DF-G3 Long-Range Expert Dual Display Fiber Amplifier with Analog Output

Original Instructions
p/n: 190341 Rev G
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ПРОМЭЛЕКТРОНИКА/ sales@prom-elec.com

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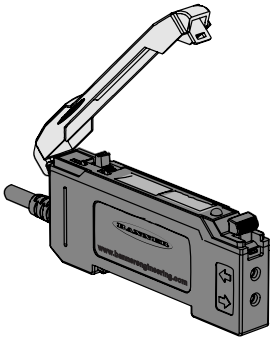
Chapter 1 Product Description

Advanced sensor with dual digital displays for use with plastic and glass fiber optic assemblies; analog current or voltage output models with an independent NPN or PNP discrete output are available.

- World-class long-range sensing capability, more than 6 m (20 ft) with opposed mode fibers
- Models with high visibility red, extreme high-power infrared and water-detecting long infrared sensing beams available
- Cross-talk avoidance function allows seven inspections in dense sensing point applications
- Energy efficient light resistance enables stable detection in industrial lighting environments
- High power amplifier with small core fibers enables precise position sensing of small components
- One analog output (current or voltage) proportional to signal strength and one NPN or PNP discrete output.



- 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 or remote input teach wire
- *Expert* TEACH and SET methods ensure optimal gain and threshold for all applications, especially for high speed or 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 shorten start-up time and maintain signal stability during operation
- ECO (economy) display mode reduces amplifier power consumption by 25%
- Sleek 10 mm wide housing mounts to 35 mm DIN rail

WARNING:

- **Do not use this device for personnel protection**
- Using this device for personnel protection could result in serious injury or death.
- This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A device failure or malfunction can cause either an energized (on) or de-energized (off) output condition.

Models

Model	Sensing Beam Color	Reference Sensing Range[1]	Outputs	Connector
DF-G3-NU-2M	Visible red, 635 nm	3000 mm	Voltage and NPN Discrete	2 m (6.5 ft) cable, 5-wire
DF-G3-PU-2M			Voltage and PNP Discrete	
DF-G3-NI-2M			Current and NPN Discrete	
DF-G3-PI-2M			Current and PNP Discrete	
DF-G3IR-NU-Q5	Infrared, 850 nm	6000 mm	Voltage and NPN Discrete	150 cable with a 5-pin M12 QD
DF-G3IR-PU-2M			Voltage and PNP Discrete	2 m (6.5 ft) cable, 5-wire

Continued on page 4

[1] Excess gain = 1 (high sensitivity), opposed mode sensing. PIT46U plastic fiber used for visible models, IT.83.3ST5M6 glass fiber used for IR models.

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Model	Sensing Beam Color	Reference Sensing Range	Outputs	Connector
DF-G3IR-NI-2M			Current and NPN Discrete	2 m (6.5 ft) cable, 5-wire
DF-G3IR-PI-2M			Current and PNP Discrete	
Water Detection Models				
DF-G3LIR-NU-2M	Long infrared, 1450 nm	900 mm	Voltage and NPN Discrete	2 m (6.5 ft) cable, 5-wire
DF-G3LIR-PU-Q5			Voltage and PNP Discrete	150 cable with a 5-pin M12 QD
DF-G3LIR-NI-2M			Current and NPN Discrete	2 m (6.5 ft) cable, 5-wire
DF-G3LIR-PI-2M			Current and PNP Discrete	

- A model with a QD connector requires a mating cordset (see "Quick-Disconnect Cordsets" on page 35)
- To order the 150 mm (6 in) PVC cable with a 5-pin M12 QD model, change the suffix 2M to Q5 in the 2 m model number (DF-G3-NS-Q5)
- To order the integral 5-pin M8 model, change the suffix 2M to Q7in the 2 m model number (DF-G3-NS-Q7)
- For the Q3 and Q7 Dual Output models, use a 5-pin M8 or a 6-pin M8 mating cordset

The following models are no longer available for order but are still covered by the information in this document.

Models	Sensing Beam Color	Reference Sensing Range	Outputs	Connector
DF-G3-NI-9M	Visible red, 635 nm	3000 mm	Current and NPN discrete	9 m cable
DF-G3-NI-Q3			Current and NPN discrete	150 mm cable with a 5-pin M8 QD
DF-G3-NU-9M			Voltage and NPN discrete	9 m cable
DF-G3-NU-Q3			Voltage and NPN discrete	150 mm cable with a 5-pin M8 QD
DF-G3-PI-9M			Current and PNP discrete	9 m cable
DF-G3-PU-9M			Voltage and PNP discrete	9 m cable
DF-G3IR-NI-9M	Infrared, 850 nm	6000 mm	Current and NPN discrete	9 m cable
DF-G3IR-NI-Q3			Current and NPN discrete	150 mm cable with a 5-pin M8 QD
DF-G3IR-NU-2M			Voltage and NPN discrete	2 m cable
DF-G3IR-NU-9M			Voltage and NPN discrete	9 m cable
DF-G3IR-NU-Q3			Voltage and NPN discrete	150 mm cable with a 5-pin M8 QD
DF-G3IR-NU-Q7			Voltage and NPN discrete	Integral M8 QD
DF-G3IR-PI-Q3			Current and PNP discrete	150 mm cable with a 5-pin M8 QD
DF-G3IR-PI-9M			Current and PNP discrete	9 m cable
DF-G3IR-PU-Q3			Voltage and PNP discrete	150 mm cable with a 5-pin M8 QD
DF-G3IR-PU-9M			Voltage and PNP discrete	9 m cable
DF-G3LIR-NI (all models)	Long infrared, 1450 nm	900 mm	Current and NPN discrete	
DF-G3LIR-NU (all models except the -2M model)			Voltage and NPN discrete	
DF-G3LIR-PI-9M			Current and PNP discrete	9 m cable
DF-G3LIR-PI-Q3			Current and PNP discrete	150 mm cable with a 5-pin M8 QD
DF-G3LIR-PI-Q7			Current and PNP discrete	Integral M8 QD
DF-G3LIR-PU (all models except the Q5)			Voltage and PNP discrete	

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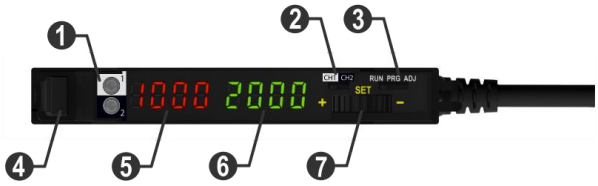
Overview

DF-G3 Dual Output Analog with Discrete Output



1. Analog and discrete output LEDs
2. CH1/Ch2 switch
3. RUN/PRG/ADJ mode switch
4. Lever-action fiber clamp
5. Red signal level
6. Green CH1 analog output signal or CH2 threshold
7. +/SET/- Rocker button

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, CH1/CH2 switch, +/SET/- rocker button, dual red/green digital displays, and output LED(s).



RUN/PRG/ADJ Mode Switch

The RUN/PRG/ADJ mode switch puts the sensor in RUN, PRG (Program), or ADJ (Adjust) mode.

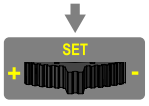
- RUN mode allows the sensor to operate normally and prevents unintentional programming changes via the +/SET/- rocker button.
- PRG mode allows the sensor to be programmed through the display-driven programming menu (see Program Mode).
- ADJ mode allows the user to perform Expert TEACH/SET methods and Manual Adjust (see "Adjust Mode" on page 23).



CH1/CH2 Switch

The CH1/CH2 switch selects which output's parameters can be accessed and changed in the interface of the display.

- CH1 selects the Analog Output
- CH2 selects the Discrete Output



+/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.

In ADJ mode, SET is used to perform TEACH/SET methods and +/- are used to manually adjust the threshold(s). In CH1 RUN mode, the rocker button is used to view the analog endpoints and midpoint signal values. The rocker button is disabled during CH2 RUN mode, except when using Window SET (see Window SET).



Red/Green Digital Displays

During RUN and ADJ modes, the Red display shows the signal level, and the Green display shows the analog output in volts or milliamps when CH1 is selected or the threshold when CH2 is selected. During PRG mode, both displays are used to navigate the display-driven programming menu.

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Dual Output LEDs

The output LEDs provide a visible indication of when the associated output is active.

- 1 represents the Channel 1 analog output. When on, it indicates that the signal is within the analog range.
- 2 represents the Channel 2 discrete output. When on, it indicates that the output is conducting.

Specifications

Sensing Beam

DF-G3: Visible red, 635 nm

DF-G3IR: Infrared, 850 nm

DF-G3LIR: Long infrared, 1450 nm

Supply Voltage

Voltage output models: 12 V DC to 30 V DC Class 2 (10% maximum ripple)

Current output models: 10 V DC to 30 V DC Class 2 (10% maximum ripple)

Power and Current Consumption (exclusive of load)

Standard display mode: 840 mW, Current consumption < 35 mA at 24 V DC

ECO display mode: 672 mW, Current consumption < 28 mA at 24 V DC

Supply Protection Circuitry

Protected against reverse polarity, overvoltage, and transient voltages

Delay at Power-Up

500 milliseconds maximum; outputs do not conduct during this time

Output Configuration

Voltage Output Models: 1 analog voltage output (user configurable as 1 V to 5 V or 0 V to 10 V) with 1 NPN or 1 PNP discrete output, depending on model.

Current Output Models: 1 analog current output (4 mA to 20 mA) with 1 NPN or 1 PNP discrete output, depending on model

Discrete Output Rating

100 mA maximum combined load—analog plus discrete outputs (derate 1 mA per °C above 30 °C)

OFF-state leakage current: < 5 µA at 30 V DC

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

Analog Output Recovery Time

< 2 times the selected response speed

Analog Output Ripple Content (p-p)

< 0.5% of the full-scale analog output

Analog Output Rating

Voltage Outputs: 2.5 kOhm minimum load resistance

Current Outputs: 1 kOhm maximum load resistance at 24 V; maximum load resistance = [(Vcc - 4)/.02] Ohms

Output Protection

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

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

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: 50% at +50 °C maximum relative humidity (non-condensing)

Environmental Rating

IP50, NEMA 1

Connections

PVC-jacketed 2 m or 9 m (6.5 ft or 30 ft) 5-wire integral cable; or integral 5-pin M8 quick disconnect; or 150 mm (6 in) cable with a 5-pin M8 quick disconnect; or 150 mm (6 in) cable with a 5-pin M12 quick disconnect

For Q3 or Q7 models, either a 5-pin M8 or a 6-pin M8 mating cordset may be used

Construction

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

Adjustments

3-way RUN/PRG/ADJ Mode Switch

2-way CH1/CH2 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)
- Output Selection, TEACH Selection, Response Speed, Offset Percent, Auto Thresholds, Delays/ Timers, Sensitivity Selection, Input Selection, Display Readout, Gain Selection, Factory Defaults (from top panel)
- Top panel interface lockout (from remote input only)

Certifications

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Industrial Control Equipment
3TJJ
Class 2 power

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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	2.0	30	0.5

Respond Speed and Features

Description	Response Speed	Repetition Period	Repeatability	Cross-Talk Avoidance	Energy Efficient Light Resistance	Maximum Range, Red[2]	Maximum Range, IR850[3]	Maximum Range, LIR1450[4]
High Speed	500 µs	100 µs	100 µs	No	No	1200 mm	2400 mm	360 mm
Fast	1000 µs	100 µs	150 µs	Yes	No	1500 mm	3000 mm	450 mm
Standard	2 ms	100 µs	180 µs	Yes	Yes	1500 mm	3000 mm	450 mm
Long Range	8 ms	100 µs	180 µs	Yes	Yes	1950 mm	3900 mm	585 mm
Extra Long Range	24 ms	100 µs	180 µs	Yes	Yes	3000 mm	6000 mm	900 mm

Factory default settings

Setting	Factory Default
Output (CH2 only)	LO
Threshold	5024
TEACH Selection	Two-Point TEACH
Output Response Time	Standard: 2 ms
Offset Percent	10%
Analog Output Slope (CH1 only)	Positive
Analog Output Range (CH1, Voltage models only)	0 V to 10 V
Filter Counts (CH1 only)	1
Input Wire selection	Off
Display Readout	Numeric, ECO disabled, Normal Orientation
Gain Selection	Auto Gain
Auto Threshold (CH2 only)	Off
Output Delay Selection (CH2 only)	Off
Sensitivity Selection (CH2 only)	Standard

[2] Excess gain = 1 (high sensitivity), opposed mode sensing. PIT46U plastic fiber used for visible LED models.
[3] Excess gain = 1 (high sensitivity), opposed mode sensing. IT.83.3ST5M6 glass fiber used for IR models.
[4] Excess gain = 1 (high sensitivity), opposed mode sensing. IT.83.3ST5M6 glass fiber used for IR models.

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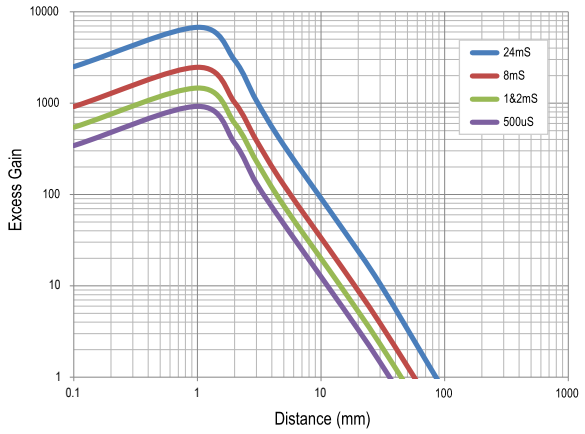
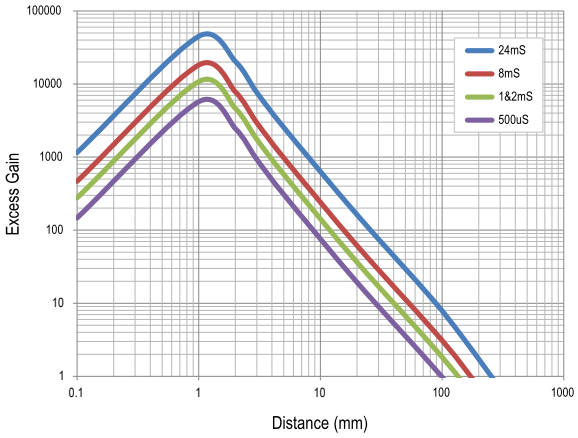
Excess Gain Curves

Diffuse—PBT16U



Diffuse—PBT26U



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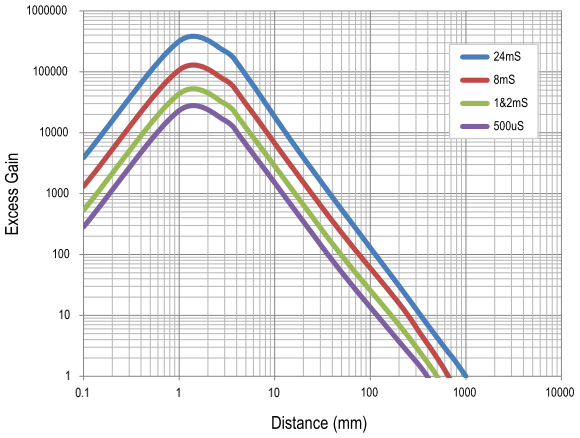
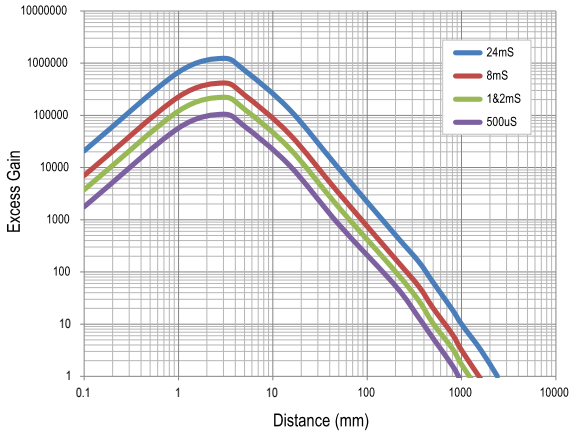
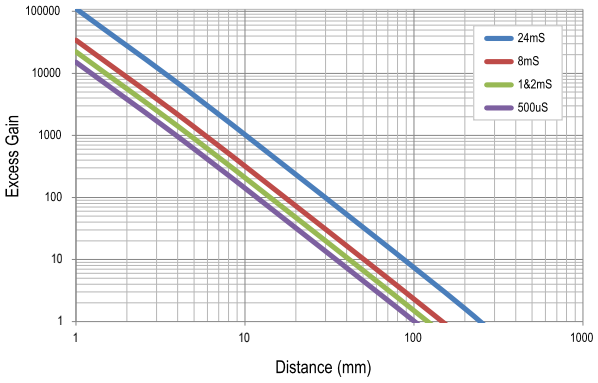


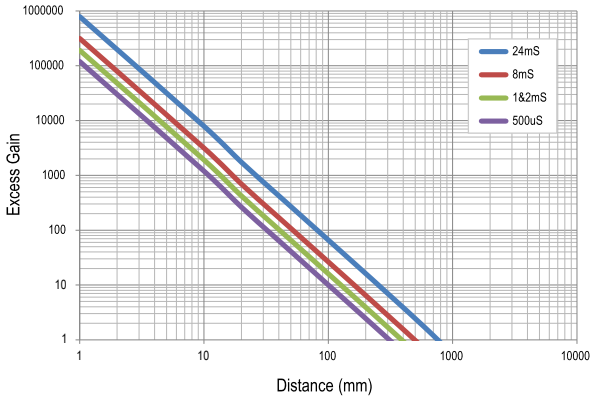
Diffuse—PBT66U



Opposed Mode—PIT16U



Opposed Mode—PIT26U



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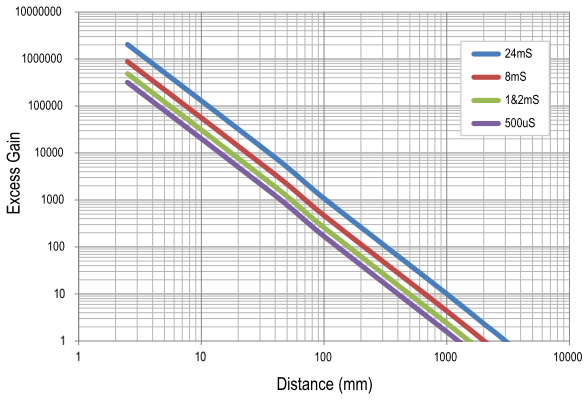
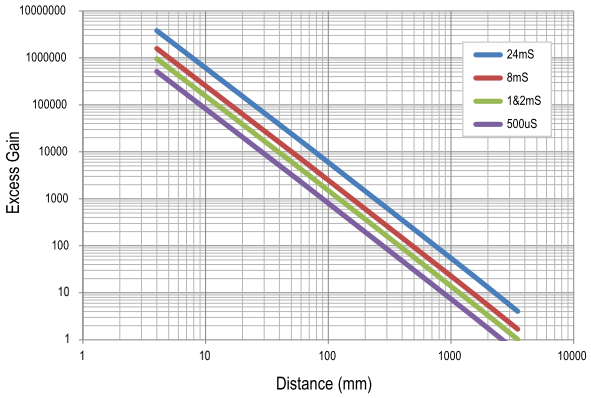
Opposed Mode—PIT46U

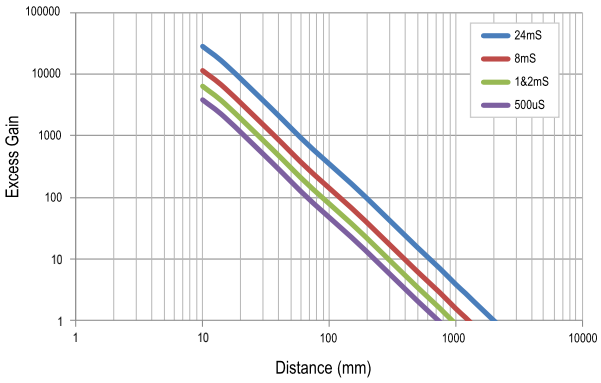


Opposed Mode—PIT66U



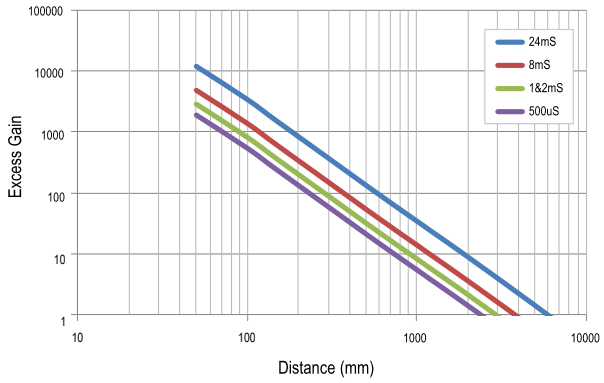
NOTE: The length of the fiber optics limits the range for the 8 and 24 ms response speeds.

Diffuse—IR850



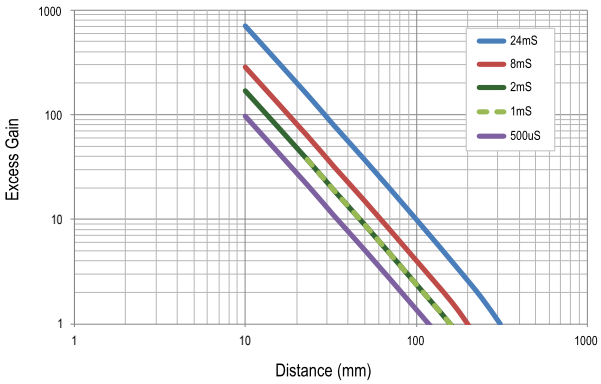
NOTE: BTC1.13.4ST5M6 glass fiber used for diffuse mode

Opposed Mode—IR850

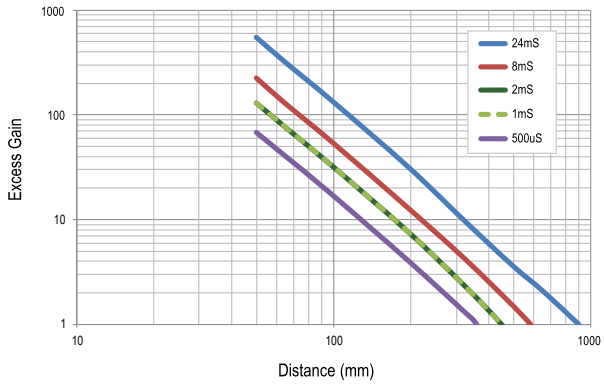


NOTE: IT.83.3ST5M6 glass fiber used for opposed mode

Diffuse—LIR1450



Opposed Mode—LIR1450



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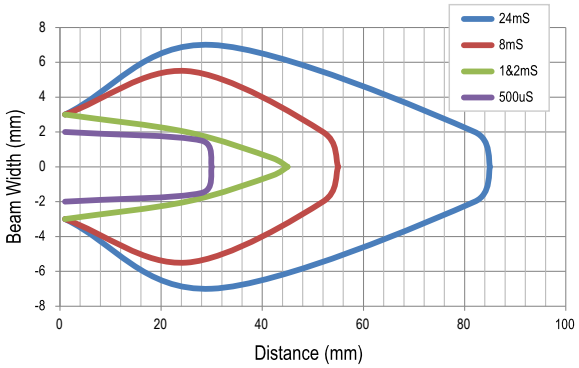
Beam Patterns

Diffuse—PBT16U



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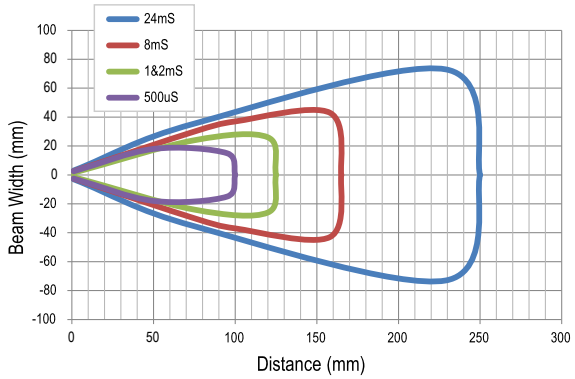

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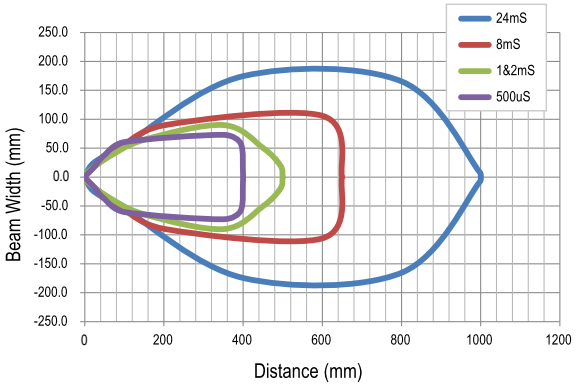
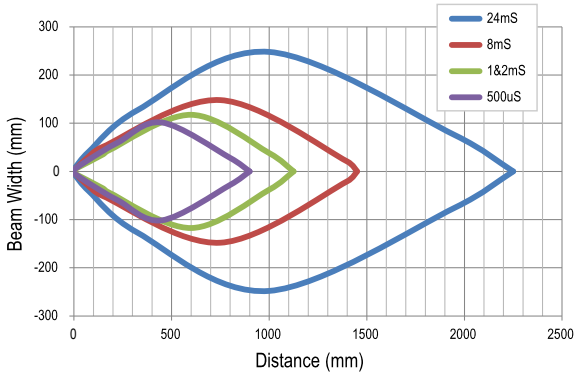
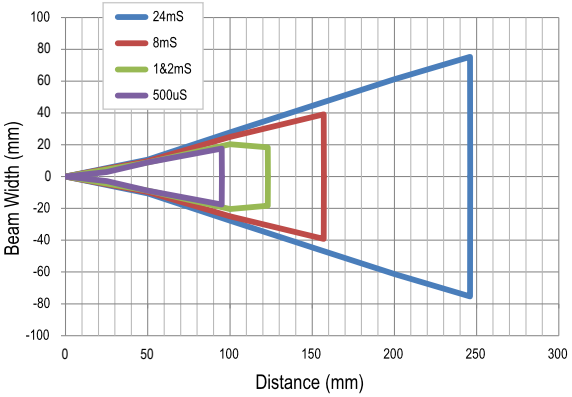


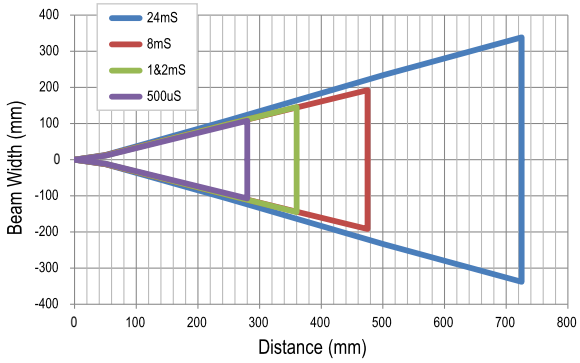
Diffuse—PBT66U



Opposed Mode—PIT16U



Opposed Mode—PIT26U



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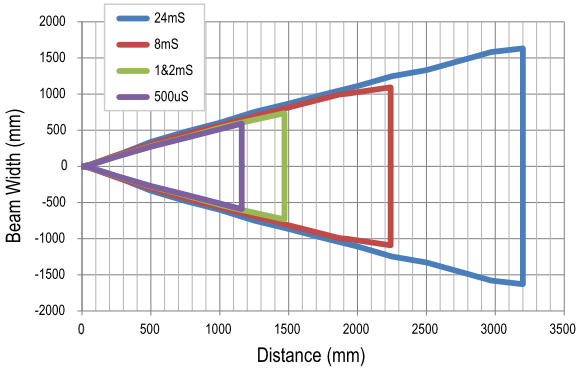
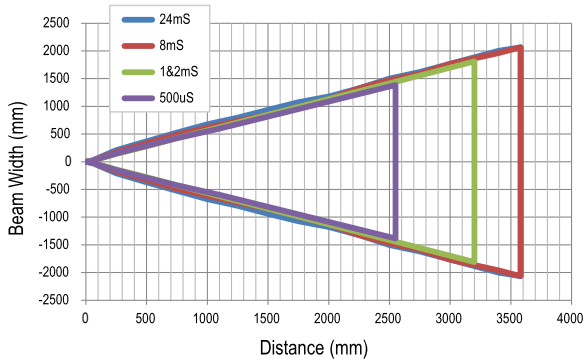
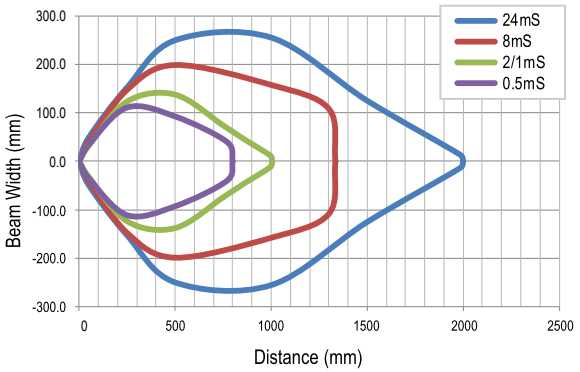
Opposed Mode—PIT46U



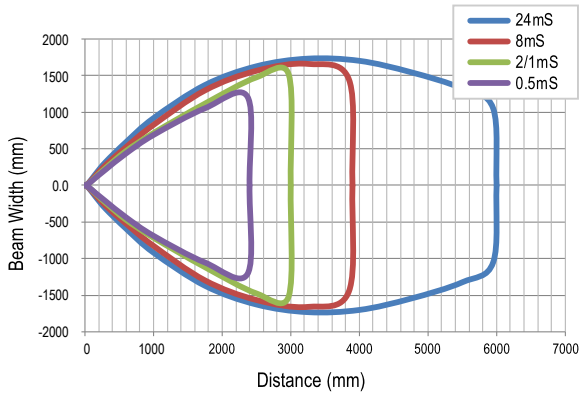
Opposed Mode—PIT66U



Diffuse—IR850



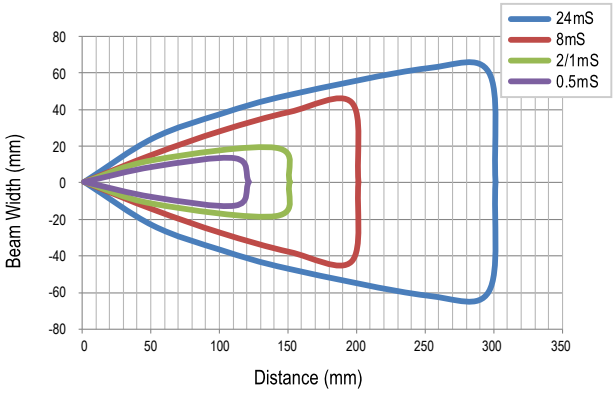
Opposed Mode—IR850



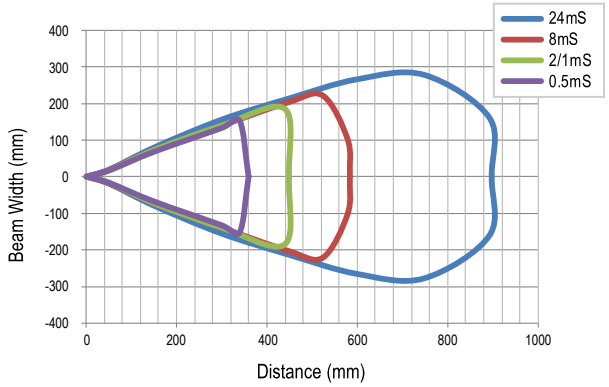
NOTE: BTC1.13.4ST5M6 glass fiber used for diffuse mode

NOTE: IT.83.3ST5M6 glass fiber used for opposed mode

Diffuse—LIR1450



Opposed Mode—LIR1450



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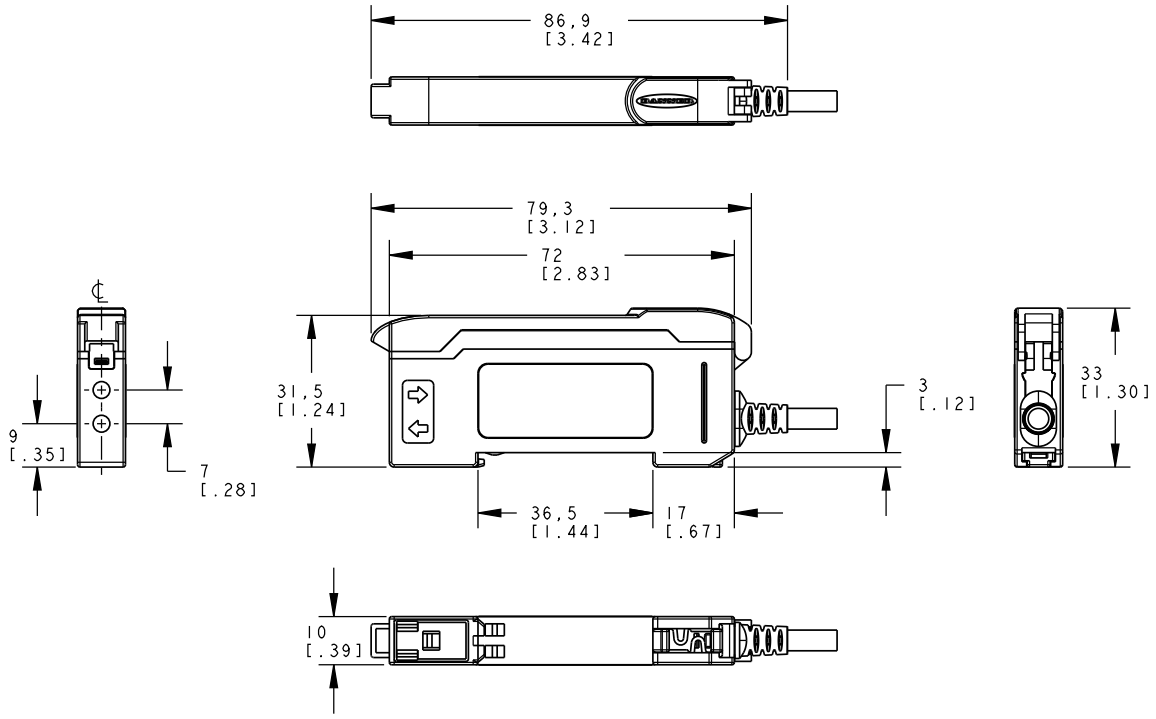
Dimensions



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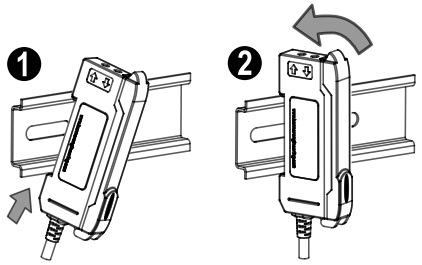
Chapter 2 Installation Instructions

Mounting Instructions

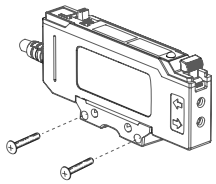
Mount on a DIN Rail

1. Hook the DIN rail clip on the bottom of the DF-G3 over the edge of the DIN rail (1).
2. Push the DF-G3 up on the DIN rail (1).
3. Pivot the DF-G3 onto the DIN rail, pressing until it snaps into place (2).



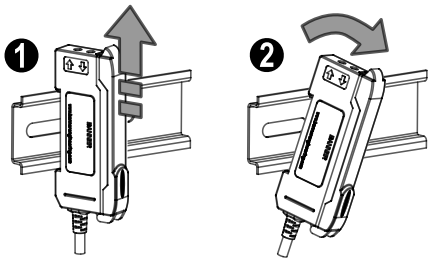
Mount to the Accessory Bracket (SA-DIN-BRACKET)

1. Position the DF-G3 in the SA-DIN-BRACKET.
2. Insert the supplied M3 screws.
3. Tighten the screws.



Remove from a DIN rail

1. Push the DF-G3 up on the DIN rail (1).
2. Pivot the DF-G3 away from the DIN rail and remove it (2).



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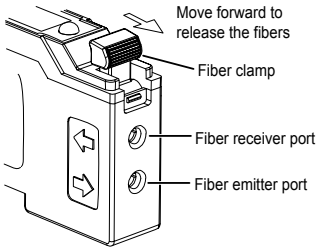
Installing the Fibers in a DF-Gx Sensor

Follow these steps to install glass or plastic fibers.

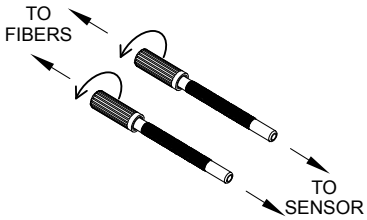
1. Open the dust cover.
2. Move the fiber clamp forward to unlock it.
3. Insert the fiber(s) into the fiber port(s) until they stop.
4. Move the fiber clamp backward to lock the fiber(s).
5. Close the dust cover.

For optimum performance of IR models, if applicable, glass fibers must be used.



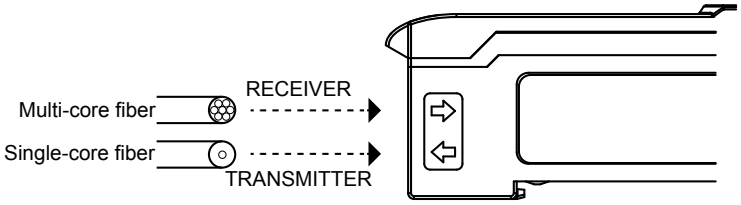
Fiber Adapters

If a thin fiber with less than 2.2 mm outer diameter is used, install the fiber adapter provided with the fiber assembly to ensure a reliable fit in the fiber holder. Align the fibers to the end of the adaptors. Banner includes the adapters with all fiber assemblies.



Fiber Outer Diameter (mm)	Adapter Color
Ø 1.0	Black
Ø 1.3	Red
Ø 2.2	No adapter needed

When connecting coaxial-type fiber assemblies to the amplifier, install the single-core (center) fiber to the Transmitter port, and the multi-core (outer) fiber to the Receiver port. This will result in the most reliable detection.



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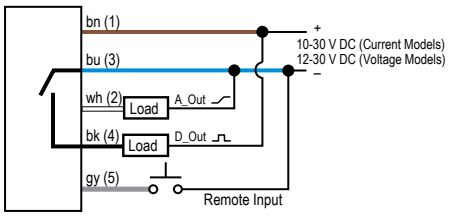
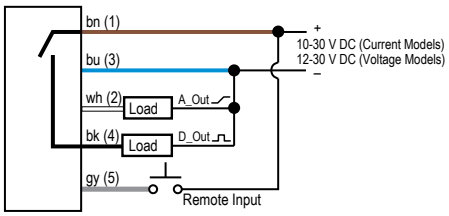
Wiring Diagrams

NPN models

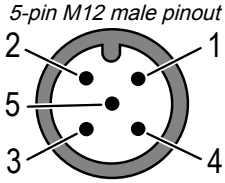


PNP models

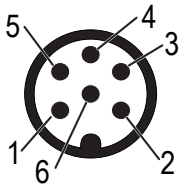


1 = Brown
2 = White
3 = Blue
4 = Black
5 = Gray
(6 = no connection)

5-pin M12 male pinout



5-pin M8 male pinout



NOTE: Open lead wires must be connected to a terminal block.

NOTE: When using multiple sensors in Master/Slave mode, the gray wires from each sensor should be connected together. The remote programming function cannot be used.

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Chapter 3 Operating Instructions

Run Mode



Run mode allows the sensor to operate normally and prevents unintentional programming changes. In CH1 RUN mode, the +/SET/- rocker button is used to view the analog endpoints and midpoint signal values. The rocker button is disabled during CH2 RUN mode, except when using Window SET (see "Window SET" on page 27).

Program Mode



Channel 1 Analog Menu

Program (PRG) mode allows the following settings to be programmed in the DF-G3.

CH1 Analog factory default settings

tch SEL1	2-pt tch
rESP SPd	2 ms
OFSt Pct1	10 Pct
AOut SLPE	POS
AOut RnGE	0 to 10 V
FLtr CntS	1
inPt SEL	oFF
diSP rEAd	diSP 1234
GAin SEL	Auto GAin

NOTE: The CH1 settings programmed for rESP SPd, inPt SEL, diSP rEAd and GAin SEL also apply to CH2.

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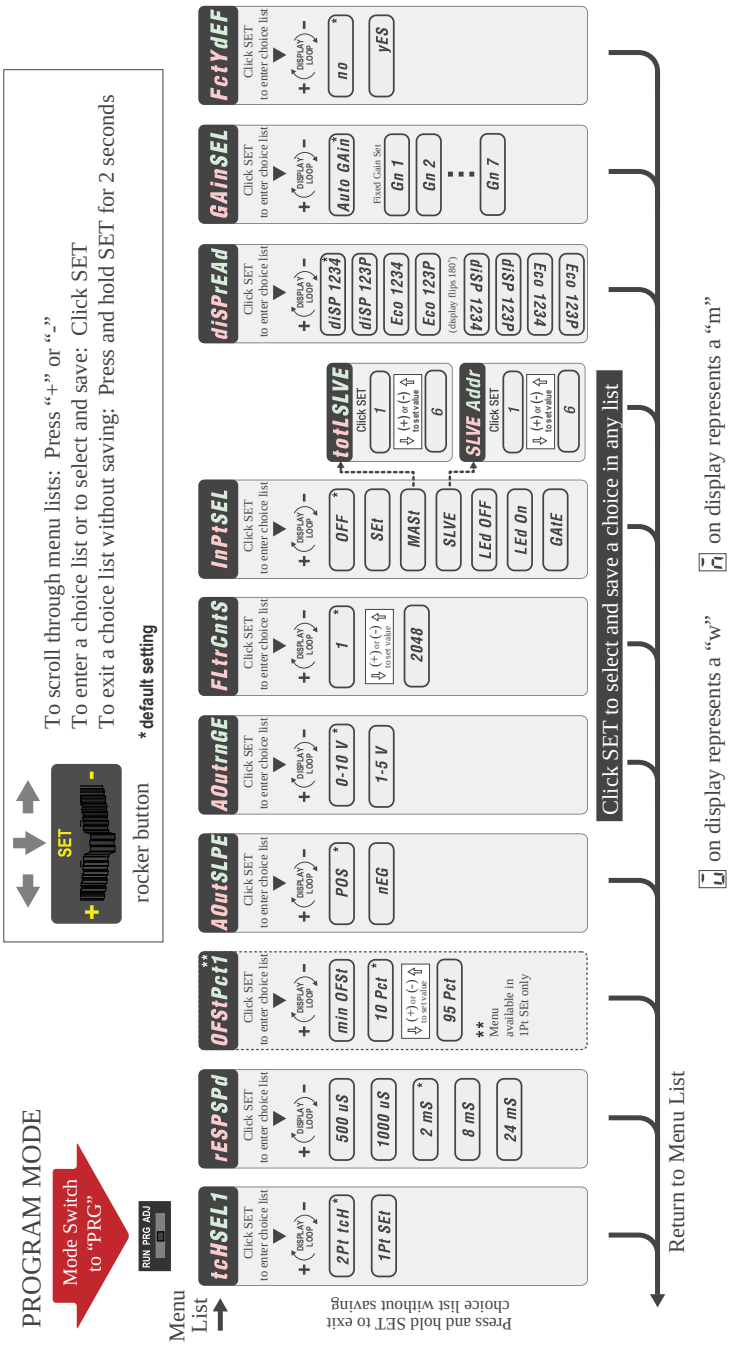



Channel 2 Discrete Menu

Program (PRG) mode allows the following settings to be programmed in the DF-G3.

When CH2 is selected in Program mode, the settings below can be configured for CH2 discrete output and are independent from CH1 settings.

CH2 Discrete factory default settings

Out SEL2	LO
tch SEL2	2-pt tch

Continued on page 18

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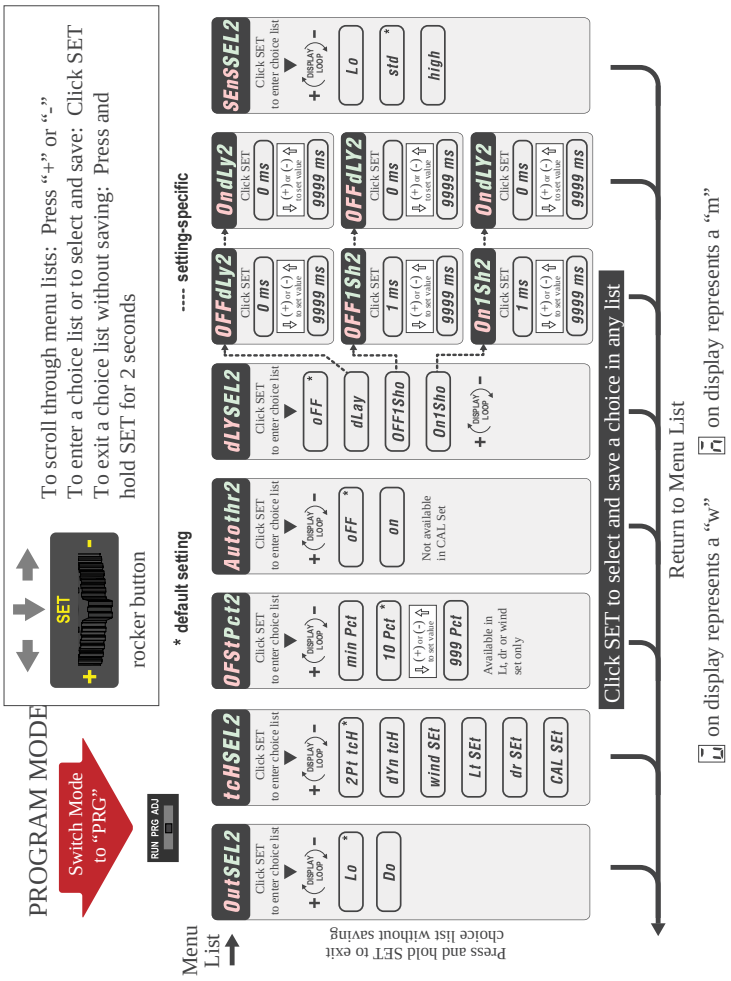
Continued from page 17

OFSt Pct2	10 pct
Auto thr2	oFF
dLY SEL2	oFF
SEnS SEL2	Std



TEACH Selection

tcH SEL1 tcH SEL2

The DF-G3 can be programmed for one of the following TEACH/SET methods.

CH1 Analog

- Two-Point TEACH
- One-Point SET

CH2 Discrete

- 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.

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Response Speed

rESP SPd

The DF-G3 can be programmed for one of the following Response Speeds:

Respond Speed and Features

Description	Response Speed	Repetition Period	Repeatability	Cross-Talk Avoidance	Energy Efficient Light Resistance	Maximum Range, Red[5]	Maximum Range, IR850[6]	Maximum Range, LIR1450[7]
High Speed	500 µs	100 µs	100 µs	No	No	1200 mm	2400 mm	360 mm
Fast	1000 µs	100 µs	150 µs	Yes	No	1500 mm	3000 mm	450 mm
Standard	2 ms	100 µs	180 µs	Yes	Yes	1500 mm	3000 mm	450 mm
Long Range	8 ms	100 µs	180 µs	Yes	Yes	1950 mm	3900 mm	585 mm
Extra Long Range	24 ms	100 µs	180 µs	Yes	Yes	3000 mm	6000 mm	900 mm

Offset Percent

OFSt Pct1 OFSt Pct2

For the Analog Output CH1, the Offset Percent is used in One-Point Set mode to generate a threshold window above and below the TEACH point. This window is equivalent to the Analog Range.

The allowable range for CH1 is 5% minimum to 95% maximum for all response speeds.

For the Discrete Output CH2, 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 for CH2 is 2% minimum to 999% maximum (depending on the selected TEACH method) for all response speeds.

MIn OFSt The offset percent can also be programmed to **Minimum Offset**. This allows the DF-G3 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).

Analog Output Slope

AOut SLPE

The slope of the analog output can be configured as positive (analog value increases with increasing signal strength) or negative (analog value decreases with increasing signal strength).

Analog Output—Voltage Output Models Only

AOut rnGE

The analog output can be configured to range from 0 to 10 volts or 1 to 5 volts.

Filter Counts

FLtr CntS

Use this menu to set the number of readings that are averaged together before the analog output value updates. Increasing the Filter Counts decreases the amount of noise on the analog signal, but it increases the time constant of the analog output's response to a signal change. This time constant is a product of the selected Response Speed and the Filter Counts.

Input Wire Function

inPt SEL

The DF-G3 can be programmed for one of the following input wire functions:

---

[5] Excess gain = 1 (high sensitivity), opposed mode sensing. PIT46U plastic fiber used for visible LED models.
[6] Excess gain = 1 (high sensitivity), opposed mode sensing. IT.83.3ST5M6 glass fiber used for IR models.
[7] Excess gain = 1 (high sensitivity), opposed mode sensing. IT.83.3ST5M6 glass fiber used for IR models.

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- Off—Ignore all pulses
- Set—Remote TEACH input
- Master—Master sync line output for multi-sensor cross-talk avoidance
- Slave—Slave sync line input for mutli-sensor cross-talk avoidance
- LED off—When the input wire is active the emitter LED turns off
- LED on—When the input wire is active the emitter LED turns on
- Gate—When the input wire is active the outputs are locked in their present state; any active delay timers are paused

For remote programming in Set Mode see "Remote Input" on page 21.

To configure sensors for master-slave operation, see "Sync Master/Slave" on page 22.

Display Readout



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 (1234)

Gain Selection



The DF-G3 can operate in Auto Gain mode or the Gain can be fixed to be in Gain 1...7. In Auto Gain, the DF-G3 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-G3 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



The Factory Defaults menu allows the DF-G3 to be easily restored back to original factory default settings (see **Factory Default Settings** in Specifications).

Output Selection



Only the discrete output, CH2, can be programmed for either light operate (LO) or dark operate (DO).

Auto Thresholds



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 32)
- Severe contamination/changes in the taught condition can prevent the Auto Thresholds algorithm from optimizing the threshold(s). If this occurs, the DF-G3 enters a **Threshold Alert** or **Threshold Error** state. See "Troubleshooting" on page 37 for more explanation.

Delays/Timers









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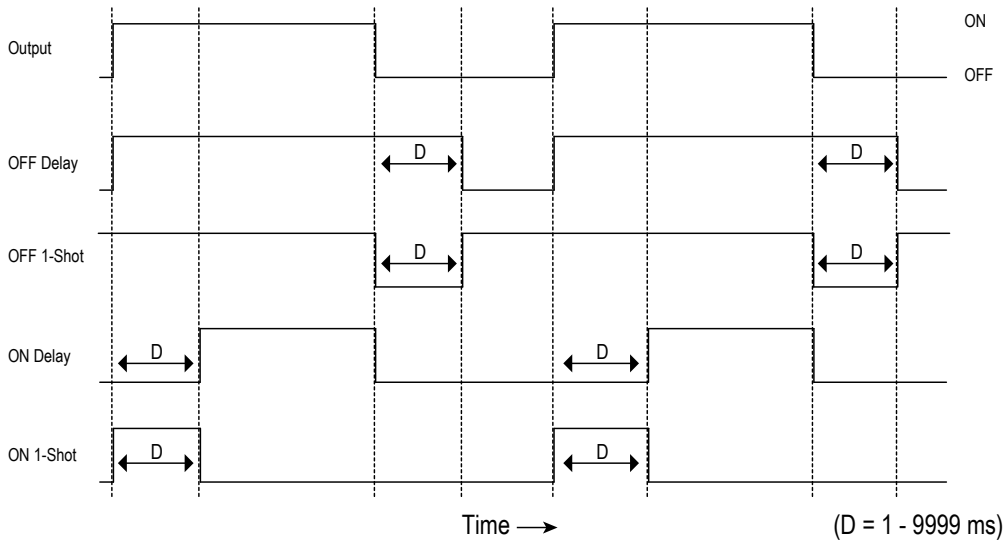
DF-G3 Delays/Timers



ON/OFF Delays and ON/OFF One-Shot timers can be programmed (for CH2 only) between 1 - 9999 ms (a value of 0 disables the delay/timer). "Figure: DF-G3 Delays/Timers " on page 21 defines how the delays/timers affect the output behavior.

Some combinations of delays/timers are not allowed. The DF-G3 programming menu automatically disables invalid combinations of delays/timers.

The following table shows the allowable combinations of 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	-

Sensitivity Selection



The Sensitivity selection can be programmed for CH2. Use this setting to increase (lo) or decrease (high) the switch-point hysteresis from the default (std) setting.

- high—High sensitivity. Use this setting for low-contrast sensing
- Std—Standard sensitivity
- Lo—Low sensitivity. Use this setting to stabilize the output in high-vibration applications

Remote Input

Use the input wire to program the sensor remotely. To program the sensor using the input wire, remote input must be enabled (inPt SEL = SEt, see "Input Wire Function" on page 19). The remote input provides limited programming options (see the figure below). Pulse the remote input according to the figures and the instructions provided in this manual.

> **NOTE:** For NPN models, the remote input pulses are active low as shown in the following figures. For PNP models, the remote input pulses are active high and are inverted from the following figures.

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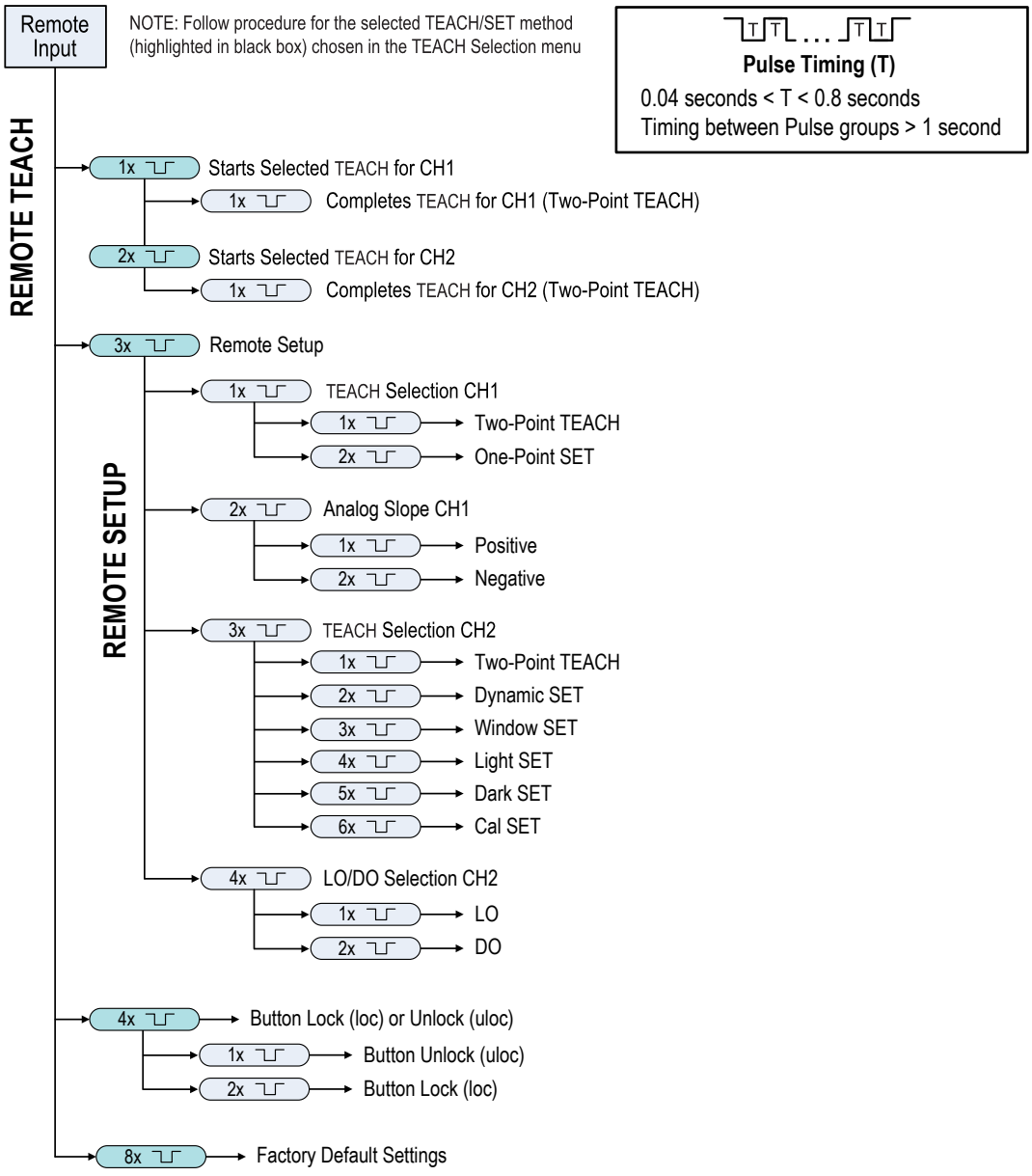
Remote Input Flowcart



Sync Master/Slave

Up to seven DF-G3 Long Range Expert Dual Display Fiber Amplifier with Analog Output sensors may be used together in a single sensing application. To eliminate crosstalk between the sensors, configure one sensor to be the master and the remaining sensors to be the slaves. In this mode, the sensors alternate taking measurements and the response speed is 2 ms.

NOTE: Note: In this mode, all sensors must either be NPN or PNP output models.

1. Configure the first sensor as the Master (inPt SEL = MAST).
2. In the Master sensor set-up, enter the total number of Slave sensors you will be using (tOtL SLAV = 1 - 6).
3. For each Slave sensor used, configure the input as a Slave (inPt SEL = SLVE).
4. Give each Slave its own identifying address (SLAV Addr = 1 - 6).
5. Connect the Input wires of the Master and all of the Slaves together.

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NOTE: Note: Giving two Slave sensors the same address will cause them to fire their emitters at the same time in the firing sequence.

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 and the midpoint or endpoints of the analog output depending on whether a 1-point SET or 2-point TEACH was used.

NOTE: For threshold and analog endpoints, when teaching CH2, the gain setting will be the same as the gain setting made during the CH1 teach. Reteaching CH1 may invalidate the previous CH2 teach.

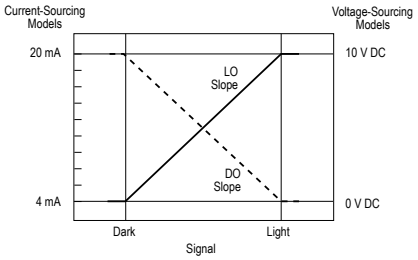
CH1 Analog Output

Two-Point TEACH

- Establishes defined endpoints for the analog output range
- Analog endpoints can be adjusted by using the "+" and "-" rocker button (Manual Adjust)

Two-Point TEACH is used when two conditions can be presented statically to the sensor. The first taught condition is set to 0 V (4 mA), and the second taught condition to 10 V (20 mA). The order of the taught points determines the slope. If the first taught condition is darker, the slope will be positive. If the first taught condition is lighter, the slope will be negative. Reverse the slope of the analog output by changing the AOut SLPE menu setting.

Two-Point TEACH (Light Operate shown)



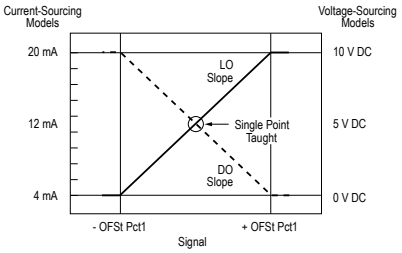
NOTE: Depending on the application configuration and fibers used, the analog function may or may not behave linearly. The received light intensity will be dictated by the inverse square properties of light.

One-Point SET

- Defines the 5 V (12 mA) midpoint of the analog output
- Analog midpoint can be adjusted by using the "+" and "-" rocker button (Manual Adjust)

A single sensing condition is presented, and the sensor positions the midpoint of its analog range (5 V or 12 mA) exactly at the presented condition. The size of the window is determined by the OFSt Pct1 menu setting. The slope of the analog output is determined by the AOut SLPE setting.

One-Point SET (Light Operate shown)



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CH2 Discrete Output

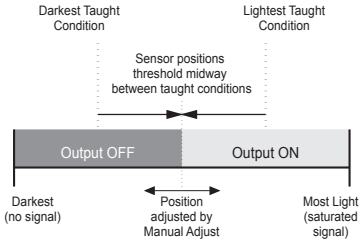
Two-Point TEACH

- Establishes a single switching threshold
- Threshold can be adjusted by using the "+" 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 switch point) midway between the two taught conditions, with the Output ON condition on one side, and the Output OFF condition on the other.

The Output ON and OFF conditions can be reversed by using the LO/DO (Light Operate/ Dark Operate) switch or through the program interface for the dual-output model.

Two-Point TEACH (Light Operate shown)



Two-Point TEACH and Manual Adjust

Moves the 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 the operation

REMEMBER: Manual adjustments are disabled when Auto Thresholds are ON

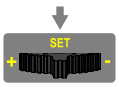
Follow these steps to perform a Two-Point TEACH:

NOTE: TEACH Selection must be programmed to **2Pt tcH**.

1. Enter Adjust mode.

Method	Action		Result
SET Button [8]	Set the Mode switch to ADJ.		Display: Red - Signal Level; Green - Threshold 
Remote Input [9]	No action is required; the sensor is ready for the Two-Point TEACH method		

2. Teach the first condition.

Method	Action		Result
SET Button	a. Present the first condition. b. Click the SET rocker button.		Display: Flashes "**2Pt tch**" then holds on "**1234 2nd**" 
Remote Input	a. Present the first condition. b. Single-pulse the remote input.		

3. Teach the second condition.

[8] SET Button: 0.04 seconds ≤ "Click" ≤ 0.8 seconds
[9] Remote Input: 0.04 seconds ≤ T ≤ 0.8 seconds

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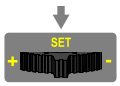
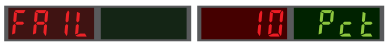
Method	Action		Result
SET Button	a. Present the second condition. b. Click the SET rocker button.		**TEACH Accepted** Displays alternate "**PASS**" and % Minimum Difference[10]; Sensor returns to Adjust mode  **TEACH Not Accepted** Displays alternate "**FAIL**" and % Minimum Difference[10] ; Sensor returns to Adjust mode 
Remote Input	a. Present the second condition. b. Single-pulse the remote input.		

4. Return to Run mode.

Method	Action		Result
SET Button	Move the Mode switch to RUN		Display: Red - Signal Level; Green - Threshold 
Remote Input	No action is required; sensor returns to RUN mode automatically		

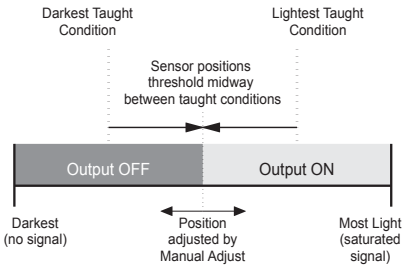
Dynamic TEACH

- 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.

Reverse the CH2 Output ON and OFF conditions by using the LO/DO (Light Operate/ Dark Operate) selection through the program interface.

Dynamic TEACH (Light Operate shown)



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

Follow these steps to perform **Dynamic TEACH**:

NOTE: TEACH Selection must be programmed to **dYn tcH**.

[10] See "Troubleshooting" on page 37 for more explanation of the % Minimum Difference displayed after the Two-Point TEACH method.

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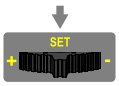
1. Enter Adjust Mode.

Method	Action		Result
SET Button [11]	Set Mode switch to ADJ		Display: Red - Signal Level; Green - Threshold 
Remote Input [12]	No action required; sensor is ready for Dynamic TEACH method		

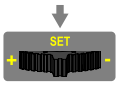
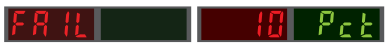
2. Enter Dynamic TEACH.

Method	Action		Result
SET Button	Click the SET rocker button		Display: Flashes "**dYn tch**" then holds on "**1234 dYn**" 
Remote Input	Single-pulse remote input		

3. Present ON and OFF Conditions.

Method	Action		Result
SET Button	Present ON and OFF conditions		Display: Red - Signal Level; Green - Threshold 
Remote Input	Present ON and OFF conditions		

4. Exit Dynamic TEACH.

Method	Action		Result
SET Button	Click the SET rocker button		**TEACH Accepted** Displays alternate "**PASS**" with % Minimum Difference[13][13] , Sensor returns to Adjust mode  **TEACH Not Accepted** Displays alternate "**FAIL**" with % Minimum Difference[13] , Sensor returns to Adjust mode 
Remote Input	Single-pulse remote input		

5. Return to RUN Mode.

Method	Action		Result
SET Button	Move Mode switch to RUN		Display: Red - Signal Level; Green - Threshold 

Continued on page 27

[11] SET Button: 0.04 seconds ≤ "Click" ≤ 0.8 seconds
[12] Remote Input: 0.04 seconds ≤ T ≤ 0.8 seconds
[13] See "Troubleshooting" on page 37 for more explanation of the % Minimum Difference displayed after the Dynamic TEACH method.

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Continued from page 26

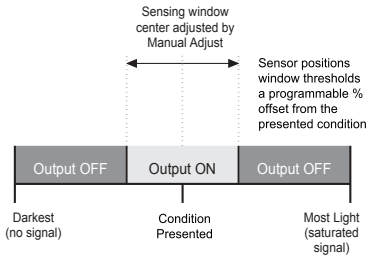
Method	Action		Result
Remote Input	No action required; sensor returns to RUN mode automatically		

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 for programming the Offset Percent setting

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.

Window SET (Light Operate shown)



Reverse the Output ON and OFF conditions by using the LO/DO (Light Operate/ Dark Operate) selection through the program interface for the dual output model.

Window SET and Manual Adjust Window SET

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
  - Two seconds after adjustment, the GREEN display will flash three times to confirm
- Slide Mode switch to RUN to complete operation

> **REMEMBER:** Manual adjustments are disabled when Auto Thresholds are ON

Follow these steps to perform a Window SET:

> **NOTE:** TEACH Selection must be programmed to **wind SEt**.

1. Enter Adjust Mode

Method	Action		Result
SET Button [14]	Set Mode switch to ADJ		Display: Red - Signal Level; Green - Threshold 
Remote Input [15]	No action is required; the sensor is ready for Window SET method		

2. SET Sensing Condition

[14] SET Button: 0.04 seconds ≤ "Click" ≤ 0.8 seconds
[15] Remote Input: 0.04 seconds ≤ T ≤ 0.8 seconds

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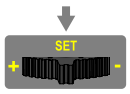
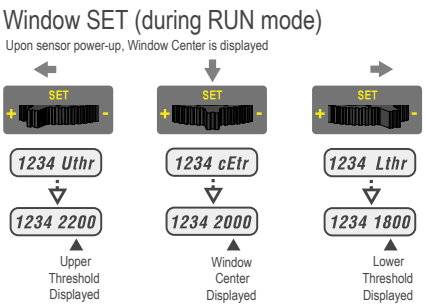
Method	Action		Result
SET Button	◦ Present sensing condition ◦ Click the SET rocker button		**Threshold Condition Accepted** Displays read "**wInd SEt**" then alternate "**PASS**" with % Offset[16]; Sensor returns to Adjust mode  **Threshold Condition Not Accepted** Displays read "**wInd SEt**" then alternate "**FAIL**" with minimum % Offset[16] for sensing condition; Sensor returns to Adjust mode 
Remote Input	◦ Present sensing condition ◦ Single-pulse the remote input		

3. Return to RUN Mode

Method	Action		Result
SET Button	Move Mode switch to Run		Display: Red - Signal Level; Green - Window Center (see "Figure: Upper and Lower Thresholds " on page 28 for instructions on how to display upper and lower thresholds) 
Remote Input	No action is required; the sensor returns to Run mode automatically		

Upper and Lower Thresholds



[16] See "Troubleshooting" on page 37 for more explanation of the % Offset displayed after the Window SET method

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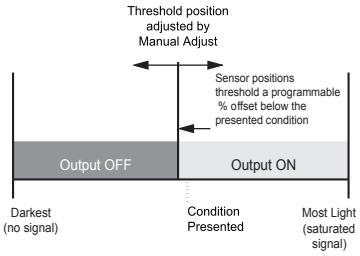
Light SET

- 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 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 setting.

Light SET (Light Operate shown)



Light SET and Manual Adjust

Moves the 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
  - Two seconds after adjustment, the GREEN display will flash three times to confirm
- Slide Mode switch to RUN to complete operation

REMEMBER: Manual adjustments are disabled when Auto Thresholds are ON

Follow these steps to perform a Light SET:

NOTE: TEACH Selection must be programmed to **Lt SEt**.

1. Enter Adjust Mode

Method	Action		Result
SET Button [17]	Set Mode switch to ADJ		Display: Red - Signal Level; Green - Threshold 
Remote Input [18]	No action is required; the sensor is ready for Light SET method		

2. SET Sensing Condition

[17] SET Button: 0.04 seconds ≤ "Click" ≤ 0.8 seconds
[18] Remote Input: 0.04 seconds ≤ T ≤ 0.8 seconds

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Method	Action		Result
SET Button	◦ Present sensing condition ◦ Click the SET rocker button		**Threshold Condition Accepted** Displays read "**Lt SEt**" then alternate "**PASS**" with % Offset[19]; Sensor returns to Adjust mode  **Threshold Condition Not Accepted** Displays read "**Lt SEt**" then alternate "**FAIL**" with minimum % Offset[19] for sensing condition; Sensor returns to Adjust mode 
Remote Input	◦ Present sensing condition ◦ Single-pulse the remote input		

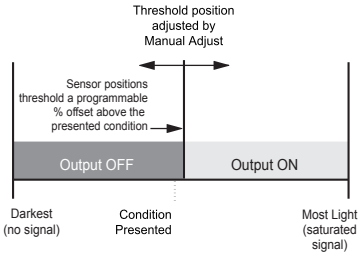
3. Return to RUN Mode

Method	Action		Result
SET Button	Move Mode switch to RUN		Display: Red - Signal Level; Green - Threshold 
Remote Input	No action is required; the sensor returns to RUN mode automatically		

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 for programming the Offset Percent setting

Dark SET (Light Operate shown)



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 setting.

Dark SET and Manual Adjust

Moves the 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
  - Two seconds after adjustment, the GREEN display will flash three times to confirm
- Slide Mode switch to RUN to complete the operation

[19] See "Troubleshooting" on page 37 for more explanation of the % Offset displayed after the Light SET method

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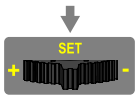
Follow these steps to perform a Dark SET:

NOTE: TEACH Selection must be programmed to **dr SEt**.

1. Enter Adjust Mode.

Method	Action		Result
SET Button [20]	Set Mode switch to ADJ		Display: Red - Signal Level; Green - Threshold 
Remote Input [21]	No action is required; the sensor is ready for Dark SET method		

2. SET Sensing Condition.

Method	Action		Result
SET Button	◦ Present sensing condition ◦ Click the SET rocker button		**Threshold Condition Accepted** Displays read "**dr SEt**" then alternate "**PASS**" with % Offset[22]; Sensor returns to Adjust mode  **Threshold Condition Not Accepted** Displays read "**dr SEt**" then alternate "**FAIL**" with minimum % Offset[22] for sensing condition; Sensor returns to Adjust mode  
Remote Input	◦ Present sensing condition ◦ Single-pulse the remote input		

3. Return to RUN Mode.

Method	Action		Result
SET Button	Move Mode switch to RUN		Display: Red - Signal Level; Green - Threshold 
Remote Input	No action is required; the sensor returns to RUN mode automatically		

[20] SET Button: 0.04 seconds ≤ "Click" ≤ 0.8 seconds
[21] Remote Input: 0.04 seconds ≤ T ≤ 0.8 seconds
[22] See "Troubleshooting" on page 37 for more explanation of the % Offset displayed after the Dark SET method

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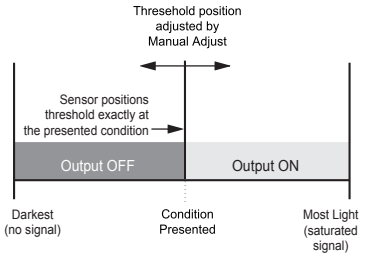
Calibration SET

- 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 setting.

Calibration SET (Light Operate shown)



Calibration SET and Manual Adjust

Moves the 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
  - Two seconds after adjustment, the GREEN display will flash three times to confirm
- Slide Mode switch to RUN to complete the operation

Follow these steps to perform a Calibration SET:

NOTE: TEACH Selection must be programmed to **CAL SEt**.

1. Enter Adjust Mode

Method	Action		Result
SET Button [23]	◦ Set Mode switch to ADJ		Display: Red - Signal Level; Green - Threshold 
Remote Input [24]	No action is required; the sensor is ready for Calibration SET method		

2. SET Sensing Condition

Method	Action		Result
SET Button	◦ Present sensing condition ◦ Click the SET rocker button		**Threshold Condition Accepted** Displays read "**cAL SEt**" then flashes "**PASS**"; Sensor returns to Adjust mode 
Remote Input	◦ Present sensing condition ◦ Single-pulse the remote input		**Threshold Condition Unacceptable** Displays read "**cAL SEt**" then flashes "**FAIL**"; Sensor returns to Adjust mode 

3. Return to RUN Mode

[23] SET Button: 0.04 seconds ≤ "Click" ≤ 0.8 seconds
[24] Remote Input: 0.04 seconds ≤ T ≤ 0.8 seconds

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Method	Action		Result
SET Button	Move Mode switch to RUN		Display: Red - Signal Level; Green - Threshold 
Remote Input	No action is required; the sensor returns to RUN mode automatically		

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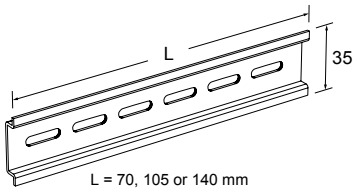
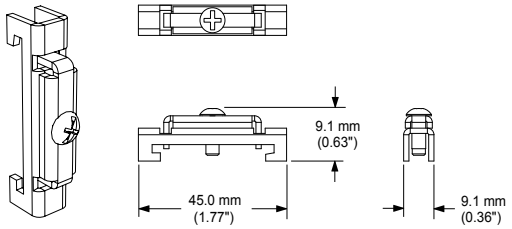
Chapter 4 Accessories

DIN-35-..	Models	Length (mm)
35 mm DIN Rail  **Hole center spacing:** 35.1 **Hole size:** 25.4 x 5.3	**DIN-35-70** CAD Files: DXF, PDF, IGS, STP	70
	DIN-35-105 CAD Files: DXF, PDF, IGS, STP	105
	DIN-35-140 CAD Files: DXF, PDF, IGS, STP	140
	DIN-35-180 CAD Files: DXF, PDF, IGS, STP	180
	DIN-35-220 CAD Files: DXF, PDF, IGS, STP	220

SA-DIN-CLAMP

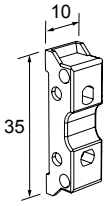
- Pair of metal DIN rail end stops; slide onto DIN rail at either side of the sensor stack
- Combination (#2 Phillips, #8 standard slotted) set screw



SA-DIN-BRACKET

- Plastic bracket with mounting screws
- CAD Files: DXF, PDF, IGS, STP

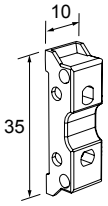
Hole center spacing: A = 16, B = 25.4, C = 15.2
Hole size: A = ø 3.2, B = ø 3.3, C = ø 4.4



SA-DIN-BRACKET-10

- Package of 10 plastic brackets with mounting screws
- CAD Files: DXF, PDF, IGS, STP

Hole center spacing: A = 16, B = 25.4, C = 15.2
Hole size: A = ø 3.2, B = ø 3.3, C = ø 4.4



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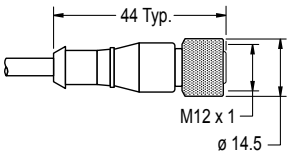
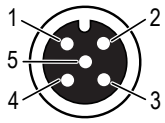
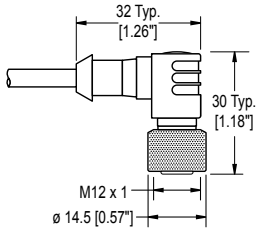
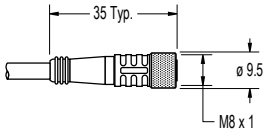
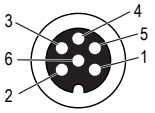
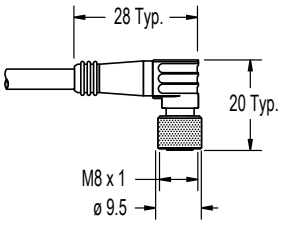
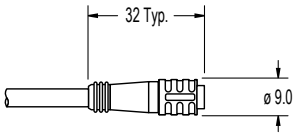
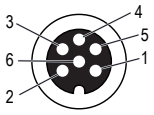
Quick-Disconnect Cordsets

5-Pin Single-Ended M12 Female Cordsets				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
MQDC1-501.5	0.5 m (1.5 ft)	Straight		 1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray
MQDC1-503	0.9 m (2.9 ft)			
MQDC1-506	2 m (6.5 ft)			
MQDC1-515	5 m (16.4 ft)			
MQDC1-530	9 m (29.5 ft)			
MQDC1-560	18 m (59 ft)			
MQDC1-5100	31 m (101.7 ft)			
MQDC1-506RA	2 m (6.5 ft)	Right-Angle		
MQDC1-515RA	5 m (16.4 ft)			
MQDC1-530RA	9 m (29.5 ft)			
MQDC1-560RA	19 m (62.3 ft)			

5-Pin Single-Ended M8 Female Cordsets				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
PKG5M-2	2 m (6.56 ft)	Straight		 1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray 6 = N.C.
PKG5M-5	5 m (16.4 ft)			
PKG5M-9	9 m (29.5 ft)			
PKW5M-2	2 m (6.56 ft)	Right Angle		
PKW5M-5	5 m (16.4 ft)			
PKW5M-9	9 m (29.5 ft)			

6-Pin Single-Ended Snap-on M8 Female Cordsets				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
PKG6Z-2	2 m (6.56 ft)	Straight		 1 - brown 2 = White 3 = Blue 4 = Black 5 = Gray 6 = Pink
PKG6Z-9	9 m (29.53 ft)			

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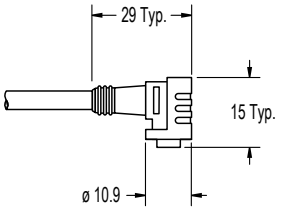
6-Pin Single-Ended Snap-on M8 Female Cordsets				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
PKW6Z-2	2 m (6.56 ft)	Right-angle		
PKW6Z-9	9 m (29.53 ft)			

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Chapter 5 Product Support and Maintenance

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 Auto.

Percent Minimum Difference after TEACH

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

Percent Offset after SET

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)	The 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

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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