Product Line Catalog

ISO9002
DOCUMENTED QUALITY

BANNER®
the photoelectric specialist

Printed in USA P/N 36595G6A

WARRANTY: Banner Engineering Corporation warrants its products to be free from defects for one year. Banner Engineering Corporation will repair or replace, free of charge, any product of its manufacture found to be defective at the time it is returned to the factory during the warranty period. This warranty does not cover damage or liability for the improper application of Banner products. This warranty is in lieu of any other warranty either expressed or implied.

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

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

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

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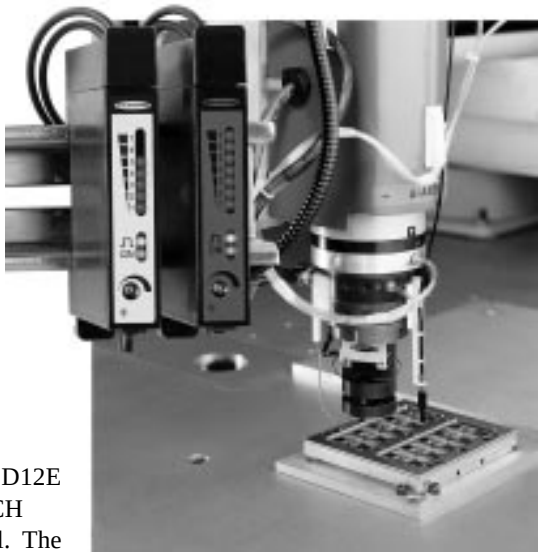
The D12 Family

High-Performance Fiber Optic Sensors



The D12 Sensor Family offers models to solve nearly any fiber optic sensing requirement. D12s are self-contained sensors for 10 to 30V dc operation. They are housed in a compact 12 mm-wide package, designed for DIN-rail mounting. Most D12 sensor types are available with either an attached cable or a 150 mm pigtail pico-type quick disconnect connector.

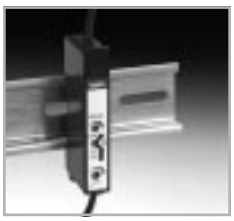
The D12 Family offers five product groups. Models are available within each group for plastic or for glass fiber optic cables.

D12 Expert is the ultimate teach mode fiber optic sensor. D12E sensors have simple one-button programming. The TEACH mode automatically adjusts sensitivity to the optimal level. The D12E offers exceptional sensing performance for either high-power or low contrast applications. The D12E also features an advanced and comprehensive LED status display, plus sensor self-diagnostics with a separate alarm output for marginal signal conditions.

Standard D12 sensors feature 500 µs (0.5 ms) response and a 7-segment moving-dot LED bargraph display† which indicates received signal strength. This feature greatly simplifies sensitivity adjustment and fiber optic alignment, and provides a constant display of sensing system performance. In addition, flashing segments of the display signal problems such as output overload or marginal sensing. †U.S. Patent #4965548

High-speed D12 models offer the same features as standard D12s, plus a switch for selecting either 500 µs or 50 µs response. High-speed D12s excel in reliable sensing of fast-moving small parts. Models with suffix "FPY1" or "FVY1" (when used in the 50 µs response mode) include a 20 ms pulse stretcher for use in applications where the load (or input circuit) requires a signal which is longer than the sensing event.

High-power D12 sensors offer the highest optical power available in a fiber optic presence sensing device. They are intended for applications where high excess gain is required for long sensing range, small diameter fibers, or optically-demanding sensing environments. High-power D12 models include the 7-segment display and the self-diagnostic features of standard D12 models. Models for plastic fiber optic cables are standard, and models for glass fibers are available by special order.



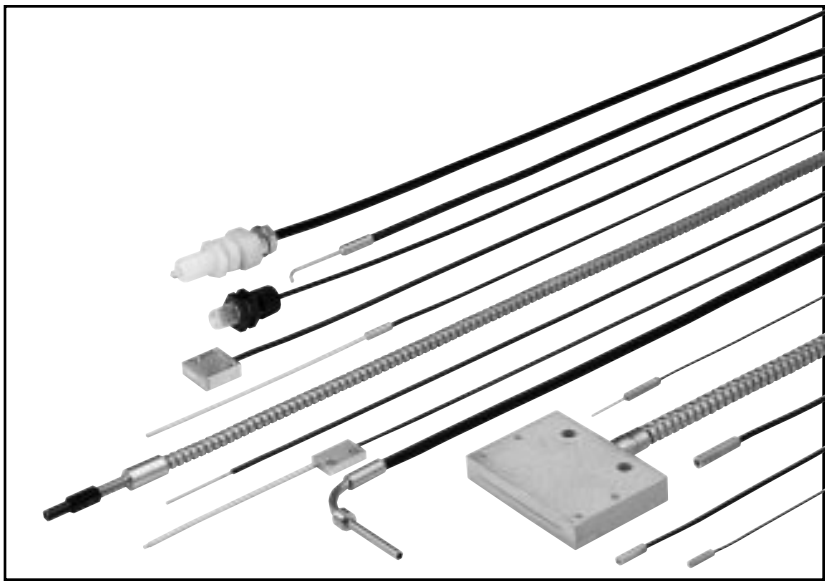
AC-coupled D12 sensors are designed for applications in which the light signal change is so small that a conventional sensitivity control is difficult or impossible to adjust. AC-coupled D12s perform well in applications where the sensing contrast is even too small for D12 Expert sensors. D12DAB6 Series sensors have an automatic gain control (AGC) system that locks onto the light signal and continually adjusts the emitter for maximum performance. The ac-coupled amplifier reliably reacts to very small signal changes, resulting in a "pulse" output for each sensing event. Typical applications for ac-coupled sensors include thread break detection, web flaw detection, and detection of small, randomly-falling parts.

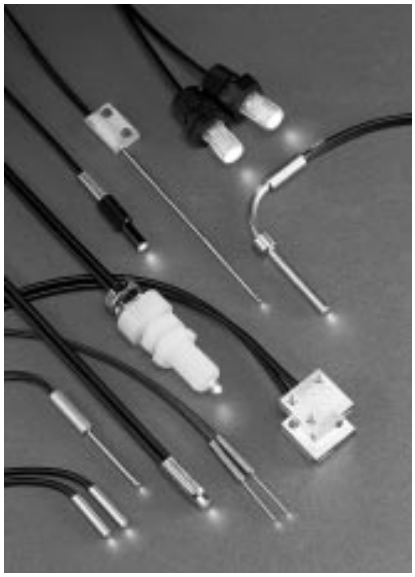
Plastic and Glass Fibers

An Unmatched Selection of Standard & Custom Designs

The Broadest Line

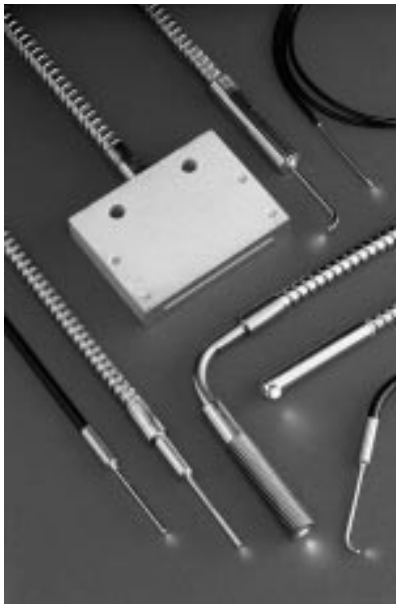
Banner fiber optics allow you to "pipe" light into otherwise inaccessible and hostile enviornments. Banner has the broadest, most readily-available line of fibers in the world. Choose from a huge selection of standard fibers in virtually all shapes and sizes. Custom fibers can be quickly and easily designed for unique applications, and built to your exact specifications. Choose from two general styles: individual fibers used in pairs in the opposed sensing mode, and bifurcated fibers that emit and receive light signals in the same assembly.





Plastic Fibers

Banner plastic fibers offer a uniquely affordable solution because they are inexpensive and many can be easily cut to length during installation using the cutting device supplied with each fiber. They bend very easily to fit precisely where you want them. They are also extremely flexible and are available in coiled versions for use in a variety of applications including those requiring articulated or reciprocating motion. Choose diameters of 0.25, 0.5, 1.0, or 1.5 millimeter. The larger the fiber diameter, the higher the attainable excess gain.



Glass Fibers

Banner glass fiber optics overcome a multitude of environmental challenges including temperatures to 480ºC (900ºF), corrosive materials, and extreme moisture. And, because of their low mass, Banner glass fibers can withstand high levels of shock and vibration. They are inherently immune to extreme electrical noise. Banner glass fibers can be quickly custom-built for your own unique application, and can even be designed to create a sensing beam that precisely profiles the object you need to detect.

See the Banner Product Catalog for detailed specifications on fiber optic assemblies for your application.

D12 Expert Fiber Optic Sensors

Product Features

- Fiber optic sensors for DIN rail mounting; 10 to 30V dc operation
- Easy teach mode programming automatically adjusts sensitivity to optimal setting
- Offers high optical sensing power, when needed, yet excels in low-contrast sensing applications
- Visibile red light source; models for use with either Banner glass or plastic fiber optic assemblies
- Output may be programmed for either light or dark operate
- Fast 200 microsecond sensing response; a 40 millisecond pulse stretcher may be programmed, when needed
- Sealed one-button programming† assures security of settings
- 7-segment LED bargraph† indicates relative received signal strength and sensing contrast, programming status, and diagnostic trouble warnings
- Dedicated alarm output for marginal sensing alert; separate input for remote sensor programming by external switch, process controller, etc.

D12 Expert sensors offer a unique one-button programming design which provides security for your settings, yet is simple to set up. Like standard D12 Series sensors, D12E sensors may be used for applications where high sensing power is needed. However, unlike standard and high power D12 sensors, the D12E series sensors also excel in low contrast applications, which require low sensitivity settings. The D12E **TEACH** mode evaluates the light and dark sensing conditions and automatically adjusts the sensitivity to the optimal level. Sensor setup is fast, easy, and accurate. The D12E also features an advanced and comprehensive LED status display†, plus sensor self-diagnostics with a separate alarm output for marginal signal conditions.

D12E sensors offer two programming modes: the **TEACH** mode and the **SENSOR OUTPUT CONFIGURATION** mode. All photoelectric sensing applications (excluding analog response applications) involve differentiating between two received light levels. We refer to the condition with the higher received light level as the light condition, and the condition with the lower received light level as the dark condition. The difference between the two received light levels is called the sensing contrast.

During installation, a typical photoelectric sensor's sensitivity control is adjusted to switch the sensor's output one way (i.e. either ON or OFF) for the light condition and the opposite way for the dark condition. Ideally, the sensitivity is adjusted so that the switching threshold is positioned midway between the light and dark received light levels. With the click of a push button, the D12E "learns" the light and dark conditions and automatically sets the sensitivity to the optimal setting during the **TEACH** mode process.

High sensing contrast allows a high sensitivity setting, which results in high excess gain and high sensing reliability. The D12E offers high excess gain for a demanding sensing environment and/or for long-range sensing. However, the D12E also does an impressive job of handling those applications which offer only low sensing contrast. When the D12E recognizes a low contrast application during the **TEACH** mode process, the sensor's on-board microprocessor expands the bottom end of the sensitivity range to establish an accurate sensitivity setting for recognizing the small difference in received light levels†. At the end of the **TEACH** mode, the D12E flashes an indication of the relative sensing contrast so you know just how forgiving your application will be to changing sensing conditions.

The **OUTPUT CONFIGURATION PROGRAM** mode allows you to set the sensor's output for either no delay or a fixed 40 millisecond pulse stretcher (OFF-delay) for use with loads (or circuit inputs) that are too slow to react to a quick event. With no OFF delay, sensing response is a fast 200 microseconds (.0002 seconds) both ON and OFF.

The output can also be configured for either light operate (LO) or dark operate (DO). Light operate energizes the sensor's load output when the light condition is sensed, and dark operate energizes the load output for the dark condition.

† Patent pending

The output configuration can be checked at any time by simply holding down the push button for 2 seconds. The sensor's 7-segment LED display will indicate the current settings for 10 seconds, while the sensor continues normal operation. Factory settings for the output configuration are no delay (0 ms) and light operate (LO).

Normal operation of the D12E is called the **RUN** mode. During the **RUN** mode, the 7-segment LED display becomes a moving dot signal strength indicator. When the light and dark sensing conditions are analyzed by the sensor during the **TEACH** mode, the sensor's microprocessor automatically distributes the range of signal strength seen in the light condition evenly between the 7 LEDs†. The resulting display gives a true reading of the relative signal strength for the actual application, and is a useful indicator of changing sensing conditions.

D12E sensors also offer several self-diagnostic functions. A trouble condition is indicated by one or more flashing LEDs on the 7-segment display. In addition, a separate alarm output is provided to warn of marginal sensing conditions.

Unlike competitive sensors, D12Es have no exposed switches or adjustments. All programming is done using a single, sealed push button using quick and simple commands. Your settings remain secure, and the sensor remains sealed against the elements of the sensing environment. Also, a separate input is provided for remote programming.

D12 sensors are designed for direct mounting onto standard 35 millimeter DIN rail track, or can be mounted directly to any surface using the supplied mounting bracket and hardware. D12s are constructed of rugged ABS (Cycolac® KJB), with a transparent acrylic housing cover.

Models are available for either plastic or glass fiber optics. The choice of NPN (sinking) or PNP (sourcing) models enables D12 sensors to interface to a wide variety of loads. D12Es are also available with either a 2 meter (6-1/2 foot) or 9 meter (30 foot) cable.

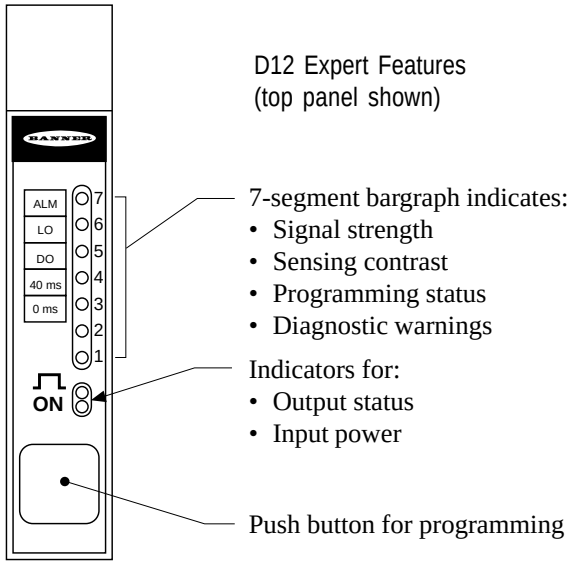
Maximum Sensing Range

The following chart indicates the maximum sensing range for representative fiber optic cables. Maximum range is obtained by adjusting the sensitivity to maximum. Diffuse mode ranges assume that the target has reflectivity equal to a Kodak 90 percent reflectance white test card. Expect less range for fiber assemblies with angled sensing ends. Range data is for 2 meter (6-1/2 foot) plastic and 3 foot (0.9 meter) glass fiber assemblies.

Plastic Fiber Assembly Fiber Diameter	Typical Fiber Model	Maximum Range
0.25 mm (.01 in) individual pair	**PIT16U**	18 mm (0.7 in) opposed mode
0.5 mm (.02 in) individual pair	**PIT26U**	84 mm (3.3 in) opposed mode
1.0 mm (.04 in) individual pair	**PIT46U**	315 mm (12.4 in) opposed mode
1.5 mm (.06 in) individual pair	**PIT66U**	660 mm (26.0 in) opposed mode
0.25 mm (.01 in) bifurcated	**PBP16U**	3.8 mm (0.15 in) diffuse mode
0.5 mm (.02 in) bifurcated	**PBT26U**	25 mm (1.0 in) diffusemode
1.0 mm (.04 in) bifurcated	**PBT46U**	95 mm (3.7 in) diffuse mode
1.5 mm (.06 in) bifurcated	**PBT66U**	190 mm (7.5 in) diffuse mode

Glass Fiber Assembly Fiber Diameter	Typical Fiber Model	Maximum Range
.027 in (0.7 mm) individual pair*	**IMM.443S**	107 mm (4.2 in) opposed mode
.046 in (1.2 mm) individual pair*	**IM.753S**	295 mm (11.6 in) opposed mode
.062 in (1.6 mm) individual pair*	**IT13S**	442 mm (17.4 in) opposed mode
.125 in (3.2 mm) individual pair*	**IT23S**	930 mm (36.6 in) opposed mode
.027 in (0.7 mm) bifurcated	**BMM.443P**	15 mm (0.6 in) diffuse mode
.046 in (1.2 mm) bifurcated	**BM.753S**	46 mm (1.8 in) diffusemode
.062 in (1.6 mm) bifurcated	**BT13S**	68 mm (2.7 in) diffuse mode
.125 in (3.2 mm) bifurcated	**BT23S**	178 mm (7.0 in) diffuse mode

**Note:* *Individual glass fibers are used in pairs - two are required. Plastic fibers are sold in pairs.*



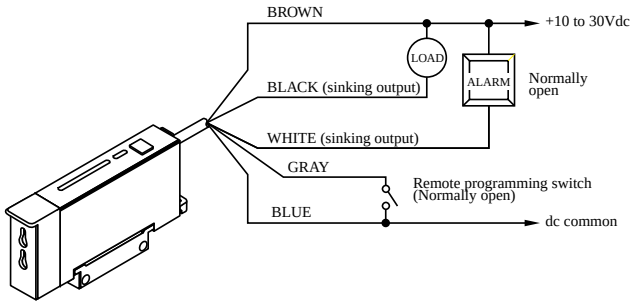
Product Specifications

Type	Description	Cable	Plastic Fiber Optics Model	Plastic Fiber Optics Part No.	Glass Fiber Optics Model	Glass Fiber Optics Part No.
NPN (sinking)	**Expert Series** (200µs response)	Attached, 2 m (6-1/2 ft) Attached, 9 m (30 ft)	**D12EN6FP** **D12EN6FP W/30**	41959 41960	**D12EN6FV** **D12EN6FV W/30**	41962 41963
PNP (sourcing)	**Expert Series** (200µs response)	Attached, 2 m (6-1/2 ft) Attached, 9 m (30 ft)	**D12EP6FP** **D12EP6FP W/30**	41965 41966	**D12EP6FV** **D12EP6FV W/30**	41968 41969
Required Fiber Optic Cable			PI Series or PB Series plastic fibers		I Series or B Series glass fibers	
Sensing Range	see maximum range tables, page 7					
Sensing Beam	Pulse modulated visible red, 680 nanometers					
Supply Voltage	10 to 30V dc at 45 mA max, exclusive of load; 10% ripple max.					
Supply Protection Circuitry	Protected against reverse polarity and load transient voltages					
Output Configuration	NPN - open collector (both outputs) or PNP - open collector (both outputs), depending on model; Load output: N.O. - programmable light or dark operate; Alarm output N.O.					
Output Rating	150 mA maximum each output; **Off-state leakage current** <10 microamps at 30V dc; **On-state saturation voltage** <1V at 10 mA dc; <1.5V at 150 mA dc; ***The* total load *may not exceed 150 mA***					
Output Protection Circuitry	No false pulse on power-up; (False pulse protection circuit causes a 0.1 second delay on power-up) Short circuit protected					
Output Response Time	200 microseconds "on" and "off" (40 milliseconds "off" when OFF-delay selected); Repeatability is 65µs					
Output Operation Mode	Light operate or dark operate; selected by push button					
Output Timing Functions	ON/OFF (no delay) or fixed 40 millisecond OFF-delay; selected by push button					
Indicators	Green LED lights for DC power ON and flashes when ready for teach mode: 1 Hz when ready to learn first condition; 2 Hz for second condition Yellow LED lights for load output ON (conducting) 7-segment moving dot red LED display indicates relative received light signal strength, output program settings, relative contrast level, and alarm					
Adjustments	Push button teach mode sensitivity setting; Remote teaching input is provided					
Construction	Black ABS (Cycolac® KJB) housing with acrylic cover; Rated NEMA 4; IEC IP66; The plastic fiber clamping element is Delrin®; Stainless steel M3 x 0,5 hardware for use with VALOX® mounting bracket (supplied)					
Cable	5 conductors: 2 m (6-1/2 ft) or 9 m (30 ft) attached PVC-covered					
Operating Temperature	-20° to +70°C (-5° to +158°F); Max. rel. humidity 90% at 50°C (non-condensing)					

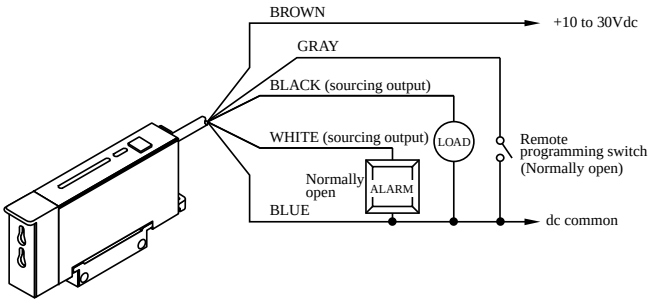
Cycolac® is a registered trademark of Borg-Warner
VALOX® is a registered trademark of General Electric
Delrin® is a registered trademark of Dupont

Hookup Diagrams

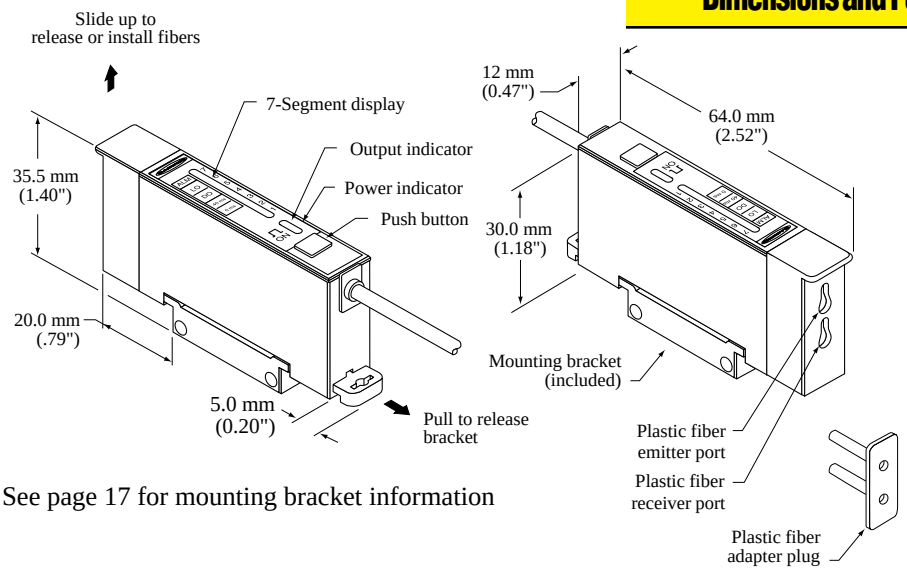
Hookup for NPN (sinking) models



Hookup for PNP (sourcing) models



Dimensions and Features (Plastic Fiber Optic Models)



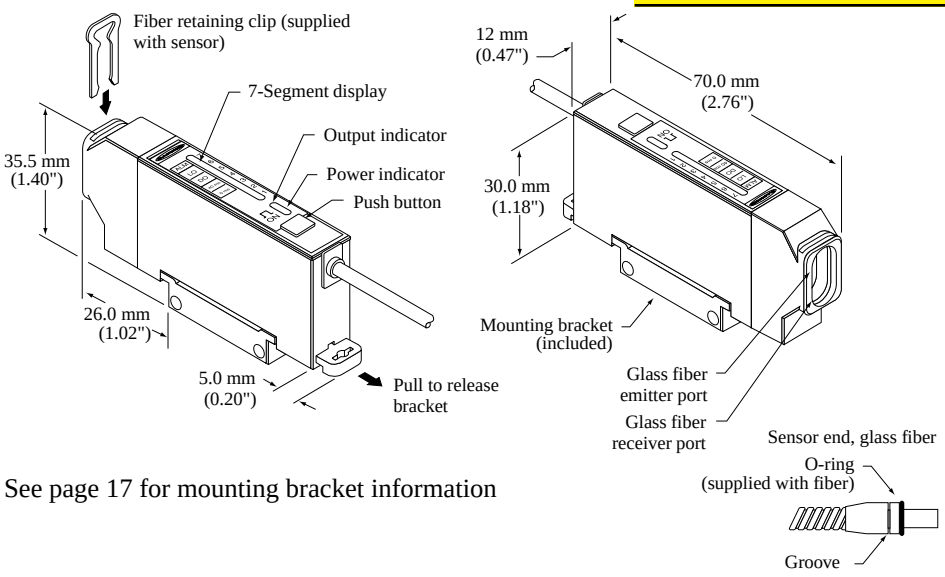
Adapter (supplied with sensor) is for use with 0.25 mm (.01") or 0.5 mm (.02") diameter fibers

Plastic fiber installation:

1. Cut fiber ends per instructions included with the fibers. Slide the fiber gripper up (open). For 0.25 or 0.5 mm dia. fibers, insert the adaptor (shown below) into the ports as far as it will go.
2. All fibers: Insert the prepared plastic fiber sensor ends gently into the ports as far as they will go.
3. Slide the fiber gripper back down to lock.

See page 17 for mounting bracket information

Dimensions and Features (Glass Fiber Optic Models)



Glass fiber installation

1. Slide the sensor ends of the fiber(s) into the D12's fiber ports as far as they will go.
2. Push firmly on the fiber ends to compress the o-rings (supplied with the fibers) and to align the grooves in the fiber ends with the slot above the emitter port. Slide the retaining clip into the slot and press the clip until it snaps into the grooves.

See page 17 for mounting bracket information

D12 Series Standard and High Speed Fiber Optic Sensors

Product Features

- Fiber optic sensors for DIN rail mounting; cabled or QD
- Fast response: 500µs standard, 50µs for "Y" & "Y1" models
- Visibile red light source; models for use with either Banner glass or plastic fiber optic assemblies
- Choice of either NPN (sinking) or PNP (sourcing) complementary outputs; 150mA max. (continuous) load
- Normally closed output of most models may be wired as a diagnostic alarm output (depending on hookup to power)*
- Sensors operate from 10-30V dc
- LED indicators for POWER ON and N.O. OUTPUT CONDUCTING
- 7-segment LED bargraph† indicates received signal strength OUTPUT OVERLOAD, and MARGINAL EXCESS GAIN

Standard D12**FP** and D12**FV** plastic and glass fiber optic sensors offer fast 0.5 millisecond (500 µs) response. D12**FPY** Series and D12**FVY** Series sensors have switch-selectable 50µs/500µs response modes for applications that require a faster, high speed response time (50µs as compared to the 500µs of FP and FV models). D12**FPY1** and D12**FVY1** models have switch-selectable response times along with a built-in 20 millisecond pulse stretcher for use with loads (or input circuits) that are too slow to react to quick sensing events when using the 50µs response mode.

All models operate from 10-30V dc. D12s are available with a choice of NPN or PNP complementary outputs (one output normally open, one output normally closed). The normally closed output of **FP** and **FV** models (only) may be used as a diagnostic alarm output, depending upon the hookup of the sensor to the power supply*. All models are available with either an attached cable or a 150 mm pigtail with a pico-type quick disconnect connector. A complete listing of models is given on page 12.

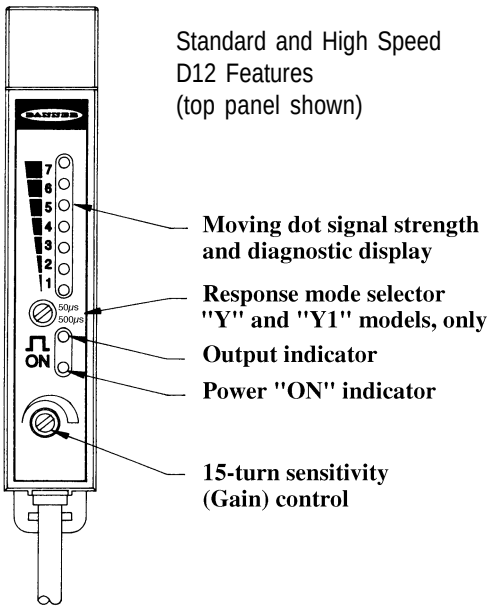
Plastic fiber models may be used with either the small diameter (0.25 and 0.5 mm) or large diameter (1.0 and 1.5 mm) Banner cut-to-length plastic fibers.

Two top-mounted LED indicators (see drawing, below) light to indicate POWER ON and NORMALLY OPEN OUTPUT CONDUCTING conditions.

On all D12 sensors operating in the 500µs (standard) response mode, a red seven-segment moving-dot LED bargraph† (below) lights to indicate the relative strength of the received light signal. This feature can greatly simplify sensitivity adjustment and the task of fiber optic alignment, as well as provide a constant indication of sensing system performance. In all models, and in both response modes, segment #1 of the bargraph flashes to indicate an output overload. On all sensors operating in the 500µs response mode, segment #7 flashes to indicate marginal excess gain. On standard (**FP** and **FY**) models, a flashing LED corresponds to the "on" state of the D12's alarm output.

D12s have a 15-turn SENSITIVITY control, with a slotted brass screw clutched at both ends of travel.

D12s are constructed of black ABS (Cycolac® KJB). The transparent housing cover is acrylic. Sensors are completely sealed. All D12 sensors are rated NEMA 4.



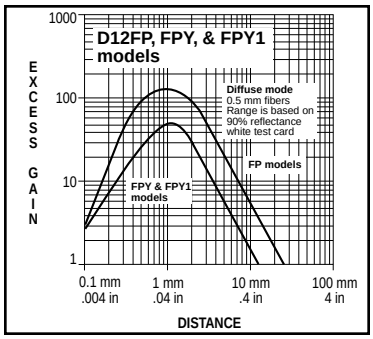
Standard and High Speed D12 Features (top panel shown)

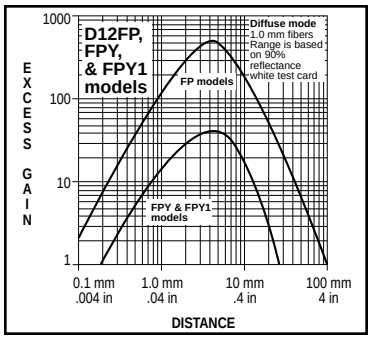
* U.S. Patent #5087838
† U.S. Patent #4965548

Range and Gain Information for D12 Series Plastic Fiber Optic Sensors

D12SN6FP(Q) NPN sinking complementary outputs (standard 500µs response time)
D12SN6FPY(Q) NPN sinking complementary outputs (with selectable 50µs high speed response mode)
D12SN6FPY1(Q) NPN sinking complementary outputs (with selectable 50µs high speed response mode and 20 ms pulse stretcher)

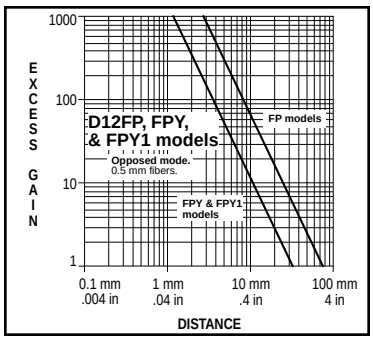
D12SP6FP(Q) PNP sourcing complementary outputs (standard 500µs response time)
D12SP6FPY(Q) PNP sourcing complementary outputs (with selectable 50µs high speed response mode)
D12SP6FPY1(Q) PNP sourcing complementary outputs (with selectable 50µs high speed response mode and 20 ms pulse stretcher)

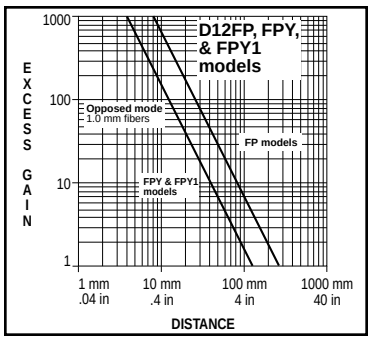


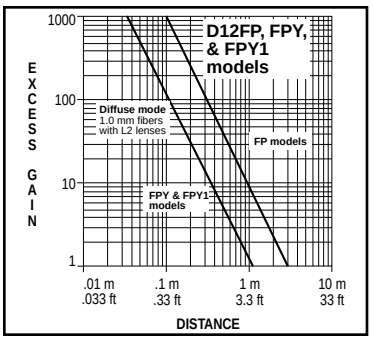


Excess gain curves for plastic fibers in the diffuse sensing mode are given to the left (top row). Fiber sizes are noted on the curves.

Excess gain curves for plastic fibers in the opposed mode are given below. Fiber sizes are noted on the curves. The curve at the far lower right uses model L2 lenses for extended sensing range (see Banner Product Catalog).



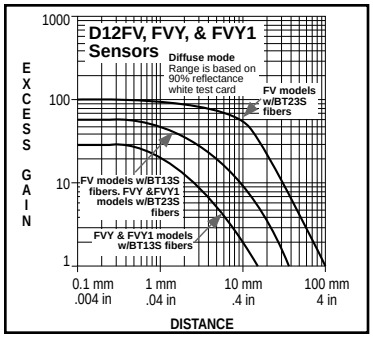


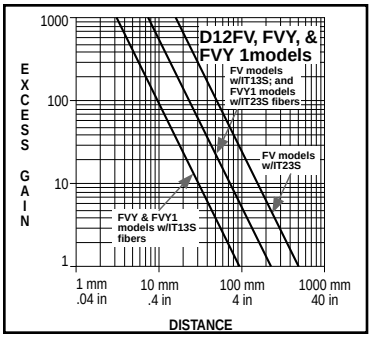


Range and Gain Information for D12 Series Glass Fiber Optic Sensors

D12SN6FV(Q) NPN sinking complementary outputs (standard 500µs response time)
D12SN6FVY(Q) NPN sinking complementary outputs (with selectable 50µs high speed response mode)
D12SN6FVY1(Q) NPN sinking complementary outputs (with selectable 50µs high speed response mode and 20 ms pulse stretcher)

D12SP6FV(Q) PNP sourcing complementary outputs (standard 500µs response time)
D12SP6FVY(Q) PNP sourcing complementary outputs (with selectable 50µs high speed response mode)
D12SP6FVY1(Q) PNP sourcing complementary outputs (with selectable 50µs high speed response mode and 20 ms pulse stretcher)





The excess gain curves for glass fibers in the diffuse sensing mode is given to the far left. Fiber size is noted on the curve.

The excess gain curves for glass fibers in the opposed mode are given to the immediate left . Fiber size is noted on the curve.

Note: A "Q" suffix in the model number specifies a 150 mm (6") pigtail with a 4-pin pico style QD. See the Product Specifications Chart for complete listing of D12 models and page 22 for mating QD cable information.

Product Specifications

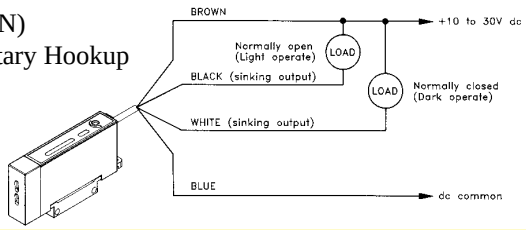
Type	Description	Cable	Plastic Fiber Optics Model	Plastic Fiber Optics Part No.	Glass Fiber Optics Model	Glass Fiber Optics Part No.
NPN (sinking)	**Standard** (500µs response)	Attached, 2 m (6-1/2 ft) Attached, 9 m (30 ft) 150 mm pigtail w/pico-style QD	**D12SN6FP** **D12SN6FP W/30** **D12SN6FPQ**	32820 35932 33712	**D12SN6FV** **D12SN6FV W/30** **D12SN6FVQ**	33710 35883 33714
	High Speed (selectable 50 or 500µs response)	Attached, 2 m (6-1/2 ft) Attached, 9 m (30 ft) 150 mm pigtail w/pico-style QD	**D12SN6FPY** **D12SN6FPY W/30** **D12SN6FPYQ**	34869 35936 35347	**D12SN6FVY** **D12SN6FVY W/30** **D12SN6FVYQ**	35400 35890 35402
	High Speed w/20ms pulse stretcher (selectable 50 or 500µs)	Attached, 2 m (6-1/2 ft) Attached, 9 m (30 ft) 150 mm pigtail w/pico-style QD	**D12SN6FPY1** **D12SN6FPY1 W/30** **D12SN6FPY1Q**	35501 36061 35503	**D12SN6FVY1** **D12SN6FVY1 W/30** **D12SN6FVY1Q**	35505 36062 35507
PNP (sourcing)	**Standard** (500µs response)	Attached, 2 m (6-1/2 ft) Attached, 9 m (30 ft) 150 mm pigtail w/pico-style QD	**D12SP6FP** **D12SP6FP W/30** **D12SP6FPQ**	32821 35933 33713	**D12SP6FV** **D12SP6FV W/30** **D12SP6FVQ**	33711 35884 33715
	High Speed (selectable 50 or 500µs response)	Attached, 2 m (6-1/2 ft) Attached, 9 m (30 ft) 150 mm pigtail w/pico-style QD	**D12SP6FPY** **D12SP6FPY W/30** **D12SP6FPYQ**	35348 35937 35349	**D12SP6FVY** **D12SP6FVY W/30** **D12SP6FVYQ**	35401 35931 35403
	High Speed w/20ms pulse stretcher (selectable 50 or 500µs)	Attached, 2 m (6-1/2 ft) Attached, 9 m (30 ft) 150 mm pigtail w/pico-style QD	**D12SP6FPY1** **D12SP6FPY1 W/30** **D12SP6FPY1Q**	35502 36063 35504	**D12SP6FVY1** **D12SP6FVY1 W/30** **D12SP6FVY1Q**	35506 36064 35508
Required Fiber Optic Cable			PI Series or PB Series plastic fibers		I Series or B Series glass fibers	

Sensing Range	see individual excess gain curves, page 11
Sensing Beam	visible red, 680 nanometers
Supply Voltage	10 to 30V dc at 45 mA max, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltage
Output Configuration	Complementary: one normally open (N.O.) and the other normally closed (N.C.); N.C. output may be wired as diagnostic alarm output by reversing power supply connections (see Hookups); Outputs are NPN (sinking) or PNP (sourcing), depending on model
Output Rating	150 mA maximum each output; **Off-state leakage current** <10 microamps at 30V dc; **On-state saturation voltage** <1V at 10 mA dc; <1.5V at 150 mA dc; ***The* total load *may not exceed 150 mA***
Output Protection Circuitry	No false pulse on power-up; (False pulse protection circuit causes a 0.1 second delay on power-up) Short circuit protected
Output Response Time	500 microseconds "on"; 500 microseconds "off"; **Repeatability** is 130 microseconds; "Y" and "Y1" models have selectable 50µs/500µs response; Repeatablility 50µs mode is 15µs.
Output Timing Functions	"Y1" models have fixed 20 ms pulse stretcher (off-delay) when in 50µs response mode
Indicators	Two top-mounted LED indicators, one yellow and one green, and one 7-segment red LED moving-dot bargraph; Note that the seven segment bargraph and marginal excess gain indication (bargraph segment #7) are inoperative in the 50µs response mode on "Y" and "Y1" models GREEN LED lights for DC POWER ON YELLOW LED lights for NORMALLY OPEN OUTPUT CONDUCTING On all models in 500µs response mode, the 7-segment moving dot red LED bargraph lights to indicate relative received light signal strength; On all models in 50 and 500µs response modes, segment #1 flashes to indicate OUTPUT OVERLOAD; On all models in the 500µs response mode, segment #7 flashes to indicate MARGINAL EXCESS GAIN; On standard FV and FP models, a flashing LED corresponds to the "on" state of the alarm output; (Alarm output not available on Ys & Y1s)
Adjustments	All models have a SENSITIVITY control on top of sensor (15-turn slotted brass screw, clutched at both ends of adjustment); "Y" and "Y1" (high speed models) also have a top-mounted response mode selector switch
Construction	Black ABS (Cycolac® KJB) housing with acrylic cover; Rated NEMA 4; IEC IP66; The plastic fiber clamping element is Delrin®; Stainless steel M3 x 0,5 hardware for use with VALOX® mounting bracket (supplied)
Cable	2 m (6-1/2 ft) or 9 m (30 ft) attached PVC-covered cable, or 150 mm (6-inch) pigtail with pico-type 4-pin QD connector; Mating QD cable is ordered separately (see page 22)
Operating Temperature	-20° to +70°C (-5° to +158°F); Max. rel. humidity 90% at 50°C (non-condensing)

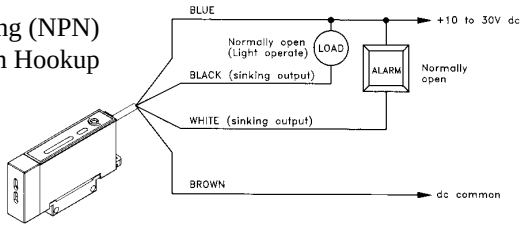
Cycolac® is a registered trademark of Borg-Warner, VALOX® is a registered trademark of General Electric, Delrin® is a registered trademark of Dupont

Hookup Diagrams

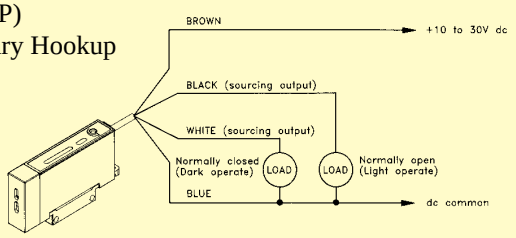
Sinking (NPN)
Complementary Hookup



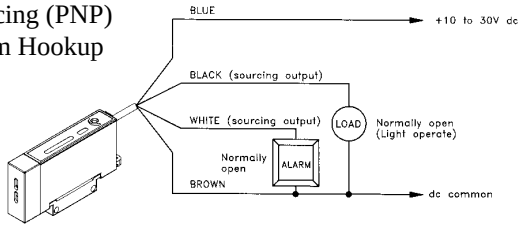
Sinking (NPN)
Alarm Hookup



Sourcing (PNP)
Complementary Hookup

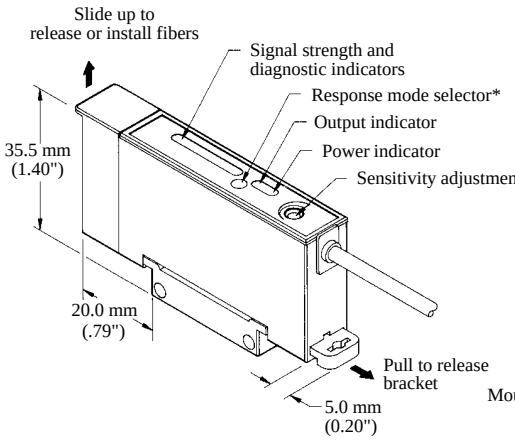


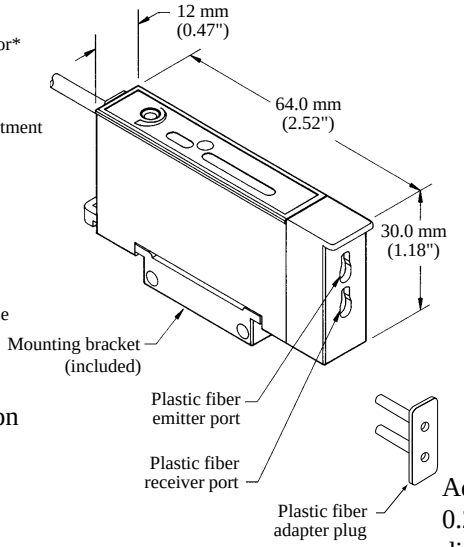
Sourcing (PNP)
Alarm Hookup



Note 1: FPY, FPY1, FVY, and FVY1 models use complementary hookup only.
Note 2: Models with"Q" suffix require mating QD cable, ordered separately, see page 22.

Dimensions and Features (Plastic Fiber Optic Models)





Plastic fiber installation:

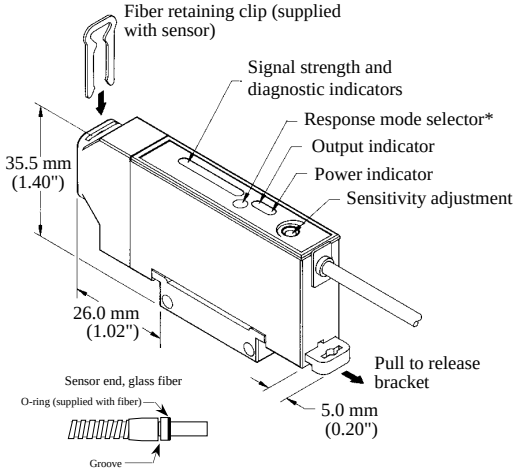
1. Cut fiber ends per instructions included with the fibers. Slide the fiber gripper up (open). For 0.25 or 0.5 mm dia. fibers, insert the adaptor (shown below) into the ports as far as it will go.
2. All fibers: Insert the prepared plastic fiber sensor ends gently into the ports as far as they will go.
3. Slide the fiber gripper back down to lock.

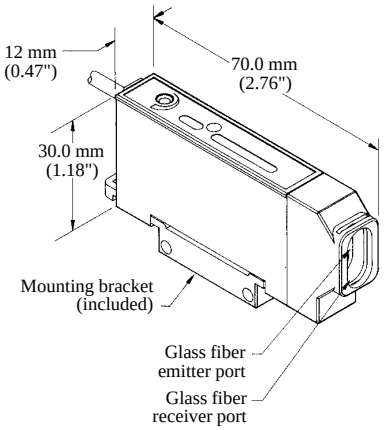
See page 17 for mounting bracket information

* Response Mode Selection on "Y" and "Y1" models only

Adaptor (included) is for use with 0.25 mm (.010") or 0.5 mm (.020") diameter fibers.

Dimensions and Features (Glass Fiber Optic Models)





Glass fiber installation

1. Slide the sensor ends of the fiber(s) into the D12's fiber ports as far as they will go.
2. Push firmly on the fiber ends to compress the o-rings (supplied with the fibers) and to align the grooves in the fiber ends with the slot above the emitter port. Slide the retaining clip into the slot and press the clip until it snaps into the grooves.

See page 17 for mounting bracket information

D12FPH High Power Fiber Optic Sensors

Product Features

- Highest optical power available in a plastic fiber optic sensor
- Visibile red light source; for use with Banner cut-to-length plastic fiber optic assemblies
- Models for glass fibers optics available by special order
- Choice of either NPN (sinking) or PNP (sourcing) complementary outputs; 150mA max. (continuous) load
- Normally closed output may be wired as a diagnostic alarm output (depending on hookup to power)*
- Sensors operate from 10-30V dc
- LED indicators for POWER ON and N.O. OUTPUT CONDUCTING
- 7-segment LED bargraph† indicates received signal strength OUTPUT OVERLOAD, and MARGINAL EXCESS GAIN

D12FPH Series sensors are designed for use with Banner cut-to-length plastic fiber optic assemblies. They may be used in the opposed and diffuse fiber optic sensing modes. D12FPH Series sensors have the highest optical power available in a plastic fiber optic sensor. *Note: High power models for glass fiber optics are available by special order. Contact your Banner sales engineer to discuss the details of your application.*

D12FPH's operate from 10-30V dc. Models are available with a choice of NPN or PNP complementary outputs (one output normally open, one output normally closed). The normally closed output of all models may be used as a diagnostic alarm output, depending upon the hookup of the sensor to the power supply*. All models are available with either an attached cable or a 150 mm pigtail with a pico-style quick disconnect connector. A complete listing of models is given on page 15 or 16.

Each output is capable of 150 mA continuous load. The choice of NPN (sinking) or PNP (sourcing) models enables D12 sensors to interface to a wide variety of loads.

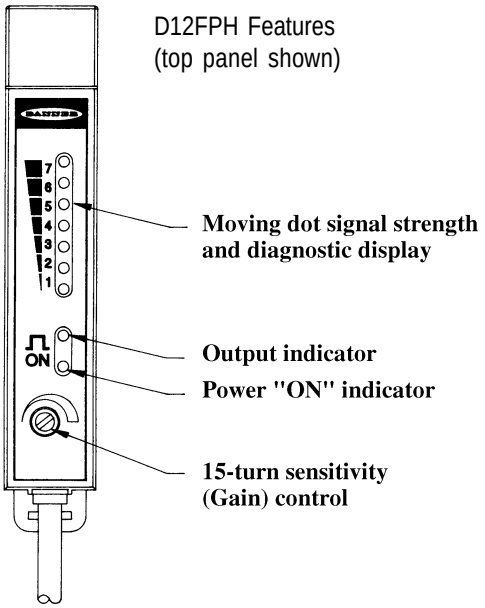
Two top-mounted LED indicators (see drawing, below) light to indicate POWER ON and NORMALLY OPEN OUTPUT CONDUCTING conditions.

A highly-visible red 7-segment moving-dot LED bargraph† (below) lights to indicate the relative strength of the received light signal. This feature can greatly simplify sensitivity adjustment and the task of fiber optic alignment, as well as provide a constant indication of sensing system performance. Also, segment #1 of the bargraph flashes to indicate an output overload, and segment #7 flashes to indicate marginal excess gain. A flashing LED corresponds to the "on" state of the D12's alarm output.

D12s have a 15-turn SENSITIVITY control, with a slotted brass screw clutched at both ends of travel.

D12FPH Series sensors may be used with either the small diameter (0.25 and 0.5 mm) or large diameter (1.0 and 1.5 mm) Banner cut-to-length plastic fibers.

See page 17 for sensor hookup and dimension information. D12 Sensors mount directly to a standard DIN rail. They may also be through-hole mounted to a surface using the supplied bracket (see page 17) and stainless steel M3 x 0,5 mounting hardware.



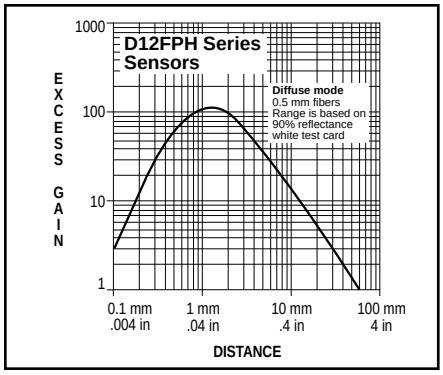
D12FPH Features
(top panel shown)

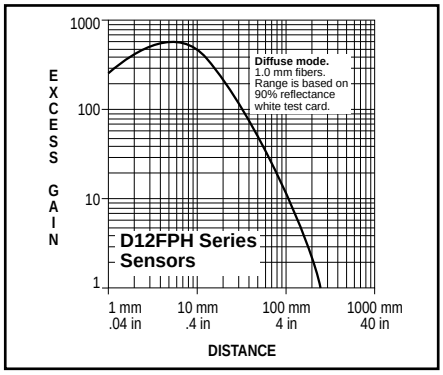
* U.S. Patent #5087838
† U.S. Patent #4965548

Range and Gain Information for D12 FPH Series Plastic Fiber Optic Sensors

The following D12 FPH high power models are available for use with plastic fiber optics:

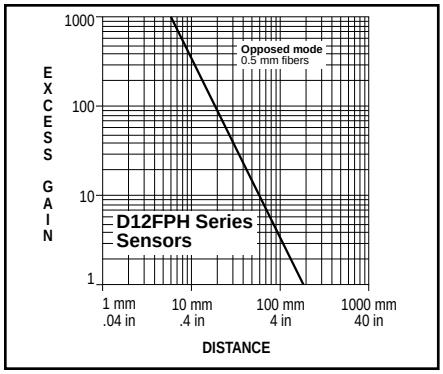
D12SN6FPH	p/n 34464	NPN sinking complementary outputs, 2 meter attached cable.
D12SN6FPH W/30	p/n 35934	NPN sinking complementary outputs, 9 meter attached cable.
D12SN6FPHQ	p/n 34973	NPN sinking complementary outputs, 150 mm pigtail with pico-style QD.
D12SP6FPH	p/n 34972	PNP sourcing complementary outputs, 2 meter attached cable.
D12SP6FPH W/30	p/n 35935	PNP sourcing complementary outputs, 9 meter attached cable.
D12SP6FPHQ	p/n 34974	PNP sourcing complementary outputs, 150 mm pigtail with pico-style QD.

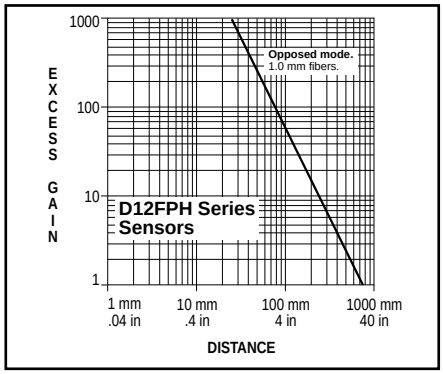


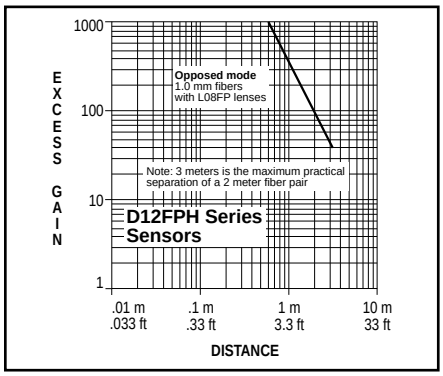


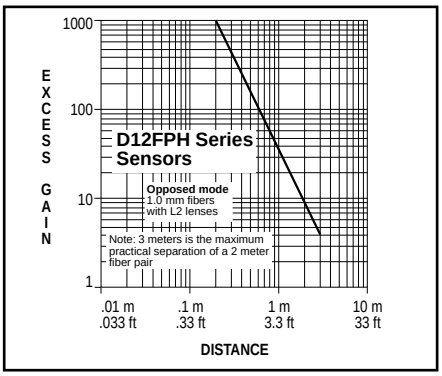
Diffuse Sensing Mode

Excess gain curves for bifurcated plastic fibers in the diffuse sensing mode are given to the left. Fiber sizes are noted on the curves.









Opposed Sensing Mode

Excess gain curves for individual plastic fibers in the opposed sensing mode (without lenses) are given to the left. Fiber sizes are noted on the curves.

The curve at the far lower left shows the performance of two individual unterminated 1.0 mm dia. plastic fibers, each fitted with a model L08FP lens (see Banner Product Catalog). The curve at the near lower left shows the performance of two individual threaded 1.0 mm dia. plastic fibers (PIT4 Series), each fitted with a model L2 lens (see Banner Product Catalog). Note that, in both lensed situations, the curves stop at 3 meters separation (the maximum practical separation of the sensing ends for a pair of 2-meter single fiber assemblies).

Product Specifications

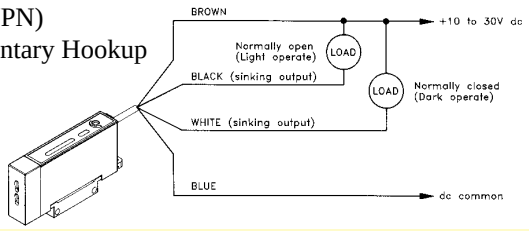
Type	Description	Cable	Plastic Fiber Optics Model	Plastic Fiber Optics Part No.	Glass Fiber Optics Special Order
NPN (sinking)	**High Power** (500µs response)	Attached, 2 m (6-1/2 ft) Attached, 9 m (30 ft) 150 mm pigtail w/pico-style QD	**D12SN6FPH** **D12SN6FPH W/30** **D12SN6FPHQ**	34464 35934 34973	Contact your Banner Sales Engineer or factory Applications Engineering Department
PNP (sourcing)	**High Power** (500µs response)	Attached, 2 m (6-1/2 ft) Attached, 9 m (30 ft) 150 mm pigtail w/pico-style QD	**D12SP6FPH** **D12SP6FPH W/30** **D12SP6FPHQ**	34972 35935 34974	Contact your Banner Sales Engineer or factory Applications Engineering Department
Required Fiber Optic Cable			PI Series or PB Series plastic fibers		I Series or B Series glass fibers

Sensing Range	see individual excess gain curves, page 15
Sensing Beam	visible red, 660 nanometers
Supply Voltage	10 to 30V dc at 45 mA max, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltage
Output Configuration	Complementary: one normally open (N.O.) and the other normally closed (N.C.); N.C. output may be wired as diagnostic alarm output by reversing power supply connections (see Hookups); Outputs are NPN (sinking) or PNP (sourcing), depending on model
Output Rating	150 mA maximum each output; **Off-state leakage current** <10 microamps at 30V dc; **On-state saturation voltage** <1V at 10 mA dc; <1.5V at 150 mA dc; ***The* total load *may not exceed 150 mA.***
Output Protection Circuitry	No false pulse on power-up; (False pulse protection circuit causes a 0.1 second delay on power-up;) Short-circuit protected
Output Response Time	500 microsecond "on"; 500 microsecond "off"; **Repeatability** is 130 microseconds; *Response time and repeatability are independent of signal strength*
Indicators	Two top-mounted LED indicators, one yellow and one green, and one 7-segment red LED moving-dot bargraph; GREEN LED lights to indicate DC POWER ON YELLOW LED lights to indicate NORMALLY OPEN OUTPUT CONDUCTING 7-segment moving dot red LED bargraph lights to indicate relative received light signal strength; In addition, segment #1 flashes to indicate OUTPUT OVERLOAD, and segment #7 flashes to indicate MARGINAL EXCESS GAIN (i.e. a "dark" signal that lights LED #2 for at least one second, or a "light" signal that lights LED #3 for at least one second); A flashing LED corresponds to the “on” state of the alarm output
Adjustments	SENSITIVITY control on top of module (15-turn slotted brass screw, clutched at both ends of adjustment)
Construction	Black ABS (Cycolac® KJB) housing with acrylic cover; Rated NEMA 4; IEC IP66; The plastic fiber clamping element is Delrin®; Stainless steel M3 x 0,5 hardware for use with VALOX® mounting bracket (supplied)
Cable	2 m (6-1/2 ft) or 9 m (30 ft) long attached PVC-covered cable, or 150 mm (6") pigtail with pico-style 4-pin QD connector; Mating QD cable is ordered separately (see page 22)
Operating Temperature	-20° to +70°C (-5° to +158°F); Max. rel. humidity 90% at 50°C (non-condensing)

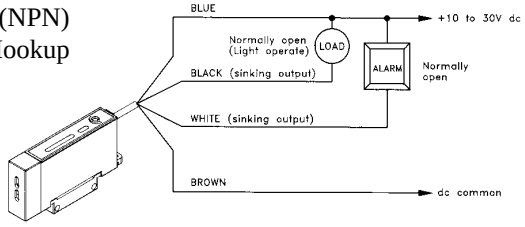
Cycolac® is a registered trademark of Borg-Warner
VALOX® is a registered trademark of General Electric
Delrin® is a registered trademark of Dupont

Hookup Diagrams

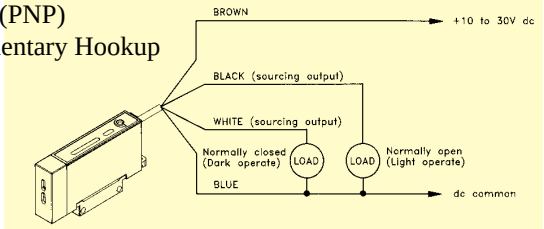
Sinking (NPN)
Complementary Hookup



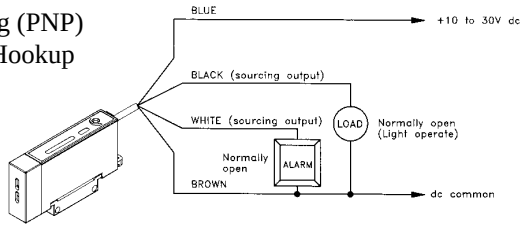
Sinking (NPN)
Alarm Hookup



Sourcing (PNP)
Complementary Hookup

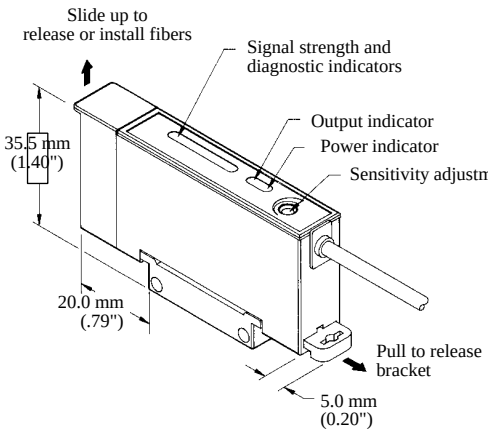


Sourcing (PNP)
Alarm Hookup

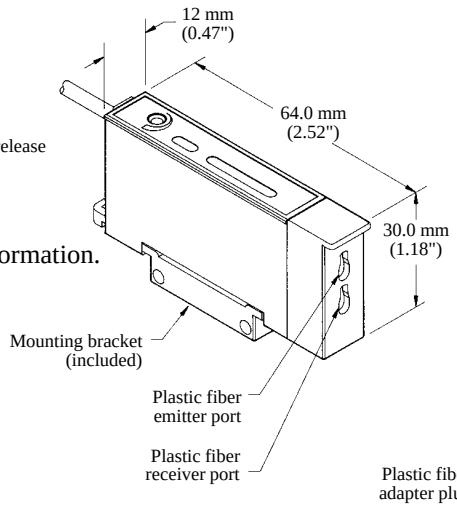


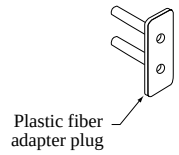
Note: Models with"Q" suffix require mating QD cable, ordered separately. See page 22.

Dimensions and Features (Plastic Fiber Optic Models)



See page below for mounting bracket information.



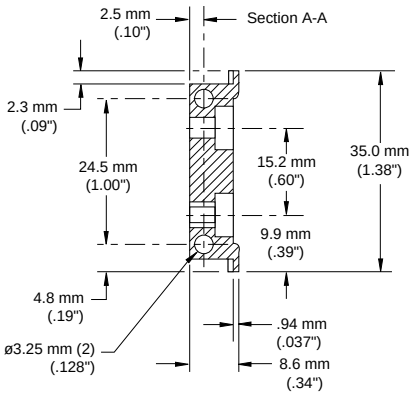


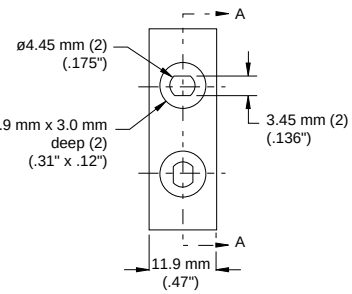
Plastic fiber installation:

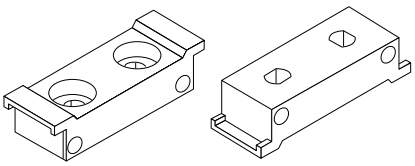
1. Cut fiber ends per instructions included with the fibers. Slide the fiber gripper up (open). For 0.25 or 0.5 mm dia. fibers, insert the adaptor (shown below) into the ports as far as it will go.
2. All fibers: Insert the prepared plastic fiber sensor ends gently into the ports as far as they will go.
3. Slide the fiber gripper back down to lock.

Adaptor (included) is for use with 0.25 mm (.010") or 0.5 mm (.020") diameter fibers.

Mounting Bracket Information







D12DAB6 AC-Coupled Fiber Optic Sensors

Product Features

- Highly sensitive to very small signal changes; fast response
- Automatic gain control circuit continually adjusts emitter output to maintain system gain
- Ideal for low contrast applications such as web flaw, thread break, and falling parts detection
- Sensors operate from 10-30V dc
- One NPN (sinking) and PNP (sourcing) output; 150 mA max. (continuous) load
- LED indicators for POWER ON, OUTPUT CONDUCTING, and AGC LOCK conditions
- Selectable light- or dark-operate; no false pulse on power-up
- Adjustable output pulse
- D12DAB6FPs for plastic fibers; D12DAB6FVs for glass fibers

D12DAB6 Series fiber optic sensors are intended for applications in which the light signal change is so small that sensitivity adjustment of ordinary dc-coupled sensors is difficult or impossible. D12DAB6 Series sensors can respond to even smaller signal changes than the D12 Expert sensors, and are less affected by gradual signal changes due to dirt buildup, etc. Typical applications include thread break detection, web flaw detection, and detection of small parts falling randomly from vibratory feeders or small presses.

Many low contrast photoelectric sensing applications present problems to dc-coupled sensors because of *switching hysteresis*. Switching hysteresis is a designed-in property of most sensors that causes the "turn-on point" of a sensor's dc-coupled amplifier to be slightly different than the "turn-off point". This is to prevent indecision and erratic operation of the sensor's output circuit when the light signal is at or near the switching point of the dc-coupled amplifier.

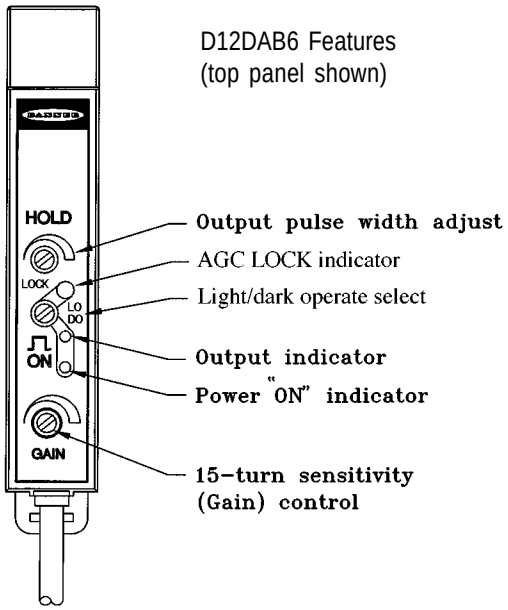
With their ac-coupled amplifier, D12DAB6 Series sensors reliably amplify the small signal changes found in many low contrast sensing applications. An automatic gain control (AGC) feedback system locks onto the light signal and continually adjusts the light intensity of the emitter so that the system is always maintained at the desired reference level, regardless of the sensing range or the degree of environmental contamination. A multi-turn control enables setting of the amplifier sensitivity.

D12DAB6 Series sensors operate from +10 to 30V dc, and have two normally open outputs: one NPN (sinking) and one PNP (sourcing). Maximum switching capacity for each output is 150 mA (continuous). A hookup diagram and dimension information is given on page 21.

Model D12DAB6FV models are for use with Banner glass fiber optic assemblies. The D12DAB6FP plastic fiber models may be used with either the small diameter (0.25 or 0.5 mm) or large diameter (1.0 or 1.5 mm) Banner cut-to-length plastic fiber optics.

D12DAB6 Series sensors have a POWER ON indicator, a LOCK indicator that lights when the AGC circuit has locked onto the signal, and a LOAD indicator that lights whenever the sensor's outputs are energized.

D12DAB6 Features
(top panel shown)



A switch on the sensor's top panel selects either light- or dark-operate. When light-operate is selected, output occurs on a dark-to-light transition. When dark-operate is selected, output occurs on a light-to-dark transition.

AC-Coupled sensors amplify only changing light levels. As a result, the output is in the form of a timed pulse. The output pulse duration is adjustable from 1 to 70 milliseconds (.001 to .070 seconds).

D12s are constructed of rugged black ABS (Cycolac® KJB). They are designed for mounting directly to a 35 mm DIN rail, or may be mounted via a convenient through-hole bracket (included, see page 17). The transparent housing cover is acrylic. Sensors are completely sealed All D12 sensors are rated NEMA 4 (IEC IP 66).

Sensors are available with either 2 m (6-1/2 foot) or 9 m (30 foot) attached PVC-jacketed cable, or a 150 mm pigtail with attached 4-pin pico-type QD connector. A complete model listing appears on page 20.

Sensing Modes and Ranges for Plastic Fibers

Sensing Mode	Fiber Diameter	Sensing Range
Opposed	0.5 mm (.020") fibers, no lenses	13 mm (0.5 in)
Diffuse	0.5 mm (.020") fibers, no lenses	5 mm (0.2 in); distance to 90% reflectance white test card
Opposed	1.0 mm (.040") fibers, no lenses	76 mm (3 in)
Opposed	1.0 mm (.040") fibers, L2 lenses	760 mm (30 in)
Opposed	1.0 mm (.040") fibers, L08 lenses	> 3 m (10 ft*)
Diffuse	1.0 mm (.040") fibers, no lenses	25 mm (1 in); distance to 90% reflectance white test card

* Range exceeds maximum practical separation of sensing ends for a pair of 2-meter individual fibers.

Sensing Modes and Ranges for Glass Fibers

Sensing Mode	Fiber Bundle Diameter	Sensing Range
Opposed	0.062 in (1.6 mm) fibers, no lenses	75 mm (3 in)
Opposed	0.062 in (1.6 mm) fibers, L9 lenses	> 150 cm (60 in)*
Opposed	0.062 in (1.6 mm) fibers, L16F lenses	> 150 cm (60 in)*
Diffuse	0.062 in (1.6 mm) fibers, no lenses	25 mm (1 in); distance to 90% reflectance white test card
Opposed	0.125 in (3.2 mm) fibers, no lenses	20 mm (8 in)
Opposed	0.125 in (3.2 mm) fibers, L9 lenses	> 150 cm (60 in)*
Opposed	0.125 in (3.2 mm) fibers, L16F lenses	> 150 cm (60 in)*
Diffuse	0.125 in (3.2 mm) fibers, no lenses	60 mm (2.5 in); distance to 90% reflectance white test card

* Range exceeds maximum practical separation of sensing ends for a pair of 3-foot individual fibers.

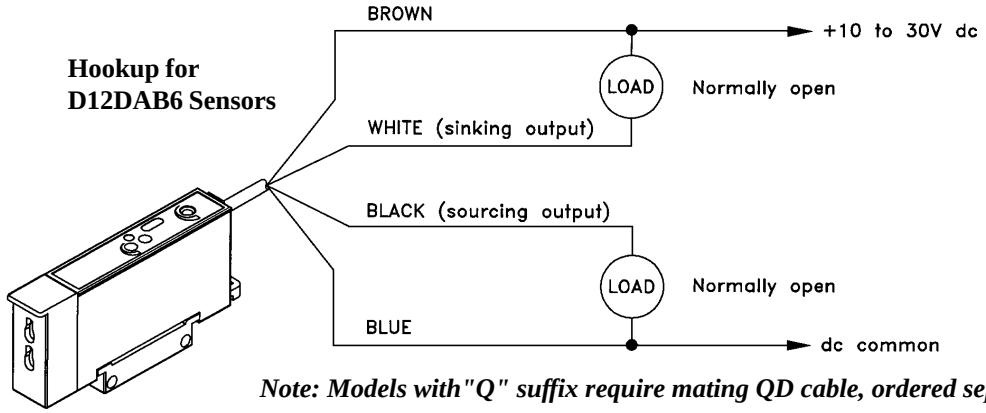
Product Specifications

Description	Cable	Plastic Fiber Optics Model	Plastic Fiber Optics Part No.	Glass Fiber Optics Model	Glass Fiber Optics Part No.
AC-Coupled (50µs "on" response)	Attached, 2 m (6 1/2 ft) Attached, 9 m (30 ft) 150 mm pigtail w/pico-style QD	**D12DAB6FP** **D12DAB6FP W/30** **D12DAB6FPQ**	38382 39544 39543	**D12DAB6FV** **D12DAB6FV W/30** **D12DAB6FVQ**	39545 39547 39546
Required Fiber Optic Cable		PI Series or PB Series plastic fibers		I Series or B Series glass fibers	
Sensing Range	see Sensing Modes and Ranges, page 19				
Sensing Beam	visible red, 680 nanometers				
Supply Voltage	10 to 30V dc at 60 mA max, exclusive of load				
Supply Protection Circuitry	Protected against reverse polarity and transient voltages				
Output Configuration	Bipolar: one NPN (current sinking) and one PNP (current sourcing) open-collector transistor				
Output Rating	150 mA maximum each output; **Off-state leakage current** <10 microamps at 30V dc; **On-state saturation voltage** <1V at 10 mA dc; <1.5V at 150 mA dc; ***The* total load *may not exceed 150 mA.***				
Output Protection Circuitry	No false pulse on power-up; (False pulse protection circuit causes a 0.1 second delay on power-up;) Short-circuit protected;				
Output Response Time	50 microseconds "on"; **Repeatability** is 15 microseconds "on"				
Output Operation Mode	Light operate or dark operate; selected by switch				
Output Timing Functions	Pulse output; adjustable from 1 to 70 milliseconds				
Indicators	Three top-mounted LED indicators, one yellow and one green, and one red GREEN LED lights to indicate DC POWER ON YELLOW LED lights for OUTPUT CONDUCTING RED LED lights whenever AGC system is locked onto the signal				
Adjustments	(three top-panel controls): SENSITIVITY control (15-turn slotted brass screw, clutched at both ends of adjustment), a LIGHT- or DARK-OPERATE select switch, and an OUTPUT PULSE adjustment (3/4-turn potentiometer)				
Construction	Black ABS (Cycolac® KJB) housing with acrylic cover; Rated NEMA 4; IEC IP66; The fiber clamping element is Delrin®; Stainless steel M3 x 0,5 hardware for use with VALOX® mounting bracket (supplied)				
Cable	2 m (6-1/2-foot) or 9 m (30-foot) attached PVC-covered cable, or 150 mm pigtail with pico-type 4-pin QD connector; Mating QD cable is ordered seperately (see page 22)				
Operating Temperature	-40° to +70°C (-40° to +158°F); Max. rel. humidity 90% at 50°C (non-condensing)				

Cycolac® is a registered trademark of Borg-Warner
VALOX® is a registered trademark of General Electric
Delrin® is a registered trademark of Dupont

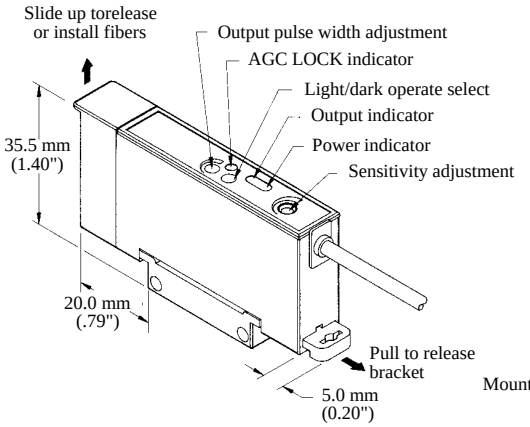
Hookup Diagrams

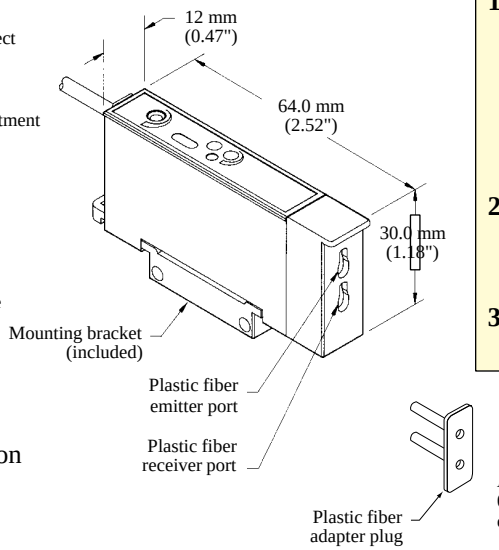
Hookup for D12DAB6 Sensors



Note: Models with"Q" suffix require mating QD cable, ordered separately. See page 22.

Dimensions and Features (Plastic Fiber Optic Models)





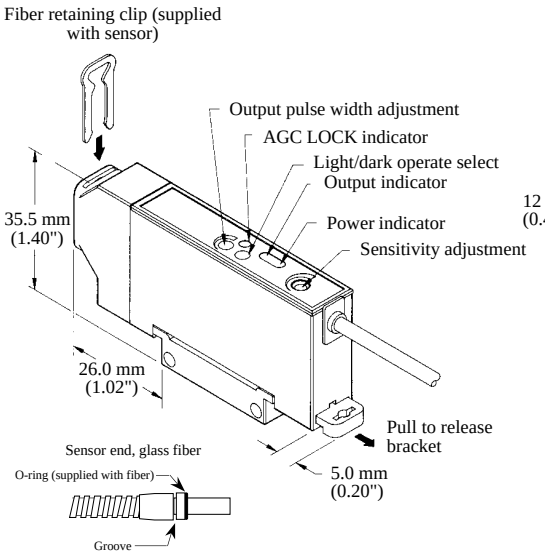
See page 17 for mounting bracket information

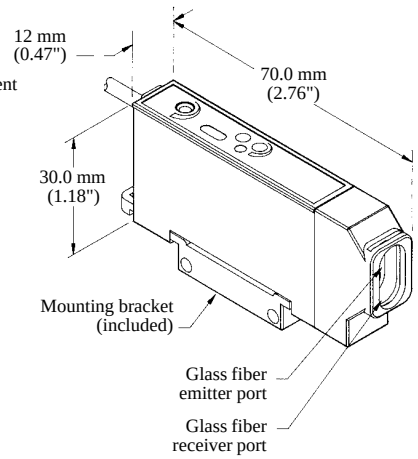
Plastic fiber installation:

1. Cut fiber ends per instructions included with the fibers. Slide the fiber gripper up (open). For 0.25 mm or 0.5 mm dia. fibers, insert the adaptor (shown below) into the ports as far as it will go.
2. All fibers: Insert the prepared plastic fiber sensor ends gently into the ports as far as they will go.
3. Slide the fiber gripper back down to lock.

Adaptor (included) is for use with 0.25 mm (.010") and 0.5 mm (.020") diameter fibers.

Dimensions and Features (Glass Fiber Optic Models)





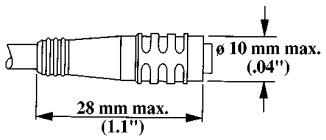
See page 17 for mounting bracket information

Glass fiber installation

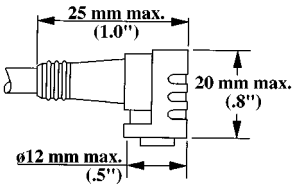
1. Slide the sensor ends of the fiber(s) into the D12's fiber ports as far as they will go.
2. Push firmly on the fiber ends to compress the o-rings (supplied with the fibers) and to align the grooves in the fiber ends with the slot above the emitter port. Slide the retaining clip into the slot and press the clip until it snaps into the grooves.

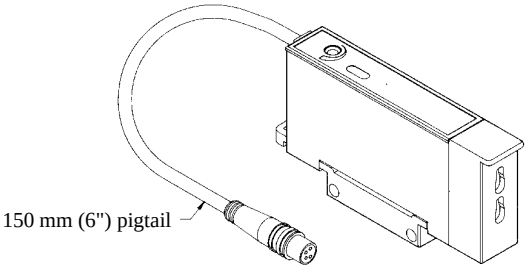
Quick-Disconnect Information

Model PKG4-2 cable (straight connector)
4-wire cable p/n 32438
length 2 meters (6-1/2 feet)



Model PKW4-2 cable (right-angle connector)
4-wire cable p/n 34462
length 2 meters (6-1/2 feet)





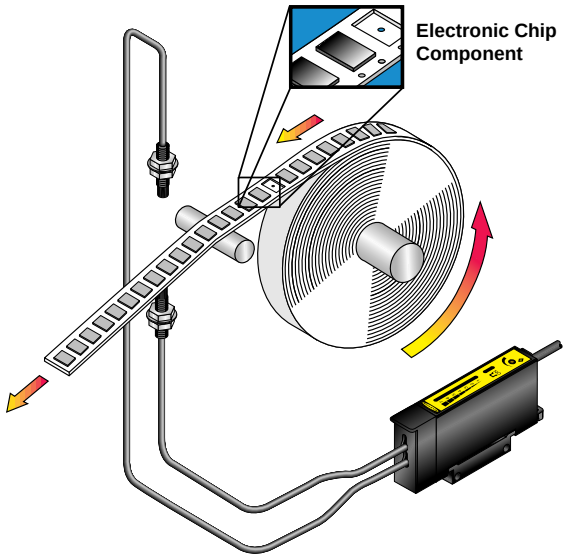
D12 Series Application Examples

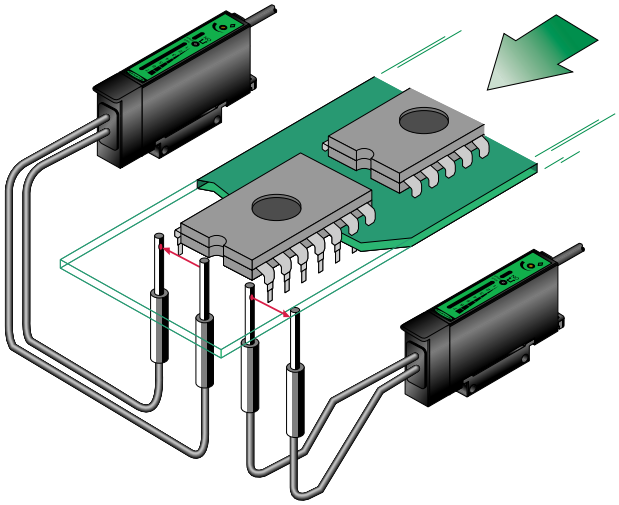
Objective: Sense the absence of an integrated circuit (IC) in plastic tape.

Sensor Model: **D12SN6FP** or **D12SP6FP**

Fiber Optic Model: **PIT46U** or equivalent

Operation: Surface mount integrated circuits are packaged in a black plastic web with pockets to hold the components. There are holes in the pockets which are covered when the component is present. The opposed beam is located so the beam is established when a part is not present in the pocket.





Objective: Count the leads on an integrated circuit

Sensor Model: **D12SN6FPY** or **D12SP6FPY**

Fiber Optic Model: **PIPSM26U** or equivalent

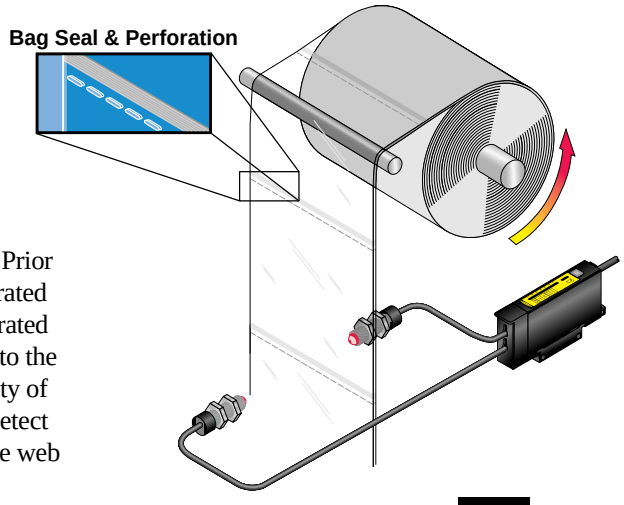
Operation: Leaded integrated circuits are mounted on a circuit board. Before the leads are trimmed, the boards are inspected to ensure proper insertion of the IC into the board. Miniature, "side view", opposed mode fibers are used to count the leads. Two pairs are used to sense both rows of leads simultaneously.

Objective: To sense the perforations in a continuous web of clear plastic

Sensor Model: **D12EN6FP** or **D12EP6FP**

Fiber Optic Model: **PIL46U** or equivalent

Operation: Plastic packaging bags are manufactured in a continuous web with perforations between bags. Prior to filling the bags with product, the bags are separated from the web. To ensure the bag is properly separated from the web, a sensor is needed to send a signal to the separation mechanism. The low contrast capability of the D12 Expert sensor, with PIL46U fibers, can detect the difference between the web and the slots in the web formed by the perforations.



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