WORLD-BEAM® QS30 Series Sensor (DC Voltage)

Instruction Manual

Compact, self-contained photoelectric sensors in universal-style housing

- Advanced one-piece photoelectric sensors with exceptional long-range optical performance
- Compact housing with mounting versatility, via its popular 30 mm threaded barrel or side-mount holes
- 10 V DC to 30 V DC operation with bipolar discrete outputs, NPN and PNP
- Selectable Light or Dark Operate, depending on wiring
- Tough ABS/polycarbonate blend housing is rated to IEC IP67; NEMA 6
- Easy-to-see sensor status indicators: two status LEDs visible from 360°; extra-large Output indicator on back of sensor housing (except emitters) visible from long distance
- Opposed, retroreflective, polarized retroreflective, diffuse and fixed-field (200 mm, 400 mm, or 600 mm cutoff) models available
- Retroreflective, polarized retroreflective, and diffuse models have potentiometer on back of housing for easy sensor range adjustment
- Choose 2 m integral cable or M12/Euro-style integral QD models

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

Model [1]	Sensing Mode	Beam	Range [2]	Output
QS30E (emitter)	Opposed	875 nm Infrared	60 m (200 ft)	N/A
QS30R (receiver)		Effective Beam: 18 mm (0.7 in)		Bipolar NPN/PNP
QS30LP	Polarized Retroreflective	630 nm Visible Red	8 m (26 ft)	
QS30LV	Retroreflective		12 m (40 ft)	
QS30D	Diffuse	940 nm Infrared	1 m (3.3 ft)	
QS30FF200	Fixed Field	680 nm Visible Red	200 mm (8 in)	
QS30FF400			400 mm (16 in)	
QS30FF600			600 mm (24 in)	

Fixed-Field Mode Overview

QS30 self-contained fixed-field sensors are small, powerful, visible red diffuse mode sensors with far-limit cutoff (a type of background suppression). Their high excess gain and fixed-field technology allow detection of objects of low reflectivity, while ignoring background surfaces.

The cutoff distance is fixed. Backgrounds and background objects must always be placed beyond the cutoff distance.

Fixed-Field Sensing – Theory of Operation

The WORLD-BEAM QS30 Series Sensor compares the reflections of its emitted light beam (E) from an object back to the sensor's two differently aimed detectors, R1 and R2. See Figure 1 on p. 2. If the near detector's (R1) light signal is stronger than the far detector's (R2) light signal (see object A in the Figure below, closer than the cutoff distance), the sensor responds to the object. If the far detector's (R2) light signal is stronger than the near detector's (R1) light signal (see object B in the Figure below, beyond the cutoff distance), the sensor ignores the object.

The cutoff distance for the QS30 is fixed at 200 mm, 400 mm, or 600 mm (8 in, 16 in, or 24 in). Objects lying beyond the cutoff distance are usually ignored, even if they are highly reflective. However, under certain conditions, it is possible to falsely detect a background object (see Background Reflectivity and Placement on p. 2).

[1] Only standard 2 m (6.5 ft) cabled models are listed.
- To order the 9 m (30 ft) integral cable model, add suffix “W/30” to the model number (for example, QS30E W/30).
- To order the 5-pin integral M12/Euro-style quick disconnect (QD), add suffix “Q” (for example, QS30EQ).

[2] Polarized Retroreflective and Retroreflective ranges are specified using a model BRT-84 retroreflector.

Figure 1. Fixed-Field Concept

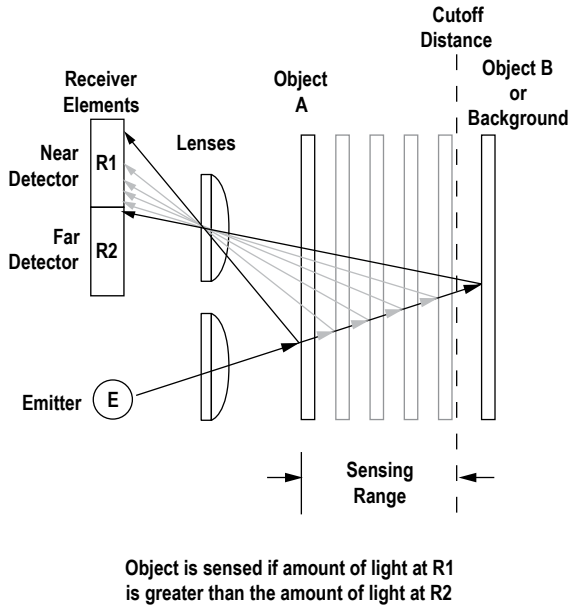
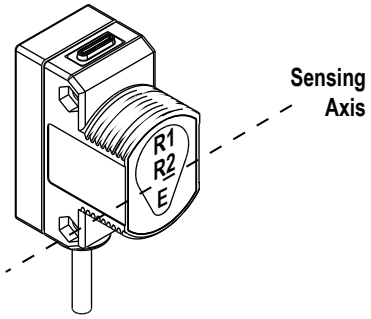


Figure 2. Fixed-Field Sensing Axis



In the drawings and information provided in this document, the letters E, R1, and R2 identify how the sensor's three optical elements (Emitter "E", Near Detector "R1", and Far Detector "R2") line up across the face of the sensor. The location of these elements defines the sensing axis, see Figure 2 on p. 2. The sensing axis becomes important in certain situations, such as those illustrated in Figure 5 on p. 3 and Figure 6 on p. 3.

Configuring a Sensor

Sensing Reliability

For highest sensitivity, position the target for sensing at or near the point of maximum excess gain. Refer to the Performance Curves for the excess gain. Sensing at or near this distance makes the maximum use of each sensor's available sensing power. The background must be placed beyond the cutoff distance. Note that the reflectivity of the background surface also may affect the cutoff distance. Following these guidelines improves sensing reliability.

Background Reflectivity and Placement

Avoid mirror-like backgrounds that produce specular reflections. A false sensor response occurs if a background surface reflects the sensor's light more to the near detector (R1) than to the far detector (R2). The result is a false ON condition (Figure 3 on p. 2). Correct this problem by using a diffusely reflective (matte) background, or angling either the sensor or the background (in any plane) so the background does not reflect light back to the sensor (Figure 4 on p. 2). Position the background as far beyond the cutoff distance as possible.

An object beyond the cutoff distance, either stationary (and when positioned as shown in Figure 5 on p. 3), or moving past the face of the sensor in a direction perpendicular to the sensing axis, may cause unwanted triggering of the sensor if more light is reflected to the near detector than to the far detector. Correct the problem by rotating the sensor 90° (Figure 6 on p. 3). The object then reflects the R1 and R2 fields equally, resulting in no false triggering. A better solution, if possible, may be to reposition the object or the sensor.

Figure 3. Reflective Background - Problem

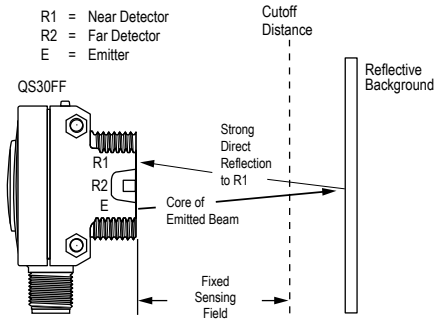


Figure 4. Reflective Background - Solution

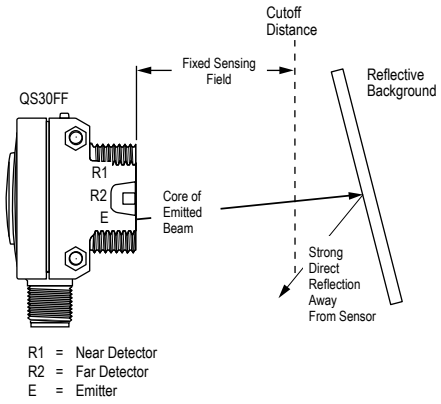
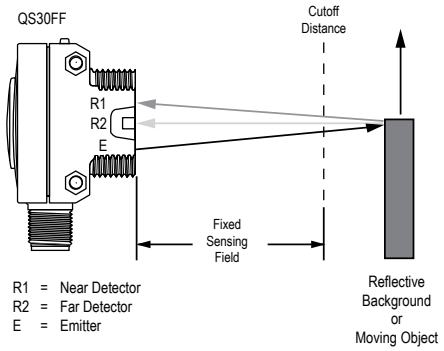
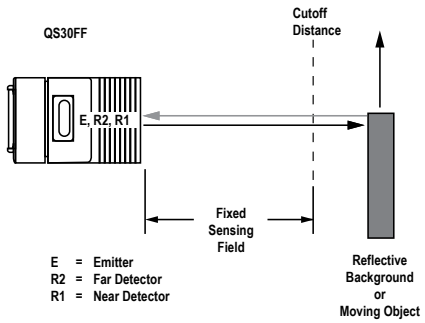


Figure 5. Object Beyond Cutoff - Problem



A reflective background object in this position or moving across the sensor face in this axis and direction may cause a false sensor response.

Figure 6. Object Beyond Cutoff - Solution



A reflective background object in this position or moving across the sensor face in this axis is ignored.

Color Sensitivity

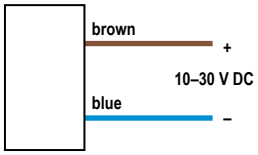
The effects of object reflectivity on cutoff distance, though small, may be important for some applications. It is expected that at any given cutoff setting, the actual cutoff distance for lower reflectance targets is slightly shorter than for higher reflectance targets. This behavior is known as color sensitivity.

For example, an excess gain of 1 for an object that reflects 1/10 as much light as the 90% white card is represented by the horizontal graph line at excess gain = 10. An object of this reflectivity results in a far limit cutoff of approximately 190 mm (7.5 in) cutoff model, for example; and 190 mm (7.5 in) represents the cutoff for this sensor and target.

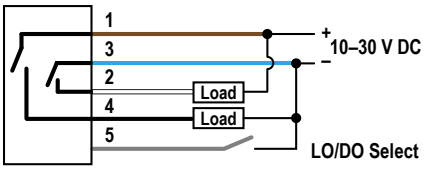
These excess gain curves were generated using a white test card of 90% reflectance. Objects with reflectivity of less than 90% reflect less light back to the sensor, and thus require proportionately more excess gain in order to be sensed with the same reliability as more reflective objects. When sensing an object of very low reflectivity, it may be especially important to sense it at or near the distance of maximum excess gain.

Wiring Diagrams

Cabled Emitters



Other Cabled Models



Key

1. Brown
2. White
3. Blue
4. Black
5. Gray

Cabled wiring diagrams are shown. Quick disconnect wiring diagrams are functionally identical.

Specifications

Supply Voltage
10 V DC to 30 V DC (10% max. ripple) at less than 40 mA, exclusive of load
Protected against reverse polarity and transient voltages

Output Response
Opposed Mode: 5 milliseconds ON and OFF
All others: 2 milliseconds
NOTE: 100 millisecond delay on power-up; outputs do not conduct during this time

Repeatability
Opposed Mode: not applicable
All others: 500 microseconds

Output Configuration
Bipolar: One current sourcing and one current sinking
Rating: 100 mA maximum each output at 25 °C
Off-state leakage current:
NPN: less than 200 µA
PNP: less than 10 µA
ON-state saturation voltage:
NPN: less than 1.6 V at 100 mA
PNP: less than 2.0 V at 100 mA
Protected against false pulse on power-up and continuous overload or short circuit of outputs

Cutoff Point Tolerance
Fixed-Field only: ± 5% of nominal cutoff distance

Construction and Mounting
ABS housing, rated IEC IP67; NEMA 6; Acrylic lens cover
3 mm mounting hardware included

Connections
2 m (6.5 ft) unterminated 5-wire PVC cable; 9 m (30 ft) unterminated 5-wire PVC cable ; or Integral 5-pin M12/Euro-style male quick disconnect

Application Tip for the QS30LV Model
For best sensing reliability, targets should be a minimum of 0.5m from the sensor

Adjustments
Selectable Light/Dark Operate is achieved via the gray wire.
Opposed, Retroreflective, and Polarized Retroreflective models:
Light Operate - Low (0 V to 3 V)*
Dark Operate - High (open or 5 V to 30 V)*
Diffuse and Fixed-Field models:
Light Operate - High (open or 5 V to 30 V)*
Dark Operate - Low (0 V to 3 V)*
Diffuse, Retroreflective, and Polarized Retroreflective mode models (only):
Single-turn Sensitivity (Gain) adjustment potentiometer
* Input impedance 10 kΩ

Indicators

2 LEDs on sensor top:

	Green	Yellow
On	Power on	Light sensed
Flashing	Output overloaded (except receivers)	Marginal excess gain (1–1.5× excess gain)

Large oval LED on sensor back (except emitters): Yellow on indicates the output is conducting

Operating Conditions

–20 °C to +70 °C (–4 °F to +158 °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

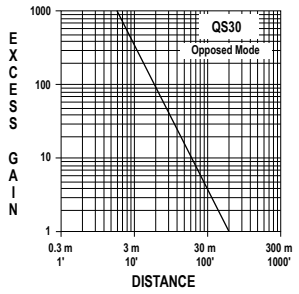
Pending

Performance Curves

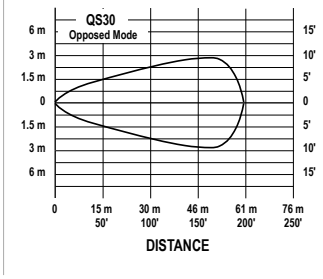
For the diffuse models, the performance is based on using a 90% reflectance white test card.

Opposed Mode

Excess Gain

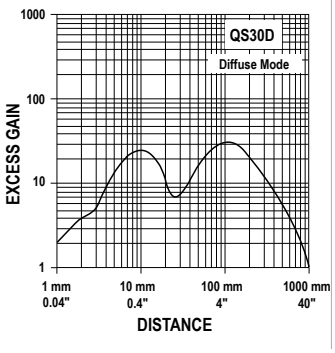


Beam Pattern

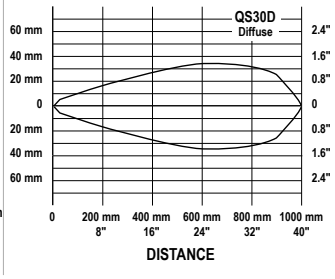


Diffuse Mode

Excess Gain



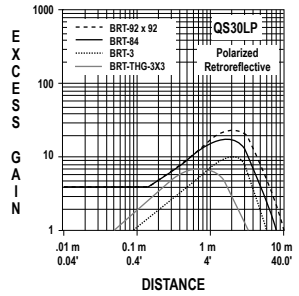
Beam Pattern



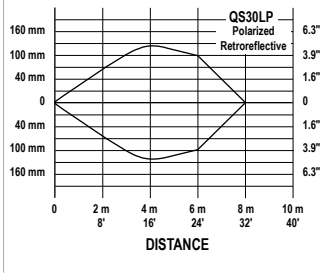
For the polarized retroreflective and retroreflective models, the performance is based on using the specified retroreflector.

Polarized Retroreflective

Excess Gain

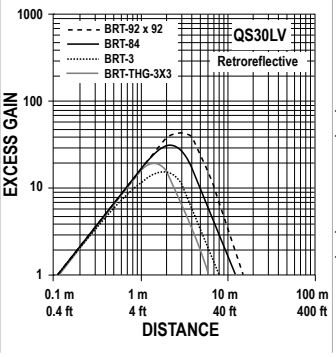


Beam Pattern

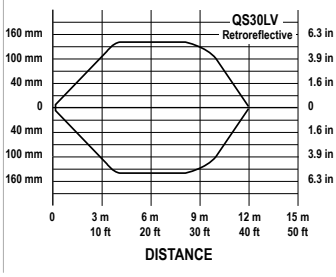


Retroreflective

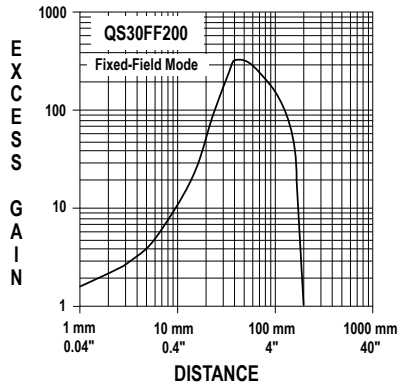
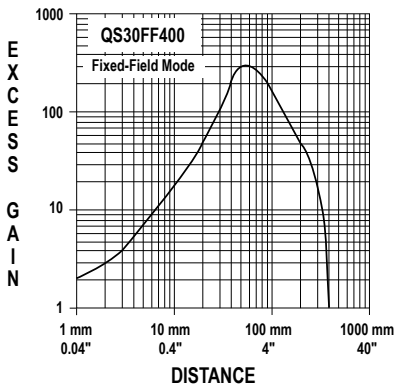
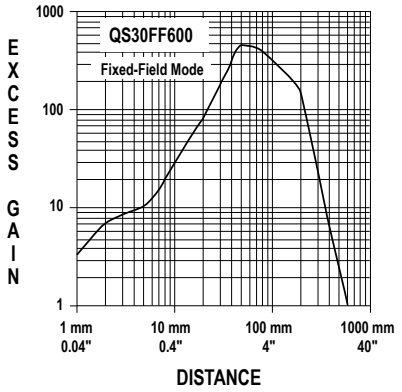
Excess Gain



Beam Pattern

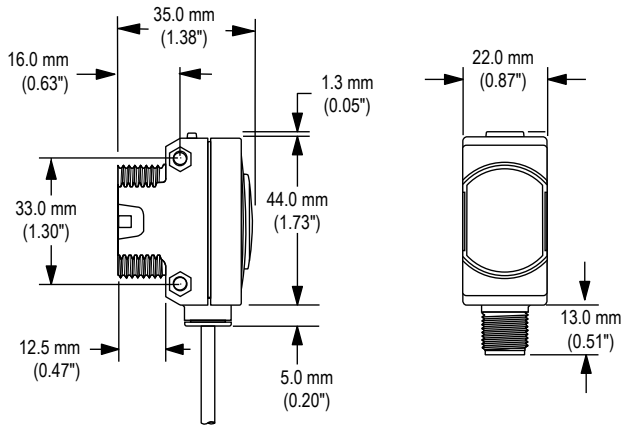


Fixed field performance is based on using a 90% reflectance white test card.

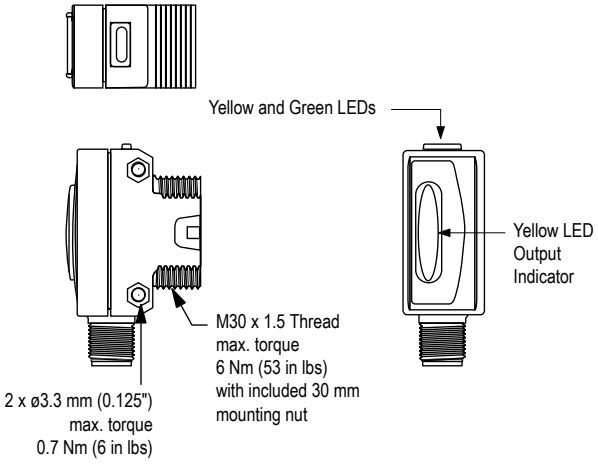
Fixed Field		
200 mm	**400 mm**	**600 mm**
		
ø 10 mm spot size at 160 mm focus ø 7 mm spot size at 200 mm cutoff Using 18% gray test card: performance will be 95% of values shown. Using 6% black test card: performance will be 90% of values shown.	ø 10 mm spot size at 160 mm focus ø 10 mm spot size at 400 mm cutoff Using 18% gray test card: performance will be 90% of values shown. Using 6% black test card: performance will be 85% of values shown.	ø 10 mm spot size at 160 mm focus ø 15 mm spot size at 600 mm cutoff Using 18% gray test card: performance will be 85% of values shown. Using 6% black test card: performance will be 75% of values shown.

Dimensions

Cabled Models



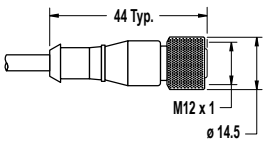
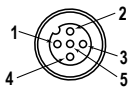
QD Models

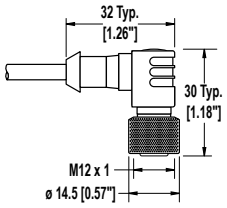


All measurements are listed in millimeters [inches], unless noted otherwise.

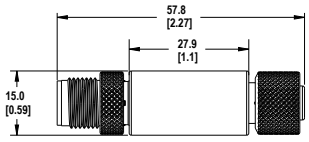
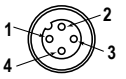
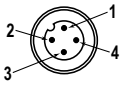
Accessories

Quick-Disconnect Cables

5-Pin Threaded M12/Euro-Style Cordsets—Single Ended				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
MQDC1-501.5	0.5 m (1.5 ft)	Straight		 1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray
MQDC1-506	2 m (6.5 ft)			
MQDC1-515	5 m (16.4 ft)			
MQDC1-530	9 m (29.5 ft)			

5-Pin Threaded M12/Euro-Style Cordsets—Single Ended				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
MQDC1-506RA	2 m (6.5 ft)	Right-Angle		
MQDC1-515RA	5 m (16.4 ft)			
MQDC1-530RA	9 m (29.5 ft)			

Sensor Status Indicators

S15L Series In-Line Sensor Status Indicator						
Model	**Input Type**	**LED Color**	**Dimensions**	**Female**	**Male**	**Wiring**
S15LGYPQ	PNP	Power ON = Green Input Active = Yellow				1 = Brown, 10 to 30 V DC 2 = White 3 = Blue, dc common 4 = Black, Sensor Input
S15LGYNQ	NPN					

Brackets

SMBQS30L
- Right-angle bracket for cable sensor models
- Clearance for M4 (#8) hardware
- ± 12° tilt adjustment
- 14-ga. stainless steel

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

SMBQS30LT
- Tall right-angle bracket for QD models
- ± 8° tilt adjustment
- 14-ga. stainless steel

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

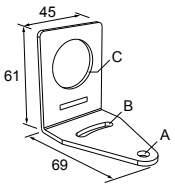
SMBQS30Y
- Heavy-duty die-cast bracket
- M18 vertical mount option
- ± 8° tilt adjustment with cabled units
- Includes nuts and lock washer

Hole size: A=ø 15.3

SMBQS30YL
- Heavy-duty die-cast bracket designed for industrial protection
- M18 vertical mount option
- Replaceable window
- Includes nuts and lock washer

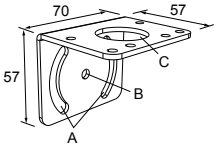
Hole size: A=ø 15.3

SMB30A
- Right-angle bracket with curved slot for versatile orientation
- Clearance for M6 (¼ in) hardware
- Mounting hole for 30 mm sensor
- 12-ga. stainless steel



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

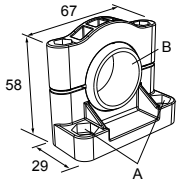
SMB30MM
- 12-ga. stainless steel bracket with curved mounting slots for versatile orientation
- Clearance for M6 (¼ in) hardware
- Mounting hole for 30 mm sensor



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

SMB30SC

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



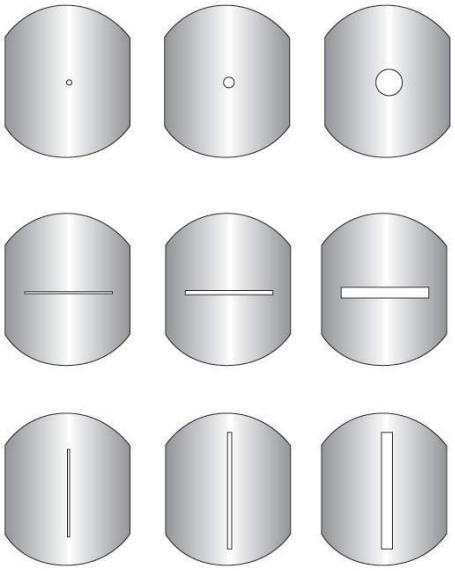
Hole center spacing: A=ø 50.8
Hole size: A=ø 7.0, B=ø 30.0

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

Apertures

Opposed-mode QS30 sensors may be fitted with apertures to narrow or shape the sensor's effective beam to more closely match the size or profile of the objects being sensed. A common example is the use of "line" (or "slot") type apertures to sense thread.

Note: The use of apertures reduces the sensing range.

Model	Description	Pieces	
	Circular		
APQS30-040	1 mm (0.04 in) diameter	6	
APQS30-100	2.5 mm (0.10 in) diameter	6	
APQS30-200	5 mm (0.20 in) diameter	6	
	Horizontal Slot		
APQS30-040H	1 × 12 mm (0.04 in × 0.47 in)	6	
APQS30-100H	2.5 × 12 mm (0.10 in × 0.47 in)	6	
APQS30-200H	5 × 12 mm (0.20 in × 0.47 in)	6	
	Vertical Slot		
APQS30-040V	1 × 17 mm (0.04 in x 0.67 in)	6	
APQS30-100V	2.5 × 17 mm (0.10 in × 0.67 in)	6	
APQS30-200V	5 × 17 mm (0.20 in × 0.67 in)	6	
APQS30-DVHX2	Kit containing two of each aperture above	18	
APQS30-DVH	Kit containing one each of aperture models: APQS30-040, APQS30-040H, APQS30-040V	18	

Reduced Range for QS30E and QS30R Pair with Apertures

Aperture Model	Maximum Range	
	Aperture on Both Emitter and Receiver	Aperture on Receiver Only
APQS30-040	0.5 m (1.5 ft)	4.1 m (13.5 ft)
APQS30-100	2.4 m (8 ft)	14.3 m (47 ft)
APQS30-200	11.6 m (38 ft)	23.5 m (77 ft)
APQS30-040H	7 m (23 ft)	16.8 m (23 ft)
APQS30-100H	16.5 m (54 ft)	24.7 m (54 ft)
APQS30-200H	28.7 m (94 ft)	36.6 m (94 ft)
APQS30-040V	7 m (23 ft)	16.8 m (23 ft)
APQS30-100V	16.5 m (54 ft)	24.7 m (54 ft)
APQS30-200V	28.7 m (94 ft)	36.6 m (94 ft)

Example: The QS30E/QS30R sensor pair is used with apertures APQS30-040. Using the circular aperture on only the receiver, the range reduces to 4.1 m (13.5 ft). When the APQS30-040 aperture is installed on both the receiver and emitter, the sensor range reduces to 0.5 m (1.5 ft).

Retroreflective Targets

Banner offers a wide selection of high-quality retroreflective targets. See www.bannerengineering.com for complete information.

Note: Polarized sensors require corner cube type retroreflective targets. Non-polarized sensors may use any retroreflective target.

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