =  
40 VDC. Zener protected  
from voltage spikes.

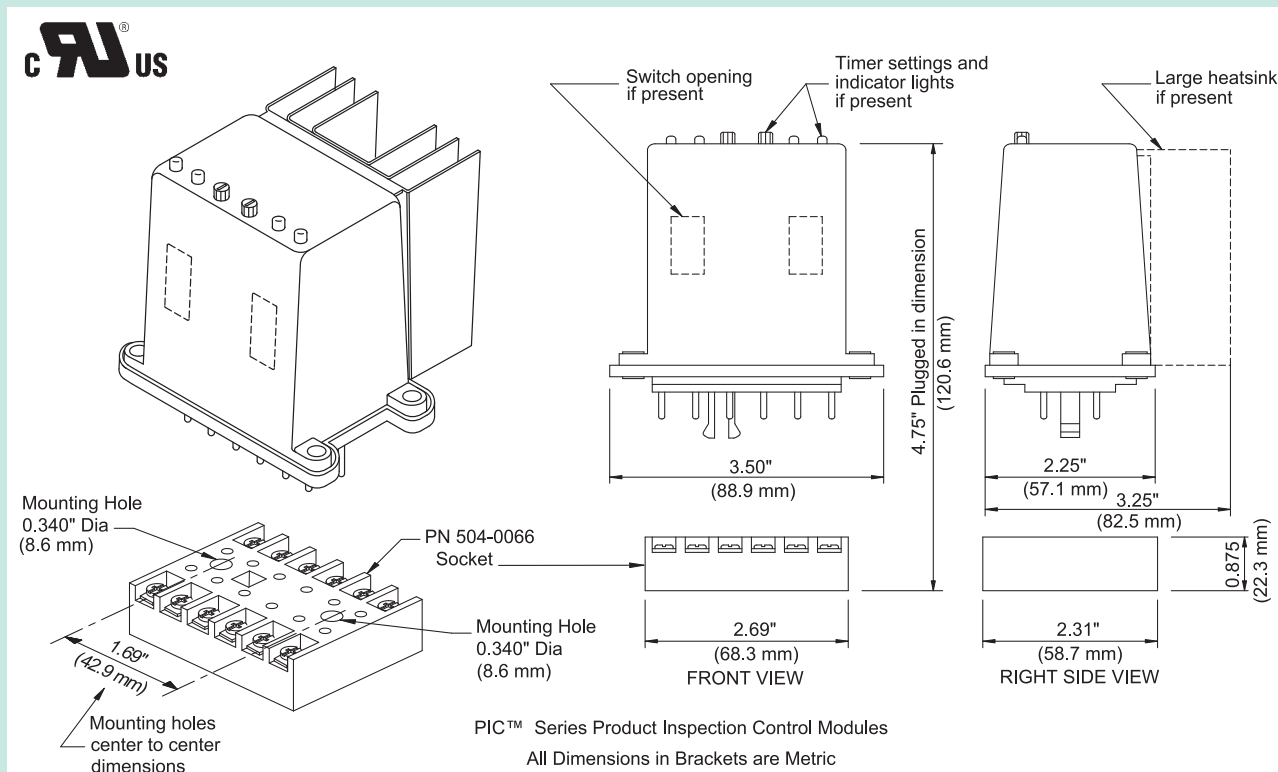
## Inputs

(Pins 7,10 and 11) -All  
Models All inputs are  
opto-isolated for high  
immunity to noise. All  
accept inputs from NPN  
transistors or switch to  
negative. Inputs respond  
to input durations as

short as 100 microsec-  
onds. Interrogate Input:  
Pin 7. Inspection Input:  
Pin 11. Reset Input (for  
latched output): Pin10.

Model	Power Output Current Draw	Operating Voltage	Description
PIC-1	24V DC 150 mA	120V AC 50/60HZ	Solid State AC Relay, 10 Amp Triac
PIC-1-240	24V DC	240V AC 50/60HZ	Solid State AC Relay, 10 Amp Triac
504-0066			Plug-In socket sold separately

## Dimensions





## Accessories

- Cables
- Reflectors
- Lenses
- Optical Blocks
- Sensor Mounting Brackets

# Cable Connection

## 4-Wire Shielded Micro Cables, M12

Black shielded cable assemblies that are lightweight and flexible



BSEC-6  
6' (1.8 m) cable with connector



BSEC-15  
15' (4.6 m) cable with connector

BSEC-25  
25' (7.6 m) cable with connector

BRSEC-6  
6' (1.8 m) cable / right angle conn.

BRSEC-15  
15' (4.6 m) cable / right angle conn.

BRSEC-25  
25' (7.6 m) cable / right angle conn.

## 4-Wire Yellow Shielded Cables, M12



SEC-6  
6' (1.8 m) cable with connector

SEC-15  
15' (4.6 m) cable with connector

SEC-25  
25' (7.6 m) cable with connector



RSEC-6  
6' (1.8 m) cable / right angle conn.

RSEC-15  
15' (4.6 m) cable / right angle conn.

RSEC-25  
25' (7.6 m) cable / right angle conn.

## 4-Wire Extension Cable, M12



BX-10  
10' (3.1 m) Extension cable

BX-25  
25' (7.6 m) Extension cable

## 4-Wire, Unshielded, M12



SEC-2MU  
6.5' (2.0 m) Low-cost

SEC-5MU  
16.4' (5.0 m) Low-cost

# Cable Connection

## 4-Wire Nano Cable, M8



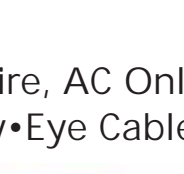
GEC-6  
6' (1.8 m) cable with connector



GEC-15  
15' (4.6 m) cable with connector



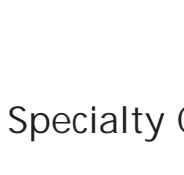
GEC-25  
25' (7.6 m) cable with connector



RGEC-6  
6' (1.8 m) cable / right angle conn.



RGEC-15  
15' (4.6 m) cable / right angle conn.



GEX-9  
9' (2.7 m) extension cable

## 4-Wire, AC Only Mity•Eye Cable



CAC15  
AC Mity•Eye  
15' (4.6 m) cable,  
AC only

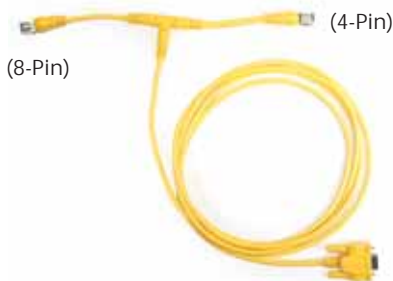
## Field Replacable 4-wire Connectors (waterproof)



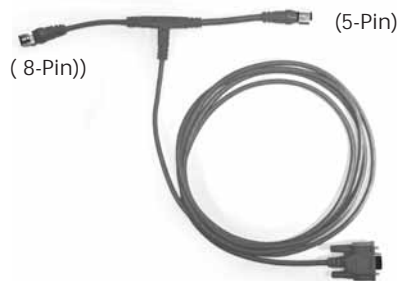
M12-4F  
4-Wire, Female/Receptacle

M12-4M  
4-Wire, Male/Plug

## DCS Specialty Cables



TJC-2  
"T" Junction Splitter Cable,  
4-Pin Output



TJC-3  
"T" Junction Splitter Cable,  
5-Pin Output



DCS8-2M  
8-wire (2 m), M12  
Non-metallic shell

# Cable Connection

## 5-Wire Shielded Micro Cables, M12



GSEC-6  
6' (1.8 m) cable with connector

GSEC-15  
15' (4.6 m) cable with connector

GSEC-25  
25' (7.6 m) cable with connector



GRSEC-6  
6' (1.8 m) cable / right angle conn.

GRSEC-15  
15' (4.6 m) cable / right angle conn.

GRSEC-25  
25' (7.6 m) cable / right angle conn.



GPSEC-15  
15' (4.6 m) Non-metallic shell

### Field Replacable 5-wire Connectors (waterproof)



M12-5F  
5-Wire, Female/Receptacle

M12-5M  
5-Wire, Male/Plug

## 5-Wire Unshielded Cable, M12, low cost



GSEC-2MU  
6.5' (2.0 m) Low-cost

GSEC-5MU  
16.4' (5.0 m) Low-cost

## 5-Wire Extension Cable, M12



GX-25  
25' (7.6 m) Extension cable

# Reflectors and Mounting Brackets

NEW!

## Standard Reflectivity

### Screw Mount



78P  
4.4" x 1.9"



AR3  
3" diam.

### Glue Mount



AR114  
1 1/4" diam.



AR158  
1 5/8" diam.



AR58  
5/8" diam.



AR78  
7/8" diam.

### Self-Adhesive Mount



98S  
3.2" x 1.45"

## Reflector Mounting Brackets



RB-1  
Mounting kit includes  
98S Reflector and  
RB-2 Bracket



RB-2  
98S Reflector  
Mounting Bracket

## Prismatic High Performance Reflectors NEMA 4, IP67

These reflectors work with all retroreflective sensors, including the RetroSmart® (RSR) series.

### Acrylic



AR4060  
40.5 x 60 mm



AR6151  
AR6151G  
(Chemical Resistant Glass Cover)  
2.4" x 2.0", (61 x 51 mm)



AR82  
82.1 mm diam.



AR46  
46 mm diam.

### Flexible Acrylic, Self-Adhesive Mount



PRD1 Round Reflector  
1" (25 mm) diam.



SPR1 Square Reflector  
1 1/16" (27 mm)

PRD2 Round Reflector  
2" (50 mm) diam.

SPR2 Square Reflector  
2" (50.8 mm)

## Acrylic, Self-Adhesive Reflector Tape

Very thin – .03" (.76 mm)



- 2000X Square Reflector Tape 3" (76.2 mm)
- 2001X-1F Reflector Tape 1" x 12" (25.4 mm x 304.8 mm) 12" minimum
- 2001X-50F Reflector Tape 1" x 50' (25.4 mm x 15.2 m) 50' roll
- 2002X-1F Reflector Tape 2" x 12" (50.8 mm x 304.8 mm) 12" minimum
- 2002X-75F Reflector Tape 2" x 75' (50.8 mm x 22.8 m) 75' roll

# Fiberoptic Accessories Lenses and Mounting Brackets



**FMB-1**  
(8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket  
Use with Threaded Glass  
Fiberoptic



**FMB-2** (5.1 mm diam.)  
**FMB-3** (3.1 mm diam.)  
Miniature Glass or Plastic  
Fiberoptic Mounting  
Brackets



**FPA-1**  
Slip-on Polarizing Adaptor  
Lens (2 Required)  
Slips over end of  
Model F-A-36 Straight  
Light Guides only



**FPA-2**  
Friction Mount Polarizing  
Adaptor Lens (2 Required)  
Friction mounts onto  
F-A-36P Straight Light  
Guides only



**GLA-1**  
1/4" X 1"  
Slip-on Lens Assembly  
Slips on Model  
EH-4001 plastic fibers



**GLA-2**  
Long Range Lens  
for Through-Beam  
Use with M4 Tips



**HLA-1**  
3/8" X 1" Threaded  
Slip-on Lens Assembly  
Slips on Model EH-4001  
plastic fibers



**HLA-2**  
Spot Focus Lens for  
Diffused Beam  
Use with M6 Tips  
Focal Point .50" (12.7 mm)



**UAC-12**  
Slip-on Long Range Plastic  
Lens, Use on .187" O.D.  
straight or right angle  
fiber tip or .040" fiber



**UAC-15**  
Threaded Long Range Glass  
Lens, 2" Focal Point  
Fits any standard threaded  
tip Glass Fiberoptic  
Lg. 1 3/8" (35 mm)



**UAC-5**  
Threaded Spot Focus Plastic  
Lens, 1" Focal Point  
Fits any standard threaded  
tip Glass Fiberoptic  
Lg. 2" (51 mm)



**UAC-5G**  
Threaded Spot Focus Glass  
Lens, 1" Focal Point  
Fits any standard threaded  
tip Fiberoptic  
Lg. 2" (51 mm)



**NFA-50**  
.5" Nylon Fiberoptic Adaptor,  
50 pieces, Insert adapts F1 and F4  
optical blocks to all .040" diam.  
cut-to-length plastic fiberoptic  
light guides.



**NFA12-50**  
.25" Nylon Fiberoptic  
Adaptor, 50 pieces,  
Use to adapt UAC-12  
Lens to .040" diam.  
plastic fibers.



**PFC-1**  
Plastic Fiber Cutter



# Optical Blocks Accessories

## Optical Blocks — SMARTEYE® Series for Standard Sensors



Model No.	Description	Model No.	For Standard Sensors
F1	Fiberoptic Adaptor Block	GP1	Gap Probe, provides a 1.5" probe
O1	Medium Range Proximity Block, Plastic	GP2	Gap Probe, provides a 2.5" probe
O1G	Medium Range Proximity Block, Glass	GP3	Gap Probe, provides a 3.5" probe
O2	Short Range Proximity Block		
R1	Retroreflective Block		
V1	"V" Axis Block, Plastic Lens		
V1G	"V" Axis Block, Glass Lens		

## Optical Blocks for Miniature Sensors



Model No.	Description	Model No.	For Miniature Sensors
F4	Fiberoptic Optical Block	GP6	Gap Probe, provides a 1.5" probe
F5	Plastic Fiberoptics	GP7	Gap Probe, provides a 2.5" probe
F6	Plastic Fiberoptics	GP8	Gap Probe, provides a 3.5" probe
O4	Proximity, Wide Beam Optical Block		
O5	Proximity, Long Range Optical Block		
R4	Retroreflective Optical Block		
R5	Polarized Retroreflective Optical Block		
V4	"V" Axis Optical Block, 1 in. Range		
V4A	Apertured Optical Block, 1 in. Range		
V6	"V" Axis Optical Block, 1.5 in. Range		
V8	"V" Axis Optical Block, .5 in. Range		

LK-4  
Lens Kit (one each F4, F5, F6, O4, O5, R4, R5, V4, V4A, V6, V8)



# Sensor Accessories

## Sensor Mounting Brackets (Assembly Includes Mounting Screws)

NOTE: All black mounting brackets are aluminum.



DCB-1  
HSL-12 Mounting  
Stainless Bracket  
Assembly



DRB-1  
Smarteye Mark III  
Din Rail Bracket



MB-18  
18 mm Bracket,  
for use with TA-18



NUT-18  
18 mm Mounting Nut  
for use with MINI-EYE™



SEB-1  
Smarteye® Mark II  
Smarteye® Classic  
Smarteye® Colormark II  
Stainless Mounting  
Bracket Assembly



SEB-3  
Opti-Eye, Mark III,  
Smarteye Pro,  
Stainless Bracket  
Assembly



SEB-4  
Stealth  
Stainless Mounting  
Bracket Assembly



MEB-1  
Mity-Eye  
Mounting Bracket  
Assembly



TEB-1  
Tiny-Eye  
Vertical Mount,  
Mounting Bracket  
Assembly



TEB-2  
Tiny-Eye  
Horizontal Mount,  
Mounting Bracket  
Assembly



UMB-1  
U.S. Eye  
Mounting Bracket  
Assembly



USB-1  
U.S. Eye  
Adjustable  
Sub-Bracket Assembly



FMB-1 (8.4 mm diam.)  
Standard Fiberoptic  
Mounting Bracket



FMB-2 (5.1 mm diam.)  
FMB-3 (3.1 mm diam.)  
Miniature Glass or  
Plastic Fiberoptic  
Mounting Brackets



MIB-1  
Mini-Eye  
Stainless Bracket  
Assembly



MIB-2  
Stainless Bracket  
Assembly



## Data Reference Tables

# NEMA RATINGS

## 2.1 GENERAL

The features of each enclosure Type are applicable only when the enclosure is completely and properly installed.

All mechanical and electrical parts mounted on or through an enclosure shall pass the applicable tests for the enclosure Type unless otherwise specified.

## 2.2 SPECIFIC TYPES

Table 2.1 and table 2.2 are guides for comparing specific applications of enclosures.

The specific enclosure Types, their applications, and the environmental conditions they are designed to protect against are as follows:

Type 1	Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection against falling dirt.
Type 2	Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment, to provide a degree of protection against falling dirt, and to provide a degree of protection against dripping and light splashing of liquids.
Type 3	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, and windblown dust; and that will be undamaged by the external formation of ice on the enclosure.
Type 3R	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, and windblown dust; and in which the external mechanism(s) remain operable when ice laden.
Type 4	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, and windblown dust; splashing water, and hose-directed water; and that will be undamaged by the external formation of ice on the enclosure.
Type 4x	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, and windblown dust; splashing water, and hose-directed water; and corrosion; and that will be undamaged by the external formation of ice on the enclosures.
Type 5	Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment, to provide a degree of protection against falling dirt; against setting airborne dust, lint, fibers, and flyings; and to provide a degree of protection against dripping and light splashing of liquids.
Type 6	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against hose-directed water and the entry of water during occasional temporary submersion at a limited depth; and that will be undamaged by the external formation of ice on the enclosure.

# NEMA RATINGS

- Type 6P Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against hose-directed water and the entry of water during prolonged submersion at a limited depth; and that will be undamaged by the external formation of ice on the enclosure.
- Type 12 Enclosures constructed ( without knockouts) for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against circulating dust, lint, fibers, and flyings; and against dripping and light splashing of liquids.
- Type 12K Enclosures constructed ( with knockouts) for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against circulating dust, lint, fibers, and flyings; and against dripping and light splashing of liquids.
- Type 13 Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment, to provide a degree of protection against falling dirt; against circulating dust, lint, fibers, and flyings; and against the spraying, splashing and seepage of water, oil, and non-corrosive coolants.

The rating 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

TABLE 2-1

## Comparison of Specific Applications of Enclosures for Indoor Nonhazardous Locations

Provides a Degree of Protection Against the Following Environmental Conditions	Type of Enclosure									
	1*	2*	4	4X	5	6	6P	12	12K	13
Incidental contact with the enclosed equipment	X	X	X	X	X	X	X	X	X	X
Falling dirt	X	X	X	X	X	X	X	X	X	X
Falling liquids and light splashing	–	X	X	X	X	X	X	X	X	X
Circulating dust, lint, fibers, and flyings**	–	–	X	X	–	X	X	X	X	X
Settling airborne dust, lint, fibers, and flyings**	–	–	X	X	X	X	X	X	X	X
Hosedown and splashing water	–	–	X	X	–	X	X	–	–	–
Oil and coolant seepage	–	–	–	–	–	–	–	X	X	X
Oil or coolant spraying and splashing	–	–	–	–	–	–	–	–	–	X
Corrosive agents	–	–	–	X	–	–	X	–	–	–
Occasional temporary submersion	–	–	–	–	–	X	X	–	–	–
Occasional prolonged submersion	–	–	–	–	–	–	X	–	–	–

\* These enclosures maybe be ventilated

\*\* These fibers and flyings are nonhazardous materials and are not considered Class III type ignitable fibers or combustible flyings. For Class III type ignitable fibers or combustible flyings see the National Electrical Code, Article 500.

TABLE 2-2

## Comparison of Specific Applications of Enclosures for Outdoor Nonhazardous Locations

Provides a Degree of Protection Against the Following Environmental Conditions	Type of Enclosure						
	3	3R*	3S	4	4X	6	6P
Incidental contact with the enclosed equipment	X	X	X	X	X	X	X
Rain, snow, and sleet **	X	X	X	X	X	X	X
Sleet ***	–	–	X	–	–	–	–
Windblown dust, lint, fibers, and flyings	X	–	X	X	X	X	X
Hosedown	–	–	–	X	X	X	X
Corrosive agents	–	–	–	–	X	–	X
Occasional temporary submersion	–	–	–	–	–	X	X
Occasional prolonged submersion	–	–	–	–	–	–	X

\* These enclosures maybe be ventilated

\*\* External operating mechanisms are not required to be operable when the enclosure is ice covered.

\*\*\* External operating mechanisms are operable when the enclosure is ice covered. See 5.6

# Reference Tables

TABLE 1. Units of Measure

Unit	Symbol	Physical Quantity
ac volts	V ac	electrical potential - alternating current
ampere	A	electrical current
dc volts	V dc	electrical potential - direct current
degrees Celsius	°C	temperature
degrees Fahrenheit	°F	temperature
diameter	∅	circular width
Hertz	Hz	frequency
lumen*	lm	light energy
lux	lx	illumination (lm/m <sup>2</sup> )
meter	m	length
microamp	μA	electrical current (10 <sup>-6</sup> A)
microsecond	μs	time (10 <sup>-6</sup> s)
milliamp	mA	electrical current (10 <sup>-3</sup> A)
millimeter	mm	length (10 <sup>-3</sup> m)
millisecond	ms	time (10 <sup>-3</sup> s)
nanometer	nm	length (light wavelength)
ohm	Ω	electrical resistance
second	s	time
volt	V	electrical potential
volt-amp	VA	power
watt	W	power

\* 1 lumen = 0.001496 watt of monochromatic light at a wavelength of 546 nm

TABLE 2. Unit Prefixes

Decimal Equivalent	Prefix	Symbol	Exponential Expression
1 000 000 000 000	tera	T	10 <sup>12</sup>
1 000 000 000	giga	G	10 <sup>9</sup>
1 000 000	mega	M	10 <sup>6</sup>
1 000	kilo	k	10 <sup>3</sup>
100	hecto	h	10 <sup>2</sup>
10	deka	da	10
0.1	deci	d	10 <sup>-1</sup>
0.01	centi	c	10 <sup>-2</sup>
0.001	milli	m	10 <sup>-3</sup>
0.000 001	micro	μ	10 <sup>-6</sup>
0.000 000 001	nano	n	10 <sup>-9</sup>
0.000 000 000 001	pico	p	10 <sup>-12</sup>

# English/Metric Conversion Chart

To convert millimeters to inches, multiply by 0.0394. • To convert inches to millimeters, multiply by 25.4.

Inches Fraction	Inches Decimal	Millimeter	Inches Fraction	Inches Decimal	Millimeter
----	.0039	0.1	15/32	.4688	11.906
----	.0079	0.2	----	.4724	12
----	.0118	0.3	31/64	.4844	12.303
1/64	.0156	0.397	1/2	.500	12.700
----	.0157	0.4	----	.5118	13
----	.0197	0.5	33/64	.5156	13.097
----	.0236	0.6	17/32	.5312	13.494
----	.0276	0.7	35/64	.5469	13.891
1/32	.0312	0.794	----	.5512	14
----	.0315	0.8	9/16	.5625	14.288
----	.0354	0.9	37/64	.5781	14.684
----	.0394	1	----	.5905	15
3/64	.0469	1.191	19/32	.5938	15.081
1/16	.0625	1.588	39/64	.6094	15.478
5/64	.0781	1.984	5/8	.625	15.875
----	.0787	2	----	.6299	16
3/32	.0938	2.381	41/64	.6406	16.272
7/64	.1094	2.778	21/32	.6562	16.669
----	.1181	3	----	.6693	17
1/8	.1250	3.175	43/64	.6719	17.066
9/64	.1406	3.572	11/16	.6875	17.462
5/32	.1562	3.969	45/64	.7031	17.859
----	.1575	4	----	.7087	18
11/64	.1719	4.366	23/32	.7188	18.256
3/16	.1875	4.762	47/64	.7344	18.653
----	.1968	5	----	.7480	19
13/64	.2031	5.159	3/4	.750	19.050
7/32	.2188	5.556	49/64	.7656	19.447
15/64	.2344	5.953	25/32	.7812	19.844
----	.2362	6	----	.7874	20
1/4	.2500	6.350	51/64	.7969	20.241
17/64	.2656	6.747	13/16	.8125	20.638
----	.2756	7	----	.8268	21
9/32	.2812	7.144	53/64	.8281	21.034
19/64	.2969	7.541	27/32	.8438	21.431
5/16	.3125	7.938	55/64	.8594	21.828
----	.3150	8	----	.8661	22
21/64	.3281	8.334	7/8	.875	22.225
11/32	.3438	8.731	57/64	.8906	22.622
----	.3543	9	----	.9055	23
23/64	.3594	9.128	29/32	.9062	23.019
3/8	.375	9.525	59/64	.9219	23.416
25/64	.3906	9.922	15/16	.9375	23.812
----	.3937	10	----	.9449	24
13/32	.4062	10.319	61/64	.9531	24.209
27/64	.4219	10.716	31/32	.9688	24.606
----	.4331	11	----	.9842	25
7/16	.4375	11.112	63/64	.9844	25.003
29/64	.4531	11.509	1	1.000	25.400



## Glossary of Photoelectric Terms

# Glossary of Photoelectric Terms

## Alignment

Positioning the light beam in the best possible location to optimize the sensor's response to contrasting light levels.

## Alternating Output

Successive input events alternately energize and de-energize the outputs. The output signal can switch on either the leading edge or the trailing edge of the input event.

## Ambient Light

Environmental light in the sensing area.

## Analog Output

An output event (voltage or current) that varies in proportion to the received light intensity.

## Angle Of Incidence

The angle between a beam of light striking a surface and a line perpendicular to that surface.

## Aperture

An opening in opaque material that is placed in-line with the light beam path, so as to restrict, or shape, the effective beam.

## Attenuation

Lessening of sensing energy caused by environmental elements such as dirt, dust, moisture, or other contaminants in the sensing area.

## AUTOSET™

Provides for a one-button, one-push setup routine.

## Automatic Contrast Tracking (ACT™)

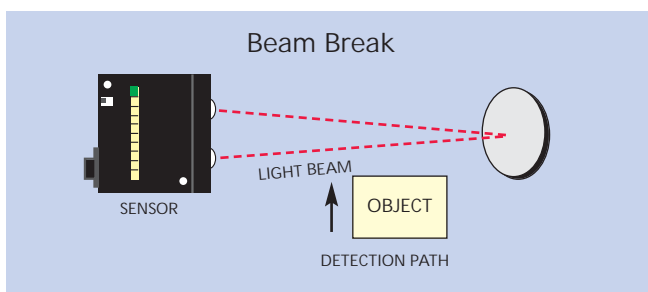
Provides for self adjusting sensor to changes in contrasting light levels as input events are ongoing. Automatic Contrast Tracking (ACT™) automatically adjusts the sensor as conditions change, both light and dark states.

## Automatic Gain Select (AGS™)

This unique feature provides automatic digital selection of amplifier gain based upon your sensing requirements.

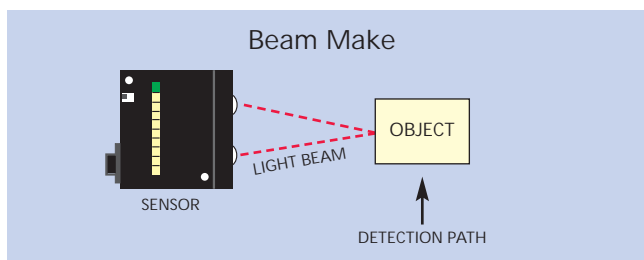
## Beam Break Mode (Thru-Beam)

A sensing mode in which the object to be sensed breaks, or diminishes, an existing light beam path between the light source and the receiver.



## Beam Make Mode

A sensing mode in which the object itself reflects, or diffuses, the transmitted light beam on its path to the receiving lens.



## Bifurcated Fiber Optic

A fiber optic bundle that branches into 2 parts.

## Burn-Through

Describes the ability of high-powered modulated opposed mode sensors to "see" through paper, thin cardboard, opaque plastics, and materials of similar optical density. Burn-through may be used to advantage in some sensing situations, such as when looking through an opaque walled container (like a cereal box) to sense the presence or absence of product inside.

## Color Perception Sensor

Differentiates between two different colors or between a colored mark and the background material. (See Registration Mark)

## Continuous Motion

Constant machine motion without interruption. As opposed to cyclic motion.

## Complementary Outputs

Dual state outputs from a common source. When one output is normally open, the other is normally closed.

## Contrast

The difference in the intensity of the received light beam in its lightest state vs. its darkest state.

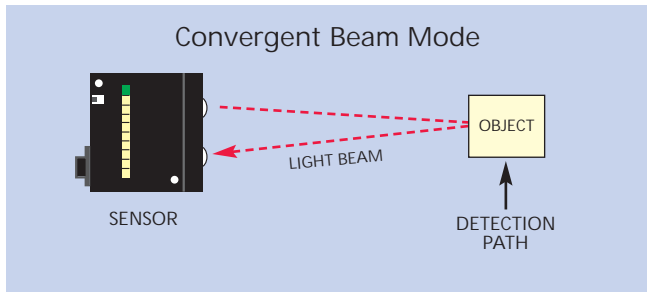
## Convergent Beam Mode

A type of proximity sensing in which the field of illumination from the light source and the field of vision seen by the receiver converge at a fixed point in front of the sensor. (See illustration on next page)

## Corner-Cube Reflector

Also called a corner-cube prism. A prism having three mutually perpendicular surfaces and a hypotenuse face. Light entering through the hypotenuse face is reflected

# Glossary of Photoelectric Terms



by each of the three surfaces and emerges back through the hypotenuse face parallel to the entering beam. The light beam is returned to its source. May also be constructed from three first-surface mirrors. Corner-cube geometry is used for retroreflective materials. See "retroreflector".

## Crosstalk (Electrical)

Electrical crosstalk occurs in modulated photoelectric component systems when the modulated emitter signal (which is a high-current pulsed signal) couples directly onto the receiver lead wires. This results in a "lock-on" condition of the amplifier (i.e. the amplifier recognizes a light condition regardless of the sensor's status). Crosstalk is usually a result of improper splicing of additional remote sensor lead length. In component systems, remote sensors require separate shielded cables for emitter and receiver lead extension, even if the original cable length contained wires for both the emitter and the receiver.

## Crosstalk (Optical)

Optical crosstalk occurs when a photoelectric receiver responds to light from an adjacent emitter. This is often an unwanted situation. If crosstalk cannot be resolved by repositioning of sensors, it can often be eliminated using sensor multiplexing, as with the MP-8 multiplexer module. Crosstalk can be resolved by repositioning the sensor.

## Current Sinking Output (NPN)

A transistor output from a control circuit that, when in the "on" state, allows current flow from the load through the output transistor and then to negative. The output device is usually an NPN transistor with its emitter tied to negative of the supply. The load is connected from the output to positive.

## Current Sourcing Output (PNP)

A transistor output from a control circuit that, when in the "on" state, allows current flow from the output transistor, through the load and then to negative. The output device is usually a PNP transistor with its emitter tied to positive of the supply. The load is connected from the output to negative.

## Cyclic Motion

Intermittent motion of machinery occurring in repetitive cycles, i.e., start then stop then start. As opposed to continuous motion.

## Dark State

A condition that produces an output when the intensity of the received light beam falls below a sensor's fixed threshold. (See Beam Break Mode)

## Detection Path

Direction of travel of the object to be detected past the sensing site.

## Detector (photoelectric)

Element that receives the light coming from the emitter.

## Diffused Mode

See Proximity Mode

## Digital Output

A switching output signal that has only 2 stable states... "On" or "Off".

## DIN

An abbreviation for "Deutsches Institut für Normung", West German industry standards.

## DIN Rail Mount

Convenient method for mounting a sensor to a DIN Rail.

## Disable

(See Inhibit)

## Divergent Sensing Mode

A variation of the diffuse photoelectric sensing mode in which the emitted beam and the receiver's field of view are both very wide. Divergent mode sensors have very forgiving alignment requirements, but have shorter sensing range as compared to diffuse mode sensors of the same basic design. Divergent sensors are particularly useful for sensing transparent or translucent materials or for sensing objects with irregular surfaces (e.g. webs with "flutter"). They are also used to reflectively sense objects with very small profiles, like small diameter thread or wire, at close range.

## DPDT Relay

Double-Pole, Double-Throw. A relay with two sets of Single-Pole, Double-Throw form C contacts that are operated simultaneously by a single action.

# Glossary of Photoelectric Terms

## Duty Cycle

The duration of time the sensor will be in the dark state or the light state. Equal times are referred to as a 50/50 duty cycle.

## Enhanced Dynamic Range (EDR®)

A circuit that extends the dynamic operating range to provides unequalled performance at very bright light levels.

## Effective Beam

That portion of the transmitted light beam collected by the receiving lens.

## Electromagnetic Interference (EMI)

Electrical “noise” which may interfere with proper operation of sensors, programmable logic controllers, counters, data recorders, and other sensitive electronic equipment. Common sources of EMI include lighting fixtures and controls, motors, generators, and contactors. EMI emissions are distributed evenly across the radio frequency spectrum. Emissions are readily conducted along cables, so EMI sources can often be found by following along wireways with a portable radio.

## Emitter (Photoelectric)

1. The sensor containing the light source in an opposed mode photoelectric sensing pair (see “opposed sensing mode”).
2. The light emitting device within any photoelectric sensor (e.g. LED, incandescent bulb, laser diode, etc.).

## Enable

To allow an output to occur in response to an input signal. Synonymous with “interrogate” when used to describe the gating function in an inspection scheme. See “inspection logic”.

## Excess Light

(Excess Gain) The amount of light received in excess of the amount necessary to switch the output.

## Fiber Optics

Transparent fibers of glass or plastic used to “carry” light to and from a sensing site.

## Field Of View

Refers to the area of response of a photoelectric sensor.

## Fixed Focal Point

See Convergent Beam.

## Fluorescence

The emission by a material of light radiation at a longer wavelength as a result of the absorption of some other radiation of shorter wavelengths. For example, the emission of visible light as a result of excitation by ultraviolet light.

## Gain Adjustment

See Sensitivity Adjustment.

## Gate

1. A combinational logic circuit having one or more input channels.
2. Used as shorthand for “interrogate”.

## Hysteresis

The differential between the operate point and the release point of the sensor’s output.

## Hertz (Hz)

The international unit of frequency, equal to one cycle per second.

## IEC

International Electrotechnical Commission; a standard rating system for environmental conditions.

## Individual Fiber(Optic)

A fiber optic assembly having one control end and one sensing end. Used for piping photoelectric light from an emitter to the sensing location or from the sensing location back to a receiver. Usually used in in pairs in the opposed sensing mode, but can also be used side-by-side in the diffuse proximity mode or angled for the specular reflection or mechanical convergent mode.

## Infrared Led

IR, Invisible light emitting device, 880nm or above.

## Inhibit

To prevent a control circuit’s response to an input signal.

## Input

1. The signal (voltage or current) applied to a circuit to

# Glossary of Photoelectric Terms

cause the output of that circuit to change state.  
2. The terminals, jack, or receptacle provided for reception of the input signal.

## Input Voltage

The power source required by an electric or electronic device (e.g. a self-contained sensor) in order for the device to operate properly.

## Interrogate Signal

A command signal used to sample the status of the state of a variable signal or condition. Typically used to instantaneously sample the status of an inspection sensor. Product inspection systems often require an interrogate signal to determine if an output response is required.

## IP Ratings

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

## Latching Output

An output that switches, and permanently latches, its output to the opposite state until a reset signal is applied. The latching action can occur on either the leading edge or the trailing edge of an input signal.

## LED (Light Emitting Diode)

A semiconductor device that emits visible or invisible light.

## Leakage Current

Residual current flow when a solid state switching device is in the off state.

## Light Beam Path

Direction of travel of the light beam from the light source lens to the receiving lens.

## Light State

A condition that produces an output when the intensity of the received light beam is above a fixed threshold. (See Beam Make)

## Light State Tracking (LST™)

When enabled, the sensor will continually adjust to the appropriate Light State setting on the Contrast Indicator.

## Linear Output

An analog sensor's output voltage that is proportional to the light level.

## Load

A device or circuit that is connected to and operated by the sensor's output.

## Logic Module

A module that modifies input signals for use in control system processing.

## Maximum Load

The maximum continuous current that an output switching device can provide without the possibility of damage.

## Microsecond

One millionth of a second. 1 microsecond = 0.000001 second or 0.001 millisecond. Abbreviated:  $\mu$ s

## Minimum Load

The minimum current required to insure proper operation of an output switching device.

## Millisecond

One thousandth of a second. 1 millisecond = 0.001 second or 1000 microseconds. Abbreviated: ms

# Glossary of Photoelectric Terms

## Modulation

In photoelectrics, modulation of an LED simply means to turn it on and off at a high frequency (typically several kilohertz). The secret of a modulated photoelectric sensor's superior performance is that the sensor's phototransistor and amplifier are tuned to the frequency of modulation. Only the modulated light is amplified, and all other light which reaches the receiver is ignored. This is analogous to a radio receiver which tunes solidly to one station, while ignoring all of the other radio waves that are present in the room. In fact, a modulated sensor's LED is most often referred to as the transmitter or emitter and its phototransistor as the receiver.

## MOTION DETECTOR

(See Retriggerable One-Shot)

## MOV: (METAL-OXIDE VARISTOR)

A component that is used to protect against damage from voltage spikes.

## NEMA

National Electrical Manufacturers Association. NEMA standards are used to specify suitability of sensor and sensing system enclosures for various sensing environments.

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

## Non-Contact Sensor

A sensing device that can detect the presence or absence of an object without the necessity of physical contact.

## NPN

(See Current Sinking)

## Off-Delay Timer

A control circuit that switches its output on the leading edge of an input signal. If, and when, the input signal returns to its original state over a preset timed interval, the output signal will return to its original state.

## Offset Adjustment

Duplicates the function of a sensitivity adjustment by allowing the operator to preset the sensor's response to contrasting light levels as viewed on the Contrast Indicator.

## Ohm's Law

$E = I \times R$ . Current (I) is directly proportional to voltage (E) and inversely proportional to total resistance (R) of a circuit.

## On-Delay Timer

A control circuit that "times" the duration of the input signal. The output of this circuit switches only if, and when, the duration of the input signal exceeds a preset timed interval. When this occurs, the output stays switched for the remaining duration of the input signal.

## One-Shot Timer (Non-Retriggerable)

Produces preset timed output signal on the occurrence of an input signal. The timed output response may begin on either the leading edge or the trailing edge of the input signal. The preset time is independent of the duration of the input signal.

## Opacity Mode

See Beam Break.

## Opaque

A term used to describe a material that blocks the passage of light energy. "Opacity" is the relative ability of a material to obstruct the passage of light.

## Open-Collector

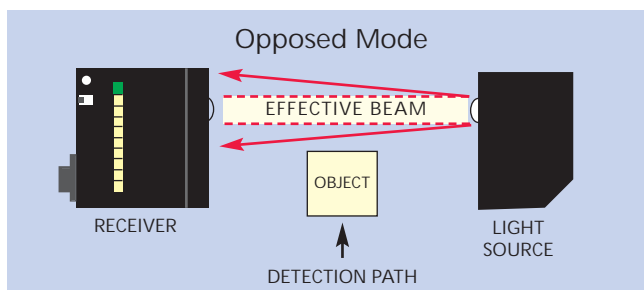
An NPN or PNP transistor that is not connected to any other part of the output circuit.

## Operating Speed

Maximum output switching rate usually expressed by maximum rate of input events that can be resolved under set conditions.

## Opposed Mode

See Beam Break



# Glossary of Photoelectric Terms

## Output

1. The section of a sensor or control circuit that energizes and/or de-energizes the attached load (or input).
2. The useful energy delivered by a circuit or device.

## Output Mode

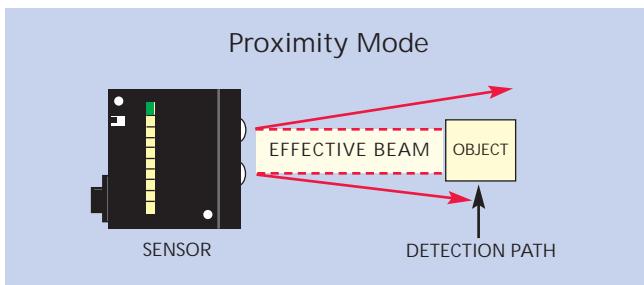
Light or Dark on.

## Polarized Light

Light that vibrates in one plane only (in contrast to ordinary light, which vibrates in all directions).

## Proximity Mode

A sensing mode in which the light beam bounces off an object in front of the sensor and is reflected back to the sensor. (See Beam Make)



## Proxing

An undesirable characteristic of a retroreflective sensor to respond to light reflected off the surface of the sensed object. Shiny objects passing near a retroreflective sensor can reflect sufficient light to accidentally switch the output. Some retroreflective sensors include polarized filters to reduce proxing.

## Pulse Stretcher

(See Off-Delay Timer) A signal conditioning circuit used to insure a minimum duration output signal response to a short duration input signal.

## Pulse Modulated Sensor

A sensor with an LED light source that is pulsed or turned "on" and "off" at a high rate of speed. The output signal from the sensor's receiving device is processed by a tuned circuit that responds only to the frequency of the pulsed LED light source. This prevents unwanted response to ambient light.

## PVC (polyvinyl chloride)

A member of the vinyl plastic resin family, with many applications, including jacketing of wire and fiberoptic cables. Characterized by its high degree of flexibility and good chemical resistance.

## Radio Frequency Interference (RFI)

Interference caused by electromagnetic radiation at radio frequencies to sensors or to other sensitive electronic circuitry. RFI may originate from radio control equipment, stepper motor controls, CRTs, computers, walkie-talkies, public service communications, commercial broadcast stations, or a variety of other sources. RFI occurs most often at a specific frequency or within a specific range of frequencies. As a result, one electronic instrument may be radically affected by the presence of RF interference, while another similar instrument in the same area may appear completely immune.

## Receiver (photoelectric)

Element that receives the light coming from the emitter.

## Refraction

The "bending" of light rays as they pass through the boundary from a medium having one refractive index into a medium with a different refractive index. For example, as from air into water or from air into glass or plastic.

## Registration Mark

A contrasting color mark printed on material that can be "seen" by a sensor. Used to control a variety of packaging and material handling operations.

## Repeatability

A measure of the repeat accuracy of a sensor and/or timer and/or control mechanism (e.g. motor, brake, solenoid, etc.). Usually expressed as a distance or time.

## Response Time

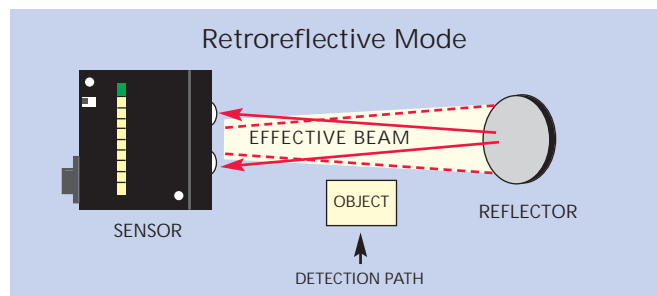
The length of time it takes for the output to switch from light state to dark state and vice versa.

## Retriggerable One-Shot Timer

Same as one-shot timer, except that, if input events occur before the preset time expires, the timer is automatically reset, the timed period begins again and the output signal remains switched. Used for Motion Detection.

## Retroreflective Mode

The light source and receiver are contained in one housing, projecting a light beam to a reflector mounted on the opposite side of the product flow. When the product breaks the beam, an output signal is produced.



# Glossary of Photoelectric Terms

## RoHS (Reduction of Hazardous Substances)

European Union regulations enforceable on July 1, 2006 that set maximum concentration limits on hazardous materials used in electrical and electronic equipment.

## Reverse Polarity Protector

Protects the sensor from damage if power leads are accidentally reversed.

## Ripple

An ac voltage component on the output of a dc power supply. Usually expressed as a percentage of the supply voltage. Ripple may be suppressed ("smoothed") with capacitor filtering. Most dc only devices require less than about 10% ripple for reliable operation.

## R/S Flip-Flop

A control circuit that has both "set" and "re-set" inputs. A momentary input signal to the "set" input circuit sets the output to one of the two states. A momentary input signal to the "re-set" input toggles the output back to the original state.

## Saturation Voltage

The voltage drop appearing across a switching transistor or SCR that is fully turned "on". See "voltage drop".

## Sensing Task

The specific purpose or application assigned to a sensing device.

## Sensitivity Adjustment

A potentiometer device that is used to adjust the gain of an amplifier stage in photoelectric sensing.

## Signal Conditioning

The addition of timing functions to achieve on-delay, off-delay, motion, latching and one shot.

## Short Circuit Protection

Protects output transistors from damage if accidentally connected to power supply leads or if the load becomes shorted.

## Skew Angle

An alignment technique used in diffuse, retroreflective and convergent mode sensing to increase the optical contrast ratio. In diffuse and convergent sensing, it is done to reduce background reflections. The sensor is angled so that its beam strikes the background at an angle other than 90 degrees (i.e. straight on). In reflective sensing, skewing the sensor is done to reduce the amount of light reflected directly back.

## Snubber Network

A capacitor in series with a resistor placed across the output terminals of a solid state switching device or relay contacts to prevent damage caused by voltage transients.

## SPDT Relay

Single-Pole, Double-Throw. A relay with one set of form C contacts. One contact is open when the other is closed. (Complementary switching)

## Supply Voltage

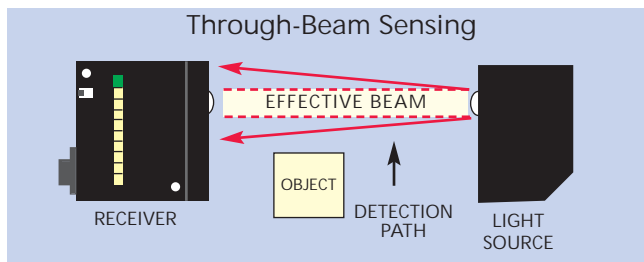
The acceptable operating voltage range of the sensor's power input.

## Straight Light Guides

For fiberoptic Thru-beam. Separate light source and receiver for Beam Break.

## Through-Beam Sensing

See Beam Break.



## Transient

A very short duration pulse of voltage (or current) that is many times larger in magnitude than the supply voltage. Transients are usually caused by the operation of a heavy load or of any size inductive load like motors, contactors, and solenoids. Voltage transients can cause false actuation of fast electronic circuits such as solid-state counters, one-shot timers, and latching outputs. The problems resulting from transients are dealt with by careful shielding and grounding of remote sensor lead wires, by physical separation of signal wires from power wires in wireways, and by installing transient suppressors directly across offending loads.

## Translucent

Refers to material that allows some light to pass through, but not transparent. Clear images cannot be viewed through translucent objects.

## Transparent

Refers to material that allows light to pass through with little, if any, loss. Clear images can be viewed through transparent objects..

## TRIAC

Solid state AC switch

## UL

Underwriters Laboratories; an independent testing laboratory that certifies products conforming to industry safety standards.

## UV (Ultraviolet)

Invisible short wavelength light energy that lies immediately beyond the violet end of the color spectrum between approximately 100 and 380 nm. Some materials "fluoresce" and produce light of visible wavelengths when excited by UV energy. This re-radiation of visible light can be detected by a "UV sensor". See "LED".



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USB-1	17877	Sub Bracket Assy US Eye	2-79 through 2-82
UT	17878	US Eye Lightsource Only	2-79 through 2-82
UT-A	17879	US Eye Through Beam	2-79 through 2-82
UT-AR	17881	US Eye Receiver Only	2-79 through 2-82
UT-AT1	17882	US Eye Through-Beam W/Delay	2-79 through 2-82
UT-AT1R	17883	US Eye Reciever Only	2-79 through 2-82
UT-AT2	17884	US Eye Through-Beam/Pulse/Motn	2-79 through 2-82
UT-AT2R	17885	US Eye Receiver Only	2-79 through 2-82
UVS-1	19790	Stealth-UV Sensor, 1/2"	2-89 through 2-93
UVS-1A	20852	Stealth-UV Sensor, 1/2", Analog Output	2-89 through 2-93
UVS-1AG	20858	Stealth-UV Sensor, 1/2", Analog Output, Glass Window	2-89 through 2-93
UVS-1G	20847	Stealth-UV Sensor, 1/2", Glass Window	2-89 through 2-93
UVS-2	19791	Stealth-UV Sensor, 1"	2-89 through 2-93
UVS-2A	20853	Stealth-UV Sensor, 1", Analog Output	2-89 through 2-93
UVS-2AG	20859	Stealth-UV Sensor, 1", Analog Output, Glass Window	2-89 through 2-93

Model Number	Part #	Description	Page Numbers
UVS-2G	20848	Stealth-UV Sensor, 1" , Glass Window	2-89 through 2-93
UVS-3	19792	Stealth-UV Sensor, 2"	2-89 through 2-93
UVS-3A	20854	Stealth-UV Sensor, 2" , Analog Output	2-89 through 2-93
UVS-3AG	20860	Stealth-UV Sensor, 2" , Analog Output, Glass Window	2-89 through 2-93
UVS-3G	20849	Stealth-UV Sensor, 2" , Glass Window	2-89 through 2-93
UVS-4	19864	Stealth-UV Sensor, 4"	2-89 through 2-93
UVS-4A	20855	Stealth-UV Sensor, 4" , Analog Output	2-89 through 2-93
UVS-4AG	20861	Stealth-UV Sensor, 4" , Analog Output, Glass Window	2-89 through 2-93
UVS-4G	20850	Stealth-UV Sensor, 4" , Glass Window	2-89 through 2-93
UVS-5	19865	Stealth-UV Sensor, 8"	2-89 through 2-93
UVS-5A	20856	Stealth-UV Sensor, 8" , Analog Output	2-89 through 2-93
UVS-5AG	20862	Stealth-UV Sensor, 8" , Analog Output, Glass Window	2-89 through 2-93
UVS-G	20851	Stealth-UV Sensor, 8" , Glass Window	2-89 through 2-93
UVS-6	19866	Stealth-UV Sensor, Fiber Optic	2-89 through 2-93
UVS-6A	20857	Stealth-UV Sensor, Fiber Optic, Analog Output	2-89 through 2-93
V1	17886	Optical Block Convergent Beam	5-8
V1G	17888	Convergent Beam Block/Glass	5-8
V4	17890	Convergent Block 1 in. axis	5-8
V4A	19751	Conv. Block 1" V-axis, Apertured	5-8
V6	17892	Convergent Block 1.5 in axis	5-8
V8	18131	Convergent Block 1/2 in axis	5-8
VSDF1	17902	Very High Speed Smarteye	2-34 through 2-41
VSDO1	17906	Very High Speed Smarteye	2-34 through 2-41
VSDO2	17907	Very High Speed Smarteye	2-34 through 2-41
VSDR1	17910	Very High Speed Smarteye	2-34 through 2-41
VSDV1	17915	Very High Speed Smarteye	2-34 through 2-41

## WARRANTY & LIMITATION OF LIABILITY

Tri-Tronics Company, Inc., warrants that the products delivered by it will be of the kind and quality described in the order or contract and will be free of defects in workmanship or material. Should any failure to conform to the express warranty appear within one (1) year of delivery, Tri-Tronics shall upon written notification correct such non-conformity, including non-conformance with Tri-Tronics' specifications, at its option, either by repairing any defective part or parts or by making available, F.O.B. the seller's plant, a repaired or replacement part. This warranty shall be for a period of one (1) year after the date of delivery of any product not meeting Tri-Tronics' specifications.

This warranty is in lieu of all warranties of merchantability, fitness for a particular purpose, or other warranties, expressed or implied, except of title and against patent infringement. Correction of non-conformities in the manner and for the period of time provided above shall constitute fulfillment of all liabilities of Tri-Tronics to anyone, whether based on contract, negligence, or otherwise with respect to or arising out of such products.

Tri-Tronics shall not be liable for special, indirect, or consequential damages. The remedies set forth herein are exclusive, and the liability of Tri-Tronics with respect to any contract or sale or anything done in connection therewith, whether in contract, in tort, under any warranty, or otherwise, shall not, except as expressly provided herein, exceed the price of the product or products on which such liability is based.

This warranty shall not apply to any product that has been subjected to misuse, negligence, accident, or misapplied or modified or repaired usage by unauthorized persons, or as the result of improper installation thereof. Furthermore, any improper use, operation beyond capacity, substitution of parts not approved by Tri-Tronics, or any alteration or repair by others in such manner as in Tri-Tronics' judgment affects the product materially and adversely shall void this warranty.

Tri-Tronics Company, Inc.  
7705 Cheri Court  
Tampa, FL 33634-2419  
813.886.4000



## Terms & Conditions of Sale

Orders placed with Tri-Tronics (written or verbal) are subject to the terms and conditions as stipulated in this document. No modifications or revisions to the terms and conditions as listed will be allowed without special written authorization by an officer of Tri-Tronics Co. Inc. No employee or representative of Tri-Tronics is authorized to change the warranty or terms and conditions in any way or to grant any other warranty. Purchaser's acceptance of an order shall be deemed as assenting to the terms and conditions set forth herein. The lack of an objection by Tri-Tronics to any and all revisions, alterations, or additions to the terms and conditions, as set forth herein, by the purchaser contained in any prior or subsequent purchase order or communication shall not be construed as a waiver or acceptance by Tri-Tronics.

### CREDIT

Tri-Tronics reserves the right to decline any order if the purchaser fails to provide necessary credit information regarding the purchaser's ability and willingness to pay for the merchandise within the net 30-day terms. Tri-Tronics may, as an option to refusing the order, elect to require an advance payment, a credit card, or a C.O.D. shipment.

In the event of purchaser's default in payment for orders shipped on credit, the purchaser shall be responsible for all reasonable collection costs and expenses, and Tri-Tronics shall not be obligated to make any further shipments to the purchaser.

All sales shall be governed by the laws of the State of Florida. Tri-Tronics and the purchaser mutually agree that venue for any action at law or in equity in any way arising out of any order, sale, or this agreement shall lie exclusively in Hillsborough County, Florida, USA.

### PAYMENT TERMS

Contingent upon prior credit approval, Tri-Tronics' terms are net 30 days from the invoice date, unless otherwise indicated. Payment is to be made to the address printed on the face of the invoice.

### SHIPPING

Tri-Tronics will ship the merchandise to the purchaser as soon as possible after the receipt of an order. In the event that the ordered merchandise is not in stock, Tri-Tronics reserves the right to make partial shipments. These shipments will be individually invoiced and the purchaser agrees to submit payment within the net 30-day terms for each shipment. If, for any reason, Tri-Tronics fails to ship by a specified date, Tri-Tronics shall not be held responsible for any special or consequential damages.

### PRICING

All quoted prices are FOB Tampa, Florida, and are subject to change without notice. All written quotations are valid for 30 days if not otherwise specified. Quoted prices do not include sales, use, or excise taxes or shipping costs. All applicable taxes must be paid by the purchaser. Customer will be responsible for payment of import duties, customs fees and permits, and licenses.

### DAMAGE AND LOSS

All Tri-Tronics products are packed and labeled for shipment adhering to good commercial packaging techniques. Upon delivery to the carrier for shipment, responsibility for delivery intact to its destination rests with the carrier. Upon receipt of the shipment at its destination, the merchandise should be inspected for visible or concealed damage. Claims for damage or loss should be filed with the carrier immediately. Tri-Tronics will assist whenever possible in securing adjustment of claims; however, all claims for damage or loss must be initiated by the purchaser directly to the carrier.

### RETURN OF MERCHANDISE

Any material returns must be marked with a Return Authorization Number that shall be obtained from Tri-Tronics. All material must be properly packed and shipped prepaid. No C.O.D. shipments will be accepted. Any materials being returned for credit will be subject to examination by Tri-Tronics for customer misuse or abuse before determining the amount of credit.

### IMPORTANT

The products of Tri-Tronics Company, Inc., are not authorized for use as critical components in any life support devices or systems whatsoever without the express written approval of the President of Tri-Tronics:

- a. Life support devices or systems are devices or systems which (1) are intended for surgical implant into the body or (2) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user;
- b. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system or to affect its safety or effectiveness.

In addition to the foregoing and without limiting or modifying the foregoing, Tri-Tronics hereby expressly prohibits the use of its products or any component parts thereof in or on personal safety devices including, but not limited to, punch presses or any other dangerous machinery in which the failure of such product could cause serious bodily injury, without the express written consent of Tri-Tronics. The definitions of "personal safety devices" and "other dangerous machinery" shall be those definitions formulated by Tri-Tronics in its sole discretion and will be provided to the purchaser upon written request.



P.O. Box 25135  
Tampa, FL 33622-5135  
800.237.0946

7705 Cheri Court  
Tampa, FL 33634-2419  
800.375.8861 fax

## SENSOR SELECTION GUIDE

A. Brief description of sensing task: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

B. Size and shape of object (or condition of object) to be sensed: \_\_\_\_\_

C. Spacing or gap between sensed objects: \_\_\_\_\_

D. Motion of conveying device/machine: ☐ Continuous ☐ Cyclic

E. Length of time sensed object will remain in view of sensor: \_\_\_\_\_

### Considerations

Velocity of sensed object: \_\_\_\_\_

Quantity of sensed objects per hour/minute: \_\_\_\_\_

Conveyor/web speed: \_\_\_\_\_

F. Sensing Environment: ☐ Clean ☐ Slightly Dirty

☐ Dirty ☐ Very Dirty ☐ Moist ☐ Washdown area

G. Ambient temperature: \_\_\_\_\_

H. Preferred Sensing Mode:

### BEAM BREAK

#### Retroreflective Mode ☐

#### Considerations:

Distance between sensor and reflector \_\_\_\_\_

Distance between sensor and sensed object \_\_\_\_\_

Surface reflectivity of sensed object:

☐ Shiny ☐ Moderately Shiny ☐ Dull

Light transmission properties of sensed object:

☐ Transparent ☐ Translucent ☐ Opaque

#### Opposed Mode ☐

#### Considerations:

Distance between light source and receiver: \_\_\_\_\_

Light transmission properties of sensed object:

☐ Transparent ☐ Translucent ☐ Opaque

### BEAM MAKE

#### Proximity Mode ☐ or Convergent ☐

#### Considerations:

Distance between sensed objects and objects in background: \_\_\_\_\_

Color of sensed objects: \_\_\_\_\_

Color of background objects: \_\_\_\_\_

Surface reflectivity of sensed object:

☐ Shiny ☐ Moderately Shiny ☐ Dull

Surface reflectivity of background:

☐ Shiny ☐ Moderately Shiny ☐ Dull

Light transmission properties of sensed object::

☐ Transparent ☐ Translucent ☐ Opaque

1. Power Source:

A.C. Voltage \_\_\_\_\_ D.C. Voltage \_\_\_\_\_

J. Output Requirements:

☐ NPN (sinking) Transistor ☐ Conventional Relay

☐ PNP (sourcing) Transistor ☐ Solid State AC Switch (TRIAC)

K. Load A.C. Load: Current \_\_\_\_\_ Voltage \_\_\_\_\_

D.C. Load: Current \_\_\_\_\_ Voltage \_\_\_\_\_

PLC Load: A.C. Voltage \_\_\_\_\_

Allowable Leakage Current \_\_\_\_\_

D.C.: ☐ NPN (sinking) Transistor

☐ PNP (sourcing) Transistor

### Simplified Drawing of Application



Custom Fiber Fax Form

Fax: 813-884-8818

Distributor _____	TTCO Rep _____
Distributor Phone _____ Fax _____	TTCO Rep Phone _____ Fax _____
Customer Phone _____ Fax _____	Delivery Date _____
Model # _____	Customer Approval _____

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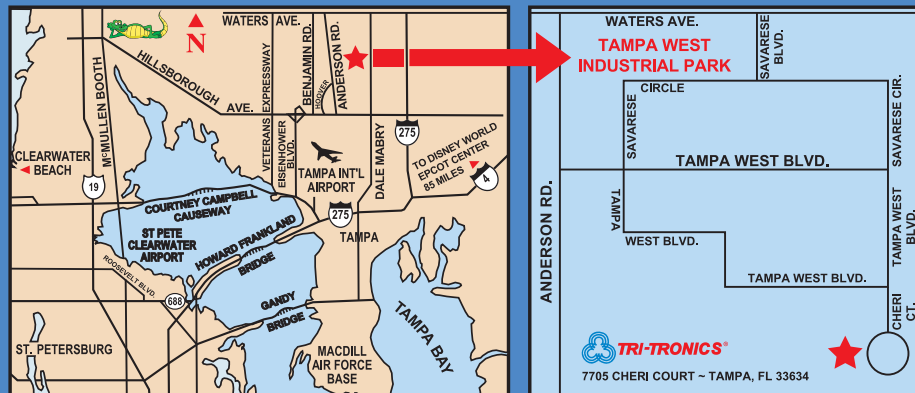


**TRI-TRONICS** designs, manufactures, and supplies high-quality photoelectric sensors, fiberoptic light guides, and controls for a wide variety of industrial applications.

This catalog provides documentation regarding the capabilities of **TRI-TRONICS** products and is specifically designed to simplify the process of selecting the proper sensing technique to fit a particular sensing requirement. Using this catalog combined with the expertise of a local

**TRI-TRONICS** stocking distributor should provide quick answers to your questions regarding photoelectric sensors and controls.

For the name and location of the nearest **TRI-TRONICS** representative and stocking distributor, call (813) 886-4000 or e-mail us at: [info@ttco.com](mailto:info@ttco.com). Factory application engineers are also available to provide technical assistance for solving your most difficult problems.



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813-886-4000 • 800-237-0946

FAX: 813-884-8818 • 800-375-8861

**ttco.com • info@ttco.com**