BANNER®
more sensors, more solutions

FI22FP Series

Low-Profile, Inline Plastic Fiber Optic Sensor

CE
c UL us

Features

- Low-profile fiber optic sensors are designed for inconspicuous surface mounting
- 8-segment LED light bar indicates relative received signal strength, sensing contrast, programming status, and diagnostic warnings
- Easy-to-set automatic *Expert*-style TEACH options including static, dynamic, and single-point programming plus manual adjustment for fine-tuning
- Smart power-control algorithms to maximize sensing contrast
- Fast 500-microsecond sensing response
- Programmable 30-millisecond pulse stretcher (OFF delay)
- Extreme programming flexibility via two push buttons or a remote input wire
- Output may be programmed for either light or dark operate
- Bipolar discrete outputs: one current sourcing (PNP) and one current sinking (NPN)
- Visible red (660 nm) light source
- Easy-to-read TEACH and signal strength readout, plus indicators for a continuous readout of operating status

Models

Model	Cable*	Supply Voltage	Output Type	Maximum Range**
FI22FP	2 m (6.5') 5-wire integral cable	10V dc to 30V dc	Bipolar NPN/PNP	**Range varies depending on sensing mode and fiber optic(s) used; see below and page 2 for typical values.** **Opposed Mode** **PIT26U Fiber:** 60 mm (2.36") **PIT46U Fiber:** 260 mm (10.24") **PIT66U Fiber:** 540 mm (21.26")
FI22FPQ	Integral 6-pin Pico-style QD			**Diffuse Mode** **PBT26U Fiber:** 15 mm (0.59") **PBT46U Fiber:** 65 mm (2.56") **PBT66U Fiber:** 115 mm (4.53")

*9 m (30') cables are available by adding suffix "**W/30**" to the model number of any cabled sensor (e.g., **FI22FP W/30**). A model with a QD connector requires a mating cable (see page 9).

**See page 2 for beam patterns and excess gain curves.

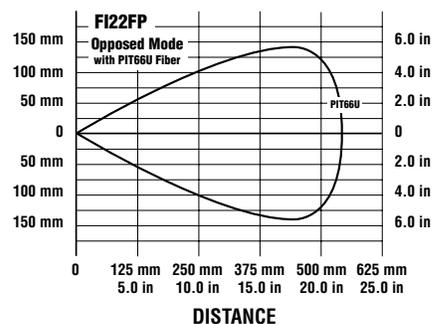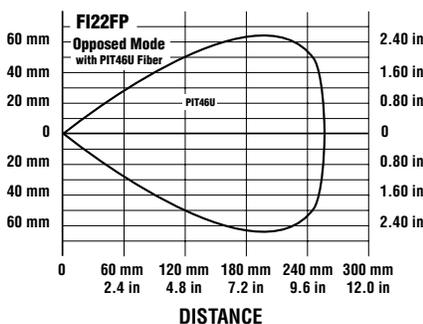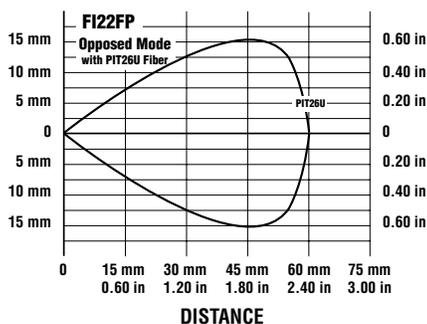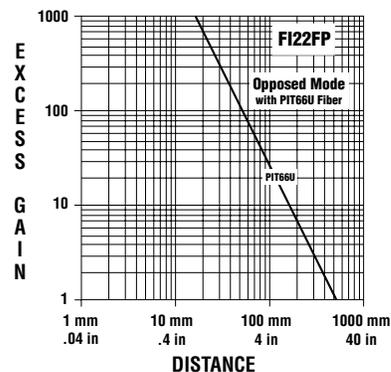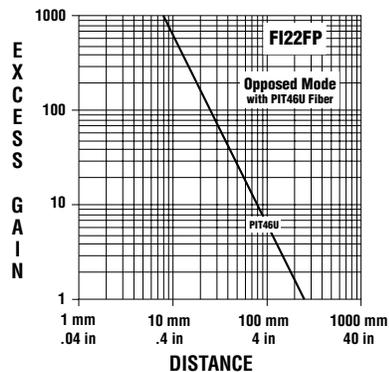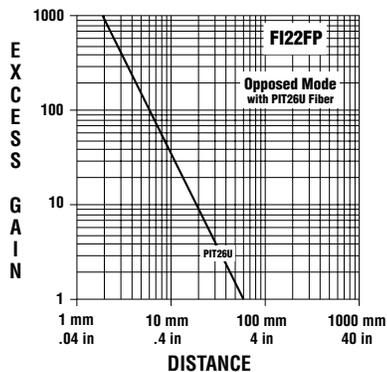⚠ **WARNING . . . Not To Be Used for Personnel Protection**

Never use this product as a sensing device for personnel protection. Doing so could lead to serious injury or death.

This product does NOT include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition. Consult your current Banner Safety Products catalog for safety products which meet OSHA, ANSI and IEC standards for personnel protection.
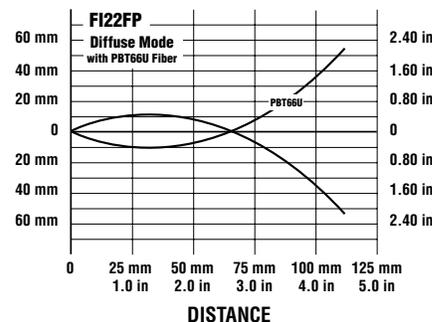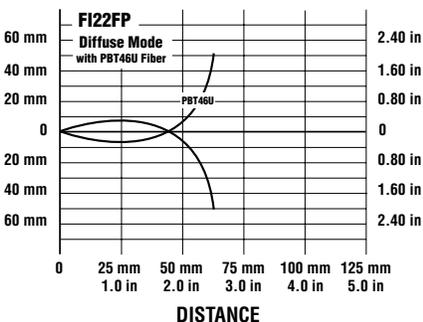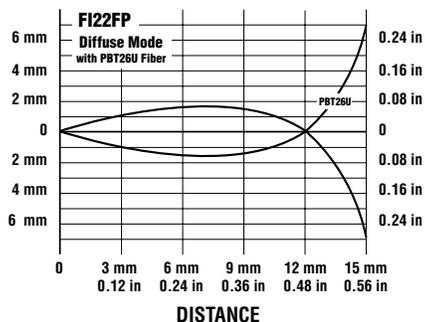
FI22FP Low-Profile Inline Plastic Fiber Optic Sensor

Excess Gain Curves and Beam Patterns

Opposed Mode

FI22FP Opposed Mode with PIT26U Fiber

FI22FP Opposed Mode with PIT46U Fiber

FI22FP Opposed Mode with PIT66U Fiber

FI22FP Opposed Mode with PIT26U Fiber

FI22FP Opposed Mode with PIT46U Fiber

FI22FP Opposed Mode with PIT66U Fiber

Diffuse Mode

FI22 Diffuse Mode with PBT26U Fiber

FI22 Diffuse Mode with PBT46U Fiber

FI22 Diffuse Mode with PBT66U Fiber

FI22FP Diffuse Mode with PBT26U Fiber

FI22FP Diffuse Mode with PBT46U Fiber
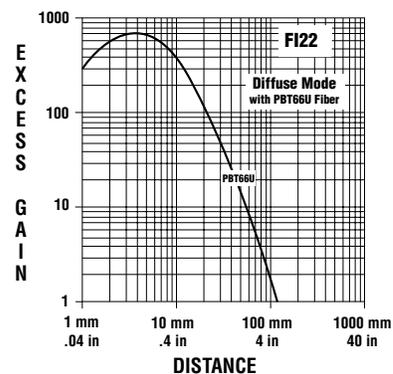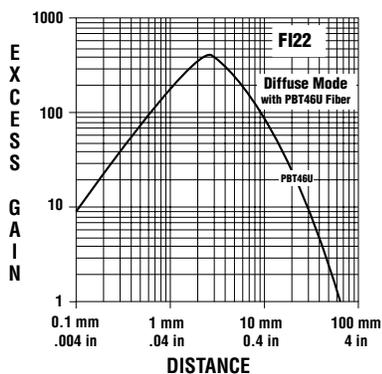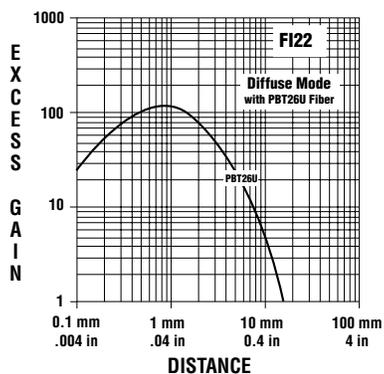
FI22FP Diffuse Mode with PBT66U Fiber

Figure 1. FI22FP features

Overview

The FI22FP is an easy-to-use, low-profile fiber optic sensor. It provides high-performance sensing in low-contrast applications and its small size lets it mount almost anywhere. Configuration options include SETUP mode plus static, dynamic and single-point TEACH-mode programming, in addition to manual fine adjustment, remote programming and security lockout options.
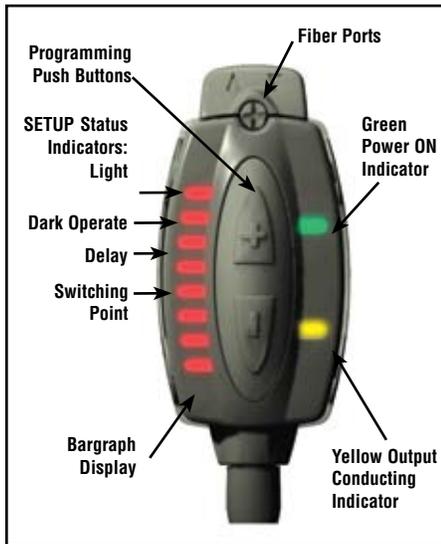
The sensor has bipolar outputs, one each NPN and PNP.

The sensor's compact housing has a large, easy-to-see bargraph display plus bright LEDs for easy programming and status monitoring during operation. The sensor quickly snap-mounts to its custom bracket (included with sensor).

Sensor Programming

Sensor configuration is accomplished through TEACH-mode programming and SETUP mode. After TEACH mode has defined the sensing parameters, SETUP mode may be used to enable the delay or to change the light/dark operate status. Manual Adjust may be used to fine-tune the thresholds (see page 9). Two push buttons, Dynamic (+) and Static (-), or the remote wire, may be used to access and set programming parameters.

Sensor programming may be accomplished using any of three TEACH methods. A single switching threshold may be programmed using either dynamic (on-the-fly) or static TEACH. In addition, single-point static TEACH may be used to define a sensing window, centered on a single taught condition. Single-point TEACH can be accomplished only statically.

Remote Programming
The Remote Programming function may be used to program the sensor remotely or to disable the push buttons for security. Connect the gray wire of the sensor to ground (0V dc), with a remote programming switch connected between them. Pulse the remote line according to the diagrams in the programming procedures. The length of the individual programming pulses is equal to the value T:

$$0.04 \text{ seconds} \leq T \leq 0.8 \text{ seconds}$$

Returning to RUN Mode
TEACH and SETUP modes each may be exited either after the 60-second time-out, or by exiting the process:

- In static TEACH mode, press and hold the Static (-) button (or hold the remote line) for 2 seconds. The sensor returns to RUN mode without saving any new settings.

- In SETUP mode, press and hold both the Static (-) and Dynamic (+) buttons (or hold the remote line) for 2 seconds. The sensor returns to RUN mode and saves the current setting.

FI22FP Low-Profile Inline Plastic Fiber Optic Sensor

Two-Point Static TEACH (Switch Point)

- Sets a single switching threshold
- Threshold position is adjustable using "+" and "-" buttons (Manual Adjust)

Two-Point TEACH is the traditional setup method, used when two conditions can be presented by the user. The sensor locates a single sensing threshold (the switch point) midway between the two taught conditions, with the Output ON condition on one side, and the Output OFF condition on the other (see Figure 2).

The first condition taught is the ON condition. The Output ON and OFF conditions can be reversed by changing Light/Dark Operate status in SETUP mode.

Two-Point TEACH and Manual Adjust
Using Manual Adjust with Two-Point TEACH moves the switching threshold. The lighted LED on the bargraph will move to exhibit the relative amount of received signal.
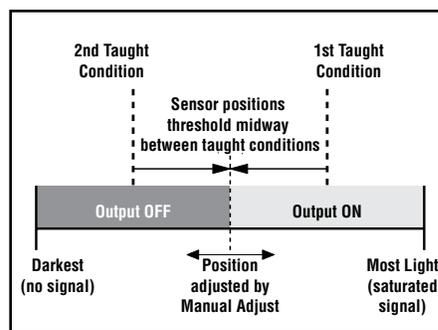
Figure 2. Two-Point TEACH (Light Operate shown)

Bargraph LED Following TEACH	Relative Signal Difference/ Recommendation
6 to 8	**Excellent:** Very stable operation
4 to 5	**Good:** Minor sensing variables will not affect sensing reliability.
2 to 3	**Low:** Minor sensing variables may affect sensing reliability.
1	**Unreliable:** Consider an alternate sensing scheme.

|	Push Button 0.04 sec. ≤ "click" ≤ 0.8 sec.	Remote Line 0.04 sec. ≤ T ≤ 0.8 sec.	Result	
Access TEACH Mode	• Press and Hold > 2 seconds	No action required; sensor is ready for 1st TEACH condition.	Power LED: OFF Output LED: ON Status LEDs: #2 & 3 Alternately flashing	
Learn Output ON Condition	• Present Output ON condition • Click push button	• Present Output ON condition • Single-pulse remote line	Power LED: OFF Output LED: OFF Status LEDs: #2 & 3 Alternately flashing	
Learn Output OFF Condition	• Present Output OFF condition • Click push button	• Present Output OFF condition • Single-pulse remote line	**Teach Accepted** Power LED: ON Bargraph: One LED flashes to show relative contrast (good signal difference shown; see table above) Sensor returns to Run mode	
			Teach Unacceptable Power LED: OFF Bargraph: #1, 3, 5, 7 Alternately flash to show failure Sensor returns to "Learn Output ON" condition	
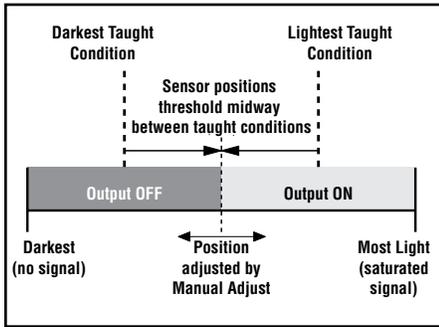
Figure 3. Two-Point Dynamic TEACH (Light Operate shown)

Bargraph LED Following TEACH	Relative Signal Difference/ Recommendation
6 to 8	**Excellent:** Very stable operation.
4 to 5	**Good:** Minor sensing variables will not affect sensing reliability.
2 to 3	**Low:** Minor sensing variables may affect sensing reliability.
1	**Unreliable:** Consider an alternate sensing scheme.

Dynamic TEACH and Adaptive Thresholds

- Teach on-the-fly
- Sets a single switching threshold
- Threshold position is adjustable using "+" and "-" buttons (Manual Adjust)

Dynamic TEACH is best used when a machine or process may not be stopped for teaching. A variation of two-point TEACH, it programs the sensor during actual machine run conditions, taking multiple samples of the light and dark conditions and automatically setting the threshold at the optimum level (see Figure 3).

Dynamic TEACH activates the sensor's adaptive threshold system, which continuously tracks minimum and maximum signal levels, and automatically maintains centering of the switch point between the light and dark conditions. The adaptive threshold system remains in effect during RUN mode. The adaptive routine saves to non-volatile memory at least once per hour.

When Dynamic TEACH mode is used, the output ON state (light or dark operate) will remain as it was last programmed. To change the output ON state, use SETUP mode (see page 7).

The sensing set point may be adjusted (fine-tuned) whenever the sensor is in RUN mode by clicking the "+" and "-" buttons. However, when a manual adjustment is made, the adaptive threshold system is disabled (cancelled).

	Push Button	Remote Line	Result	
Access TEACH Mode	• Press and Hold > 2 seconds	• Hold remote line low (to ground) > 2 seconds	Power LED: OFF Bargraph: #6 & 7 Alternately flashing	
Learn Output ON Condition	• Continue to hold • Present Output ON and OFF conditions	• Present Output ON and OFF conditions • Continue to hold remote line low (to ground)	Power LED: OFF Bargraph: #6 & 7 Alternately flashing	
Learn Output OFF Condition	• Release	• Release remote line/ switch	**Teach Accepted** Power LED: ON Bargraph: One LED flashes to show relative contrast (good signal difference shown; see table above) Sensor returns to Run mode with new settings	
			Teach Unacceptable Power LED: OFF Bargraph: #1, 3, 5, 7 Alternately flash to show failure Sensor returns to Run mode without changing settings	

Single-Point Static TEACH (Sensing Window)

- Sets a single ON condition

- All other conditions (lighter or darker) result in OFF output

- Sensing window size (sensitivity) is adjustable using "+" and "-" buttons (Manual Adjust)

Single-Point TEACH is most useful when a product may not always appear in the same place, or when other signals may appear. Single-point TEACH programs a sensing window, with the Output ON condition inside the window, and the Output OFF conditions outside the window (see Figure 4). Output ON and OFF conditions can be reversed by changing Light/Dark Operate status in SETUP mode.

Single-Point TEACH programming may be accomplished only using Static TEACH. The sensor learns a single sensing condition, and adds switching thresholds above and below the taught condition to create a sensing window.

Single-Point TEACH and Manual Adjust
Using Manual Adjust with Single-Point TEACH expands or contracts the size of the window. The lighted LEDs on the light bar separate to a greater or lesser extent to exhibit the relative sensing window size.
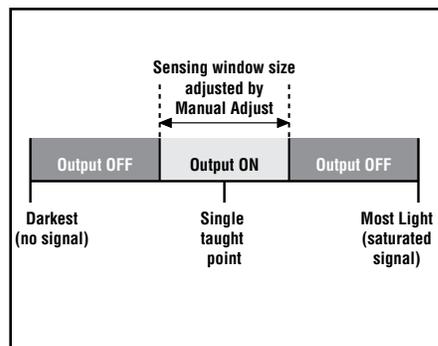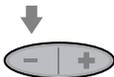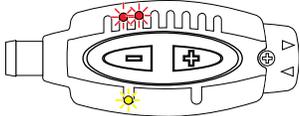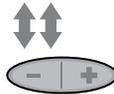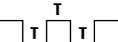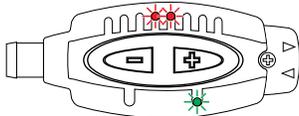

Figure 4. Single-Point TEACH (Light Operate shown)

|	Push Button 0.04 sec. ≤ "click" ≤ 0.8 sec.	Remote Line 0.04 sec. ≤ T ≤ 0.8 sec.	Result	
Access TEACH Mode	• Press and Hold > 2 seconds	• Present Output ON condition • Single-pulse remote line	Power LED: OFF Output LED: ON (Push Button) Output LED: OFF (Remote) Static LEDs: #2 & 3 alternately flashing	
Learn Set Point (Output ON) Condition	• Present Output ON conditions • Double-click push button	• Double-pulse remote line	**Teach Accepted** Power LED: ON Bargraph: 2 indicators flash together to show single-point Teach accepted Sensor returns to Run mode with new settings	
			Teach Unacceptable Power LED: OFF Bargraph: #1, 3, 5, 7 flash to show failure Sensor returns to "Teach 1st Condition"	
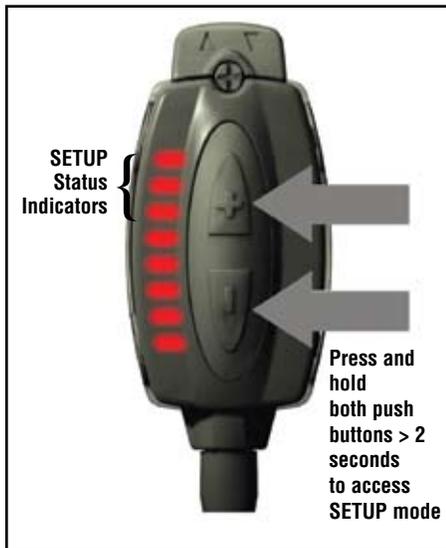
Figure 5. SETUP mode

SETUP Mode

SETUP mode is used to change sensor output response for:

• Light or Dark operate

• 30-millisecond pulse stretcher (OFF delay), if required.

The status LEDs, active only during SETUP mode, indicate the output response configuration when the sensor will be in RUN mode. Four combinations are possible:

    Light Operate, No Delay
    Dark Operate, No Delay
    Dark Operate, 30 ms Delay
    Light Operate, 30 ms Delay

To access SETUP mode and change the output response settings:

1. Press and hold BOTH push buttons (or double-pulse Remote line) until the green LED indicator turns OFF.

2. Click EITHER push button (or pulse Remote line) to toggle through the four possible setting combinations.

3. Press and hold both push buttons (or hold Remote line) until the green LED indicator turns ON, indicating return to RUN mode.

NOTES: • If SETUP mode programming is interrupted and remains inactive for 60 seconds, the sensor returns to RUN mode with the most recent settings (i.e., exits and saves current selection).

           • SETUP mode operates in the "background", while the outputs are active.

Manual Adjust

Use during Run mode, accomplished via push buttons only.

Two-Point TEACH (Static or Dynamic):

    • Fine-tunes sensing sensitivity
    • Press "+" to increase; press "-" to decrease

Single-Point TEACH:

    • Adjusts sensing window size (tolerance) for the single-point target condition
    • Press "+" to increase; press "-" to decrease

The lighted bargraph LEDs move to reflect the increase or decrease.

Push Button Disable

In addition to its programming function, Remote Programming may be used to disable the push buttons for security. Disabling the push buttons prevents undesired tampering with the programming settings. Connect the gray wire of the sensor as described on page 9, and four-pulse to either enable or disable the push buttons:

FI22FP Low-Profile Inline Plastic Fiber Optic Sensor

Specifications	
Sensing Beam	660 nm visible red
Supply Voltage	10 to 30V dc (10% max. ripple) @ less than 32 mA exclusive of load
Supply Protection Circuitry	Protected against reverse polarity, over voltage, and transient voltages
Delay at Power Up	250 milliseconds max.; outputs do not conduct during this time
Output Configuration	Bipolar: 1 current sourcing (PNP) and 1 current sinking (NPN)

Output Rating	100 mA maximum load @25° C (derate 1 mA per °C increase)
	OFF-state leakage current: < 50 µA at 30V dc
	ON-state saturation voltage:
	      NPN: < 200 mV @ 10 mA and 1V @ 100 mA load
	      PNP: < 1.5V @ 10 mA and 2.0V @ 100 mA load

Output Protection	Protected against output short-circuit, continuous overload, transient over-voltages, and false pulse on power up
Output Response Time	500 microseconds
Repeatability	100 microseconds
Adjustments	2 push buttons and remote wire • Expert Teach programming (two-point static, dynamic, and single-point static) • Manually adjust (+/–) thresholds (from buttons only) • LO/DO and Off Delay configurable (from buttons or remote wire) • Push-button lockout (from remote wire only)

Indicators	**8-segment red bargraph:**
	   Light-to-dark signal difference relative to taught condition (single-point TEACH), or
	   Sensing contrast (two-point TEACH)
	Green LED: Power On
	Yellow LED: Output conducting

Construction	PC/ABS blend plastic housing; polycarbonate cover
Environmental Rating	IP67, NEMA 6
Connections	5-conductor 2 m (6.5') PVC cable, 9 m (30') PVC cable, or 6-pin integral Pico-style quick-disconnect
Operating Conditions	**Temperature:** -10° to +55°C **Relative Humidity:** 90% @ 50° C (non-condensing)
Certifications	CE cULus

Sensor and Bracket Dimensions

Bracket

12.1 mm
(0.48")

10.5 mm
(0.41")

25.0 mm
(0.98")

6.0 mm
(0.24")

Sensor

23.0 mm
(0.91")

50.0 mm
(1.98")

7.0 mm
(0.28")

14.5 mm
(0.57")

**Pico-style
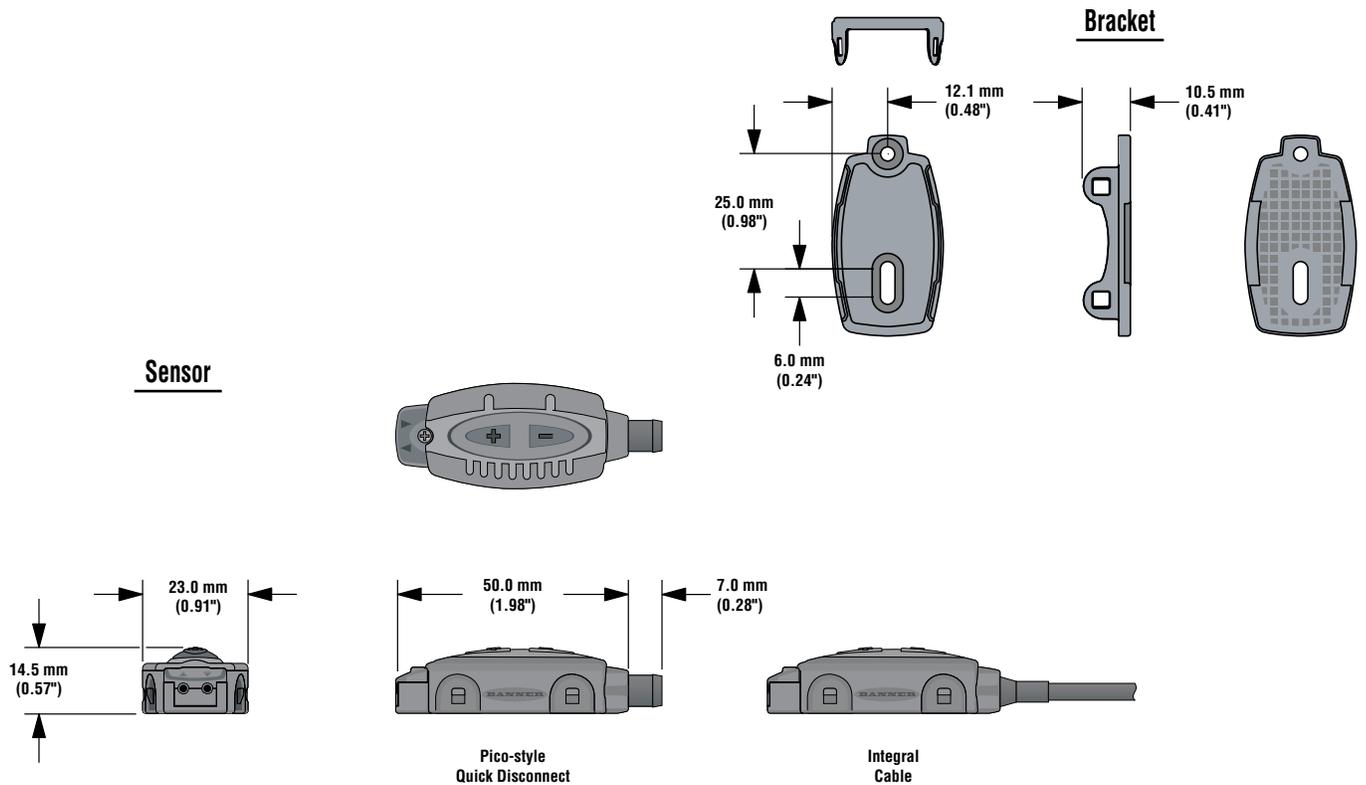Quick Disconnect**

**Integral
Cable**

**Figure 6.   Installing plastic optical fiber into
the FI22FP fiber ports**

Installing the Optical Fibers

To install fibers:

1. Use a small Phillips screwdriver to loosen set screw, as shown in Figure 6.

2. Insert prepared fiber ends (2.2 mm diameter) into emitter and receiver ports, as far as they will go.

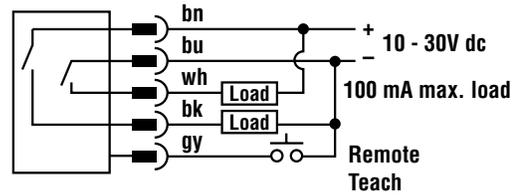3. Holding fibers in place, tighten screw to lock in securely.

FI22FP Low-Profile Inline Plastic Fiber Optic Sensor

Hookups

Cabled Models

bn
bu
wh
bk
gy

+ 10 - 30V dc
−
Load
Load
100 mA max. load
Remote
Teach
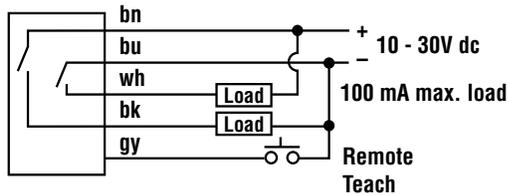
Quick-Disconnect Models

bn
bu
wh
bk
gy

+ 10 - 30V dc
−
Load
Load
100 mA max. load
Remote
Teach

NOTE: Pink wire not used

Accessories

Quick-Disconnect Cables

Style	Model	Length	Dimensions	Pinout
6-pin Pico-style straight	**PKG6Z-2** **PKG6Z-9**	2 m (6.5') 9 m (30')	ø 10 mm max. (0.4") 28 mm max. (1.1")	Brown Wire, White Wire, Gray Wire, Blue Wire, Pink Wire, Black Wire
6-pin Pico-style right-angle	**PKW6Z-2** **PKW6Z-9**	2 m (6.5') 9 m (30')	25 mm max. (1.0") 20 mm (0.8") ø12 mm max. (0.5")	

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Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period.This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

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