S18 Series Sensor (DC Voltage) Product Manual

Original Instructions
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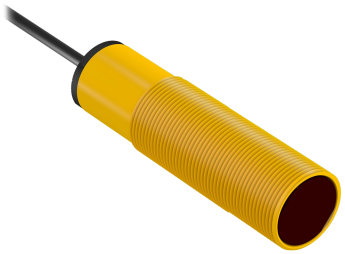
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Chapter Contents

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Chapter 1 Features

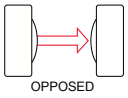
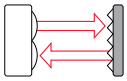
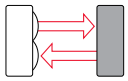


- Featuring EZ-BEAM® technology for reliable sensing without the need for adjustments
- Completely epoxy-encapsulated to provide superior durability, designed to meet rigorous IP69K standards for use in 1200 psi washdowns
- Innovative dual-indicator system for simple sensor performance monitoring
- Advanced diagnostics to warn of marginal sensing conditions or output overload
- 10 V DC to 30 V DC; choose SPDT (complementary) NPN or PNP outputs (150 mA maximum, each)

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

Sensing Mode	Model [1]		Range	LED	Output
 OPPOSED	**S186E**	Emitter	20 m (66 ft)	Infrared 950 nm	-
	S18SN6R	Receiver			NPN
	S18SP6R				PNP
 RETRO	**S18SN6L**		2 m (79 in)	Infrared 950 nm	NPN
	S18SP6L				PNP
 POLAR RETRO (2)	**S18SN6LP**		2 m (79 in)	Visible Red 680 nm	NPN
	S18SP6LP				PNP
 DIFFUSE	**S18SN6D**		100 mm (4 in)	Infrared 880 nm	NPN
	S18SP6D				PNP
	S18SN6DL		300 mm (12 in)		NPN
	S18SP6DL				PNP

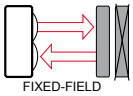
Continued on page 4

[1] Standard 2 m (6.5 ft) cable models are listed.
- To order the 9 m (30 ft) cable models, add suffix **W/30** (for example, **S186E W/30**).
- To order the 4-pin M12 QD models, add suffix **Q** (for example, **S186EQ**). A model with a QD connector requires a mating cable.

[2] Use polarized models when shiny objects will be sensed.

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Continued from page 3

Sensing Mode	Model	Range	LED	Output
 FIXED-FIELD	S18SN6FF25	25 mm (1 in) cutoff	Infrared 880 nm	NPN
	S18SP6FF25			PNP
	S18SN6FF50	50 mm (2 in) cutoff		NPN
	S18SP6FF50			PNP
	S18SN6FF100	100 mm (4 in) cutoff		NPN
	S18SP6FF100			PNP

NOTE: Users must purchase one emitter and one receiver for opposed mode sensors.

Specifications

Supply Voltage and Current

10 to 30 V DC (10% maximum ripple)

Supply current (exclusive of load current):

Emitters, non-polarized retroreflective, retroreflective, diffuse models: 25 mA
Receivers: 20 mA
Polarized retroreflective models: 30 mA
Fixed-field models: 35 mA

Supply Protection Circuitry

Protected against reverse polarity and transient voltages

Output Protection Circuitry

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

Indicators

Two LEDs (green and amber):

Green on: power to sensor is on
Green flashing: output is overloaded
Amber on: normally open (NO) output is conducting
Amber flashing: excess gain marginal (1 to 1.5×) in light condition

Construction

Housing: PBT polyester housing

Lens: polycarbonate (opposed-mode) or acrylic (other models)

Connections

2 m (6.5 ft) integral cable; 9 m (30 ft) integral cable; or 4-pin M12 quick-disconnect fitting

Repeatability

Opposed mode models: 375 µs

Retroreflective, fixed-field, and diffuse mode models: 750 µs

Repeatability and response are independent of signal strength.

Output Configuration

SPDT solid-state DC switch; Choose NPN (current sinking) or PNP (current sourcing) models

Light Operate: Normally open (NO) output conducts when sensor sees its own (or the emitter's) modulated light

Dark Operate: Normally closed (NC) output conducts when the sensor sees dark; the NC output may be wired as a normally open marginal signal alarm output, depending upon wiring to power supply (U.S. patent 5087838)

Output Rating

150 mA maximum (each) in standard wiring. When wired for alarm output, the total load may not exceed 150 mA.

OFF-state leakage current: < 1 microamp at 30 V DC

ON-state saturation voltage: < 1 V at 10 mA DC; < 1.5 V at 150 mA DC

Output Response Time

Opposed mode models: 3 ms ON, 1.5 ms OFF

Retroreflective, fixed-field, and diffuse mode models: 3 ms ON and OFF

NOTE: 100 ms delay on power-up; outputs do not conduct during this time.

Operating Conditions

–40 °C to +70 °C (–40 °F to +158 °F)

90% at +50 °C maximum relative humidity (non-condensing)

Environmental Rating

Leakproof design rated NEMA 6P and IEC IP67 per IEC 60529

IP69K per DIN40050 for quick disconnect and cable models when the cables are protected from direct spray

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 acceleration) requirements.

Method 213B conditions H&I.

Shock: 75G with device operating; 100G for non-operation

Certifications

Banner Engineering BV
Park Lane, Culliganlaan 2F bus 3
1831 Diegem, BELGIUM

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

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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

FCC Part 15 Class B for Unintentional Radiators

(Part 15.105(b)) This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

(Part 15.21) Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

Industry Canada ICES-003(B)

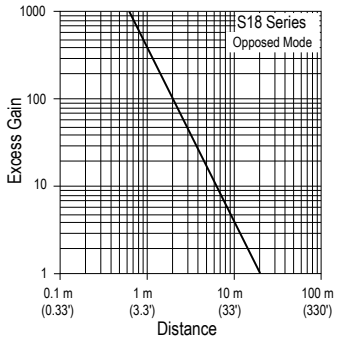
This device complies with CAN ICES-3 (B)/NMB-3(B). Operation is subject to the following two conditions: 1) This device may not cause harmful interference; and 2) This device must accept any interference received, including interference that may cause undesired operation.

Cet appareil est conforme à la norme NMB-3(B). Le fonctionnement est soumis aux deux conditions suivantes : (1) ce dispositif ne peut pas occasionner d'interférences, et (2) il doit tolérer toute interférence, y compris celles susceptibles de provoquer un fonctionnement non souhaité du dispositif.

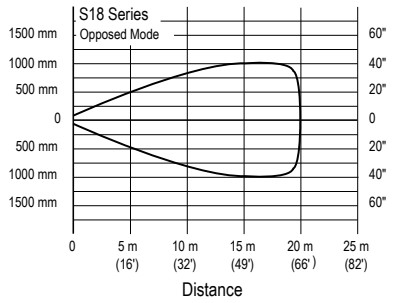
Performance Curves

Opposed mode sensors

Excess Gain



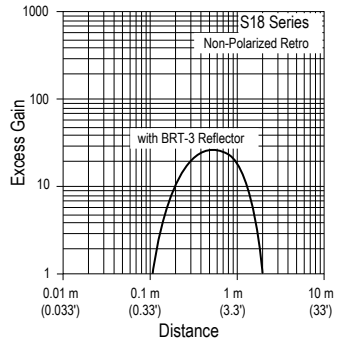
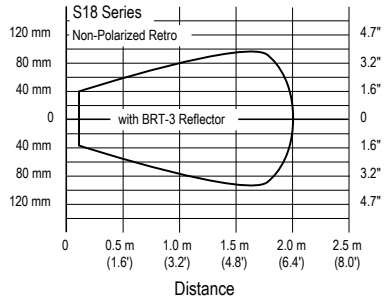
Beam Pattern



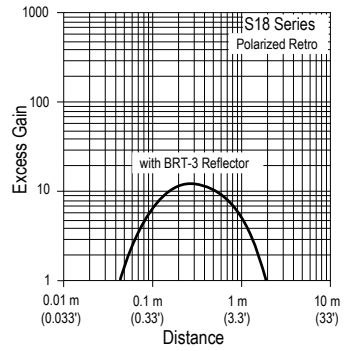
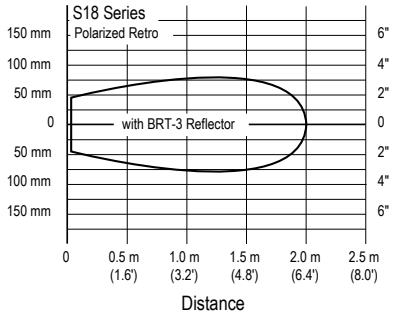
Retroreflective and **polarized retroreflective** mode sensor performance is based on the use of a model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending on the efficiency and reflective area of the retroreflector used.

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Retroreflective mode sensors

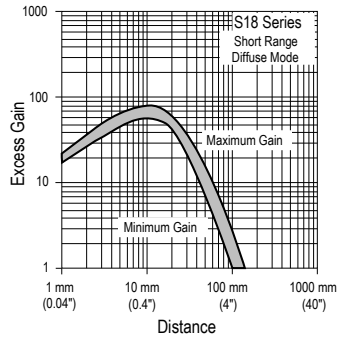
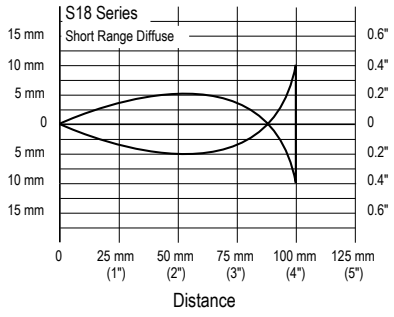
Excess Gain	Beam Pattern
	

Polarized retroreflective mode sensors

Excess Gain	Beam Pattern
	

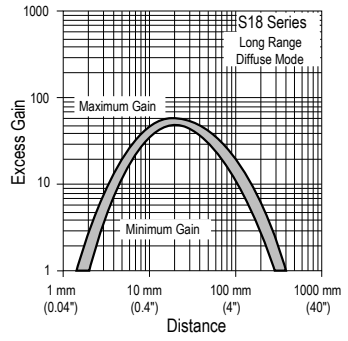
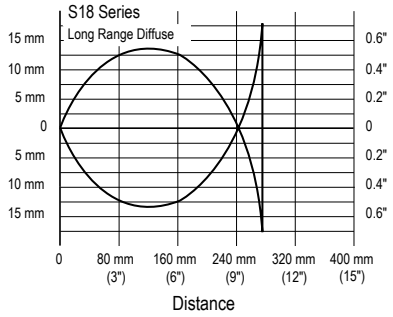
Diffuse and **fixed-field** mode sensor performance is based on the use of a 90% reflectance white test card.

Diffuse 100 mm mode sensors

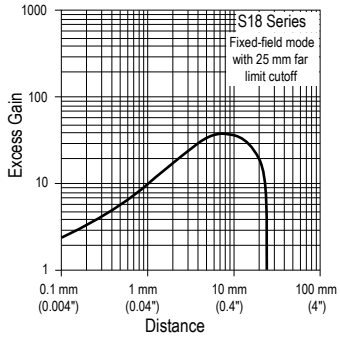
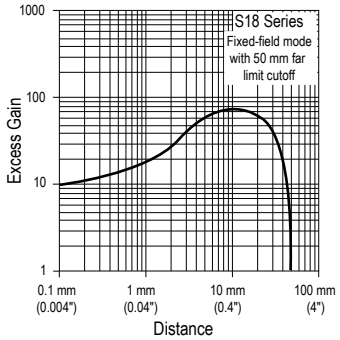
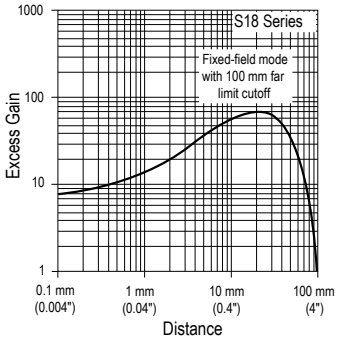
Excess Gain	Beam Pattern
	

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Diffuse 300 mm mode sensors

Excess Gain	Beam Pattern
	

Fixed-field mode sensors

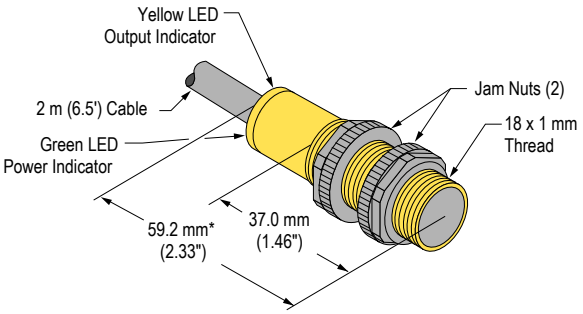
25 mm Mode	50 mm Mode	100 mm Mode
Excess Gain	**Excess Gain**	**Excess Gain**
		
Using 18% gray test card: Cutoff distance will be 95% of value shown. Using 6% black test card: Cutoff distance will be 90% of value shown. Ø 10 mm spot size @ 8 mm focus Ø 10 mm spot size @ 25 mm cutoff	Using 18% gray test card: Cutoff distance will be 90% of value shown. Using 6% black test card: Cutoff distance will be 85% of value shown. Ø 10 mm spot size @ 10 mm focus Ø 10 mm spot size @ 50 mm cutoff	Using 18% gray test card: Cutoff distance will be 85% of value shown. Using 6% black test card: Cutoff distance will be 75% of value shown. Ø 10 mm spot size @ 20 mm focus Ø 10 mm spot size @ 100 mm cutoff

Focus and spot sizes are typical.

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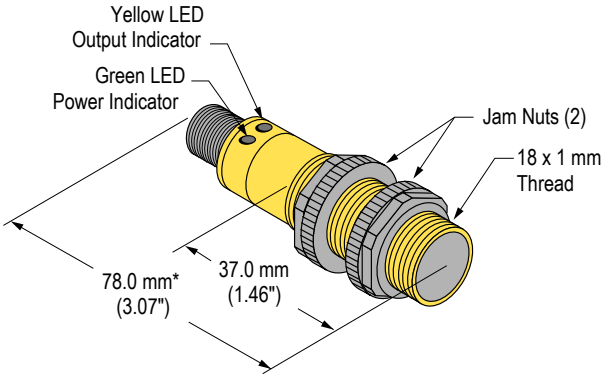
Dimensions

Cabled models



*Polarized retro and fixed-field models = 65.0 mm (2.56")

Quick disconnect models



*Polarized retro and fixed-field models = 83.8 mm (3.30")

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Chapter 2 Installation Instructions

Fixed-Field Overview

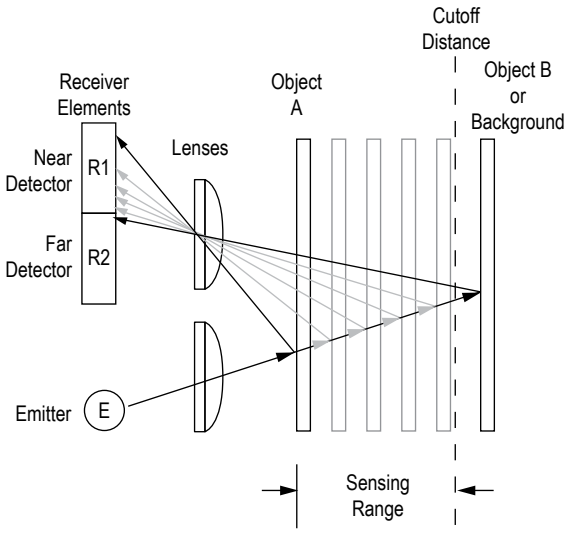
S18 self-contained fixed-field sensors are small, powerful, infrared diffuse mode sensors with far-limit cutoff (a type of background suppression). Their high excess gain and fixed-field technology allow them to detect objects of low reflectivity, while ignoring background surfaces.

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

The S18FF compares the reflections of its emitted light beam (E) from an object back to the sensor's two differently aimed detectors, R1 and R2. 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, beyond the cutoff distance), the sensor ignores the object.

The cutoff distance for model S18FF sensors is fixed at 25, 50, or 100 millimeters (1 in, 2 in, or 4 in). Objects lying beyond the cutoff distance usually 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).

Fixed-field concept



Object is sensed if amount of light at R1 is greater than the amount of light at R2

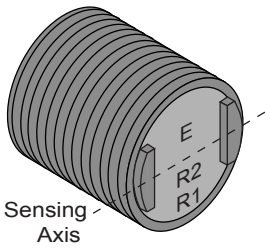
In the drawings and discussion on these pages, the letters E, R1, and R2 identify how the sensor's three optical elements (Emitter "E", Near Detector "R1", and Far Detector "R2") line up across the face of the sensor. The location of these elements defines the sensing axis (see "Sensor Setup" on page 9). The sensing axis becomes important in certain situations, such as those illustrated in "Figure: Object Beyond Cutoff - Problem" on page 10 and "Figure: Object Beyond Cutoff - Solution" on page 10.

Sensor Set Up

Sensing Reliability

As a general rule, the most reliable sensing of an object approaching from the side occurs when the line of approach is parallel to the sensing axis.

Fixed-field sensing axis



For highest sensitivity, position the target object for sensing at or near the point of maximum excess gain. The excess gain curves for these products are shown. Maximum excess gain for the 25 mm models occurs at a lens-to-object distance of about 7 mm; for 50 mm models, at about 10 mm; and for the 100 mm models, at about 20 mm. Sensing at or near this distance will make 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 two guidelines will improve sensing reliability.

Background Reflectivity and Placement

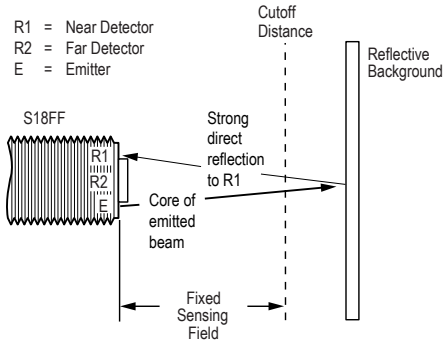
Avoid mirror-like backgrounds that produce specular reflections. False sensor response will occur if a background surface reflects the sensor's light more strongly to the near detector, or "sensing" detector (R1), than to the far detector, or "cutoff" detector (R2). The result is a false ON condition (see "Figure:

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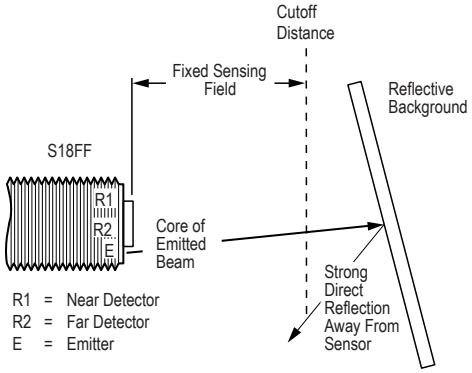
Reflective Background - Problem" on page 10). To cure this problem, use a diffusely reflective (matte) background, or angle either the sensor or the background (in any plane) so the background does not reflect light back to the sensor (see "Figure: Reflective Background - Solution" on page 10). Position 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 10), or moving past the face of the sensor in a direction perpendicular to the sensing axis, can cause unwanted triggering of the sensor if more light is reflected to the near detector than to the far detector. The problem is easily remedied by rotating the sensor 90° ("Figure: Object Beyond Cutoff - Solution" on page 10). 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.

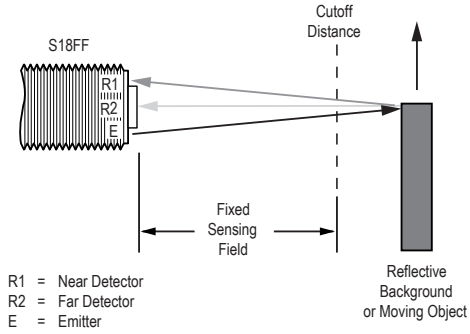
Reflective Background - Problem



Reflective Background - Solution

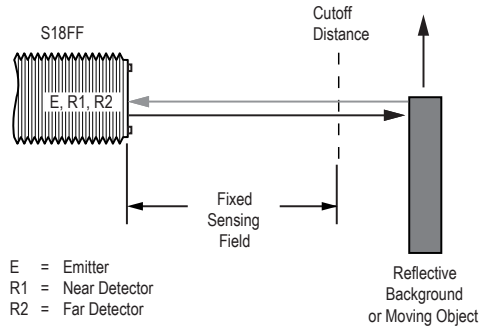


Object Beyond Cutoff - Problem



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

Object Beyond Cutoff - Solution



A reflective background object in this position or moving across the sensor face in this axis will be 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 will be slightly shorter than for higher reflectance targets (see *Performance Curves*). This behavior is known as color sensitivity.

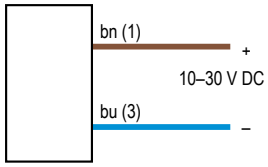
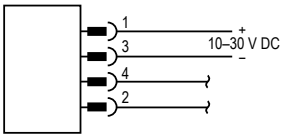
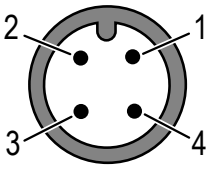
For example, an excess gain of 1 for an object that reflects 1/10 as much light as the 90% white card is represented by the horizontal graph line at excess gain = 10. An object of this reflectivity results in a far limit cutoff of approximately 20 mm (0.8 inches), for the 25 mm (1 inch) cutoff model for example; thus 20 mm represents the cutoff for this sensor and target.

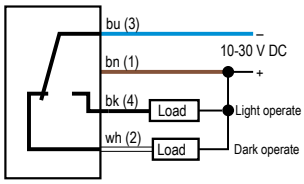
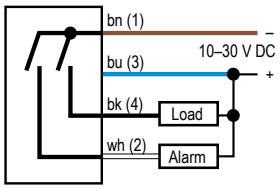
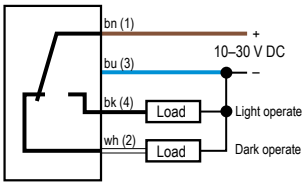
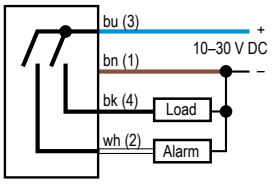
These excess gain curves were generated using a white test card of 90% reflectance. Objects with reflectivity of less than 90% reflect less light back to the sensor, and thus require proportionately more excess gain to be sensed with the same reliability as more reflective objects. When sensing an object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

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Wiring Diagrams

Wiring for the quick disconnect (QD) models is functionally identical.

Cabled Emitters	QD Emitters	Pinout (male)	Key
			1. Brown 2. White 3. Blue 4. Black

NPN Standard	NPN Alarm	PNP Standard	PNP Alarm
			

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 **opposed and retroreflective sensing modes**, light operate is active when the beam is unblocked. In **diffuse, fixed field, and adjustable field sensor modes**, light operate is active when the target is present.

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 **opposed and retroreflective sensing modes**, dark operate is active when the beam is blocked. In **diffuse, fixed field, and adjustable field sensor modes**, dark operate is active when the target is absent.

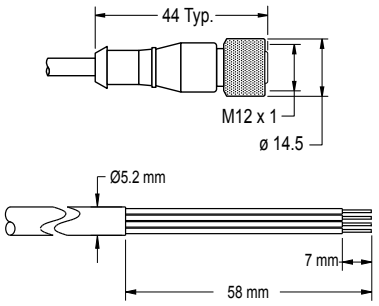
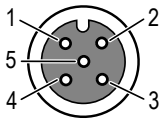
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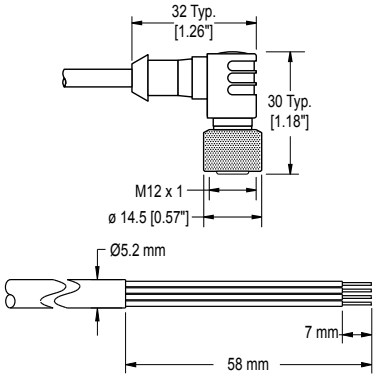
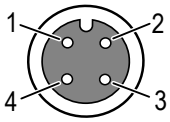
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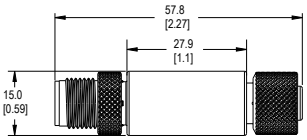
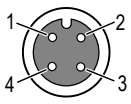
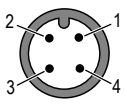
Chapter 3 Accessories

Cordsets

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 2 = White 3 = Blue 4 = Black 5 = Unused 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)			

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 2 = White 3 = Blue 4 = Black 5 = Unused c UL us LISTED
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)			

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					

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Chapter 4 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.

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.

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