DF-G1 Expert™ Dual Display Fiber Amplifier

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Installation Guide

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

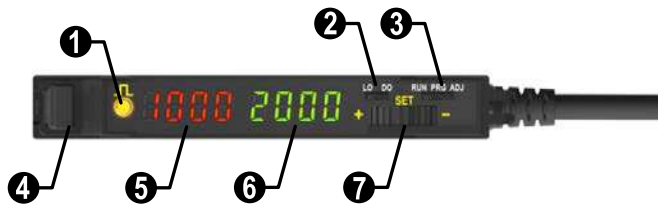For complete technical information about this product, including dimensions, accessories, and specifications, see *http://www.bannerengineering.com* and search 161999.

Overview

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

Figure 1. DF-G1 Model Features

⚠️ **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)	

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[1] Connector options:
- A model with a QD connector requires a mating cordset .
- 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**).
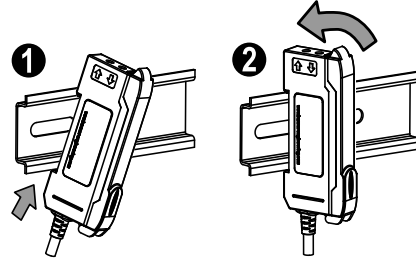
# Installation Instructions

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).
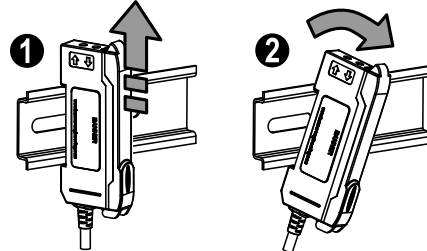3. Pivot the DF-G1 onto the DIN rail, pressing until it snaps into place (2).

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.
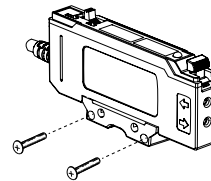
Remove from a DIN rail

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 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.

Move forward to release the fibers

Fiber Clamp

Fiber Receiver Port

Fiber Emitter Port
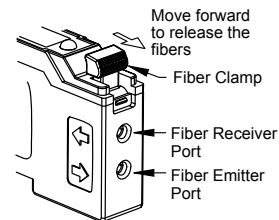
Fiber Adapters

NOTE: 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. Banner includes the adapters with all fiber assemblies.
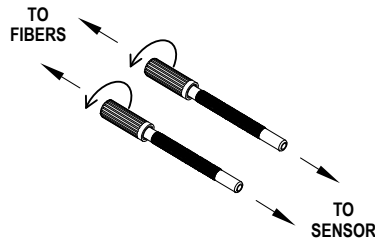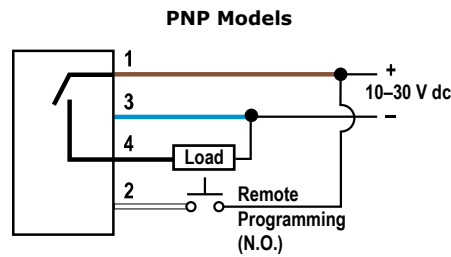
Fiber Outer Diameter (mm)	Adapter Color
Ø 1.0	Black
Ø 1.3	Red
Ø 2.2	No adapter needed

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

Wiring Diagrams

NPN Models
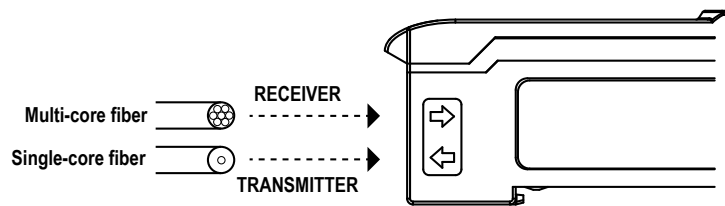
PNP Models
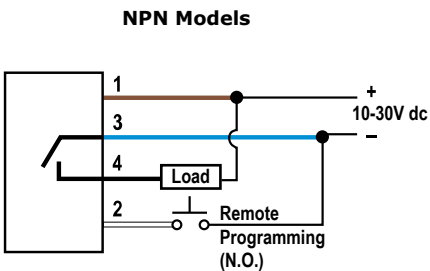
Key

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

IO-Link Models

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

Top Panel Interface

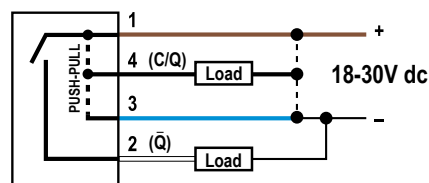Opening the dust cover provides access to the top panel interface. The top panel interface consists of the RUN/PRG/ADJ mode switch, LO/DO switch, +/SET/- rocker button, dual red/green digital displays, and output LED.

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/- rocker button. PRG mode allows the sensor to be programmed through the display-driven programming menu (see **Program Mode** below). ADJ mode allows the user to perform Expert TEACH/SET methods and Manual Adjust (see **Adjust Mode** below).

LO/DO Switch

The LO/DO switch selects 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.)
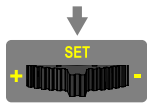
+/SET/- Rocker Button

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 7.

Red/Green Digital Displays

During RUN and ADJ modes, 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.

Operating Instructions

Remote Input/IO-Link

For more information about how to perform TEACH/SET methods, to program the sensor remotely, or to interface with the sensor via IO-Link, see the DF-G1 Manual (P/N 161999).

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 7.

Program Mode

Program (PRG) mode allows the following settings to be programmed in the DF-G1:

DF-G1 Expert™ Dual Display Fiber Amplifier

RUN PRG ADJ

PROGRAM MODE

Mode Switch to "PRG"

RUN PRG ADJ

SET

+ − rocker button

To scroll through menu lists: Press "+" or "-"
To enter a choice list or to select and save: Click SET
To exit a choice list without saving: Press and hold SET for 2 seconds

Menu List →

Press and hold SET to exit choice list without saving

tcH SEL	rESP SPd	OFSt Pct	Auto thr	OFF dLY	OFF 1Sho	On dLY	On 1Sho	diSP rEAd	GAin SEL	FctY dEF
Click SET to enter choice list	Click SET to enter choice list	Click SET to enter choice list	Click SET to enter choice list	Click SET to enter choice list	Click SET to enter choice list	Click SET to enter choice list	Click SET to enter choice list	Click SET to enter choice list	Click SET to enter choice list	Click SET to enter choice list
+ DISPLAY LOOP −	+ DISPLAY LOOP −	▼	+ DISPLAY LOOP −	▼	▼	▼	▼	+ DISPLAY LOOP −	+ DISPLAY LOOP −	+ DISPLAY LOOP −
2Pt tcH	200 uS	min OFSt	oFF	0 ms	0 ms	0 ms	0 ms	diSP 1234	Auto GAin	no
dYn tcH	500 uS	10 Pct	On	(+) or (-) to set value	(+) or (-) to set value	(+) or (-) to set value	(+) or (-) to set value	diSP 123P	Fixed Gain Set	yES
wind SEt	2000 uS	(+) or (-) to set value		9999 ms	9999 ms	9999 ms	9999 ms	Eco 1234	1234 Gn 1	
Lt SEt	5000 uS	999 Pct						Eco 123P	1234 Gn 2	
dr SEt								(display flips 180°)	⋮	
CAL SEt								diSP 1234	1234 Gn 8	
								diSP 123P		
								Eco 1234		
								Eco 123P		

Click SET to select and save a choice in any list

Return to Menu List

⌷ on display represents a "w"   ⌷ on display represents a "m"

Factory Default Settings:

Setting	Factory Default
Threshold	2026
TEACH Selection	Two-Point TEACH
Response Speed	Standard - 500 µs
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

Adjust Mode

`RUN PRG ADJ`

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).

TEACH Procedures

The instruction manual has detailed instructions for these TEACH modes:
- Two-Point TEACH
- Dynamic TEACH
- Window SET
- Light SET
- Dark SET
- Calibration SET

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.
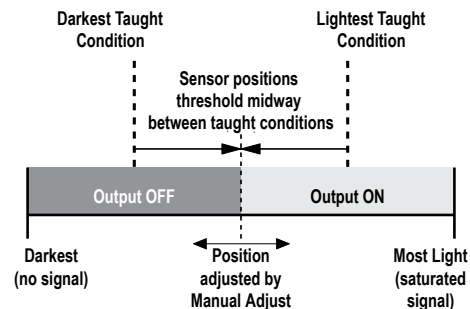

Figure 2. Two-Point TEACH (Light Operate shown)

The Output ON and OFF conditions can be reversed by using the LO/DO (Light Operate/ Dark Operate) switch.

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.
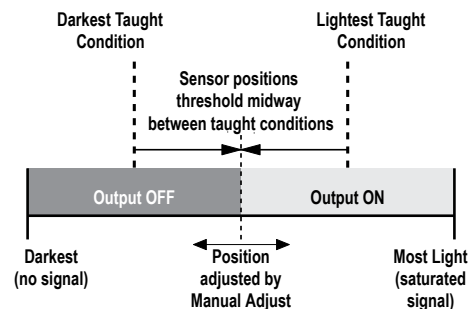

Figure 3. Dynamic TEACH (Light Operate shown)

The output ON and OFF conditions can be reversed using the LO/DO switch.

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 in the user's manual 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.
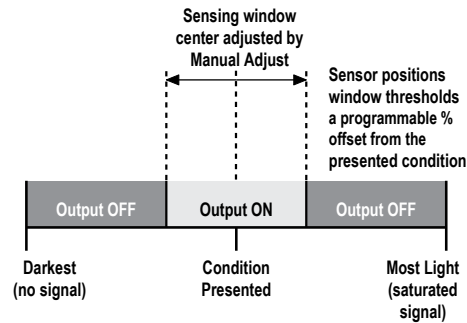

Figure 4. Window SET (Light Operate shown)

Output ON and OFF conditions can be reversed using the LO/DO switch.

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 5 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.
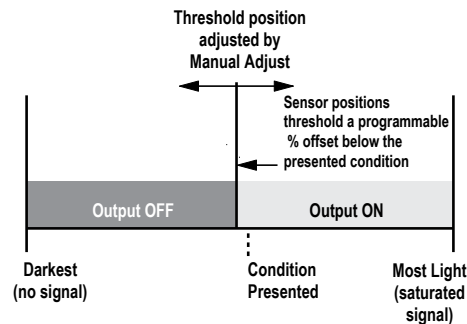

Figure 5. Light SET (Light Operate shown)

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 5 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 setting.

Figure 6. Dark SET (Light Operate shown)

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.
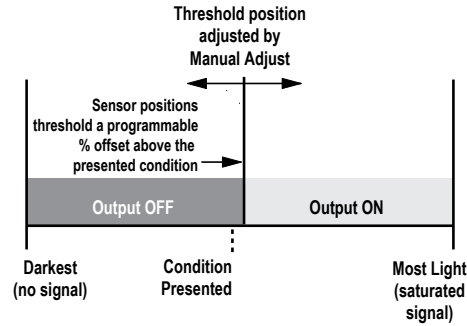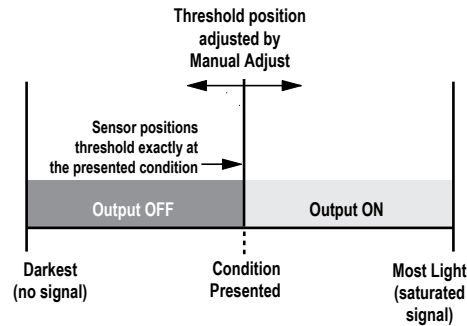

Figure 7. Calibration SET (Light Operate shown)

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

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 to 99%	FAIL	The difference of the taught conditions does not meet the required minimum
100 to 300%	PASS	The difference of the taught conditions just meets/exceeds the required minimum, minor sensing variables may affect sensing reliability

Value	PASS/FAIL	Description
300 to 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

Percent 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 `thr` `ALrt` and `1234` `1234`	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	`thr` `Err`	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 30 V dc Class 2 (10% maximum ripple)
IO-Link models: 18 to 30 V dc (10% maximum ripple)

Power and Current Consumption (exclusive of load)
Standard display mode: 960 mW, Current consumption < 40 mA at 24 V dc
ECO display mode: 720 mW, Current consumption < 30 mA at 24 V dc

Supply Protection Circuitry
Protected against reverse polarity and transient overvoltages

Delay at Power-Up
500 milliseconds maximum; 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)

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 *http://www.bannerengineering.com*.

Supply Wiring	Required Overcurrent Protection
20	5.0 Amps
22	3.0 Amps
24	2.0 Amps
26	1.0 Amps
28	0.8 Amps
30	0.5 Amps

Output Rating
100 mA maximum load (derate 1 mA per °C above 30 °C)
OFF-state leakage current: NPN/PNP models: < 5 μA at 30 V dc; **IO-Link models:** < 50 μA at 30 V dc
ON-state saturation voltage: NPN: < 1.5 V; **PNP /IO-Link:** < 2 V

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

Output Response Time
High Speed: 200 μs; Standard: 500 μs; Long Range: 2 ms; Extra Long Range: 5 ms

Repeatability
High Speed: 66 μs, Standard/Long Range/Extra Long Range: 100 μs

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

Connections
PVC-jacketed 2 m or 9 m (6.5 ft. or 30 ft.) 4-wire integral cable; or integral 4-pin M8/Pico-style quick disconnect; or 150 mm (6 in.) cable with a 4-pin M12/Euro-style quick disconnect; or 150 mm (6 in.) cable with a 4-pin M8/Pico-style quick disconnect.

Environmental Rating
IEC IP50, NEMA 1

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
IODD files: Provide all programming options of top panel interface, plus additional functionality, see the DF-G1 Manual (P/N 161999)

Certifications

CE   c(UL)us LISTED   Industrial Control Equipment 3TJJ   ● IO-Link®
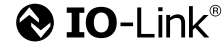
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