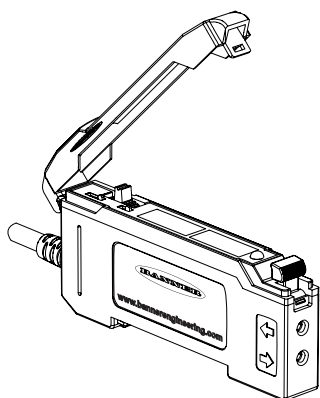


DF-G1 - Expert Dual Display Fiber Amplifier Manual



more sensors, more solutions

Advanced sensor with dual digital displays for use with plastic and glass fiber optic assemblies



- Easy to read dual digital displays show both signal level and threshold simultaneously
- Lever action fiber clamp provides stable, reliable, and trouble-free fiber clamping
- Simple user interface ensures easy sensor set-up and programming via displays and switches/buttons, remote input teach wire, or IO-Link
- *Expert* TEACH and SET methods ensure optimal gain and threshold for all applications, especially low contrast applications
- User has full control over all operating parameters: threshold, Light Operate or Dark Operate, output timing functions, gain level, and response speed
- Thermally stable electronics minimize warm-up drift and the effect of side-by-side mounting of multiple fiber amplifiers
- ECO (economy) display mode reduces amplifier power consumption by 25%
- Cross talk avoidance algorithm allows two sensors to operate in close proximity for many applications
- Response speeds of: 200 μ s (High Speed), 500 μ s (Standard), 2 ms (Long Range), and 5 ms (Extra Long Range) allow operator to optimize for fast or long distance applications
- Sleek 10 mm wide housing mounts to 35 mm DIN rail
- Visible red LED sensing beam



WARNING: Not To Be Used for Personnel Protection

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

Models

Model	Outputs	Connector ¹
DF-G1-NS-2M	Single NPN	2 m (6.5 ft) cable, 4-wire
DF-G1-PS-2M	Single PNP	
DF-G1-KS-2M	Dual outputs, 1 push-pull IO-Link and 1 PNP (complementary outputs)	
DF-G1-NS-Q5	Single NPN	150 mm (6 in) PVC pigtail, M12 Euro QD connector, 4-pin
DF-G1-PS-Q5	Single PNP	
DF-G1-KS-Q5	Dual outputs, 1 push-pull IO-Link and 1 PNP (complementary outputs)	
DF-G1-NS-Q7	Single NPN	Integral M8 Pico QD connector, 4-pin
DF-G1-PS-Q7	Single PNP	
DF-G1-KS-Q7	Dual outputs, 1 push-pull IO-Link and 1 PNP (complementary outputs)	

Connector options:

- A model with a QD connector requires a mating cordset (see [Quick-Disconnect Cordsets](#) on page 27).
- For 9 m cable, change the suffix 2M to **9M** in the 2 m model number (example, DF-G1-NS-**9M**).
- For 150 mm (6 in) PVC pigtail, M8 Pico QD connector, 4-pin change the suffix 2M to **Q3** in the 2 m model number (example, DF-G1-NS-**Q3**).



Overview

The DF-G1 is an easy-to-use, DIN-rail-mountable fiber optic sensor. It provides high-performance sensing in low-contrast applications.

The sensor's compact housing has dual digital displays (Red/Green) and a bright output LED for easy programming and status monitoring during operation. The sensor features a single discrete output, either NPN or PNP, by model.

The DF-G1 features increased temperature compensation compared with previous fiber optic sensors. An accessory clamp is available to secure a bank of connected sensors together on a DIN rail (see [Accessories](#) on page 28).

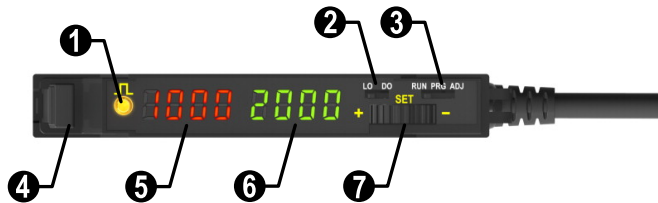


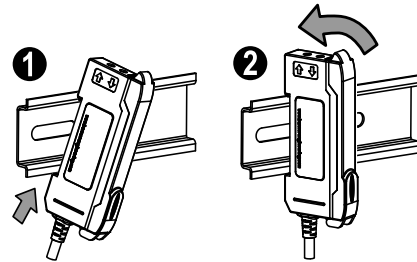
Figure 1. DF-G1 Model Features

1	Output LED
2	LO/DO Switch
3	RUN/PRG/ADJ Mode Switch
4	Lever Action Fiber Clamp
5	Red Signal Level
6	Green Threshold
7	+/-SET/- Rocker Button

Mounting Instructions

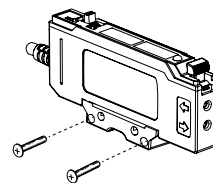
Mount on a DIN Rail

1. Hook the DIN rail clip on the bottom of the DF-G1 over the edge of the DIN rail (1).
2. Push the DF-G1 up on the DIN rail (1).
3. Pivot the DF-G1 onto the DIN rail, pressing until it snaps into place (2).



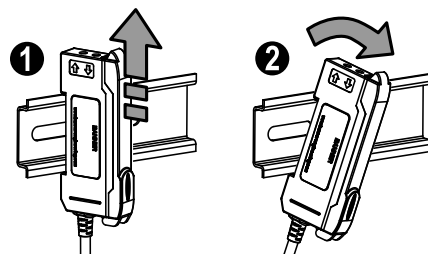
Mount to the Accessory Bracket

1. Position the DF-G1 in the SA-DIN-BRACKET.
2. Insert the supplied M3 screws.
3. Tighten the screws.



Remove from a DIN rail

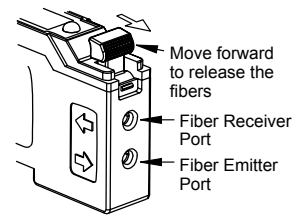
1. Push the DF-G1 up on the DIN rail (1).
2. Pivot the DF-G1 away from the DIN rail and remove it (2).



Installing the Fibers

Follow these steps to install glass or plastic fibers.

1. Open the dust cover.
2. Move the fiber clamp forward to unlock it.
3. Insert the fibers into the fiber ports until they stop.
4. Move the fiber clamp backward to lock the fibers.
5. Close the dust cover.



Top Panel Interface

Opening the dust cover provides access to the top panel interface. The top panel interface consists of the RUN/PRG/ADJ mode switch, LO/DO switch, +/-SET/- rocker button, dual red/green digital displays, and output LED.

RUN/PRG/ADJ Mode Switch



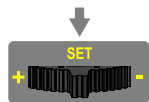
The RUN/PRG/ADJ mode switch puts the sensor in RUN, PRG (Program), or ADJ (Adjust) mode. RUN mode allows the sensor to operate normally and prevents unintentional programming changes via the +/-SET/- button. PRG mode allows the sensor to be programmed through the display driven programming menu (see [Program Mode](#) on page 3). ADJ mode allows the user to perform Expert TEACH/SET methods and Manual Adjust (see [Adjust Mode](#) on page 8).

LO/DO Switch



The LO/DO switch is used to select Light Operate or Dark Operate mode. In Light Operate mode, the output is ON when the sensing condition is above the threshold (for Window SET, the output is ON when the sensing condition is inside the window). In Dark Operate mode, the output is ON when the sensing condition is below the threshold (for Window SET, the output is ON when the sensing condition is outside the window).

+/-SET/- Rocker Button



The +/-SET/- rocker button is a 3-way button. The +/- positions are engaged by rocking the button left/right. The SET position is engaged by clicking down the button while the rocker is in the middle position. All three button positions are used during PRG mode to navigate the display driven programming menu. During ADJ mode, SET is used to perform TEACH/SET methods and +/- are used to manually adjust the threshold(s). The rocker button is disabled during RUN mode, except when using Window SET, see [Window SET](#) on page 12 .

Red/Green Digital Displays



During RUN and ADJ mode, the Red display shows the signal level and the Green display shows the threshold. During PRG mode, both displays are used to navigate the display driven programming menu.



Output LED

The output LED provides a visible indication when the output is activated.

Run Mode



Run mode allows the sensor to operate normally and prevents unintentional programming changes. The +/-SET/- rocker button is disabled during RUN mode, except when using Window SET, see [Window SET](#) on page 12 .

Program Mode



Program (PRG) mode allows the following settings to be programmed in the DF-G1 (refer to [Figure 3.](#) on page 6 and [Figure 4. Remote Input Flowchart](#) on page 7 for programming).

TEACH Selection



The DF-G1 can be programmed for one of the following TEACH/SET methods:

- Two-Point TEACH
- Dynamic TEACH
- Window SET
- Light SET
- Dark SET
- Calibration SET



NOTE: A **TEACH Selection** must be selected by programming before TEACH/SET methods can be used.

Response Speed RESP SPd

The DF-G1 can be programmed for one of the following Response Speeds:

Response Speed	Display Range	Crosstalk Avoidance Algorithm
200 μ s (High Speed)	0 - 4000	Disabled
500 μ s (Standard)	0 - 4000	Enabled
2000 μ s (Long Range)	0 - 9999	Enabled
5000 μ s (Extra Long Range)	0 - 9999	Enabled

Offset Percent OFFSt Pct

The Offset Percent is used during the Window, Light, or Dark SET methods. The threshold(s) are positioned a programmable % offset from the taught condition. The allowable range depends upon the Response Speed Mode, as shown below:

Response Speed	MIN %	MAX %
200 μ s (High Speed)	10	999
500 μ s (Standard)	10	999
2000 μ s (Long Range)	2	999
5000 μ s (Extra Long Range)	2	999

Min OFFSt The offset percent can also be programmed to **Minimum Offset**. This allows the DF-G1 to set the threshold(s) as close as possible to the presented condition, but still provide for reliable sensing.



NOTE: Offset Percent MUST be programmed to **Minimum Offset** for Dark SET to accept conditions of no signal (0 counts).

Auto Thresholds Auto THR

Auto Thresholds can be programmed to be ON/OFF. The Auto Thresholds algorithm continuously tracks slow changes in the taught condition(s), and optimizes the threshold(s) to provide for reliable sensing. For Two-Point and Dynamic TEACH, the algorithm optimizes the threshold to be centered between the light and dark conditions. For Window, Light, and Dark SET, the algorithm optimizes the threshold(s) to maintain the programmed Offset Percent from the taught condition.

- After programming Auto Thresholds to ON, it is highly recommended to re-perform the TEACH/SET method
- Manual Adjustments are disabled when Auto Thresholds are ON
- Auto Thresholds are automatically disabled in Calibration SET (see [Calibration SET](#) on page 18)
- Severe contamination/changes in the taught condition can prevent the Auto Thresholds algorithm from optimizing the threshold(s). If this occurs, the DF-G1 will enter a **Threshold Alert** or **Threshold Error** state. See [Troubleshooting](#) on page 20 for more explanation.

Delays/Timers OFF dLY OFF 1Sho On dLY On 1Sho

ON/OFF Delays and ON/OFF One-Shot timers can be programmed between 1 - 9999 ms (a value of 0 disables the delay/timer). [Figure 2. DF-G1 Delays/Timers](#) on page 5 defines how the delays/timers affect the output behavior.

Some combinations of delays/timers are not allowed. The DF-G1 programming menu automatically disables invalid combinations of delays/timers. The following table shows the allowable combinations of delays/timers:

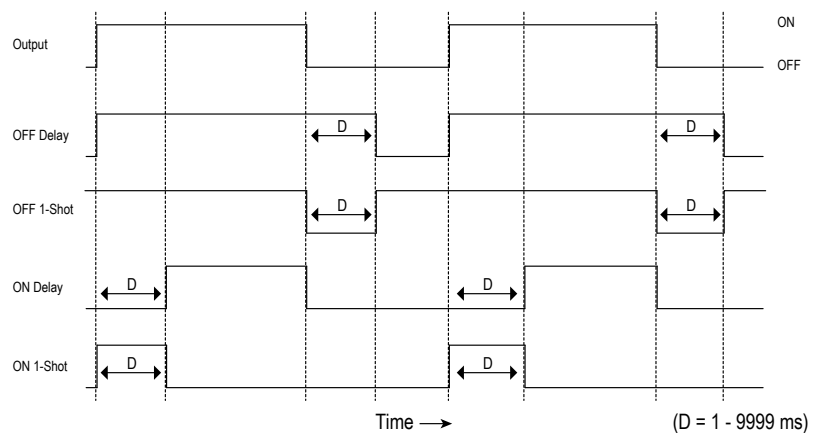


Figure 2. DF-G1 Delays/Timers

	OFF Delay	OFF One-Shot Timer	ON Delay	ON One-Shot Timer
OFF Delay	-	OK	OK	N/A
OFF One-Shot Timer	OK	-	N/A	N/A
ON Delay	OK	N/A	-	OK
ON One-Shot Timer	N/A	N/A	OK	-

Display Readout dISP rEAd

The readout of the digital displays can be programmed for the following options:

- Signal/Threshold readout - Numeric (1234) or % (123P)
- ECO mode - Enabled or Disabled (ECO mode dims the displays to reduce current consumption)
- Display Orientation - Normal (1234) or Flipped (ɹƎƆL)

Gain Selection GR In SEL

The DF-G1 can operate in Auto Gain mode or the Gain can be fixed to be in Gain 1...8. In Auto Gain, the DF-G1 optimizes the gain during a TEACH/SET method for the presented condition(s). While viewing the fixed gains in the Gain Selection choice list, the DF-G1 will automatically switch to the selected gain and display the measured signal on the Red display. This allows for easy and quick evaluation of the fixed gain mode.

Factory Defaults Fcty dEF

The Factory Defaults menu allows the DF-G1 to be easily restored back to original factory default settings (see **Factory Default Settings** in [Specifications](#) on page 21).

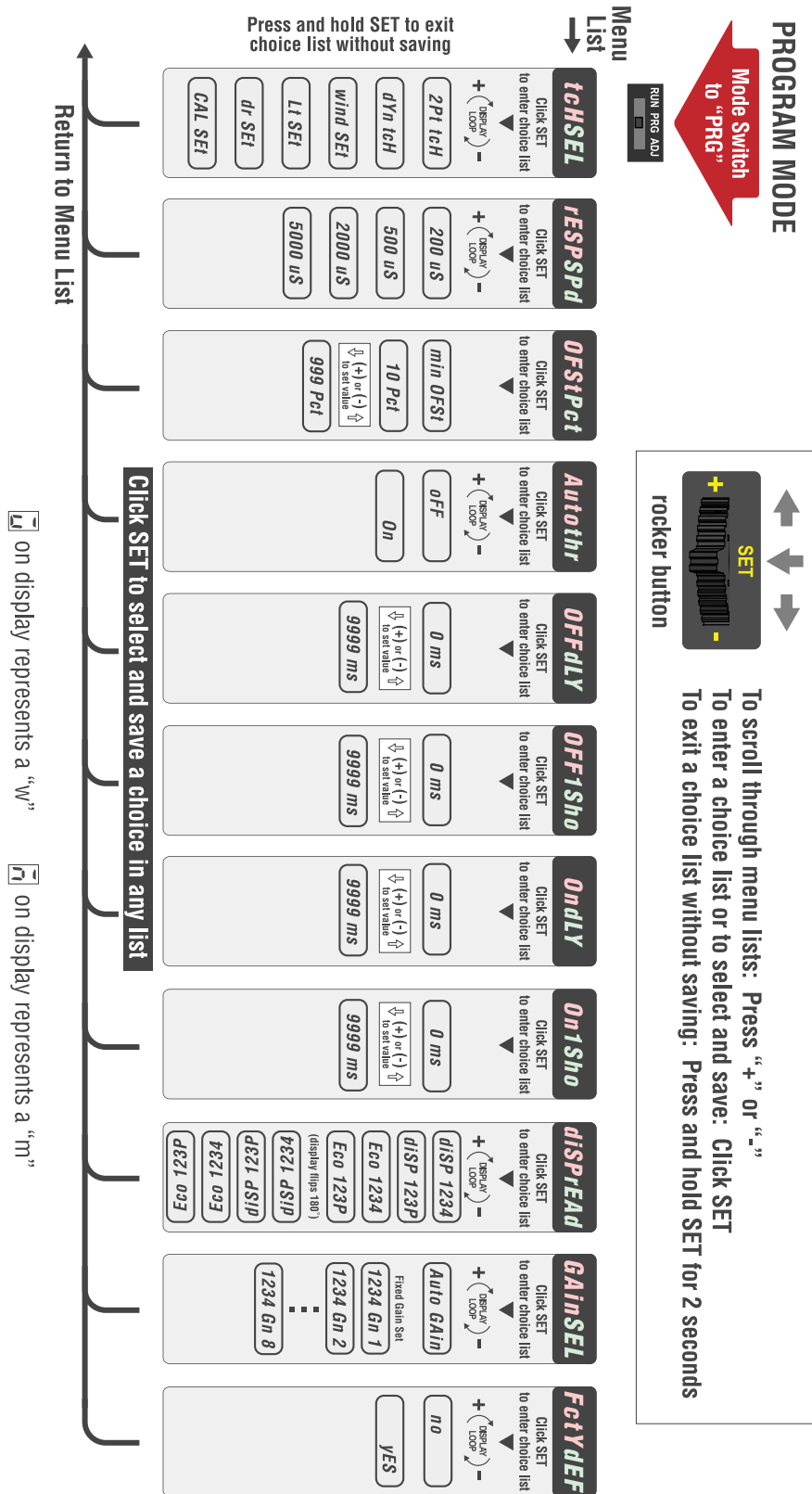
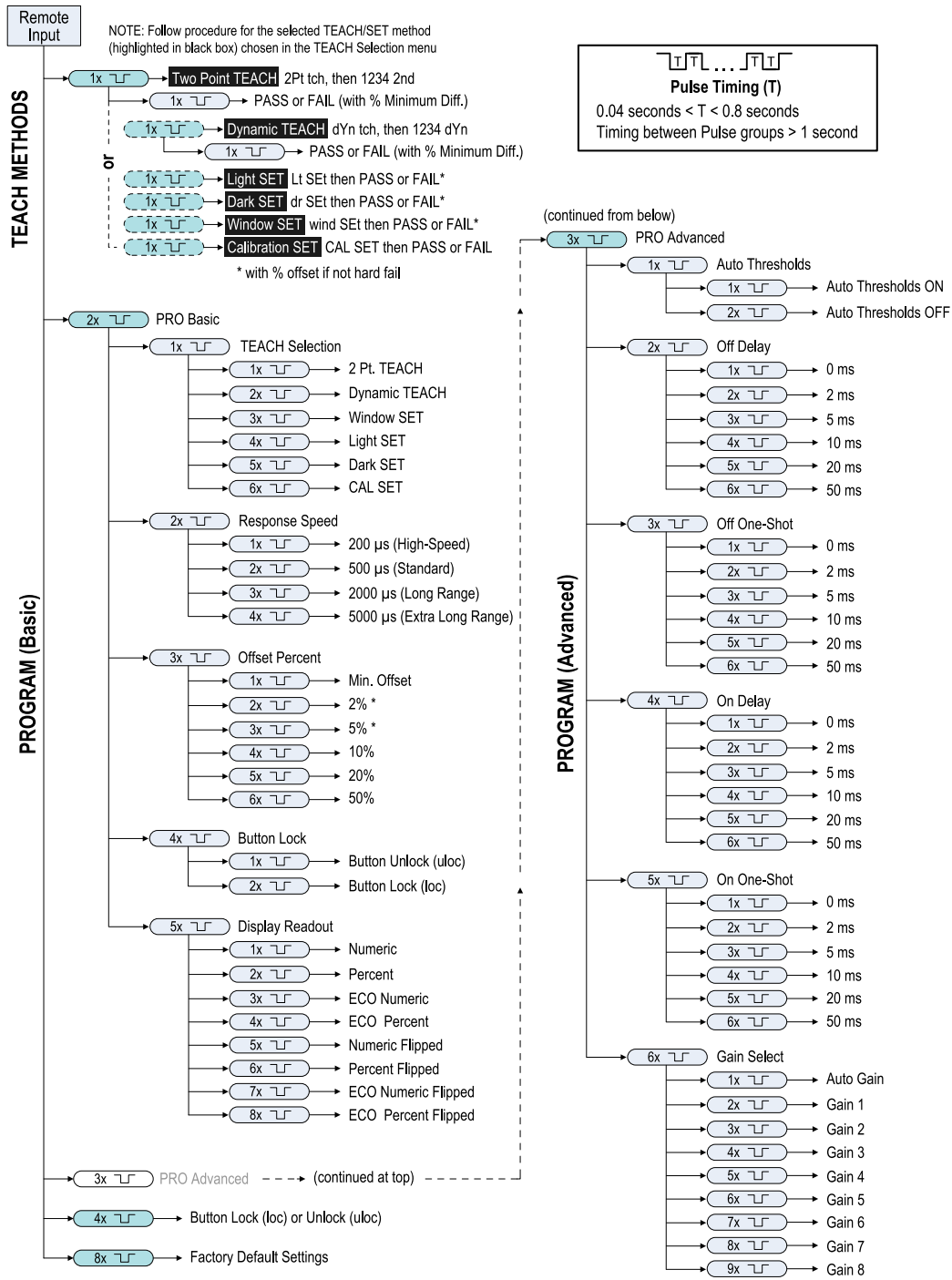


Figure 3.

Remote Input (not available on IO-Link models)

The remote input may be used to perform TEACH/SET methods and to program the sensor remotely. Connect the white input wire of the sensor to ground (0V dc), with a remote switch connected between them. Pulse the remote input according to the diagram shown in [Figure 4. Remote Input Flowchart](#) on page 7. Follow the instructions in the TEACH/SET sections in [Adjust Mode](#) on page 8 to perform a TEACH/SET method.

TEACH methods and remote programming modes may be exited either after a 60-second timeout or by holding the remote input low for > 2 seconds, the sensor will return to RUN mode without saving any new settings.



* In High Speed and Standard Response, 2% and 5% offsets are forced to Min. Offset

Figure 4. Remote Input Flowchart



Adjust Mode

Sliding the RUN/PRG/ADJ mode switch to the ADJ position allows the user to perform Expert TEACH/SET methods and Manual Adjustment of the threshold(s).

Two-Point TEACH

- Establishes a single switching threshold
- Threshold can be adjusted using “+” and “-” rocker button (Manual Adjust)

Two-Point TEACH is used when two conditions can be presented statically to the sensor. 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 (see Figure below).

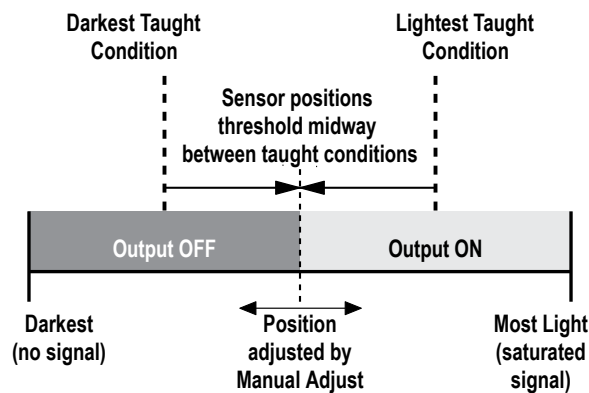


Figure 5. Two-Point TEACH (Light Operate shown)

The Output ON and OFF conditions can be reversed by using the LO/DO (Light Operate/ Dark Operate) switch (see **LO/DO Switch** in [Top Panel Interface](#) on page 3).

Two-Point TEACH and Manual Adjust







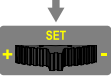





Moves switching threshold value up or down to make adjustments

- Slide Mode switch to ADJ to enter Adjust mode
- Press “+” to increase; press “-” to decrease
 - GREEN display shows the switching threshold value
 - 2 seconds after adjustment, the GREEN display will flash 3 times to confirm
- Slide Mode switch to RUN to complete operation



Remember: Manual adjustments are disabled when Auto Thresholds are ON

Two-Point TEACH

	SET Button 0.04 seconds < "Click" < 0.8 seconds	Remote Input 0.04 seconds < T < 0.8 seconds	Result
 Note: TEACH Selection must be programmed to 2Pt tch (see Program Mode on page 3)			
Enter Adjust Mode	Set Mode switch to ADJ 	No action required; sensor is ready for Two-Point TEACH method	Display: Red - Signal Level; Green - Threshold 
TEACH 1st Condition	<ul style="list-style-type: none"> Present 1st condition Click the SET rocker button 	<ul style="list-style-type: none"> Present 1st condition Single-pulse remote input 	Display: Flashes "2Pt tch" then holds on "1234 2nd" 
TEACH 2nd Condition	<ul style="list-style-type: none"> Present 2nd condition Click the SET rocker button 	<ul style="list-style-type: none"> Present 2nd condition Single-pulse remote input 	TEACH Accepted Displays alternate "PASS" and % Minimum Difference*; Sensor returns to Adjust mode 
			TEACH Unacceptable Displays alternate "FAIL" and % Minimum Difference*; Sensor returns to Adjust mode 
Return to RUN Mode	Move Mode switch to RUN 	No action required; sensor returns to RUN mode automatically	Display: Red - Signal Level; Green - Threshold 

*See [Troubleshooting](#) on page 20 for more explanation of the % Minimum Difference displayed after the Two-Point TEACH method.

Dynamic TEACH

- Teaches on-the-fly
- Establishes a single switching threshold
- Threshold can be adjusted using "+" and "-" rocker button (Manual Adjust)

Dynamic TEACH is best used when a machine or process may not be stopped for teaching. The sensor learns during actual sensing conditions, taking multiple samples of the light and dark conditions and automatically setting the threshold at the optimum level (see Figure below).

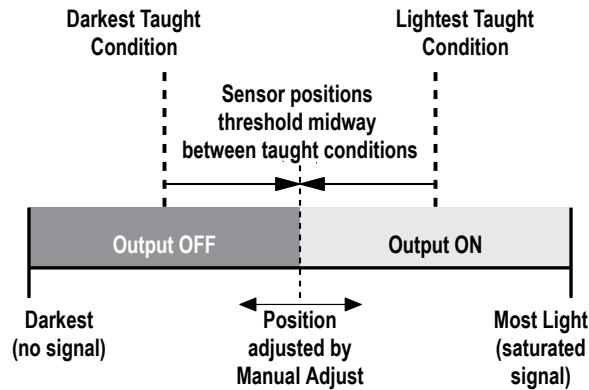


Figure 6. Dynamic TEACH (Light Operate shown)

The output ON and OFF conditions can be reversed using the LO/DO switch (see **LO/DO Switch** in [Top Panel Interface](#) on page 3).

Dynamic TEACH and Manual Adjust






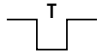

















Moves switching threshold value up or down to make adjustments

- Slide Mode switch to ADJ to enter Adjust mode
- Press "+" to increase; press "-" to decrease
 - GREEN display shows the switching threshold value
 - 2 seconds after adjustment, GREEN display will flash 3 times to confirm
- Slide Mode switch to RUN to complete operation



Remember: Manual adjustments are disabled when Auto Thresholds are ON

Dynamic TEACH

	SET Button 0.04 seconds < "Click" < 0.8 seconds	Remote Input 0.04 seconds < T < 0.8 seconds	Result
 Note: TEACH Selection must be programmed to dYn tcH (see Program Mode on page 3)			
Enter Adjust Mode	<ul style="list-style-type: none"> Set Mode switch to ADJ 	No action required; sensor is ready for Dynamic TEACH method	Display: Red - Signal Level;  Green - Threshold 
Enter Dynamic TEACH	<ul style="list-style-type: none"> Click the SET rocker button 	<ul style="list-style-type: none"> Single-pulse remote input 	Display: Flashes "dYn tcH" then holds on "1234 dYn"    
Present ON and OFF Conditions	<ul style="list-style-type: none"> Present ON and OFF conditions 	<ul style="list-style-type: none"> Present ON and OFF conditions 	Display: Red - Signal Level;  Green - Threshold 
Exit Dynamic TEACH	<ul style="list-style-type: none"> Click the SET rocker button 	<ul style="list-style-type: none"> Single-pulse remote input 	TEACH Accepted  Displays alternate "PASS" with % Minimum Difference*, Sensor returns to Adjust mode  
			TEACH Unacceptable  Displays alternate "FAIL" with % Minimum Difference*, Sensor returns to Adjust mode  
Return to RUN Mode	<ul style="list-style-type: none"> Move Mode switch to RUN 	No action required; sensor returns to RUN mode automatically	Display: Red - Signal Level;  Green - Threshold 

*See [Troubleshooting](#) on page 20 for more explanation of the % Minimum Difference displayed after the Dynamic TEACH method.

Window SET

- Sets window thresholds that extend a programmable % offset above and below the presented condition
- All other conditions (lighter or darker) cause the output to change state
- Sensing window center can be adjusted using "+" and "-" rocker button (Manual Adjust)
- Recommended for applications where a product may not always appear in the same place, or when other signals may appear
- See [Program Mode](#) on page 3 for programming the Offset Percent setting (to increase/decrease the window size)

A single sensing condition is presented, and the sensor positions window thresholds a programmable % offset above and below the presented condition. In LO mode, Window SET designates a sensing window with the Output ON condition inside the window, and the Output OFF conditions outside the window (see Figure below).

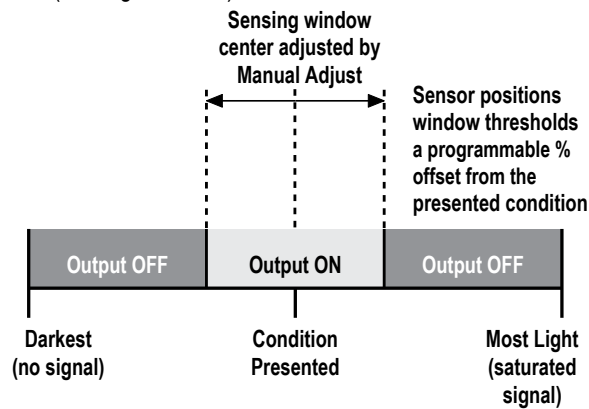


Figure 7. Window SET (Light Operate shown)

Output ON and OFF conditions can be reversed using the LO/DO switch (see **LO/DO Switch** in [Top Panel Interface](#) on page 3).

Window SET and Manual Adjust




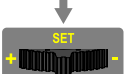










Moves sensing window center value up or down to make adjustments

- Slide Mode switch to ADJ to enter Adjust mode
- Press "+" to increase; press "-" to decrease
 - GREEN display shows the sensing window center value
 - 2 seconds after adjustment, the GREEN display will flash 3 times to confirm
- Slide Mode switch to RUN to complete operation



Remember: Manual adjustments are disabled when Auto Thresholds are ON

Window SET

	SET Button 0.04 seconds < "Click" < 0.8 seconds	Remote Input 0.04 seconds < T < 0.8 seconds	Result
 Note: TEACH Selection must be programmed to wind SET (see Program Mode on page 3)			
Enter Ad-just Mode	<ul style="list-style-type: none"> Set Mode switch to ADJ 	No action required; sensor is ready for Window SET method	Display: Red - Signal Level; Green - Threshold 
SET Sens-ing Condi-tion	<ul style="list-style-type: none"> Present sensing condition Click the SET rocker but-ton 	<ul style="list-style-type: none"> Present sensing condition Single-pulse the remote in-put 	Threshold Condition Accep-ted   Displays read "wInd SET" then alternate "PASS" with % Off-set*; Sensor returns to Adjust mode
			Threshold Condition Unac-ceptable   Displays read "wInd SET" then alternate "FAIL" with minimum % Offset* for sensing condition; Sensor returns to Adjust mode
Return to RUN Mode	<ul style="list-style-type: none"> Move Mode switch to RUN 	No action required; sensor re-returns to RUN mode automati-cally	Display: Red - Signal Level; Green - Window Center (see Figure below for instructions on how to display upper and lower thresholds) 
<p>Window SET (during RUN mode) Upon sensor power-up, Window Center is displayed</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">  1234 Uthr ↓ 1234 2200 ▲ Upper Threshold Displayed </div> <div style="text-align: center;">  1234 cEtr ↓ 1234 2000 ▲ Window Center Displayed </div> <div style="text-align: center;">  1234 Lthr ↓ 1234 1800 ▲ Lower Threshold Displayed </div> </div> <p style="text-align: center;">Figure 8.</p>			

* See [Troubleshooting](#) on page 20 for more explanation of the % Offset displayed after the Window SET method

Light SET

- Sets a threshold a programmable % offset below the presented condition
- Changes output state on any condition darker than the threshold condition
- Threshold can be adjusted using "+" and "-" rocker button (Manual Adjust)
- Recommended for applications where only one condition is known, for example a stable light background with varying darker targets
- See [Program Mode](#) on page 3 for programming the Offset Percent setting

A single sensing condition is presented, and the sensor positions a threshold a programmable % offset below the presented condition. When a condition darker than the threshold is sensed, the output either turns ON or OFF, depending on the LO/DO switch setting (see [LO/DO Switch](#) in [Top Panel Interface](#) on page 3).

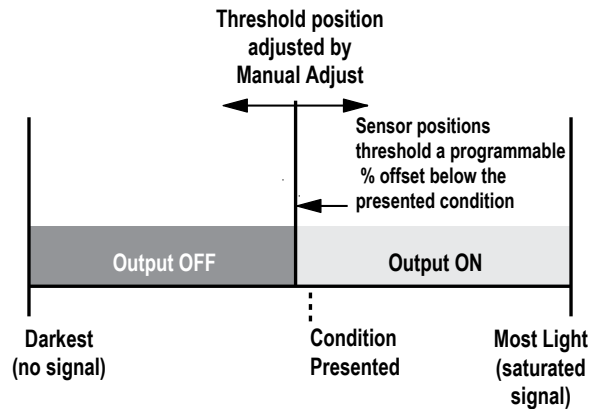


Figure 9. Light SET (Light Operate shown)

Light SET and Manual Adjust




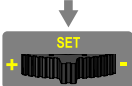
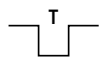








Moves switching threshold value up or down to make adjustments

- Slide Mode switch to ADJ to enter Adjust mode
- Press "+" to increase; press "-" to decrease
 - GREEN display shows the switching threshold value
 - 2 seconds after adjustment, the GREEN display will flash 3 times to confirm
- Slide Mode switch to RUN to complete operation



Remember: Manual adjustments are disabled when Auto Thresholds are ON

Light SET

	SET Button 0.04 seconds < "Click" < 0.8 seconds	Remote Input 0.04 seconds < T < 0.8 seconds	Result
 Note: TEACH Selection must be programmed to Lt SET (see Program Mode on page 3)			
Enter Ad-just Mode	<ul style="list-style-type: none"> Set Mode switch to ADJ 	No action is required; sensor is ready for Light SET method	Display: Red - Signal Level; Green - Threshold 
SET Sensing Condition	<ul style="list-style-type: none"> Present sensing condition Click the SET rocker button 	<ul style="list-style-type: none"> Present sensing condition Single-pulse the remote input 	Threshold Condition Accepted    Displays read "Lt SET" then alternate "PASS" with % Offset*; Sensor returns to Adjust mode
			Threshold Condition Unacceptable    Displays read "Lt SET" then alternate FAIL with minimum % Offset* for sensing condition; Sensor returns to Adjust mode
Return to RUN Mode	<ul style="list-style-type: none"> Move Mode switch to RUN 	No action required; sensor returns to RUN mode automatically	Display: Red - Signal Level; Green - Threshold 

* See [Troubleshooting](#) on page 20 for more explanation of the % Offset displayed after the Light SET method

Dark SET

- Sets a threshold a programmable % offset above the presented condition
- Any condition lighter than the threshold condition causes the output to change state
- Threshold can be adjusted using "+" and "-" rocker button (Manual Adjust)
- Recommended for applications where only one condition is known, for example a stable dark background with varying lighter targets
- See [Program Mode](#) on page 3 for programming the Offset Percent setting



NOTE: Offset Percent MUST be programmed to **Minimum Offset** to accept conditions of no signal (0 counts).

A single sensing condition is presented, and the sensor positions a threshold a programmable % offset above the presented condition. When a condition lighter than the threshold is sensed, the output either turns ON or OFF, depending on the LO/DO switch setting (see [LO/DO Switch](#) in [Top Panel Interface](#) on page 3).

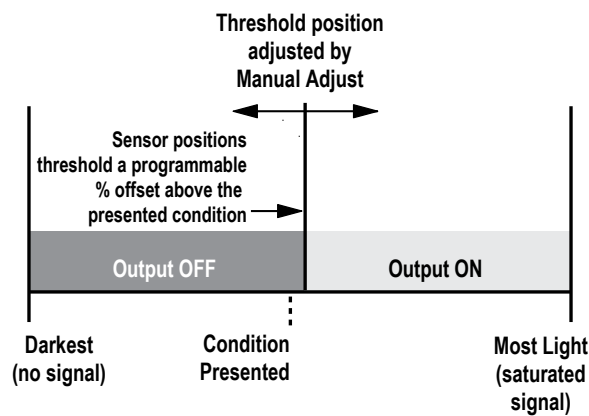


Figure 10. Dark SET (Light Operate shown)

Dark SET and Manual Adjust




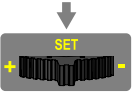









Moves switching threshold value up or down to make adjustments

- Slide Mode switch to ADJ to enter Adjust mode
- Press "+" to increase; press "-" to decrease
 - GREEN display shows the switching threshold value
 - 2 seconds after adjustment, the GREEN display will flash 3 times to confirm
- Slide Mode switch to RUN to complete operation



Remember: Manual adjustments are disabled when Auto Thresholds are ON

Dark SET

	SET Button 0.04 seconds < "Click" < 0.8 seconds	Remote Input 0.04 seconds < T < 0.8 seconds	Result
 Note: TEACH Selection must be programmed to dr SET (see Program Mode on page 3)			
Enter Ad-just Mode	<ul style="list-style-type: none"> Set Mode switch to ADJ 	No action required; sensor is ready for Dark SET method	Display: Red - Signal Level; Green - Threshold 
SET Sensing Condition	<ul style="list-style-type: none"> Present sensing condition Click the SET rocker button 	<ul style="list-style-type: none"> Present sensing condition Single-pulse the remote input 	Threshold Condition Accepted    <p>Displays read "dr SET" then alternate "PASS" with % Offset*; Sensor returns to Adjust mode</p> Threshold Condition Unacceptable    <p>Displays read "dr SET" then alternate "FAIL" with minimum % Offset* for sensing condition; Sensor returns to Adjust mode</p>
Return to RUN Mode	<ul style="list-style-type: none"> Move Mode switch to RUN 	No action required; sensor returns to RUN mode automatically	Display: Red - Signal Level; Green - Threshold 

* See [Troubleshooting](#) on page 20 for more explanation of the % Offset displayed after the Dark SET method

Calibration SET

- Sets a threshold exactly at the presented condition
- Threshold can be adjusted using "+" and "-" rocker button (Manual Adjust)

A single sensing condition is presented, and the sensor positions a threshold exactly at the presented condition. When a condition lighter than the threshold is sensed, the output either turns ON or OFF, depending on the LO/DO switch setting (see **LO/DO Switch** in [Top Panel Interface](#) on page 3).

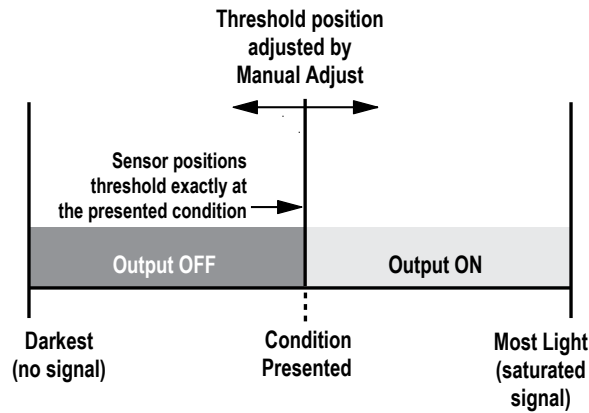


Figure 11. Calibration SET (Light Operate shown)

Calibration SET and Manual Adjust




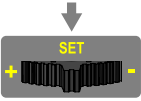





Moves switching threshold value up or down to make adjustments

- Slide Mode switch to ADJ to enter Adjust mode
- Press "+" to increase; press "-" to decrease
 - GREEN display shows the switching threshold value
 - 2 seconds after adjustment, the GREEN display will flash 3 times to confirm
- Slide Mode switch to RUN to complete operation




Remember: Auto Thresholding is automatically disabled in Calibration SET

Calibration SET

	SET Button 0.04 seconds < "Click" < 0.8 seconds	Remote Input 0.04 seconds < T < 0.8 seconds	Result
 Note: TEACH Selection must be programmed to CAL SET (see Program Mode on page 3)			
Enter Ad-just Mode	<ul style="list-style-type: none"> Set Mode switch to ADJ 	No action required; sensor is ready for Calibration SET method	Display: Red - Signal Level; Green - Threshold 
SET Sensing Condition	<ul style="list-style-type: none"> Present sensing condition Click the SET rocker button 	<ul style="list-style-type: none"> Present sensing condition Single-pulse the remote input 	Threshold Condition Accepted Displays read "cAL SET" then flashes "PASS"; Sensor returns to Adjust mode 
			Threshold Condition Unacceptable Displays read "cAL SET" then flashes "FAIL"; Sensor returns to Adjust mode 
Return to RUN Mode	<ul style="list-style-type: none"> Move Mode switch to RUN 	No action required; sensor returns to RUN mode automatically	Display: Red - Signal Level; Green - Threshold 

Troubleshooting

Manual Adjustments Disabled

Manual adjustments are disabled when Auto Thresholds are ON. If a manual adjustment is attempted while Auto Thresholds are ON, the Green display will flash .

% Minimum Difference after TEACH

The Two-Point and Dynamic TEACH methods will flash a % minimum difference on the displays after a PASS or FAIL.

Value	PASS/FAIL	Description
0-99%	FAIL	The difference of the taught conditions does not meet the required minimum
100-300%	PASS	The difference of the taught conditions just meets/exceeds the required minimum, minor sensing variables may affect sensing reliability
300-600%	PASS	The difference of the taught conditions sufficiently exceeds the required minimum, minor sensing variables will not affect sensing reliability
600% +	PASS	The difference of the taught conditions greatly exceeds the required minimum, very stable operation




% Offset after SET

The Window, Dark, and Light SET methods will flash a % offset on the displays after a PASS or FAIL.

SET Result	% Offset Meaning
PASS (with % Offset)	Displays the % offset used for the SET method
FAIL (with % Offset)	Displays the minimum required % offset necessary to PASS the SET method
FAIL (without % Offset)	Presented condition cannot be used for the SET method

Threshold Alert or Threshold Error

Severe contamination/changes in the taught condition can prevent the Auto Thresholds algorithm from optimizing the threshold(s).

State	Display	Description	Corrective Action
Threshold Alert	Alternates  and 	The threshold(s) cannot be optimized, but the sensor's output will still continue to function	Cleaning/correcting the sensing environment and/or a re-teach of the sensor is highly recommended
Threshold Error		The threshold(s) cannot be optimized, and the sensor's output will stop functioning	Cleaning/correcting the sensing environment and/or a re-teach of the sensor is required

Specifications

Sensing Beam

660 nm visible red

Supply Voltage

NPN/PNP models: 10 to 30V dc Class 2 (10% max ripple)

IO-Link models: 18 to 30V dc (10% max ripple)

Power and Current Consumption (exclusive of load)

Standard display mode: 960 mW, Current consumption < 40 mA at 24V dc

ECO display mode: 720 mW, Current consumption < 30 mA at 24V dc

Supply Protection Circuitry

Protected against reverse polarity, overvoltage, and transient voltages

Delay at Power Up

500 milliseconds max.; outputs do not conduct during this time

Output Configuration

NPN/PNP models: 1 current sinking (NPN) or 1 current sourcing (PNP) output, depending on model

IO-Link models: 1 push-pull and 1 PNP (complementary outputs)

Output Rating

100 mA max. load (derate 1 mA per °C above 30 °C)

OFF-state leakage current: **NPN/PNP models:** < 5 μ A at 30V dc; **IO-Link models:** < 50 μ A at 30V dc

ON-state saturation voltage: **NPN:** < 1.5V; **PNP /IO-Link:** < 2V

Output Protection

Protected against output short-circuit, continuous overload, transient over-voltages, and false pulse on power up

Output Response Time

High Speed: 200 μ s

Standard: 500 μ s

Long Range: 2 ms

Extra Long Range: 5 ms

Repeatability

High Speed: 66 μ s, Standard/Long Range/Extra Long Range: 100 μ s

Connections

PVC-jacketed 2 m or 9 m (6.5 ft or 30 ft) 4-wire integral cable or integral 4-pin Pico-style QD or Pico-style 150 mm (6 in) pigtail QD or Euro-style 150 mm (6 in) pigtail QD

Construction

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

Adjustments

3-way RUN/PRG/ADJ Mode Switch

2-way LO/DO Switch

3-way +/-SET/- Rocker Button

- Expert-style teaching (Two-Point and Dynamic TEACH, Light/Dark/Window/Calibration SET)
- Manually adjust sensitivity (from "+" and "-" rocker button only)
- Response Speed, TEACH Selection, Offset Percent, Auto Thresholds, Delays/Timers, Display Readout, Gain Selection, Factory Defaults (from top panel or remote input)
- Top panel interface lockout (from remote input only)

Factory Default Settings:

Setting	Factory Default
Threshold	2026
TEACH Selection	Two-Point TEACH
Response Speed	Standard: 500 μ s
Offset Percent	10%
Auto Thresholds	OFF
OFF Delay	0 (Disabled)
OFF One-Shot	0 (Disabled)
ON Delay	0 (Disabled)
ON One-Shot	0 (Disabled)
Display Readout	Numeric, ECO disabled, Normal Orientation
Gain Selection	Auto Gain

Operating Conditions

Temperature: -10 °C to +55 °C (+14 °F to +131 °F)

Storage Temperature: -20 °C to +85 °C (-4 °F to +185 °F)

Humidity: 90% at +60 °C maximum relative humidity (non-condensing)

IO-Link Interface

Supports Smart Sensor Profile: Yes

Baud Rate: 38,400 bps (COM2)

Process Data Width: 16 bits

IO-Link files: Provide all programming options of top panel interface, plus additional functionality, see [IO-Link Interface](#) on page 25

Indicators

Red 4-digit Display: Signal Level

Green 4-digit Display: Threshold

(In Program Mode, Red and Green displays are used for programming menus)

Yellow LED: Output conducting

Environmental Rating

IEC IP50, NEMA 1

Certifications

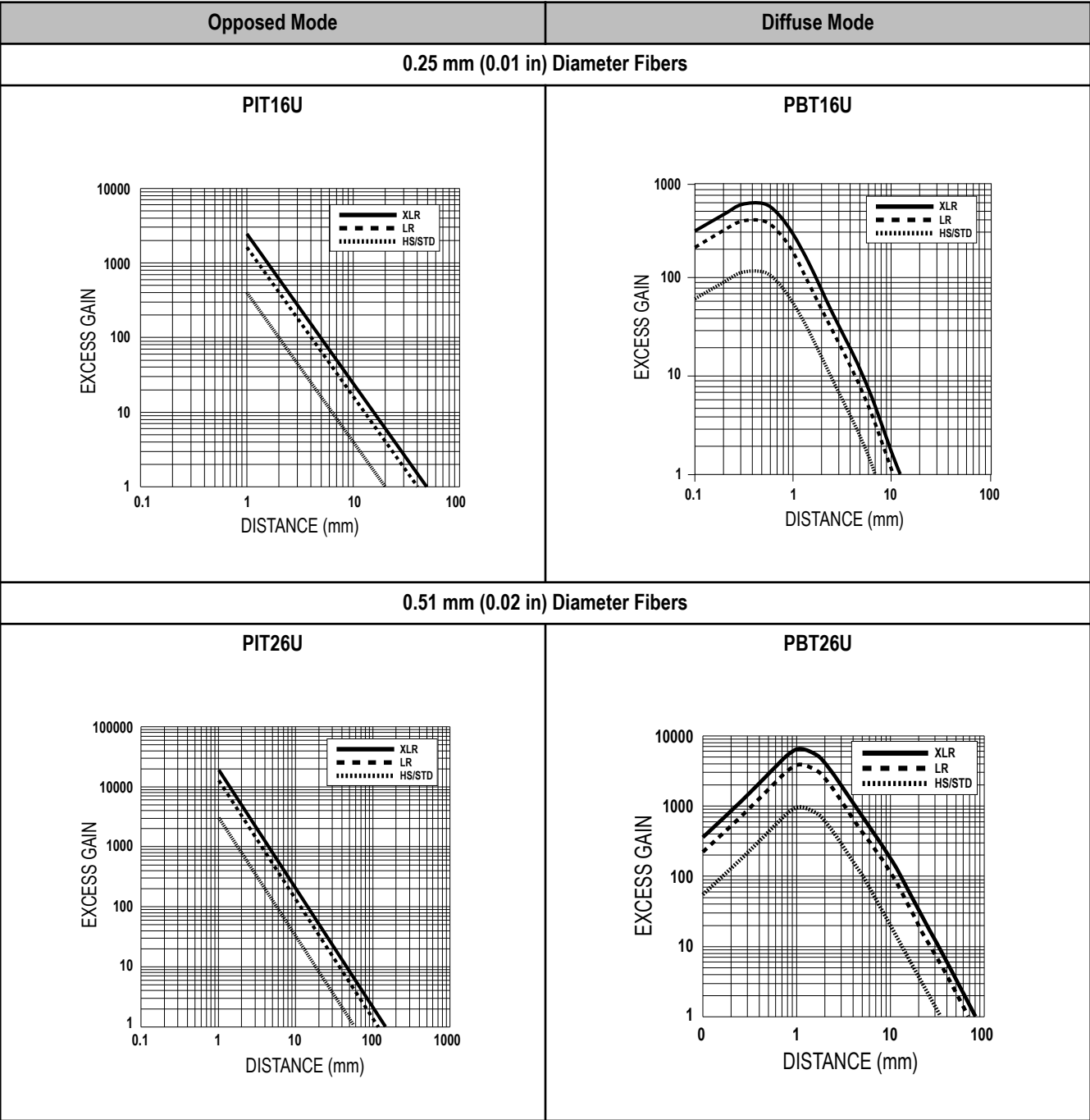


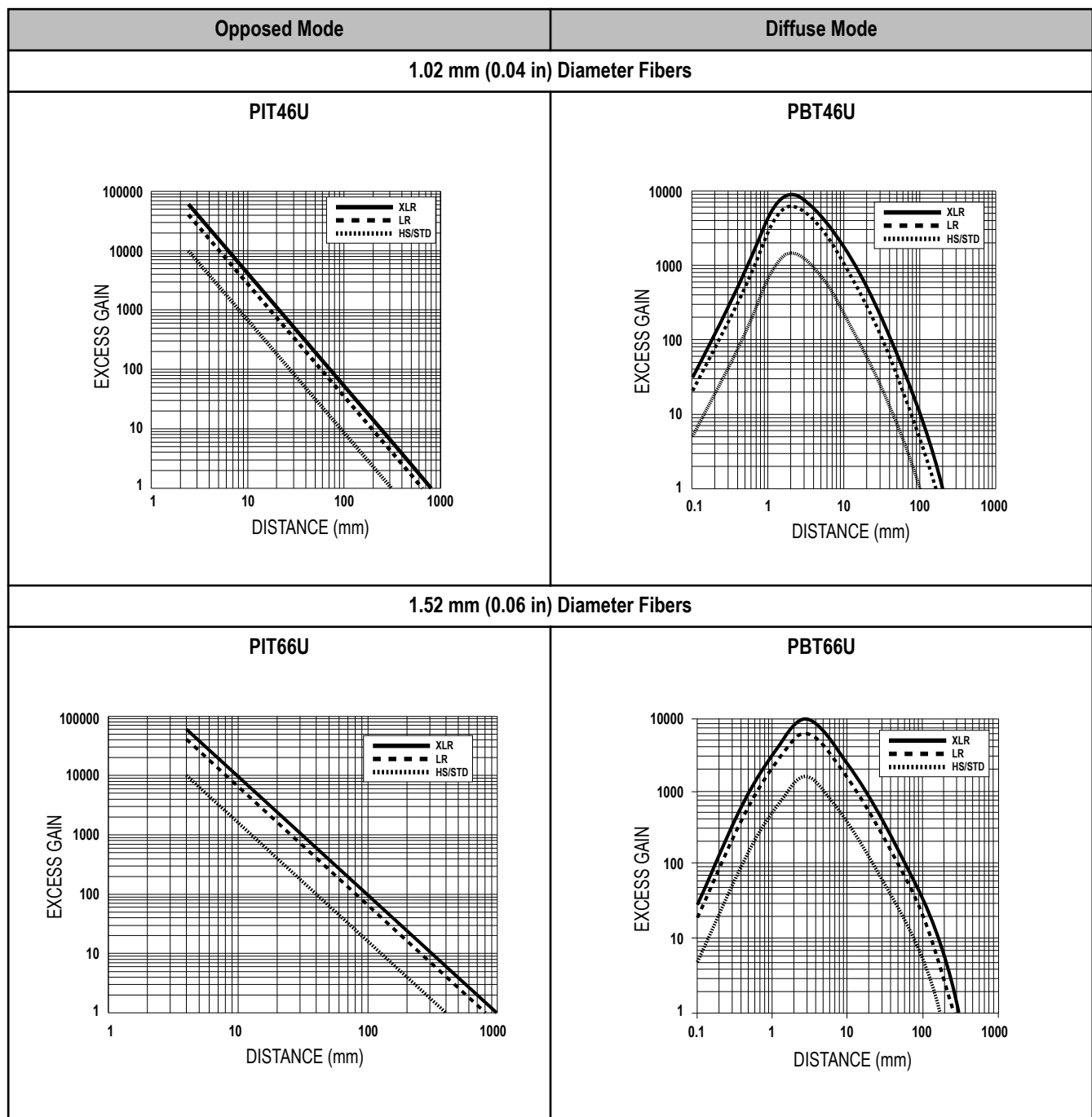
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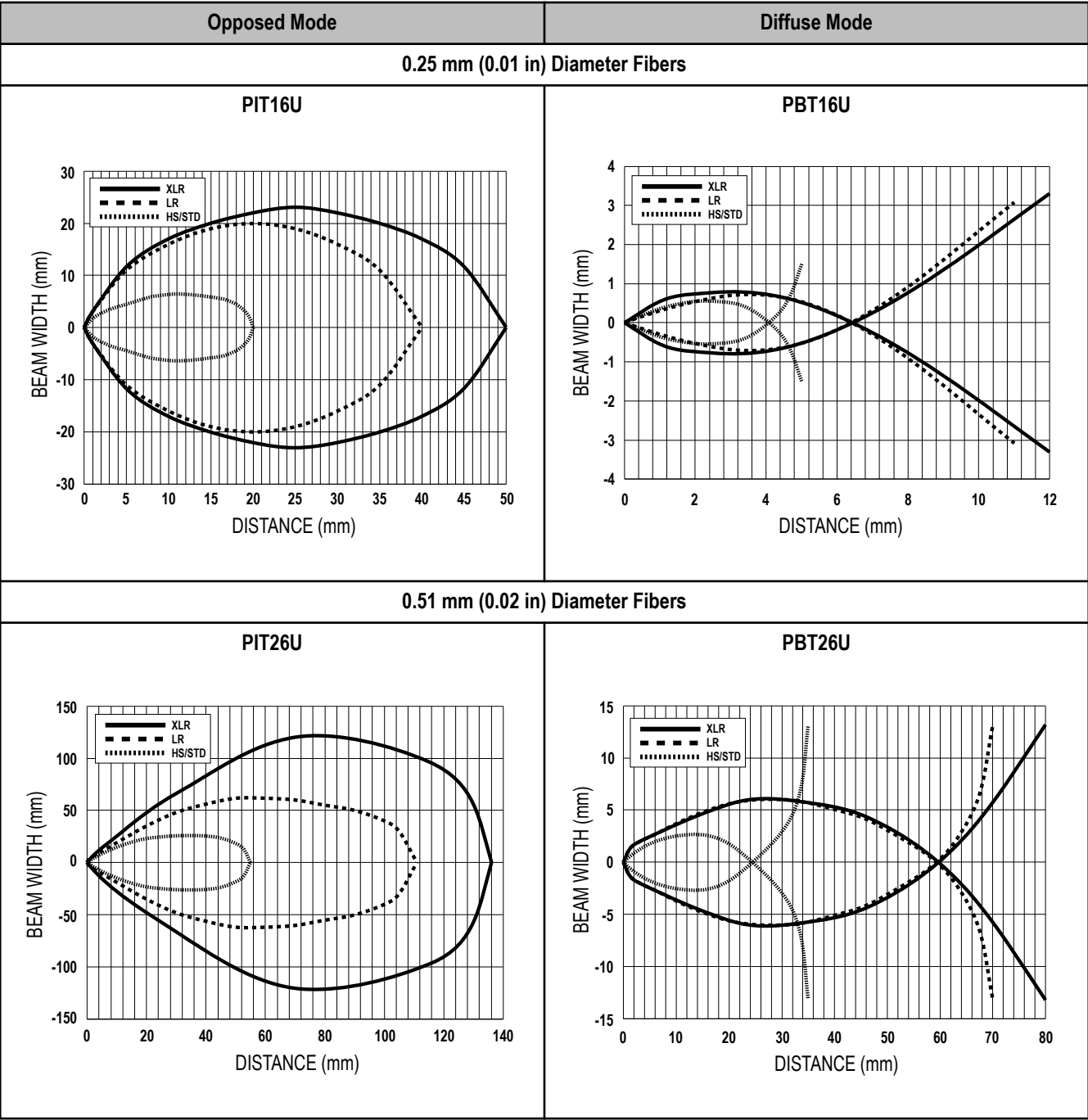
3TJJ

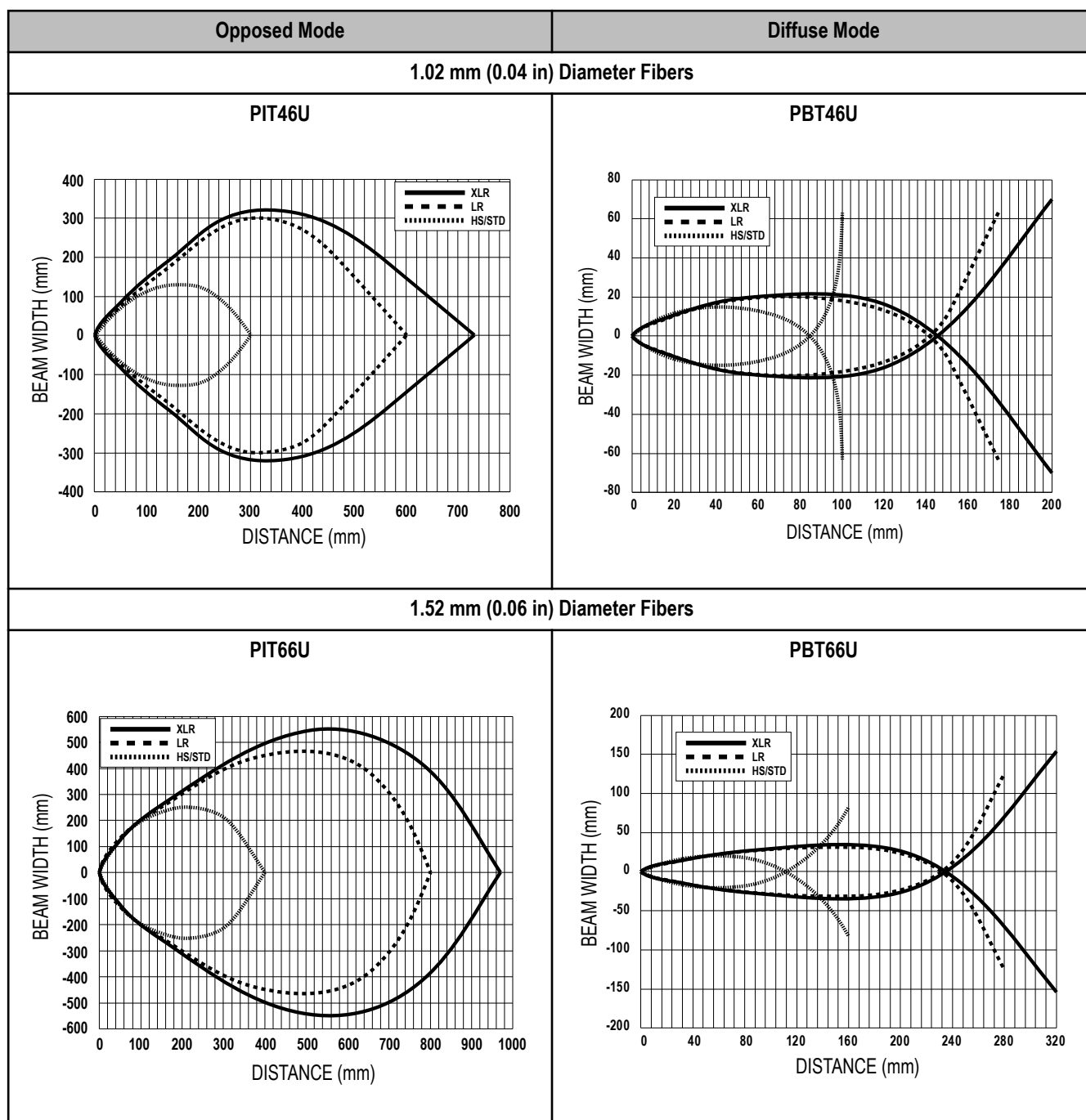
Excess Gain Curves





Beam Patterns



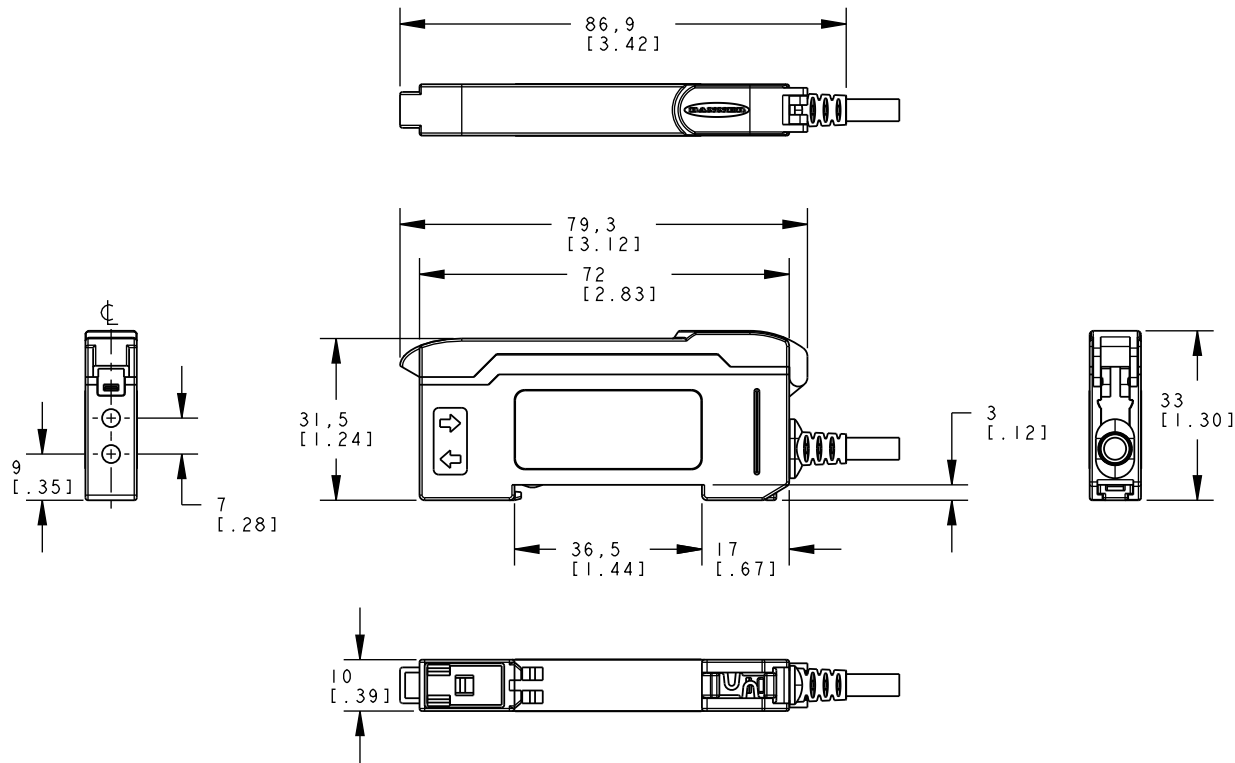


IO-Link Interface

IO-Link is a point-to-point communication link between a master device and sensor. It can be used to automatically parameterize sensors and transmit process data. For the latest IO-Link protocol and specifications, please visit the web site at <http://www.io-link.com>.

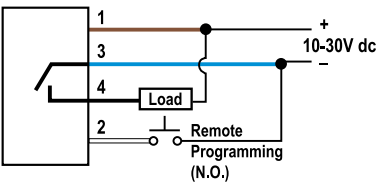
The IO-Link IODD package is contained on the Banner IO-Link Device Description Resource CD (P/N 18491). For the latest IODD files, please refer to the Banner Website at <http://www.bannerengineering.com/IO-Link>.

Dimensions

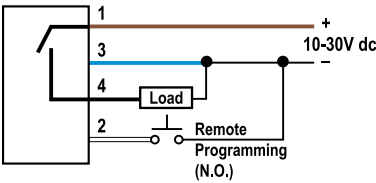


Hookups

NPN Models



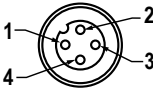
PNP Models



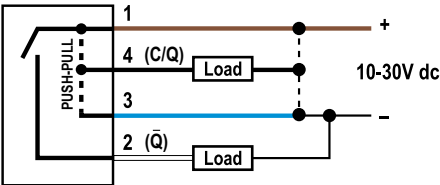
Key

- 1 = Brown
- 2 = White
- 3 = Blue
- 4 = Black

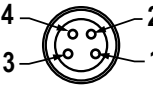
Euro



IO-Link Models

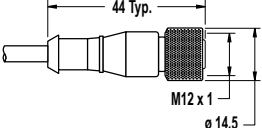
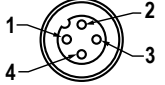
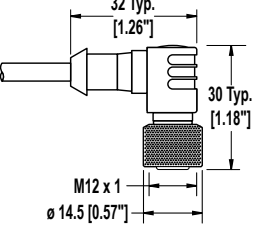


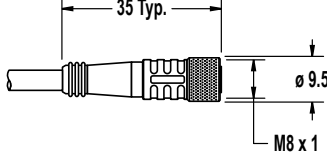

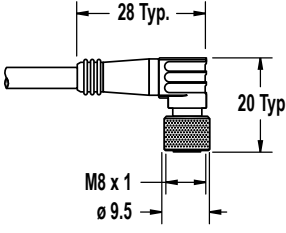
Pico

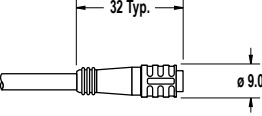



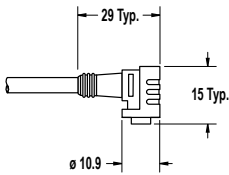
Quick-Disconnect Cordsets

All measurements in mm

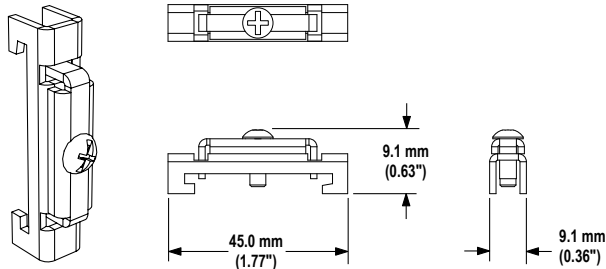
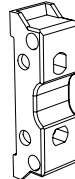
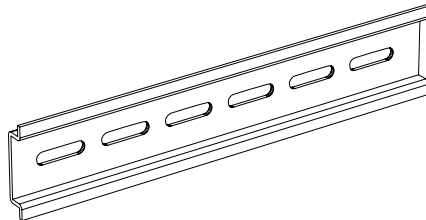
4-Pin Threaded M12/Euro-Style Cordsets				
Model	Length	Style	Dimensions	Pinout
MQDC-406	1.83 m (6 ft)	Straight		 <p>1 = Brown 2 = White 3 = Blue 4 = Black</p>
MQDC-415	4.57 m (15 ft)			
MQDC-430	9.14 m (30 ft)			
MQDC-450	15.2 m (50 ft)			
MQDC-406RA	1.83 m (6 ft)	Right-Angle		<p>1 = Brown 2 = White 3 = Blue 4 = Black</p>
MQDC-415RA	4.57 m (15 ft)			
MQDC-430RA	9.14 m (30 ft)			
MQDC-450RA	15.2 m (50 ft)			

4-Pin Threaded M8/Pico-Style Cordsets				
Model	Length	Style	Dimensions	Pinout
PKG4M-2	2.00 m (6.56 ft)	Straight		 <p>1 = Brown 2 = White 3 = Blue 4 = Black</p>
PKG4M-5	5.00 m (16.4 ft)			
PKG4M-9	9.00 m (29.5 ft)			
PKW4M-2	2.00 m (6.56 ft)	Right Angle		<p>1 = Brown 2 = White 3 = Blue 4 = Black</p>
PKW4M-5	5.00 m (16.4 ft)			
PKW4M-9	9.00 m (29.5 ft)			

4-Pin Snap-on M8/Pico-Style Cordsets				
Model	Length	Style	Dimensions	Pinout
PKG4-2	2 m (6.6 ft)	Straight		 <p>1 = Brown 2 = White</p>
PKG4-5	5 m (16.4 ft)			
PKG4-10	10 m (32.8 ft)			

4-Pin Snap-on M8/Pico-Style Cordsets				
Model	Length	Style	Dimensions	Pinout
PKW4Z-2	2 m (6.6 ft)	Right-Angle		3 = Blue 4 = Black
PKW4Z-5	5 m (16.4 ft)			

Accessories

<div>SA-DIN-CLAMP</div> <div><ul style="list-style-type: none">• Pair of metal DIN rail end stops; slide onto DIN rail at either side of DF-G1 sensor stack• Combination (#2 Phillips, #8 standard slotted) set screw</div>	<div></div>								
<div>SA-DIN-BRACKET</div> <div><ul style="list-style-type: none">• 1 plastic bracket with mounting screws</div>	<div></div>								
<div>SA-DIN-BRACKET-10</div> <div><ul style="list-style-type: none">• Package of 10 plastic brackets with mounting screws</div>									
<div>DIN-35-..</div> <div><ul style="list-style-type: none">• 35 mm DIN Rail• <table><tr><th>Model</th><th>Length</th></tr><tr><td>DIN-35-70</td><td>70 mm</td></tr><tr><td>DIN-35-105</td><td>105 mm</td></tr><tr><td>DIN-35-140</td><td>140 mm</td></tr></table></div>	Model	Length	DIN-35-70	70 mm	DIN-35-105	105 mm	DIN-35-140	140 mm	<div></div>
Model	Length								
DIN-35-70	70 mm								
DIN-35-105	105 mm								
DIN-35-140	140 mm								

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