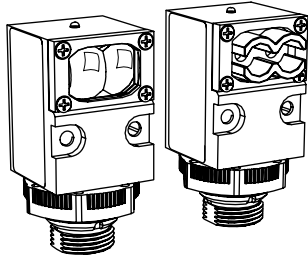


## Datasheet

### 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, go to [www.bannerengineering.com](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 connection
- 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:

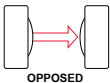
- **Do not use this device for personnel protection**
- Using this device for personnel protection could result in serious injury or death.
- This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A device failure or malfunction can cause either an energized (on) or de-energized (off) output condition.

## Models

To order the 9 m (30 ft) PVC 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 9.

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

Infrared, 880 nm



Models	Range	Connection	Supply Voltage	Output Type
SMA91E	60 m (200 ft)	2 m (6.5 ft) cable	10 to 250 V AC/DC	-
SMA91EQD		3-pin 7/8 in-16UNF Quick Disconnect		
SM91R		2 m (6.5 ft) cable	10 to 30 V DC	Bipolar NPN/PNP
SM91RQD		4-pin 7/8 in-16UNF Quick Disconnect		
SM2A91R		2 m (6.5 ft) cable	24 to 250 V AC	SPST SCR Solid-state 2-wire
SM2A91RQD		3-pin 7/8 in-16UNF Quick Disconnect		
SMA91ESR	3 m (10 ft)	2 m (6.5 ft) cable	10 to 250 V AC/DC	-
SMA91ESRQD		3-pin 7/8 in-16UNF Quick Disconnect		
SM91RSR		2 m (6.5 ft) cable	10 to 30 V DC	Bipolar NPN/PNP
SM91RSRQD		4-pin 7/8 in-16UNF Quick Disconnect		
SM2A91RSR		2 m (6.5 ft) cable	24 to 250 V AC	SPST SCR Solid-state 2-wire
SM2A91RSRQD		3-pin 7/8 in-16UNF Quick Disconnect		



## Retroreflective Mode Models

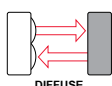
Visible red, 650 nm



Models	Range <sup>1</sup>	Connection	Supply Voltage	Output Type
<b>Non-Polarized</b>				
SM912LV	0.15 to 9 m (6 in to 30 ft)	2 m (6.5 ft) cable	10 to 30 V DC	Bipolar NPN/PNP
SM912LVQD		4-pin 7/8 in-16UNF Quick Disconnect		
SM2A912LV		2 m (6.5 ft) cable	24 to 250 V AC	SPST SCR Solid-state 2-Wire
SM2A912LVQD		3-pin 7/8 in-16UNF Quick Disconnect		
<b>Polarized <sup>2</sup></b>				
SM912LVAG	0.3 to 4.5 m (1 ft to 15 ft)	2 m (6.5 ft) cable	10 to 30 V DC	Bipolar NPN/PNP
SM912LVAGQD		4-pin 7/8 in-16UNF Quick Disconnect		
SM2A912LVAG		2 m (6.5 ft) cable	24 to 250 V AC	SPST SCR Solid-state 2-Wire
SM2A912LVAGQD		3-pin 7/8 in-16UNF Quick Disconnect		

## Diffuse Mode Models

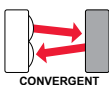
Infrared, 880 nm



Models	Range	Connection	Supply Voltage	Output Type
SM912D	760 mm (30 in)	2 m (6.5 ft) cable	10 to 30 V DC	Bipolar NPN/PNP
SM912DQD		4-pin 7/8 in-16UNF Quick Disconnect		
SM2A912D		2 m (6.5 ft) cable	24 to 250 V AC	SPST SCR Solid-state 2-Wire
SM2A912DQD		3-pin 7/8 in-16UNF Quick Disconnect		
SM912DSR	380 mm (15 in)	2 m (6.5 ft) cable	10 to 30 V DC	Bipolar NPN/PNP
SM912DSRQD		4-pin 7/8 in-16UNF Quick Disconnect		
SM2A912DSR		2 m (6.5 ft) cable	24 to 250 V AC	SPST SCR Solid-state 2-Wire
SM2A912DSRQD		3-pin 7/8 in-16UNF Quick Disconnect		

## Convergent Mode Models

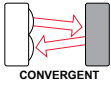
Visible red or infrared



Models (Visible Red, 650 nm)	Range	Cable*	Supply Voltage	Output Type
SM912CV	38 mm (1.5 in) Spot Size at Focus: 1.5 mm (0.06 in)	2 m (6.5 ft) cable	10 to 30 V DC	Bipolar NPN/PNP
SM912CVQD		4-pin 7/8 in-16UNF Quick Disconnect		
SM2A912CV		2 m (6.5 ft) cable	24 to 250 V AC	SPST SCR Solid-state 2-Wire
SM2A912CVQD		3-pin 7/8 in-16UNF Quick Disconnect		

<sup>1</sup> Retroreflective range is specified using one model BRT-3 retroreflector (3-inch diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector used.

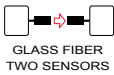
<sup>2</sup> Use polarized models when shiny objects will be sensed.



Models (Infrared, 880 nm)	Range	Cable*	Supply Voltage	Output Type
<b>SM912C</b>	38 mm (1.5 in)	2 m (6.5 ft) cable	10 to 30 V DC	Bipolar NPN/PNP
<b>SM912CQD</b>		4-pin 7/8 in-16UNF Quick Disconnect		
<b>SM2A912C</b>		2 m (6.5 ft) cable	24 to 250 V AC	SPST SCR Solid-state 2-Wire
<b>SM2A912CQD</b>		3-pin 7/8 in-16UNF Quick Disconnect		

### Glass Fiber Optic Individual Emitter or Receiver Models

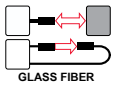
Infrared, 880 nm . Use where the separation between emitting and receiving fibers is more than a few feet, or where it is inconvenient to run both fibers from a single sensor. Watertight o-ring-sealed sensor/fiber interface.



Models	Range	Connection	Supply Voltage	Output Type
<b>SMA91EF</b>	Range varies with fiber used	2 m (6.5 ft) cable	10 to 250 V AC/DC	-
<b>SMA91EFQD</b>		3-pin 7/8 in-16UNF Quick Disconnect		
<b>SM91RF</b>		2 m (6.5 ft) cable	10 to 30 V DC	Bipolar NPN/PNP
<b>SM91RFQD</b>		4-pin 7/8 in-16UNF Quick Disconnect		
<b>SM2A91RF</b>		2 m (6.5 ft) cable	24 to 250 V AC	SPST SCR Solid-state 2-Wire
<b>SM2A91RFQD</b>		3-pin 7/8 in-16UNF Quick Disconnect		

### Glass Fiber Optic Models

Infrared, 880 nm . Watertight o-ring-sealed sensor/fiber interface.



Models	Range	Connection	Supply Voltage	Output Type
<b>SM912F</b>	Range varies with sensing mode and fiber optics used	2 m (6.5 ft) cable	10 to 30 V DC	Bipolar NPN/PNP
<b>SM912FQD</b>		4-pin 7/8 in-16UNF Quick Disconnect		
<b>SM2A912F</b>		2 m (6.5 ft) cable	24 to 250 V AC	SPST SCR Solid-state 2-Wire
<b>SM2A912FQD</b>		3-pin 7/8 in-16UNF Quick Disconnect		

## DC Wiring Diagrams

Figure 1. Emitters - Cabled

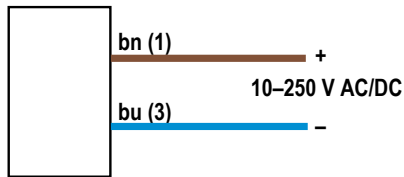


Figure 2. Emitters - QD (3-Pin 7/8 in-16UNF )

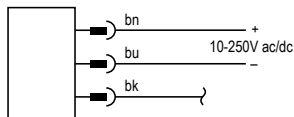
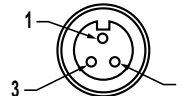


Figure 3. 3-Pin 7/8 in-16UNF Pinout



1 = Black  
2 = Brown  
3 = Blue

Figure 4. Other DC Models - Cabled

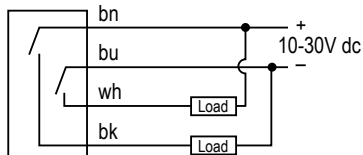


Figure 5. Other DC Models - QD (4-Pin 7/8 in-16UNF )

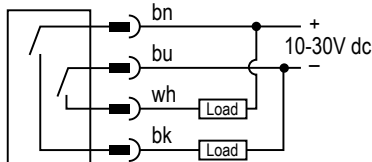
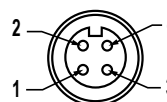


Figure 6. 4-Pin 7/8 in-16UNF Pinout



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

## AC Wiring Diagrams

Figure 7. Emitters - Cabled

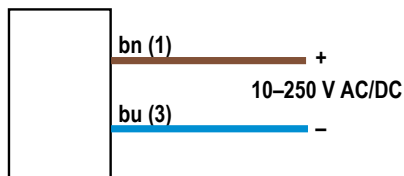


Figure 8. Emitters - QD (3-Pin 7/8 in-16UNF )

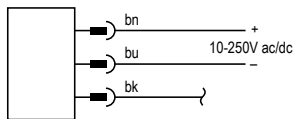


Figure 9. 3-Pin 7/8 in-16UNF Pinout

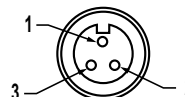


Figure 10. Other AC Models - Cabled

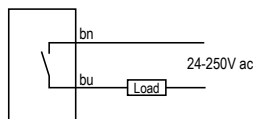
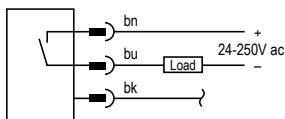


Figure 11. Other AC Models - QD (3-Pin 7/8 in-16UNF )



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

#### Construction

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

#### 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

**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 [www.bannerengineering.com](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

**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.

**Environmental Rating**

Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12 and 13  
 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 9.

**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

**Construction**

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

**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 [www.bannerengineering.com](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.

**Environmental Rating**

Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12 and 13  
 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 9.

**Operating Conditions**

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

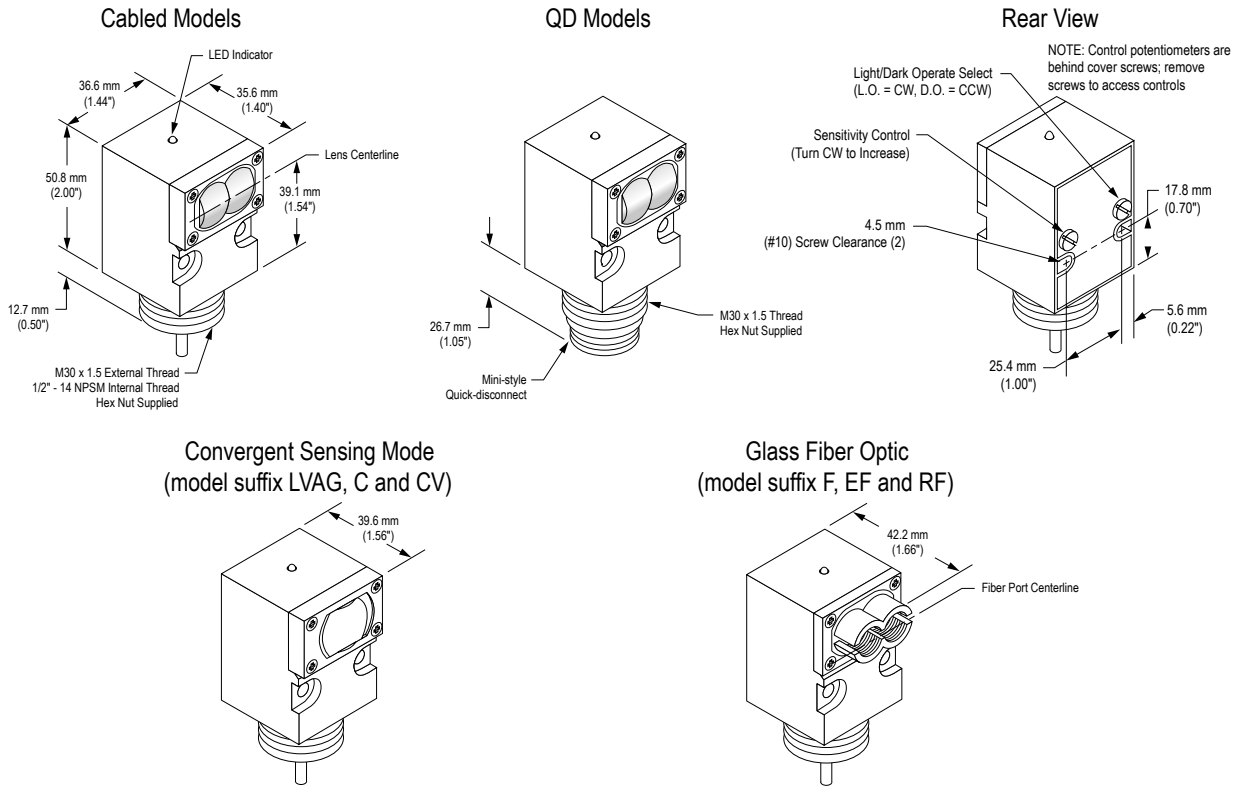
**Application Notes**

- 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.

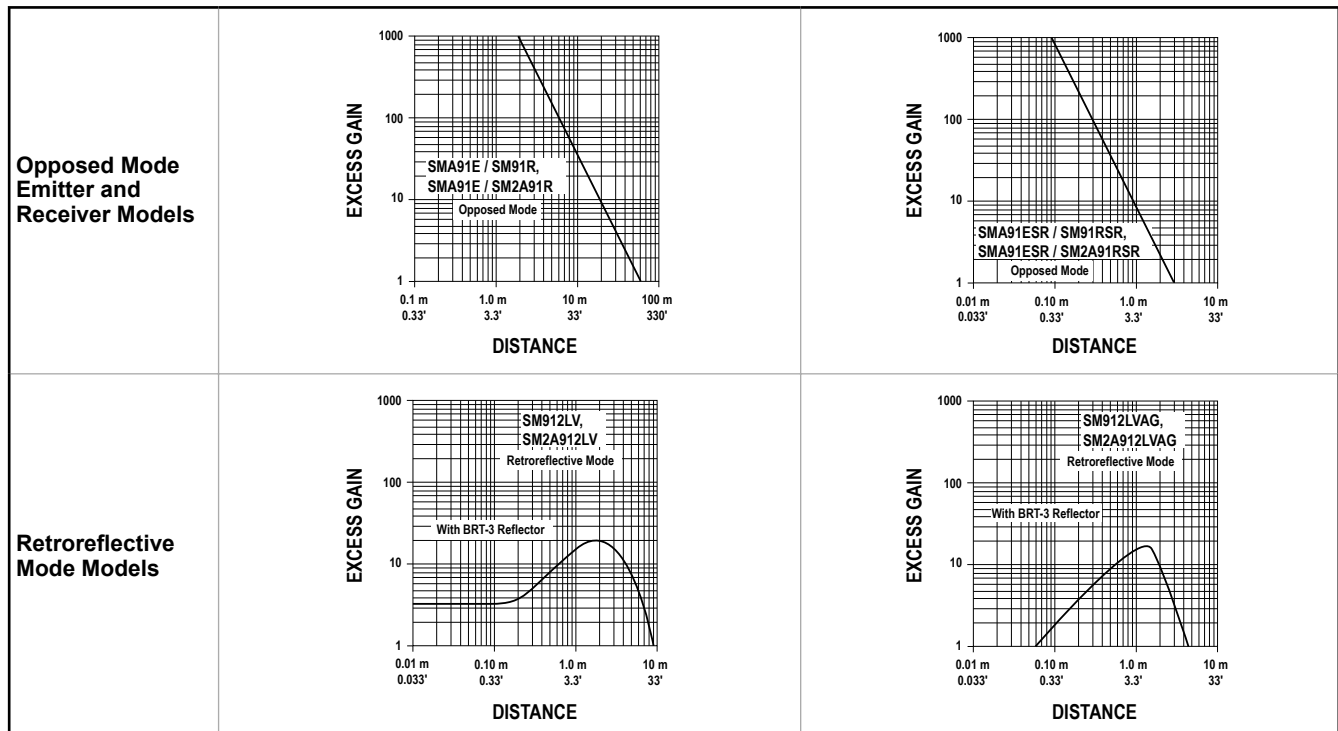
**Certifications**



Dimensions



Excess Gain



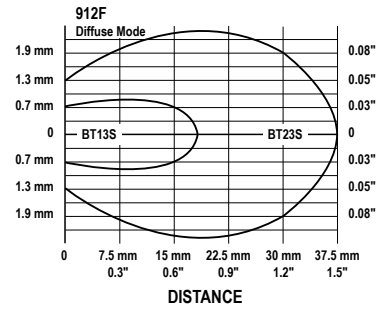
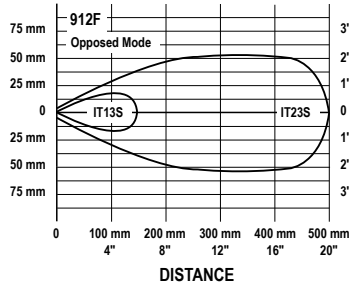
<p><b>Diffuse Mode Models</b></p>	<p>SM912D, SM2A912D Diffuse Mode</p> <p>EXCESS GAIN</p> <p>DISTANCE</p>	<p>SM912DSR, SM2A912DSR Diffuse Mode</p> <p>EXCESS GAIN</p> <p>DISTANCE</p>
<p><b>Convergent Mode Models</b></p>	<p><b>Visible Red 650 nm</b></p> <p>SM912CV, SM2A912CV Convergent Mode</p> <p>EXCESS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

Beam Patterns

<p><b>Opposed Mode Emitter and Receiver Models</b></p>	<p>91E / 91R Opposed Mode</p> <p>DISTANCE</p>	<p>91ESR / 91RSR Opposed Mode</p> <p>DISTANCE</p>
<p><b>Retroreflective Mode Models</b></p>	<p><b>Non-Polarized</b></p> <p>912LV Retroreflective Mode</p> <p>With BRT-3 Reflector</p> <p>DISTANCE</p>	<p><b>Polarized</b></p> <p>912LVAG Retroreflective Mode</p> <p>With BRT-3 Reflector</p> <p>DISTANCE</p>
<p><b>Diffuse Mode Models</b></p>	<p>912D Diffuse Mode</p> <p>DISTANCE</p>	<p>912DSR Diffuse Mode</p> <p>DISTANCE</p>
<p><b>Convergent Mode Models</b></p>	<p><b>Visible Red 650 nm</b></p> <p>912CV Convergent Mode</p> <p>DISTANCE</p>	<p><b>Infrared 880 nm</b></p> <p>SM912C, SM2A912C Convergent Mode</p> <p>DISTANCE</p>
<p><b>Glass Fiber Optic Individual Emitter or Receiver Models</b></p>	<p>91EF &amp; 91RF Opposed Mode</p> <p>IT23S Fibers With L9 lenses</p> <p>IT23S Fibers With L16F lenses</p> <p>DISTANCE</p>	



**Glass Fiber Optic Models**



**Accessories**

**Quick-Disconnect Cables**

3-pin 7/8-in Cordsets—Single Ended				
Model	Length	Style	Dimensions	Pinout (Female)
MBCC-306	1.83 m (6 ft)	Straight		<p>1 = Brown 3 = Blue 4 = Black</p>
MBCC-312	3.66 m (12 ft)			
MBCC-330	9.14 m (30 ft)			

4-Pin 7/8-in Cordsets—Single Ended				
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 (-22 °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 [www.bannerengineering.com](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

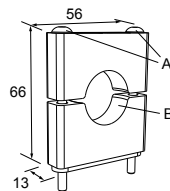
VALU-BEAM lens assemblies are field-replaceable. In addition, some lenses may be used to convert from one sensing mode to another, or to change the sensing range of a particular sensor. The possible conversions are listed in the table below.

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

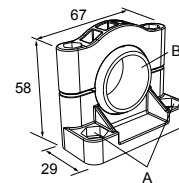


Hole center spacing: A=ø 45

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

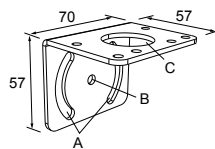


Hole center spacing: A=ø 50.8

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 = ø 6.4, C = ø 30.1

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