# D10 Expert Sensor with Analog and Discrete Outputs

**BANNER** ®

## Features

Advanced sensor for use with plastic fiber optics

To view or download the latest technical information about this product, including specifications, dimensions, accessories, and wiring, go to www.bannerengineering.com.

- 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)
- Models available with one scalable Analog output (4 to 20 mA or 0 to 10 V) and one Discrete output (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), visible green (525 nm), or visible blue (450 nm) sensing beam to match sensing beam to the application
- Models available with 2 m or 9 m (6.5 ft or 30 ft) cable or integral M8 quick-disconnect
- Sleek, ultra-slim 10 mm housing, mounts to a standard 35 mm DIN rail
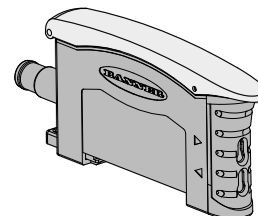
## Models

| Models | | | Cables | Discrete Outputs | Analog Output |
|---|---|---|---|---|---|
| Red Beam | Green Beam | Blue Beam | | | |
| D10INFP | D10INFPG | - | 2 m (6.5 ft) Cable | NPN | 4 to 20 mA |
| D10INFPQ | D10INFPGQ | - | 6-pin M8 QD | | |
| D10IPFP | D10IPFPG | - | 2 m (6.5 ft) Cable | PNP | |
| D10IPFPQ | D10IPFPGQ | - | 6-pin M8 QD | | |
| D10UNFP | D10UNFPG | - | 2 m (6.5 ft) Cable | NPN | 0 to 10 V |
| D10UNFPQ | D10UNFPGQ | - | 6-pin M8 QD | | |
| D10UPFP | D10UPFPG | D10UPFPB | 2 m (6.5 ft) Cable | PNP | |
| D10UPFPQ | D10UPFPGQ | D10UPFPBQ | 6-pin M8 QD | | |

To order the 9 m (30 ft) PVC cable model, add the suffix "W/30" to the cabled model number. For example, D10xFP W/30. Models with a quick disconnect require a mating cordset. See "D10E Accessories" on page 17.

## Overview

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. *Expert* TEACH and setup options provide static, dynamic, and single-point programming plus manual fine adjustment, remote programming, and push button lockout.
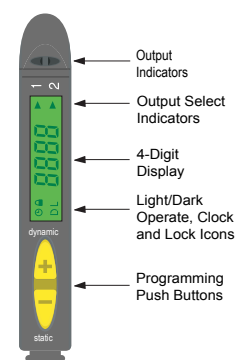
Its slender, stylized housing has a large digital display visible beneath a clear cover for easy programming and status monitoring during operation.

The sensor mounts directly to a standard 35 mm DIN rail or using the supplied mounting bracket.

The sensor features two outputs with independent setpoints: one of two analog choices, depending on model, and one discrete (NPN or PNP, also depending on model). Built-in crosstalk avoidance protocol provides trouble-free operation for multiple sensors in one area.

For emitter and receiver port locations, see "Installation" on page 14.

*D10 Features*



- Output Indicators
- Output Select Indicators
- 4-Digit Display
- Light/Dark Operate, Clock and Lock Icons
- Programming Push Buttons

## Programming Options

**Light/Dark Operate Selection**

Toggle to select the condition for which each output will

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p/n: 65448 Rev. I

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 ms

Analog Outputs: OFF-delay acts as a smoothing function

**Display Selection**

Discrete Output: Raw signal value or % excess signal

Analog Output: Raw signal value or analog value (0 to 10 V DC or 4 to 20 mA)

**Tracking Feature**

Sets Output 2 to identical settings as Output 1; Output 2 settings can then be revised as desired (see "Advanced Setup" on page 12).

**Maximum Range (Red, 680 nm)**

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

| Fiber | Super High-Speed (SHS) | High-Speed (HS) | High-Power (HP) | Super High-Power (SHP) |
|---|---|---|---|---|
| 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 |

**Response Time**

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

**Super High-Speed (SHS)**: 50 µs

**High-Speed (HS)**: 200 µs

**High-Power (HP)**: 1 ms

**Super High-Power (SHP)**: 2.5 ms

**Repeatability**

**Super High-Speed (SHS)**: 25 µs

**High-Speed (HS)**: 50 µs

**High-Power (HP)**: 75 µs

**Super High-Power (SHP)**: 100 µs

**Maximum Range (Green, 525 nm)**

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

| Fiber | Super High-Speed (SHS) | High-Speed (HS) | High-Power (HP) | Super High-Power (SHP) |
|---|---|---|---|---|
| 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 |

** ø0.010-inch bifurcated fiber not recommended in these speed settings. Contact Banner Engineering for more information.

**Factory Default Settings**—The following settings are preset at the factory; revert the sensor to factory defaults using the Advanced Setup procedure (see "Advanced Setup" on page 12).

- 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: switchpoint positioned at middle of range

# Sensor 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; the length of the individual pulses is equal to the value T: **0.04 seconds ≤ T ≤ 0.8 seconds**

**Returning to RUN mode:** Exit TEACH and SETUP modes in one of two ways: by exercising the 60-second time-out, or by canceling 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 setpoint(s) for each output can be set independently of one another. 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. Output 1 sets the emitter power. If only output 2 will be used, output 1 must be taught first. Or, enable tracking and teach only output 1, and then output 2 will be the same as output 1.

**Dynamic TEACH and Adaptive Thresholds:** Dynamic TEACH is used to program sensitivity during actual machine run conditions. During Dynamic TEACH, the sensor takes multiple samples of the light and dark conditions and automatically sets the sensitivity at the optimum level. For the discrete output, 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.

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 "Sensor Setup" on page 11).

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).

# Configuration Instructions

## Analog Outputs

Output 1 is configured for either 4 to 20 mA or 0 to 10 V DC analog output, depending on the model. The sensor may be programmed using the two-point TEACH (either static or dynamic) or single-point window SET.



*Analog output as a function of target position – two-point static or dynamic TEACH*
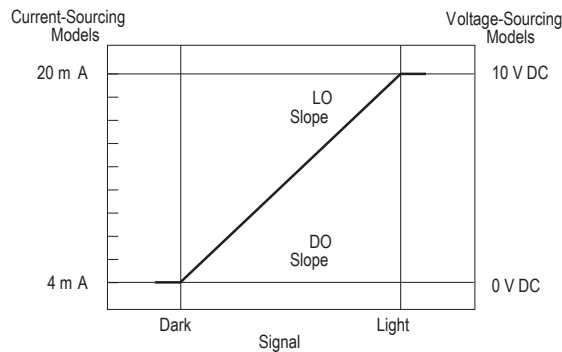


*Analog output as a function of target position – window SET*
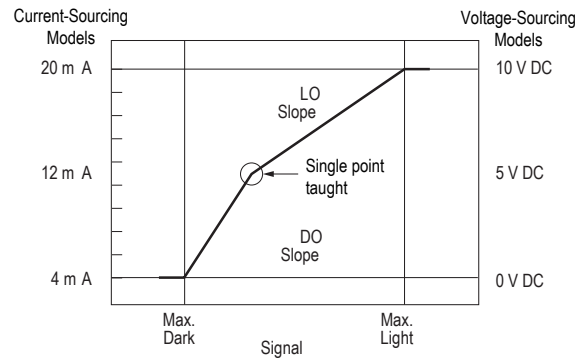
**Two-point static or dynamic TEACH:** The sensor sets the first taught condition to the highest output level (either 20 mA or 10V), and the second taught condition to the lowest level (either 4 mA or 0V), and scales between these points. If the first condition taught has more returned light, the sensor will be in Light Operate mode (LO). If the first taught condition is darker, the sensor will be in Dark Operate mode (DO). To change the slope of the analog output, toggle LO/DO in "Sensor Setup" on page 11.

**Single-point window SET:** The sensor sets the taught condition to the mid-point of its range (12 mA or 5V, depending on the model). For Light Operate mode, the sensor will automatically scale up to 20 mA (or 10V) for maximum light condition (the maximum possible received signal) and down to 4 mA (or 0V) for maximum dark condition (no signal), and vice-versa for Dark Operate mode. To change the slope of the analog output, toggle LO/DO in "Sensor Setup" on page 11.

An OFF-delay enabled for the analog output acts as an averaging function. During the OFF-delay period, the sensor will take multiple analog readings and average the result before changing the analog value. This acts to reduce the effects of major spikes in the analog system, in effect "smoothing" the output reading.

> **NOTE:** Depending on the application configuration and fibers used, the analog function may or may not behave linearly. The received light intensity will be dictated by the inverse square properties of light.

## Active Channel Select

- Selects which channel to teach
- Displays channel configuration information.

The duration of each button click or remote input pulse is defined as T, where T is: 0.04 s < T < 0.8 s.

| Method | Action | | Result |
|---|---|---|---|
| Push Button | Single-click both buttons simultaneously. |  | **Pointer icon:** moves to the other channel indicator.  |
| Remote Input | Triple-pulse the remote line.<br>Triple-pulse will change the display, but will not save. To save Channel Select, make an adjustment to that channel as a TEACH, SET, or Sensor Setup. |  |  |

# Two-Point Static TEACH (Threshold)

- Establishes a single switching threshold
- Threshold position is adjustable using "+" and "-" buttons (see "Manual Adjust" on page 10)

*Static TEACH (Light Operate shown)*
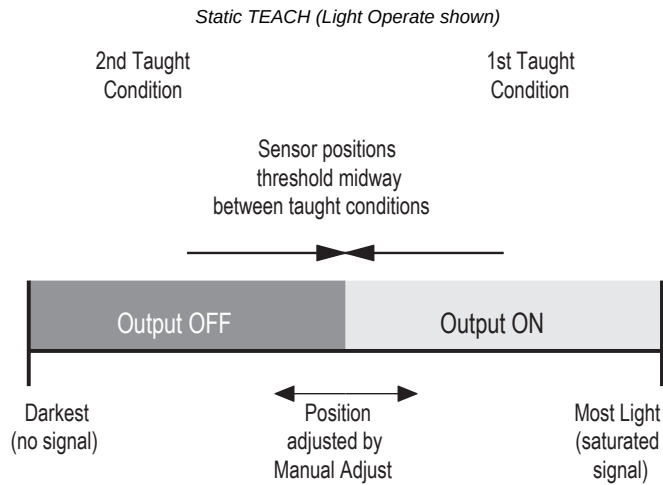


*Contrast values*

| Contrast Values | Description |
|---|---|
| 500+ | Excellent: Very stable operation. |
| 100-500 | Good: Minor sensing variables will not affect sensing reliability. |
| 32-99 | Low: Minor sensing variables may affect sensing reliability. |
| 0-31 | Marginal: Consider an alternate sensing scheme. |

Static TEACH is the traditional setup method, used when two conditions can be presented by the user. The sensor locates a single sensing threshold (the switchpoint) midway between the two taught conditions, with the Output ON condition on one side, and the Output OFF condition on the other.

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 (see "Sensor Setup" on page 11 ).

### Static TEACH and Manual Adjust

**Discrete output:** Using Manual Adjust with Static TEACH moves the switching threshold.

**Analog output:** Using Manual Adjust with Static TEACH moves the entire span up (+) or down (-).

The duration of each button click or remote input pulse is defined as T, where T is: 0.04 s < T < 0.8 s.

1. Access the Static TEACH Mode.

| Method | Action | | Result |
|---|---|---|---|
| Push Button | Press and hold the Static (-) button > 2 seconds. |  | ◦ Display flashes "**1St**"<br>◦ Arrow icon turns red<br> |
| Remote Input | No action is required; the sensor is automatically ready for the 1st TEACH condition. | | |

2. TEACH the Output ON condition.

| Method | Action | | Result |
|---|---|---|---|
| Push Button | a. Present the Output ON condition.<br>b. Click the Static button. |  | Display flashes "**2nd**"<br> |

 31-Dec-24

Continued from page 4

| Method | Action | | Result |
|---|---|---|---|
| Remote Input | a. Present the Output ON condition.<br>b. Single-pulse the remote line. | T | |

3. TEACH the Output OFF condition.

| Method | Action | | Result |
|---|---|---|---|
| Push Button | a. Present the Output OFF condition.<br>b. Click the Static button. | ↕<br>− \| + | **TEACH conditions accepted**<br>◦ Display flashes "**PASS**," followed by a number (denoting contrast); see "Contrast values on page 4.<br><br>D L  PASS  1 2<br><br>◦ Sensor returns to RUN mode with new settings<br>◦ Arrow icon turns green<br><br>**TEACH conditions not accepted**<br>◦ Display flashes "**FAIL**" and returns to "**1St**"<br><br>D L  FAIL  1 2<br><br>D L  1St  1 2<br><br>◦ Arrow icon remains red<br>◦ After 60 seconds, sensor returns to RUN mode (Arrow icon turns green) without changing settings |
| Remote Input | a. Present the Output OFF condition.<br>b. Single-pulse the remote line. | T | |

## Dynamic TEACH and Adaptive Thresholds

- TEACH on-the-fly
- Sets a single threshold
- Threshold position is adjustable using the "+" and "-" buttons (see "Manual Adjust" on page 10)

*Dynamic TEACH (Light Operate shown)*
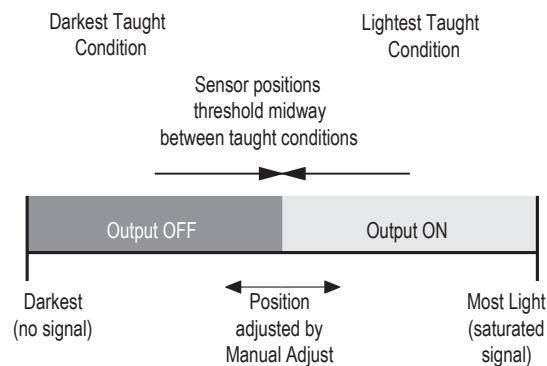


| Dynamic Contrast Values | |
|---|---|
| 500+ | **Excellent:** Very stable operation. |
| 100-500 | **Good:** Minor sensing variables will not affect sensing reliability. |
| 32-99 | **Low:** Minor sensing variables may affect sensing reliability. |
| 0-31 | **Marginal:** Consider an alternate sensing scheme. |

Dynamic TEACH is used to program sensitivity during actual machine run conditions. During Dynamic TEACH, the sensor 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 the 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.

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

**Dynamic TEACH and Manual Adjust**— Sensitivity may be adjusted 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).

The duration of each button click or remote input pulse is defined as T, where T is: 0.04 s < T < 0.8 s.

1. Access the Dynamic TEACH Mode.

| Method | Action | | Result |
|---|---|---|---|
| **Push Button** | Press and hold the Dynamic (+) button. | | ◦ Display flashes "**dYn**"<br>◦ Arrow icon turns red |
| **Remote Input** | Hold the remote line low (to ground). | | |

2. TEACH the Sensing Conditions.

| Method | Action | | Result |
|---|---|---|---|
| **Push Button** | Present the Output ON/OFF conditions while continuing to hold the Dynamic button. | | |
| **Remote Input** | Present the Output ON/OFF conditions while continuing to hold the remote line low (to ground). | | |

3. Return to RUN Mode.

| Method | Action | | Result |
|---|---|---|---|
| **Push Button** | Release the Dynamic button. | | **TEACH conditions accepted**<br>◦ Display flashes "**PASS**," followed by a number that denotes the contrast value.<br>◦ Sensor returns to RUN mode with new settings<br>◦ Arrow icon turns green |
| **Remote Input** | Release the remote line/switch. | | **TEACH conditions not accepted**<br>◦ Display flashes "**FAIL**"<br>◦ Arrow icon remains red<br>◦ Sensor returns to RUN mode (Arrow icon turns green) without changing settings |

# Single-Point Window Set

- Sets a single ON condition that extends 200 counts above and below the taught condition (including ±100 counts hysteresis)
- All other conditions (lighter or darker) result in OFF output
- Sensing window size (sensitivity) is adjustable using "+" and "-" buttons (see )

The duration of each button click or remote input pulse is defined as T, where T is: 0.04 s < T < 0.8 s.

31-Dec-24

*Single-Point Window SET and Hysteresis (Light Operate shown)*

Sensing window size adjusted by
Manual Adjust

Sensor positions
window thresholds
±100 counts from the
presented condition

| Hysteresis 100 counts | 200 counts | Hysteresis 100 counts |
|---|---|---|
| Output OFF | Output ON | Output OFF |

Darkest
(no signal)

Taught
Condition

Most Light
(saturated
signal)
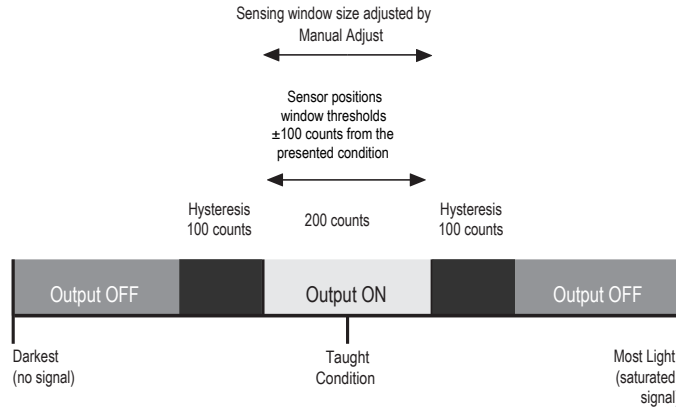
Window Set is most useful when a product may not always appear in the same place, or when other signals may appear. Window Set designates a sensing window, with the Output ON condition inside the window, and the Output OFF condi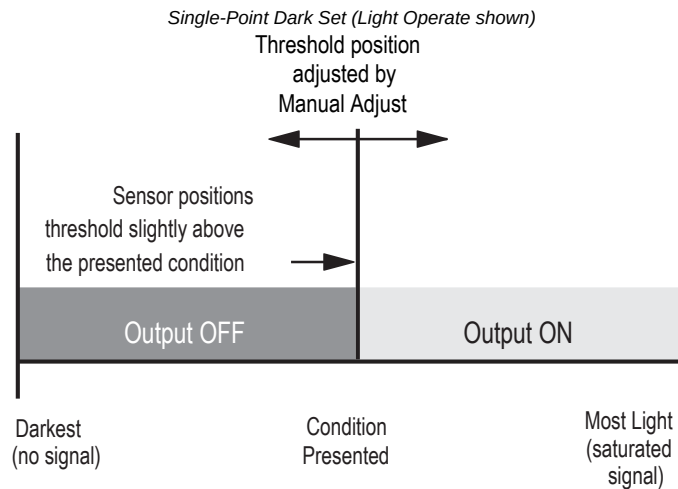tions outside the window. The sensor accepts a single sensing condition, and adds switching thresholds and hysteresis above and below that condition to create a sensing window. Output ON and OFF conditions can be reversed by changing Light/Dark Operate status in Setup mode.

### Window Set and Manual Adjust

**Discrete:** Using Manual Adjust with Window Set expands or contracts the size of the window.

**Analog:** Analog manual adjust increases (+) or decreases (-) counts on both ends by the same amount, but it does not rescale. Cycling the power will rescale the window and adjustments.

1. Access the SET Mode.

| Method | Action | Result |
|---|---|---|
| Push Button | Press and hold the Static (-) button > 2 seconds. | ◦ Display flashes "**1St**" <br><br> `D L 15t 1 2` <br><br> ◦ Arrow icon turns red |
| Remote Input | a. Present the sensing condition. <br> b. Single-pulse the remote line. | ◦ Display flashes "**2nd**" <br><br> `D L 2nd 1 2` <br><br> ◦ Arrow icon turns red |

2. SET the sensing condition.

| Method | Action | Result |
|---|---|---|
| Push Button | a. Present the sensing condition. <br> b. Double-click the Static button. | **TEACH conditions accepted** <br> ◦ Display flashes "**Sn6l**," then "**Pt**" twice <br><br> `D L Sn6L 1 2` <br><br> `D L Pt 1 2` <br><br> ◦ Sensor returns to RUN mode with new settings <br> ◦ Arrow icon turns green |
| Remote Input | Double-pulse the remote line. | **TEACH conditions not accepted** <br> ◦ Display flashes "**FAIL**" and returns to "**1St**" <br><br> `D L FA IL 1 2` <br><br> `D L 15t 1 2` <br><br> ◦ Arrow icon remains red <br> ◦ After 60 seconds, the sensor returns to RUN mode (the arrow icon turns green) without changing settings |

# Single-Point Light Set - Discrete Only

- Sets a threshold slightly below the taught condition.
- Any condition darker than the threshold condition causes the output to change state
- Threshold position is adjustable using the "+" and "-" buttons (see "Manual Adjust" on page 10)
- Recommended for applications where only one condition is known, for example, a stable light background with varying darker targets

*Single-Point Light Set (Light Operate shown)*

Threshold position
adjusted by
Manual Adjust

Sensor positions
threshold slightly below
the presented condition

Output ON    Output OFF

Darkest
(no signal)

Condition
Presented

Most Light
(saturated signal)
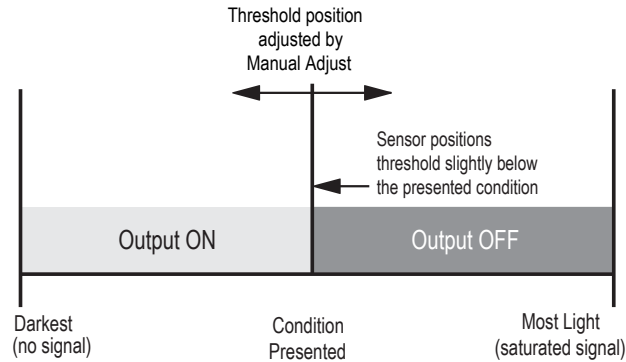
*Light set threshold offset*

| Mode | Threshold Offset (counts below taught signal value) |
|---|---|
| Super High-Speed | 30 |
| High-Speed | 22 |
| High-Power | 9 |
| Super High-Power | 6 |

A single sensing condition is presented, and the sensor positions a threshold slightly below the presented condition. When a condition darker than the threshold is sensed, the output either turns ON or OFF, depending on the Light/Dark Operate setting (see "Sensor Setup" on page 11).
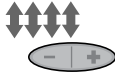
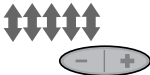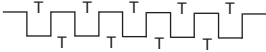**Light SET and Light/Dark Operate Selection**— Light Set teaches the Output OFF condition and forces the sensor into Dark Operate (DO) mode. The sensor can be reconfigured to Light Operate (LO) mode after the condition has been taught (see "Sensor Setup" on page 11).

The duration of each button click or remote input pulse is defined as T, where T is: 0.04 s < T < 0.8 s.

1. Access the SET Mode.

| Method | Action | Result |
|---|---|---|
| **Push Button** | Press and hold the Static (-) button > 2 seconds. | ◦ Display flashes "**1St**" <br> ◦ Arrow icon turns red <br> DL  15t  1 2 |
| **Remote Input** | Single-pulse the remote line. | ◦ Display flashes "**2nd**" <br> ◦ Arrow icon turns red <br> DL  2nd  1 2 |

2. SET the Output OFF condition.

 31-Dec-24

| Method | Action | Result |
|---|---|---|
| Push Button | a. Present the Output OFF condition.<br>b. Four-click the Static button. | **Threshold condition accepted**<br>◦ Display flashes "**Sn6l**," then "**Lt**" twice<br><br>_(display: **Sn6L**, D L, 1 2)_<br><br>_(display: **Lt**, D L, 1 2)_<br><br>◦ Sensor returns to RUN mode with new settings<br>◦ Arrow icon turns green |
| Remote Input | a. Present the Output OFF condition.<br>b. Four-pulse the remote line. | **Threshold conditions not accepted**<br>◦ Display flashes "**FAIL**" and returns to<br><br>_(display: **FAIL**, D L, 1 2)_<br>"**1St**"<br><br>_(display: **1St**, D L, 1 2)_<br><br>◦ Arrow icon remains red<br>◦ After 60 seconds, the sensor returns to RUN mode (the Arrow icon turns green) without changing settings |

## Single-Point Dark Set - Discrete Only

• Sets a threshold slightly above the taught condition
• Any condition lighter than the threshold condition causes the output to change state
• Threshold position is adjustable using the "+" and "-" buttons (see "Manual Adjust" on page 10)
• Recommended for applications where only one condition is known, for example, a stable dark background with varying lighter targets

_Single-Point Dark Set (Light Operate shown)_

Threshold position
adjusted by
Manual Adjust

Sensor positions
threshold slightly above
the presented condition

Output OFF          Output ON

Darkest
(no signal)

Condition
Presented

Most Light
(saturated
signal)

_Dark set threshold offset_

| Mode | Threshold Offset (counts above taught signal value) |
|---|---|
| Super High-Speed | 30 |
| High-Speed | 22 |
| High-Power | 9 |
| Super High-Power | 6 |

A single sensing condition is presented, and the sensor positions a threshold slightly above the taught condition. When a condition lighter than the threshold is sensed, the output either turns ON or OFF, depending on the Light/Dark Operate setting (see "Sensor Setup" on page 11).

**Dark Set and Light/Dark Operate Selection**— Dark Set teaches the Output OFF condition and forces the sensor into Light Operate (LO) mode. The sensor can be reconfigured to Dark Operate (DO) mode after the condition has been taught (see "Sensor Setup" on page 11).

The duration of each button click or remote input pulse is defined as T, where T is: 0.04 s < T < 0.8 s.

1. Access the Set Mode.

| Method | Action | | Result |
|---|---|---|---|
| **Push Button** | Press and hold the Static button > 2 seconds. | ↓ <br> — │ + | ◦ Display flashes "**1St**" <br> ◦ Arrow icon turns red <br> D L  `1St`  1 2 |
| **Remote Input** | Single-pulse the remote line. | ‾|_|‾ T | ◦ Display flashes "**2nd**" <br> ◦ Arrow icon turns red <br> D L  `2nd`  1 2 |

2. Set the Output OFF condition.

| Method | Action | | Result |
|---|---|---|---|
| **Push Button** | a. Present the Output OFF condition. <br> b. Five-click the Static button. | ↓↓↓↓↓ <br> — │ + | **Threshold condition accepted** <br> ◦ Display flashes "**Sn6l**," then "**dr**" twice <br> D L  `Sn6L`  1 2 <br> D L  `dr`  1 2 <br> ◦ Sensor returns to RUN mode with new settings <br> ◦ Arrow icon turns green |
| **Remote Input** | a. Present the Output OFF condition. <br> b. Five-pulse the remote line. | ‾|_|‾|_|‾|_|‾|_|‾ T T T T T <br> T T T T T | **Threshold condition not accepted** <br> ◦ Display flashes "**FAIL**" and returns to "**1St**" <br> D L  `FAIL`  1 2 <br> D L  `1St`  1 2 <br> ◦ Arrow icon remains red <br> ◦ After 60 seconds, the sensor returns to RUN mode (the Arrow icon turns green) without changing settings |

## Manual Adjust

Manual Adjust is used during Run mode and is accomplished using the push buttons only. Its behavior depends on whether a switching threshold or a sensing window is used.

**Switching Threshold:**
- Fine-tunes sensing sensitivity
- Press "+" to increase; press "-" to decrease

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

The duration of each button click or remote input pulse is defined as T, where T is: 0.04 s < T < 0.8 s.

 31-Dec-24
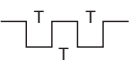
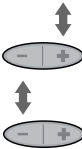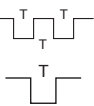| Method | Action | | Result |
|---|---|---|---|
| Push Button | Click "+" to increase, or click "-" to decrease. | ↕ or ↕ | Display briefly flashes the threshold setpoint value as it is being changed <br><br> **OR** <br><br> Display flashes "**inc**" or "**dEc**" as the window size is adjusted <br><br> or |
| Remote Input | Not available with remote programming. | | n/a |

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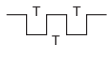
- Configures sensor display and operating parameters
- Changes are updated instantly
- Click Dynamic (+) or double-pulse remote line to select an option
- Click Static (-) or single-pulse remote line to advance

The duration of each button click or remote input pulse is defined as T, where T is: 0.04 s < T < 0.8 s.

1. Access SETUP Mode.

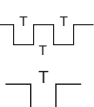| Method | Action | | Result |
|---|---|---|---|
| Push Button | Press and hold both buttons concurrently for > 2 seconds. | ↓ ↓ | The indicator arrow icon 1 is ON red. |
| Remote Input | Double-pulse the remote line. | T T | |
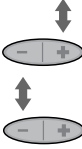
2. Select Light/Dark Operate.

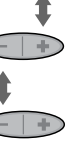| Method | Action | | Result |
|---|---|---|---|
| Push Button | a. Click Dynamic (+) to toggle between selections. <br>b. Click Static (-) to save selection and advance to "OFF-Delay." | ↕ | **Light Operate** <br>∘ Display flashes "**lo**" <br>∘ L icon <br><br> **Dark Operate** <br>∘ Display flashes "**do**" <br>∘ D icon |
| Remote Input | a. Double-pulse remote line to toggle between selections. <br>b. Single-pulse remote line to save selection and advance to "OFF-Delay." | T T <br><br> T | |
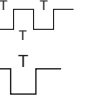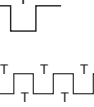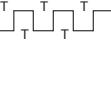
3. Select OFF-Delay Timing Enable.

| Method | Action | | Result |
|---|---|---|---|
| Push Button | a. Click Dynamic (+) to toggle between selections.<br>b. Click Static (-) to save selection and advance to "Display." | | **Off (No OFF-Delay)**<br>◦ "t 0"<br>◦ Clock icon OFF<br><br>**2 to 100 ms OFF-Delay**<br>◦ "t 2," "t 5," "t 10," "t 15," "t 20," "t 30," "t 40," "t 60," "t 80," or "t100"<br>◦ Clock icon ON |
| Remote Input | a. Double-pulse remote line to toggle between selections.<br>b. Single-pulse remote line to save selection and advance to "Display." | | |

4. Select Display Parameters.

| Method | Action | | Result |
|---|---|---|---|
| Push Button | a. Click Dynamic (+) to toggle between selections.<br>b. Click Static (-) to save selection and advance to "Power/Speed." | | **Raw Signal Value**<br>Discrete: "1234"<br><br>**Analog: 4 -20, 0-10, A = mA , V = Volts** |
| Remote Input | a. Double-pulse remote line to toggle between selections.<br>b. Single-pulse remote line to save selection and advance to "Power/Speed." | | **Percent of excess signal**<br>Discrete: "123P" |

5. Select Speed and Power Combination.

| Method | Action | | Result |
|---|---|---|---|
| Push Button | a. Click Dynamic (+) to toggle between selections.<br>b. Click Static (-) to save selection and return to RUN mode.<br><br>**OR**<br><br>c. Press Static (-) four times to proceed to Advanced Setup. | | Indicator Arrow Icons 1 and 2 ON Red<br><br>**Super-high-speed (50-μs response)**<br><br>"**SHS**" (Complementary outputs; see note below)<br><br>**High-speed (200-μs response)**<br>"HS" |
| Remote Input | a. Double pulse the remote line to toggle between selections.<br>b. Single-pulse the remote line to save selection and return to RUN mode.<br><br>**OR**<br><br>c. Four-pulse the remote line to proceed to Advanced Setup. | | **High-power (1-ms response)**<br>"HP"<br><br>**Super-high-power (2.5-ms response)**<br>"SHP"<br><br>**OR**<br><br>See "Advanced Setup" on page 12. |

**Super-High-Speed Operation Note**: Under most conditions, the sensor's two discrete outputs operate independently. However, the outputs become complementary when operating at Super-High-Speed, due to its extremely fast response time. Only channel 1 is taught/adjusted; channel 2 is complementary to it (output 1 conducts for the taught ON condition, and output 2 conducts for the OFF state). To invert these conditions (output 1 – OFF condition, output 2 – ON), change light/dark operate setting.
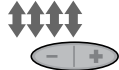
## Advanced Setup

- 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

 31-Dec-24

- Click Dynamic (+) or double-pulse remote line to select an option
- Click Static or single-pulse remote line to advance
- Changes are updated instantly

The duration of each button click or remote input pulse is defined as T, where T is: 0.04 s < T < 0.8 s.

1. Enter SETUP Mode.

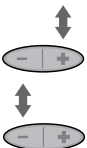| Method | Action | | Result |
|---|---|---|---|
| Push Button | From the Power and Speed mode, quad-click the Static (-) button. | | ◦ Indicator Arrow Icons 1 and 2 remain red<br>◦ Display shows "Tracking Enabled" option |
| Remote Input | From the Power and Speed mode, quad-pulse the remote line. | | |

2. Set tracking, if desired.

| Method | Action | | Result |
|---|---|---|---|
| Push Button | a. Click Dynamic (+) to toggle between selections.<br>b. Click Static (-) to save selection and advance to "Factory Default." | | **Sets output 2 identical to output 1**<br>Tracking Disabled: Display shows "**tr n**" |
| Remote Input | a. Double-pulse the remote line to toggle between selections.<br>b. Single-pulse the remote line to save selection and advance to "Factory Default." | | Tracking Enabled: Display shows "**tr Y**" |

3. Return the sensor to the factory default settings, if desired.

| Method | Action | | Result |
|---|---|---|---|
| Push Button | a. Click Dynamic (+) to toggle between selections.<br>b. Click Static (-) to save selection and advance to "Display Orientation." | | **Returns to factory default factory settings**<br>Factory Default Settings Not Selected: Display shows "**Fd n**" |
| Remote Input | a. Double-pulse the remote line to toggle between selections.<br>b. Single-pulse the remote line to save selection and advance to "Display Orientation." | | Factory Default Settings Selected: Display shows "**Fd Y**" |

4. Change the display orientation, if desired.

| Method | Action | | Result |
|---|---|---|---|
| Push Button | a. Click Dynamic (+) to toggle between selections.<br>b. Click Static (-) to return to RUN mode. | | **Inverts the display to read "upside-down"**<br>Normal<br><br>For example: 1234<br><br>**Inverted**<br><br>For example: ⱱƐᏃⱢ |
| Remote Input | a. Double-pulse the remote line to toggle between selections.<br>b. Single-pulse the remote line to return to RUN mode. | | Icons do not invert. |

# 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

The duration of each button click or remote input pulse is defined as T, where T is: 0.04 s < T < 0.8 s.

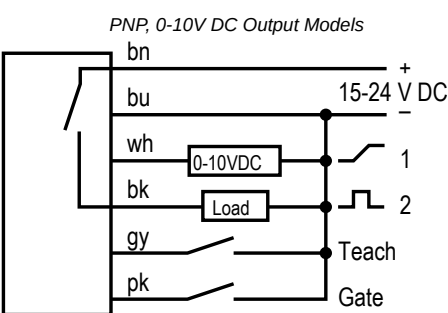| Method | Action | | Result |
|---|---|---|---|
| Push Button | Not available with push-button programming. | | **Push buttons Disabled**<br>• Display flashes "**loc**"<br>• Padlock icon appears<br>• Sensor remains in RUN mode |
| Remote Input | From RUN mode, quad-pulse the remote line to toggle between selections. | | **Push Buttons Enabled**<br>• Display flashes "**uloc**"<br>• Padlock icon disappears<br>• Sensor remains in RUN mode |

## Self-Diagnostic Error Modes

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

## Gate Input

The pink wire is configured as a gate input. When this wire is pulled low (for example, to the sensor ground; 0–0.5 V DC), it inhibits the outputs from switching, while all other sensor 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.

## Wiring

*NPN, 4-20 mA Output Models*



*NPN, 0-10V DC Output Models*



*PNP, 4-20 mA Output Models*



*PNP, 0-10V DC Output Models*
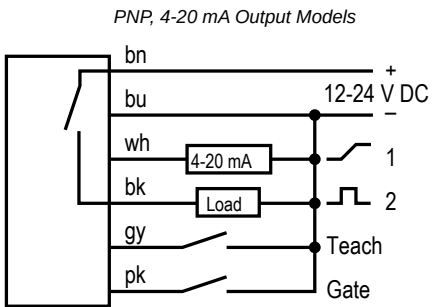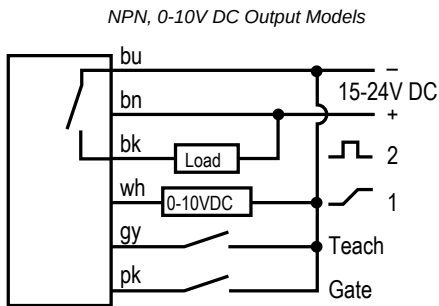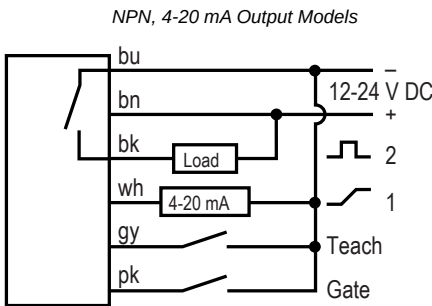


Quick disconnect connections are functionally identical.

## Installation

Install the product on a 35 mm DIN rail or the included mounting bracket.

 31-Dec-24

Slides Up to
Release Fibers

Plastic Fiber
Emitter Port

Plastic Fiber
Receiver Port

# Specifications

**Supply Voltage and Current**

**4-20 mA Analog Models:** 12 to 24 V DC (10% maximum ripple) at less than 65 mA, exclusive of load

**0-10 V DC Analog Models:** 15 to 24 V DC (10% maximum ripple) at less than 70 mA, exclusive of load
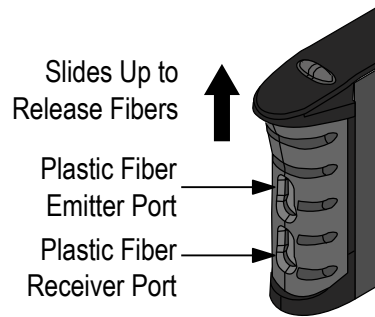
**Supply Protection Circuitry**

Protected against reverse polarity and transient voltage

**Sensing Beam**

680 nm visible red, 525 nm visible green, or 450 nm visible blue, depending on the model

**Required Fiber-Optic Cable**

Banner P-Series plastic fibers

**Output Configuration**

Two independently configurable outputs, depending on model: NPN w/analog (4-20 mA or 0-10 V) or PNP w/analog (4-20 mA or 0-10 V)

**Adjustments**

Push-button or remote programming of response time, OFF-delay, light/dark operate, and display

**Indicators**

Four-digit digital display plus LED indicators for active channel, push-button lockout, OFF-delay and light/dark operate selection; two yellow output indicators

**Construction**

Black ABS/polycarbonate alloy (UL94 V-0 rated) housing, clear polycarbonate cover

**Connections**

PVC-jacketed 2 m or 9 m (6.5 ft or 30 ft) 6-wire integral cable or integral 6-pin M8 quick-disconnect

**Installation**

35 mm DIN rail or included mounting bracket

**Output Rating**

Discrete Output: 150 mA, maximum load

OFF-state leakage current: < 10 µA at 24 V DC

ON-state saturation voltage: **NPN:** < 1.5 V at 150 mA load; **PNP** < 2.5 V at 150 mA load

Analog Output: 4-20 mA or 0-10 V DC

Load: **4-20 mA Models:** 100Ω maximum impedance; **0-10 V DC Models:** 1 MΩ min. impedance

**Output Response Time**

Discrete Output: Programmable, 50 microseconds, 200 microseconds, 1 millisecond, 2.5 milliseconds

Analog Output: 1 millisecond

> **NOTE:** < 1 second delay on power-up; outputs do not conduct during this time.

**Output Protection Circuitry**

Protected against false pulse on power-up and continuous short-circuit

**Environmental Rating**

Red and green beam models: IP50, NEMA 1

Blue beam models: IP50, NEMA 4X

**Operating Conditions**

Red and Green beam models operating temperature: –20 to +55 °C (–4 to +131 °F)

Blue beam models operating temperature: –10 °C to +55 °C (+14 °F to +131 °F)

Storage: –20 to +80 °C (–4 to +175 °F)

Maximum Relative Humidity: 90% at 50 °C (non-condensing)

| Number of Devices, Stacked | Ambient Temperature Rating | Load Specification |
|---|---|---|
| 3 | 55 °C (131 °F) | 150 mA |
| 7 | 50 °C (122 °F) | 50 mA |
| 10 | 45 °C (113 °F) | 50 mA |

**Certifications**

CE
Banner Engineering BV
Park Lane, Culliganlaan 2F bus 3
1831 Diegem, BELGIUM

UK CA
Turck Banner LTD Blenheim House
Blenheim Court
Wickford, Essex SS11 8YT
GREAT BRITAIN

c**UL**us

**Required Overcurrent Protection**

> ⚠️ **WARNING:** Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.

Overcurrent protection is required to be provided by end product application per the supplied table.

Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply.
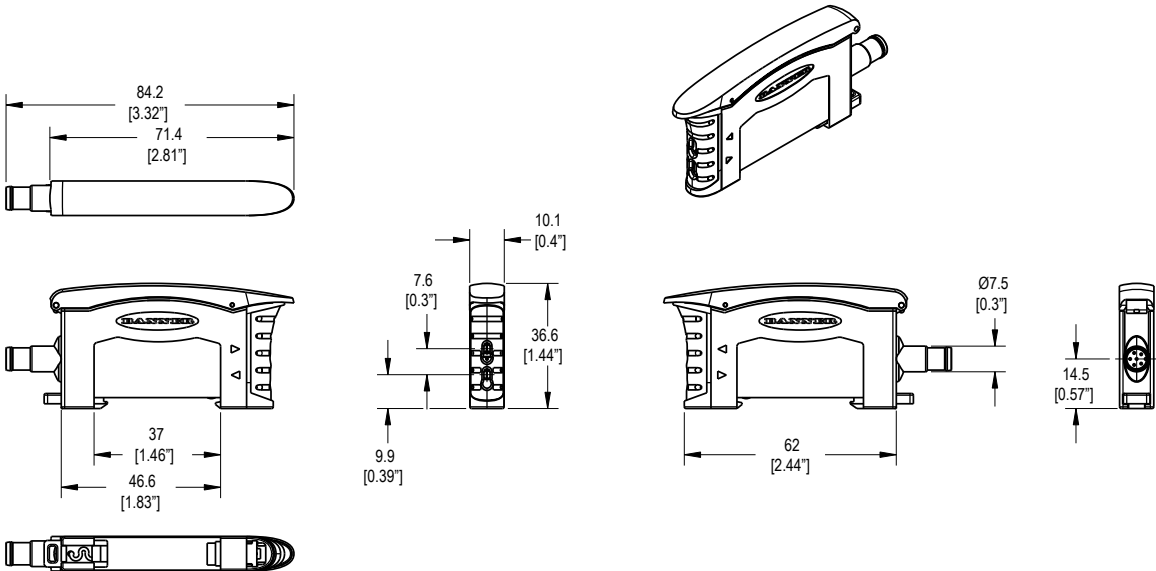
Supply wiring leads < 24 AWG shall not be spliced.

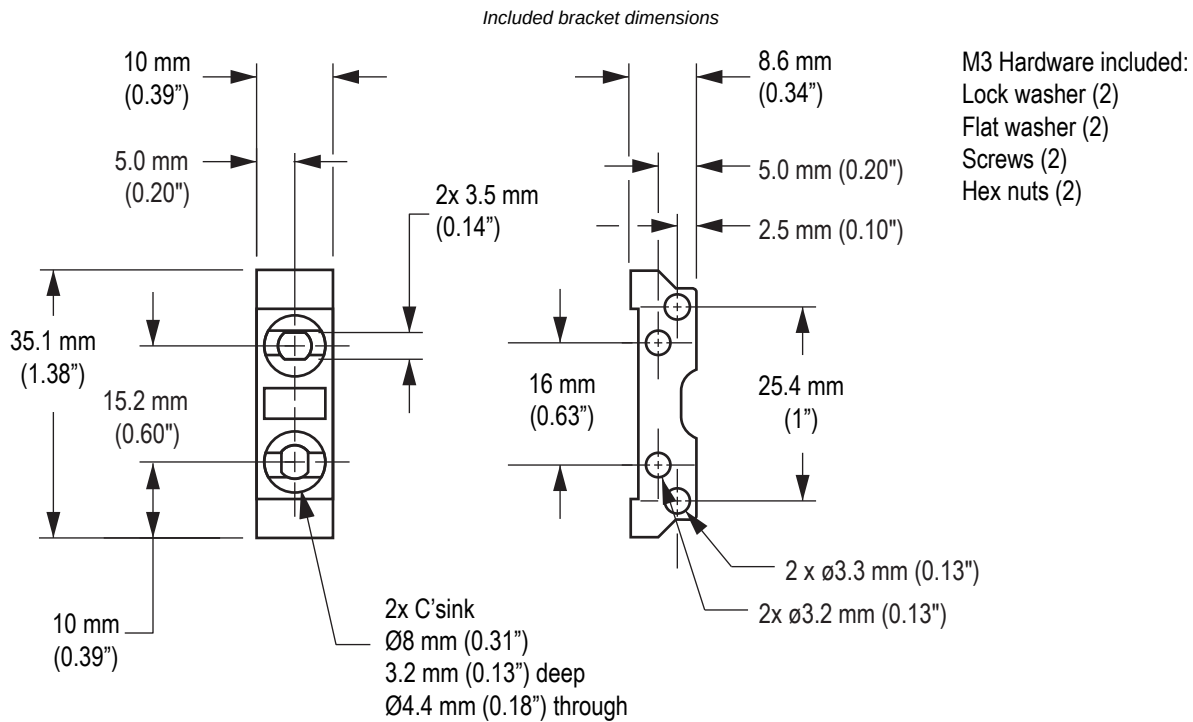For additional product support, go to www.bannerengineering.com.

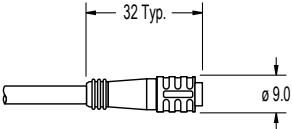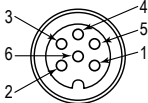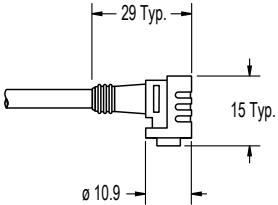| Supply Wiring (AWG) | Required Overcurrent Protection (A) | Supply Wiring (AWG) | Required Overcurrent Protection (A) |
|---|---|---|---|
| 20 | 5.0 | 26 | 1.0 |
| 22 | 3.0 | 28 | 0.8 |
| 24 | 1.0 | 30 | 0.5 |

# Dimensions

All measurements are listed in millimeters [inches], unless noted otherwise. The measurements provided are subject to change.

*D10 dimensions*

31-Dec-24

*Included bracket dimensions*



10 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 mm (0.39")
2x C'sink Ø8 mm (0.31") 3.2 mm (0.13") deep Ø4.4 mm (0.18") through

8.6 mm (0.34")
5.0 mm (0.20")
2.5 mm (0.10")
16 mm (0.63")
25.4 mm (1")
2 x ø3.3 mm (0.13")
2x ø3.2 mm (0.13")

M3 Hardware included:
Lock washer (2)
Flat washer (2)
Screws (2)
Hex nuts (2)

# Accessories

| 6-Pin Single-Ended Snap-on M8 Female Cordsets | | | | |
|---|---|---|---|---|
| Model | Length | Style | Dimensions | Pinout (Female) |
| PKG6Z-2 | 2 m (6.56 ft) | Straight | 32 Typ. ø 9.0 | |
| PKG6Z-9 | 9 m (29.53 ft) | | | |
| PKW6Z-2 | 2 m (6.56 ft) | Right-angle | 29 Typ. 15 Typ. ø 10.9 | |
| PKW6Z-9 | 9 m (29.53 ft) | | | |

1 - brown
2 = White
3 = Blue
4 = Black
5 = Gray
6 = Pink

# Banner Engineering Corp Limited Warranty

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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31-Dec-24