

WORLD-BEAM® QS30 Diffuse-Mode Laser Sensor



Datasheet



- Visible laser beam for diffuse sensing
- Available with Class 1 or long-range Class 2 laser
- Excellent optical performance throughout sensing range, even close up
- Easy-to-set Expert-style TEACH options¹ including Static, Dynamic, and Single-Point programming plus manual adjustment for fine-tuning
- Easy-to-read operating status indicators, with 8-segment bargraph 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
- Compact housing, mounting versatility – popular 30 mm threaded nose or side-mount



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.

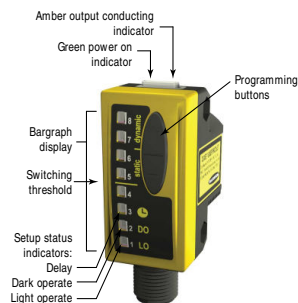
Models

Models ²	Laser Class	Range	Spot Size at Focus	Connection
QS30LD	Class 1	400 mm (16 in)	Approx. 1 mm at 400 mm (0.039 in at 16 in)	2 m (6.5 ft) unterminated 5-wire cable
QS30LDQ				Integral 5-pin M12/Euro-style male quick disconnect (QD)
QS30LDL	Class 2	800 mm (32 in)	Approx. 1 mm at 800 mm (0.039 in at 32 in)	2 m (6.5 ft) unterminated 5-wire cable
QS30LDLQ				Integral 5-pin M12/Euro-style male quick disconnect (QD)

QS30 Laser Diffuse Overview

The QS30 is an easy-to-use, high-performance laser sensor whose many configuration options make it suitable for demanding applications. It provides high-performance sensing in low-contrast applications at relatively long range. It features static, dynamic and single-point TEACH-mode programming, in addition to manual fine adjustment, remote programming and security lockout options. A SETUP mode also may be used to change the sensor's output response.

The sensor features two identically configured outputs, one each NPN and PNP. The sensor's compact housing has a large, easy-to-see bar graph display plus bright LEDs for easy programming and status monitoring during operation. The sensor can be side-mounted, using its integral mounting holes, or front-mounted, via its 30 mm threaded barrel.



¹ U.S. Patent #5,808,296

² To order the 9 m (30 ft) cable models, add the suffix "W/30" to the model number of any cabled sensor (for example, QS30LD W/30). A model with a QD connector requires a mating cable.



Description of Laser Classes



Class 1 Lasers

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

Reference IEC 60825-1:2001, Section 8.2.



Class 2 Lasers

Class 2 lasers are lasers that emit visible radiation in the wavelength range from 400 nm to 700 nm, where eye protection is normally afforded by aversion responses, including the blink reflex. This reaction may be expected to provide adequate protection under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing.

Reference IEC 60825-1:2001, Section 8.2.

Class 2 Laser Safety Notes

Low-power lasers are, by definition, incapable of causing eye injury within the duration of a blink (aversion response) of 0.25 seconds. They also must emit only visible wavelengths (400 to 700 nm). Therefore, an ocular hazard may exist only if individuals overcome their natural aversion to bright light and stare directly into the laser beam.

For Safe Laser Use (Class 1 or Class 2):

- 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.



CAUTION: 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.

Sensor Configuration

Configure the sensor configuration by using the TEACH or Set options, plus Setup mode.

After TEACH or Set have defined the sensing parameters, use the Setup mode to enable the delay or to change the Light Operate/Dark Operate status.

Use the Manual Adjust to fine-tune the thresholds. Two push buttons, Dynamic (+) and Static (-), or the remote wire, may be used to access and set the parameters.

Sensor configuration options include:

- Two-Point Static TEACH: a single switching threshold, determined by two taught conditions.
- Dynamic (on-the-fly) TEACH: a single switching threshold, determined by multiple sampled conditions.
- Window Set: a sensing window, centered on a single sensing condition.
- Light Set and Dark Set: a single switching threshold, offset from a single sensing condition.

Remote Configuration

The remote function can be used to configure the sensor remotely or to disable the push button 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 configuration procedures. The length of the individual programming pulses is equal to the value T where: 0.04 seconds \leq "T" \leq 0.8 seconds

Returning to Run Mode

Configuration modes each may be exited either after the 60-second time-out or by exiting the process in one of the two following ways:

- In static TEACH or SET modes, press and hold the Static (-) button (or hold the remote line) for 2 seconds. The sensor returns to Run mode without saving any new settings.

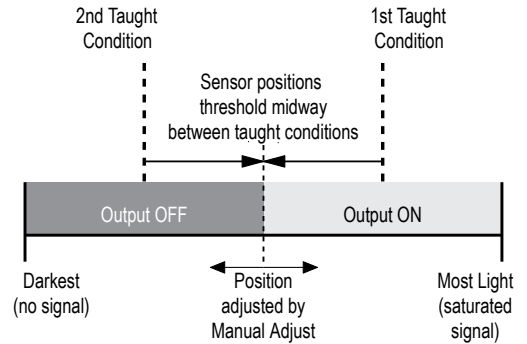
- In SETUP mode, press and hold both the Static (-) and Dynamic (+) buttons (or hold the remote line) for 2 seconds. The sensor returns to Run mode and saves the current setting.

Two-Point Static TEACH (Threshold)

- Sets a single switching threshold (switching point)
- Threshold position is adjustable using “+” and “-” buttons (Manual Adjust).
- Recommended for applications where two conditions can be presented by the user.

Two-Point TEACH is the traditional configuration method. The sensor locates a single sensing threshold (switch point) midway between the two taught conditions, with the Output ON condition on one side and the Output OFF condition on the other.

The first condition taught is the ON condition. The Output ON and OFF conditions can be reversed by changing Light/Dark Operate status in Setup Mode.



Two-Point TEACH and Manual Adjust

Using Manual Adjust with Two-Point TEACH moves the switching threshold position. The lighted LED on the bar graph moves to exhibit the received signal, relative to the threshold.

Bargraph LED (Following TEACH)	Relative Signal Difference/ Recommendation
6 to 8	Excellent: Very stable operation.
4 to 5	Good: Minor variables will not affect sensing reliability.
2 to 3	Low: Minor sensing variables may affect sensing reliability.
1	Unreliable: Consider an alternate sensing scheme.

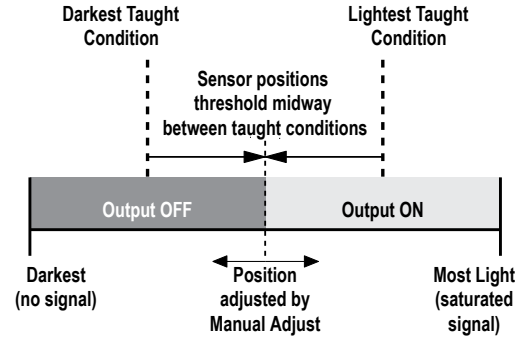
	Push Button	Remote Line	Result
	0.04 seconds ≤ “Click” ≤ 0.8 seconds	0.04 seconds ≤ T ≤ 0.8 seconds	
Access TEACH Mode	Press and hold Static (-) button for more than 2 seconds	No action required; sensor is ready for 1st TEACH condition.	Power LED: OFF Output LED: ON Bar graph: # 5 and 6 flash
TEACH Output ON Condition	Present Output ON condition and click the Static (-) button	Present Output ON condition and single-pulse the remote line	Power LED: OFF Output LED: OFF Bar graph: # 5 and 6 flash
TEACH Output OFF Condition	Present Output OFF condition and click the Static (-) button	Present Output OFF condition and single-pulse the remote line	TEACH Accepted Power LED: ON Bar graph: One LED flashes to show relative contrast (good signal difference shown; see table above) Sensor returns to RUN mode
			TEACH Unacceptable Power LED: OFF Bar graph: # 1, 3 and 6, 8 flash to show failure Sensor returns to “TEACH Output ON Condition”

Dynamic TEACH and Adaptive Thresholds

- Teach on-the-fly
- Sets a single switching threshold (switching point)
- Threshold position is adjustable using “+” and “-” buttons (Manual Adjust)
- Recommended for applications where a machine or process may not be stopped for teaching.

Dynamic TEACH is a variation of two-point TEACH. It programs the sensor during actual machine run conditions, taking multiple samples of the light and dark conditions and automatically setting the threshold 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 threshold between the light and dark conditions. The adaptive threshold system remains in effect during Run mode. The adaptive routine saves to non-volatile memory at least once per hour.



When Dynamic TEACH mode is used, the output ON state (Light or Dark Operate) will remain as it was last programmed. To change the output ON state, use Setup Mode.

The sensing threshold may be adjusted (fine-tuned) whenever 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).

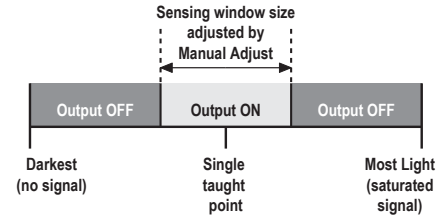
Bar Graph LED (Following TEACH)	Relative Signal Difference/ Recommendation
6 to 8	Excellent: Very stable operation.
4 to 5	Good: Minor variables will not affect sensing reliability.
2 to 3	Low: Minor sensing variables may affect sensing reliability.
1	Unreliable: Consider an alternate sensing scheme.

	Push Button	Remote Line	Result
Access Dynamic TEACH Mode	Press and hold Dynamic (+) push button for more than 2 seconds	Hold the remote line low (to ground) for more than 2 seconds	Power LED: OFF Output LED: OFF Bar graph: # 7 and 8 flash
TEACH Sensing Conditions	Continue to hold push button (+) and present the Output ON and OFF conditions	Continue to hold remote line low (to ground) and present the Output ON and OFF conditions	Power LED: OFF Output LED: OFF Bar graph: # 7 and 8 flash
Return to Run Mode	Release push button (+)	Release the remote line/ switch	TEACH Accepted Power LED: ON Bar graph: One LED flashes to show relative contrast (good signal difference shown; see table above)
			TEACH Unacceptable Power LED: OFF Bar graph: # 1, 3 and 6, 8 flash to show failure Sensor returns to RUN mode without changing settings

Single-Point Window Set

- Sets a single ON condition
- All other conditions (lighter or darker) result in OFF output
- Sensing window size (sensitivity) is adjustable using “+” and “-” buttons (Manual Adjust)

Single-Point TEACH is most useful when a product may not always appear in the same place or when other signals may appear. Single-Point TEACH programs a sensing window, with the Output ON condition inside the window, and the Output OFF conditions outside the window. Output ON and OFF conditions can be reversed by changing Light/Dark Operate status in SETUP mode.



Single-Point TEACH programming may be accomplished only using Static TEACH. The sensor learns a single sensing condition, and adds switching thresholds above and below the taught condition to create a sensing window.

Single-Point Window Set and Manual Adjust

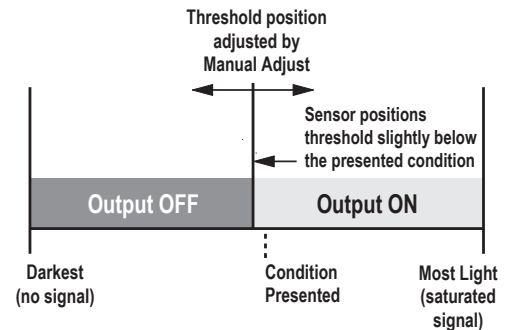
Using Manual Adjust with Single-Point Window Set expands or contracts the size of the window. The lighted LEDs on the light bar separate to a greater or lesser extent to exhibit the relative sensing window size.

	Push Button	Remote Line	Result
	0.04 seconds ≤ “Click” ≤ 0.8 seconds	0.04 seconds ≤ T ≤ 0.8 seconds	
Access Set Mode	Press and hold Static (-) push button for more than 2 seconds	Present the output ON condition and single-pulse the remote line	Power LED: OFF Output LED: ON (Push Button) Output LED: OFF (Remote) Bar graph: # 5 and 6 flash
Teach Set Point (Output ON) Condition	Present the output ON condition and double-click the Static (-) push button	Double-pulse the remote line	TEACH Accepted Power LED: ON Bar graph: # 3, 6 flash together to show single-point TEACH Sensor returns to RUN mode with new settings
			TEACH Unacceptable Power LED: OFF Bar graph: # 1, 3 and 6, 8 flash to show failure, then 5 and 6 flash Sensor waits for valid TEACH condition

Single-Point Light Set

- Sets a threshold slightly below the taught condition.
- Any condition darker than the threshold condition causes the output to change state.
- Threshold position is adjustable using the “+” and “-” buttons (Manual Adjust).
- Recommended for applications where only one condition is known, for example a stable light background with varying darker targets.

A single sensing condition is presented, and the sensor positions a threshold below the presented condition. When a condition darker than the threshold is sensed, the output either turns ON or OFF, depending on the Light/Dark Operate setting (see [Setup Mode](#) on page 7).



Light Set and Light/ Dark Operate Selection

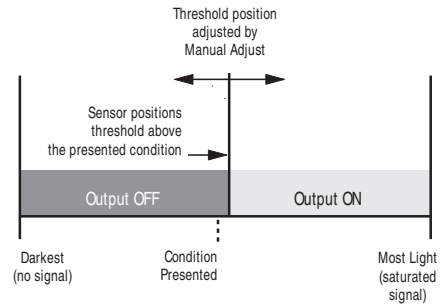
In Light Operate mode, Light Set teaches the Output ON condition. In Dark Operate mode, Light Set teaches the Output OFF condition.

	Push Button	Remote Line	Result
	0.04 seconds ≤ "Click" ≤ 0.8 seconds	0.04 seconds ≤ T ≤ 0.8 seconds	
Access Set Mode	Press and hold Static (-) push button for more than 2 seconds	Single-pulse the remote line	Power LED: OFF Output LED: ON (Push Button) Output LED: OFF (Remote) Bar graph: # 5 and 6 alternately flash
Set Sensing Condition	Present the sensing condition and click the Static (-) push button four times	Present the sensing condition and four-pulse the remote line	Threshold Condition Accepted Power LED: ON Bar graph: Indicators # 5–8 flash together to show that the threshold condition is accepted Sensor returns to RUN mode with new settings
			Threshold Condition Unacceptable Power LED: OFF Bar graph: # 1, 3 and 5, 7 alternately flash to show failure Sensor returns to "SET Sensing Condition"

Single-Point Dark Set

- Sets a threshold slightly above the taught condition.
- Any condition lighter than the threshold condition causes the output to change state.
- Threshold position is adjustable using the "+" and "-" buttons (Manual Adjust).
- Recommended for applications where only one condition is known, for example a stable dark background with varying lighter targets.

A single sensing condition is presented, and the sensor positions a threshold above the taught condition. When a condition lighter than the threshold is sensed, the output either turns ON or OFF, depending on the Light/Dark Operate setting (see [Setup Mode](#) on page 7).



Dark Set and Light/ Dark Operate Selection

In Light Operate mode, Dark Set teaches the Output OFF condition. In Dark Operate mode, Dark Set teaches the Output ON condition.

	Push Button	Remote Line	Result
	0.04 seconds ≤ "Click" ≤ 0.8 seconds	0.04 seconds ≤ T ≤ 0.8 seconds	
Access Set Mode	Press and hold the Static (-) push button for more than 2 seconds	Single-pulse remote line	Power LED: OFF Output LED: ON (Push Button) Output LED: OFF (Remote) Bar graph: # 5 and 6 alternately flash
Set Sensing Condition	Present the sensing condition and click the Static (-) push button five times	Present the sensing condition and five-pulse the remote line	Threshold Condition Accepted Power LED: ON Bar graph: Indicators # 1–4 flash together to show that the threshold condition is accepted Sensor returns to Run mode with new settings
			Threshold Condition Unacceptable Power LED: OFF Bar graph: # 1, 3 and 5, 7 alternately flash to show failure Sensor returns to "Set Sensing Condition"

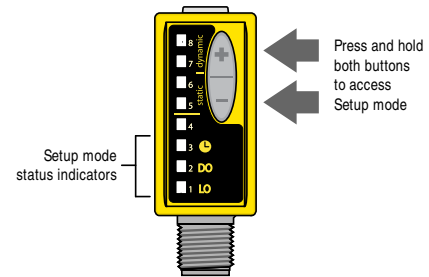
Setup Mode

SETUP mode 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 is in Run mode. Four combinations are possible:

- Light Operate, No Delay
- Dark Operate, No Delay
- Dark Operate, 30 ms Delay
- Light Operate, 30 ms Delay



To access SETUP mode and change the output response settings:

1. Press and hold BOTH push buttons (or double-pulse Remote line) until the green LED indicator turns OFF.
2. Click EITHER push button (or pulse Remote line) to toggle through the four possible setting combinations.
3. Press and hold both push buttons (or hold Remote line) until the green LED indicator turns ON, indicating return to RUN mode.



NOTE:

- If Setup mode programming is interrupted and remains inactive for 60 seconds, the sensor returns to Run mode with the most recent settings (i.e., exits and saves current selection).
- Setup mode operates in the “background”, while the outputs are active.

Manual Adjust

Manual adjust is used during Run mode via the push buttons only. Its behavior depends on whether a switching threshold or sensing window is used.

Switching Threshold (Static TEACH, Dynamic TEACH, Light Set, and Dark Set):

- Fine-tunes sensing threshold set-point value
- Press “+” to increase; press “-” to decrease

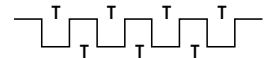
Sensing Window (Window Set):

- Adjusts sensing window size
- Press “+” to increase; press “-” to decrease

The lighted bar graph LEDs move to reflect the increase or decrease.

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.



Reset to Factory Defaults

To reset the sensor back to its factory default settings, eight-pulse the remote input wire.



Where T is: $0.04 \text{ seconds} \leq T \leq 0.8 \text{ seconds}$.

Specifications

Supply Voltage

10 to 30 V dc (10% maximum ripple at 10% duty cycle) at 35 mA maximum current, exclusive of load

Supply Protection Circuitry

Protected against reverse polarity and transient over voltages

Laser Classification

Class 1 or Class 2, depending on model

Output Configuration

Bipolar: 1 current sourcing (PNP) and 1 current sinking (NPN)
 Rating: 150 mA maximum load
 OFF-state leakage current: < 10 µA at 30 V dc
 ON-state saturation voltage: NPN: < 1.0 V at 150 mA load; PNP: < 2.0 V at 150 mA load

Output Protection Circuitry

Protected against output short-circuit and continuous overload

Output Response Time

500 microseconds

Indicators

8-segment red bar graph: Signal strength relative to switch-point
 Green LED: Power ON
 Amber LED: Output conducting

Environmental Rating

IEC IP67; NEMA 6

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 requirements. Method 201A (Vibration: 10 to 60Hz max. double amplitude 0.06 in, maximum acceleration 10G). Also meets IEC 947-5-2 requirements: 30G, 11 ms duration, half sine wave.

Certifications



Sensing Beam

Class 1 Laser: Visible red, 650 nm
 Class 2 Laser: Visible red, 658 nm

Beam Size at Aperture

Approximately 2 mm

Delay at Power Up

1 second maximum; outputs do not conduct during this time

Repeatability

70 microseconds

Adjustments

2 push buttons and remote wire
 Expert Teach programming (two-point static, dynamic, window set, light set, dark set)
 Manually adjust (+/-) thresholds (from buttons only)
 LO/DO and OFF-delay configuration options
 Push-button lockout (from remote wire only)
 Reset to factory defaults (from remote wire only)

Factory Default Settings

Maximum gain
 Single threshold set at midpoint range
 Light operate
 No delays

Construction

ABS housing; acrylic lens cover

Connections

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

Required Overcurrent Protection

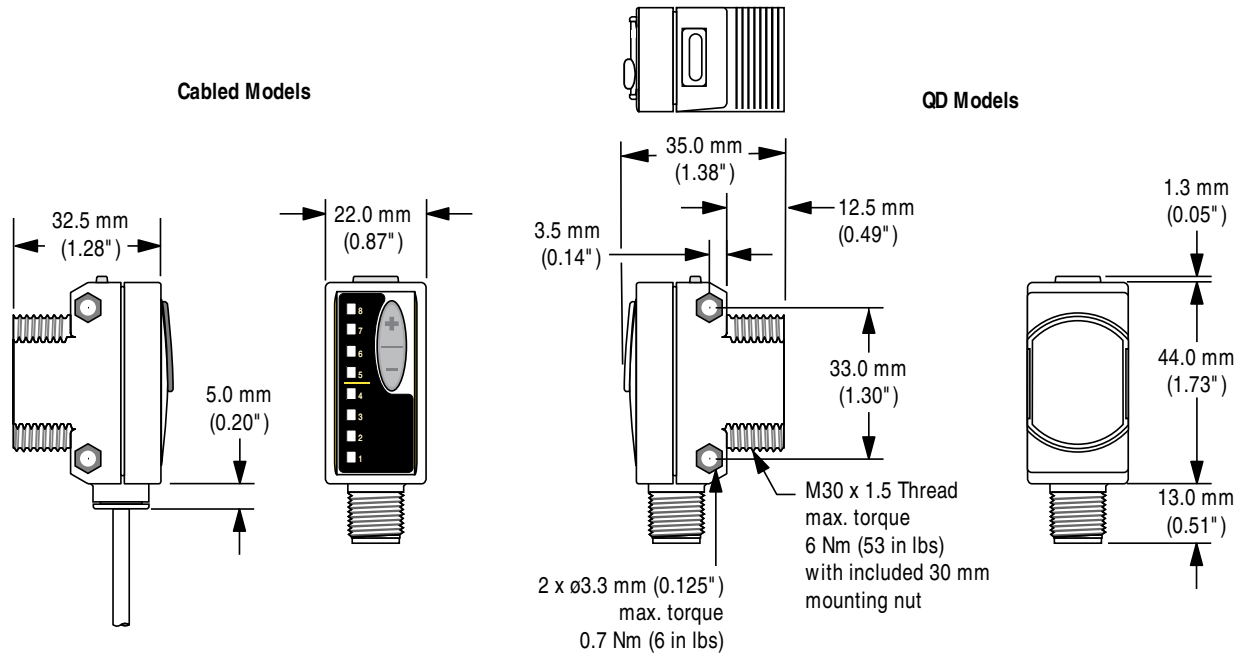


WARNING: Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.

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.

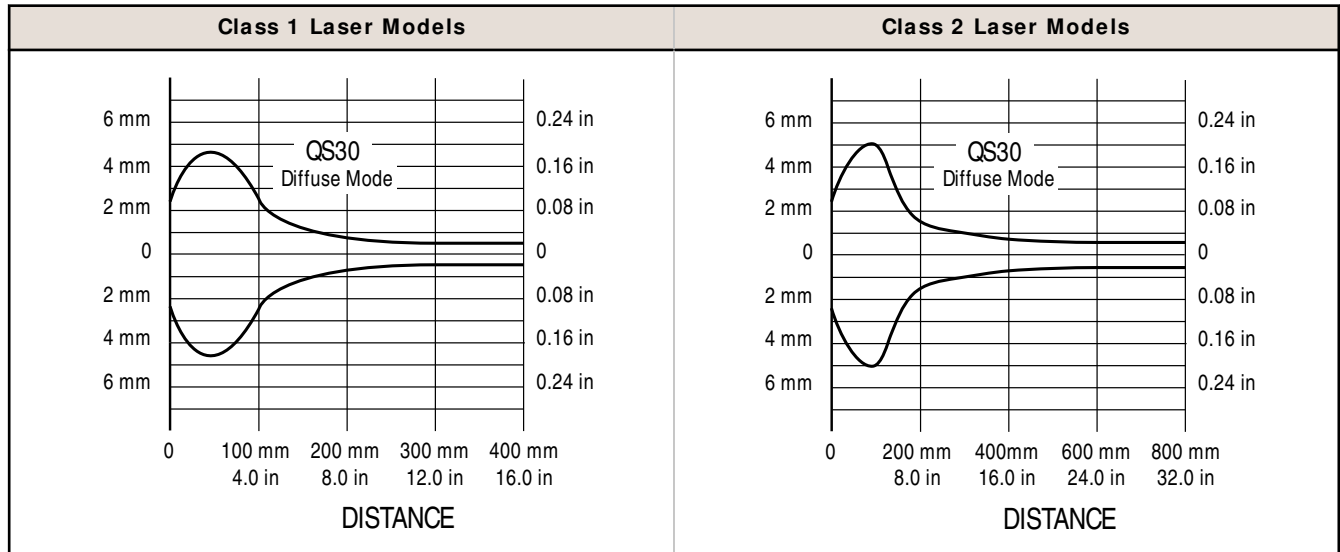
Supply Wiring (AWG)	Required Overcurrent Protection (Amps)
20	5.0
22	3.0
24	2.0
26	1.0
28	0.8
30	0.5

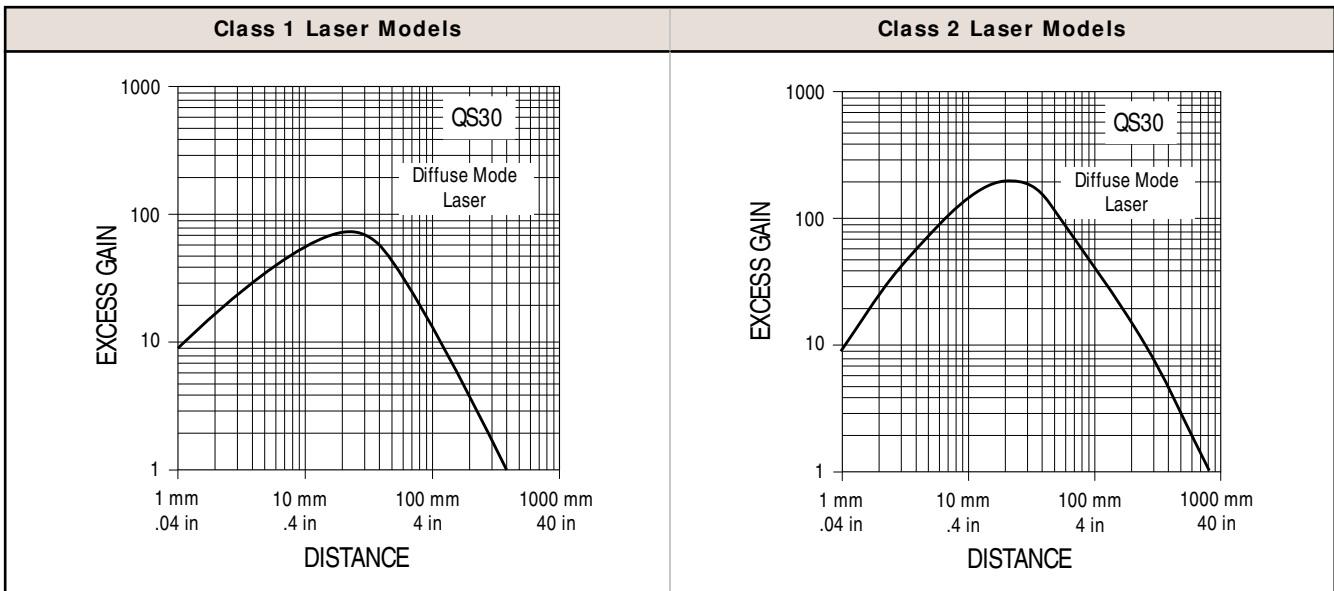
Dimensions



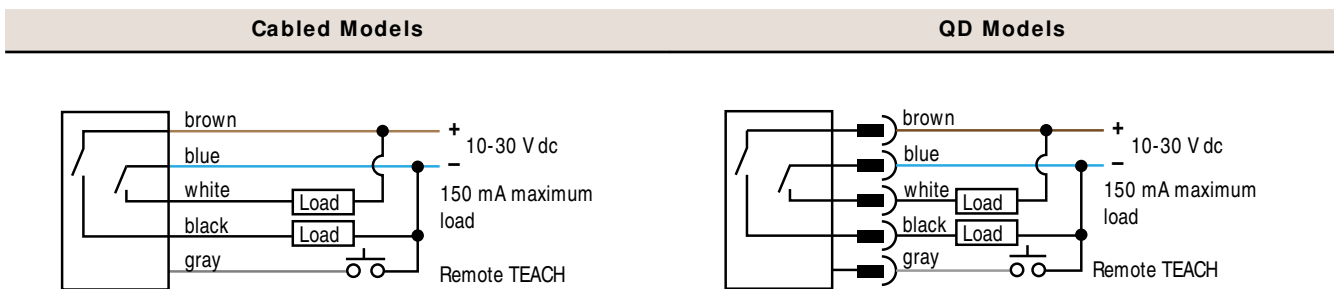
Hardware Included: (2) M3 x 0.5 x 28 stainless steel machine screws, nuts, and washers

Performance Curves





Wiring Diagrams



Accessories

Quick-Disconnect Cables

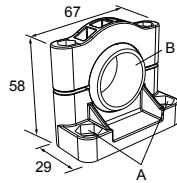
5-Pin Threaded M12/ Euro-Style Cordsets—Single Ended				
Model	Length	Style	Dimensions	Pinout (Female)
MQDC1-501.5	0.50 m (1.5 ft)	Straight		<p style="margin-top: 10px;">1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray</p>
MQDC1-506	1.83 m (6 ft)			
MQDC1-515	4.57 m (15 ft)			
MQDC1-530	9.14 m (30 ft)			

5-Pin Threaded M12/ Euro-Style Cordsets—Single Ended				
Model	Length	Style	Dimensions	Pinout (Female)
MQDC1-506RA	1.83 m (6 ft)	Right-Angle		
MQDC1-515RA	4.57 m (15 ft)			
MQDC1-530RA	9.14 m (30 ft)			

Brackets

SMB30SC

- Swivel bracket with 30 mm mounting hole for sensor
- Black reinforced thermoplastic polyester
- Stainless steel mounting and swivel locking hardware included



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

SMBQS30L

- Right-angle bracket for cable sensor models
- Clearance for M4 (# 8) hardware
- $\pm 12^\circ$ tilt adjustment
- 14-ga. stainless steel



Hole center spacing: A to B= 35.0
Hole size: A= \varnothing 4.3, B= \varnothing 4.25x16.3

SMBQS30LT

- Tall right-angle bracket for QD models
- $\pm 8^\circ$ tilt adjustment
- 14-ga. stainless steel



Hole center spacing: A to B= 35.0
Hole size: A= \varnothing 4.3, B= \varnothing 4.25x16.3

SMBQS30Y

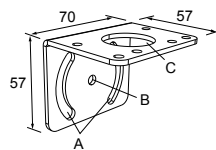
- Heavy-duty die-cast bracket
- M18 vertical mount option
- $\pm 8^\circ$ tilt adjustment with cabled units
- Includes nuts and lock washer



Hole size: A= \varnothing 15.3

SMB30MM

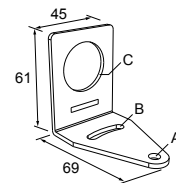
- 12-ga. stainless steel bracket with curved mounting slots for versatile orientation
- Clearance for M6 (1/4 in) hardware
- Mounting hole for 30 mm sensor



Hole center spacing: A = 51, A to B = 25.4
Hole size: A = 42.6 x 7, B = \varnothing 6.4, C = \varnothing 30.1

SMB30A

- Right-angle bracket with curved slot for versatile orientation
- Clearance for M6 (1/4 in) hardware
- Mounting hole for 30 mm sensor
- 12-ga. stainless steel



Hole center spacing: A to B= 40
Hole size: A= \varnothing 6.3, B= 27.1 x 6.3, C= \varnothing 30.5

All measurements are listed in millimeters, unless noted otherwise.

Banner Engineering Corp. Limited Warranty

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

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