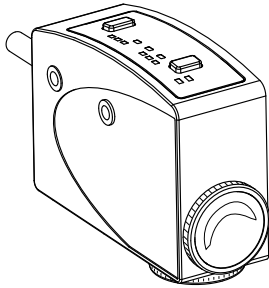


Datasheet

Registration Mark Sensor with Three-Color Light Source

Features



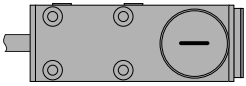
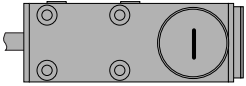
- Ultra-fast 10 kHz switching frequency
- Sensor automatically selects red, green, or blue LED during TEACH to optimize application contrast
- Outstanding color contrast sensitivity; detects 16 levels of gray scale
- Smart gain-control algorithm to maximize performance in low-contrast or high-gloss applications
- Easy to set, automatic *Expert*-style TEACH options include Static and Dynamic programming plus manual adjustment for fine tuning
- Easy-to-read 8-segment light bar indicator for TEACH and signal strength readout, plus indicators for continuous readout of output status and setup
- Fixed-convergent sensing at 10 mm \pm 3 mm (0.39 in \pm 0.12 in); rectangular sensing image measure 1.2 mm x 3.8 mm (0.05 in x 0.15 in) at 10 mm (0.39 in) from the lens
- Models available with either parallel or perpendicular sensing image
- Rugged zinc alloy die-cast housing with high-quality acrylic lens suitable for food processing applications; rated IEC IP67, NEMA 6
- Easy selection of Light/Dark Operate (LO/DO), 30 ms pulse stretcher (OFF-delay), and 30 ms ON-delay, using the push buttons or a remote input wire



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

Models	Cable ¹	Focus	Supply Voltage	Output Type	Sensing Image Orientation
R58EORGB1	5-wire 2 m (6.5 ft)	10 mm (0.39 in)	10 V dc to 30 V dc	Bipolar NPN/ PNP	Parallel to sensor length 
R58EORGB1Q8	5-pin Euro-style integral QD				
R58EORGB1Q	5-pin Euro-style 150 mm QD				
R58EORGB2	5-wire 2 m (6.5 ft)				Perpendicular to sensor length 
R58EORGB2Q8	5-pin Euro-style integral QD				
R58EORGB2Q	5-pin Euro-style 150 mm QD				

¹ Integral 2 m (6.5 ft) unterminated cable models are listed.

- To order the 9 m (30 ft) PVC cable model, add the suffix "W/30" to the cabled model number. For example, R58EORGB1 W/30.
- Models with a quick disconnect require a mating cordset.



Overview

R58 Expert offer maintenance-free, solid-state reliability for typical color contrasts found in product and material registration applications. Fast 50-microsecond sensing response produces excellent registration repeatability, even in ultra-high-speed applications. This fast response, coupled with the small 1.2 x 3.8 mm (0.05 in x 0.15 in) sensing image, allows the detection of small and inconspicuous registration marks.

R58E sensors feature TEACH mode sensitivity adjustment by presenting two sensing conditions to the sensor. TEACH mode has two options: Static TEACH and Dynamic TEACH. Static TEACH is used to position the two sensing conditions individually. Dynamic TEACH provides a means for teaching a series of conditions on-the-fly; the R58E samples the sensing events and automatically sets the switchpoint between the lightest and darkest conditions. The sensor then determines which sensing condition is present for the shortest time and assigns the Output ON condition to that event (therefore, LO/DO selection is automatic). If necessary, the LO/DO setting can be reversed in Setup mode.

The sensor uses a tri-color LED during either teach process and automatically selects a red, green, or blue sensing beam, based on the contrast between the registration mark and its background. For applications where the user wishes to select the sensing beam color, individual colors may be enabled/disabled in Setup mode.

Sensitivity may be fine-tuned at any time by clicking the “+” or “-” buttons on the sensor. The eight-element bargraph display clearly displays the relative received signal strength. The discrete bipolar (one NPN and one PNP) outputs may be configured in Setup mode to include a 30-millisecond ON-delay and/or OFF-delay, if required.

Configuration is accomplished either by using the push-buttons on the sensor, or by supplying input pulses using the remote input. The buttons may be disabled using the remote input.

The construction of the R58E is extremely robust, with a die-cast metal housing, plastic optics, IP67 and NEMA 6 leakproof design for harsh sensing environments.

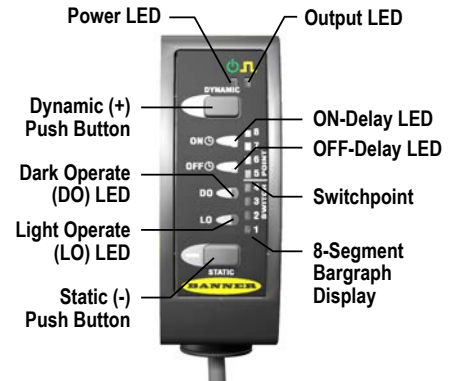


Figure 1. Sensor Features

Status Indicators

LED	Indicates
Power	On Green: Run mode Off: TEACH or Setup mode
Output	On Amber: Output is conducting, or TEACH Output ON condition Off: Output is not conducting, or TEACH Output OFF condition
Light Operate	On Green: Light Operate (LO) operation
Dark Operate	On Green: Dark Operate (DO) operation
OFF-Delay	On Green: 30 ms pulse stretcher (OFF-delay) is active Off: No OFF-delay
ON-Delay	On Green: 30 ms ON-delay is active Off: No ON-delay
8-Segment Bargraph Display	On Red: Run mode — Indicates signal strength with respect to the sensing threshold (switchpoint); higher segment number for higher sensing contrast TEACH mode — Indicates relative contrast Setup mode — Displays sensing beam LED color (see Figure 8 on page 7) Off: TEACH or Setup mode — Sensor configuration active

Installation

Install the Lens

The lens may be installed at either of two lens ports (see [Figure 2](#) on page 3). The lens and the lens port cap are both threaded and may be exchanged by hand; no tools are required. The lens and cap both include an o-ring seal.



Note: The lens port cap must be installed on the unused port for reliable operation. Fully seat the lens cap to ensure a liquid-tight seal.

Mounting Considerations

The F58 Expert includes a total of eight size M5 threaded holes used for mounting. These threaded holes are positioned to match the mounting hole patterns common to other registration mark sensors. The F58E includes four M5 x 0.8 x 6 mm stainless steel cap screws and a hex key wrench.

The F58E focus is 10 mm (0.39 in) from the lens surface. The F58E must be mounted within 3 mm (0.12 in) of this distance from the surface of the material for reliable sensing ([Figure 2](#) on page 3).

Consider the following when mounting the F58E:

- When sensing a registration mark on a reflective (shiny) material, mount the F58E at an angle which places the lens centerline at approximately 15° off perpendicular to the material's surface ([Figure 4](#) on page 3). This minimizes strong direct reflections (which tend to overwhelm the sensor), and allows the sensor to discern the relatively small optical contrast offered by differences in colors.
- Clear materials are poor reflectors of light. When sensing a mark printed on a clear material (for example, a clear poly web), position a reflective surface directly behind the clear material to return light to the F58E. The printed mark, regardless of its color, then becomes the dark condition, as it blocks the light from reaching the reflective surface. Most clear materials are also shiny; it is important to include a 15° skew angle when sensing clear materials ([Figure 4](#) on page 3).
- Whenever possible, sense a web material at a location where it passes over a tension bar or roller, to minimize the adverse effects of web "flutter" or sag ([Figure 3](#) on page 3).

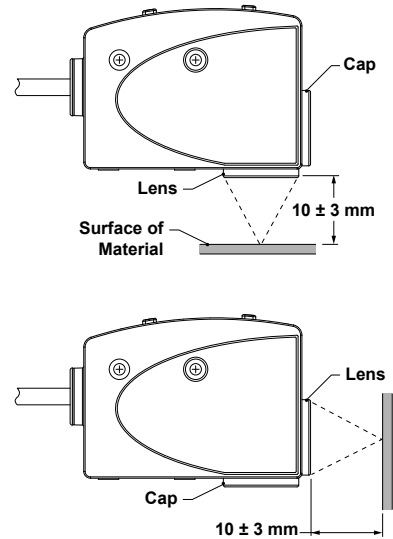
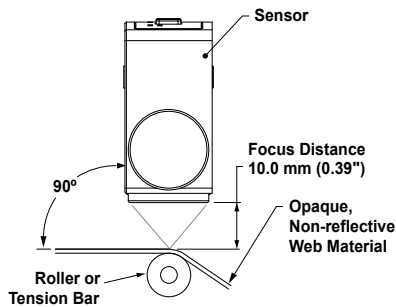
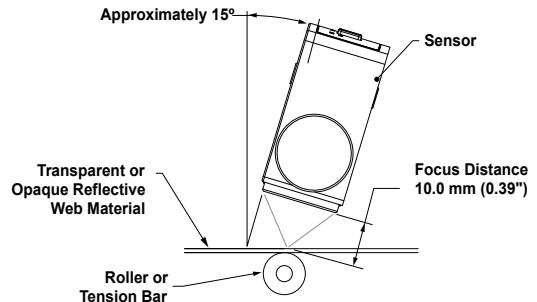


Figure 2. Mounting Distance and Lens Positions



Mount the sensor perpendicular to non-reflective (matte) materials

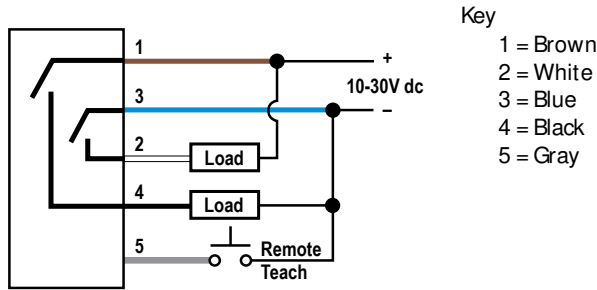
Figure 3. Mounting for Matte Material



Mount the sensor at approximately 15° from perpendicular to transparent and opaque reflective materials

Figure 4. Mounting for Transparent and Opaque Material

Wiring Diagrams



- Key
- 1 = Brown
 - 2 = White
 - 3 = Blue
 - 4 = Black
 - 5 = Gray

Quick disconnect (QD) wiring diagrams are functionally identical.

Sensor Configuration

The F58E is pre-set to power up in Run mode and to sense the most recently taught registration mark. Quickly optimize the sensitivity of the F58E using one of two available TEACH modes: Static TEACH or Dynamic TEACH.

Static TEACH: Both the Output ON and Output OFF conditions are presented, and sensitivity can be adjusted manually using the push buttons.

Dynamic TEACH: The registration mark is presented during actual sensing conditions, and the sensitivity can be adjusted manually using the push buttons.

Remote TEACH

Configure the sensor either using the push buttons, or using a remote switch. Remote configuration also may be used to enter Setup mode to set the ON- and OFF-delay, and to disable the push buttons to prevent unauthorized adjustment of the configuration settings. To access this feature, connect the gray wire of the sensor to 0 V dc, with a remote switch between the sensor and 0 V dc.

Follow the sequence of input pulses to configure the sensor (see the procedures in this document). The duration of each pulse (corresponding to a push button “click”), and the period between multiple pulses, are defined as: “T”: 0.04 seconds ≤ “T” ≤ 0.8 seconds.

Push Button Enable/ Disable (Lockout)

In addition to its configuration function, the remote input may be used to disable the push buttons for security. Disabling the push buttons prevents unauthorized adjustment of the configuration settings. Connect the gray wire of the sensor as described in [Wiring Diagrams](#) on page 4, and four-pulse to either enable or disable the push buttons (0.04 seconds ≤ “T” ≤ 0.8 seconds):



Note: Push buttons can be disabled/enabled from the remote line only.

Static TEACH

In Static TEACH mode, the sensor learns two sensing conditions after each is presented one time. The sensor automatically positions the switchpoint midway between the two conditions.

The sensor returns to Run mode if either TEACH condition is not registered within 60 seconds. The sensor reverts to the previous taught conditions.

Cancel TEACH mode by pressing and holding the Static push button for ≥ 2 seconds. The sensor reverts to the previous taught conditions (that is, exit without saving).

Static TEACH and Manual Adjust

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 bargraph display. For best sensing reliability, both sensing conditions should register equally distant from the switchpoint on the signal strength bargraph display.

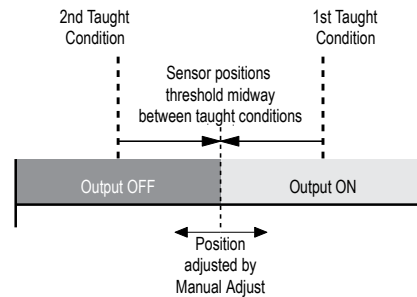


Figure 5. Static TEACH (Light Operate Shown)

1. Access TEACH mode.

Method	Action	Result
Push Button ²	Press and hold Static (-) for > 2 seconds.	LO and DO: Alternately flash green Output: On amber (indicating ready to teach first sensing condition) Bargraph display: Turns off
Remote Input ³	No action required; sensor is ready for the first sensing condition.	N/A

2. Teach the first sensing condition.

Method	Action	Result
Push Button	a. Present the first sensing condition. b. Click Static (-) .	LO and DO: Alternately flash green
Remote Input	a. Present the first sensing condition. b. Single-pulse the remote input. c. Wait at least 8 seconds.	Output: Off (indicating ready to teach the second sensing condition) Bargraph display: Remains off



3. Teach the second sensing condition.

Method	Action	Result
Push Button	a. Present the second sensing condition. b. Click Static (-) .	<p>Teach Accepted</p> <ul style="list-style-type: none"> The bargraph display flashes one segment for three seconds to indicate relative contrast (see Table 1 on page 6) . The sensor enters Run mode. <p>Teach Not Accepted</p> <ul style="list-style-type: none"> Pairs of bargraph display segments flash for three seconds to indicate low contrast. The sensor returns to TEACH the first sensing condition.
Remote Input	a. Present the second sensing condition. b. Single-pulse the remote input.	



Dynamic TEACH

Dynamic TEACH is used to configure sensitivity during actual sensing conditions, when looking for a mark against its background condition.

The R58E takes multiple samples of the registration mark against its background material and automatically positions the threshold at the optimum level. The registration mark must be presented at least two times during Dynamic TEACH.

When Dynamic TEACH is used, the Output ON state is the shorter duration (smaller) event sensed, and LO/ DO is set accordingly. To change the output state, change to either LO or DO in Setup mode, or pulse the remote line three times.

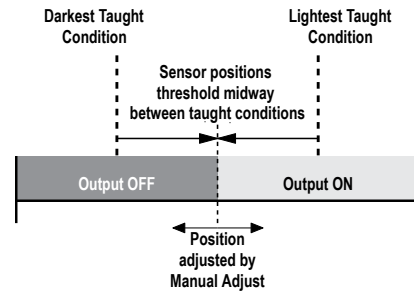


Figure 6. Dynamic TEACH (Light or Dark Operate, depending on the sensing condition shown)

Maximum Feed Rate

To optimize performance and to ensure that all LED color and gain combinations are evaluated during Dynamic TEACH, the registration mark must encompass the 1.2 mm dimension of the 1.2 mm x 3.8 mm sensing image for at least 0.002 seconds. Determine the maximum feed rate using the following formula:

- ² 0.04 seconds ≤ “click” ≤ 0.8 seconds
- ³ 0.04 seconds ≤ “T” ≤ 0.8 seconds

Maximum Feed Rate in mm/sec. = (registration mark width in mm – 1.2) / 0.002

Example with a 5 mm registration mark:

Maximum Feed Rate = (5 mm – 1.2) / 0.002 = 1900 mm/sec.



Note: Registration marks narrower than the 1.2 mm sensing image width can be detected at feed rates less than 600 mm/sec, but the contrast is reduced due to averaging of the background and the registration mark.

Dynamic TEACH and Manual Adjust

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 bargraph display. For best sensing reliability, the light and dark conditions should register equally distant from the switchpoint on the bargraph display.

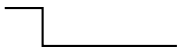
Table 1: Contrast

Bargraph Display Segment (following TEACH)	Relative Contrast/Recommendation
6 to 8	Excellent: Very stable operation.
4 to 5	Good: Minor sensing variables will not affect sensing reliability.
2 to 3	Low: Minor sensing variables may affect sensing reliability.
1	Poor: Consider an alternate sensing scheme.

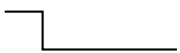


Note: High contrast relates directly to sensing reliability; high-contrast sensing applications are most tolerant of sensing variables (for example, web flutter or variations in registration mark color and print density).


1. Access TEACH mode.

Method	Action	Result
Push Button ⁴	Press and hold Dynamic (+) for > 2 seconds.	LO and DO: Alternately flash green
Remote Input ⁵	Hold the remote line low for >2 seconds. 	Output: Off Bargraph display: Turns off

2. Teach the sensing conditions.

Method	Action	Result
Push Button	a. Continue to press Dynamic (+). b. Present the sensing conditions. Present registration marks at least twice.	LO and DO: Alternately flash green Output: Off
Remote Input	a. Continue to hold the remote line low. b. Present the sensing conditions. Present registration marks at least twice. 	Bargraph display: Remains off

3. Return to Run mode.

Method	Action	Result
Push Button	Release Dynamic (+).	<u>Teach Accepted</u> <ul style="list-style-type: none"> The bargraph display flashes one segment for three seconds to indicate relative contrast (see Table 1 on page 6). The sensor enters Run mode.
Remote Input	Release the remote input/ switch. 	<u>Teach Not Accepted</u> <ul style="list-style-type: none"> Pairs of bargraph display segments flash in unison for three seconds to warn of unacceptably low contrast. The sensor returns to Run mode without changing settings.

Setup Mode

Use Setup mode to configure the discrete sensor output response for:

⁴ 0.04 seconds ≤ “click” ≤ 0.8 seconds

⁵ 0.04 seconds ≤ “T” ≤ 0.8 seconds

- Light or Dark Operate
- 30-millisecond pulse stretcher (OFF-delay), if required
- 30-millisecond ON-delay, if required

Setup mode is also used to disable one or more sensing beam colors, to force the sensor to use a particular color. Access Setup mode only if the settings which result from TEACH mode configuration are not the settings required for the application or if a delay is required. The status LEDs indicate the output response configuration when the sensor is in Run mode, as shown.

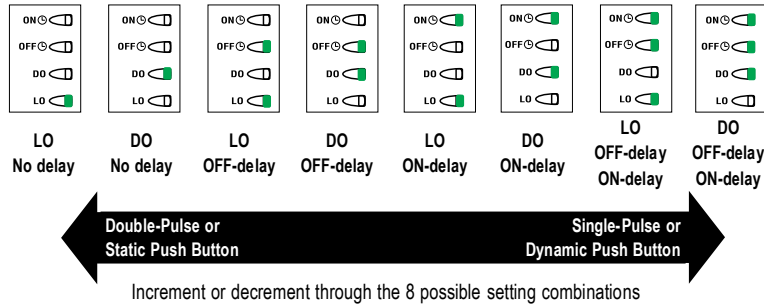


Figure 7. Output Response Configuration Options

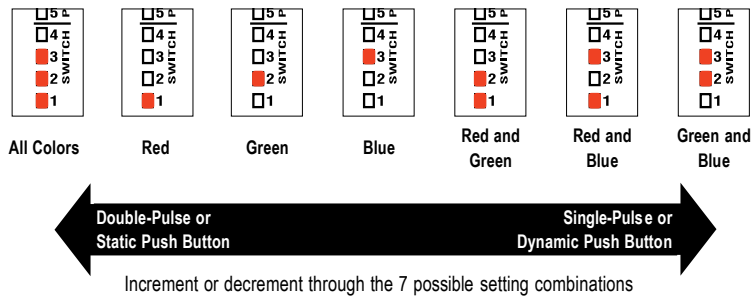


Figure 8. LED Color Configuration Options

Change the output response settings or disable sensing beam color(s) as shown in [Setup Configuration](#) on page 7.

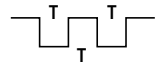


Note: If Setup mode programming is interrupted and remains inactive for 60 seconds, the sensor returns to Run mode with the most recent settings (that is, exits and saves the current selection).

Setup Configuration

1. Enter Setup mode.

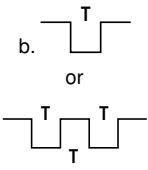
Method	Action	Result
Push Button ⁶	Press and hold both Static (-) and Dynamic (+) for > 2 seconds.	The 8-segment display turns off.
Remote Input ⁷	Double-pulse the remote input.	The sensor is in Setup mode.



⁶ 0.04 seconds ≤ “click” ≤ 0.8 seconds

⁷ 0.04 seconds ≤ “T” ≤ 0.8 seconds

2. Select the LO/DO and Delay settings.

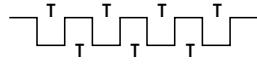
Method	Action	Result
Push Button	a. Release the buttons. b. Click Static (-) or Dynamic (+) to toggle between choices: <ul style="list-style-type: none"> • Dynamic (+)—increment • Static (-)—decrement 	a. The sensor is ready to select a new setting combination. b. Sensor steps between LO/DO and Delay setting combinations, as shown Figure 7 on page 7.
Remote Input	a. Wait > 8 seconds. b. Enter sequential pulses to toggle between choices: <ul style="list-style-type: none"> • Single-pulse—increment • Double-pulse—decrement 	



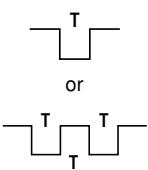
Note: There is a LO/DO settings shortcut using the remote input. From Run mode, triple-pulse the remote line. The sensor toggles between LO/DO settings on-the-fly, and continues in Run mode.

3. Enter the sensing beam color select mode from Setup mode.

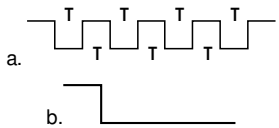
Method	Action	Result
Push Button	From Setup mode, press and hold Dynamic (+) > 2 seconds.	The sensor displays the currently selected sensing beam color combinations, as shown Figure 8 on page 7. The visible sensing beam also provides indication of enabled sensing beam color(s).
Remote Input	From Setup mode, four pulse the remote input.	



4. Enable/Disable sensing beam colors.

Method	Action	Result
Push Button	Click Static (-) or Dynamic (+) to toggle between choices: <ul style="list-style-type: none"> • Dynamic (+)—increment • Static (-)—decrement 	The sensor steps between the possible sensing beam color combinations, as shown in Figure 8 on page 7. ⁸ The visible sensing beam also provides indication of enabled sensing beam color(s).
Remote Input	Enter sequential pulses to toggle between choices: <ul style="list-style-type: none"> • Single-pulse—increment • Double-pulse—decrement 	

5. Return to Run mode.

Method	Action	Result
Push Button	a. Press and hold Static (-) for > 2 seconds to return to Setup mode. b. Press and hold both push buttons > 2 seconds to return to Run mode OR wait > 60 seconds.	The sensor returns to Run mode with new settings. These steps return to Run mode from both Setup modes.
Remote Input	a. Four-pulse the remote line to return to Setup mode. b. Hold the remote line low > 2 seconds to return to Run mode OR wait > 60 seconds. 	

⁸ If the new color setting has only one sensing beam color enabled, the sensor will switch to that color for sensing.

If the new color setting has multiple sensing beam colors enabled, the sensor will use the color that was active prior to configuration; following the next TEACH procedure, it will select the enabled sensing beam color that has the greatest contrast.

Specifications

Supply Voltage and Current

- 10 V dc to 30 V dc (10% maximum ripple)
- Supply current (exclusive of load current):
 - 75 mA max at 10 V dc
 - 35 mA at 30 V dc

Supply Protection Circuitry

Protected against reverse polarity and transient voltages

Output Configuration

Outputs are bipolar: one current sourcing (PNP) and one current sinking (NPN) open-collector transistor

Output Rating

- 100 mA maximum, each output
- OFF-state leakage current: NPN < 200 microamps; PNP < 10 microamps (see Application Note 1)
- NPN Saturation: < 1.6 V at 100 mA
- PNP Saturation: < 3.0 V at 100 mA

Output Protection Circuitry

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

Output Response Time

50 microseconds



Note: 1 second delay on power-up; output does not conduct during this time

Repeatability

15 microseconds

Tri-Color LED Sensing Image

Rectangular: 1.2 mm x 3.8 mm (0.05 in x 0.15 in) at 10 mm (0.39 in) from the face of the lens; image oriented either parallel or perpendicular to sensor length, depending on model
 Red: 636 nm; Green: 525 nm; Blue: 472 nm

Adjustments

- Using push buttons ("+" Dynamic and "-" Static):
 - Manually adjust discrete output switchpoint using "+" or "-" buttons
 - Dynamic TEACH (teach on-the-fly) sensitivity adjustment
 - Static TEACH sensitivity adjustment
 - Light operate/Dark operate
 - OFF-delay/ON-delay
 - Sensing beam color enable/disable

- Using Remote TEACH input (gray wire):
 - Dynamic TEACH (teach on-the-fly) sensitivity adjustment
 - Static TEACH sensitivity adjustment
 - Light operate/Dark operate
 - OFF-delay/ON-delay
 - Sensing beam color enable/disable
 - Disable push buttons for security

Indicators

8-segment Barograph display: Red signal strength indicator relative to taught signal level; higher segment number for higher sensing contrast
 Light Operate: Green
 Dark Operate: Green
 OFF-Delay: Green
 ON-Delay: Green
 Output Conducting: Amber
 Power/Run Mode: Green

Construction:

- Housing: Zinc alloy die-cast and steel housing with black painted finish and o-ring sealed lens and lens port cap
- Lens: Acrylic
- Lens port cap and lens holder: ABS
- Push-buttons: Thermoplastic elastomer
- Labels: Polycarbonate

Environmental Rating

IEC IP67, NEMA 6

Connections

PVC-jacketed 5-conductor 2 m (6.5 ft) or 9 m (30 ft) cable with internal strain relief; integral 5-pin Euro-style QD fitting; or 150 mm (6 in) pigtail with 5-pin Euro-style QD fitting

Operating Conditions

- Temperature: -10 °C to +55 °C (+14 °F to +131 °F)
- Storage Temperature: -20 °C to +80 °C (-4 °F to +176 °F)
- 90% at +50 °C maximum relative humidity (non-condensing)

Vibration and Mechanical Shock

All models meet IEC 68-2-6 and IEC 68-2-27 testing criteria

Application Notes

1. NPN OFF-state leakage current is < 200 µA for load impedances > 3kΩ or optically isolated loads. For load current of 100 mA, leakage is < 1% of load current.
2. Do not mount the sensor directly perpendicular to shiny surfaces; position it at approximately a 15° angle in relation to the sensing target (see [Mounting Considerations](#) on page 3).
3. Minimize web or product "flutter" whenever possible to maximize sensing reliability.

Required Overcurrent Protection



WARNING: Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.

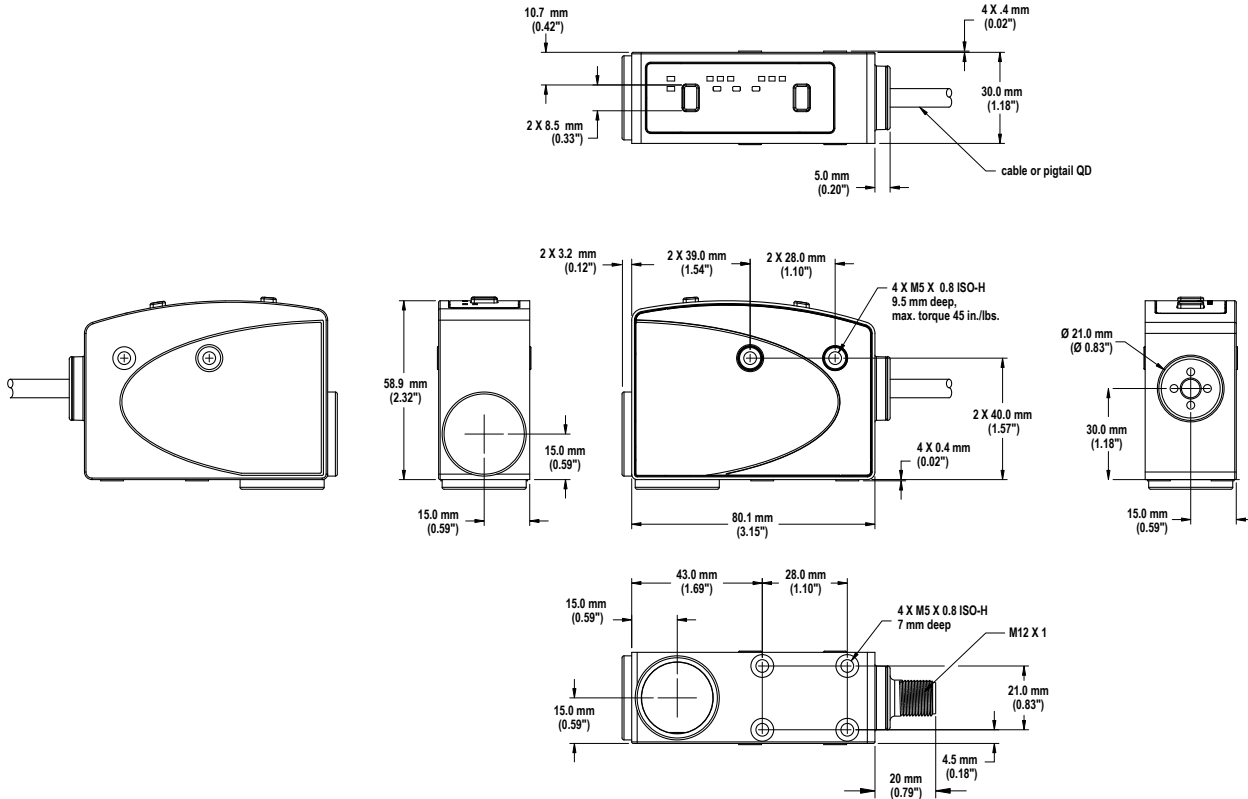
Overcurrent protection is required to be provided by end product application per the supplied table. Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply. Supply wiring leads < 24 AWG shall not be spliced. For additional product support, go to www.bannerengineering.com.

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

Certifications



Dimensions



All measurements are listed in millimeters [inches], unless noted otherwise.

Accessories

Quick-Disconnect (QD) Cordsets

5-Pin Threaded M12/Euro-Style Cordsets—with Shield				
Model	Length	Style	Dimensions	Pinout (Female)
MQDEC2-506	1.83 m (6 ft)	Straight		<p>1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray</p>
MQDEC2-515	4.57 m (15 ft)			
MQDEC2-530	9.14 m (30 ft)			
MQDEC2-550	15.2 m (50 ft)			
MQDEC2-506RA	1.83 m (6 ft)	Right-Angle		
MQDEC2-515RA	4.57 m (15 ft)			
MQDEC2-530RA	9.14 m (30 ft)			
MQDEC2-550RA	15.2 m (50 ft)			

Mounting Brackets

SMB55A

- 15° offset bracket
- 12-gauge stainless steel



SMB55F

- Flat-mount bracket
- 12-gauge stainless steel



SMB55RA

- Right-angle bracket
- 12-gauge stainless steel



SMB55S

- 15° offset bracket
- 12-gauge stainless steel



Replacement Lens

UC-F55

- Replacement lens for F58A, F58B, and F58E



Banner Engineering Corp. Limited Warranty

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