BANNER®
the photoelectric specialist

R55F Series Fiber-Optic Color Mark Sensors

For Plastic and Glass Fiber Optics



R55F Series Sensor Features

- Outstanding color contrast sensitivity; detects 16 levels of gray scale.
- Depending on beam color, reliably detects the toughest color mark contrasts, including 20% yellow against white.
- Fast, 50-microsecond response.
- Choose from infrared or one of four visible beam colors: red, blue, green and white.
- Fibers mount in small and otherwise inaccessible areas.
- Easy push-button programming options include Static TEACH, Static Single-Point TEACH, Dynamic TEACH and Remote TEACH; plus manual sensitivity adjustment.
- Non-volatile memory.
- Glass fiber models function well in harsh environments typically associated with printing processes.
- Plastic fiber models function well in applications that require repeated flexing of the fibers.
- Fibers install quickly without tools.
- Bipolar (NPN/PNP) outputs with three Delay settings (0, 20 or 40 milliseconds).
- Choice of integral cable or QD connector models.
- Mounts flat or to 35 mm DIN rail; two brackets included with sensor (one for angle mount, one for flat mount).

R55F Series Sensor Overview

The R55F Fiber-Optic Sensor was developed to provide simplicity of operation and access to tight areas for color mark (registration) sensing applications. The R55F is a technological advancement from earlier R55 models.

R55F sensors feature TEACH mode sensitivity adjustment, by presenting the light and the dark sensing conditions to the sensor. In addition, sensitivity may be fine-tuned at any time by simply clicking the “+” or “-” buttons on the sensor. The ten-element signal strength light bar clearly displays the relative received signal strength.

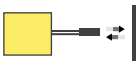
The bipolar (one NPN and one PNP) outputs may be programmed to include a 20 or 40-millisecond pulse stretcher (OFF Delay), if required. Both TEACH mode sensitivity adjustment and output SETUP are accomplished using the push-buttons on the sensor, or by supplying input pulses via the Remote Teach input.

TEACH mode has two options: Static TEACH and Dynamic TEACH. Static TEACH is used to manually set the two sensing conditions individually or to program a specific condition to be sensed (single-point TEACH). Dynamic TEACH provides a means for teaching a series of conditions on-the-fly; the R55F “averages” the sensing events and automatically sets (and periodically updates via the adaptive threshold feature) the switch point between light and dark conditions.

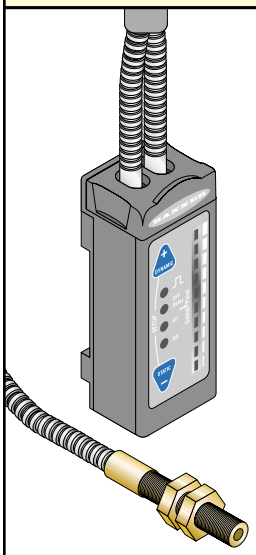
R55F Series Fiber-Optic Color Mark Sensors

Advantages of glass fiber optics for color mark sensing:
- *Randomly mixed bifurcated fiber bundles produce the best optics for color mark sensing.*
- *Bundle of small fibers may be shaped at sensing end tip to match the color mark shape.*
- *Best chemical resistance.*

Visible Red, 650 nm
Visible Green, 525 nm
Visible Blue, 475 nm
Visible White, 450-650 nm
Infrared, 880 nm



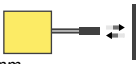
R55F Series Glass Fiber-Optic Sensor Models



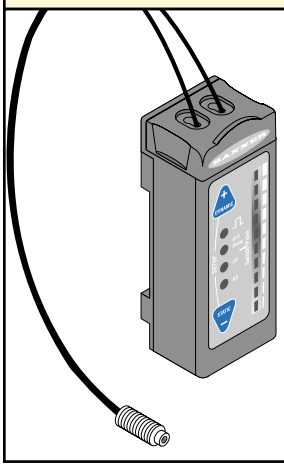
Model Number	Maximum Sensing Distance For black-to-white contrast	Cable*	Supply Voltage	Output Type
Visible Red, 650 nm			10 to 30V dc	Bipolar NPN/PNP
R55FV	**0.060" dia. Bundle:** 28 mm (1.1")	5-wire 2 m (6.5') cable		
R55FVQ	**0.125" dia. Bundle:** 110 mm (4.3")	5-pin Euro-style QD		
Visible Green, 525 nm				
R55FVG	**0.060" dia. Bundle:** 12 mm (0.5")	5-wire 2 m (6.5') cable		
R55FVGQ	**0.125" dia. Bundle:** 50 mm (2.0")	5-pin Euro-style QD		
Visible Blue, 475 nm				
R55FVB	**0.060" dia. Bundle:** 12 mm (0.5")	5-wire 2 m (6.5') cable		
R55FVBQ	**0.125" dia. Bundle:** 50 mm (2.0")	5-pin Euro-style QD		
Visible White, 450 - 650 nm				
R55FVW	**0.060" dia. Bundle:** 12 mm (0.5")	5-wire 2 m (6.5') cable		
R55FVWQ	**0.125" dia. Bundle:** 50 mm (2.0")	5-pin Euro-style QD		
Infrared, 880 nm				
R55F	**0.060" dia. Bundle:** 40 mm (1.6")	5-wire 2 m (6.5') cable		
R55FQ	**0.125" dia. Bundle:** 140 mm (5.5")	5-pin Euro-style QD		

Advantages of plastic fiber optics for color mark sensing:
- *Plastic fibers may be repeatedly flexed.*
- *Low cost.*
- *Most models may be cut to fit in the field.*

Visible Red, 650 nm
Visible Green, 525 nm
Visible Blue, 475 nm
Visible White, 450-650 nm



R55F Series Plastic Fiber-Optic Sensor Models



Model Number	Maximum Sensing Distance For black-to-white contrast	Cable*	Supply Voltage	Output Type
Visible Red, 650 nm			10 to 30V dc	Bipolar NPN/PNP
R55FP	**0.040" dia. Fibers:** 60 mm (2.4")	5-wire 2 m (6.5') cable		
R55FPQ		5-pin Euro-style QD		
Visible Green, 525 nm				
R55FPG	**0.040" dia. Fibers:** 28 mm (1.1")	5-wire 2 m (6.5') cable		
R55FPGQ		5-pin Euro-style QD		
Visible Blue, 475 nm				
R55FPB	**0.040" dia. Fibers:** 28 mm (1.1")	5-wire 2 m (6.5') cable		
R55FPBQ		5-pin Euro-style QD		
Visible White, 450 - 650 nm				
R55FPW	**0.040" dia. Fibers:** 28 mm (1.1")	5-wire 2 m (6.5') cable		
R55FPWQ		5-pin Euro-style QD		

* 9m (30') cables are available by adding suffix "**W/30**" to the model number of any cabled sensor (e.g., **R55FV W/30**). A model with a QD connector requires a mating cable (see page 11).

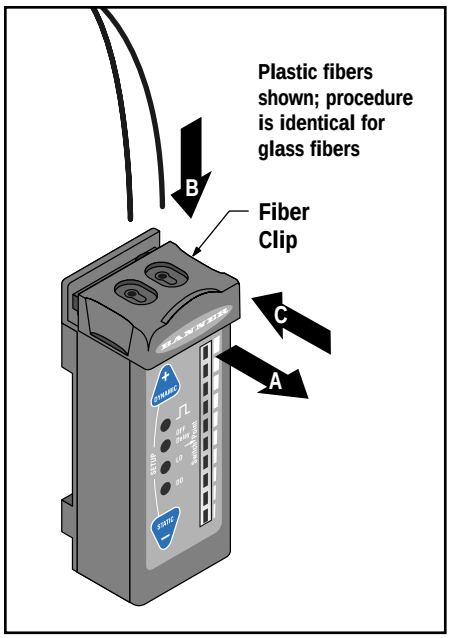


Figure 1. Installing fibers into the R55F Series sensor

Glass Fiber Installation Procedure:

1) Check to see that a rubber o-ring is pre-installed on each fiber control end.
2) Slide the fiber clip to the open position (A).
3) Insert one fiber end into each port (B). Push firmly on the fiber ends to compress the o-rings and align the grooves in the fiber ends with the slot in the fiber clip.
4) Slide the fiber clip back into place, locking the fibers into position (C).

Plastic Fiber Installation Procedure:

NOTE: R55F sensors accept 0.75, 1.0, and 1.5 mm (0.03", 0.04", and 0.06") core diameter plastic fibers.

1) Cut the “control ends” (sensor ends) of the plastic fiber(s) to the desired length per the procedure which accompanies the fiber assembly.
2) If not already done, separate bifurcated fibers by approximately 2" from the control ends.
3) Slide the fiber clip to the open position (A).
4) Insert the fiber ends into each port and push them in as far as they will go (B).
5) Slide the fiber clip back into place, locking the fibers into position (C).

Fiber Optic Mounting Considerations

Mount the sensing end of the fiber optic assembly so that the light image is totally contained within the boundaries of the color mark to be sensed. The light image is made smaller by moving the sensing tip closer to the surface of the material to be sensed.

When sensing marks on shiny (specular) materials, such as metal, plastic or glossy paper, mount the sensing tip of the fiber at approximately 15° from perpendicular to the material surface to minimize strong direct reflections.

Isolate the fiber mounting from vibration. Also, maintain mechanical stability of the surface to be sensed (e.g., stabilize web flutter at the sensing point).

Using the R55F Series Sensor

RUN Mode

Normal operation of the R55F is called RUN mode. The LED indicators (see Figure 2) operate as follows in RUN mode:

Output Conducting LED: ON when outputs are active

Delay Configuration Indicator LED: OFF No OFF Delay is programmed
ON 20 or 40-ms OFF Delay is programmed

Light Operate LED: ON to indicate Light Operate configuration

Dark Operate LED: ON to indicate Dark Operate configuration
(NOTE: Since either one of these is always ON when the sensor is operating, the combined Light/Dark Operate LEDs also provide a functional Power-ON indication.)

10-Segment Light Bar: indicates signal strength, with respect to the sensing threshold ("Switch Point").

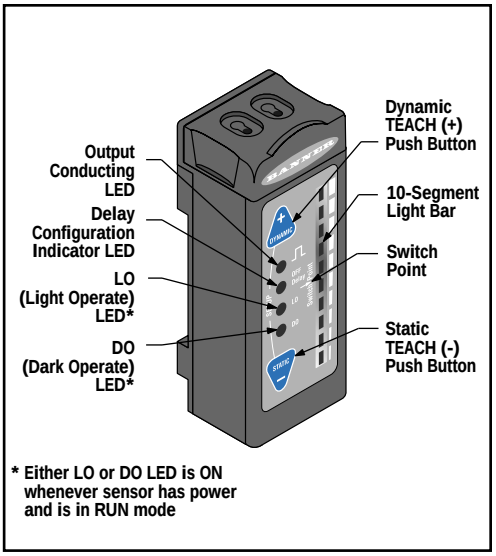


Figure 2. R55F Series sensor features

TEACH Modes

The sensitivity of the R55F may be quickly optimized by using one of two available TEACH modes: **Static TEACH** or **Dynamic TEACH.** Either may be performed using the push buttons on the sensor, or remotely, using a remote switch or process controller connected to the sensor's gray wire (see page 8). Either a sensing window or a specific point may be taught.

Static TEACH

In Static TEACH mode, the sensor learns the light condition and the dark condition, each one time. Sensitivity is automatically set to place the switch point midway between the two conditions. In addition, the condition taught first becomes the output ON condition.

Sensitivity may be adjusted at any time when the sensor is in RUN mode by clicking the "+" and "-" buttons. Each click translates to 1/2 segment on the signal strength light bar. For best sensing reliability, the light and dark conditions should register equally distant from the switch point on the signal strength light bar.

Single-Point TEACH

The R55F sensor also may be taught a single specific target, using an alternate Static TEACH procedure. The sensor will sense only the mark taught and will ignore signals both stronger and weaker. The sensitivity to the taught mark then may be adjusted up or down.

To perform single-point TEACH, place the target in front of the sensor. Press and hold the "Static" button until the LO and DO LEDs begin to flash, then double-click the Static button. If the single point was successfully taught, the two center sections of the bar graph will flash.

Manually adjust the sensitivity by clicking either the "+" or "-" button; the bar graph will flash two segments centered about the sensing point. If the sensitivity is increased (-), the two lighted segments will become closer together, and farther apart if the sensitivity is decreased (+). If the segments do not flash while the sensitivity is being adjusted, the setting has reached its maximum and cannot be adjusted further.

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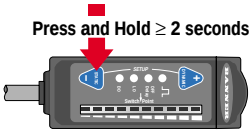
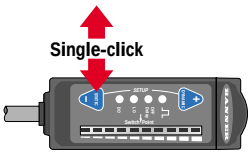
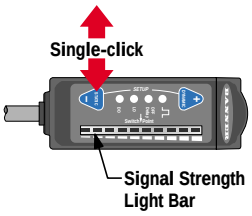
See page 8 for Remote TEACH procedures

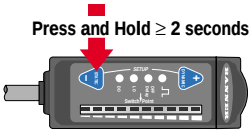
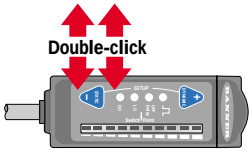
Static TEACH Procedure - Push Button

Push Button		Resulting Indicator Status
Press and hold STATIC button until LO and DO indicators alternately flash, then release button.		**LO and DO:** Alternately flash green ⎍: ON amber (indicating ready to teach output ON condition) **Light Bar:** Goes OFF
TEACH Condition #1 (Output ON state) Present the output ON sensing condition and single-click STATIC button.		**LO and DO:** Alternately flash Green ⎍: OFF (indicating ready to teach output OFF condition) **Light Bar:** Remains OFF
TEACH Condition #2 (Output OFF state) Present the output OFF sensing condition and single-click STATIC button.		**Contrast accepted:** one of the ten segments flashes for three seconds to indicate relative contrast, and then the sensor enters RUN mode. **Contrast too low:** every other segment flashes for three seconds to indicate low contrast, and the sensor returns to TEACH Condition #1.

NOTES:

1) The sensor will return to RUN mode if either TEACH condition is not registered within 90 seconds. Also, TEACH mode may be cancelled by pressing and holding the push button for ≥ 2 seconds. In either case, the sensor will revert to the previous conditions taught (i.e., exit without save).
2) If the sensing conditions are accepted at the end of TEACH Condition #2, the signal strength light bar flashes one of its ten segments for three seconds to indicate relative sensing contrast. The higher the flashing segment, the higher the measured sensing contrast. High contrast relates directly to sensing reliability. High-contrast sensing applications are most tolerant of sensing variables, such as web flutter or variations in color mark color or print density.

Static Single-Point TEACH Procedure - Push Button

Push Button		Resulting Indicator Status
Press and hold STATIC button until LO and DO indicators alternately flash, then release button.		**LO and DO:** Alternately flash green ⎍: ON amber (indicating ready to teach output ON condition) **Light Bar:** Goes OFF
TEACH Condition to be Sensed (Output ON state) Present the output ON sensing condition and double-click STATIC button.		**LO or DO:** depending on condition of taught ⎍: OFF **Light Bar:** Two center segments are lit if TEACH was successful.

Dynamic TEACH

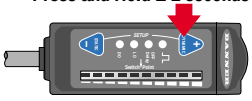
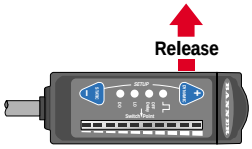
Dynamic TEACH is used to program sensitivity during actual machine run conditions. During Dynamic TEACH, the R55F samples many color marks against their background material and automatically sets the sensitivity at the optimum level. Dynamic TEACH activates the sensor's adaptive threshold system, which continuously tracks minimum and maximum signal levels, and automatically maintains centering of the switch point between the light and dark conditions. The adaptive threshold system remains in effect during RUN mode to automatically adjust for changes in the light or the dark conditions.

When Dynamic TEACH mode is used to program sensitivity, the output ON state must be assigned to either the light or dark condition using the SETUP mode (see page 7).

Sensitivity may be adjusted at any time when the sensor is in RUN mode by clicking the "+" and "-" buttons. However, when a manual adjustment is made, the adaptive threshold system is disabled (cancelled).

Dynamic TEACH Procedure - Push button

See page 8 for Remote TEACH procedures

Push Button		Resulting Indicator Status
Press and hold DYNAMIC button until LO and DO indicators alternately flash.	**Press and Hold ≥ 2 seconds** 	**LO and DO:** Alternately flash green ⎍ : OFF **Light Bar:** Goes OFF
Continue depressing the DYNAMIC button while sampling light and dark sensing conditions.	**Continue to Depress While Sensor Samples Light and Dark Conditions** 	**LO and DO:** Alternately flash green ⎍ : OFF **Light Bar:** Remains OFF
Release the DYNAMIC button when finished sampling light and dark sensing conditions.	**Release** 	**Contrast accepted:** one of the ten segments flashes for three seconds to indicate relative contrast, and the sensor enters RUN mode. **Contrast too low:** five light bar segments flash for three seconds to indicate low contrast, and sensor reverts to the previously taught conditions.

NOTES:

1) If the sensing conditions are accepted at the end of Dynamic TEACH, the signal strength light bar flashes one of its ten segments for three seconds to indicate relative sensing contrast. The higher the flashing segment, the higher the measured sensing contrast. High contrast relates directly to sensing reliability. High contrast sensing applications are most tolerant of sensing variables, such as web flutter or variations in color mark color or print density.
2) If the sensor does not measure enough contrast at the end of Dynamic TEACH, every other segment of the signal strength light bar flashes in unison for three seconds to warn of unacceptably low contrast, and the sensor returns to RUN mode with its previously taught conditions.

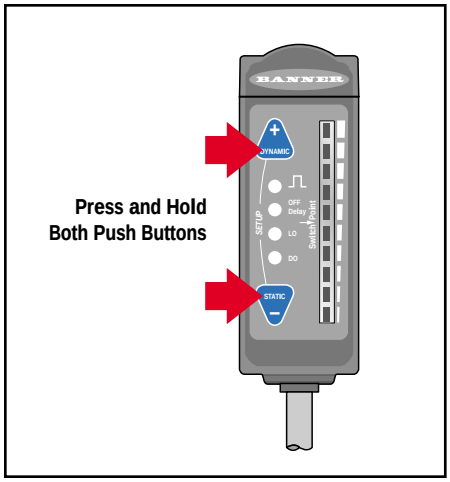


Figure 3. SETUP mode

SETUP Mode

SETUP mode is used to configure sensor output response for:

- Light or Dark operate
- 20- or 40-millisecond pulse stretcher (OFF delay), if required.

It will be necessary to access SETUP mode only if the settings which result from TEACH mode programming are not the settings required for the application. The status LEDs indicate the output response configuration when the sensor is in RUN mode, as follows:

- LO indicator ON = output is light operate
- DO indicator ON = output is dark operate
- OFF Delay indicator ON = either 20- or 40-millisecond delay is programmed
- OFF Delay indicator OFF = no output delay is programmed

To change the output response settings;

1) Press and hold **BOTH** push buttons until the signal strength light bar turns OFF.
2) Click **EITHER** push button to toggle through the six possible settings indicated as follows:

Output Configuration	Delay Indicator	LO Indicator	DO Indicator
Light operate with no delay	**OFF**	**ON**	**OFF**
Light operate with 20 ms delay	**Flashing**	**ON**	**OFF**
Light operate with 40 ms delay	**ON**	**ON**	**OFF**
Dark operate with no delay	**OFF**	**OFF**	**ON**
Dark operate with 20 ms delay	**Flashing**	**OFF**	**ON**
Dark operate with 40 ms delay	**ON**	**OFF**	**ON**

3) Press and hold both push buttons until the signal strength light bar turns ON, indicating return to RUN mode.

NOTE: If SETUP mode programming is interrupted and remains inactive for 30 seconds, the sensor returns to RUN mode with the most recent settings (i.e., exit and save current selection).

Remote Programming

The gray wire of the R55F may be connected to a remote switch or to a process controller to:

- Set sensitivity via either Static or Dynamic TEACH mode
- Set output response via SETUP mode
- Disable the push button functions

A remote programming switch is connected between the gray wire and dc common (see Hookup diagrams on page 11). The switch may be either a normally-open contact, or an open-collector NPN transistor with its emitter connected to dc common.

Remote programming is accomplished using a specified sequence of input pulses. The duration of each pulse is defined as:

0.04 seconds < T < 0.8 seconds (40 ms < T< 800 ms)

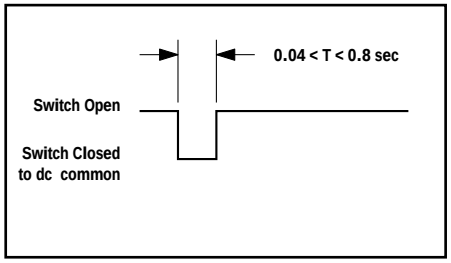


Figure 4. Input pulse timing

Remote Static TEACH Mode

1) Present the Output ON condition to the fiber sensing end and pulse the Remote TEACH input once.
2) Wait at least 0.8 seconds, present the Output OFF condition, and pulse the Remote TEACH input once.

If sensing contrast is adequate, the sensor flashes one segment of the signal strength light bar for 3 seconds to indicate relative contrast, and then enters RUN mode.

If contrast is too low, the sensor flashes five segments of the signal strength light bar in unison to warn of unacceptably low contrast, and returns to re-teach the Output ON condition (Step 1).

Remote Static Single-Point TEACH

The single-point TEACH may also be performed using the remote wire. Present the target and single-click the remote wire. Wait for at least 0.8 second, then double-click the remote wire. If the TEACH is successful, the sensor will flash the middle two LEDs of the bar graph, and return to RUN mode.

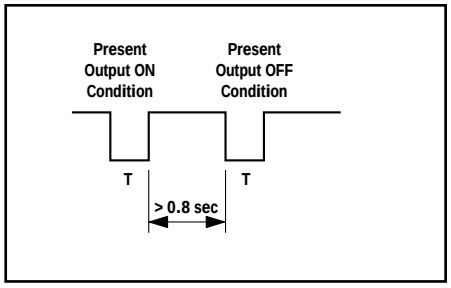


Figure 5. Static TEACH mode

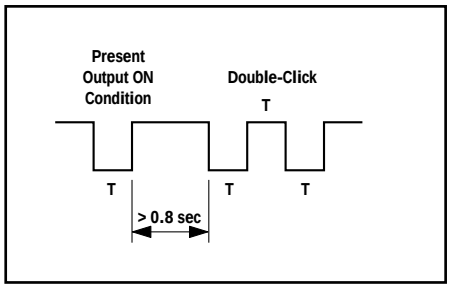


Figure 6. Static Single-Point TEACH mode

Remote Dynamic TEACH Mode

1) Hold the TEACH input low for > 2 seconds
2) Continue holding the TEACH input low while presenting light and dark sensing conditions. Open switch when finished teaching.

If sensing contrast is adequate, the sensor flashes one segment of the signal strength light bar for 3 seconds to indicate relative contrast, and then enters RUN mode.

If contrast is too low, the sensor flashes five segments of the signal strength light bar in unison to warn of unacceptably low contrast, and returns to RUN mode with its previously taught conditions.

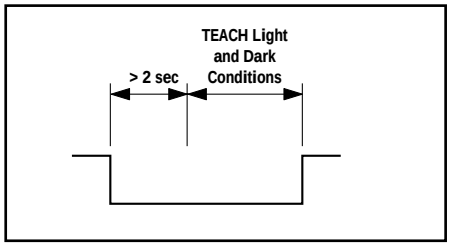


Figure 7. Dynamic TEACH mode

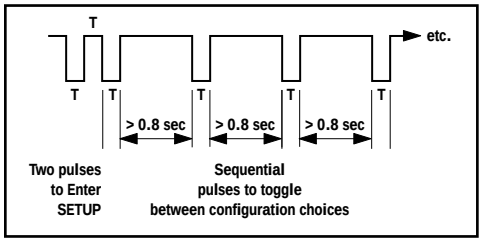


Figure 8. SETUP mode

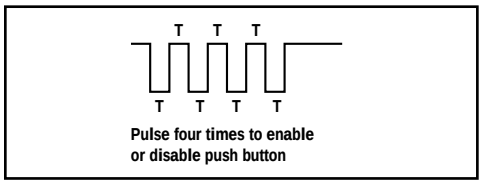


Figure 9. Push button lockout

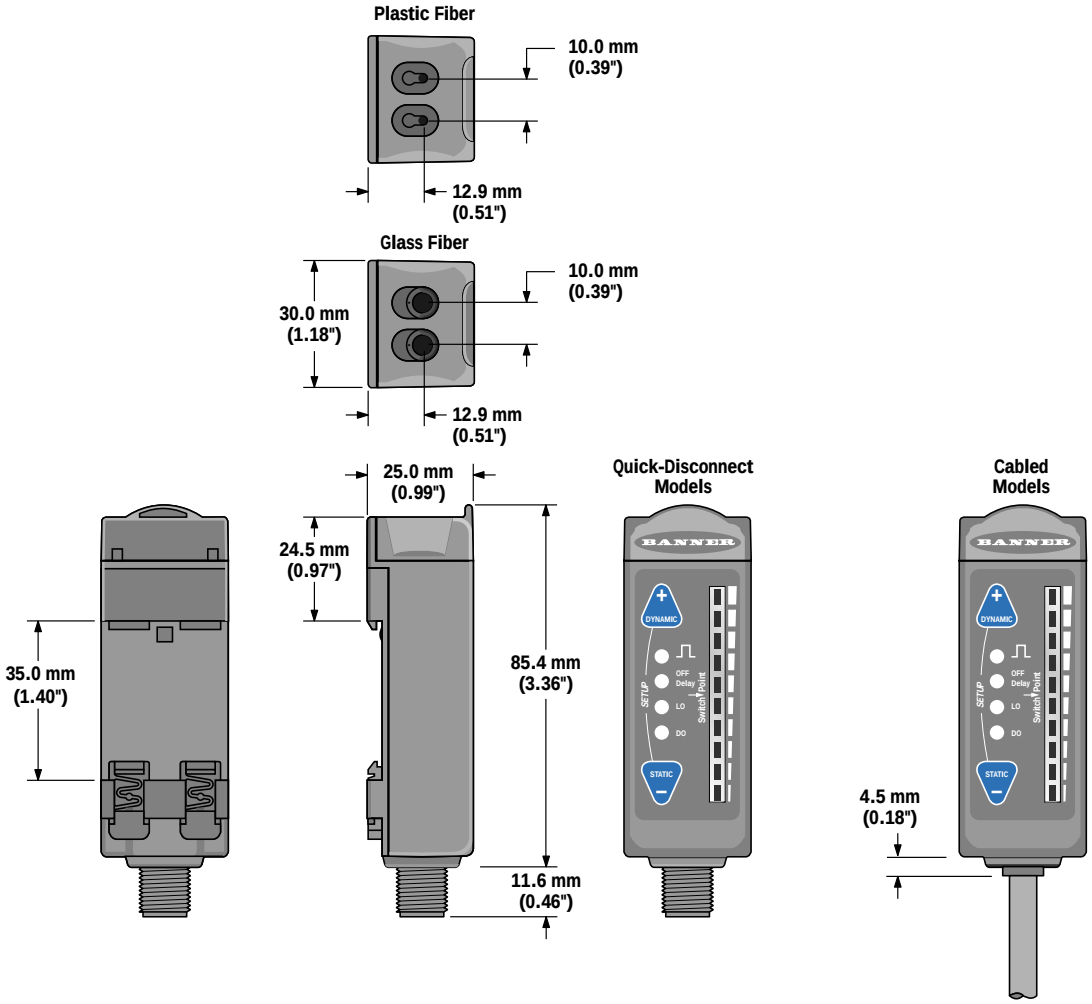
Remote SETUP Mode

1) To enter SETUP mode, pulse once, wait 0.04 to 0.8 seconds, then pulse again.
2) Wait > 0.8 seconds, then enter sequential pulses to toggle between the six output configuration choices (see page 7). Spacing between sequential pulses must be > 0.8 seconds.
3) To exit SETUP mode, hold the TEACH input low for > 2 seconds.

Locking Out (Disabling) the Push Buttons

Pulse four times to disable (or to re-enable) the push buttons.

R55F Series Sensor Dimensions

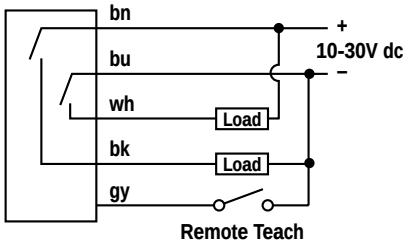


R55F Series Sensor Specifications

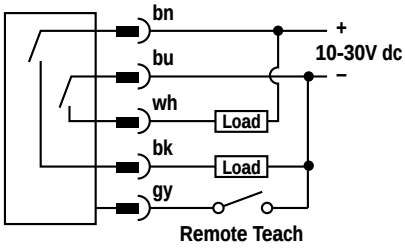
Supply Input	10 to 30V dc (10% maximum ripple) at less than 70 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar (NPN and PNP)
Output Rating	150 mA max each output @ 25°C (derate ≈ 1 mA per °C increase) **OFF-state leakage current:** < 5 µA @ 30V dc **ON-state saturation voltage:** PNP Output < 1V @ 10 mA and 1.5V @ 150 mA NPN Output < 200 mV @ 10 mA and 1V @ 150 mA
Output Protection	Protected against false pulse on power-up and continuous overload or short-circuit of outputs.
Output Response	50 microseconds NOTE: 100 millisecond delay on power-up; outputs do not conduct during this time.
Adjustments (see pages 4 - 9)	**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 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 Light operate/Dark operate OFF Delay select: 0 milliseconds, 20 milliseconds or 40 milliseconds Push button lockout for security
Indicator LEDs	10-segment (green) light bar indicates signal strength Light Operate (green) Dark Operate (green) Outputs Conducting (yellow) OFF Delay (green): **SETUP Mode:** OFF — no delay; Flashing — 20 ms delay; ON — 40 ms delay **RUN Mode:** OFF — no delay; ON — 20 or 40 ms Delay
Construction	**Housing:** 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	**Power:** 2 m or 9 m PVC-jacketed 5-conductor cable or 5-pin Euro-style quick-disconnect (QD) connector **Fibers:** Fiber clip (no tool required)
Operating Conditions	**Temperature:** -10° to +55° C (+14° to 131° F) **Maximum 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

R55F Series Sensor Hookups

Cabled Models



Quick-Disconnect Models

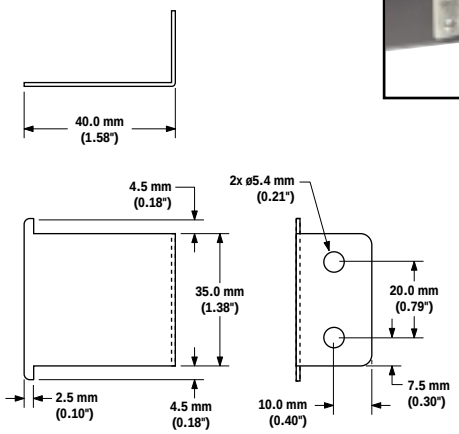


Mounting Brackets

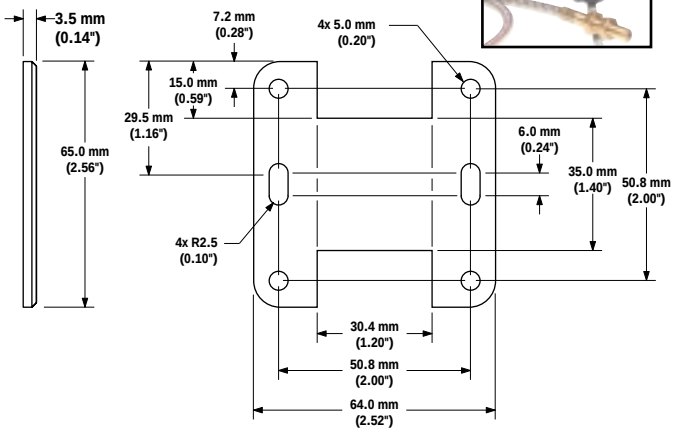
Both brackets are included with sensor.

SMBR55FRA	• Side-mounting bracket • 19 ga stainless steel
SMBR55F01	• Flat-mounting bracket • Molded PBT polyester

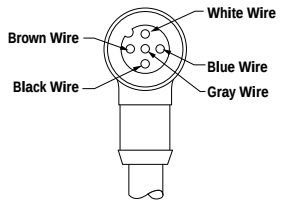








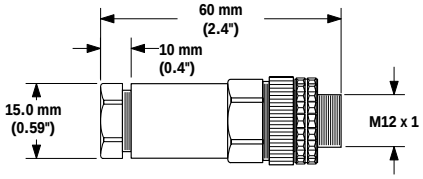
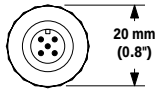
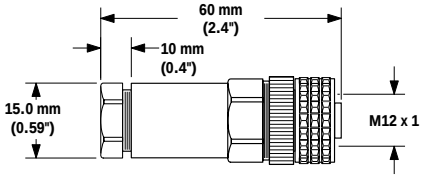
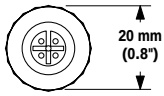
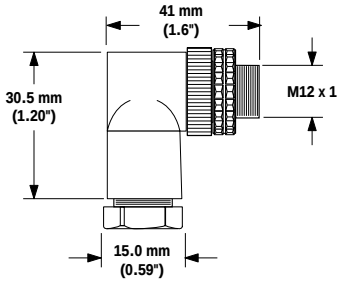
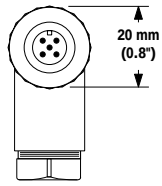
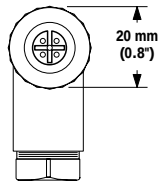
Quick-Disconnect (QD) Cables

Style	Model	Length	Connector	
5-Pin Euro	**MQDC1-506**	2 m (6.5')	Straight	
	MQDC1-515	5 m (15')	Straight	
	MQDC1-530	9 m (30')	Straight	
	MQDC1-506RA	2 m (6.5')	Right-angle	
	MQDC1-515RA	5 m (15')	Right-angle	
	MQDC1-530RA	9 m (30')	Right-angle	

R55F Series Glass and Plastic Fiber-Optic Color Mark Sensors

Euro-Style Field-Wireable Connectors

Contacts: Gold-plated; 4-pin models rated 250V ac/dc max., 4 A max.; 5-pin models rated 50V ac/dc max., 4A max.
Cable Diameter: 4.0 to 5.0 mm (0.16 to 0.20")
Temperature: -25° to +90°C (-13° to +194°F)
Environmental Rating: NEMA 6P, IP 67

Style	Model	Gender	Dimensions	Pin-out
5-Pin Straight	**FIC-M12M5**	Male		
	FIC-M12F5	Female		
5-Pin Right-angle	**FIC-M12M5A**	Male		
	FIC-M12F5A	Female		

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WARNING . . . Not To Be Used for Personnel Protection

Never use these products as sensing devices for personnel protection. Doing so could lead to serious injury or death.

These sensors do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition. Consult your current Banner Safety Products catalog for safety products which meet OSHA, ANSI and IEC standards for personnel protection.

WARRANTY: Banner Engineering Corp. warrants its products to be free from defects for one year. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture found to be defective at the time it is returned to the factory during the warranty period. This warranty does not cover damage or liability for the improper application of Banner products. This warranty is in lieu of any other warranty either expressed or implied.