# QS18VxAF Mechanically Adjustable Background Suppression Sensor

## Features

Miniature sensors with visible red LED or visible red laser




- Exceptional optical performance, comparable to larger sensors
- Simple multi-turn screw adjustment of cutoff distance
- 10 V DC to 30 V DC operation, with complementary (SPDT) NPN or PNP outputs, depending on model
- Less than 1 millisecond output response for excellent sensing repeatability

**Laser Models:**

- Narrow effective beam (approx. 1 mm spot size) for small-object detection and precise position control
- Crosstalk rejection algorithm to avoid optical disturbance from adjacent sensors
- Class 2 models have reduced excess gain within 20 mm of sensor for decreased susceptibility to the effects of lens contamination and to allow use of external lens shield

**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

| Models | Sensing Beam | Range | Cordset | Supply Voltage | Output Type |
|---|---|---|---|---|---|
| QS18VN6AF100 | 660 nm Visible Red LED | 1 mm (0.04 in) to cutoff point; Adjustable cutoff point, 20 mm to 100 mm (0.8 in to 4 in) | 2 m (6.5 ft) 4-wire | 10 V DC to 30 V DC | NPN |
| QS18VP6AF100 | | | | | PNP |
| QS18VN6LAF | 650 nm Visible Red Class 1 Laser | 1 mm (0.04 in) to cutoff point; Adjustable cutoff point, 30 mm to 150 mm (1.2 in to 6 in) | | | NPN |
| QS18VP6LAF | | | | | PNP |
| QS18VN6LAF250 | 658 nm Visible Red Class 2 Laser | 20 mm (0.08 in) to cutoff point; Adjustable cutoff point, 50 mm to 250 mm (2 in to 10 in) | | | NPN |
| QS18VP6LAF250 | | | | | PNP |

Standard 2 m (6.5 ft) cable models are listed.

- **For 4-pin M8 pigtail QD:** add suffix "**Q**" to the model number (for example, **QS18VN6AF100Q**); accessory mating cordset required, see " Quick-Disconnect (QD) Cordsets " on page 10.
- **For 4-pin M12 pigtail QD:** add suffix "**Q5**" to the model number (for example, **QS18VN6AF100Q5**); accessory mating cordset required, see " Quick-Disconnect (QD) Cordsets " on page 10.

Original Instructions
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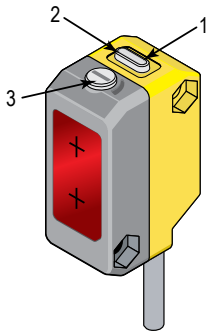
66981
p/n: 66981 Rev. N

ПРОМЭЛЕКТРОНИКА/ sales@prom-elec.com

# Overview

The QS18 Adjustable-Field Sensor are a full-featured sensor in a miniature package. It provides background suppression sensing capability for small or difficult-to-reach areas. Models are available with a visible red LED sensing beam, or one of two visible red lasers (see "QS18VxAF Models" on page 1).

*Sensor features*



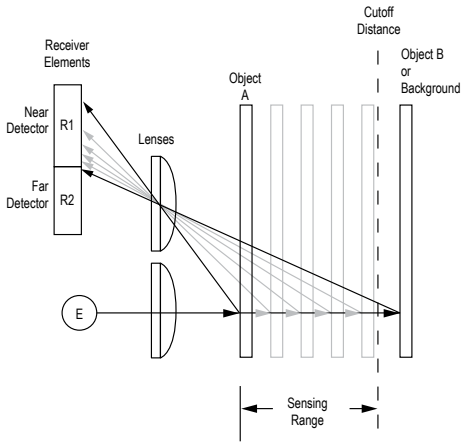

These adjustable-field sensors are able to detect objects of relatively low reflectivity, while ignoring other objects in the background (beyond the cutoff point). The cutoff distance is mechanically adjustable, using the 5-turn adjustment screw on the sensor top. Backgrounds and background objects must *always* be placed beyond the cutoff distance.

1. Green: Power Indicator (Flashes for Output Overload)
2. Amber: Light Sensed Indicator (Flashes for Low Gain Conditions)
3. Cutoff Point Adjustment Screw

## Adjustable-Field Sensing — Theory of Operation

The 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.

*Adjustable field sensing concept*




If the near detector (R1) light signal is stronger than the far detector (R2) light signal (see object A, closer than the cutoff distance), the sensor responds to the object. If the far detector (R2) light signal is stronger than the near detector (R1) light signal (see object B, object beyond the cutoff distance), the sensor ignores the object.

The cutoff distance for these sensors is adjustable. Objects lying beyond the cutoff distance are ignored, even if they are highly reflective. However, it is possible to falsely detect a background object, under certain conditions (see "Background Reflectivity and Placement" on page 4).

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 "Setting the Cutoff Distance" on page 4). The sensing axis becomes important in certain situations, such as those illustrated in "Figure: Object Beyond Cutoff - Problem" on page 5 and "Figure: Object Beyond Cutoff - Solution" on page 5.

## 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 will be slightly shorter than for higher reflectance targets (see the cutoff point deviation graphs). This behavior is known as color sensitivity.

The 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.

In the cutoff point deviation graphs, the percentage of deviation indicates a change in the cutoff point for either 18% gray or 6% black targets, relative to the cutoff point set for a 90% reflectance white test card.

For example, in "Figure: QS18AF100 minimum separation between object and background" on page 3, the cutoff point decreases 10% for a 6% reflectance black target when the cutoff point is adjusted for 100 mm (4 in) using a 90% reflectance white test card. In other words, the cutoff point for the black target is 90 mm (3.6 in) for this setting.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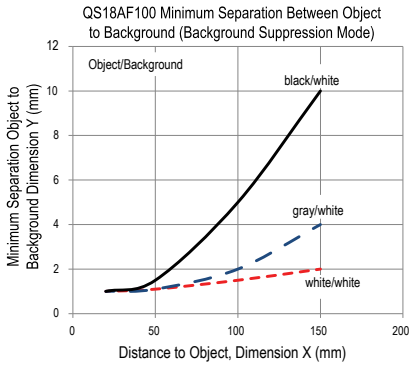
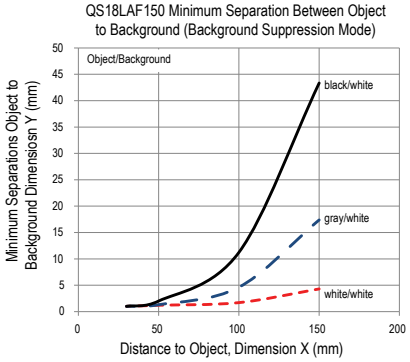
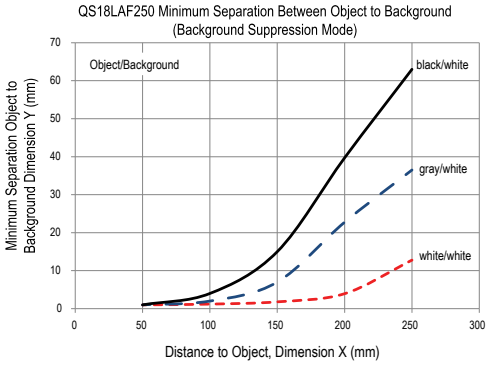
*QS18AF100 minimum separation between object and background*

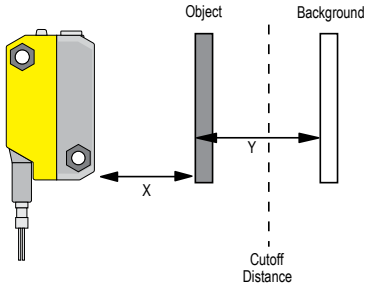



*QS18LAF150 minimum separation between object and background*




*QS18LAF250 minimum separation between object and background*




X: Distance to Object (mm)

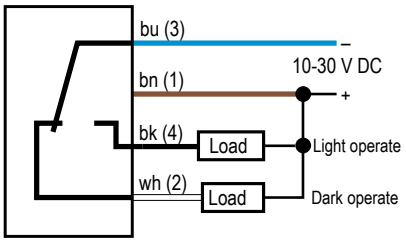
Y: Minimum Separation Between Object and Background (mm)

# Installation

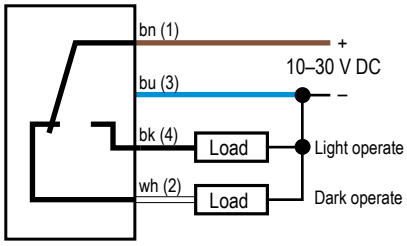
## Wiring Diagrams

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

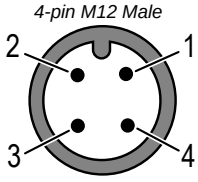
*NPN (sinking) outputs*



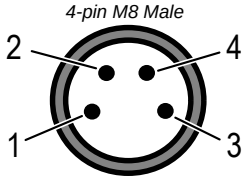

*PNP (sourcing) outputs*




*4-pin M12 Male*




*4-pin M8 Male*




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

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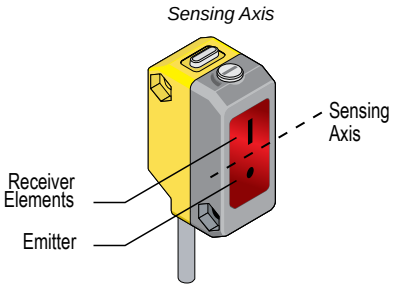
In light operate (LO) mode, the output is ON when the target returns the same or more light to the sensor and OFF when the sensor detects less light than the configured/taught target.

In **adjustable field** sensing modes, light operate is active when the target is present and dark operate is active when the target is absent.

## Setting the Cutoff Distance

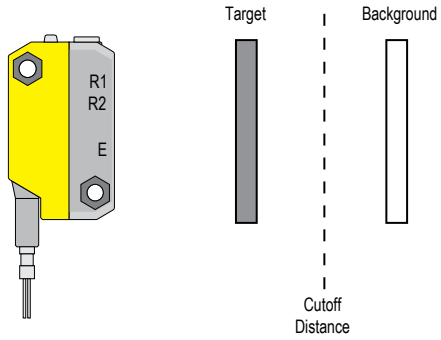



When an object approaches from the side, the most reliable sensing usually occurs when the line of approach is parallel to the sensing axis.

The cutoff distance for the QS18AF models may be adjusted between 20 mm and 100 mm (0.8 in to 4 in); for QS18LAF models, between 30 mm and 150 mm (1.2 in to 6 in); and for QS18LAF250 models, between 50 mm and 250 mm (2 in to 10 in).

To properly set the cutoff point, position the lightest possible background to be used, at the closest position it will come to the sensor during use. Using a small screwdriver in the adjustment screw, adjust the cutoff distance until the threshold is reached and the yellow Light Sensed indicator changes state. (If the indicator never comes ON, the background is beyond the maximum sensing distance and will be ignored.) Repeat the procedure, using the darkest target, placed in its most distant position for sensing. Adjust the cutoff approximately midway between the two positions ("Figure: Set cutoff distance approximately midway between the farthest target and the closest background" on page 4).

*Set cutoff distance approximately midway between the farthest target and the closest background*




## Sensing Reliability

For the highest sensitivity, position the target for sensing at or near the point of maximum excess gain. See the Performance Curves section for the excess gain curves. Maximum excess gain for model QS18VN6AF100 at a 20 mm cutoff occurs at a lens-to-object distance of about 7 mm, for example. Sensing at or near this distance makes 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: Reflective Background - Problem" on page 5). 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: Reflective Background - Solution" on page 5). 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: Object Beyond Cutoff - Problem" on page 5), 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: Object Beyond Cutoff - Solution" on page 5). 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.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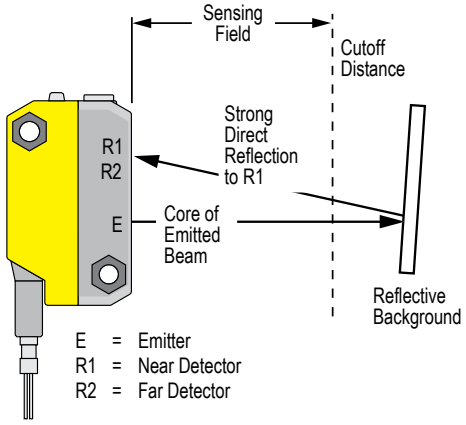
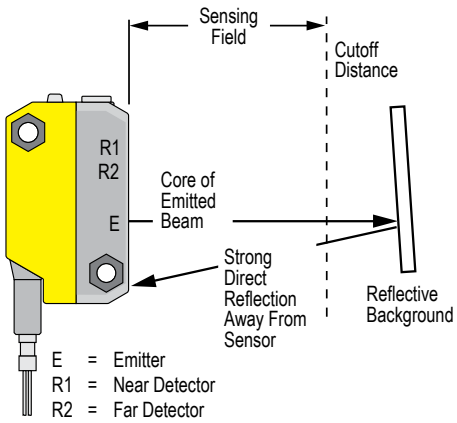
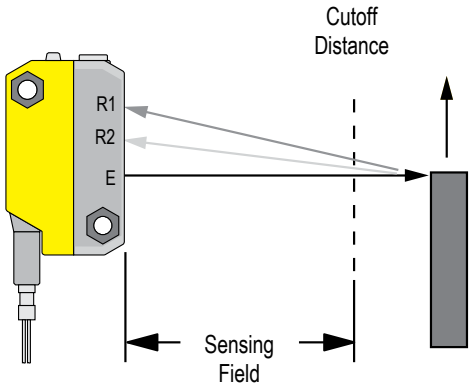
*Reflective Background - Problem*




*Reflective Background - Solution*

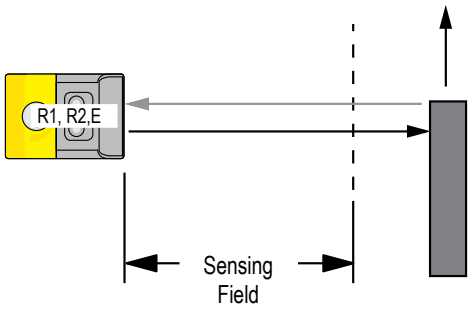



*Object Beyond Cutoff - Problem*




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

*Object Beyond Cutoff - Solution*




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

# Specifications

**Supply Voltage**

**QS18AF Models:** 10 V DC to 30 V DC (10% maximum ripple) at less than 25 mA, exclusive of load;

**QS18LAF / QS18LAF250 Models:** 10 V DC to 30 V DC (10% maximum ripple) at less than 15 mA, exclusive of load

**Sensing Beam**

**QS18AF Models:** Visible red LED, 640 nm

**QS18LAF / QS18LAF250 Models:** Visible red laser (see below)

**Laser Characteristics - QS18AF Models**

N/A

**Laser Characteristics - QS18LAF Models**

See "Class 1 Laser Description and Safety Information" on page 6

Rep Rate: 130 microseconds

**Laser Characteristics - QS18LAF250 Models**

See "Class 2 Laser Description and Safety Information" on page 7

Rep Rate: 130 microseconds

**Supply Protection Circuitry**

Protected against reverse polarity and transient voltages

**Output Configuration - All Models**

**Solid-state complementary (SPDT):** NPN or PNP (current sinking or sourcing), depending on model;

**Rating:** 100 mA maximum eh output at 25 °C

Protected against false pulse on power-up and continuous overload or short circuit of outputs

**Output Configuration - QS18AF Models**

**Off-state leakage current:** less than 50 µA at 30 V DC

**ON-state saturation voltage:** less than 1.5 V at 10 mA; less than 3.0 V at 100 mA

**Output Configuration - QS18LAF / QS18LAF250 Models**

**Off-state leakage current:** NPN: less than 200 µA at 30 V DC (See Application Note 1); PNP: less than 10 µA at 30 V DC

**ON-state saturation voltage:** NPN: less than 1.6 V at 100 mA; PNP: less than 3.0 V at 100 mA

**Output Response**

**QS18AF Models:** 850 microseconds ON/OFF; 100 ms delay on power-up; outputs do not conduct during this time

**QS18LAF / QS18LAF250 Models:** 700 microseconds ON/OFF; 200 ms delay on power-up; outputs do not conduct during this time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### Application Notes

NPN off-state leakage current is < 200 µA for load resistances > 3 kΩ or optically isolated loads. For load current of 100 mA, leakage is < 1% of load current.

### Repeatability

**QS18AF Models:** 85 microseconds

**QS18LAF / QS18LAF250 Models:** 130 microseconds

### Adjustments

Five-turn adjustment screw sets cutoff distance between min. and max. positions clutched at both ends of travel

### Laser Classification

**QS18AF Models:** N/A

**QS18LAF Models:** Class 1 laser product; Complies with IEC 60825-1:2014 and 21 CFR 1040.10, except for deviations pursuant to Laser Notice 56, dated May 8, 2019

**QS18LAF250 Models:** Class 2 laser product; Complies with IEC 60825-1:2001 and 21 CFR 1040.10, except for deviations pursuant to Laser Notice 50, dated 7-26-01

### Spot Size

| QS18AF100 | |
|---|---|
| **Distance (mm)** | **Size (Horizontal × Vertical)** |
| 20 | 5 × 5 |
| 75 | 7 × 7 |
| 150 | 10 × 10 |

| QS18LAF150 | |
|---|---|
| **Distance (mm)** | **Size (Horizontal × Vertical)** |
| 30 | 3.0 × 1.0 |
| 75 | 3.0 × 1.0 |
| 150 | 2.5 × .80 |

| QS18LAF250 | |
|---|---|
| **Distance (mm)** | **Size (Horizontal × Vertical)** |
| 50 | 2.2 × 1.1 |
| 125 | 2.0 × 1.0 |
| 250 | 1.5 × .75 |

### Environmental Rating

IEC IP67; NEMA 6; UL Type 1

### Operating Conditions

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

**QS18AF Models:**

**QS18LAF / QS18LAF250 Models:** –10 °C to 50 °C (14 °F to 122 °F)

### Construction

ABS housing, acrylic lens cover, 2.5 mm and 3 mm mounting hardware included

### Connections

2 m (6.5 ft) 4-wire PVC cable, 9 m (30 ft) PVC cable, 4-pin M8 or M12 150 mm (6 in) cable with quick-disconnect connector, depending on model

### Certifications

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1831 Diegem, BELGIUM

Turck Banner LTD Blenheim House
Blenheim Court
Wickford, Essex SS11 8YT
GREAT BRITAIN

### 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 |

## 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.

**CLASS 1 LASER PRODUCT**

**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.


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**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.

**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: 0.065 mW
Laser wavelength: 650 nm
Pulse duration: 7 µs

## Class 2 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 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.

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

**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 nm 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:**
- 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.

**IMPORTANT:** This laser device is not bore-sighted.

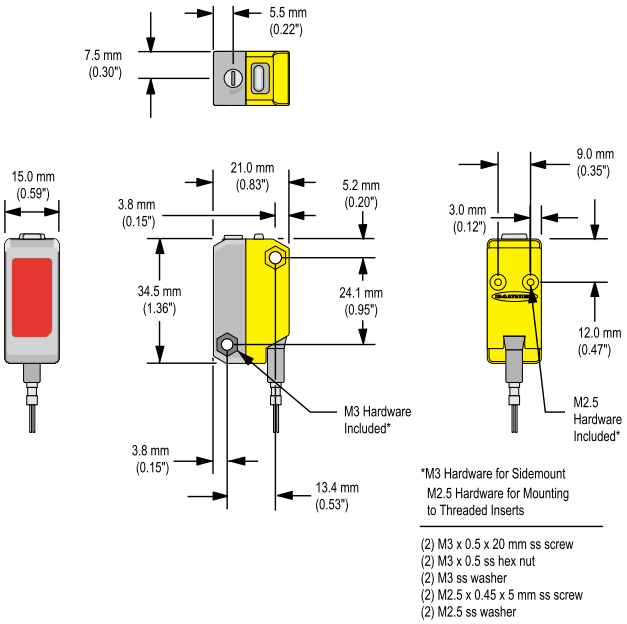
**Class 2 Laser Characteristics**

Output power: 0.2 mW
Laser wavelength: 658 nm
Pulse duration: 7 µs

# Dimensions

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

*QS18AF Dimensions*





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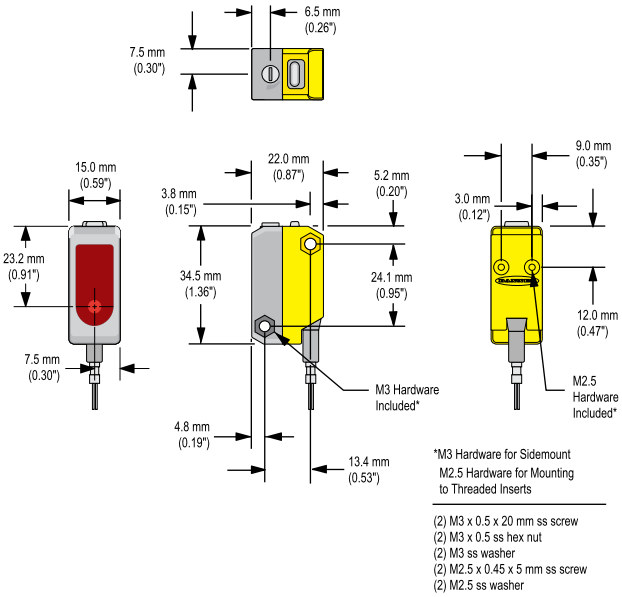
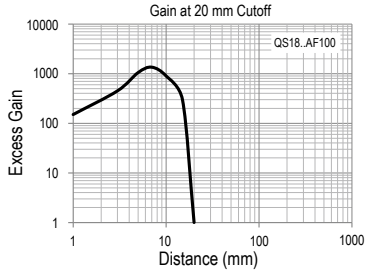
*QS18LAF and QS18LAF250*



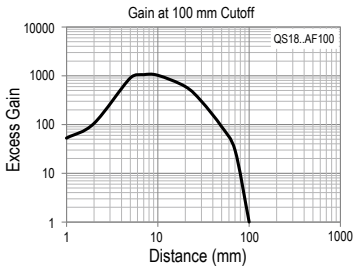

# Performance Curves

The performance is based on 90% reflectance white test card

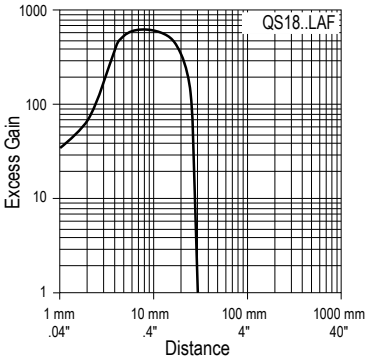
**Gain at 20 mm Cutoff**



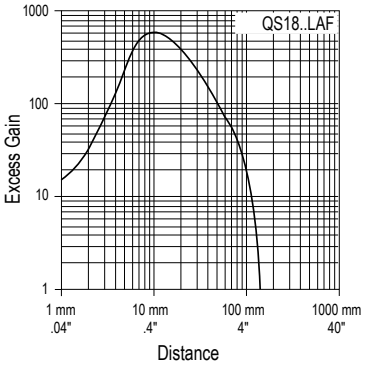

**Gain at 100 mm Cutoff**




**Gain at 30 mm Cutoff**




**Gain at 150 mm Cutoff**




Continued on page 10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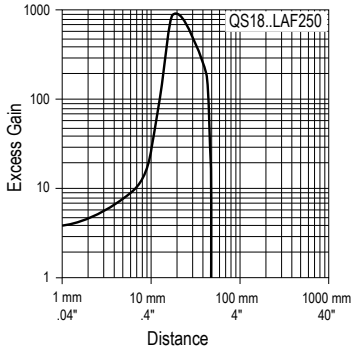
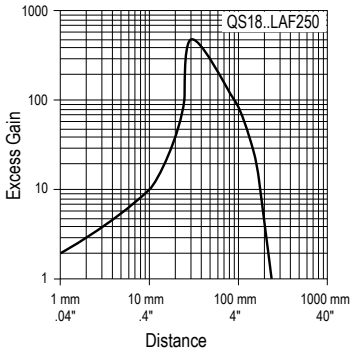
Continued from page 9

**Gain at 50 mm Cutoff**



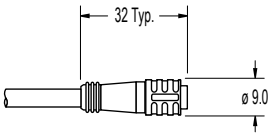
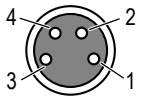

**Gain at 250 mm Cutoff**

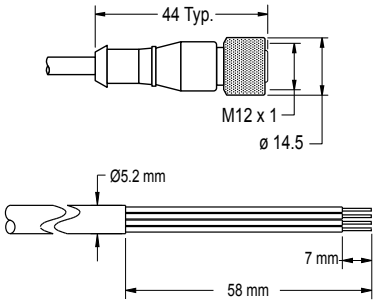
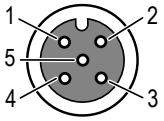



# Accessories

## Quick-Disconnect (QD) Cordsets

Use the M8 cordsets with QS18 with Q suffix; use the M12 cordsets with QS18 with Q5 suffix.

| 4-Pin Single-Ended Snap-on M8 Female Cordsets | | | | | |
|---|---|---|---|---|---|
| **Model** | **Length** | **Style** | **Dimensions** | **Pinout (Female)** | |
| **PKG4-2** | 2.03 m (6.66 ft) | Straight |  |  | 1 = Brown<br>2 = White<br>3 = Blue<br>4 = Black |

| 4-pin Single-Ended M12 Female Cordsets (datasheet p/n 235937) | | | | |
|---|---|---|---|---|
| **Model** | **Length** | **Dimensions (mm)** | **Pinout (Female)** | |
| **BC-M12F4-22-1** | 1 m (3.28 ft) |  |  | 1 = Brown<br>2 = White<br>3 = Blue<br>4 = Black<br>5 = Unused<br>c UL us LISTED |
| **BC-M12F4-22-2** | 2 m (6.56 ft) | | | |
| **BC-M12F4-22-5** | 5 m (16.4 ft) | | | |
| **BC-M12F4-22-8** | 8 m (26.25 ft) | | | |
| **BC-M12F4-22-10** | 10 m (30.81 ft) | | | |
| **BC-M12F4-22-15** | 15 m (49.2 ft) | | | |
| **BC-M12F4-22-20** | 20 m (65.61 ft) | | | |
| **BC-M12F4-22-25** | 25 m (82.02 ft) | | | |
| **BC-M12F4-22-30** | 30 m (98.42 ft) | | | |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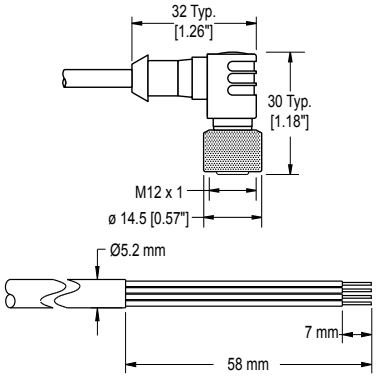
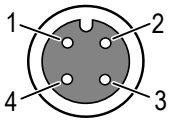
| 4-pin Single-Ended M12 Female Right-Angle Cordsets (datasheet p/n 235937) | | | | |
|---|---|---|---|---|
| **Model** | **Length** | **Dimensions (mm)** | **Pinout (Female)** | |
| **BC-M12F4A-22-1** | 1 m (3.28 ft) |  |  | 1 = Brown<br>2 = White<br>3 = Blue<br>4 = Black<br>5 = Unused |
| **BC-M12F4A-22-2** | 2 m (6.56 ft) | | | |
| **BC-M12F4A-22-5** | 5 m (16.4 ft) | | | |
| **BC-M12F4A-22-8** | 8 m (26.25 ft) | | | |
| **BC-M12F4A-22-10** | 10 m (30.81 ft) | | | |
| **BC-M12F4A-22-15** | 15 m (49.2 ft) | | | |

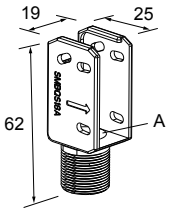
## Mounting Brackets

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

**SMBQS18A**

- Wrap-around protection bracket
- Die-cast bracket
- Base fits 18 mm threaded hole
- Metal hex nut, lock washer and grommet included
- Mounting holes specially designed for QS18AF sensors
- CAD Files: DXF, PDF, IGS, STP

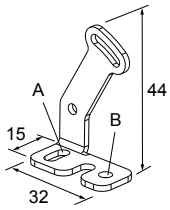
**Hole size:** A = ø 15.3




**SMBQS18AF**

- Right-angle mounting bracket
- 14-ga. 304 stainless steel
- CAD Files: DXF, PDF, IGS, STP

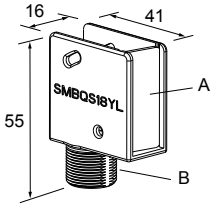
**Hole center spacing:** A to B = 20.3
**Hole size:** A = 4.3 × 9.4, B = ø 4.3




**SMBQS18YL**

- Heavy-duty die-cast bracket for industrial protection
- Replaceable window (A)
- M18 vertical mount-option
- Nut and lock washer included
- Only for use with Class 2 laser models
- CAD Files: DXF, PDF, IGS, STP

**Hole size:** B = ø 15.3




# Product Support and Maintenance

## Clean Sensor with Compressed Air Then Isopropyl Alcohol

Handle the sensor with care during installation and operation. Sensor windows soiled by fingerprints, dust, water, oil, etc. create stray light that may degrade the peak performance of the sensor.

Blow dust from the sensor using filtered, compressed air. If the sensor is still dirty, gently wipe the sensor with a dry optical cloth. If the dry optical cloth does not remove all residue, use 70% isopropyl alcohol on a clean optical cloth, then dry with a clean dry optical cloth and blow with filtered, compressed air. Do not use any other chemicals for cleaning.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## Repairs

Contact Banner Engineering for troubleshooting of this device. **Do not attempt any repairs to this Banner device; it contains no field-replaceable parts or components.** If the device, device part, or device component is determined to be defective by a Banner Applications Engineer, they will advise you of Banner's RMA (Return Merchandise Authorization) procedure.

> **IMPORTANT:** If instructed to return the device, pack it with care. Damage that occurs in return shipping is not covered by warranty.

## Contact Us

Banner Engineering Corp. | 9714 Tenth Avenue North | Plymouth, MN 55441, USA | Phone: + 1 888 373 6767

For worldwide locations and local representatives, visit www.bannerengineering.com.

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