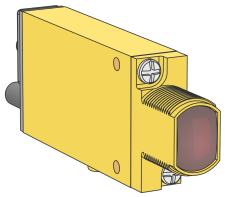
MINI-BEAM SMU31 Universal Voltage Series Sensor

Features

Photoelectric sensors with electromechanical relay output



- Popular, compact MINI-BEAM package
- Universal supply voltage: 24 to 240 V AC, 50/60 Hz; 24 to 240 V DC (1.5 watts or 2.5 V A maximum)
- Easy-to-operate sensors with few necessary adjustments
- Light/Dark Operate select switch and 15-turn Gain potentiometer are protected by a gasketed clear acrylic cover
- Multiple sensing modes include: Opposed, Retroreflective, Diffuse, Divergent, and Convergent, plus Glass and Plastic Fiber Optic models
- 3-amp SPDT (Single-Pole-Double-Throw) electromechanical relay output
- Exclusive, patented Alignment Indicating Device system (AID™) lights a rear-panel mounted LED indicator when the sensor sees a light condition; superimposed pulse rate indicates received light signal strength
- Wide array of mounting options, including 18 mm in-line thread
- Integral, unterminated cables 2 m (6.5 ft) or 9 m (30 ft) long are 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

Opposed mode emitters (E) and receiver (R) sensors have a small effective beam size and are ideal for accuracy-dependent applications, particularly when used with an aperture. They have the power to burn through dust and dirt and may even sense opaque materials through a thin-walled container.

Opposed mode sensors

Model	Range	LED	Sensing Mode
SMU31E	3 m (10 ft)	Infrared, 880 nm	Opposed emitter
SMU31R			Opposed receiver
SMU31EL	30 m (100 ft)		Opposed emitter, long range
SMU31RL			Opposed received, long range

Non-polarized and polarized retroreflective mode sensors are excellent for sensing even small items where sensing is possible from one side only. Recommended for relatively clean environments where high excess gain is not required.

Retroreflective mode sensors

Model	Range	LED	Sensing Mode
SMU315LV	5 m (15 ft)	Visible Red, 650 nm	Non-Polarized Retroreflective
SMU315LP	10 mm to 3 m (0.4 in to 10 ft)		Polarized Retroreflective

Diffuse mode sensors are economical single-unit sensors that are excellent for sensing objects of adequate size and reflectivity at short range. Divergent models are useful for sensing small items and translucent or transparent materials at close range.

Diffuse mode sensors

Model	Range	LED	Sensing Mode
SMU315D	380 mm (15 in)	Infrared, 880 nm	Diffuse
SMU315W	130 mm (5 in)		Divergent diffuse

Convergent mode sensors feature high excess gain and can detect objects with low reflectivity. They are a good choice for counting adjacent radiused objects and for accurate position sensing.

Convergent mode sensors

Model	Range	LED	Sensing Mode
SMU315CV	16 mm (0.65 in); 1.3 mm (0.05 in) spot size (diameter of sensing beam) at focus	Visible Red, 650 nm	Convergent
SMU315CV2	43 mm (1.7 in); 3 mm (0.07 in) spot size at focus		

69944
p/n: 69944 Rev. C

Glass fiber sensors are an excellent option for sensing in tight or inaccessible areas. Fibers withstand vibration and shock and are immune to electrical noise. Glass fibers withstand high temperatures, extreme moisture, and corrosive materials. Glass fiber models are not recommended for applications requiring bending or repeated flexing of fibers (see plastic fiber models).

Glass fiber sensors

Model	Range	LED	Sensing Mode
SMU315F	Range varies depending on the sensing mode and fiber optics used	Infrared, 880 nm	Glass Fiber Optic
SMU315FV		Visible Red, 650 nm	

Plastic fiber sensors are an excellent option for sensing in tight or inaccessible areas. Fibers withstand vibration and shock and are immune to electrical noise. Plastic fibers function well at temperatures between -30º and +70ºC (-20º to +158ºF) and stand up to repeated flexing. Most are easy to shorten in the field, for custom installations. Plastic fiber models are not recommended for severe environments (see glass fiber models).

Plastic fiber sensors

Model	Range	LED	Sensing Mode
SMU315FP	Range varies depending on the sensing mode and fiber optics used	Visible Red, 650 nm	Plastic Fiber Optic

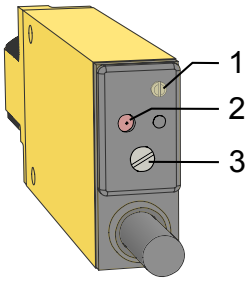
Integral 2 m (6.5 ft) unterminated cable models are listed. To order the 9 m (30 ft) PVC cable model, add the suffix "W/30" to the cabled model number. For example, SMU31E W/30.

Overview

MINI-BEAM Universal Voltage sensors (except opposed-mode emitters) have the following features:

- Gain adjustment (1)
- Light/dark operate selection (3)
- Signal strength indicator LED on the back of the sensor, protected behind a clear acrylic cover (2)

Sensor shown with gasketed acrylic cover removed.



To increase the gain, turn the 15-turn potentiometer clockwise. It is clutched at both ends of travel to avoid damage. A clicking sound may be heard and/or felt when attempting to adjust beyond either limit.

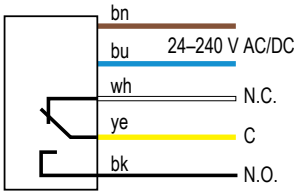
The Signal Strength indicator is Banner's exclusive, patented AID (Alignment Indicating Device). Its pulse rate increases as the received light signal strength increases. This simplifies accurate alignment and gives a relative indication of sensing contrast.

To select Light Operate, insert a small screwdriver into the slot on the select switch and turn it fully clockwise, until the tabs on the control touch the stop. To select Dark Operate, turn the select switch fully counterclockwise, until the tabs touch the opposite side of the stop. Carefully turn the Light/Dark Operate select switch to avoid damaging the small tabs on the switch.

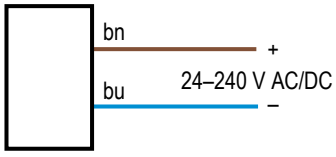
MINI-BEAM Universal Voltage Series sensors have no field-serviceable parts, other than replaceable lenses.

Wiring

All models except emitters



Emitters



- Output type for all models (except emitters) is SPDT Electromechanical Relay
- Install transient suppressor (MOV) across contacts switching inductive loads
- Connection of DC power is without regard to polarity
- Maximum switching current is 3 amps - see Specifications

Installation and Alignment

MINI-BEAM sensors perform most reliably if they are properly aligned and securely mounted. For maximum mechanical stability, mount MINI-BEAM sensors through 18 mm diameter holes by their threaded barrel (where available), or use a mounting bracket. A complete selection of mounting brackets is available. Visit www.bannerengineering.com or contact Banner Engineering for information on mounting options.

1. Using line-of-sight, position the MINI-BEAM sensor to its emitter (opposed-mode sensing) or to its target (all other sensing modes).
    - When using a retroreflective sensor, the target is the retroreflector (or *retro target*).
    - For diffuse or convergent sensing modes, the target is the object to be detected.

2. Apply power to the sensor (and to the emitter, if using the opposed mode).
3. Advance the 15-turn Gain control to maximum (clockwise end of rotation), using a small flat-blade screwdriver.

   The Gain control is clutched at both ends to avoid damage and will free-wheel when either endpoint is reached.

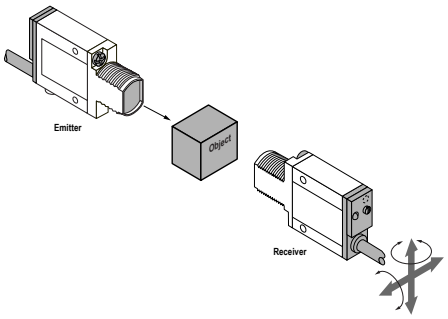
   If the MINI-BEAM sensor receives its light signal, then the red LED alignment indicator flashes at a rate proportional to the signal strength (faster = more signal).
4. Move the sensor (or move the retro target, if applicable) up-down-right-left (including angular rotation) to find the center of the movement zone within which the LED indicator remains ON.
5. Reduce the Gain setting by turning the Gain control.

   Reducing the Gain setting reduces the movement zone size and enables more precise alignment.
6. Repeat the alignment motions after each Gain reduction.
7. When optimum alignment is achieved, mount the sensor(s) (and the retro target, if applicable) solidly in that position.
8. Increase the Gain to the maximum.
9. Test the sensor by placing the object to be detected in the sensing position, and then removing it.

   The Alignment Indicator LED should turn ON when the sensing beam is established (Light condition), and turn OFF when the beam is broken (Dark condition).

Opposed Mode Alignment

In opposed-mode sensing, the sensor's emitter and receiver are housed in two separate units. The emitter is placed opposite the receiver so that the light beam goes directly from the emitter to the receiver. An object is detected when it breaks the working part of the light beam, known as the effective beam.



In **opposed** sensing modes, light operate means the output is on when the beam is unblocked and dark operate means the output is on when the beam is blocked.

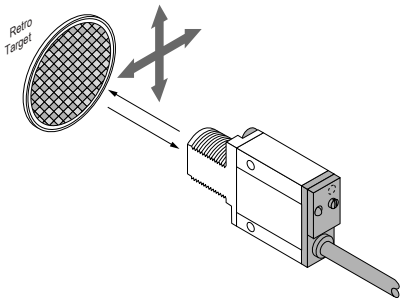
Flooding occurs when a portion of the sensing beam passes around the object to be sensed. *Burn-through* occurs when a portion of the emitter's light energy passes through a thin or translucent object, and is sensed by the receiver.

To correct either problem, do one or more of the following to reduce the light energy:

- Reduce the Gain adjustment on the receiver
- Add an aperture to one or both lenses (MINI-BEAM apertures, available from Banner, fit neatly inside the lens assembly)
- Intentionally misalign the emitter and receiver

Retroreflective Mode Alignment

A retroreflective sensor contains both the emitter and receiver elements. The effective beam is established between the emitter, the retroreflector, and the receiver. As with an opposed-mode sensor, an object is sensed when it interrupts or "breaks" the effective beam.



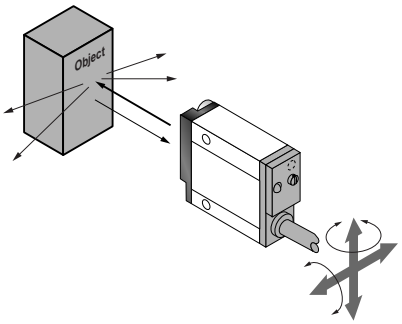
In **retroreflective** sensing modes, light operate means the output is on when the beam is unblocked and dark operate means the output is on when the beam is blocked.

A highly reflective object may reflect enough light back to a retroreflective sensor to allow that object to slip through the beam, without being detected. This problem is called *proxing*, and the following methods may be used to correct it:

- Position the sensor and retro target so the beam will not strike a shiny surface perpendicular to the sensor lens
- Reduce the Gain adjustment
- Add a polarizing filter (for model SMU315LV).

Diffuse Mode Alignment

In diffuse-mode sensing, light emitted from the sensor strikes the surface of the object to be detected and is reflected back to the receiver, which is housed with the emitter. With a diffuse-mode sensor, the object is detected when it "makes" the beam, that is, the object reflects the sensor's transmitted light energy back to the sensor.



In **diffuse** sensing modes, light operate means the output is on when the target is present and within the sensing range. Dark operate means the output is on when no target is detected.

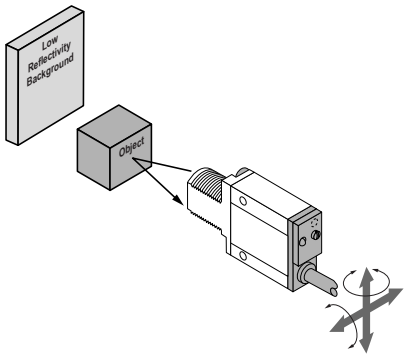
If the Alignment LED does not turn OFF when the object is removed from the beam, the sensor is probably detecting light reflected from some background object. To remedy this problem:

- Reduce the reflectivity of the background by painting the surface(s) flat-black, scuffing any shiny surface, or drilling a large hole, directly opposite the diffuse sensor

- Move the sensor closer to the object to be detected and reduce the Gain adjustment. Rule of thumb for diffuse sensing: The distance to the nearest background object should be at least three times the sensing distance

Convergent Mode Alignment

Convergent-mode sensors use a lens system to focus the emitter and receiver elements to an exact point in front of the sensor. Like diffuse-mode and divergent-mode sensors, convergent-mode sensors detect an object when that object completes or "makes" the light beam. This design produces a small, intense, and well-defined sensing area, at a fixed distance from the sensor lens. It is a very efficient use of reflective energy.

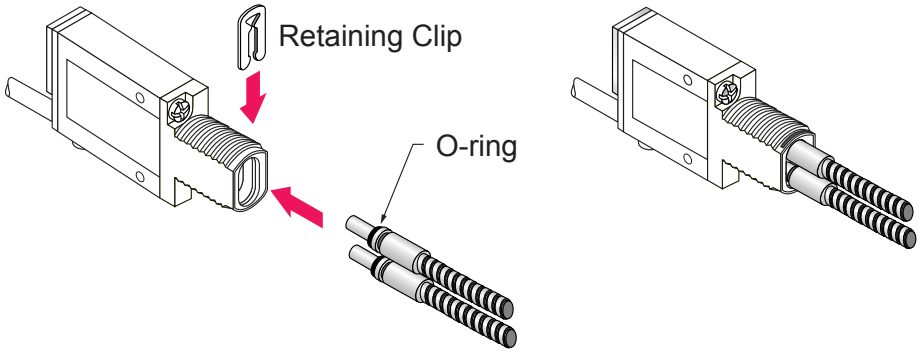


In **convergent** sensing modes, light operate means the output is on when the object is present and within the sensing range. Dark operate means the output is on when no target is detected.

The sensing energy of a convergent mode sensor is concentrated at the specified focus point. Convergent mode sensors are less sensitive to background reflections than diffuse mode sensors. However, if background reflections are a problem:

- Skew the sensor position at a 10° to 25° angle to eliminate direct reflections from shiny background surfaces
- Reduce the reflectivity of the background by painting the surface(s) flat-black, scuffing any shiny surface, or drilling a large hole, directly opposite the sensor
- Reduce the Gain adjustment

Installing the Glass Fibers in MINI-BEAMs

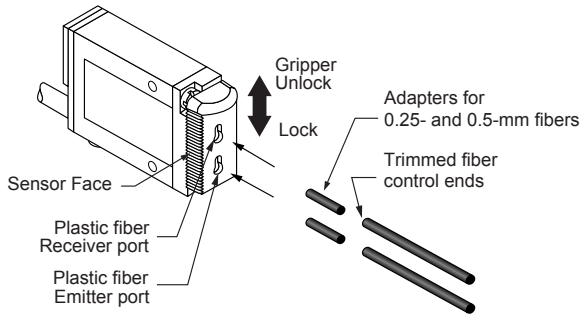


1. Install the O-ring (supplied with the fiber) on each fiber end, as shown in the drawing.
2. While pressing the fiber ends firmly into the ports on the sensor front, slide the U-shaped retaining clip (supplied with the sensor) into the slot in the sensor's barrel, until it snaps into place.

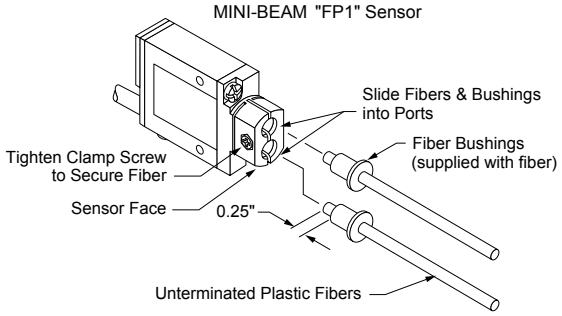
Installing Plastic Fibers on a MINI-BEAM

Follow these instructions to install plastic fibers into your sensor. MINI-BEAMS may have either a fiber gripper or a clamp screw. **MINI-BEAM** and **ECONO-BEAM** sensors for use with plastic fiber optic assemblies include sensors with the letters **FP** in their model number.

MINI-BEAM with fiber grippers



MINI-BEAM with clamp screws



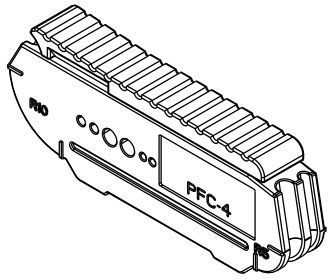
1. Prepare the sensor ends of the fibers (see "Cut the Plastic Fiber" on page 5).
2. Prepare the sensor for the fibers.
    - For models with a fiber gripper: Unlock the fiber gripper as shown in the figure and apply the appropriate fiber adaptors to the fiber, if needed.

- For models with a clamp screw: Loosen the clamp screw on the sensor face.

3. Insert the plastic fibers.
   - For models with a fiber gripper: Gently insert the prepared fiber ends into the ports as far as they will go.
   - For models with a clamp screw: Align the fiber ends flush with the ends of the bushings as shown. Hold the bushings to the fibers and slide both into the sensor ports. Push the fiber an additional 1 inch through the bushing.
4. Lock in the fibers.
   - For models with a fiber gripper: Slide the fiber gripper back to lock, as shown in the figure.
   - For models with a clamp screw: Tighten the clamp screw to secure the fibers.

Cut the Plastic Fiber

- An unterminated plastic fiber is designed to be cut by the customer to the length required for the application. To facilitate cutting, a Banner model PFC-4 cutting device is supplied with this fiber.



1. Locate the non-terminated end, and determine the length of fiber required for the application.
2. Lift the top of the cutter to open the cutting ports.
3. Insert the non-terminated end through one of the four large cutting ports on the PFC-4 cutter so that the excess fiber protrudes from the back of the cutter.
4. Double-check the fiber length, and close the cutter until the fiber is cut.
5. Gently wipe the cut ends of the fiber with a clean, dry cloth to remove any contamination.

NOTE: Do not use solvents or abrasives on any exposed optical fiber. Do not use a cutting port more than once. The blade may tend to dull after one cut.

Specification

Supply Voltage and Current

24 V AC to 240 V AC, 50/60 Hz or
24 V DC to 240 V DC (1.5 watts or 2.5 VA maximum)

Supply Protection Circuitry

Protected against transient voltages. DC wiring is without regard to polarity.

Output Configuration

SPDT (Single-Pole, Double Throw) (form C) electromechanical relay, ON/OFF output

Output Rating

Maximum switching power (resistive load): 90 watts, 250 VA
Maximum switching voltage (resistive load): 250 V AC or 30 V DC
Maximum switching current (resistive load): 3 A
Minimum voltage and current: 5 V DC, 10 mA
Mechanical life: 20,000,000 operations
Electrical life at full resistive load: 100,000 operations

Output Protection Circuitry

Protected against false pulse on power up

Output Response Time

Closure time: 20 milliseconds maximum
Release time: 20 milliseconds maximum
Maximum switching speed: 25 operations per second

Repeatability

All sensing modes: 1 millisecond

Adjustments

Light/Dark Operate select switch
15-turn slotted brass screw Gain (sensitivity) adjustment potentiometer
Located on the rear panel, protected by a gasketed, clear acrylic cover. See "Installation and Alignment" on page 2.

Indicators

Patented Alignment Indicator Device system (AID™) lights a rear-panel-mounted 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).

Construction

Reinforced thermoplastic polyester housing, totally encapsulated, o-ring seal, acrylic lenses, and stainless steel screws

Environmental Rating

NEMA 1, NEMA 2, NEMA 3, NEMA 3S, NEMA 4, NEMA 4X, NEMA 63, NEMA 12, and NEMA 13
IP67

Connections

5-conductor (2-conductor for emitters) 2 m (6.5 ft) unterminated PVC-jacketed cable or 9 m (30 ft) unterminated PVC-jacketed cable, depending on the model

Operating Conditions

Temperature: –20 °C to +55 °C (–4 °F to +131°F)
90% at +50 °C maximum relative humidity (non-condensing)

Application Note

Install transient suppressor (MOV) across contacts switching inductive loads

FCC Part 15 Class A for Unintentional Radiators

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

(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.

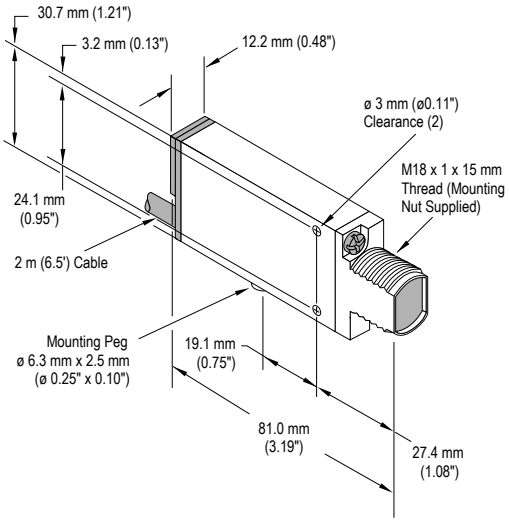
Industry Canada ICES-003(A)

This device complies with CAN ICES-3 (A)/NMB-3(A). 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.

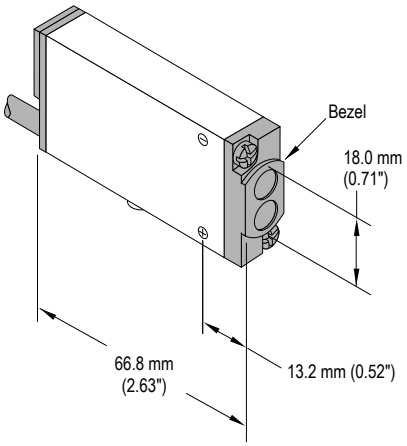
Cet appareil est conforme à la norme NMB-3(A). Le fonctionnement est soumis aux deux conditions suivantes : (1) ce dispositif ne peut pas occasionner d'interférences, et (2) il doit tolérer toute interférence, y compris celles susceptibles de provoquer un fonctionnement non souhaité du dispositif.

Dimensions

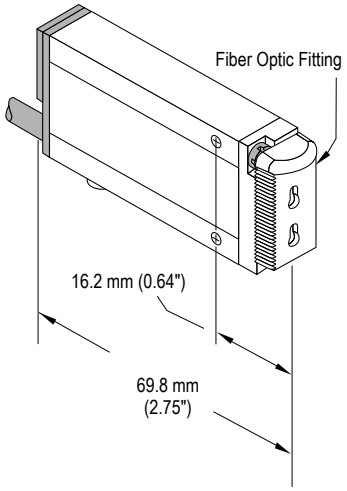
Models with suffix E, EL, R, RL, LV, LP, D, CV, and CV2



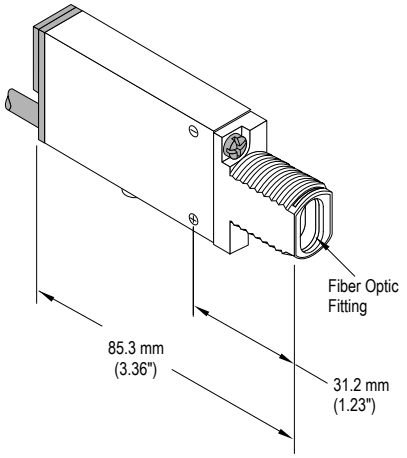
Model SMU315W



Model SMU315FP



Models with suffix F and FV



Accessories

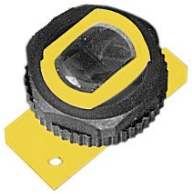
Retroreflective Targets

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

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

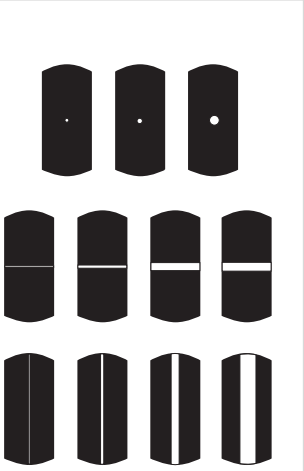
Replacement MINI-BEAM Lens Assemblies

MINI-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 below.

Replacement Lens Model	Replacement Lens for MINI-BEAM Model	Possible Sensing Mode or Range Changes	
UC-300AG	LVAG	LV to LVAG	
UC-300BZ	W and DBZ	D to DBZ and F to DBZ	
UC-300C..7	C, CV, and CVG	CV2 to CV	
UC-300C2	C2 and CV2	CV to CV2	
UC-300E	E and R	-	
UC-300EL	EL and RL	Extends the range of the E/R models	
UC-300EPD	EPD	-	
UC-300F	F and FV	D to F and DBZ to F	
UC-300FP	FP (old style)	-	
UC-300FP2	FP	-	
UC-300L	LV and D	F to D, LVAG to LV, and DBZ to D	
UC-300LP	LP	-	
UC-300RPD	RPD	-	

Aperture Kits for MINI-BEAMs

Opposed-mode MINI-BEAM sensors may be fitted with apertures that narrow or shape the effective beam of the sensor to more closely match the size or profile of the object to be sensed, for example, the use of “line” (or “slit”) apertures for sensing wire or thread. Each model contains 20 apertures.

MINI-BEAM Opposed-Mode Aperture Kits			
Model	**Description**	**Qty**	
Circular			
AP31-020	0.5 mm dia.	20	
AP31-040	1.0 mm dia.	20	
AP31-100	2.5 mm dia.	20	
Horizontal Slot			
AP31-020H	0.5 x 6.4 mm	20	
AP31-040H	1.0 x 6.4 mm	20	
AP31-100H	2.5 x 6.4 mm	20	
AP31-200H	5.1 x 6.4 mm	20	
Vertical Slot			
AP31-020V	0.5 x 12.7 mm	20	
AP31-040V	1.0 x 12.7 mm	20	
AP31-100V	2.5 x 12.7 mm	20	
AP31-200V	5.1 x 12.7 mm	20	
Kit			
AP31-DVHX2	2 of each aperture	2	

Aperture	Range (Standard Group I and II Sensor Pairs)				Range (Group I Sensor Pairs with UC-300EL Upper Covers Substituted)	
	Aperture on Both Emitter and Received		Aperture on Receiver Only			
	Group I Sensors	Group II Sensors	Group I Sensors	Group II Sensors	Aperture on Both Emitter and Received	Aperture on Receiver Only
AP31-020	89 mm	102 mm	457 mm	1.5 m	127 mm	914 mm
AP31-040	330 mm	457 mm	940 mm	3.2 m	183 mm	2 m
AP31-100	1.5 m	3 m	2.5 m	8.2 m	2.1 m	5.8 m
AP31-020H	406 mm	1.8 m	965 mm	9.1 m	864 mm	3.4 m
AP31-040H	914 mm	4 m	1.8 m	12.5 m	1.8 m	5.2 m
AP31-100H	2.3 m	10.4 m	2.9 m	20.7 m	5.2 m	8.5 m
AP31-200H	2.8 m	21.3 m	3 m	24.4 m	8.2 m	11 m

Continued on page 8

Continued from page 7

Aperture	Range (Standard Group I and II Sensor Pairs)				Range (Group I Sensor Pairs with UC-300EL Upper Covers Substituted)	
	Aperture on Both Emitter and Received		Aperture on Receiver Only			
	Group I Sensors	Group II Sensors	Group I Sensors	Group II Sensors	Aperture on Both Emitter and Received	Aperture on Receiver Only
AP31-020V	457 mm	1.7 m	1 m	8.2 m	1 m	3.4 m
AP31-040V	1 m	5.5 m	1.8 m	15.8 m	2.1 m	5.5 m
AP31-100V	2.3 m	10.7 m	2.9 m	22.9 m	6.1 m	8.5 m
AP31-200V	2.8 m	22.9 m	3 m	25.9 m	8.5 m	11 m

GROUP I Emitter/ Receiver Pairs (see Range): SMU31E/SMU31R

GROUP II Emitter/ Receiver Pairs (see Range): SMU31EL/SMU31RL

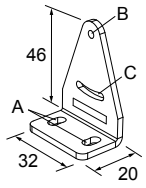
Example: The MINI-BEAM SMU1E/SMU31R sensor pair is in Group I. With an AP31-040 circular aperture on the receiver only, range is 940 mm (37 in). With AP31-040 apertures on both emitter and receiver, range is 330 mm (13 in). Group I range with AP31-040 apertures and UC-300EL upper covers on both units is 483 mm (19 in); range with receiver aperture only is 2.0 m (80 in).

Brackets

SMB312S

- Stainless steel 2-axis, side-mount bracket

A = 4.3 × 7.5, B = diam. 3, C = 3 × 15.3

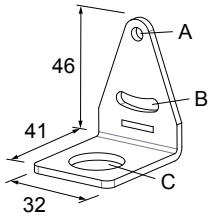


SMB312PD

- Right-angle mounting bracket with a curved slot for versatile orientation
- 12-ga. stainless steel
- 18 mm sensor mounting hole
- Clearance for M4 (#8) hardware

Hole center spacing: A to B = 24.2
Hole size: A = ø 4.6, B = 17 × 4.6, C = ø 18.5

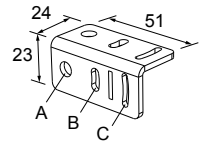
NOTE: Not for use with plastic fiber optic sensors



SMB312B

- Stainless steel 2-axis, bottom-mount bracket
- Includes mounting foot

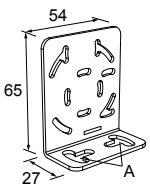
A = diam. 6.9, B = 4.3 × 10.5, C = 3.1 × 15.2



SMB46L

- Right-angle
- L bracket
- 14-ga. 316 stainless steel

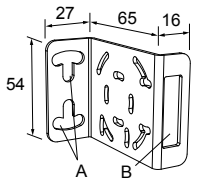
Hole center spacing: A = 16.0
Hole size: A = 16.5 × 18.7



SMB46S

- Right-angle
- S bracket
- 14-ga. 316 stainless steel

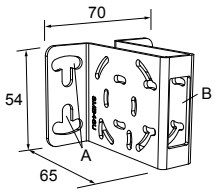
Hole center spacing: A = 16.0
Hole size: A = 16.5 × 18.7, B = 34.0 × 10.0



SMB46U

- Right-angle
- U bracket for sensor protection
- 14-ga. 316 stainless steel

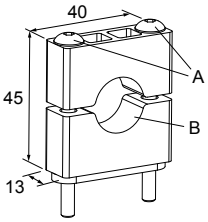
Hole center spacing: A = 16.0
Hole size: A = 16.5 × 18.7, B = 34.0 × 13.0



SMB18C

- 18 mm split clamp, black thermoplastic polyester
- Stainless steel mounting hardware included

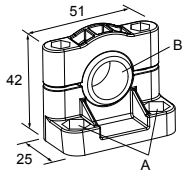
A = ø 3 mm (2)
Hole size: B = ø 18 mm



SMB18SF

- 18 mm swivel bracket with M18 × 1 internal thread
- Black thermoplastic polyester
- Stainless steel swivel locking hardware included

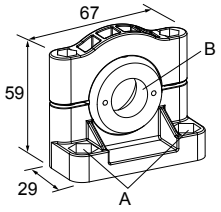
Hole center spacing: A = 36.0
Hole size: A = ø 5.3, B = ø 18.0



SMB3018SC

- 18 mm swivel side or barrel-mount bracket
- Black reinforced thermoplastic polyester
- Stainless steel swivel locking hardware included

Hole center spacing: A = 50.8
Hole size: A = ø 7.0, B = ø 18.0



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