QS30LLP and LLPC Laser Retroreflective Series Sensors

Original Instructions
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Chapter 1 Features

Polarized Retroreflective Laser Sensors



- Visible class 1 laser with small, effective beam size
- Excellent optical performance throughout sensing range, even close up
- Easy push-button SET options: Maximum Excess Gain or Low-Contrast SET, depending on model, plus Manual Adjust
- Easy-to-read operating status indicators, with 8-segment bar graph display
- Bipolar discrete outputs, PNP and NPN
- Selectable 30 millisecond OFF-delay
- Models available with 2 m or 9 m (6.5 ft or 30 ft) cable or integral quick-disconnect
- Tough ABS housing rated IP67
- Compact housing, mounting versatility – popular 30 mm threaded nose or side-mount

Excellent for applications where high sensing power and small beam size are important. Operates over sensing ranges typically accomplished only by conventional opposed-mode photoelectrics; uses a special filter to polarize the emitted light, filtering out unwanted reflections from shiny objects.

WARNING:

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

Models

Model	Range and Use	Spot Size at Focus	Cable	Supply	Output Type
QS30LLP	0.2 m to 18 m (0.67 ft to 60 ft) Maximum Excess Gain SET for Long-Range Applications	Approx. 4 mm at 10 m (0.16 in at 33 ft)	2 m (6.5 ft) 5-wire Cable	10 V DC to 30 V DC	Bipolar NPN / PNP
QS30LLPQ			Integral 5-pin M12 Quick Disconnect Connector		
QS30LLPC	0.2 m to 18 m (0.67 ft to 60 ft) Low-Contrast SET for Small Object Detection		2 m (6.5 ft) 5-wire Cable		
QS30LLPCQ			Integral 5-pin M12 Quick Disconnect Connector		

To order the 9 m (30 ft) cable models, add the suffix “W/30” to the model number of any cabled sensor (for example, QS30LLP W/30). A model with a quick disconnect connector requires a mating cable.

Overview

QS30LLP and QS30LLPC Series sensors are easy-to-use, high-performance laser sensors whose many configuration options make them suitable for demanding applications. Each sensor features two identically configured outputs, one each NPN and PNP.

The compact housing has a large, easy-to-see bar graph display plus bright LEDs for easy configuration and status monitoring during operation. The sensor can be side-mounted, using integral mounting holes, or front-mounted, via the 30 mm threaded barrel.

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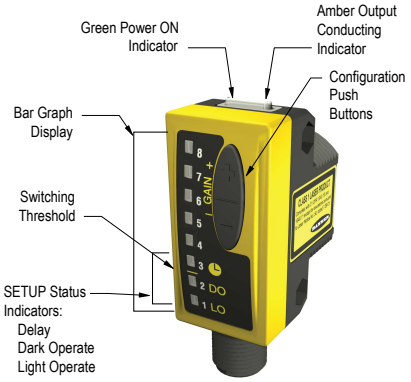
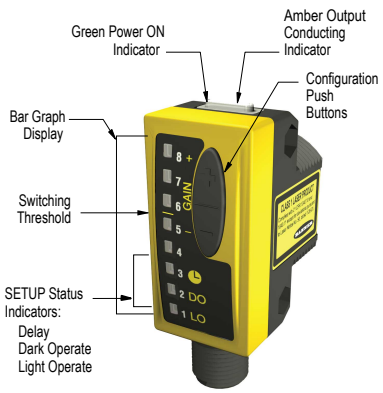
MODEL QS30LLP(Q) is configured using the Maximum Excess Gain SET procedure. It is useful for long-range applications and high variations in contrast, such as beam-break applications where the target objects are larger than the beam. See "Maximum Excess Gain SET - Model QS30LLP" on page 10 for more information.

MODEL QS30LLPC(Q) is configured using the Low-Contrast SET procedure. It is useful for small object detection and other applications with small variations in contrast, such as yarn- or thread-break applications. See "Low-Contrast SET - Model QS30LLPC" on page 11 for more information.

Model QS30LLP Features



Model QS30LLPC Features



Specifications

Supply Voltage and Current
10 V DC to 30 V DC (10% maximum ripple at 10% duty cycle) at 35 mA maximum current, exclusive of load

Sensing Beam
Class 1 visible red LED (see "Class 1 Laser Description and Safety Information" on page 5)

Beam Size at Aperture
Approximately 3 mm

Supply Protection Circuitry
Protected against reverse polarity, overvoltage, and transient voltages

Delay at Power-Up
1 second maximum; outputs do not conduct during this time

Output Configuration
Solid-state bipolar (SPDT): 1 current sourcing (PNP) and 1 current sinking (NPN)

Output Rating
150 mA maximum load

Off-state leakage current: < 10 µA at 30 V DC

ON-state saturation voltage:

NPN: less than 1.0 V at 150 mA load
PNP: less than 2.0 V at 150 mA load

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

Output Response
500 microseconds

Repeatability
70 microseconds

Required Overcurrent Protection

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

Overcurrent protection is required to be provided by end product application per the supplied table.

Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply.

Supply wiring leads < 24 AWG shall not be spliced.

For additional product support, go to www.bannerengineering.com.

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

Adjustments
2 push buttons and remote wire

Easy push-button configuration
Manually adjust (+/-) thresholds (push buttons only)
LO/DO and OFF-delay configuration options
Push-buttons lockout (from remote wire only)

Factory Defaults:

No Delay
Dark Operate
Push buttons enabled

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Indicators

Green LED: Power ON

Amber LED: Output conducting

8-Segment Red Bar Graph

SETUP mode:

LED 3 (clock): Flashes Red when delay is selected
LED 2 (DO): Flashes Red when Dark Operate is selected
LED 1 (LO): Flashes Red when Light Operate is selected

RUN mode: Signal Strength (excess gain), relative to switchpoint

Model QS30LLP	Model QS30LLPC
LED 8: >6X	LED 8: >2X
LED 7: 5-6X	LED 7: 1.5-2X
LED 6: 4-5X	LED 6: 1-1.5X
LED 5: 3-4X	LED 5: 0.8X
LED 4: 2-3X	LED 4: 0.6X
LED 3: 1-2X	LED 3: 0.4X
LED 2: 0.5-1X	LED 2: 0.2X
LED 1: 0-0.5X	LED 1: 0X

Sensor calibration failure: Alternating even-numbered and odd-numbered LEDs flash

Construction

ABS housing, acrylic lens cover

Environmental Rating

IP67

Connections

5-conductor 2 m (6.5 ft) PVC cable, 9 m (30 ft) PVC cable, or 5-pin integral M12 male quick-disconnect fitting

Operating Conditions

–10 °C to +50 °C (+14 °F to +122 °F)

95% at +50 °C maximum relative humidity (non-condensing)

Vibration and Mechanical Shock

All models meet MIL-STD-202F, Method 201A (Vibration: 10 Hz to 60 Hz maximum, 0.06 inch (1.52 mm) double amplitude, 10G maximum acceleration) requirements. Also meets IEC 60947-5-2 (Shock: 30G 11 ms duration, half sine wave) requirements.

Certifications

Class 1 Laser Description and Safety Information



Laser light. Do not stare into the beam.

Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 56, dated May 8, 2019.





CAUTION:

- **Never stare directly into the sensor lens.**
- Laser light can damage your eyes.
- Avoid placing any mirror-like object in the beam. Never use a mirror as a retroreflective target.



CAUTION:

- **Return defective units to the manufacturer.**
- Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- Do not attempt to disassemble this sensor for repair. A defective unit must be returned to the manufacturer.



CAUTION:

- **Ne regardez jamais directement la lentille du capteur.**
- La lumière laser peut endommager la vision.
- Évitez de placer un objet réfléchissant (de type miroir) dans la trajectoire du faisceau. N'utilisez jamais de miroir comme cible rétro-réfléchissante.

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CAUTION:

- **Tout dispositif défectueux doit être renvoyé au fabricant.**
- L'utilisation de commandes, de réglages ou de procédures autres que celles décrites dans le présent document peut entraîner une exposition dangereuse aux radiations.
- N'essayez pas de démonter ce capteur pour le réparer. Tout dispositif défectueux doit être renvoyé au fabricant.

Class 1 lasers are lasers that are safe under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing.

Complies with IEC 60825-1:2014 and EN 60825-1:2014+A11:2021.

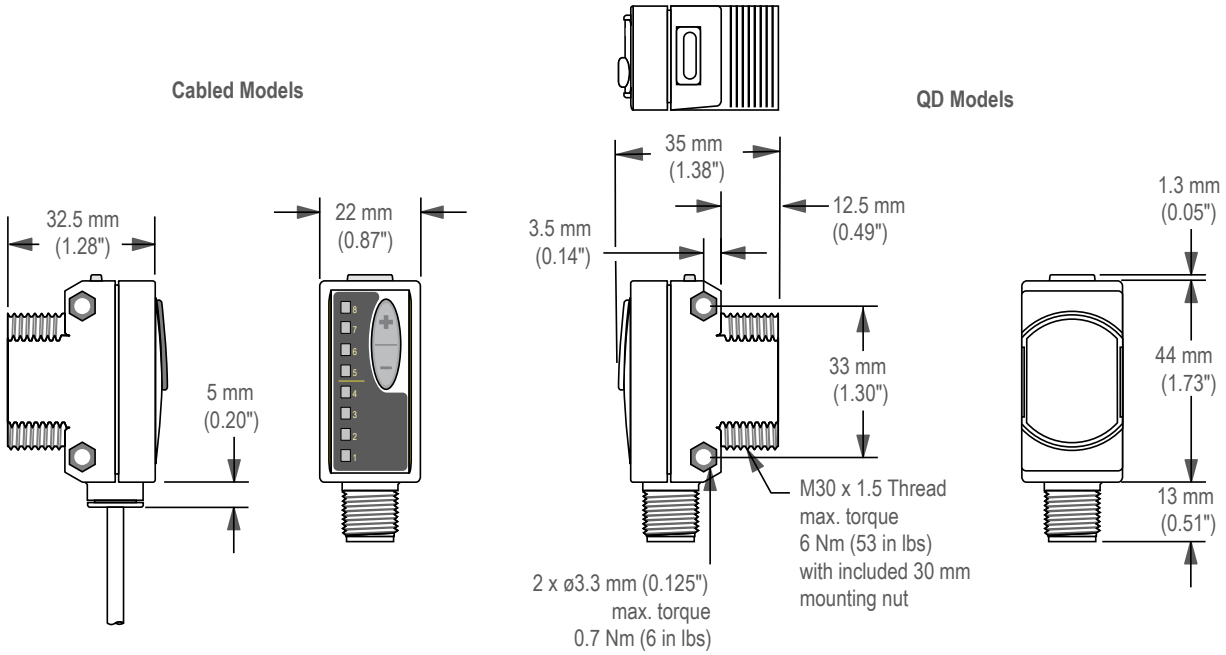
For safe laser use:

- Do not stare at the laser.
- Do not point the laser at a person’s eye.
- Mount open laser beam paths either above or below eye level, where practical.
- Terminate the beam emitted by the laser product at the end of its useful path.

Class 1 Laser Characteristics

Output power: LASER OUTPUT
Laser wavelength: 650 nm
Pulse duration: LASER PULSE µs

Dimensions



Hardware Included: (2) M3 × 0.5 × 28 stainless steel machine screws, nuts, and washers

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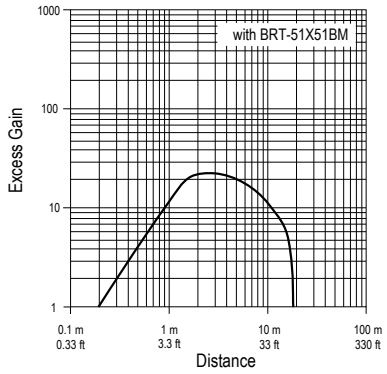
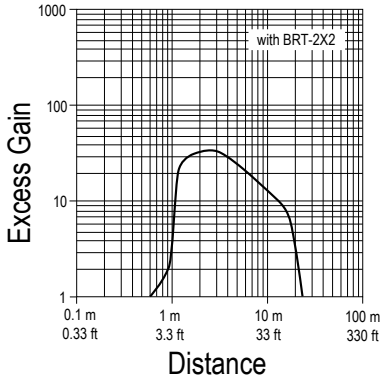
Excess Gain

With Supplied Target BRT-51X51BM



With Target BRT-2X2 (Optional)



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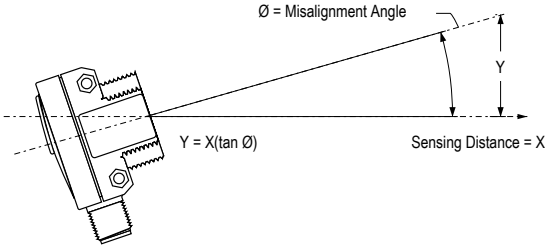
Chapter 2 Device Setup

Installation Notes

Conventional retroreflective photoelectric sensors are extremely easy to align. Beam angles are wide, and retro targets are forgiving to the light beam's angle of incidence. The beam of this laser sensor is very narrow, compared with the beam of most retro sensors. As Figure 6 indicates, the effect of angular misalignment can be dramatic. Alignment is critical because the beam may miss the retroreflective target unless the target is large.

	Sensor-to-Target Distance (X)	Beam Displacement (Y) for 1° of Misalignment
Beam Displacement per degree of misalignment  	1.5 m (5 ft)	25 mm (1 in)
	3 m (10 ft)	50 mm (2 in)
	6 m (20 ft)	100 mm (4 in)
	15 m (50 ft)	250 mm (10 in)
	30 m (100 ft)	500 mm (20 in)

For example, with one BRT-51X51BM mounted at a distance of 6 m (20 ft) from the sensor, one degree of angular misalignment will cause the center of the laser beam to miss the center of the target by 100 mm (4 in).

Alignment Tip

When using a small retroreflective target at medium or long range, it is often useful to temporarily attach (or suspend) a strip of retroreflective tape (for example, BRT-THG-3X3) along a line that intersects the actual target. The visible red laser beam is easily seen in normal room lighting on such tape. Sight along the beam toward the target (from behind the sensor). Move the sensor to scan the laser beam back and forth across the retro tape strip. Use the tape strip to guide the beam onto the target.

Consider using sensor mounting bracket model SMB30SC (see "Brackets" on page 15). This swivel bracket can simplify multiple-axis alignment. Alignment is complete when the visible image is centered on the retro target. The perpendicularity of the laser beam to the face of the retro target is forgiving, just as it is with a conventional retroreflective sensor.

Effective Beam Size

Unlike conventional retroreflective sensors, the retroreflective laser has the ability to sense relatively small profiles. Figure 7 indicates the diameter of the smallest opaque rod which will reliably break the laser beam at several sensor-to-object distances using sensor model QS30LLP(Q). These minimum object sizes were measured with the sensor aligned to a BRT-51X51BM reflector and the gain set to maximum using the Max Excess Gain SET. This sensor is typically recommended for long-range applications of relatively small targets that will completely break the beam.

Minimum object detection size vs. distance from sensor, model QS30LLP(Q)

Sensor-to-Object Distance (X)	Minimum Object Detection Size
0.3 m (1 ft)	2.5 mm (0.10 in)
1.5 m (5 ft)	5.0 mm (0.20 in)
3 m (10 ft)	7.0 mm (0.28 in)
18 m (59 ft)	13 mm (0.52 in)

Smaller objects can be detected by using model QS30LLPC(Q), adjusting the sensor gain down using the Manual Adjust, or performing a Low-Contrast SET of the reflector. Objects as small as 2.0 mm can be reliably detected after performing the Low-Contrast SET at ranges up to 6 m (18 ft). This sensor is typically recommended for shorter-range applications detecting very small targets that may break only a portion of the beam.

Note that the shape of the beam is elliptical. The minimum object sizes listed assume passage of the rod across the major diameter of the ellipse (worst case). It may be possible to detect objects smaller than the sizes listed if the direction in which the objects pass through the beam can be controlled.

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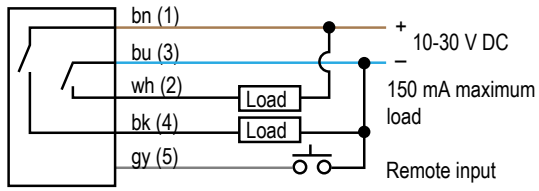
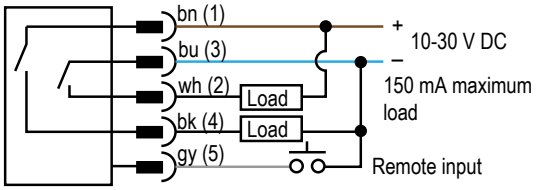
Retroreflector Recommendations

BRT-51X51BM is recommended for beam-block applications up to 18 m range.

Wiring Diagrams

Cabled Models	Quick-Disconnect Models
	

NOTE: The pink wire is not used.

Sensor Configuration

Configure the sensor using the SET and SETUP modes. After SET mode has defined the sensing parameters, use SETUP mode to add an OFF-delay or change the light/dark operate status. Use Manual Adjust to fine-tune the thresholds. Use the two push buttons, “+” and “-”, to access and set sensing parameters. The remote wire also may be used for some procedures.

In dark operate (DO) mode, the output is ON when the target returns less light to the sensor than the configured target and OFF when the sensor detects more light than the configured/taught target.

In light operate (LO) mode, the output is ON when the target returns the same or more light to the sensor and OFF when the sensor detects less light than the configured/taught target.

In **retroreflective** sensing modes, light operate is active when the beam is unblocked and dark operate is active when the beam is blocked.

Remote Configuration

Use the Remote Configuration function to set the sensor threshold remotely or to disable the push buttons for security. Connect the gray wire of the sensor to ground (0 V DC), with a remote programming switch connected between them. Pulse the remote line according to the diagrams in the programming procedures. The length of the individual programming pulses is equal to the value T: 0.04 seconds ≤ T ≤ 0.8 seconds.

Push Button Disable

In addition to its programming function, Remote Programming may be used to disable the push buttons for security. Disabling the push buttons prevents undesired tampering with the programming settings. Connect the gray wire of the sensor as described and four-pulse to enable or disable the push buttons.

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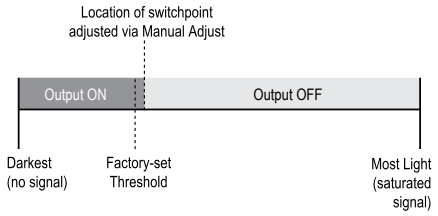
Maximum Excess Gain SET - Model QS30LLP

- Sets the sensor for maximum excess gain without allowing false proxing. Provides maximum contrast between any reflector and a blocked condition and is stable even in dirty environments.
- Useful for long-range applications and high variations in contrast, such as beam-break applications where the target objects are larger than the beam.

Sensor can be aimed at an object or the reflector during SET process to obtain the same result. All conditions darker than the switchpoint condition result in ON output (Dark Operate). Output ON and OFF conditions can be reversed by changing Light/Dark Operate in SETUP mode (factory setting: Dark Operate).

Maximum Excess Gain SET (Dark Operate shown)



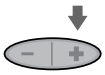
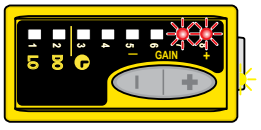
Manual Adjust – Maximum Excess Gain SET

During RUN mode, adjusts switchpoint up or down via “+” or “–” push buttons.

- Each push button “click” adjusts the switchpoint up by approximately 0.5X excess gain or down by the same increments.
- The lighted bar graph LEDs move to reflect the increase or decrease of excess gain relative to the switchpoint.
- LEDs #7 and 8 flash when maximum gain is achieved; LEDs #1 and 2 flash when minimum gain is achieved.

When the received signal is at any level greater than 6X excess gain, the first “–” (minus) click to reduce excess gain reduces it to the 6X level. Subsequent “–” clicks result in decreased values as shown in "QS30LLP and LLPC Specifications" on page 4 (approximately 2 clicks per LED change). To return to maximum excess gain, either press “+” repeatedly until LEDs #7 and 8 flash, or hold the “+” button for longer than 2 seconds. For example, in an application that results in 20X excess gain, pressing “–” once lowers the gain to 6X, exhibited by LED #8 ON. Pressing it twice more results in approximately 5X excess gain, exhibited by LED #7 ON. Holding the “+” button for 2 seconds results in a return to maximum gain (20X), exhibited by LEDs #7 and 8 flashing.

Set the Switchpoint

Method	Action		Result
Push Button	Press and hold "+" > 2 seconds		Green Power LED: OFF Amber Output LED: ON Bar graph: #7 & 8 flashing • Sensor returns to RUN mode with new settings • Use Manual Adjust to increase or decrease sensor excess gain 
Remote Input[1]	Single-pulse the remote input.		

[1] 0.04 seconds ≤ T ≤ 0.8 seconds

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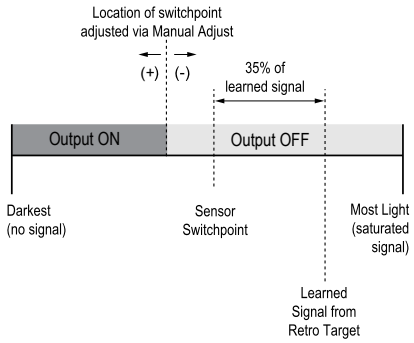
Low-Contrast SET - Model QS30LLPC

Low-Contrast SET (Dark Operate shown)



- Sets a switchpoint at 35 percent below the signal from the retroreflector.
- Useful for small object detection and other applications with small variations in contrast, such as yarn- or thread-break applications.
- Sensor must be aimed at the reflector during the SET process. All conditions darker than the switchpoint condition result in ON output (Dark Operate). Output ON and OFF conditions can be reversed by changing Light/Dark Operate in SETUP mode (factory setting: Dark Operate).

Manual Adjust – Low-Contrast SET

During RUN mode, adjusts switchpoint up or down via “+” or “–” push buttons.

- Each push button “click” adjusts the switchpoint up by 5 percent of the signal from the reflector or down by the same increments.
- The lighted bar graph LEDs move to reflect the increase or decrease in excess gain.
- LEDs #7 and 8 flash when maximum gain is achieved; LEDs #1 and 2 flash when minimum gain is achieved.

If the target object does not cause the output to change state, press the “–” button to decrease the gain, making the sensor more sensitive to small signal changes.

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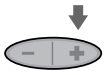
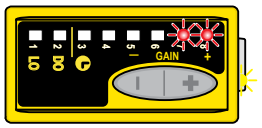
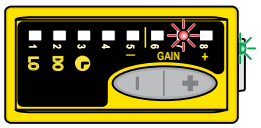
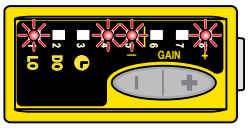
Set Switchpoint

Method	Action		Result
Push Button	a. Align sensor to the reflector. b. Press and hold "+" > 2 seconds.		Green Power LED: OFF Amber Output LED: ON  **Switchpoint Accepted** Bar graph: #7 and 8 flash for 2 sec Amber Power LED: OFF Green Power LED: ON Bar graph: Appropriate LED ON • Sensor returns to RUN mode with new settings • Use Manual Adjust to increase or decrease sensor sensitivity  **Switchpoint Not Accepted** Bar graph: #1, 4, 5, and 8 flash for 2 sec Green Power LED: ON • Sensor returns to RUN mode without saving (maintains previous settings) 
Remote Input[2]	a. Align sensor to the reflector. b. Single-pulse remote line.		

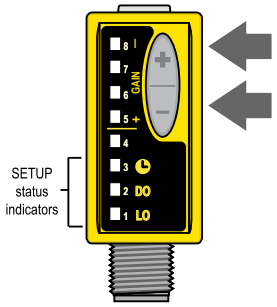
SETUP Mode

SETUP mode is accomplished via the sensor's two push buttons. It is used to change sensor output response for:

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

The status LEDs, active only during SETUP mode, indicate the output response configuration when the sensor will be in RUN mode.

SETUP Mode



1. Access SETUP Mode.

[2] 0.04 seconds ≤ T ≤ 0.8 seconds

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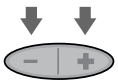
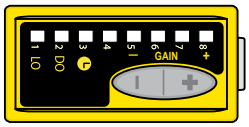
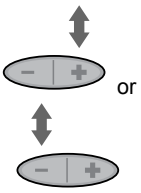
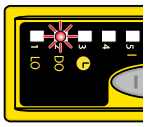
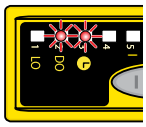
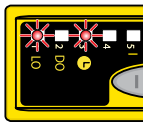
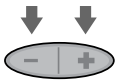
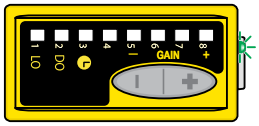
Method	Action		Result
Push Button[3]	Press and hold both push buttons > 2 seconds		Green Power LED turns OFF 

2. Select SETUP Options.

Method	Action		Result	
Push Button	Click either push button to toggle through the four possible setting combinations.	 or	DO, No Delay 	DO 30 ms Delay 
			LO, 30 ms Delay 	LO, No Delay 

3. Return to RUN Mode.

Method	Action		Result
Push Button	Press and hold both push buttons > 2 seconds.		Green Power LED turns ON 

[3] 0.04 seconds ≤ T ≤ 0.8 seconds

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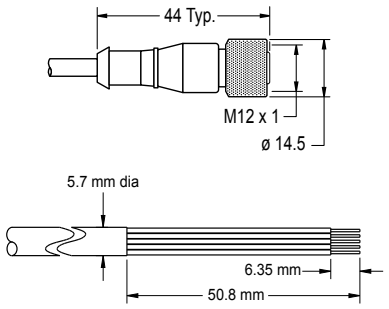
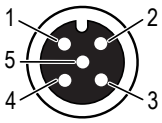
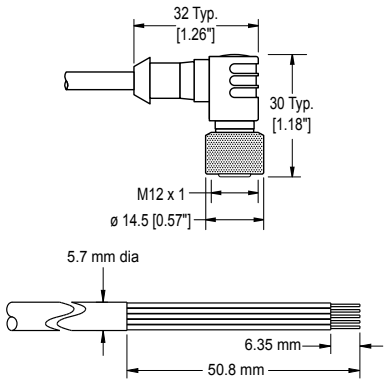
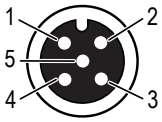
Chapter 3 Accessories

Quick-Disconnect Cordsets

5-Pin A-Code Single-Ended M12 Female Cordsets (datasheet p/n 235936)				
Model	**Length**	**Dimensions (mm)**	**Pinout (Female)**	
BC-M12F5-22-1	1 m (3.28 ft)			1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray c UL us LISTED
BC-M12F5-22-2	2 m (6.56 ft)			
BC-M12F5-22-5	5 m (16.4 ft)			
BC-M12F5-22-8	8 m (26.25 ft)			
BC-M12F5-22-10	10 m (30.81 ft)			
BC-M12F5-22-15	15 m (49.2 ft)			

5-Pin A-Code Single-Ended M12 Female Right-Angle Cordsets (datasheet p/n 235936)				
Model	**Length**	**Dimensions (mm)**	**Pinout (Female)**	
BC-M12F5A-22-1	1 m (3.28 ft)			1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray c UL us LISTED
BC-M12F5A-22-2	2 m (6.56 ft)			
BC-M12F5A-22-5	5 m (16.4 ft)			
BC-M12F5A-22-8	8 m (26.25 ft)			
BC-M12F5A-22-10	10 m (30.81 ft)			
BC-M12F5A-22-15	15 m (49.2 ft)			

Retroreflective Targets

NOTE: Polarized sensors require corner cube type retroreflective targets only.

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BRT-2X2

- Square, acrylic target
- Reflectivity factor: 1.0
- Maximum temperature: +50 °C (+122 °F)
- Optional brackets are available
- Reflector size: 51 mm × 51 mm
- Approximate size: 51.3 mm × 61 mm
- Two 4.2 mm diameter slots for mounting
- CAD files: DXF, PDF, IGS, STP

BRT-2X2-25 Qty 25

BRT-2X2-100 Qty 100



BRT-51X51BM

- Square, acrylic target
- Reflectivity Factor: 1.5
- Temperature: –20 °C to +50 °C (–4 °F to +122 °F)
- Micro-prism geometry
- Optional brackets are available
- Reflector size: 51 mm × 51 mm
- Approximate size: 51 mm × 61 mm × 6.2 mm
- Two 4.6 mm diameter slots for mounting
- CAD Files: DXF, PDF, IGS, STP



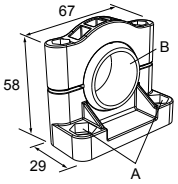
Brackets

All measurements are listed in millimeters, unless noted otherwise. The measurements provided are subject to change.

SMB30SC

- Swivel bracket with 30 mm mounting hole for sensor
- Black reinforced thermoplastic polyester
- Stainless steel mounting and swivel locking hardware included
- CAD Files: DXF, PDF, IGS, STP

Hole center spacing: A=ø 50.8
Hole size: A=ø 7.0, B=ø 30.0



SMBQS30LT

- Tall right-angle bracket for QD models
- ± 8° tilt adjustment
- 14-gauge stainless steel
- CAD Files: DXF, PDF, IGS, STP

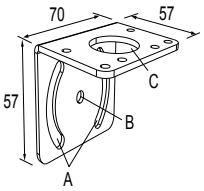
Hole center spacing: A to B=35.0
Hole size: A=ø 4.3, B=ø 4.25×16.3



SMB30MM

- 12-gauge stainless steel bracket with curved mounting slots for versatile orientation
- Clearance for M6 (¼ in) hardware
- Mounting hole for 30 mm sensor
- CAD Files: DXF, PDF, IGS, STP

Hole center spacing: A=51, A to B=25.4
Hole size: A=42.6 × 7, B=ø 6.4, C=ø 30.1



SMBQS30L

- Right-angle bracket for cable sensor models
- Clearance for M4 (#8) hardware
- ± 12° tilt adjustment
- 14-gauge stainless steel
- CAD Files: DXF, PDF, IGS, STP

Hole center spacing: A to B=35.0
Hole size: A=ø 4.3, B=ø 4.25×16.3



Continued on page 16

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Continued from page 15

SMBQS30Y

- Heavy-duty die-cast bracket
- M18 vertical mount option
- ± 8° tilt adjustment with cabled units
- Includes nuts and lock washer
- CAD Files: DXF, PDF, IGS, STP

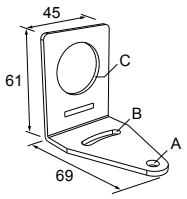
Hole size: A=ø 15.3



SMB30A

- Right-angle bracket with curved slot for versatile orientation
- Clearance for M6 (¼ in) hardware
- Mounting hole for 30 mm sensor
- 12-gauge stainless steel
- CAD Files: DXF, PDF, IGS, STP

Hole center spacing: A to B=40
Hole size: A=ø 6.3, B= 27.1 × 6.3, C=ø 30.5



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