BANNER®
the photoelectric specialist

D10 *Expert*™ – Dual Discrete Outputs

Advanced sensor for use with plastic fiber optics

D10 *Expert* Features

- Easy-to-set automatic Expert-style TEACH options* including static, dynamic, and single-point programming plus manual adjustment for fine-tuning
- 16-bit microcontroller and 12-bit Analog-to-Digital converter for high-performance, low-contrast sensing
- Easy-to-read 4-digit display for TEACH and signal strength readout, plus indicators for a continuous readout of operating status (user configurable)
- Two discrete outputs, PNP or NPN
- Four-mode power and speed selection with automatic cross-talk avoidance circuitry
- Selectable OFF-delay options
- Gate input wire can be used to selectively inhibit sensor outputs from switching
- Models available with visible red (680 nm) or visible green (525 nm) sensing beam
- Models available with 2 m or 9 m (6.5' or 30') cable or integral quick-disconnect
- Sleek, ultra-slim 10 mm housing, mounts to a standard 35 mm DIN rail

* U.S. Patent #5,808,296

D10 *Expert* Models

Models		Cables*	Discrete Outputs
Red Beam	Green Beam		
D10DNFP	**D10DNFPG**	2 m (6.5') Cable	NPN
D10DNFPQ	**D10DNFPGQ**	6-pin Pico-style QD	
D10DPFP	**D10DPFPG**	2 m (6.5') Cable	PNP
D10DPFPQ	**D10DPFPGQ**	6-pin Pico-style QD	

*9 m (30') cables are available by adding suffix "**W/30**" to the model number of any cabled sensor (e.g., **D10DNFP W/30**). A model with a QD connector requires a mating cable (see page 12).

D10 *Expert* Description

The D10 *Expert* Sensor is a high-performance plastic fiber-optic sensor whose many configuration (TEACH-mode) options make it suitable for demanding applications. Even with all its features, it is extremely easy to use. Advanced 16-bit microcontroller technology makes this possible.

The D10 *Expert* provides high-performance sensing in low-contrast applications, with its *Expert* TEACH setup with static, dynamic and single-point programming plus manual fine adjustment, remote programming and lockout. Its slender, stylized housing has a large digital display visible beneath a clear cover for easy programming and status monitoring during operation. The sensor mounts directly to standard 35 mm DIN rail or using the supplied mounting bracket.

The sensor features two outputs with independent set-points: either NPN or PNP, depending on model. Built-in crosstalk avoidance protocol provides trouble-free operation for multiple sensors in one area.

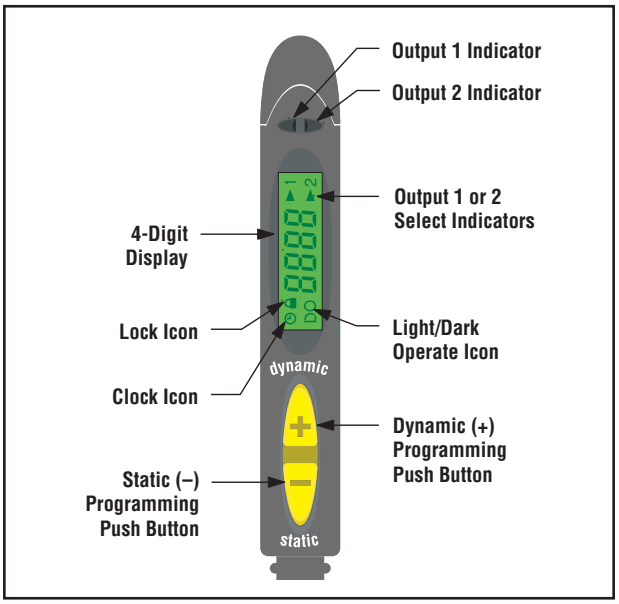

Figure 1. D10 indicators

D10 Specifications

Required Fiber-Optic Cable	Banner P-Series plastic fibers
Sensing Beam	Visible red, 680 nm, or Visible green, 525 nm, depending on model
Supply Voltage and Current	12 to 24V dc (10% maximum ripple) at less than 65 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltage.
Output Configuration	**Specify Model:** 2 NPN or 2 PNP
Output Rating	150 mA maximum load **OFF-state leakage current:** < 10 µA at 24V dc **ON-state saturation voltage:** **NPN** < 1.5V at 150 mA load **PNP** < 2.5V at 150 mA load
Output Protection Circuitry	Protected against false pulse on power-up and continuous short-circuit
Output Response Time	Programmable, 50 microseconds, 200 microseconds, 1 millisecond, 2.5 milliseconds NOTE: 150 millisecond delay on power-up; outputs do not conduct during this time.
Adjustments	Push-button or remote programming of response time, OFF-delay, light-dark operate, and display
Indicators	Four-digit digital display plus LCD indicators for active channel, push-button lockout, OFF-delay and light/dark operate selection. LCD backlight (red for Program mode or green for Run mode) indicates Power ON. Two amber output indicators
Construction	Black ABS/polycarbonate alloy (UL94 V-0 rated) housing, clear polycarbonate cover.
Environmental Rating	NEMA 1, IEC IP50
Connections	PVC-jacketed 2 m or 9 m (6.5' or 30') 6-wire integral cable or integral 6-pin Pico-style quick-disconnect
Operating Conditions	**Temperature:** -20° to +55°C (-4° to +131°F) **Storage Temperature:** -20° to +80°C (-4° to +175°F) **Max. Rel. Humidity:** 90% @ 50°C (non-condensing)

Number of Devices, Stacked	Ambient Temperature Rating	Load Specification
3	55°C	150 mA
7	50°C	50 mA
10	45°C	50 mA

Installation	35 mm DIN rail or included mounting bracket
Certifications	CE cULus

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Programming Options

Light/Dark Operate Selection			Toggle to select the condition for which each output will conduct: when the target is present or when the target is absent.			
OFF-Delay Timing Selection			Programmable OFF-delay pulse stretcher: 0, 2, 5, 10, 15, 20, 30, 40, 60, 80, or 100 milliseconds			
Display Selection			**Discrete Output:** Raw signal value or % excess signal			
Power Level/Speed Selection			**Super High-Speed† SHS**	**High-Speed HS**	**High-Power HP**	**Super High-Power SHP**
Response*			50 µs	200 µs	1 ms	2.5 ms
Repeatability			25 µs	50 µs	75 µs	100 µs
Maximum Range*	**Color**	**Fiber**				
	680 nm Red	PIT16U	20 mm	30 mm	55 mm	90 mm
		PIT26U	100 mm	150 mm	250 mm	400 mm
		PIT46U	300 mm	550 mm	1000 mm	1200 mm
		PIT66U	600 mm	1000 mm	1700 mm	2400 mm
		PBT16U	6 mm	10 mm	18 mm	30 mm
		PBT26U	30 mm	50 mm	100 mm	150 mm
		PBT46U	100 mm	175 mm	250 mm	300 mm
		PBT66U	175 mm	250 mm	400 mm	475 mm
	525 nm Green	PIT16U	9 mm	9 mm	13 mm	16 mm
		PIT26U	40 mm	40 mm	55 mm	70 mm
		PIT46U	100 mm	100 mm	160 mm	180 mm
		PIT66U	180 mm	180 mm	280 mm	320 mm
		PBT16U	**	**	3 mm	3.5 mm
		PBT26U	12 mm	12 mm	20 mm	25 mm
		PBT46U	30 mm	30 mm	42 mm	60 mm
		PBT66U	55 mm	55 mm	80 mm	100 mm
Tracking Feature			Sets Output 2 to identical settings as Output 1; Output 2 settings can then be revised as desired. (See Advanced Setup procedure, page 8.)			
Factory Default Settings			The following settings are preset at the factory; revert sensor to factory defaults using Advanced Setup procedure (page 8). • Light operate (lo) • No OFF delay (t 0) • Raw signal value (1234) • Output 1 displayed • High Speed (HS); 200 µs response • Maximum power setting • Analog: full scale • Discrete: switch-point positioned at middle of range			

* Diffuse mode performance based on 90% reflectance white test card.

** ø0.010" bifurcated fiber not recommended in these speed settings. Contact Banner Applications for more information.

† See note on page 7.

D10 Programming

Programming Procedures

Two push buttons, Dynamic (+) and Static (-), may be used to access and set programming parameters. For remote programming, connect a switch or digital input to the gray wire; length of the individual pulses is equal to the value T:

0.04 seconds ≤ T ≤ 0.8 seconds

Returning to RUN mode

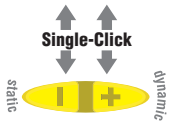
TEACH and SETUP modes each may be exited in one of two ways: by exercising the 60-second time-out, or by cancelling out of the process. In TEACH mode, the sensor will return to RUN mode without saving any of the new settings; in SETUP mode, the sensor will return to RUN mode but save all of the settings. To cancel out of TEACH mode, press and hold the Static (-) button for 2 seconds; to cancel out of SETUP mode, press and hold both the Static (-) and Dynamic (+) buttons for 2 seconds.

Output 2

The set-point(s) for each output can be set independently of one another (see Super-High-Speed Operation). However, the functional range available for output 2 is dictated by the automatic power and gain settings established for output 1. Whenever output 1 is taught, output 2 also must be retaught. Applications hint: teach the weakest signal on output 1 first.

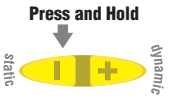
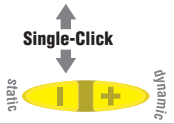
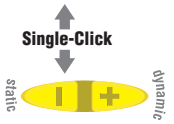
Active Channel Select

Selects which channel to teach and displays channel configuration information.

Action			Display Shows
Push Button		Single-click both Dynamic (+) and Static (-) buttons concurrently.	**Pointer icon:** moves to the other channel indicator.  
Remote		Triple-pulse the remote line.	

Static TEACH

Two-point TEACH to set a single threshold. Threshold is adjustable using the "+" and "–" buttons (see Manual Adjust, page 6).

Action			Display Shows
Push Button		Press and hold Static (-) button.	• LCD flashes "**1st**" • LCD background turns red 
Remote		No action required; sensor is automatically ready for 1st TEACH condition.	
Push Button		Present Output ON target. Click Static button.	• LCD flashes "**2nd**" 
Remote		Present Output ON target. Single-pulse the remote line.	
Push Button		Present Output OFF target. Click Static button.	**TEACH conditions acceptable:** • LCD background turns green • LCD flashes "**pass,**" followed by a number (denoting contrast); see table at right. • Sensor returns to RUN mode with new settings. 
Remote		Present Output OFF target. Single-pulse the remote line.	**TEACH conditions unacceptable:** • LCD flashes "**fail**" and returns to "**1st**" • LCD background remains red • After 60 seconds, sensor returns to RUN mode (LCD background turns green) without changing settings. 

Contrast Values	
500 +	Excellent
100 - 500	Good
32 - 99	Low
0 - 31	Marginal

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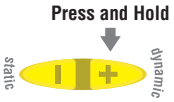
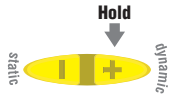
Contrast Values	
500 +	Excellent
100 - 500	Good
32 - 99	Low
0 - 31	Marginal

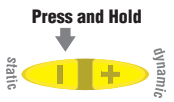
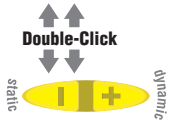
Dynamic TEACH

TEACH on-the-fly; sets a single threshold. Threshold is adjustable using the "+" and "-" buttons (see Manual Adjust, page 6).

Action			Display Shows
Push Button		Press and hold Dynamic (+) button.	• LCD shows "**dyn**" • LCD background turns red 
Remote		Hold remote line low (to ground).	
Push Button		Present Output ON/OFF conditions. Continue to hold Dynamic button.	
Remote		Present Output ON/OFF conditions. Continue to hold remote line low (to ground).	
Push Button		Release Dynamic button.	**TEACH conditions acceptable:** • LCD background turns green • LCD flashes "**pass,**" followed by a number (denoting contrast); see table at left. • Sensor returns to RUN mode with new settings. 
Remote		Release remote line/switch.	**TEACH conditions unacceptable:** • LCD flashes "**fail**" • LCD background remains red • Sensor returns to RUN mode (LCD background turns green) without changing settings. 

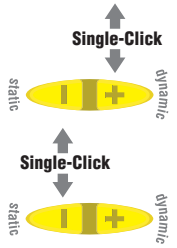
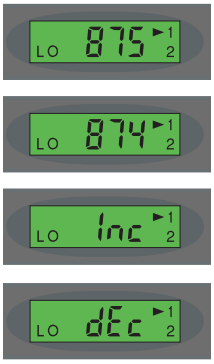
Single-Point Static TEACH

Used to set a single ON condition. All other conditions (both lighter and darker) will result in an OFF output. Target ON condition sensitivity is adjustable using the "+" and "-" buttons (see Manual Adjust, page 6).

Action			Display Shows
Push Button		Press and hold Static (-) button.	• LCD flashes "**1st**" • LCD background turns red 
Remote		Present target to learn, single-pulse remote line.	• LCD flashes "**2nd**" • LCD background turns red 
Push Button		Present target to learn, double-click Static button.	**TEACH conditions acceptable:** • LCD background turns green • LCD flashes "**sngl**," then "**pt**" twice • Sensor returns to RUN mode with new settings.  
Remote		Double-pulse the remote line.	**TEACH conditions unacceptable:** • LCD flashes "**fail**" and returns to "**1st**" • LCD background remains red • After 60 seconds, sensor returns to RUN mode (LCD background turns green) without changing settings.

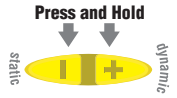
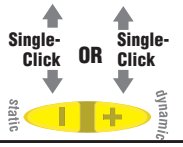
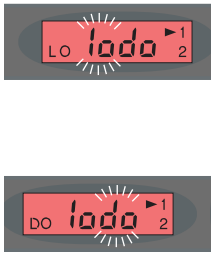
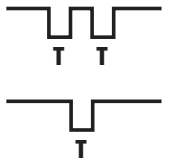
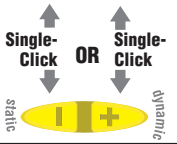
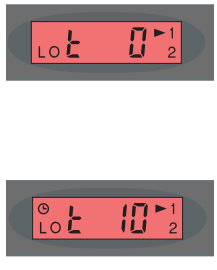
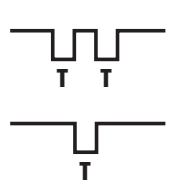
Manual Adjust

May be used at any time sensor is in RUN mode, to fine-tune the sensing thresholds or to adjust sensitivity to the single-point target conditions.

Action			Display Shows
Push Button		• Click "+" to increase, or click "-" to decrease, threshold set-point value . or • Click "+" to increase, or or click "-" to decrease, the tolerance to the single-point target condition.	• LCD display briefly flashes the threshold set-point value as it is being changed. or • LCD display flashes "**inc**" or "**dec**" as single-point tolerance is adjusted. 
Remote		Not available with remote programming.	

Setup

Configure sensor display and operating parameters. Click Dynamic (+) or double-pulse remote line to select an option. Click Static (-) or single-pulse remote line to advance. Changes are updated instantly.

Action			Display Shows
Push Button		Press and hold both Dynamic (+) and Static (-) buttons concurrently.	• LCD background turns red
Remote		Double-pulse remote line.	
Select Light/Dark Operate			
Push Button		• Click Dynamic to toggle between selections. • Click Static to save selection and advance to "OFF-Delay."	**Light Operate:** • LCD display flashes "**lo**" • LO icon **Dark Operate:** • LCD display flashes "**do**" • DO icon 
Remote		• Double-pulse remote line to toggle between selections. • Single-pulse remote line to save selection and advance to "OFF-Delay."	
Select OFF-Delay Timing Enable			
Push Button		• Click Dynamic to toggle between selections. • Click Static to save selection and advance to "Display."	**OFF (No OFF-Delay):** • "**t 0**" • Clock icon OFF **2 to 100 ms OFF-Delay:** • "**t 2**," "**t 5**," "**t 10**," "**t 15**," "**t 20**," "**t 30**," "**t 40**," "**t 60**," "**t 80**," or "**t100**" • Clock icon ON 
Remote		• Double-pulse remote line to toggle between selections. • Single-pulse remote line to save selection and advance to "Display."	

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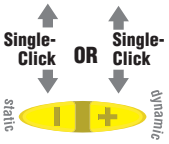
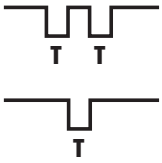
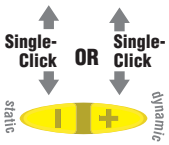
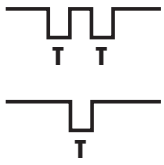
Setup (continued)

Action			Display Shows
Select Display Parameters			
Push Button		• Click Dynamic (+) to toggle between selections. • Click Static (-) to save selection and advance to "Power/Speed."	**Raw signal value:** • 1234  **Percent of excess signal:** • 123P 
Remote		• Double-pulse remote line to toggle between selections. • Single-pulse remote line to save selection and advance to "Power/Speed."	
Select Power and Speed Combination			
Push Button		• Click Dynamic (+) to toggle between selections. • Click Static (-) to save selection and return to RUN mode.	**Super-high-speed (50-µs response)** • SHS  **High-speed (200-µs response)** • HS  **High-power (1-ms response)** • HP  **Super-high-power (2.5-ms response)** • SHP 
Remote		• Double-pulse remote line to toggle between selections. • Single-pulse remote line to save selection and return to RUN mode.	

Super-High-Speed Operation Note:
Under most operating conditions, the D10's two discrete outputs operate independently of one another. However, due to its extremely fast 50 microsecond response time, the D10's outputs become complementary when operating at Super-High-Speed. Only channel 1 can then be taught or adjusted; channel 2 automatically becomes complementary to it. Specifically, output 1 will conduct when the sensor sees the taught ON condition, and output 2 conducts in the OFF state. To invert these conditions (output 1 for the OFF condition and output 2 for the ON), toggle light/dark operate in the SETUP menu (page 6).

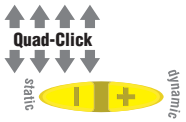
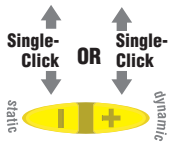
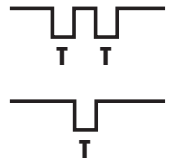
Push-Button Lockout

Prevents unwanted adjustments or tampering of the push buttons. Push buttons can be enabled or disabled only from the remote line and only during normal RUN mode.

Action			Display Shows
Push Button		Not available with push-button programming.	**Push Buttons Disabled:** • LCD flashes "**loc**" • Padlock icon appears • Sensor remains in RUN mode  **Push Buttons Enabled:** • LCD flashes "**uloc**" • Padlock icon disappears • Sensor remains in RUN mode 
Remote		Quad-pulse remote line while in RUN mode to toggle between selectons.	

Advanced Setup

Advanced adjustments to previously configured sensor display and operating parameters. ***Quad-click Static (-) or quad-pulse remote line before exiting "Power and Speed" settings to enter this mode.*** *Click Dynamic (+) or double-pulse remote line to select an option. Click Static or single-pulse remote line to advance. Changes are updated instantly.*

Action			Display Shows
Enter SETUP Mode (from "Power and Speed" mode)			• LCD background remains red and displays "Tracking Enable" option.
Push Button		Quad-click Static (-) button.	
Remote		Quad-pulse remote line.	
Tracking Enable (sets output 2 identical to output 1)			**Tracking disabled:** • LCD display shows "**tr n**"  **Tracking enabled:** • LCD display shows "**tr y**" 
Push Button		• Click Dynamic (+) to toggle between selections. • Click Static (-) to save selection and advance to "Factory Default."	
Remote		• Double-pulse remote line to toggle between selections. • Single-pulse remote line to save selection and advance to "Factory Default."	

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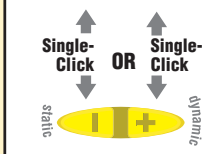
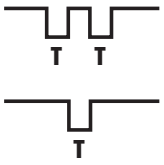
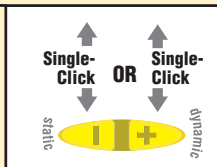
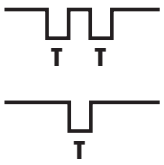
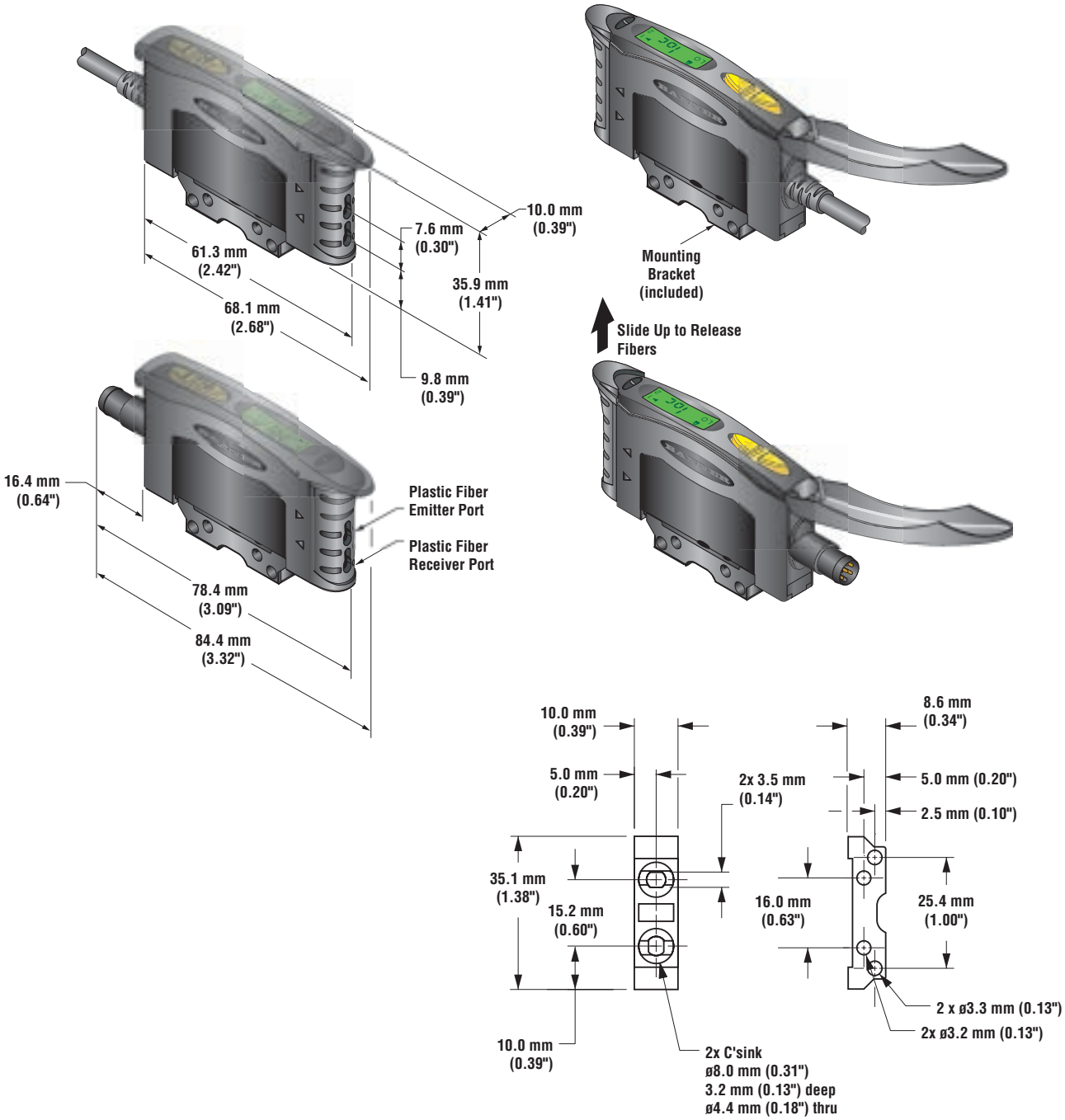
Advanced Setup (continued)

Action			Display Shows
Factory Default Settings (returns sensor to factory default settings)			
Push Button		• Click Dynamic (+) to toggle between selections. • Click Static (-) to advance to "Display Orientation."	**Factory Default Settings Not Selected:** • LCD display shows "**fd n**" **Factory Default Settings Selected:** • LCD display shows "**fd y**"
Remote		• Double-pulse remote line to toggle between selections. • Single-pulse remote line to advance to "Display Orientation."	
Display Orientation (inverts display to read "upside-down")			
Push Button		• Click Dynamic (+) to toggle between selections. • Click Static (-) to return to RUN mode.	**Normal:** • For example: 1234 **Inverted**: • For example: 1234
Remote		• Double-pulse remote line to toggle between selections. • Single-pulse remote line to return to RUN mode.	

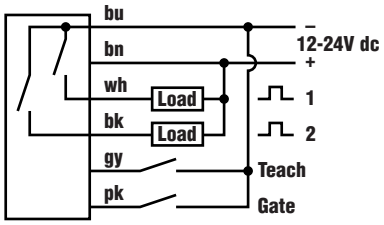
NOTE: Icons and channel indicators do not invert

Dimensions

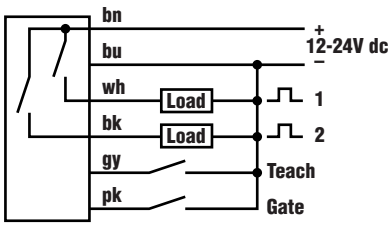

10.0 mm
(0.39")
7.6 mm
(0.30")
61.3 mm
(2.42")
35.9 mm
(1.41")
68.1 mm
(2.68")
9.8 mm
(0.39")
Mounting
Bracket
(included)
Slide Up to Release
Fibers
16.4 mm
(0.64")
Plastic Fiber
Emitter Port
Plastic Fiber
Receiver Port
78.4 mm
(3.09")
84.4 mm
(3.32")
10.0 mm
(0.39")
5.0 mm
(0.20")
2x 3.5 mm
(0.14")
35.1 mm
(1.38")
15.2 mm
(0.60")
10.0 mm
(0.39")
2x C'sink
ø8.0 mm (0.31")
3.2 mm (0.13") deep
ø4.4 mm (0.18") thru
8.6 mm
(0.34")
5.0 mm (0.20")
2.5 mm (0.10")
16.0 mm
(0.63")
25.4 mm
(1.00")
2 x ø3.3 mm (0.13")
2x ø3.2 mm (0.13")

Hookups

D10DNFP(Q)



D10DPFP(Q)



NOTE: QD Hookups are identical.

Dynamic TEACH and Adaptive Thresholds

Dynamic TEACH is used to program sensitivity during actual machine run conditions. During Dynamic TEACH, the D10 takes multiple samples of the light and dark conditions and automatically sets the sensitivity at the optimum level. 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 to automatically adjust for changes in the light or the dark conditions. The adaptive routine saves to non-volatile memory at least once per hour.

When Dynamic TEACH mode is used to program sensitivity, the output ON state (light or dark operate) will remain as it was last programmed. To change to either light or dark operate, use the SETUP mode (see page 6).

Sensitivity may be adjusted at any time when 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).

Self-Diagnostic Error Modes

In the unlikely event that the setup parameters are lost or become corrupt, the display will continuously scroll: "E2 Error." Reteach the sensor to recover. If the problem persists, contact your Banner representative for further information.

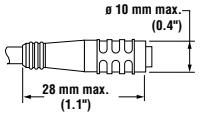
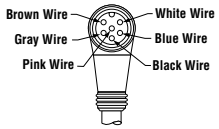
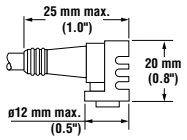
Gate Input

The D10's pink wire is configured as a gate input. When this wire is pulled low (i.e., to the sensor ground), it inhibits the outputs from switching, while all other D10 functions continue to be enabled. This feature is useful for controlling when the outputs are allowed to change states. Gate input function response time is 1 millisecond.

D10 Accessories

Pico-Style Quick-Disconnect Cables

Cable: PUR jacket, polyurethane connector body, POM snap-lock coupling
Conductors: 26 or 24 AWG high-flex stranded, gold-plated contacts
Temperature: -40° to +90°C (-40° to +194°F)
Voltage Rating: 30V ac/36V dc

Style	Model	Length	Dimensions	Pin-out
6-Pin Straight	PKG6Z-2	2 m (6.5')		
	PKG6Z-9	9 m (30')		
6-Pin Right-angle	PKW6Z-2	2 m (6.5')		
	PKW6Z-9	9 m (30')		

Repairs

NOTE: Do not attempt any repairs to the D10. It contains no field-replaceable components. Return the sensor to the factory for warranty repair or replacement.

If it ever becomes necessary to return a D10 to the factory, please do the following:

1) Contact the Banner Factory Application Engineering Group at the address or at the numbers listed at the bottom of the back page. They will attempt to troubleshoot the system from your description of the problem. If they conclude that a component is defective, they will issue an RMA (Return Merchandise Authorization) number for your paperwork, and give you the proper shipping address.

2) Pack the D10 carefully. Damage which occurs in return shipping is not covered by warranty.

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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.