FIBER OPTIC SENSORS

Fiber Sensor Overview **page 224**

- Fiber Systems Explained
- When to Use Fiber Systems
- Selection information for sensors and fibers
- Choosing Plastic or Glass Fibers

D10 **page 226**

- Advanced amplifier for use with plastic fibers
- High-performance, low-contrast sensor with numeric or bargraph display
- Models with push-button programming or manual gain adjustment
- Bussable power models for simplified wiring

D12 **page 235**

- Glass and plastic fiber optic models
- Models for standard applications, high-speed response and increased power
- AC-coupled for high-sensitivity applications

R55F **page 240**

- Green, blue, white, red or infrared LED colors
- For mounting flat or to a 35 mm DIN rail
- Models for glass and plastic fiber optics

Plastic Fibers **page 243**

- Inexpensive and easily cut to length during installation
- Very bendable, for a precise fit
- Available coiled, for applications requiring articulated or reciprocating motion
- Diameters of 0.25, 0.5, 1.0 or 1.5 mm

Glass Fibers **page 260**

- For hostile environments: high temperatures, corrosive materials, extreme moisture and high levels of shock and vibration
- Inherent immunity to extreme electrical noise
- Quickly custom designed and built for your unique applications

SENSORS

The broadest selection of fiber sensors in the world.

Fiber Systems

Two-part fiber systems include the sensor and the separately purchased application-specific fiber.

1. Sensors

The sensor contains all the electronics, the amplifier and the mechanical interface to the fiber. Some models are sealed and rated IP67 to mount directly on a machine; others are designed to be DIN-rail mounted in a centralized control enclosure.

2. Fibers

Sensing fibers are non-electronic, light-transmitting, optical-quality glass or plastic strands encased in cladding that reflects light to the core. Fibers transmit and/or receive light from the LED of a sensor. Glass fibers are arranged in bundles, and plastic fibers are typically packaged as monofilaments with a protective jacket of polyethylene, PVC, stainless-steel braid or other material. Fiber sensing tips have a wide variety of shapes and configurations.

When to Use Fiber Systems

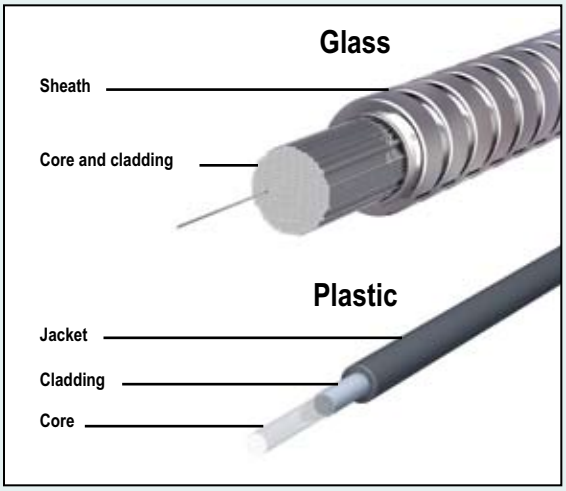
- **Confined areas.** The small size and flexibility of fibers allows precise positioning where space is limited.
- **High temperatures.** Fiber optic assemblies can tolerate elevated temperatures—in some cases as high as 480° C.
- **High vibration and shock.** The low mass of fibers enables them to withstand extreme vibration and mechanical shock.
- **Corrosive and wet environments.** Special-purpose fibers withstand corrosive materials, moisture and even repeated washdown.
- **Explosive environments.** Fibers are passive and can safely pipe light to and from hazardous areas.
- **Noisy environments.** Fibers are non-electronic mechanical components and are completely immune to electrical noise.
- **Unique target shapes and requirements.** Fiber optic sensing heads can be custom designed and optimally shaped to the physical and optical requirements of a specific application.

Typical Applications

- Punch presses
- Vibratory feeders
- Conveyors
- Web control
- Tablet counting
- Ovens
- Semiconductor processing equipment
- Liquid level

Sensor Model	Models for Plastic Fibers	Page Number	Models for Glass Fibers	Page Number
WORLD-BEAM® QS18		page 89		page 89
MINI-BEAM®		page 108		page 108
QM42		page 183		
Q45		page 191		page 191
OMNI-BEAM™		page 207		page 207
D10		page 226		
D12		page 235		page 235
R55F		page 240		page 240
FI22		page 357		
D11		page 357		
ECONO-BEAM®		page 357		page 357
MAXI-BEAM®		page 357		page 357
MULTI-BEAM®				page 357
PC44		See data sheet		
VALU-BEAM®		page 357		page 357

Fiber Construction



Core Thin glass or plastic center of the fiber through which light travels.

Cladding Outer optical material surrounding the core that reflects light back into the core.

Jacket/ Sheath Protective layer to protect fiber from damage and moisture.

Choosing Plastic or Glass

Plastic fibers are for general purpose use. They tolerate severe flexing, can be cut to length in the field and cost less than glass fibers. Glass fibers are the best choice for challenging environments such as high temperatures, corrosive materials and moisture.

Plastic fibers page 243

- Inexpensive and easily cut to length during installation
- Bend for a precise fit
- Available in high-flex models to withstand flexing
- Offered with special jackets that withstand corrosion, impact and abrasion
- Available in coiled versions for applications requiring articulated or reciprocating motion
- Available in diameters of 0.25, 0.5, 1.0 or 1.5 mm
- Can be quickly custom designed and built for your unique applications

Glass fibers page 260

- Solve numerous challenging sensing requirements
- Ideal for hostile environments such as high temperatures to 480° C, corrosive materials and extreme moisture
- Withstand high levels of shock and vibration
- Inherently immune to extreme electrical noise
- Available with choice of sheathings: standard stainless-steel flexible conduit, PVC or other flexible tubing
- Can be quickly custom designed

Specialty fibers for specific sensing applications.

DURA-BEND™ for extremely tight radius bends

Fluoropolymer encapsulated fibers

Focused beam fibers

Convergent beam fibers

Linear array fibers

Liquid level detection fibers

High temperature fibers

SteelSkin™ for impact and abrasion

SENSORS

D10 Series

Redefining High-Performance Fiber Optic Sensing

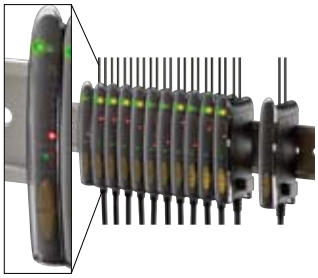
- Features advanced fiber optic amplifier for use with plastic fibers
- Available in bipolar, discrete and analog/discrete output models
- Available with a numeric or bargraph display on *Expert*™ models
- Delivers high-performance, low-contrast sensing with automatic TEACH options or manual adjustment
- Available with visible red or green beam
- Provides light-operate or dark-operate operation
- Includes specially designed models for reliable detection of objects as small as 1.5 mm
- Features bussable models for side-by-side mounting and simplified wiring of up to 16 sensors
- Features thin 10 mm housing for standard 35 mm DIN-rail mounting

ACCESSORIES page 233
PLASTIC FIBERS PAGE 243
PLASTIC FIBER

D10 *Expert*™ with Numeric Display

page 227

- Numeric display of signal strength and operating status
- Two output options: two discrete outputs in the same sensor; or discrete output and either a 4-20 mA current or a 0-10V dc voltage analog output in the same sensor
- Push buttons for easy-to-set static, dynamic light set, dark set and window set programming
- Manual fine tuning and remote configuration using TEACH wire
- Four mode power and speed selection with automatic crosstalk avoidance circuitry
- Response times as fast as 50 microseconds



D10 *Expert*™ with Bargraph Display

page 228

- Easy-to-read 8-segment light bar display indicator for TEACH and signal strength
- Bipolar discrete outputs: one current sourcing (PNP) and one current sinking (NPN)
- Push buttons for easy-to-set static, dynamic light set, dark set and window SET programming
- Manual fine tuning
- Bussable power models with improved temperature compensation for side-by-side mounting and simplified wiring of up to 16 sensors
- Selectable high-speed mode option for 200 microsecond response

D10—Discrete Output

page 228

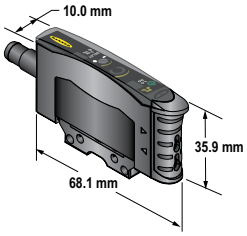
- 12-turn manual sensitivity adjustment
- Pulse rate LED indicator for signal strength
- Bipolar discrete outputs: one current sourcing (PNP) and one current sinking (NPN)
- Response time as fast as 200 microseconds

D10 *Expert*™ Small Object Counter

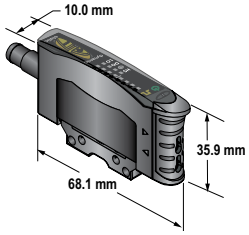
page 258

- Reliable low-contrast sensing for small object counting
- Easy-to-set selectable threshold with automatic compensation algorithm to compensate for dust or contamination on the fiber optic array and for ambient temperature changes
- Single discrete output plus Health mode output to indicate preventative maintenance is required
- A choice of three standard size fiber optic assemblies
- Custom size fibers for your application
- User-configurable Dynamic Event Stretcher (DES) to prevent double counting of objects
- Push buttons or remote wire for easy sensor configuration

ONLINE
AUTOCAD, STEP, IGES & PDF



D10—Discrete Models

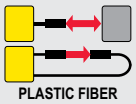
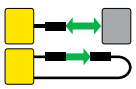


D10 *Expert*™ Models with Bargraph Display

D10 *Expert*™ Models with Numeric Display

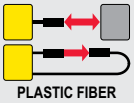
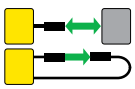
D10 *Expert*™ with Numeric Display—Dual Discrete, 12-24V dc

Visible Red LED Visible Green LED

Sensing Mode/LED	Range	Connection	Models Dual NPN	Models Dual PNP
 PLASTIC FIBER	Range varies by Power Level/Speed Selection used and with fiber optics used. See data sheet for range information.	2 m	D10DNFP	D10DPFP
		6-pin Snap-on Pico QD	D10DNFPQ	D10DPFPQ
 PLASTIC FIBER		2 m	D10DNFPG	D10DPFPG
		6-pin Snap-on Pico QD	D10DNFPGQ	D10DPFPGQ

D10 *Expert*™ with Numeric Display—Analog/Discrete, 12-24V dc

Visible Red LED Visible Green LED

Sensing Mode/LED	Range	Connection	Analog Output	Models NPN	Models PNP
 PLASTIC FIBER	Range varies by Power Level/Speed Selection used and with fiber optics used. See data sheet for range information.	2 m	4-20 mA	D10INFP	D10IPFP
		6-pin Snap-on Pico QD		D10INFPQ	D10IPFPQ
 PLASTIC FIBER		2 m	4-20 mA	D10INFPG	D10IPFPG
		6-pin Snap-on Pico QD		D10INFPGQ	D10IPFPGQ

Connection options: A model with a QD requires a mating cordset (see page 233).

For 9 m cable, add suffix **W/30** to the 2 m model number (example, **D10DNFP W/30**).

SENSORS

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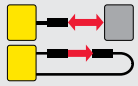
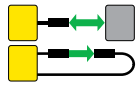
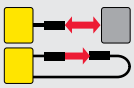
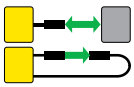
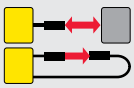
D10 *Expert*™ with Numeric Display—Analog/Discrete, 15-24V dc

Visible Red LED Visible Green LED

Sensing Mode/LED	Range	Connection	Analog Output	Models NPN	Models PNP
 PLASTIC FIBER	Range varies by Power Level/Speed Selection used and with fiber optics used. See fibers section on page 243 or reference data sheet for range information.	2 m	0-10V	D10UNFP	D10UPFP
		6-pin Snap-on Pico QD		D10UNFPQ	D10UPFPQ
 PLASTIC FIBER		2 m	0-10V	D10UNFPG	D10UPFPG
		6-pin Snap-on Pico QD		D10UNFPGQ	D10UPFPGQ

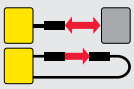
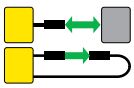
D10 *Expert*™ with Bargraph Display—Discrete

Visible Red LED Visible Green LED

Sensing Mode/LED	Range	Connection	Output Type	Supply Voltage	Description	Models	Excess Gain	Beam Pattern
 PLASTIC FIBER	Range varies by Power Level/Speed Selection used and with fiber optics used. See fibers section on page 243 or reference data sheet for range information.	2 m	Bipolar NPN/PNP	10 to 30V dc	Standard models	D10BFP	EGC-1 to EGC-4 (p. 233)	BP-1 to BP-4 (p. 234)
		6-pin Snap-on Pico QD				D10BFPQ		
 PLASTIC FIBER		2 m				D10BFPG	EGC-5 to EGC-8 (p. 233)	BP-5 to BP-8 (p. 234)
		6-pin Snap-on Pico QD				D10BFPGQ		
Bussable Power Models								
 PLASTIC FIBER	Range varies by Power Level/Speed Selection used and with fiber optics used. See fibers section on page 243 or reference data sheet for range information.	2 m	Bipolar NPN/PNP	12 to 30V dc	Main unit	D10B5FP	EGC-1 to EGC-4 (p. 233)	BP-1 to BP-4 (p. 234)
			PNP		Sub unit	D10B2PFP		
			NPN		Sub unit	D10B2NFP		

D10—Discrete, 10-30V dc

Visible Red LED Visible Green LED

Sensing Mode/LED	Range	Connection	Output Type	Response Time	Models
 PLASTIC FIBER	Range varies by Power Level/Speed Selection used and with fiber optics used. See fibers section on page 243 or reference data sheet for range information.	2 m	Bipolar NPN/PNP	500 microseconds	D10AFP
		4-pin Snap-on Pico QD			D10AFPQ
 PLASTIC FIBER		2 m			D10AFPG
		4-pin Snap-on Pico QD			D10AFPGQ

More on next page

Connection options: A model with a QD requires a mating cordset (see page 233).

For 9 m cable, add suffix **W/30** to the 2 m model number (example, **D10UNFP W/30**).

D10—Discrete, 10-30V dc (cont'd)

Visible Red LED Visible Green LED

Sensing Mode/LED	Range	Connection	Output Type	Response Time	Models
HIGH-SPEED PLASTIC FIBER	Range varies by Power Level/Speed Selection used and with fiber optics used. See fibers section on page 243 or reference data sheet range information.	2 m	Bipolar NPN/PNP	200 microseconds	D10AFPY
		4-pin Snap-on Pico QD			D10AFPYQ
HIGH-SPEED PLASTIC FIBER		2 m			D10AFPGY
		4-pin Snap-on Pico QD			D10AFPGYQ

D10 *Expert*™ Small Object Counter with Numeric Display—Discrete, 12-24V dc

Visible Red LED

Sensing Mode/LED	Connection	Output	Sensor Models
PLASTIC FIBER	2 m	NPN	D10DNCFP
	6-pin Snap-on Pico QD		D10DNCFPQ
	2 m	PNP	D10DPCFP
	6-pin Snap-on Pico QD		D10DPCFPQ

Fiber Optic Arrays

Detection Window Dimensions**	Fiber Exit	Minimum Object Detection†	Array Models*
10 x 25 mm	Side Exit	1.5 mm	PFCVA-10X25-S
	End Exit		PFCVA-10X25-E
25 x 25 mm	Side Exit	3 mm	PFCVA-25X25-S
	End Exit		PFCVA-25X25-E
34 x 25 mm	Side Exit	4 mm	PFCVA-34X25-S
	End Exit		PFCVA-34X25-E

Connection options: A model with a QD requires a mating cordset (see page 233).

For 9 m cable, add suffix **W/30** to the 2 m model number (example, **D10DNDFP W/30**).

* Custom fiber arrays and mounting configurations are possible. Consult factory for assistance with your small object counting application.
** Detailed dimension drawings for fibers are on page 258.
† With 2% Threshold Offset Percentage

D10 *Expert*™ with Numeric Display—Dual-Discrete Specifications

Required Fiber Optic Cable	Banner P-Series plastic fibers (See Plastic Fiber Optic section, page 243)
Supply Voltage and Current	12 to 24V dc (10% max. ripple) at less than 65 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltage.
Output Configuration	Two independently configured current sourcing (PNP) or current sinking (NPN) solid-state transistors, depending on model.
Output Rating	150 mA max. load **OFF-state leakage current:** less than 10 µA at 24V dc **ON-state saturation voltage: NPN:** less than 1.5V at 150 mA load **PNP:** less than 2.5V at 150 mA load
Output Protection Circuitry	Protected against false pulse on power-up and continuous short-circuit

More on next page

D10 *Expert*™ with Numeric Display—Dual-Discrete Specifications (cont'd)

Output Response Time	Programmable, 50 microseconds, 200 microseconds, 1 millisecond, 2.5 milliseconds
Delay at Power-up	Less than 1 second; outputs do not conduct during this time.
Adjustments	Two push buttons or remote programming of (TEACH) switching threshold response time, OFF-delay, light/dark operate, and display
Indicators	Four-digit digital display plus LED indicators for active channel, push-button lockout, OFF-delay and light/dark operate selection; two yellow LED output indicators.
Construction	Black ABS/polycarbonate alloy (UL94 V-0 rated) housing, clear polycarbonate cover.
Environmental Rating	IEC IP50; NEMA 1
Connections	PVC-jacketed 2 m or 9 m 6-wire integral cable, or integral 6-pin Pico-style quick-disconnect fitting. QD cordsets are ordered separately. See page 229.
Operating Conditions	**Temperature:** -20° to +55° C **Storage Temperature:** -20° to +80° C **Relative humidity:** 90% @ 50° C

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

Installation	35 mm DIN rail or included mounting bracket
Certifications	CE cULus
Hookup Diagrams	DC15 (p. 747)

D10 *Expert*™ with Numeric Display—Analog/Discrete Specifications

Required Fiber Optic Cable	Banner P-Series plastic fibers (See Plastic Fiber Optic section, page 243)
Supply Voltage and Current	**4-20 mA Analog Models:** 12-24V dc (10% max. ripple) at less than 65 mA exclusive of load **0-10V dc Analog Models:** 15-24V dc (10% max. ripple) at less than 70 mA exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltage.
Output Configuration	Two independently configurable outputs, depending on model: NPN w/analog (4-20 mA or 0-10V) or PNP w/analog (4-20 mA or 0-10V)
Output Rating	**Discrete Output:** 150 mA, max. load **OFF-state leakage current:** less than 10 µA at 24V dc **ON-state saturation voltage:** **NPN:** < 1.5V @ 150 mA **PNP:** < 2.5V @ 150 mA **Analog Output:** 4-20 mA or 0-10V dc **Load:** **4-20 mA Models:** 100Ω max. impedance **0-10V dc Models:** 1 MΩ min. impedance
Output Protection Circuitry	Protected against false pulse on power-up and continuous short-circuit
Output Response Time	**Discrete Output:** Programmable, 50 microseconds, 200 microseconds, 1 millisecond, 2.5 milliseconds **Analog Output:** 1 millisecond
Delay at Power-up	Less than 1 second; outputs do not conduct during this time.
Adjustments	Push-button or remote programming of (TEACH) switching threshold response time, OFF-delay, light/dark operate, and display
Indicators	Four-digit digital display plus LED indicators for active channel, push-button lockout, OFF-delay and light/dark operate selection; two yellow output indicators.
Construction	Black ABS/polycarbonate alloy (UL94 V-0 rated) housing, clear polycarbonate cover.
Environmental Rating	IEC IP50; NEMA 1
Connections	PVC-jacketed 2 m or 9 m 6-wire integral cable, or integral 6-pin Pico-style quick-disconnect. QD cordsets are ordered separately. See page 233.
Operating Conditions	**Temperature:** -20° to +55° C **Storage Temperature:** -20° to +80° C **Relative humidity:** 90% @ 50° C

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

Installation	35 mm DIN rail or included mounting bracket
Certifications	CE cULus
Hookup Diagrams	**NPN Models:** DC16 (p. 747) **PNP Models:** DC17 (p. 748)

D10 *Expert*™ with Bargraph Display—Discrete Specifications

	Standard Sensors	Models with Bussable Power
Required Fiber Optic Cable	Banner P-Series plastic fibers (See Plastic Fiber Optic section, page 243)	
Supply Voltage and Current	10 to 30V dc (10% max. ripple) at less than 45 mA, exclusive of load	12 to 30V dc (10% max. ripple) at less than 45 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity, over voltage and transient voltage.	
Delay at Power Up	200 milliseconds max.; outputs do not conduct during this time	850 milliseconds max.; outputs do not conduct during this time
Output Configuration	**Bipolar:** 1 current sourcing (PNP) and 1 current sinking (NPN)	**Main units:** Bipolar; 1 current sourcing (PNP) and 1 current sinking (NPN) **Sub-units:** 1 current sourcing (PNP) or 1 current sinking (NPN) output, depending on model
Output Rating	150 mA max. load @ 25° C (derate 1 mA per ° C increase) **OFF-state leakage current:** less than 5 µA at 30V dc **ON-state saturation voltage:** **NPN:** less than 200 mV at 10 mA and 1V at 150 mA load **PNP:** less than 1V at 10 mA and 1.5V at 150 mA load	100 mA max. load (derate 1 mA per ° C) **OFF-state leakage current:** less than 5 µA at 30V dc **ON-state saturation voltage: NPN:** less than 1.5V **PNP:** less than 2V **Less than 15V supply (9 m cable):** up to 4 units with 100 mA outputs up to 8 units with 50 mA outputs
Output Protection Circuitry	Protected against output short-circuit, continuous overload, transient over-voltages, and false pulse on power-up	
Output Response Time	500 microseconds (normal mode) or 200 microseconds (high-speed mode)	
Repeatability	100 microseconds (normal mode) or 66 microseconds (high-speed mode)	
Adjustments	Two push buttons and remote wire • *Expert* -style configuration (Static and Dynamic TEACH, light SET, dark SET and Windows SET) • Manually Adjust (+/–) sensitivity (from buttons only) • LO/DO, OFF-Delay, and response speed configurable (from buttons or remote wire) • Push-button lockout (from remote wire only) **Factory Default Settings:** Light Operate, Normal Speed, No Delay	
Indicators	**8-segment red bargraph*** **Green Status Indicators:** LO, DO, High Speed (HS) and OFF-Delay **Green LED:** Power ON **Yellow LED:** Output conducting *See data sheet for detailed information	
Construction	Black ABS/polycarbonate alloy (UL94 V-0 rated) housing, clear polycarbonate cover.	
Environmental Rating	IEC IP50, NEMA 1	
Connections	PVC-jacketed 2 m or 9 m 6-wire integral cable, or integral 6-pin Pico-style quick-disconnect. QD cordsets are ordered separately. See page 233.	**Main units:** PVC-jacketed 2 m or 9 m 5-wire integral cable **Sub-units:** PVC-jacketed 2 m or 9 m 2-wire integral cable
Operating Conditions	**Temperature:** -10° to +55° C **Storage Temperature:** -20° to +85° C **Relative humidity:** 90% @ 55° C	
Installation	35 mm DIN rail or included mounting bracket	
Certifications	CE c UL us	
Hookup Diagrams	**Standard Models and Main Unit:** DC08 (p. 745) **Sub-Units:** DC09 (p. 746)	

D10—Discrete Specifications

Required Fiber Optic Cable	Banner P-Series plastic fibers (See Plastic Fiber Optic section, page 243)
Supply Voltage & Current	10 to 30V dc (10% max. ripple) @ less than 25 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltage
Output Configuration	**Bipolar:** 1 current sourcing (PNP) and 1 current sinking (NPN)
Output Rating	100 mA per output with short circuit protection **OFF-state leakage current:** less than 10 µA sourcing; 200 µA sinking **ON-state saturation voltage:** **NPN:** 1.6V @ 100 mA **PNP:** 2.0V @ 100 mA
Output Protection Circuitry	Protected against output short-circuit and false pulse on power up
Delay at Power-up	Max. 100 milliseconds; outputs do not conduct during this time

More on next page

D10—Discrete Specifications (cont'd)

Output Response Time	**Standard models (with crosstalk avoidance circuitry):** 500 microseconds **High-speed models:** 200 microseconds
Repeatability	**Standard models:** 95 microseconds **High-speed models:** 50 microseconds
Adjustments	12-turn Sensitivity potentiometer with relative position indicator; LO/DO Selection switch; 0 or 40 milliseconds OFF-delay switch NOTE: Use proper ESD techniques while making adjustments under cover.
Indicators	**Two LEDs:** Green and Yellow **Green:** Power ON **Yellow:** Light Sensed Signal strength indicator See data sheet for detailed information
Construction	Black ABS/polycarbonate alloy (UL94 V-0 rated) housing, clear polycarbonate cover.
Environmental Rating	IEC IP50; NEMA 1
Connections	PVC-jacketed 2 m or 9 m attached cable, or 4-pin Pico-style quick-disconnect fitting. QD cordsets are ordered separately. See page 233.
Operating Conditions	**Temperature:** -10° to +55° C **Storage:** -20° to +85° C **Relative humidity:** 90% @ 55° C (non-condensing)
Certifications	CE c UL us
Hookup Diagrams	DC04 (p. 744)

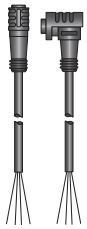
D10 *Expert*™ Small Object Counter—Numeric Display Specifications

Required Fiber Optics	PFCVA models (Custom fiber arrays and mounting configurations are possible. Consult factory for assistance with your small object counting application.)
Sensing Beam	Visible red, 680 nm
Supply Voltage and Current	12 to 24V dc (10% maximum ripple) at less than 65 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltage
Output Configuration	2 NPN or 2 PNP, depending on model
Output Rating	150 mA maximum load **OFF-state leakage current:** < 10 µA at 24V dc **ON-state saturation voltage: NPN** < 1.5V at 150 mA load **PNP** < 2.5V at 150 mA load
Output Protection Circuitry	Protected against false pulse on power-up and continuous short-circuit
Output Response Time	Programmable, 150 microseconds, 225 microseconds, 300 microseconds
Delay at Power-up	Less than 1 second; outputs do not conduct during this time.
Adjustments	Push-button or remote programming of threshold offset percentage, light/dark operate, Dynamic Event Stretcher (DES), display, and power/speed
Indicators	Four-digit digital display, 2 arrow icons, push-button lockout, Dynamic Event Stretcher, light/dark operate selection and 2 amber output LEDs
Construction	Black ABS/polycarbonate alloy (UL94 V-0 rated) housing, clear polycarbonate cover
Environmental Rating	NEMA 1; IEC IP50
Connections	PVC-jacketed 2 m or 9 m 6-wire integral cable or integral 6-pin Pico-style quick-disconnect. QD cordsets are ordered separately. See page 233.
Operating Conditions	**Temperature:** -20° to +55° C **Storage Temperature:** -20° to +80° C **Relative Humidity:** 90% @ 50° C (non-condensing)
Installation	35 mm DIN rail or included mounting bracket
Certifications	CE
Hookup Diagrams	DC18 (p. 748)

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

Cordsets

Pico QD				
See page 680				
	Snap-on 4-Pin		Snap-on 6-Pin	
Length	Straight	Right-Angle	Straight	Right-Angle
2.00 m	PKG4-2	PKW4Z-2	PKG6Z-2	PKW6Z-2
9.00 m	—	—	PKG6Z-9	PKW6Z-9



Additional cordset information available. See page 679.

Brackets

D10		
		
pg. 628	pg. 672	pg. 672
DIN-35...	SMBR55F01	SMBR55FRA

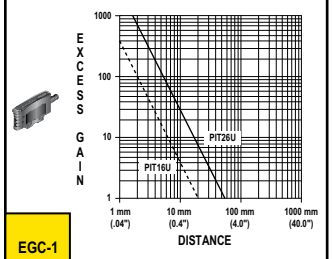
Additional bracket information available. See page 620.

Excess Gain Curves

(Diffuse-mode performance based on 90% reflectance white test card)

● = Visible Red LED ● = Visible Green LED

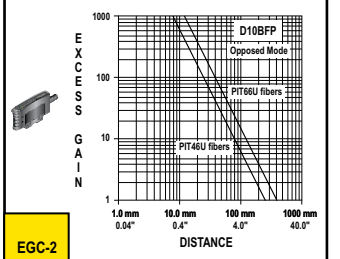
Opposed Mode D10 *Expert*™ with Bargraph



EGC-1

Range: Varies **LED:** ●

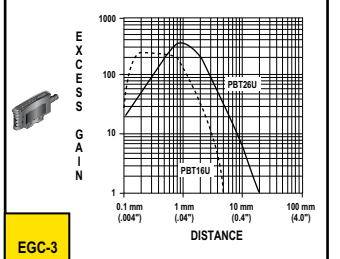
Opposed Mode D10 *Expert*™ with Bargraph



EGC-2

Range: Varies **LED:** ●

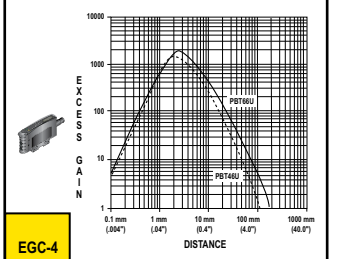
Diffuse Mode D10 *Expert*™ with Bargraph



EGC-3

Range: Varies **LED:** ●

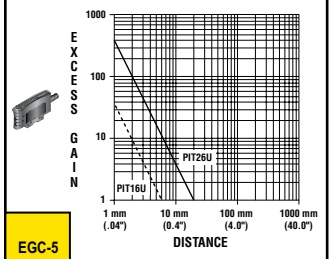
Diffuse Mode D10 *Expert*™ with Bargraph



EGC-4

Range: Varies **LED:** ●

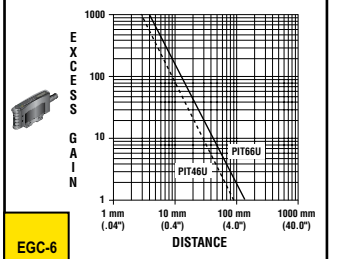
Opposed Mode D10 *Expert*™ with Bargraph



EGC-5

Range: Varies **LED:** ●

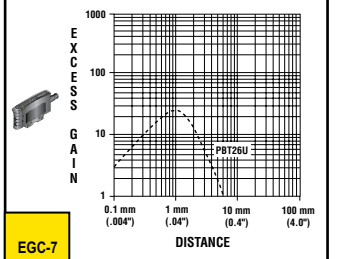
Opposed Mode D10 *Expert*™ with Bargraph



EGC-6

Range: Varies **LED:** ●

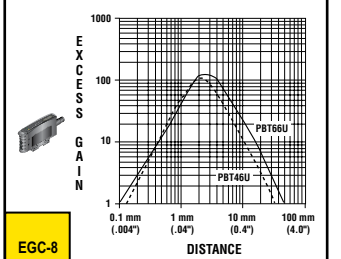
Diffuse Mode D10 *Expert*™ with Bargraph



EGC-7

Range: Varies **LED:** ●

Diffuse Mode D10 *Expert*™ with Bargraph



EGC-8

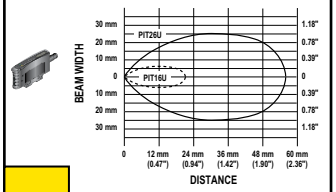
Range: Varies **LED:** ●

Beam Patterns

(Diffuse-mode performance based on 90% reflectance white test card)

● = Visible Red LED ● = Visible Green LED

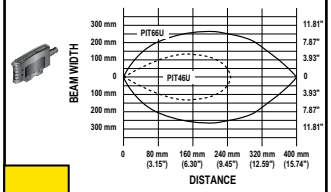
Opposed Mode D10 *Expert*™ with Bargraph



BP-1

Range: Varies **LED:** ●

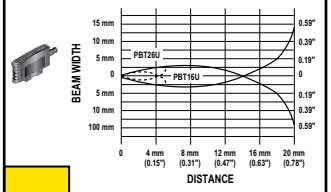
Opposed Mode D10 *Expert*™ with Bargraph



BP-2

Range: Varies **LED:** ●

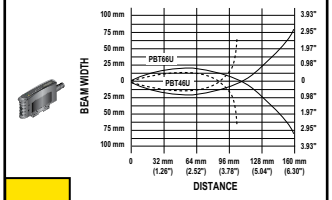
Diffuse Mode D10 *Expert*™ with Bargraph



BP-3

Range: Varies **LED:** ●

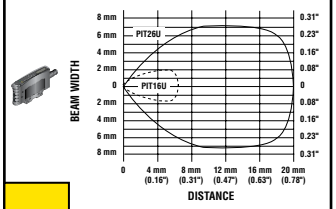
Diffuse Mode D10 *Expert*™ with Bargraph



BP-4

Range: Varies **LED:** ●

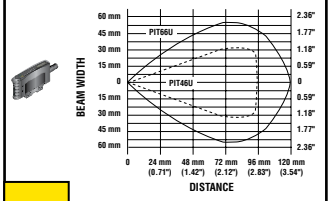
Opposed Mode D10 *Expert*™ with Bargraph



BP-5

Range: Varies **LED:** ●

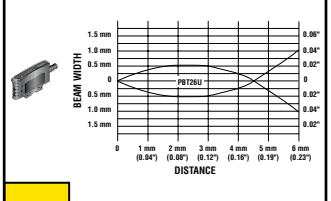
Opposed Mode D10 *Expert*™ with Bargraph



BP-6

Range: Varies **LED:** ●

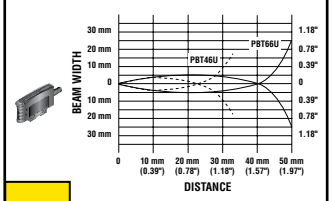
Diffuse Mode D10 *Expert*™ with Bargraph



BP-7

Range: Varies **LED:** ●

Diffuse Mode D10 *Expert*™ with Bargraph



BP-8

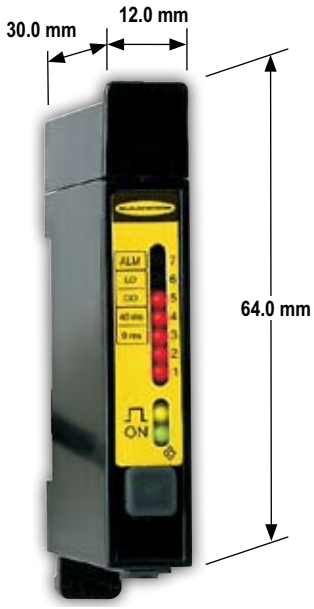
Range: Varies **LED:** ●

D12
Complete Family of Plastic and Glass Fiber Optic Sensors

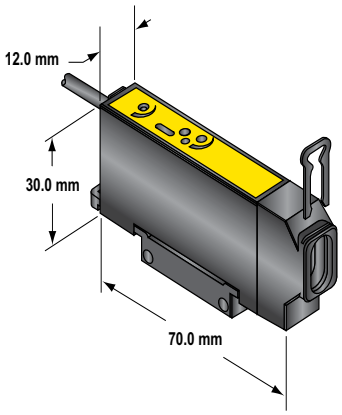
- Features LED bargraph that indicates signal strength, sensing contrast, programming status and diagnostic warnings, when not in high-speed mode
- Available in glass and plastic fiber optic models
- Includes marginal gain indicator with alarm output
- Solves routine applications with economical standard models
- Features high-speed sensing response and higher sensing power in some models
- Excels in low-contrast applications with ac-coupled models
- Features easy push-button TEACH-mode setup on D12E *Expert*™ models
- Easily mounts to standard 35 mm DIN-rail mounting

ACCESSORIES page 239

PLASTIC FIBERS PAGE 243
GLASS FIBERS PAGE 260
PLASTIC FIBER
GLASS FIBER



Plastic Fiber Models
Suffix FP and FPY



Glass Fiber Models
Suffix FV and FVY

ONLINE
AUTOCAD, STEP, IGES & PDF

Visible Red LED

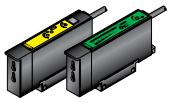
D12 *Expert*™, 10-30V dc

Sensing Mode/LED	Maximum Range	Switching Threshold Setting	Connection	Models NPN	Models PNP
GLASS FIBER	Range varies by sensing mode and fiber optics used. See data sheet for maximum range specifications.	Just above the "dark" condition	2 m	D12EN6FV	D12EP6FV
		Midway between "dark" and "light" conditions		D12E2N6FV	D12E2P6FV
PLASTIC FIBER		Just above the "dark" condition		D12EN6FP	D12EP6FP
		Midway between "dark" and "light" conditions		D12E2N6FP	D12E2P6FP

Connection options: A model with a QD requires a mating cordset (see page 239).

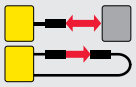
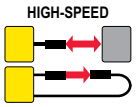
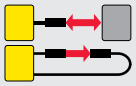
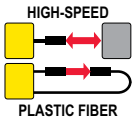
For 9 m cable, add suffix **W/30** to the 2 m model number (example, **D12EN6FV W/30**).

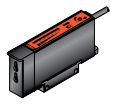
ACCESSORIES page 239



Visible Red LED

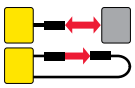
D12 and D12 High-Speed, 10-30V dc

Sensing Mode/LED	Range	Connection	Output Response	Models NPN	Models PNP	Excess Gain
 GLASS FIBER	Range varies by sensing mode and fiber optics used	2 m	500 µs	D12SN6FV	D12SP6FV	EGC-1 & EGC-2 (p. 239)
		4-Pin Pico Pigtail QD		D12SN6FVQ	D12SP6FVQ	
 HIGH-SPEED GLASS FIBER		2 m	Selectable 50 µs or 500 µs*	D12SN6FVY	D12SP6FVY	EGC-3 & EGC-4 (p. 239)
		4-Pin Pico Pigtail QD		D12SN6FVYQ	D12SP6FVYQ	
		2 m		D12SN6FVY1†	D12SP6FVY1†	
		4-Pin Pico Pigtail QD		D12SN6FVY1Q†	D12SP6FVY1Q†	
 PLASTIC FIBER	Range varies by sensing mode and fiber optics used	2 m	500 µs	D12SN6FP	D12SP6FP	EGC- 5 & EGC-6 (p. 239)
		4-Pin Pico Pigtail QD		D12SN6FPQ	D12SP6FPQ	
 HIGH-SPEED PLASTIC FIBER		2 m	Selectable 50 µs or 500 µs*	D12SN6FPY	D12SP6FPY	EGC-7 & EGC-8 (p. 239)
		4-Pin Pico Pigtail QD		D12SN6FPYQ	D12SP6FPYQ	
		2 m		D12SN6FPY1†	D12SP6FPY1†	
		4-Pin Pico Pigtail QD		D12SN6FPY1Q†	D12SP6FPY1Q†	



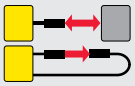
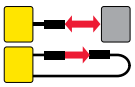
Visible Red LED

D12 High-Power, 10-30V dc

Sensing Mode/LED	Range	Connection	Output Response	Models NPN	Models PNP	Excess Gain
 PLASTIC FIBER	Range varies by sensing mode and fiber optics used	2 m	500 µs	D12SN6FPH	D12SP6FPH	EGC- 9 & EGC-10 (p. 239)
		4-Pin Pico Pigtail QD		D12SN6FPHQ	D12SP6FPHQ	

Visible Red LED

D12 AC-Coupled, 10-30V dc

Sensing Mode/LED	Range	Connection	Output Type	Output Response	Models
 GLASS FIBER	Range varies by Power Level/Speed Selection used and with fiber optics used. See data sheet for range information.	2 m	Bipolar NPN/PNP	50 µs	D12DAB6FV
		4-Pin Pico Pigtail QD			D12DAB6FVQ
 PLASTIC FIBER		2 m			D12DAB6FP
		4-Pin Pico Pigtail QD			D12DAB6FPQ

Connection options: A model with a QD requires a mating cordset (see page 239).

For 9 m cable, add suffix **W/30** to the 2 m model number (example, **D12SN6FV W/30**).

† Y1 models have 20 milliseconds output pulse stretcher.

* When 50 microseconds is selected, bargraph is disabled.

D12 *Expert*™ Specifications

Supply Voltage and Current	10 to 30V dc at 45 mA max. (exclusive of load); 10% max. ripple
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	NPN open collector (both outputs) or PNP open collector (both outputs), depending on model **Load output:** Normally open and programmable Light or Dark-Operate; **Alarm output:** Normally open
Output Rating	150 mA max. each output **OFF-state leakage current:** less than 10 µA at 30V dc **ON-state saturation voltage:** less than 1 volt at 10 mA dc; less than 1.5 volts at 150 mA dc The total load may not exceed 150 mA
Output Protection Circuitry	Protected against false pulse on power-up and short circuit of outputs (trips at 175 mA)
Output Response Time	200 microseconds ON/OFF (40 milliseconds OFF when OFF-delay selected) NOTE: False pulse protection circuit causes a 0.1 second delay on power-up
Output Operation Mode	Light operate or dark operate: selected by push button
Output Timing Functions	ON/OFF (no delay) or fixed 40 millisecond OFF-delay; selected by push button
Repeatability	66 microseconds
Adjustments	Push-button TEACH-mode sensitivity setting; Remote teaching input is provided
Indicators	**Green:** power ON and flashes when ready for TEACH mode **Yellow:** output conducting **7-segment moving dot red LED** See data sheet for detailed information
Mounting Bracket	D12 Sensors mount directly to a standard DIN rail, or may be through-hole mounted using the supplied mounting bracket and M3 x 0.5 hardware
Construction	Black ABS housing with acrylic cover, stainless steel M3 x 0.5 hardware for use with thermoplastic polyester mounting bracket (supplied); the plastic fiber clamping element is acetal
Environmental Rating	IEC IP11; NEMA 2
Connections	PVC-jacketed 2 m or 9 m cables, or 150 mm pigtail with 4-pin Pico-style quick-disconnect (QD) are available. QD cordsets are ordered separately. See page 239.
Operating Conditions	**Temperature:** -20° to +70° C **Relative humidity:** 90% at 50° C (non-condensing)
Certifications (except D10E2)	CE c UL us
Hookup Diagrams	DC19 (p. 748)

D12 Standard, High-Speed and High-Power Specifications

Supply Voltage and Current	10 to 30V dc at 45 mA max. (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Outputs are NPN (sinking) or PNP (sourcing), depending on model **Complementary:** one normally open (NO) and the other normally closed (NC); NC output may be wired as diagnostic alarm output by reversing power supply connections except high speed "Y" and "Y1" suffix models (see hookups)
Output Rating	150 mA max. each output **OFF-state leakage current:** less than 10 µA at 30V dc **ON-state saturation voltage:** less than 1 volt at 10 mA dc; less than 1.5 volts at 150 mA dc The total load may not exceed 150 mA
Output Protection Circuitry	Protected against false pulse on power-up and short circuit of outputs
Output Response Time	**Standard and High-Power Models:** 500 microseconds ON/OFF **High-Speed Models:** selectable 50 or 500 microseconds ON/OFF NOTE: False pulse protection circuit causes a 0.1 second delay on power-up
Output Timing Functions	"Y1" models have fixed 20 milliseconds pulse stretcher (OFF-delay) when 50 microseconds mode is used
Repeatability	130 microseconds; "Y" and "Y1" models have selectable 50 microseconds/500 microseconds response; repeatability in 50 microseconds mode is 15 microseconds
Adjustments	15-turn adjustment sensitivity; "Y" and "Y1" (high speed models) also have a response mode selector switch

More on next page

D12 Standard, High-Speed and High-Power Specifications (cont'd)

Indicators	**Two top-mounted LED indicators**: one yellow and one green, and one 7-segment red LED moving dot bargraph; Note that the 7-segment bargraph and marginal excess gain indication (bargraph segment #7) are inoperative in the 50 µs response mode of "Y" and "Y1" models **Green:** LED lights for DC Power ON **Yellow:** LED lights for normally open output conducting On all models in 500 microseconds response mode, the 7-segment moving dot red LED bargraph lights to indicate relative received light signal strength; On all models in 50 and 500 microseconds response mode, segment #1 flashes to indicate OUTPUT OVERLOAD; On all models in the 500 microseconds response mode, segment #7 flashes to indicate MARGINAL EXCESS GAIN; On standard and high power models, a flashing LED corresponds to the "ON" state of the alarm output; (Alarm output not available on Y & Y1 models)
Mounting Bracket	D12 Sensors mount directly to a standard DIN rail, or may be through-hole mounted using the supplied mounting bracket and M3 x 0.5 hardware
Construction	Black ABS housing with acrylic cover, stainless steel M3 x 0.5 hardware for use with thermoplastic polyester mounting bracket (supplied); the plastic fiber clamping element is acetal
Environmental Rating	IEC IP11; NEMA 2
Connections	PVC-jacketed 2 m or 9 m cables, or 150 mm pigtail with 4-pin Pico-style quick-disconnect (QD) are available. QD cordsets are ordered separately. See page 239.
Operating Conditions	**Temperature:** -20° to +70° C **Relative humidity:** 90% at 50° C (non-condensing)
Certifications	
Hookup Diagrams	**NPN Models:** DC05 (p. 745) **PNP Models:** DC06 (p. 745)

D12 AC-Coupled Specifications

Supply Voltage and Current	10 to 30V dc at 60 mA max. (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	**Bipolar:** one NPN (current sinking) and one PNP (current sourcing) open-collector transistor
Output Rating	150 mA max. each output **OFF-state leakage current:** less than 10 µA at 30V dc **ON-state saturation voltage:** less than 1 volt at 10 mA dc; less than 1.5 volts at 150 mA dc The total load may not exceed 150 mA
Output Protection Circuitry	Protected against false pulse on power-up and short circuit of outputs
Output Response Time	50 microseconds ON/OFF NOTE: False pulse protection circuit causes a 0.1 second delay on power-up
Output Operation Mode	Light operate or dark operate: selected by switch
Output Timing Functions	Pulse output; adjustable from 1 to 70 milliseconds
Repeatability	15 microseconds ON
Adjustments	Three top-panel controls: SENSITIVITY control (15-turn slotted brass screw, clutched at both ends of adjustment), a light- or dark-operate select switch, and an OUTPUT PULSE adjustment (3/4-turn potentiometer)
Indicators	**Three top-mounted LED indicators:** **Green LED:** Lights to indicate dc Power ON **Yellow LED:** Lights for Output Conducting **Red LED:** Lights whenever AGC system is locked onto the signal
Mounting Bracket	D12 Sensors mount directly to a standard DIN rail, or may be through-hole mounted using the supplied mounting bracket and M3 x 0.5 hardware
Construction	Black ABS housing with acrylic cover, stainless steel M3 x 0.5 hardware for use with thermoplastic polyester mounting bracket (supplied); the plastic fiber clamping element is acetal
Environmental Rating	IEC IP11; NEMA 2
Connections	PVC-jacketed 2 m or 9 m cables, or 150 mm pigtail with 4-pin Pico-style quick-disconnect (QD) are available. QD cordsets are ordered separately. See page 239.
Operating Conditions	**Temperature:** -40° to +70° C **Relative humidity:** 90% at 50° C (non-condensing)
Application Note	D12 AC-coupled sensors should not be used in areas of known electrical "noise" or RF fields.
Certifications	
Hookup Diagrams	DC04 (p. 744)

Cordsets

Pico QD		
See page 680		
	Snap-on 4-Pin	
Length	Straight	Right-Angle
2.00 m	PKG4-2	PKW4Z-2

Additional cordset information available. See page 679.

Brackets

D12		
		
pg. 628	pg. 672	pg. 672
DIN-35...	SMBR55F01	SMBR55FRA

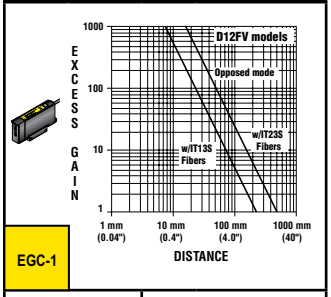
Additional bracket information available. See page 620.

Excess Gain Curves

(Diffuse-mode performance based on 90% reflectance white test card)

● = Visible Red LED

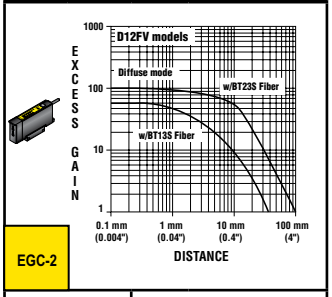
Opposed Mode—Glass Fiber D12 Standard



EGC-1

Range: Varies **LED:** ●

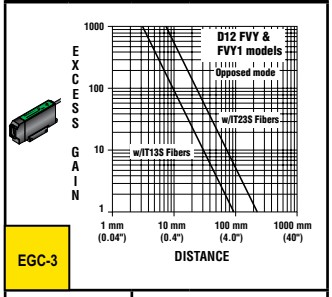
Diffuse Mode—Glass Fiber D12 Standard



EGC-2

Range: Varies **LED:** ●

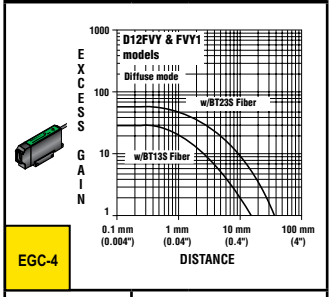
Opposed Mode—Glass Fiber D12 High Speed



EGC-3

Range: Varies **LED:** ●

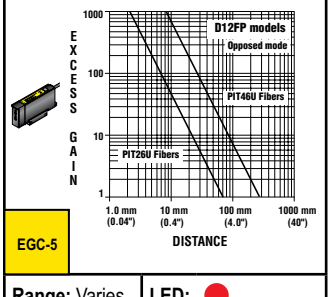
Diffuse Mode—Glass Fiber D12 High Speed



EGC-4

Range: Varies **LED:** ●

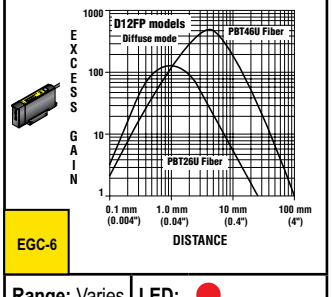
Opposed Mode—Plastic Fiber D12 Standard



EGC-5

Range: Varies **LED:** ●

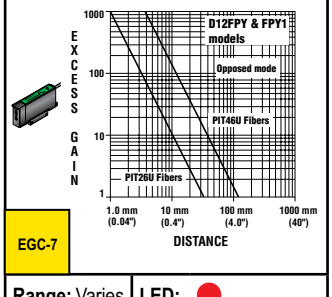
Diffuse Mode—Plastic Fiber D12 Standard



EGC-6

Range: Varies **LED:** ●

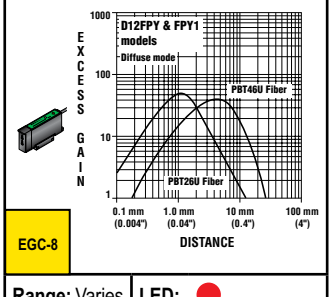
Opposed Mode—Plastic Fiber D12 High Speed



EGC-7

Range: Varies **LED:** ●

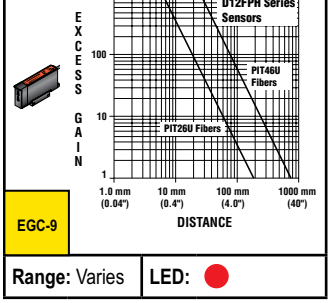
Diffuse Mode—Plastic Fiber D12 High Speed



EGC-8

Range: Varies **LED:** ●

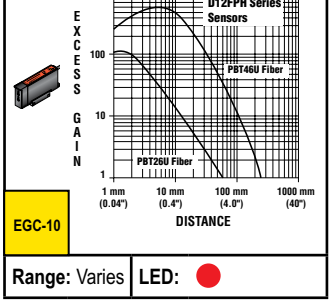
Opposed Mode—Plastic Fiber D12 High Power



EGC-9

Range: Varies **LED:** ●

Diffuse Mode—Plastic Fiber D12 High Power



EGC-10

Range: Varies **LED:** ●

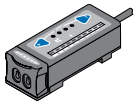
SENSORS

R55F
Glass or Plastic Fiber Optic Sensors

- Delivers outstanding color contrast sensitivity
- Features innovative TEACH function with two options for setting the sensing threshold
- Reliably detects 16 levels of grayscale at up to 10,000 actuations per second
- Available in two fiber types: economical plastic for repeated flexing and glass for harsh conditions
- Easily mounts in confined areas, either flat or to 35 mm DIN rail
- Provides bipolar (NPN/PNP) outputs with delay settings of 0, 20 and 40 milliseconds
- Clearly displays relative received signal strength with 10-element indicator bargraph

ACCESSORIES page 242
PLASTIC FIBERS PAGE 243
GLASS FIBERS PAGE 260
PLASTIC FIBER
GLASS FIBER

ONLINE
AUTOCAD, STEP, IGES & PDF



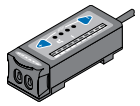
R55F Fiber Optic, 10-30V dc

Infrared LED Visible Red LED

Sensing Mode/LED	Range	Connection	Output Type	Models
GLASS FIBER	Range varies by sensing mode and fiber optics used.	2 m	Bipolar NPN/PNP	R55F
		5-pin Euro QD		R55FQ
GLASS FIBER		2 m		R55FV
		5-pin Euro QD		R55FVQ

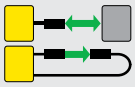
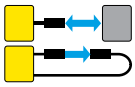
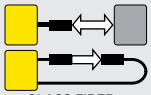
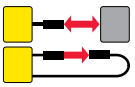
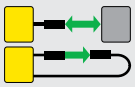
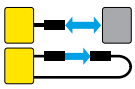
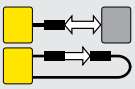
Connection options: A model with a QD requires a mating cordset (see page 242).

For 9 m cable, add suffix **W/30** to the 2 m model number (example, **R55F W/30**).



R55F Fiber Optic, 10-30V dc

Visible Green LED | Visible Blue LED | Visible White LED | Visible Red LED

Sensing Mode/LED	Range	Connection	Output Type	Models
 GLASS FIBER	Range varies by sensing mode and fiber optics used.	2 m	Bipolar NPN/PNP	R55FVG
		5-pin Euro QD		R55FVGQ
 GLASS FIBER		2 m		R55FVB
		5-pin Euro QD		R55FVBQ
 GLASS FIBER		2 m		R55FVW
		5-pin Euro QD		R55FVWQ
 PLASTIC FIBER		2 m		R55FP
		5-pin Euro QD		R55FPQ
 PLASTIC FIBER		2 m		R55FPG
		5-pin Euro QD		R55FPGQ
 PLASTIC FIBER		2 m		R55FPB
		5-pin Euro QD		R55FPBQ
 PLASTIC FIBER		2 m		R55FPW
		5-pin Euro QD		R55FPWQ

Connection options: A model with a QD requires a mating cordset (see page 242).

For 9 m cable, add suffix **W/30** to the 2 m model number (example, **R55F W/30**).

R55F Fiber Optic Specifications

Supply Voltage and Current	10 to 30V dc (10% max. ripple) at less than 70 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	**Bipolar:** One current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Rating	150 mA max each output @ 25° C (derate ≈ 1 mA per ° C increase) **OFF-state leakage current:** less than 5 µA @ 30V dc **ON-state saturation voltage: PNP:** less than 1V @ 10 mA; 1.5V @ 150 mA **NPN:** less than 200 mV @ 10 mA; 1V @ 150 mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short-circuit of outputs
Output Response Time	50 microseconds
Delay at Power-up	100 milliseconds; outputs do not conduct during this time.

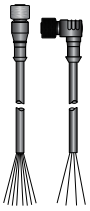
More on next page

R55F Fiber Optic Specifications

Adjustments	**Using push buttons ("+" Dynamic and "-" Static):** Manually adjust Switch Point using "+" or "-" buttons Dynamic TEACH (teach on-the-fly) sensitivity adjustment Static TEACH sensitivity adjustment Static Single-Point TEACH Light operate/Dark operate OFF-Delay select: 0 milliseconds, 20 milliseconds or 40 milliseconds **Using Remote TEACH input (gray wire):** Dynamic TEACH (teach on-the-fly) sensitivity adjustment Static TEACH sensitivity adjustment Static Single-Point TEACH Light operate/Dark operate OFF-Delay select: 0 milliseconds, 20 milliseconds or 40 milliseconds Push button lockout for security
Indicators	**10-segment light bar indicates signal strength** Light Operate: Green Dark Operate: Green Outputs Conducting: Yellow OFF-Delay (Green): **SETUP Mode:** OFF–no delay Flashing–20 milliseconds delay ON–40 milliseconds delay **RUN Mode:** OFF–no delay ON–20 or 40 milliseconds delay
Construction	Black ABS/polycarbonate blend; nylon fiber clip mounts to standard 35 mm DIN rail. 1 stainless steel right angle bracket and 1 PBT polyester bracket for mounting to flat surfaces also included with sensor.
Environmental Rating	IEC IP67; NEMA 6
Connections	2 m or 9 m PVC-jacketed 5-conductor cable, or 5-pin Euro-style quick-disconnect (QD) fitting. QD cordsets are ordered separately. See page 242. **Fibers:** Fiber clip (no tool required)
Operating Conditions	**Temperature:** -10° to +55° C **Relative humidity:** 90% at 50° C (non-condensing)
Application Notes	• Do not mount the fiber tip directly perpendicular to shiny surfaces; position it at approximately a 15° angle in relation to the sensing target. • Minimize web or product "flutter" whenever possible to maximize sensing reliability.
Certifications	CE
Hookup Diagrams	DC08 (p. 745)

Cordsets

Euro QD		
See page 685		
	Threaded 5-Pin	
Length	Straight	Right-Angle
1.83 m	MQDC1-506	MQDC1-506RA
4.57 m	MQDC1-515	MQDC1-515RA
9.14 m	MQDC1-530	MQDC1-530RA



Additional cordset information available. See page 679.

Brackets

R55F		
		
pg. 628	pg. 672	pg. 672
DIN-35...	SMBR55F01	SMBR55FRA

Additional bracket information available. See page 620