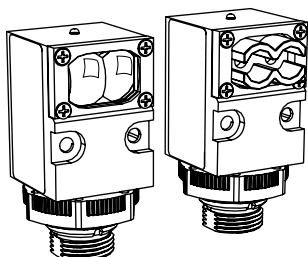


## Datasheet

AC- and DC-powered sensors with solid-state outputs

To view or download the latest technical information about this product, including specifications, dimensions, accessories, and wiring, see <http://www.bannerengineering.com>.



- Choose models for 10 to 30 V dc or 24 to 250 V ac operation
- DC models have bipolar solid-state outputs: one NPN (sinking) and one PNP (sourcing)
- AC models have an SPST solid-state output rated for up to 3/4 amp with simple 2-wire hookup
- All models have a rear panel sensitivity adjustment and light/dark operate switch
- DC models include Banner's Alignment Indicating Device (AID™) system
- Choose models with integral 2 m (6.5 ft) cable or Mini-style QD (quick-disconnect) connector; 9 m (30 ft) cables are also available



### WARNING: Not To Be Used for Personnel Protection

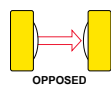
Never use this device as a sensing device for personnel protection. Doing so could lead to serious injury or death. This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.

## Models

To order the 9 m (30 ft) cable model, add the suffix "W/30" to the cabled model number. For example, SMA91E W/30.

A model with a QD connector requires a mating cable; see [Quick-Disconnect Cables](#) on page 10.

## Opposed Mode Emitter (E) and Receiver (R) Models



Infrared, 880 nm

Models	Range	Cable	Supply Voltage	Output Type
SMA91E	60 m (200 ft)	2 m (6.5 ft)	10 to 250 V ac/dc	-
SMA91EQD		3-pin Mini QD		
SM91R		2 m (6.5 ft)	10 to 30 V dc	Bipolar NPN/PNP
SM91RQD		4-pin Mini QD		
SM2A91R		2 m (6.5 ft)	24 to 250 V ac	SPST SCR Solid-state 2-wire
SM2A91RQD		3-pin Mini QD		
SMA91ESR	3 m (10 ft)	2 m (6.5 ft)	10 to 250cV ac/dc	-
SMA91ESRQD		3-pin Mini QD		
SM91RSR		2 m (6.5 ft)	10 to 30 V dc	Bipolar NPN/PNP
SM91RSRQD		4-pin Mini QD		
SM2A91RSR		2 m (6.5 ft)	24 to 250 V ac	SPST SCR Solid-state 2-wire
SM2A91RSRQD		3-pin Mini QD		



### Retroreflective Mode Models



Models	Range <sup>1</sup>	Cable	Supply Voltage	Output Type
<b>Non-Polarized</b>				
SM912LV	0.15 to 9 m (6 in to 30 ft)	2 m (6.5 ft)	10 to 30 V dc	Bipolar NPN/PNP
SM912LVQD		4-Pin Mini QD	24 to 250 V ac	
SM2A912LV		2 m (6.5 ft)		SPST SCR Solid-state 2-Wire
SM2A912LVQD		3-Pin Mini QD		
<b>Polarized<sup>2</sup></b>				
SM912LVAG	0.3 to 4.5 m (1 ft to 15 ft)	2 m (6.5 ft)	10 to 30 V dc	Bipolar NPN/PNP
SM912LVAGQD		4-Pin Mini QD	24 to 250 V ac	
SM2A912LVAG		2 m (6.5 ft)		SPST SCR Solid-state 2-Wire
SM2A912LVAGQD		3-Pin Mini QD		

### Diffuse Mode Models



Models	Range	Cable	Supply Voltage	Output Type
SM912D	760 mm (30 in)	2 m (6.5 ft)	10 to 30 V dc	Bipolar NPN/PNP
SM912DQD		4-Pin Mini QD	24 to 250 V ac	
SM2A912D		2 m (6.5 ft)		SPST SCR Solid-state 2-Wire
SM2A912DQD		3-Pin Mini QD		
SM912DSR	380 mm (15 in)	2 m (6.5 ft)	10 to 30 V dc	Bipolar NPN/PNP
SM912DSRQD		4-Pin Mini QD	24 to 250 V ac	
SM2A912DSR		2 m (6.5 ft)		SPST SCR Solid-state 2-Wire
SM2A912DSRQD		3-Pin Mini QD		

### Convergent Mode Models



Models	Range	Cable*	Supply Voltage	Output Type
<b>Visible Red, 650 nm</b>				
SM912CV	38 mm (1.5 in) Spot Size at Focus: 1.5 mm (0.06 in)	2 m (6.5 ft)	10 to 30 V dc	Bipolar NPN/PNP
SM912CVQD		4-Pin Mini QD	24 to 250 V ac	
SM2A912CV		2 m (6.5 ft)		SPST SCR Solid-state 2-Wire
SM2A912CVQD		3-Pin Mini QD		
<b>Infrared, 880 nm</b>				

<sup>1</sup> Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector used.  
<sup>2</sup> Use polarized models when shiny objects will be sensed.

Models	Range	Cable*	Supply Voltage	Output Type
SM912C	38 mm (1.5 in)	2 m (6.5 ft)	10 to 30 V dc	Bipolar NPN/PNP
SM912CQD		4-Pin Mini QD		
SM2A912C		2 m (6.5 ft)	24 to 250 V ac	
SM2A912CQD		3-Pin Mini QD		

### Glass Fiber Optic Individual Emitter or Receiver Models

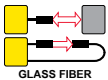


Infrared, 880 nm

Use where the separation between emitting and receiving fibers is more than a few feet, or where it is inconvenient to run both fibers from a single sensor. Watertight o-ring-sealed sensor/fiber interface.

Models	Range	Cable	Supply Voltage	Output Type
SMA91EF	Range varies with fiber used	2 m (6.5 ft)	10 to 250 V ac/dc	-
SMA91EFQD		3-Pin Mini QD		
SM91RF		2 m (6.5 ft)	10 to 30 V dc	Bipolar NPN/PNP
SM91RFQD		4-Pin Mini QD		
SM2A91RF		2 m (6.5 ft)	24 to 250 V ac	SPST SCR Solid-state 2-Wire
SM2A91RFQD		3-Pin Mini QD		

### Glass Fiber Optic Models



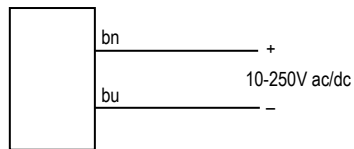
Infrared, 880 nm

Watertight o-ring-sealed sensor/fiber interface.

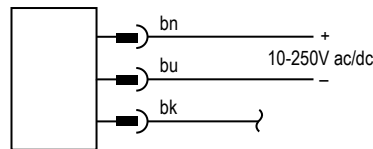
Models	Range	Cable	Supply Voltage	Output Type
SM912F	Range varies with sensing mode and fiber optics used	2 m (6.5 ft)	10 to 30 V dc	Bipolar NPN/PNP
SM912FQD		4-Pin Mini QD		
SM2A912F		2 m (6.5 ft)	24 to 250 V ac	SPST SCR Solid-state 2-Wire
SM2A912FQD		3-Pin Mini QD		

### DC Wiring Diagrams

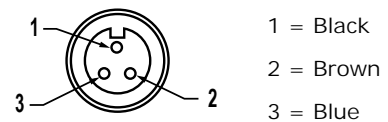
Emitters - Cabled



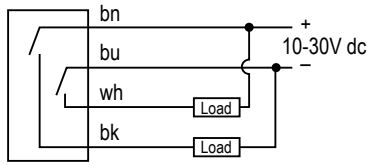
Emitters - QD (3-Pin Mini-Style)



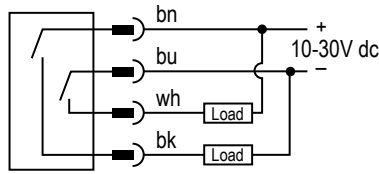
3-Pin Mini-Style Pinout (Cable Connector Shown)



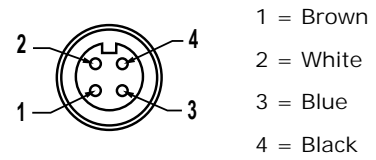
Other DC Models - Cabled



Other DC Models - QD (4-Pin Mini-Style)

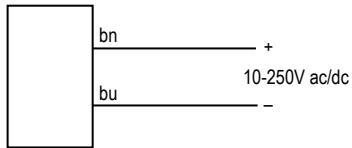


4-Pin Mini-Style Pinout (Cable Connector Shown)

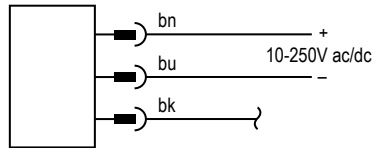


## AC Wiring Diagrams

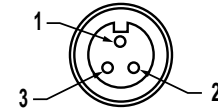
Emitters - Cabled



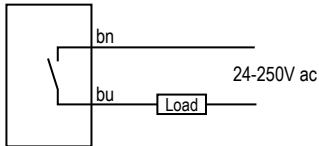
Emitters - QD (3-Pin Mini-Style)



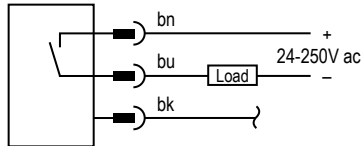
3-Pin Mini-Style Pinout (Cable Connector Shown)



Other AC Models - Cabled



Other AC Models - QD (3-Pin Mini-Style)



- 1 = Black
- 2 = Brown
- 3 = Blue

# Specifications

## Specifications - DC Models

### Supply Voltage and Current

10 to 30 V dc at 20 mA maximum, exclusive of load; except for SMA91E, ESR and EF emitters, which operate from 10 to 250 V ac or dc, 10 mA max.

### Supply Protection Circuitry

Protected against reverse polarity and transient voltages

### Output Configuration

Bipolar: One current sourcing (PNP) and one current sinking (NPN) open-collector transistor

### Output Rating

250 mA continuous, each output  
 Off-state leakage current: less than 10 microamps  
 Output saturation voltage: (PNP output) less than 1 volt at 10 mA and less than 2 volts at 250 mA  
 Output saturation voltage: (NPN output) less than 200 millivolts at 10 mA and less than 1 volt at 250 mA

### 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 <http://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

### Output Response Time

Receivers only: 8 milliseconds ON and 4 milliseconds OFF, independent of signal strength.  
 All other models: 4 milliseconds ON/OFF



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

### Repeatability

Opposed and Glass Fiber Optic Emitter-Receiver pairs: 1.0 millisecond  
 Retro, Diffuse, Convergent and Glass Fiber Optic Models: 1.3 milliseconds

### Adjustments

Light/Dark Operate select switch and Sensitivity control potentiometer, both located at rear of sensor

### Indicators

Alignment Indicating Device (AID™) lights a top-mounted red LED indicator whenever the sensor sees a "light" condition; its pulse rate is proportional to the light signal strength (the stronger the signal, the faster the pulse rate).  
 Model SMA91E and SM91ESR emitters: visible-red "tracer beam" indicates "Power ON" and enables line-of-sight alignment.

### Construction

Reinforced thermoplastic polyester housing, totally encapsulated, molded acrylic lenses and stainless steel hardware

### Environmental Rating

Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12 and 13  
 IEC IP66

### Connections

PVC-jacketed 2 m (6.5 ft) or 9 m (30 ft) cables or 4-pin Mini-style quick-disconnect (QD) fitting available.



**NOTE:** Opposed-mode emitters use 3-pin Mini-style QD fitting. See [Quick-Disconnect Cables](#) on page 10.

### Operating Conditions

Temperature: -20 °C to +70 °C (-4 °F to +158 °F)  
 90% at +50 °C maximum relative humidity (non-condensing)

### Certifications



## Specifications - AC Models

### Supply Voltage and Current

24 to 250 V ac (50/60 Hz);  
except for SMA91E, ESR and EF emitters, which operate from 10 to 250 V ac or dc

### Supply Protection Circuitry

Protected against transient voltages

### Output Configuration

SPST SCR solid-state relay with either normally closed or normally open contact (light/dark operate selectable); 2-wire hookup

### Output Rating

Minimum load current 10 mA, max. steady-state load capability 750 mA to 50 °C ambient (122 °F), 500 mA to 70 °C ambient (158 °F)  
Inrush capability: 4 amps for 1 second (non-repetitive)  
Off-state leakage: current less than 1.7 mA rms  
On-state voltage drop: ≤ 5 volts rms at 750 mA load, ≤ 10 volts rms at 15 mA load

### Output Protection Circuitry

Protected against false pulse on power-up

### 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 <http://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

### Output Response Time

Receivers only: 8 milliseconds ON and 4 milliseconds OFF, independent of signal strength.

All other models: 4 milliseconds ON/OFF

OFF time does not include load response of up to 1/2 ac cycle (8.3 milliseconds).

Response time specification of the load should be considered when total response time is important.



**NOTE:** 300 millisecond delay on power-up; outputs do not conduct during this delay.

### Repeatability

Opposed and Glass Fiber Optic Emitter-Receiver pairs: 1.0 millisecond

Retro, Diffuse, Convergent and Glass Fiber Optic Models: 2.6 milliseconds

### Adjustments

Light/Dark Operate select switch and Sensitivity control potentiometer, both located at rear of sensor

### Indicators

Top-mounted red LED indicator lights when output is conducting.

Model SMA91E and SM91ESR emitters: visible-red "tracer beam" indicates "Power ON" and enables line-of-sight alignment.

### Construction

Reinforced thermoplastic polyester housing, totally encapsulated, molded acrylic lenses and stainless steel hardware

### Environmental Rating

Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12 and 13  
IEC IP66

### Connections

PVC-jacketed 2 m (6.5 ft) or 9 m (30 ft) cables or 3-pin Mini-style (QD) fitting available. See [Quick-Disconnect Cables](#) on page 10.

### Operating Conditions

Temperature: -20 °C to +70 °C (-4 °F to +158 °F)  
90% at +50 °C maximum relative humidity (non-condensing)

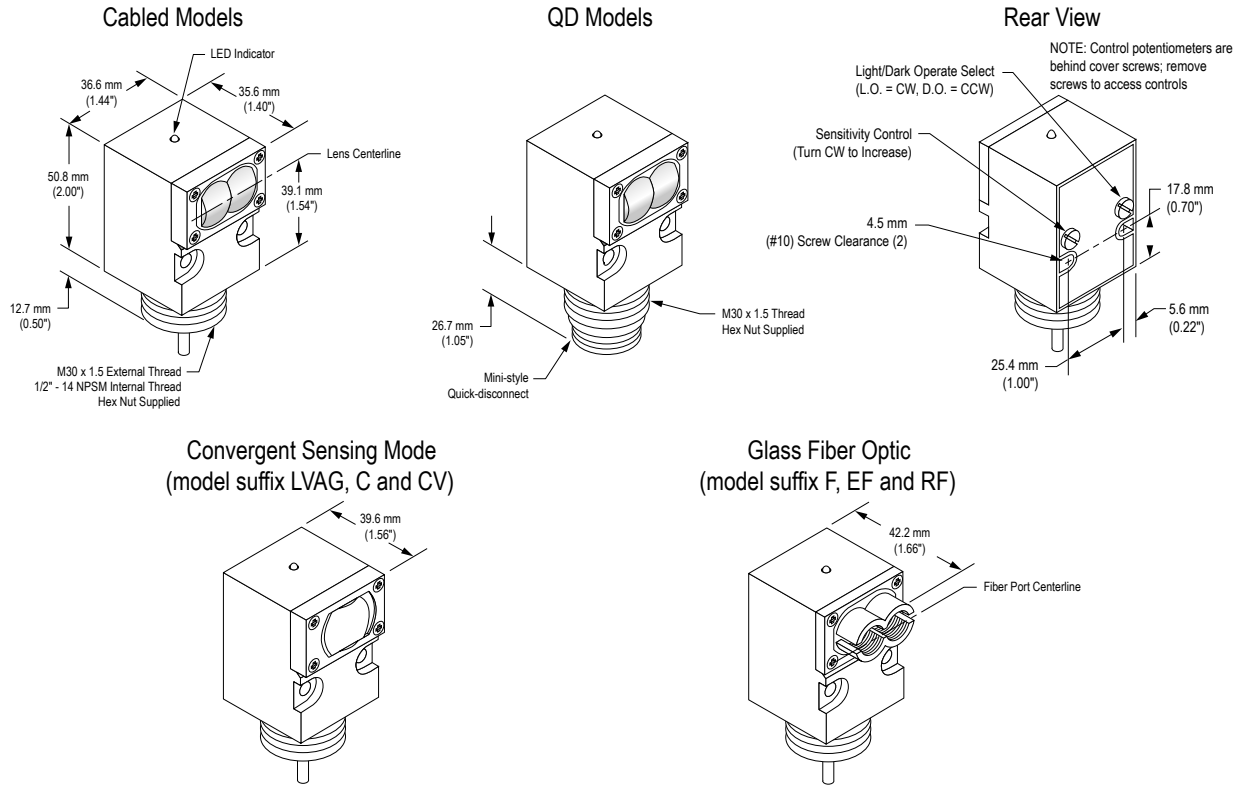
### Application Notes

- 912 Series ac sensors can be destroyed from overload conditions.
- Use on low voltage requires careful analysis of the load to determine if the leakage current or on-state voltage of the sensor will interfere with proper operation of the load.
- The false-pulse protection feature may cause momentary drop-out of the load when the sensor is wired in series or parallel with mechanical switch contacts.

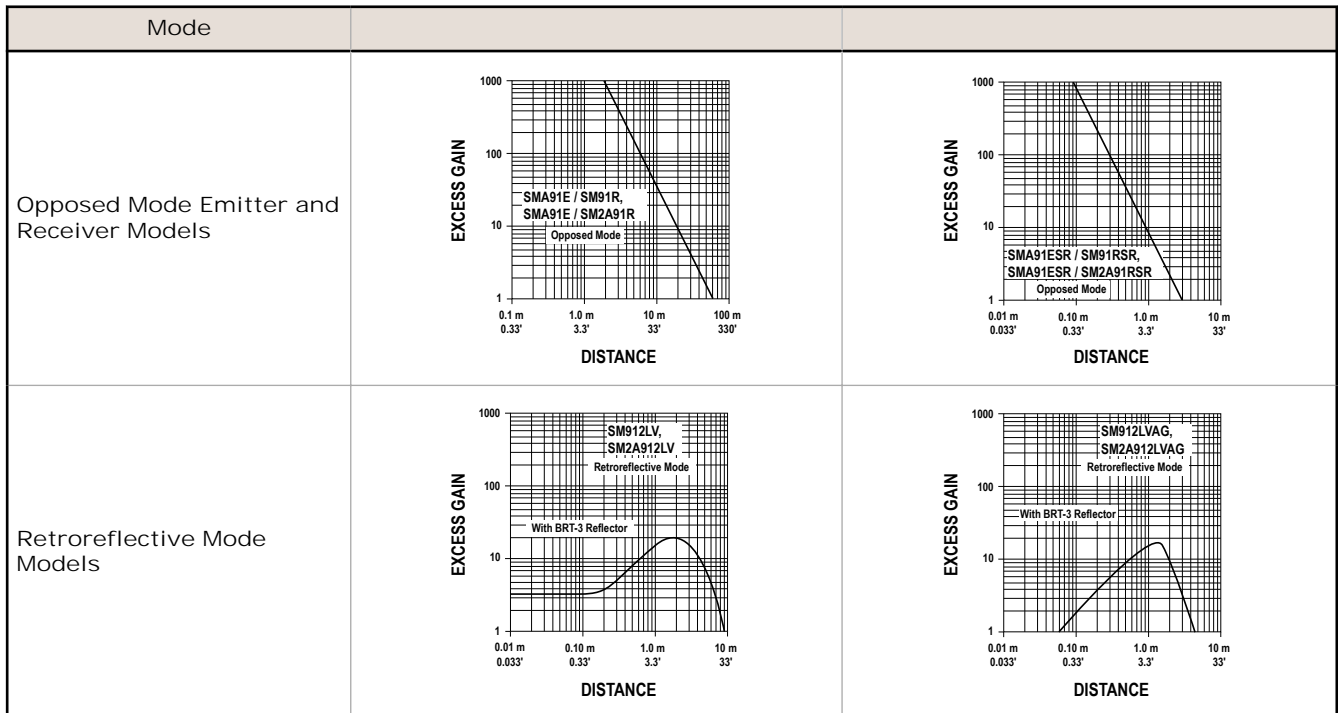
### Certifications



## Dimensions



## Excess Gain

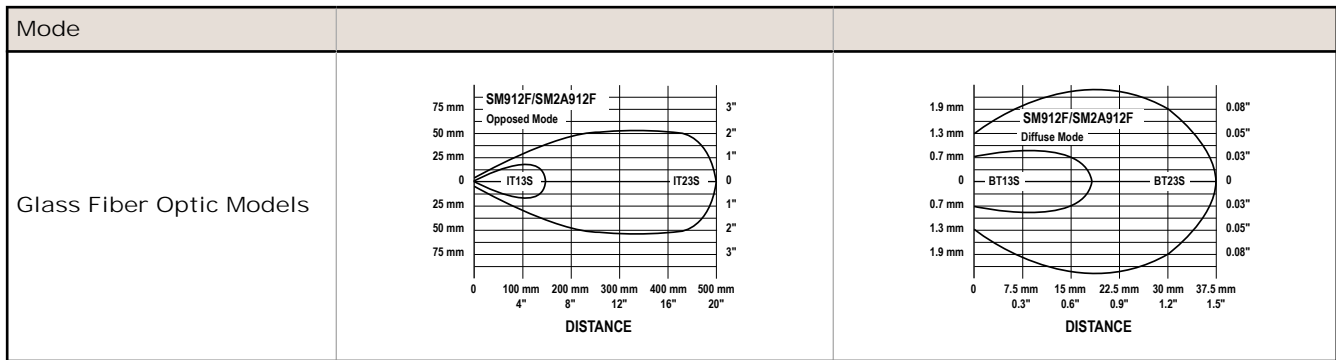


Mode		
Diffuse Mode Models	<p>SM912D, SM2A912D Diffuse Mode</p>	<p>SM912DSR, SM2A912DSR Diffuse Mode</p>
Convergent Mode Models	<p>Visible Red 650 nm</p> <p>SM912CV, SM2A912CV Convergent Mode</p>	<p>Infrared 880 nm</p> <p>SM912C, SM2A912C Convergent Mode</p>
Glass Fiber Optic Individual Emitter or Receiver Models	<p>SMA912F &amp; SMA912R, SMA912F &amp; SMA912R Opposed Mode</p> <p>IT23S Fibers W/L16F Lenses</p> <p>IT23S Fibers W/L9 Lenses</p>	
Glass Fiber Optic Models	<p>SM912F, SM2A912F Opposed Mode</p> <p>IT23S Fibers</p> <p>IT13S Fibers</p>	<p>SM912F, SM2A912F Diffuse Mode</p> <p>BT23S Fiber</p> <p>BT13S Fiber</p>



## Beam Patterns

Mode		
Opposed Mode Emitter and Receiver Models		
Retroreflective Mode Models	<p style="text-align: center;">Non-Polarized</p>	<p style="text-align: center;">Polarized</p>
Diffuse Mode Models		
Convergent Mode Models	<p style="text-align: center;">Visible Red 650 nm</p>	<p style="text-align: center;">Infrared 880 nm</p>
Glass Fiber Optic Individual Emitter or Receiver Models		



## Accessories

### Quick-Disconnect Cables

3-Pin Mini-Style Cordsets				
Model	Length	Style	Dimensions	Pinout (Female)
MBCC-306	1.83 m (6.5 ft)	Straight		<p>1 = Black 2 = Brown 3 = Blue</p>
MBCC-312	3.66 m (12 ft)			
MBCC-330	9.14 m (30 ft)			

4-Pin Mini-Style Cordsets				
Model	Length	Style	Dimensions	Pinout (Female)
MBCC-406	1.83 m (6 ft)	Straight		<p>1 = Brown 2 = White 3 = Blue 4 = Black</p>
MBCC-412	3.66 m (12 ft)			
MBCC-430	9.14 m (30 ft)			

### Cabling Accessories

Model	Description	
AC-6	2 m (6.5 ft) armored cable jacket	I.D. 5/16-in; O.D. 7/16-in
PVC-6	2 m (6.5 ft) flexible PVC tubing (not for QD models)	I.D. 1/4-in; O.D. 3/8-in
RF1-2NPS	Compression fitting for attaching armored cable or PVC tubing	—
HF1-2NPS	<ul style="list-style-type: none"> <li>Flexible black nylon cable protector</li> <li>Includes a neoprene gland that compresses around the VALU-BEAM cable to provide an additional seal against moisture</li> <li>Resistant to gasoline, alcohol, oil, grease, solvents and weak acids</li> <li>Working temperature range of -30 °C to +100 °C (-34 °F to +212 °F)</li> </ul>	

## Extension Cables (without connectors)

The following cables are available for extending the length of existing sensor cable. These are 30 m (100 ft) lengths of VALU-BEAM cable. This cable may be spliced to existing cable. Connectors, if used, must be customer-supplied.

Model	Type	Used With:
EC312-100	4-conductor	SM912 Series dc sensors
EC312A-100	2-conductor	For all emitters and SM2A912 Series ac sensors

## Retroreflective Targets

Banner offers a wide selection of high-quality retroreflective targets. See <http://www.bannerengineering.com> for complete information.



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



## Replacement Lens Assemblies

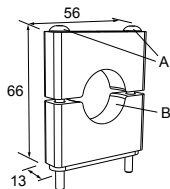
VALU-BEAM lens assemblies are field-replaceable. In addition, some lenses may be used to convert from one sensing mode to another, or to change the sensing range of a particular sensor. The possible conversions are listed in the table below.

Models	Description	Possible Sensing Mode or Range Changes
UC-900AG	Replacement lens for LVAG	Change LV to LVAG
UC-900C	Replacement lens for C and CV	Change LV to CV
UC-900DSR	Replacement lens for DSR, ESR, and RSR	Change D or F to DSR, EF to ESR, and RF to RSR
UC-900F	Replacement lens for F	Change D to F and DSR to F
UC-900FP	Replacement lens for FP	–
UC-900L	Replacement lens for E, R, LV, and D	Change LVAG to LV, CV to LV, DSR to D, and F to D
UC-900J	Attach to E, R, ESR, RSR, LV, and D models	Flat polycarbonate dust cover

## Mounting Brackets

### SMB30C

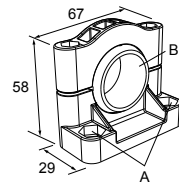
- 30 mm split clamp, black PBT bracket
- Stainless steel mounting hardware included
- Mounting hole for 30 mm sensor



Hole center spacing: A=ø 45  
Hole size: B=ø 27.2

### SMB30SC

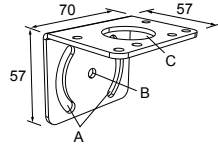
- Swivel bracket with 30 mm mounting hole for sensor
- Black reinforced thermoplastic polyester
- Stainless steel mounting and swivel locking hardware included



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

## 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 =  $\varnothing$  6.4, C =  $\varnothing$  30.1

## 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.

THIS LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED (INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), AND WHETHER ARISING UNDER COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE.

This Warranty is exclusive and limited to repair or, at the discretion of Banner Engineering Corp., replacement. IN NO EVENT SHALL BANNER ENGINEERING CORP. BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR ANY EXTRA COSTS, EXPENSES, LOSSES, LOSS OF PROFITS, OR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES RESULTING FROM ANY PRODUCT DEFECT OR FROM THE USE OR INABILITY TO USE THE PRODUCT, WHETHER ARISING IN CONTRACT OR WARRANTY, STATUTE, TORT, STRICT LIABILITY, NEGLIGENCE, OR OTHERWISE.

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