Blue datasheet part numbers in this catalog are clickable links that will launch a copy of the datasheet from this CD.

2003

Advanced Sensor Technology for

MEASUREMENT & INSPECTION

BANNER®

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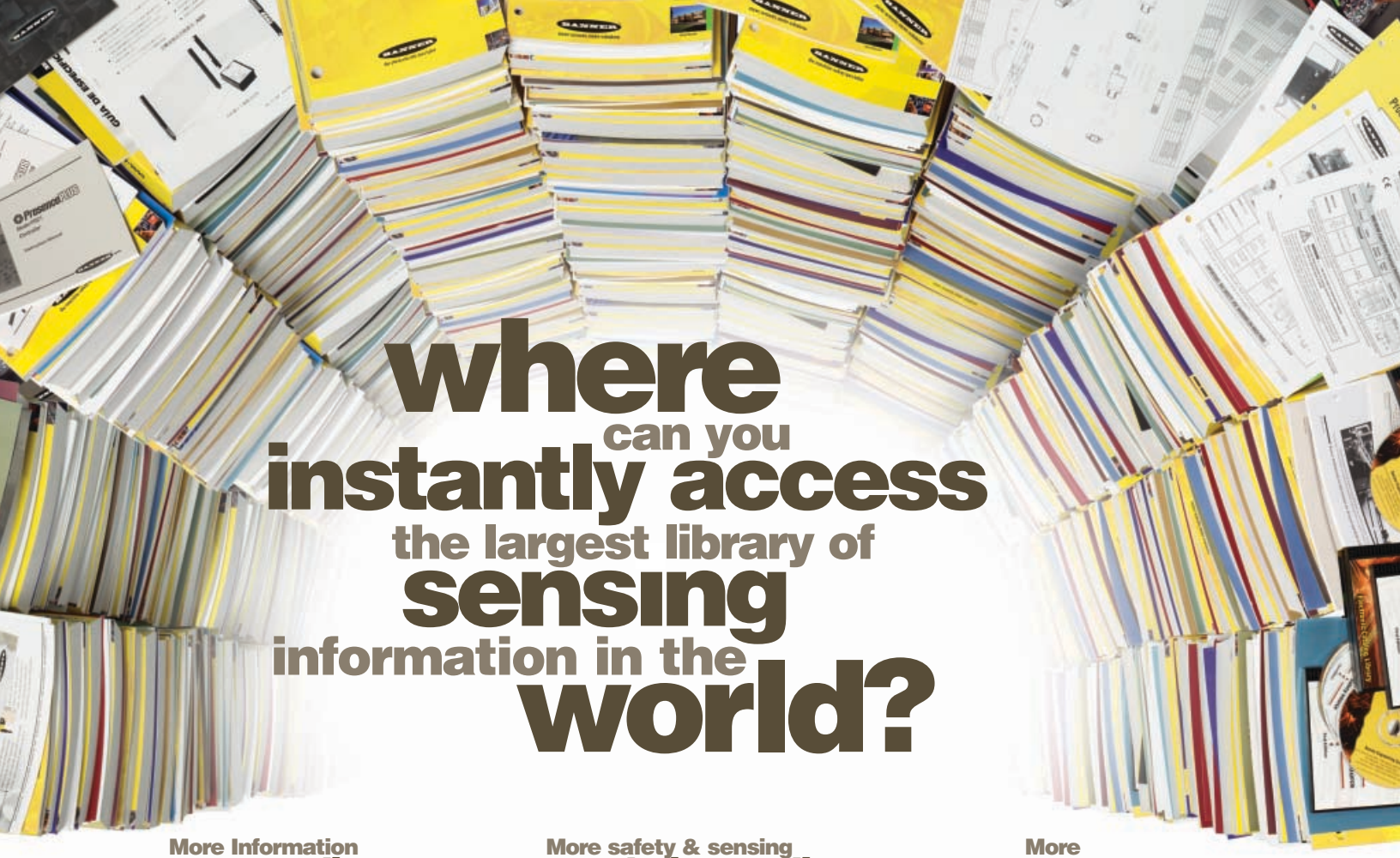

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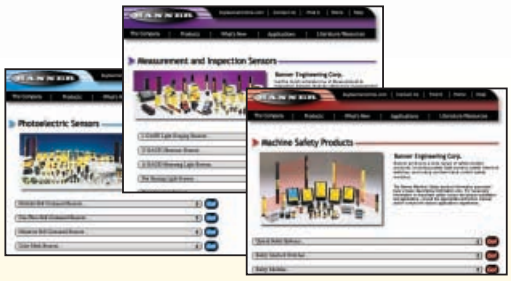

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With more than 15,000 products, Banner offers the industry's most complete and integrated line of photoelectric and ultrasonic sensors, machine safety products, and measurement/ inspection products—a solution for every possible application. We ship thousands per day; a Banner sensor is installed every 3 1/2 seconds! Whatever part or material you need to sense or inspect, Banner has the solution.

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Banner makes sensors for every manufacturing and process industry. Whatever industry you're in and whatever product you manufacture, Banner has the right sensors to automate your plants and to improve your overall efficiency, quality and safety.

⚠ Important Safety Warning...Please Read! ⚠

Sensors described in this catalog do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A sensor failure or malfunction can result in either an energized or a de-energized output condition.

Never use these products as sensing devices for personnel protection. Their use as safety devices may create an unsafe condition which could lead to serious bodily injury or death.

Only EZ-SCREEN®, MINI-SCREEN,® MULTI-SCREEN,® MICRO-SCREEN,® MACHINE-GUARD,™ PERIMETER-GUARD™ and PICO-GUARD™ Systems, and other systems so designated, are designed to meet OSHA and ANSI machine safety standards for point-of-operation guarding devices. No other Banner sensors or controls are designed to meet these standards, and they must NOT be used as sensing devices for personnel protection. See the Banner Machine Safety Products catalog for information on point-of-operation guarding devices.

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Banner has the most complete line of Measurement and Inspection Sensors. Nobody offers more measurement and inspection technologies from one source. this advanced line of products includes ultra-precise L-GAGE® light gauging sensors, U-GAGE® ultrasonics, A-GAGE® measuring light screen systems, part sensing light screens, bin-picking sensors, and *Presence*PLUS® vision sensors.

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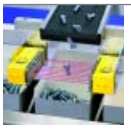
A-GAGE® Measuring Light Screen Systems

Part Sensing Light Screens and Bin-Picking Systems



*Presence*PLUS® Vision Sensors

Supplemental Information

What's new!

LONG RANGE ACCURACY

L-GAGE® LT3 Series: distance gauging up to 50 meters.

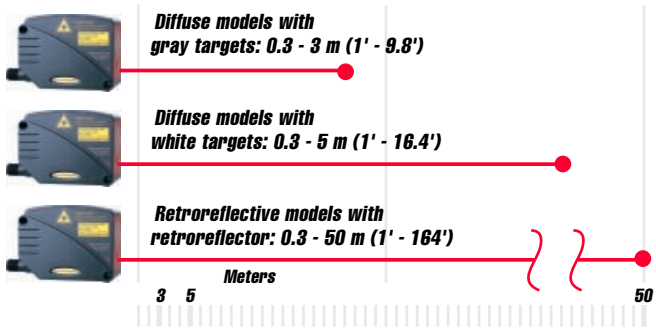
L-GAGE® LT3: advanced time-of-flight sensing at less cost.
Precise performance and low price make the LT3 an ideal solution for a variety of precision inspection applications. The microprocessor-controlled laser distance-gauging sensor features a unique design that provides exceptional accuracy and range.

Accurate diffuse-mode models with ranges to 5 m.
LT3 provides exceptional sensing ranges and gauging accuracy and extraordinary resolution. Diffuse-mode models offer ranges of 0.3 to 3 m for gray targets, and 0.3 to 5 m for white targets.

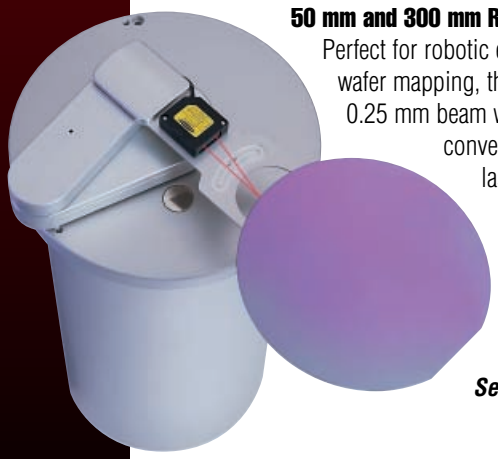
Achieve 50 m range with retroreflective models.
Perform accurate positioning at extremely long ranges. Retroreflective models accurately measure distances up to 50 m while maintaining extremely high resolution up to 5 mm.

Push-button TEACH programming sets custom sensing windows.
Program a custom sensing window or a unique set-point in TEACH mode with a single push button. The variable signal from the sensor's analog output is proportional to the target's position within the programmed window limits. The discrete output energizes whenever the target is located between the user-programmed discrete window limits. ***See page 36.***

LT3 Sensing Ranges



NEW MODELS: PicoDot® Laser Sensors.



50 mm and 300 mm Range PicoDot®
Perfect for robotic end effectors and semiconductor wafer mapping, this model provides a precise 0.25 mm beam width at the 50 mm or 300 mm convergent focus point. Its Class 2 laser produces a 650 nm visible red sensing beam that provides a fast 200 microsecond response time and both light operate (NO) and dark operate(NC) outputs.

See page 60.

Ruggedized PicoDot®
Environmentally sealed housings enable laser power and precision sensing in harsh environments. Available in convergent beam and retroreflective-mode models, the new sensors are ideal for presence sensing of tiny parts.

See page 60.

TRUE COLOR SENSOR

QC50 Series: accurately detect color & intensity.

Excellent color discrimination.
The QC50 reliably analyzes and identifies user-determined colors using a white LED light source, rather than standard methods that detect a light to dark contrast. Modulated white light, which when reflected back from an object, is electronically filtered to its red, green and blue components for accurate color determination.

Use for batch sorting or tint discrimination.
Easily batch sort products of different colors (red or green or blue, etc.) or discriminate colors within the same color range (light blue, medium blue or dark blue) with high-resolution and intensity mode.

Extraordinary versatility and diagnostics.
Three separate NPN or PNP outputs, one for each color channel include programming parameters for 1, 2, or 3 colors. Choose gated or windowed sensing and store data in the sensor's non-volatile memory. Four LEDs and a 4-digit numerical display indicate configuration and operating status.

Exceptional value.
The QC50 is priced to be the best value of any sensor in this product category, typically several hundred dollars less than competitive choices. Its compact size and self-contained design make it cost effective for applications including error proofing, product verification, product match, and batch sorting in automotive, pharmaceutical, packaging, printing, textile, ceramic and other industries.

See page 56.

NEW MODELS: L-GAGE® Q50 Sensors.

Available in two new sensing formats; visible red beam models for 50 to 300 mm range and infrared models for 50 to 400 mm range. Choose models with either a 0-10V or 4-20mA output. TEACH-mode single push-button programming is used to program a set-point threshold centered within a 50 mm window, or set a custom sensing window size and position. Banner's patented scalable analog output automatically distributes the output signal over the width of the programmed sensing window.

See page 48.

What's new!

LONGEST ULTRASONIC SENSING DISTANCE

QT50U Series: precision sensing up to 8 meters.

Long-range programmable ultrasonic sensor features an extended sensing range of 8 m. Durable, leak-proof construction is ideally suited for monitoring dry or liquid media level in a confined storage container. QT50U features automatic temperature compensation circuitry to constantly monitor surrounding area and adjust the sensor to ensure the highest level of accuracy in any environment.

A configurable sensing solution with unparalleled flexibility.

With its advanced microprocessor design, the QT50U has no potentiometers to adjust and users need only choose analog or discrete model and then configure an 8-pin DIP switch to the requirements of their specific application.

Also significant to note is the extremely short minimum sensing range of 200 mm. In retro-sonic mode the sensor ends up having no dead-zone and will detect any object regardless of shape, size or reflective angle that enters the sensing window. Programming is straightforward and intuitive with TEACH-mode input via two push buttons on the sensor or a remote TEACH wire.

See page 68.

AN INDUSTRY FIRST:

S18U Series: compact ultrasonic sensor with integrated push-button programming and diagnostic LEDs.

Extreme accuracy.
Programmable background suppression, temperature compensation and a short dead-zone add to this compact sensor's functionality. Designed for high accuracy at ranges up to 300 mm, the S18U provides reliable sensing of opaque or translucent objects and is not affected by color. A retro-sonic mode where the dead-zone is reduced to zero detects any object regardless of shape, angle or size that passes between the sensor face and a taught sensing point.

Advanced microprocessor for easy programming flexibility.
Push-button programming and bright diagnostic LEDs integrated directly on the sensor housing simplify programming.

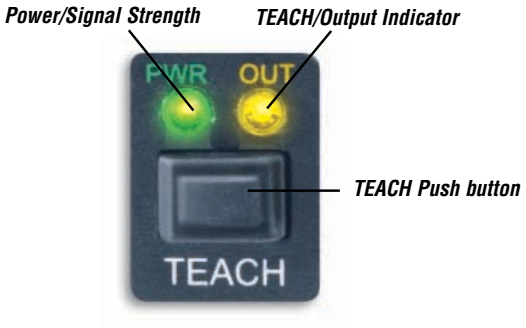
A compact, versatile sensing solution.
Available in analog or discrete versions and straight or right-angle models. A broad line of brackets compliment the compact 18 mm barrel design providing a multitude of mounting options for enhanced versatility.

Integrated push-button programming.
Programming the S18U is simple with its TEACH-mode push button located directly on the unit itself. The S18U also offers programming via a remote TEACH wire that can also be used to disable the push button preventing unwanted tampering.

See page 74.

Straight

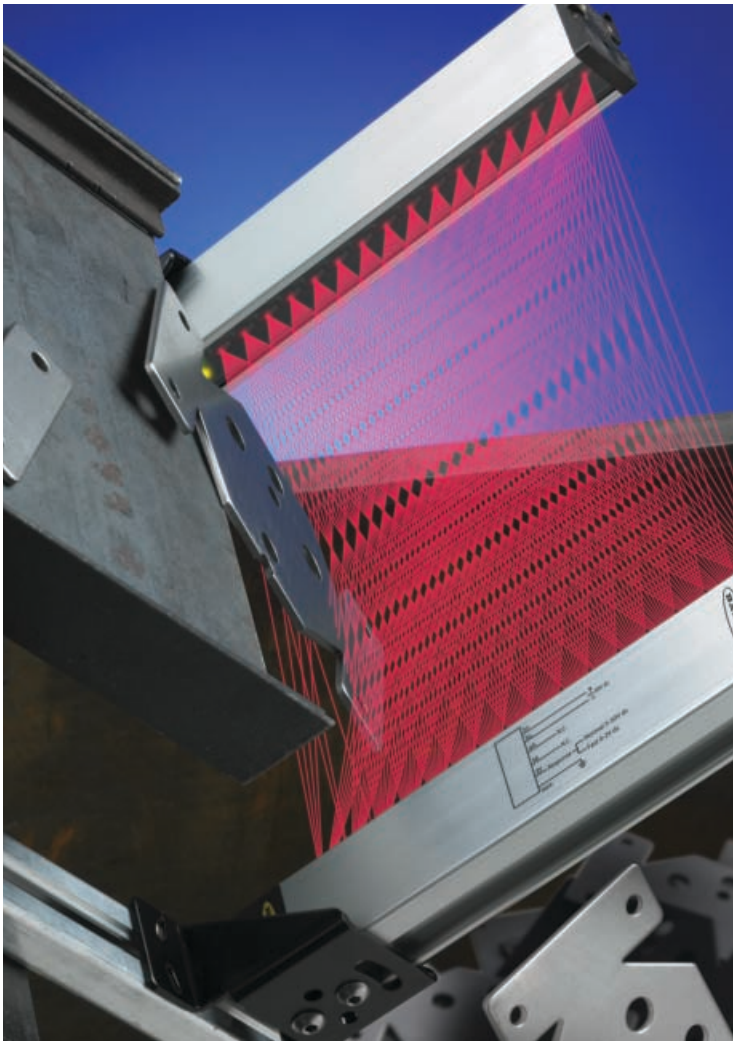
Right Angle



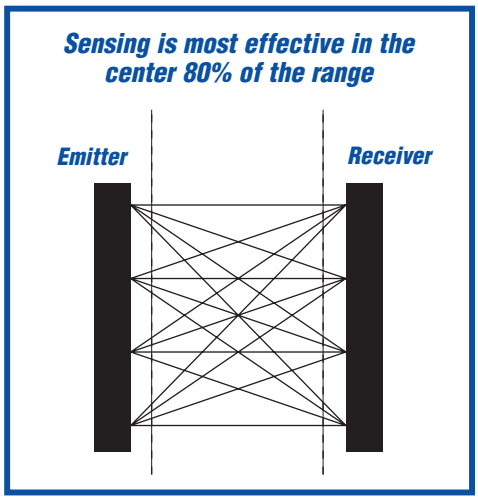
What's new!

EXTRAORDINARY OBJECT DETECTION

LX Series: a small profile high-speed light screen that detects the smallest objects other systems miss.



The LX was designed to be a no hastle, easy to align, high speed, precision part sensing light screen. It is ideal for accurate high speed sensing applications including parcel handling and conveyed object detection, parts ejection for die protection and small parts or pill counting.



LX Series optical crosshatch pattern

Versatile and simple to use.
Available in 3", 6" and 12" lengths and encased in a rugged silver anodized aluminum housing. Optional mounting brackets provide exceptional application versatility and can be located directly on a machine or in confined areas which would not accommodate a larger system. Easy to set-up and simple to use, indicator LEDs flash at a rate proportional to the number of beams completed to streamline emitter/receiver alignment.

See page 144.

CLEAR VISUAL INSTRUCTION

VTB Series: ultra-bright verification optical touch buttons offer cost-effective visual instruction for bin picking.

Verification Touch Buttons (VTB), mount near each bin in a workstation, feature ultra-bright illuminated bases and provide visual signals to guide workers to an appropriate bin picking sequence for a given assembly or parts selection operation.

A simple solution.
As an assembler removes each part, he or she touches the corresponding VTB button causing the output to send a signal to the controller that switches the job light for the picked bin OFF. The controller can then verify that the correct part has been taken and activate the job light of the next bin to pick in the sequence. An alarm can be programmed to sound for the assembler and/or supervisor if a part is accidentally pulled from an incorrect bin.

No language barriers.
Visual signals eliminate communication barriers, such as technical and/or language constraints, enabling multilingual workforces to learn and maintain new assembly procedures quickly. VTB buttons also reduce the occurrence of missed parts, and parts assembled out of order.

- Also use as automated "call for parts" system lighting the VTB base to notify the supplier
- Notify an assembler where to begin after a break or station absence

Ergonomic design for repetitive use.
Buttons activate when a finger inserted in the "touch area" breaks an infrared beam and are designed to replace capacitive touch switches and mechanical push buttons. Requiring no force to activate, VTB buttons increase production quality and efficiency, without the hand, wrist, and arm stress associated with repeated switch operation.

See page 164.

what's new!

WOW!

Introducing a full-function vision sensor at an eyepopping price!

PresencePLUS Pro®

Features that rival more expensive systems.
The all-new PresencePLUS Pro provides advanced, camera-based visual inspections at a price you'll find hard to believe. Costly, complex machine vision systems are transformed into a simple, easy-to-use and affordable sensor. Capture images and analyze them using one or more vision tools to generate judgement results.

Ethernet and flexible I/O in the same full-featured sensor.
Communicate data, measurements and information for system process control over both Ethernet or standard serial protocols. The sensor's pluggable terminal block accommodates configurable inputs (NPN/PNP), configurable outputs (NPN/PNP) and allows stored inspections to be selected.

Easy to install and operate.
With minimal knowledge of vision systems, you can quickly set up an inspection that correctly tests and rejects bad parts on your production line. PresencePLUS Pro sets up using a remote PC; after setup, inspections are stored in the system and can run without the need for the PC. PresencePLUS Pro inspects multiple features simultaneously and adjusts for both translational and rotational variation.

See page 170.

Separate video output allows direct connection to optional real-time video display.

All the tools you need!

Automatic TEACH or custom setup.
Point-and-click setup without programming. Set up an inspection by simply illuminating the target, focusing the camera, and selecting the features to analyze. Inspection tolerances can be taught or manually configured. New users can follow the guided setup sequence, while advanced users can override automatic settings and create customized inspections.

A complete selection of lenses.
Numerous standard and high-performance lenses for all your vision applications. Sizes from 4 mm to 75 mm with C-mount lens extensions and color filters also available.

See pages 174 & 175.

Locational Tool Categories.
Compensate for translational and rotational movement.

- **Locate Tool.** Determines translation and rotation by detecting relative movement of edges.
- **Pattern Find Tool.** Determines translation and rotation by detecting relative movement of a pattern.

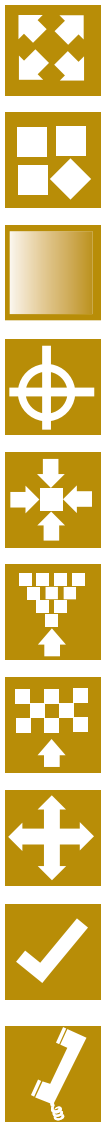
Vision Tool Categories.
Perform the "image analysis" function.

- **Gray Scale Tool.** Determines the average gray scale value.
- **Blob Tool.** Determines the presence, connectivity, and location of selected features.
- **Edge Tool.** Determines the presence, number, classification, and location of edges.
- **Object Tool.** Determines the presence, number, classification, size, and location of objects.
- **Pattern Count Tool.** Determines the presence, number, and location of a pattern(s).

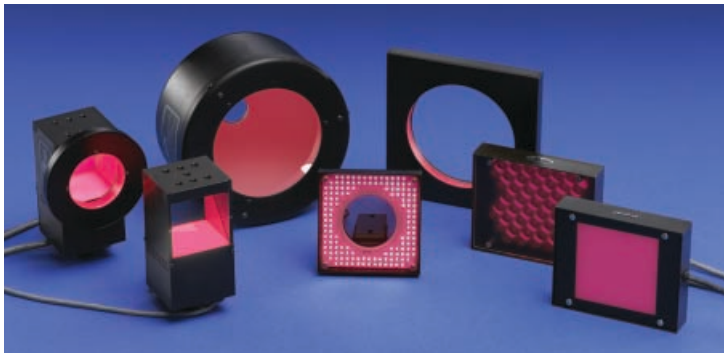
Analysis Tool Categories.
Measure or evaluate the results of the Vision Tools.

- **Measure Tool.** Measures distance between two prescribed points. These points can be either edges or centroid locations.
- **Test Tool.** Evaluates results of selected vision and analysis tools to determine whether an inspection passes or fails. It also performs logical operations and activates outputs.
- **Communication Tool.** Sends results of selected location, vision and analysis tools over the ethernet or RS-232 serial communication ports.

***Presence*PLUS® *Pro* Inspection Tools:**



Dozens of lighting options.
Complete line of lighting solutions includes direct ring lights, backlights, area lights and accessories. Choose LED or fluorescent options. Specialty lights include models for on-axis lighting, highly-diffused lighting, and indirect lighting. ***See page 178.***

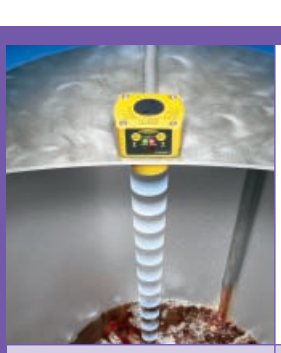


L-GAGE® Light Gauging Sensors

Series	LT3	LG	
Catalog page	36	42	
Description	Advanced time-of-flight sensing for a variety of precision inspection applications.	Ultra-precise triangulation sensor with both analog and discrete outputs.	
Technology	Time-of-Flight	Laser/PSD triangulation	
Outputs	Analog and discrete, or Dual discrete	Analog and discrete	
Sensing range	**Retroreflective:** 0.5 to 50 m **Diffuse:** 0.3 to 5 m	**LG5:** 45 to 60 mm **LG10:** 75 to 125 mm	
Dimensions (h x w x d)	69 x 36 x 87 mm	55 x 20 x 82 mm	
Light source	Class 1 and 2 laser	Class 2 laser	
Housing material	ABS/polycarbonate	Zinc alloy die-cast; black painted finish	
Protection rating	IP67, NEMA 6	IP67, NEMA 6	
Operating temperature	0° to +50°C	-10° to +50°C	
Power supply	12 to 24V dc	12 to 30V dc	
Discrete output(s)	One NPN or PNP or Dual NPN or PNP, depending on model	One NPN or PNP	
Analog output	0 to 10V dc or 4 to 20 mA	0 to 10V dc or 4 to 20 mA	
Analog resolution or discrete repeatability	Diffuse: slow: 1 mm fast: 3.2 mm Retro: slow 5 mm fast: 10 mm	LG5: 3 µm @ 50 mm LG10: 10 µm @ 100 mm	
Response speed	1 to 192 ms, depending on model and output	1 ms (fast); 10 ms (medium) 100 ms (slow)	
Adjustments	Near & far window limits response speed	Near & far window limits response speed	
Data sheet reference	LT3 Discrete: 68503 LT3 Diffuse: 65742 LT3 Retro: 68504	LG Analog Current: 59786 LG Analog Voltage: 59071	

			
	Q50	**QC50**	**PicoDot®**
	48	56	60
	Linear displacement sensor with analog output.	True color sensor that accurately detects color and intensity.	Compact laser sensor for precise part detection.
	LED-PSD triangulation	RGB white light filtering	Convergent or retroreflective
	Analog or discrete	3 discrete	Discrete
	Q50A: Visible red, 50 to 150 mm **Q50A:** Infrared, 50 to 200 mm **Q50B:** Visible red, 100 to 300 mm **Q50B:** Infrared, 100 to 400 mm	20 mm	**C50:** 25 to 58 mm **C100:** 25 to 115 mm **C200:** 25 to 216 mm **C300:** 25 to 317 mm **LLP:** 0.2 to 10.6 m
	60 x 20 x 50 mm	50 x 25 x 50 mm	**PD45:** 41 x 13 x 46 mm **PD49:** 43 x 15 x 49 mm
	Visible red and Infrared LEDs	Pulsed white LED	Class 2 laser
	ABS/polycarbonate	ABS	ABS/polycarbonate
	IP67, NEMA 6	IP67	**PD45:** IP54, NEMA 3 **PD49:** IP67, NEMA 6
	-10° to +55°C	-10° to +55°C	-10° to +45°C
	Analog: 15 to 30V dc Discrete: 12 to 30V dc	10 to 30V dc	10 to 30V dc
	Complementary NPN or PNP	NPN or PNP, 3 channels	Complementary NPN or PNP
	0 to 10V dc to 4 to 20 mA	N/A	None
	.25 to 8 mm, depending on model	N/A	N/A
	4 ms to 64 ms (depending on model)	335 ms	200 µs
	Near & far window limits response speed	Set and Select	12-turn sensitivity (Gain) adjustment
	Q50A Analog: 67416 Q50A Discrete: 67417 Q50B Analog: 64323 Q50B Discrete: 65741	111523	PD45 50 mm: 65029 PD45 100 & 200 mm: 46356 PD45 LLP models: 58607 All PD49 models: 67450

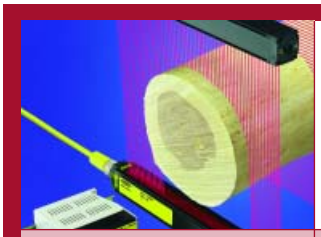
U-GAGE® Ultrasonic Sensors



					
Series	**QT50U**	**S18U**	**T30U**	**Q45U**	
Catalog page	68	74	80	86	
Description	Long-range programmable, precision ultrasonic sensor that senses up to 8 meters.	Compact ultrasonic sensor with integrated push-button programming and diagnostic LEDs.	Compact, versatile "T" packaging with both analog and discrete outputs and push-button TEACH.	High accuracy teach sensor with built-in temperature compensation.	
Outputs	Analog or Dual discrete	Analog or Discrete	Analog and discrete or Dual discrete	Analog or Discrete	
Sensing range	Proximity mode 200 mm to 8 m	Proximity mode 30 to 300 mm	Proximity mode 0.15 to 1.0 m or 0.3 to 2.0 m	Proximity mode 0.1 to 1.4 m or 0.25 to 3.0 m	
Dimensions (h x w x d)	84 x 74 x 67 mm	**Straight:** 18 x 18 x 91 mm **Right-angle:** 18 x 18 x 95 mm	52 x 40 x 45 mm	88 x 45 x 55 or 79 mm	
Housing material	ABS/Polycarbonate	ABS/Polycarbonate	PBT polyester	PBT polyester	
Protection rating	IP67; NEMA 6P	IP67; NEMA 6P	IP67; NEMA 6P	IP67; NEMA 6P	
Operating temperature	-20° to +70°C	-20° to +60°C	-20° to +70°C	-25° to +70°C	
Power supply	10 to 30V dc (ac voltage available soon – contact factory)	10 to 30V dc	Discrete output models: 12 to 24V dc Analog output models: 15 to 24V dc	Discrete output models: 12 to 24V dc Analog output models: 15 to 24V dc	
Discrete output(s) (when available)	Dual NPN or PNP, Selectable	SPST solid-state, NPN and PNP	NPN or PNP, depending on model	Bipolar: one NPN plus one PNP	
Analog resolution or discrete repeatability	1.0 mm	0.5 mm	0.25% of sensing distance	0.1% of sensing distance (.25 mm to .5 mm min'm)	
Analog output (when available)	0 to 10V dc or 4 to 20 mA, Selectable	0 to 10V dc or 4 to 20 mA, depending on model	0 to 10V dc or 4 to 20 mA, depending on model	0 to 10V dc or 4 to 20 mA, Selectable	
High/low limit control (pump control)	Yes		Yes	Yes	
Adjustments	Near & far window limits; DIP Switch functions	Near & far window limits	Near & far window limits	Near & far window limits; DIP Switch functions	
Data sheet reference	Discrete/analog: 70137 Dual discrete: 110112	Analog: 110738 Discrete : 108964	Discrete/analog: 57438 Dual discrete : 59200	Discrete SR: 44177 Discrete LR: 48454 Analog SR: 47818 Analog LR: 48456	

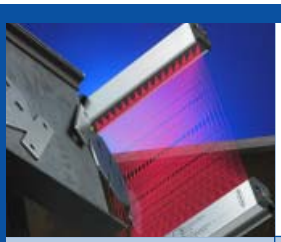
				
	Q45UR	**T18U**	**Sonic OMNI-BEAM™**	**ULTRA-BEAM™**
	92	100	106	112
	High precision inspection sensor with remote sensing transducer.	Fast, sealed opposed-mode sensor excellent for clear object detection.	Modular design sensor for use with AC or DC power and analog or relay outputs.	Long-range sensor for use with AC or DC power and analog or relay outputs.
	Analog or Discrete	Complementary discrete	SPDT relay or 0-10V dc analog	Dual analog or SPDT relay
	Proximity mode 50 to 250 mm	Opposed mode 0.6 m	Proximity mode 108 to 660 mm	Proximity mode 0.5 to 6 m
	18 mm diameter or 12 mm flat	52 x 40 x 30 mm	111 x 45 x 74 mm	120 x 50 x 49 mm
	PBT polyester or stainless steel	PBT polyester	PBT polyester	PBT polyester
	Sensor: IP65; NEMA 4 **Controller:** IP67; NEMA 6P	IP67; NEMA 6P	IP66; NEMA 4	IP54; NEMA 1, 3 and 12
	-25° to +70°C	-40° to +70°C	0° to +50°C	0° to +50°C
	Discrete output models: 12 to 24V dc Analog output models: 15 to 24V dc	12 to 30V dc	18 to 30V dc, 105 to 130V ac, or 210 to 250V ac, depending on power block	18 to 30V dc, 105 to 130V ac, or 210 to 260V ac, depending on model
	Bipolar: one NPN plus one PNP	Complementary NPN or PNP, depending on model	SPDT electromechanical relay 7 A max. load	SPDT electromechanical relay 5 A max. load
	0.2% of measured distance		0.25% of sensing distance	0.5% of sensing distance
	Selectable 0 to 10V dc or 4 to 20 mA		0 to 10V dc	Two outputs: 0 to 10V dc or 0 to 20 mA
			Yes	
	Near & far window limits; DIP Switch functions		Window limit adjustments	Window limit adjustments (analog output models)
	Discrete: 59321 Analog: 59323	40124	03536	Discrete AC: 03420 Discrete DC: 03535 Analog: 03488

A-GAGE® Measuring Light Screen Systems



		MINI-ARRAY®	High-Resolution MINI-ARRAY®	BEAM-ARRAY™
Catalog page		118	130	138
Description		Compact array housings with flexible output configurations, long range.	High-speed, high resolution scanning with 2.5 mm (0.1") minimum object detection.	Rugged construction, separate controller not required.
Minimum object detection size		19 mm for arrays/9.5 mm beam spacing 38 mm for arrays/19 mm beam spacing	2.5 mm	11.4 mm
Sensing range		For arrays with 9.5 mm beam spacing: .6 to 6.1 m for ≤ 905 mm arrays .6 to 4.6 m for > 905 mm arrays For arrays with 19 mm beam spacing: .9 to 17 m for ≤ 905 mm arrays .9 to 14 m for > 905 mm arrays	380 mm to 1.8 m	3 m
Emitter and Receivers	**Dimensions (h x w x d)**	38.1 x 38.1 x height Approximate array heights: 140 mm 750 mm 1510 mm 290 mm 900 mm 1810 mm 440 mm 1050 mm 600 mm 1210 mm	38.1 x 38.1 x height Array heights: 163 mm 813 mm 1463 mm 325 mm 975 mm 1626 mm 488 mm 1138 mm 1788 mm 650 mm 1300 mm 1951 mm	58 mm dia. x height Array heights: 305 mm 915 mm 610 mm 1220 mm
	Power supply	12V dc supplied by controller	12V dc supplied by controller	15 to 20V dc (available from BC2A or BC2B controller)
	Construction	Black anodized aluminum	Black anodized aluminum	Black anodized aluminum
	Protection rating	IP65; NEMA 4, 13	IP65; NEMA 4, 13	IP66; NEMA 4
	Operating temperature	-20° to +70°C	0° to +50°C	0° to +50°C
Controllers	**Power supply**	**For all models: 16 to 30V dc** **MACNXDN-1, MACPXDN-1:** 11-25V dc supplied by DeviceNet bus	16 to 30V dc	**BC2A**: 105 to 125V ac **BC2B**: 210 to 250V ac **BC1T**: 15 to 20V dc
	Output configuration	**MAC-1**: One reed relay + one NPN **MACN-1**: Two NPN **MAC16N-1**: 16 NPN **MACP-1**: Two PNP **MAC16P-1**: 16 PNP **MACV-1**: One 0-10V dc sourcing analog + one NPN **MACI-1**: One 4-20 mA sinking analog + one NPN **All models:** Serial RS-232, RS-485 **MACNXDN-1**: 2 NPN (DeviceNet) **MACPXDN-1**: 2 PNP (DeviceNet)	**MAHCVP-1**: Two analog 0 to 10V sourcing + two PNP **MAHCVN-1**: Two analog 0 to 10V sourcing + two NPN **MAHCIP-1**: Two analog 4 to 20 mA sinking + two PNP **MAHCIN-1**: Two analog 4 to 20 mA sinking + two NPN **All models:** Serial RS-232, RS-485	**BC2A and BC2B**: 4 discrete outputs: AC or DC, depending on I/O module selected; 2 analog outputs: 0 to 10V dc sourcing or 4 to 20mA sinking; RS-232C; RS-422; and RS-485 serial data outputs **BC1T**: RS-232C serial data output
	Protection rating	IP 20; NEMA 1	IP 20; NEMA 1	IP10; NEMA 1
	Operating temperature	-20° to +70°C	0° to +50°C	0° to +50°C
Data sheet reference		Standard: 43298 DeviceNet: 59437	64118	Sensors: 03526 BC2A, BC2B: 03575 & 03576 BC1T: 03577

Part Sensing & Bin-Picking Systems

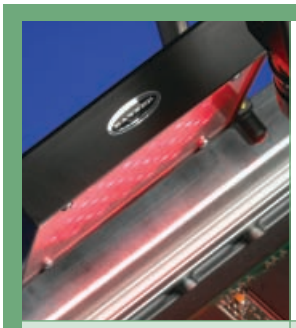






	LX Series	LS Series	BMLV Series	PVA Series	Verification Touch Buttons
Catalog page	144	148	154	158	164
Description	Highest-speed light screens detect the smallest objects.	Fast, reliable detection over a 90 mm (3.5") zone.	Retroreflective, self-contained light curtain.	Visible "pick" light & reliable error-proofing for assembly operations.	Ultra-bright verification optical touch buttons for bin-picking sequences.
Sensing range	**Standard** **Normal:** 300 mm to 2 m **Reduced:** 150 to 600 mm **Short-range** **Normal:** 100 mm to 200 mm **Reduced:** 75 to 150 mm	**LS4:** 2.3 m **LS10:** 1.2 m **LS10SR:** 0.2 m	Retroreflective-mode: 3 m	2 m	N/A
Minimum object detection size	**Standard:** 9.5 mm **Short-range:** 5.6 mm	**LS4:** 25 mm **LS10:** 7.6 mm **LS10SR:** 5.6 mm	50 mm	35 mm	N/A
Dimensions (h x w x d)	25 x 32 mm x height Array heights: 113 mm 190 mm 342 mm	116 x 40 x 49 mm	58 mm x height Array heights: 305 mm 915 mm 610 mm 1220 mm	30 x 15 mm x height Array heights: 100 mm 300 mm 225 mm 375 mm	58 x 70 x 43 mm
Construction	Aluminum	PBT Polyester	Black anodized aluminum	Black anodized aluminum	Black polysulfone or red polycarbonate with white polycarbonate base
Protection rating	IP65; NEMA 4, 13	IP54; NEMA 1, 2, 3, 12 and 13	IP56; NEMA 4	IP62; NEMA 2	IP66; NEMA 1, 2, 3, 4, 4X, 12 and 13
Operating temperature	-20° to +70°C	0° to +50°C	0° to +50°C	0° to +50°C	-20° to +50°C
Power supply	10 to 30V dc	12 to 30V dc	10 to 30V dc	12 to 30V dc	12 to 30V dc
Output configuration	Bipolar NPN + PNP	Bipolar NPN + PNP; Outputs have 5 ms pulse stretcher (OFF-delay)	One discrete Bi-modal™ output: NPN or PNP, depending on hookup; light or dark operated	One NPN or PNP, depending on model; programmable for light or dark operate	One NPN or PNP, depending on model
Connections	Integral 2 m cable or 5-pin Euro 150 mm pigtail quick-disconnect	**LS4:** Integral cable or quick-disconnect **LS10 & LS10SR:** quick-disconnect	Quick-disconnect	Integral 2 m cable with or without quick-disconnect	Integral 2 m cable, or 4-pin Euro-style quick-disconnect
Data sheet reference	108865	LS4: 39673 LS10: 03557	31096	52088	67570

PresencePLUS® Vision Systems

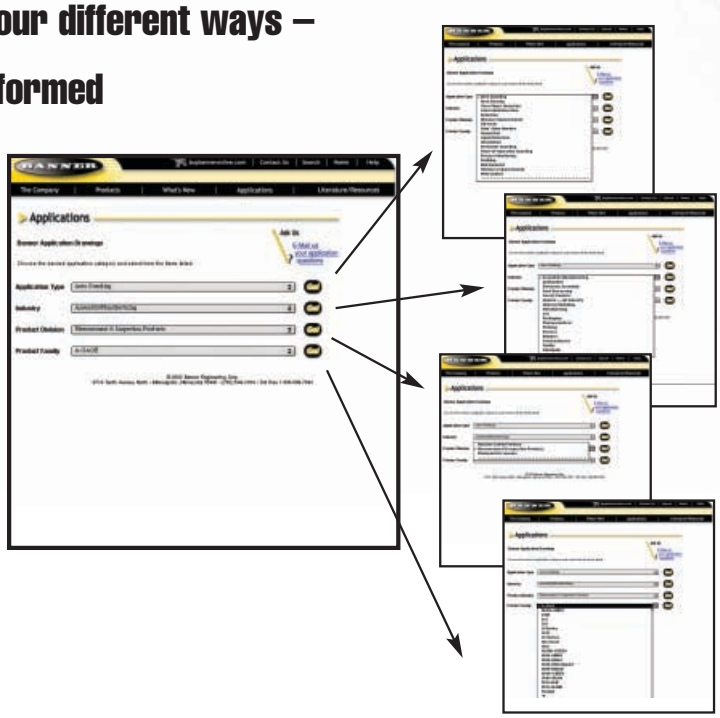
			
Series	***Presence*PLUS *Pro* Vision Sensors**	***Presence*PLUS Pixel-Counting Sensors**	**Lighting**
Catalog page	170	188	178
Description	Full-function vision sensor that provides advanced, automated visual inspections.	Pixel-counting sensors for inspecting an area.	Complete line of lighting solutions includes direct ring lights, backlights, area lights and accessories.
Setup interface	PresencePLUS Pro Windows PC graphical user interface	PresencePLUS Windows PC graphical user interface or PRC1 controller	
Supply voltage	10 to 30V dc	22 to 26V dc	
Inputs/Outputs	Six discrete inputs or outputs individually configured for function, mode and type. 1 Ethernet 2 Serial ports to output ASCII data	Three discrete outputs individually configured for function, mode and type	
Sensor response time	Depends on inspection size	50 ms	
Trigger input	Configurable to accept either NPN or PNP input	Configurable to accept either NPN or PNP input	
Dimensions (h x w x d)	**Camera:** 32 x 30 x 78 mm **Controller:** 31 x 133 x 127 mm	78 x 53 x 43 mm	
Construction	**Camera:** Black anodized aluminum **Controller:** Steel with black zinc plating	Aluminum; anodized and painted finish	
Protection rating	IP20; NEMA 1	IP20; NEMA 1	
Operating temperature	0 to 50°C	0 to 50°C	
Manual reference	Quickstart Guide: 68369 Installation Manual: 68368 Operator's Guide: 68367	56910	See Lighting Guide p/n 69951 or for individual data sheets, go to www.bannerengineering.com for complete listing

Measurement & Inspection

The following pages feature a small selection of available applications. Hundreds of additional drawings are available online at bannerengineering.com.

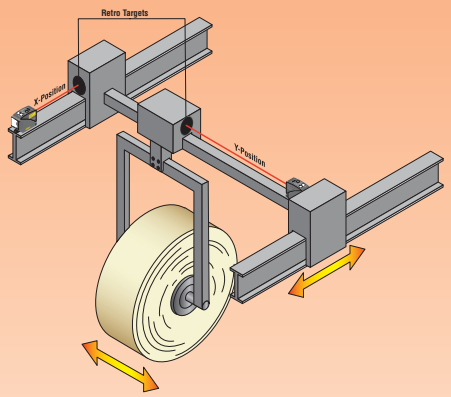
Locate applications in four different ways –

- **application being performed**
- **industry**
- **sensing product division, or**
- **product family**



www.bannerengineering.com/miapplications

L-GAGE® LT3 Time-of-Flight Sensor



Two-Axis Crane Positioning

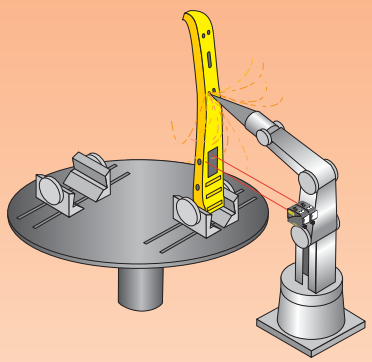
Objective: To verify the position of an overhead bridge crane, in two axes.

Sensor Models: Two LT3 retroreflective-mode sensors, with retroreflective targets

Operation: The sensors are mounted facing their retroreflective targets, which are mounted on two mobile components of a bridge crane. One component moves back and forth, and the other from side to side. As the crane maneuvers the roll of sheet stock, the two sensors monitor the distance to their respective reflectors, enabling a PLC to continuously track the crane's exact position.

See page 36.

L-GAGE® LT3 Time-of-Flight Sensor



Error-Proofing a Laser Cutting Operation

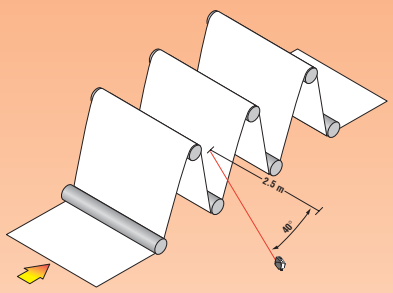
Objective: To verify that holes cut into a chassis are properly positioned.

Sensor Model: LT3 diffuse-mode sensor

Operation: A robotic laser-cutting process is used to cut openings in automotive chassis sections. As soon as a section is cut out, the LT3 inspects the region to verify that the hole is in its proper place. Because the sensor cannot be located within the robot's range of motion, the LT3's long operating range is vital for this process.

See page 36.

L-GAGE® LT3 Time-of-Flight Sensor



Web Break Detection

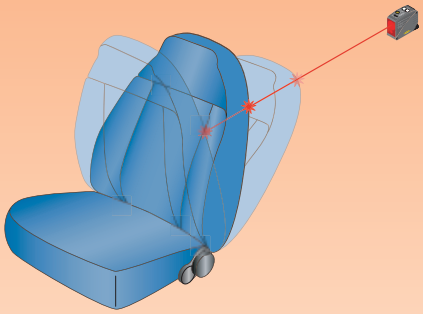
Objective: To detect a broken web in the dryer section of a paper-making machine.

Sensor Model: LT3 diffuse-mode sensor with two discrete outputs

Operation: In the paper manufacturing business, the web of newly made paper travels at speeds of more than 3,000 feet per minute through a series of rotating cylinders. A break in the web at any step in the process must be found immediately, so sensors are used throughout the line for web break detection. However, in the drying portion of the process, ambient temperature near the dryer drums is too high for electronic sensors to function. The LT3, with its high speed and long operating range, is the perfect choice, as it can reliably sense a break from a distance of 2.5 m, where the temperature is cooler. One discrete output may be programmed to send a stop signal to the machine, while the other signals an alarm.

See page 36.

L-GAGE® LT3 Time-of-Flight Sensor



Auto Seat Range-of-Motion Measurement

Objective: To accurately measure the range of motion of an auto seat back.

Sensor Model: LT3 diffuse-mode sensor

Operation: The user needs to verify that each auto seat manufactured in a plant adjusts to the correct, predetermined positions, regardless of seat color. With the seat positioned in a fixture, the LT3 measures the distance to the back of the seat when it is placed into three angles of recline.

See page 36.

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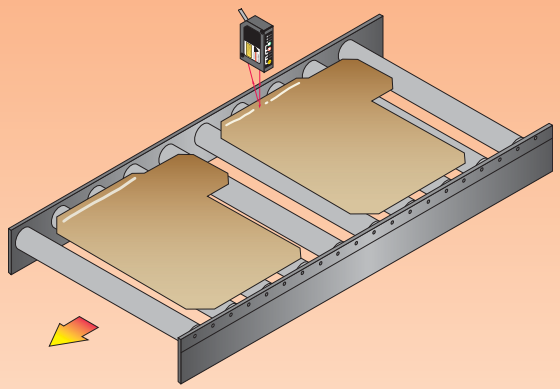
L-GAGE® LG5 Sensor



Adhesive Thickness Inspection

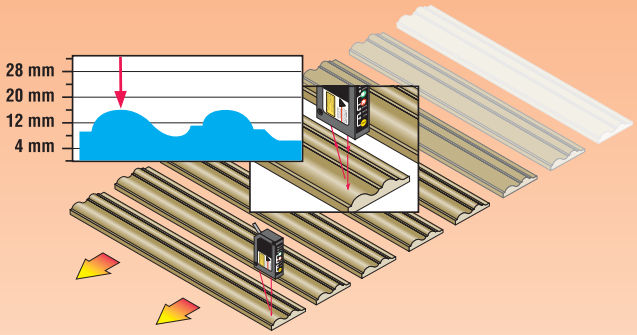
Objective: To inspect for correct adhesive height.

Sensor Model: LG5A65PU sensor

Operation: The LG5 narrow effective beam is excellent for precision height measurements. Here the LG5 verifies that the bead of adhesive is at least 6 mm thick.

See page 42.

L-GAGE® LG10 Sensor



Wood Profiling

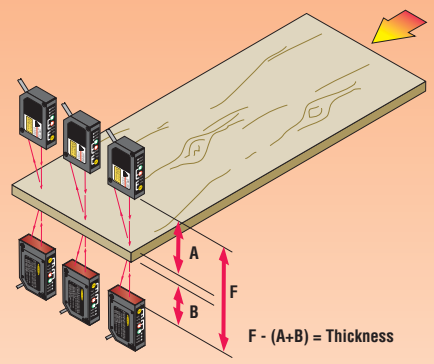
Objective: Profile wood moldings; inspect milled dimensions.

Sensor Model: LG10A65NU sensor

Operation: The LG10, with a 100 mm standoff distance and a 50 mm measuring window, can accurately profile a wide variety of wooden moldings in milling applications. Not only is the LG10 fast and accurate, it is also very tolerant of changing wood colors. For example, changing from dark walnut to light ash requires no change in sensor configuration.

See page 42.

L-GAGE® LG10 Sensor



Plywood Thickness Measurement

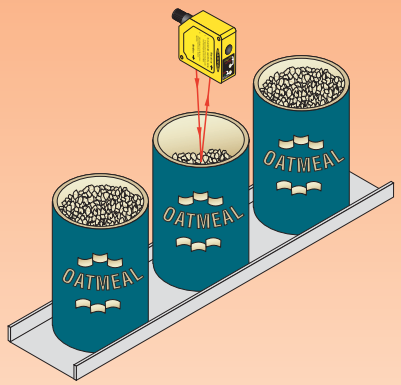
Objective: To monitor thickness at three points across the width of plywood sheet.

Sensor Model: LG10A65NU sensor

Operation: Thickness at each location is determined by subtracting the distance from each sensor to plywood (A + B) from the distance between each pair (F).

See page 42.

L-GAGE® Q50 Sensor



Fill Level control

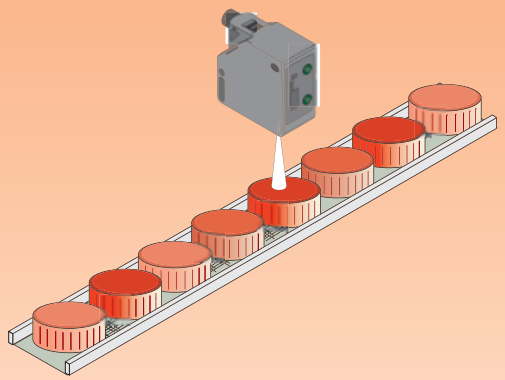
Objective: To monitor and control fill level of dry cereal in a packaging operation.

Sensor Model: Q50BU sensor

Operation: Many food processing lines now fill by level, instead of by weight. Infrared analog Q50 sensors are the best choice for fill level monitoring of irregular surfaces, such as dry cereals.

See page 48.

QC50 Sensor



Color Intensity Verification

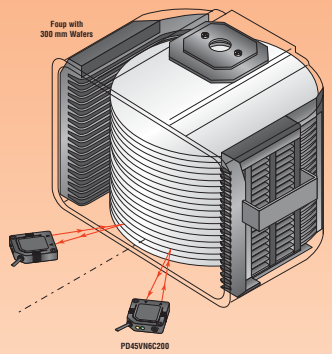
Application: To verify caps are the right color and shade.

Sensor Model: QC50 sensor

Application Notes: A QC50 is positioned above the correct color cap and output 1 is programmed using color and intensity mode. The sensor will reject any caps that are the wrong color and will also reject lighter or darker versions of the programmed color. Two other outputs can be programmed to recognize other conditions as desired.

See page 56.

PicoDot® Sensor



Semiconductor Wafer Mapping

Objective: To verify correct wafer placement in a wafer cassette.

Sensor Model: PD45VN6C100 sensor

Operation: Two PicoDots are positioned at the same height and are therefore able to detect a missing wafer or a skewed wafer in the cassette.

See page 60.

U-GAGE® QT50U Analog Sensor

Liquid Level Monitoring

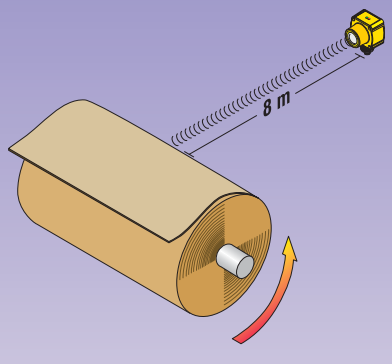
Objective: To monitor the level of liquid in a tank.

Sensor Model: QT50U sensor with analog output

Operation: The narrow beam of the QT50U allows the sensor to be mounted at the top of the storage tank without its beam reaching the tank wall. As the liquid level changes, the sensor sends an ongoing signal that is scaled to represent the current depth of the liquid in the tank.

See page 68.

U-GAGE® QT50U Analog Sensor



Roll Size Monitoring

Objective: To monitor the size of a large roll of goods from a distance of up to 8 m (26').

Sensor Model: QT50U sensor

Operation: During the printing process, the roll of paper, which may be mounted at an inconvenient location near the ceiling, must be monitored to prevent running out of paper during the print run. A QT50U sensor is mounted perpendicular to the roll, at a distance up to 8 m from an empty roll. Because the sensor can be taught remotely, it may also be located near the ceiling.

See page 68.

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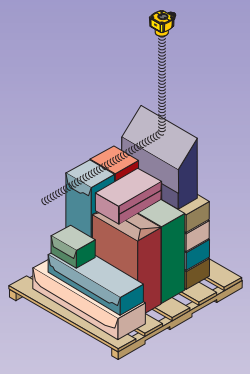
U-GAGE® QT50U Discrete Sensor



Materials Handling Detection

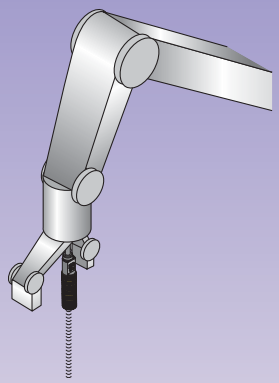
Objective: To detect the presence or absence of a target that may include a surface that is not perpendicular to the sensor.

Sensor Model: QT50U sensor with discrete output

Operation: In materials handling applications, the presence or absence of diverse targets (e.g., pallets), must be sensed reliably. The QT50U can reliably sense even pallets that do not present in a flat, perpendicular sensing surface. An ultrasonic beam is sent down from the sensor, which is mounted over the sensing location. The sensor "learns" the distance to the floor or conveyor as the "target absent" condition. When a pallet or package of any size or shape is in the sensing location, the sensor does not sense the floor and turns its output ON, signaling that a pallet is ready for loading.

See page 68.

U-GAGE® S18U Sensor



End Effector Position Feedback

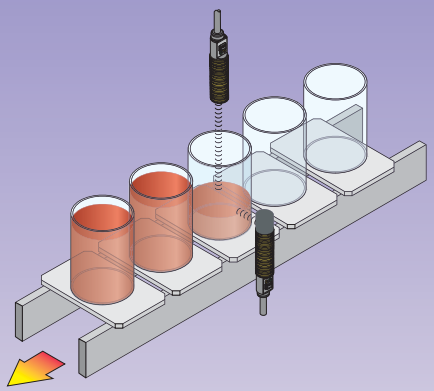
Objective: To provide proximity information to an assembly robot control.

Sensor Model: S18UIA sensor

Operation: The lightweight ultrasonic sensor provides information to the robot controller for distance of the end effector to any object or surface.

See page 74.

U-GAGE® S18U Sensor



Liquid Level Measurement in Clear Containers

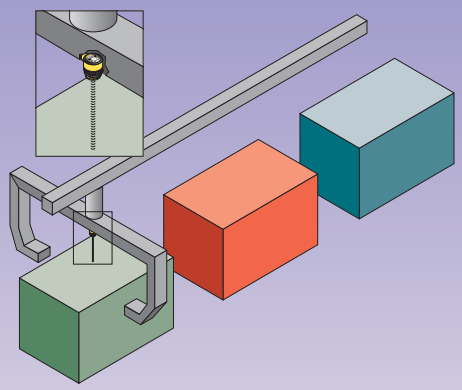
Objective: To measure liquid levels in clear containers.

Sensor Model: S18UBAR Right-angle and S18UIA Straight barrel

Operation: The S18U is ideal for detecting clear objects and measuring liquid levels regardless of color or consistency. The unique right-angle housing allows easy fixturing to peer over the sides of a conveyor.

See page 74.

U-GAGE® T30U Sensor



Crane Anti-collision

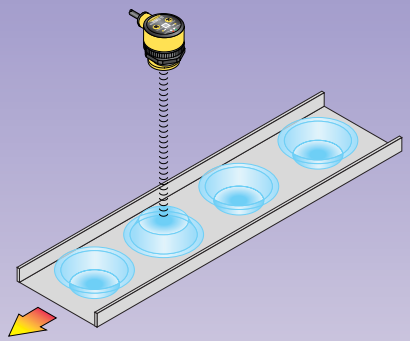
Objective: To insure that the crane apparatus does not contact the top of the container.

Sensor Model: T30UDNBQ

Operation: The T30U senses the distance to the top of the container and outputs a signal if the distance is less than a critical pre-set value.

See page 80.

U-GAGE® T30U Sensor



Inverted Object Detection

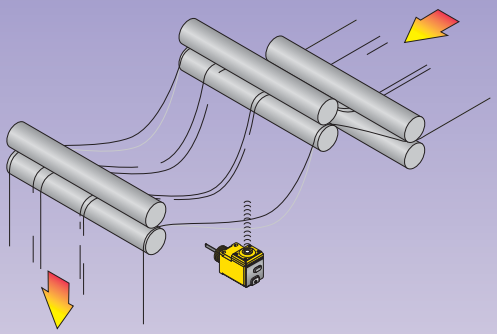
Objective: Sense product height difference to detect an inverted product.

Sensor Model: T30UDNA

Operation: A T30U Sensor mounted above the conveyor may be used to detect small differences in product height, regardless of the color or clarity of the object being detected.

See page 80.

U-GAGE® Q45U Sensor



Loop Tension

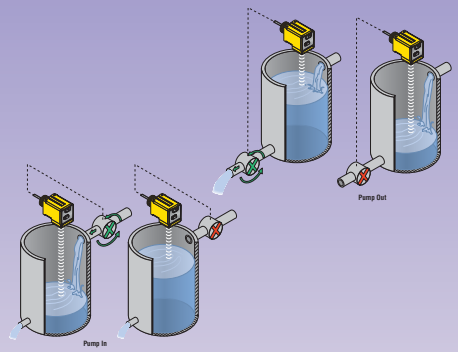
Objective: Monitor loop tension to control web speed.

Sensor Model: Q45ULIU64ACR

Operation: The analog Q45U uses dual microprocessors to smooth output response to web flutter. The sensor is able to ignore invalid or erratic echoes. The smoothed output reduces stress on motors and motor drives.

See page 86.

U-GAGE® Q45U Sensor



Pump-In/Pump-Out

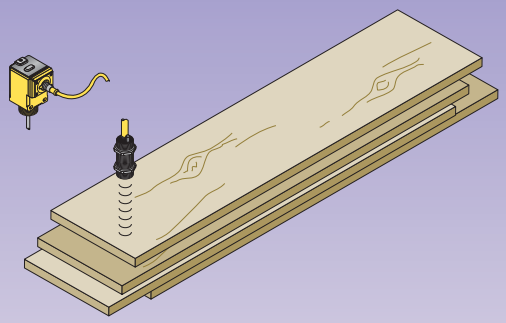
Objective: Control the flow into or out of a holding tank.

Sensor Model: Q45UBB63DAC

Operation: High/Low level control applications pose no problem for the Q45U sensor. It may be easily configured via internal DIP switches for either “pump-in” or “pump-out” fill tank applications. After the sensor is taught the high and low levels for product, it will constantly control the fill level by energizing its output at the programmed levels.

See page 86.

U-GAGE® Q45UR Sensor



Board Counting

Objective: Verify the proper number of boards have been placed in each bundle.

Sensor Model: Q45UR3BA63CK

Operation: The Q45UR sensor is configured by teaching a “Good” stack and setting an inspection tolerance with the dip switches.

See page 92.

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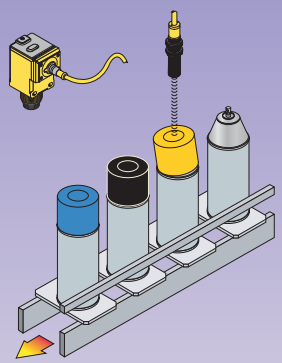
U-GAGE® Q45UR Sensor



Spray Can Inspection

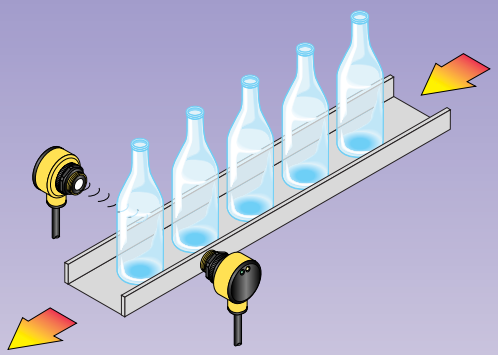
Objective: Detect crooked or missing caps on spray cans.

Sensor Models: S182C.0 remote 18 millimeter barrel sensor, used with model Q45UR3BA63C controller

Operation: The Q45UR Series controller "teaches" the remote sensor a "good" spray can with the cap fully seated. The size of an acceptance window is set using the dip switches in the controller. The controller outputs energize to reject a can if either a high (crooked) or missing cap is detected. The ultrasonic sensor is insensitive to the various cap colors.

See page 92.

U-GAGE® T18U Sensor



Bottle Conveyor Line

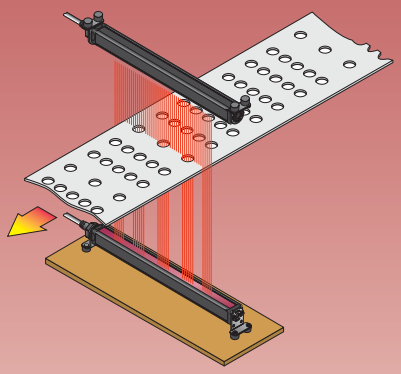
Objective: Reliably count clear objects moving on a high speed conveyor line.

Sensor Models: T186UE and T18VN6UR

Operation: Opposed mode T18 ultrasonics offer the ultimate in reliability when counting clear products. Clear glass, clear plastic or shiny materials traveling in wet or dirty environments pose no threat to the reliable performance of the T18U.

See page 100.

A-GAGE® MINI-ARRAY®



Hole in Web

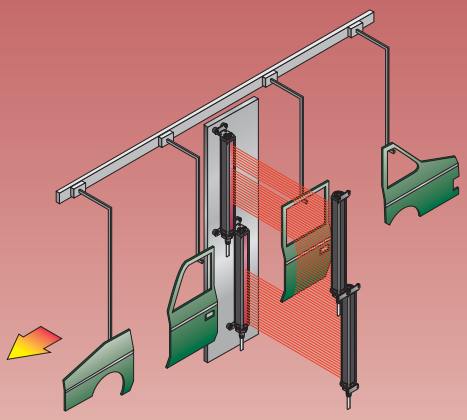
Objective: Inspecting a repetitive hole pattern for missing holes.

Sensor Model: MINI-ARRAY system

Operation: An output of a MINI-ARRAY controller is programmed to the "Contiguous Beams Blocked" measurement mode, to respond to holes missing from each line pattern. The inspection is gated by the controller's second output, which is programmed for the "Total Beams Made" measurement mode.

See page 118.

A-GAGE® MINI-ARRAY®



Paint Profiling

Objective: Provide assembly profile information to an automated paint finishing process.

Sensor Model: Two MINI-ARRAY systems

Operation: The serial data output to two MINI-ARRAY light screen controllers is used to optimize paint usage and coverage in an automated paint finishing process.

See page 118.

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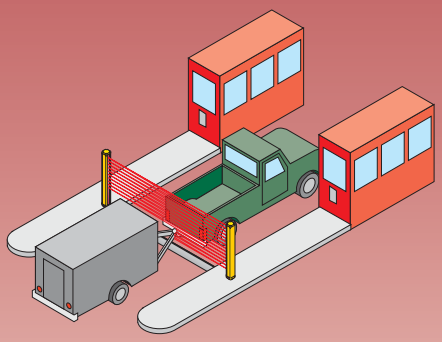
A-GAGE® MINI-ARRAY®



Toll Booth Truck

Objective: To detect vehicle separation in an Automated Vehicle Classification (AVC) system.

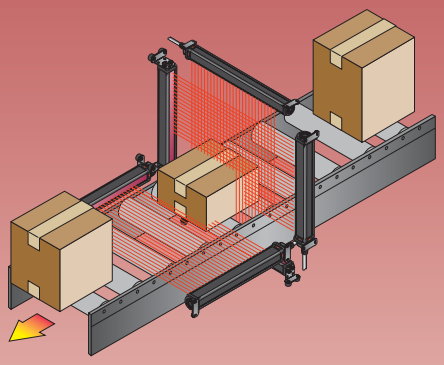
Sensor Models: BMEL3632A and BMERL3632A with SM30SEL and SM30SRL

Controller Model: MAC-1 using QDC-515C cables

Operation: An Automated Vehicle Classification (AVC) system measures the height and counts the number of axles on a given vehicle. The most difficult situation for an AVC system is the detection of a vehicle that is towing a trailer. The MINI-ARRAY system does have a resolution that can reliably detect the trailer hitch so the trailer is included with the proper vehicle.

See page 118.

A-GAGE® High-Res MINI-ARRAY®



Parcel Profiling

Objective: To accurately measure boxes to be shipped.

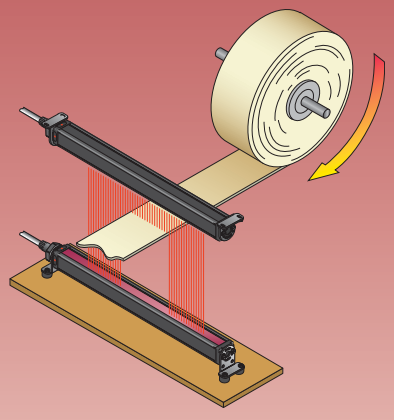
Sensor Models: Three High-resolution MINI-ARRAY models MAHE64A emitters and model MAHR64A receivers

Controller Model: Three model MAHCN-1 control modules

Operation: The three arrays are positioned at right angles to each other. Array controllers transmit box length, width, and height data to the host process controller. The host compiles size information for all of the parcels and determines a packing program which optimizes use of cargo container space.

See page 130.

A-GAGE® High-Res MINI-ARRAY®



Edge Guiding

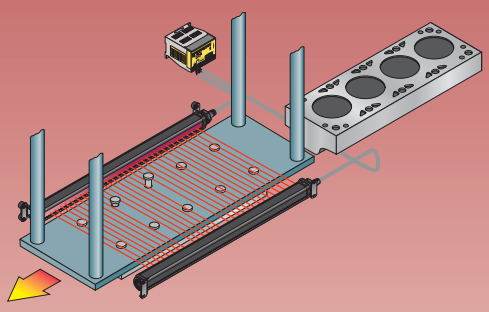
Objective: To maintain centering of opaque web materials.

Sensor Model: High Resolution MINI-ARRAY

Operation: A High-Resolution MINI-ARRAY System is positioned over and under the material coming off the roll. Using the System's unique "Middle Beam Blocked" measurement mode, the System transmits the location of the center of the material to the host process controller. The process controller uses the data to adjust the web's position, as needed.

See page 130.

A-GAGE® High-Res MINI-ARRAY®



Engine Pin Detection

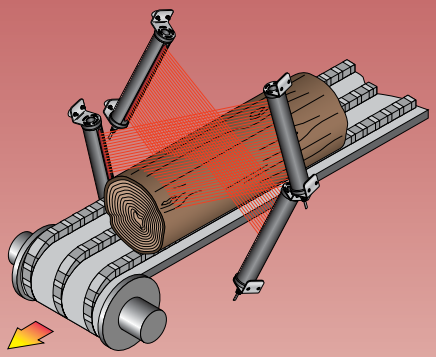
Objective: To detect a hole in a cylinder head.

Sensor Model: High Resolution MINI-ARRAY

Operation: An inspection plate is placed over the cylinder head such that the sliding pins are over each hole in the part. The plate is then lowered and the pins drop into the holes. If a hole is missing, the pin will not drop down and is detected by the Hi-Res MINI-ARRAY.

See page 130.

A-GAGE® BEAM-ARRAY™



Log Profiling

Objective: To profile logs entering a lumber mill.

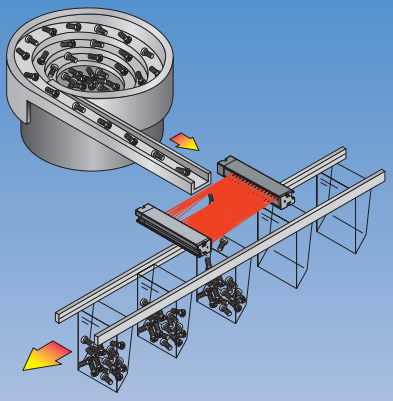
Sensor Models: Two BEAM-ARRAY BME448A emitters and two BMR448A receivers

Controller Model: Two BC1T serial data control modules

Operation: Two (or more) BEAM-ARRAY measuring light screens are positioned at different angles along the log conveyor. The serial data controller for each measuring system sends profile data to a host process controller, which calculates a milling program to maximize the board-feet of lumber produced from that log.

See page 138.

LX Series



Parts Counting

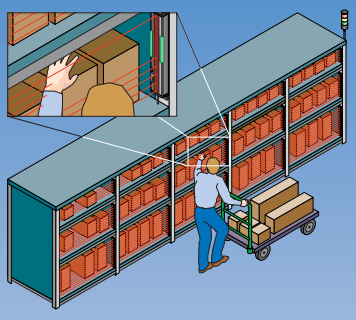
Objective: To count hardware as it leaves a vibratory feeder.

Sensor Models: LX6ESR emitter and LX6RSR receiver

Operation: The output of the LX6RSR receiver includes a 5-millisecond pulse stretcher (off-delay) to improve count accuracy. Successive parts must be separated by at least 7 milliseconds (0.007 second). Minimum object detection size is 5.6 m (0.2").

See page 144.

PVA Bin-Picking Sensors



Warehouse Order Picking

Objective: To indicate which bin to pick from, and verify that an item was removed.

Sensor Models: PVA Series emitter/receiver pairs

Operation: The system controller (typically a computer) issues an instruction to pick an item from a particular location. The controller turns ON the PVA's "job lights" at the specified location. The job lights go OFF when an item from that location is removed. If multiple items are required from one location. the job light stays ON until the correct number of items are removed.

See page 158.

VTB Bin-Picking Touch Buttons

Assembly Process Verification

Objective: To streamline and error-proof the assembly process in an ergonomic assembly station.

Sensor Models: Multiple VTB Verification Touch Buttons, connected to a process controller.

Operation: A VTB touch button is positioned in front of each of a matrix of parts bins in an assembly station and is interfaced with a process controller, programmed with the correct assembly procedure. The process controller prompts each VTB where the next part should be taken. When prompted in this way, the VTB's translucent base glows a bright green, signaling the assembler to take a part (or parts) from the corresponding bin. After removing the part, the operator inserts a finger into the VTB's touch zone, extinguishing the light and signalling the process controller that the correct part has been taken. VTBs reduce the risk of repetitive motion injury and speed and simplify the process, reducing the risk of mistakes in a repetitive process.

See page 164.

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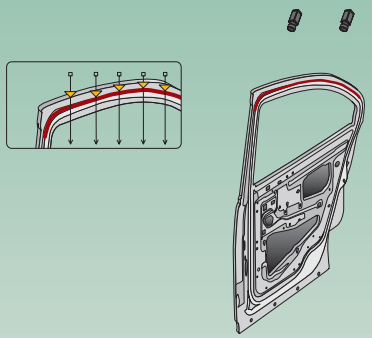
PRESENCEPLUS® PRO VISION SENSORS



DISPENSED BEAD VERIFICATION

AUTOMOTIVE

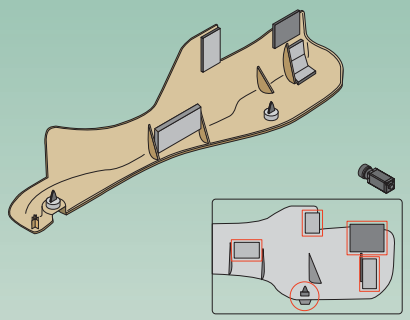
Objective: To verify the continuity, placement and thickness of a bead of adhesive or sealant on an auto door body panel.

Sensor Model: Two PresencePLUS Pro vision sensors, LCF16 lens, high-frequency fluorescent light source, PLC used as a trigger.

Operation: In an automobile manufacturing plant, after a robot lays down a bead of sealant around the perimeter of a door panel, the panel is moved to a well-lit inspection station. There, two PresencePLUS Pro sensors are mounted above the part, looking down, to inspect the sealant. A bank of high-frequency fluorescent lights is mounted above, to illuminate the part. A Locate tool is used to find the edge of the door; multiple Edge and Object tools are used to monitor the width of the sealant bead, its location, and the continuity of the bead (whether there are any skips).

See page 170.

PRESENCEPLUS® PRO VISION SENSORS



MULTIPLE COMPONENT LOCATION

AUTOMOTIVE

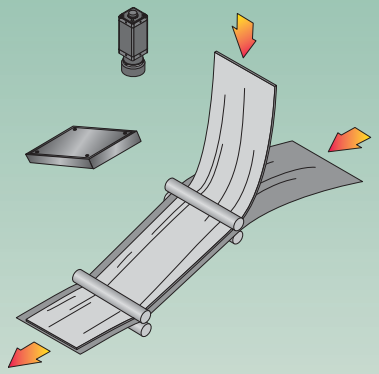
Objective: To verify the presence and location of foam padding and plastic nuts on an automobile dashboard trim piece.

Sensor Model: PresencePLUS Pro vision sensor, LCF16LT lens, high-frequency fluorescent light source, PLC used as a trigger.

Operation: In an automobile manufacturing plant, the PresencePLUS Pro is mounted to look across at a molded plastic dashboard trim piece. A bank of high-frequency fluorescent lights is mounted above, to illuminate the part. Multiple Blob, Object, and Edge tools are used to detect the presence or absence, orientation and location of pieces of foam padding and plastic components on the trim piece.

See page 170.

PRESENCEPLUS® PRO VISION SENSORS



TIRE ASSEMBLY INSPECTION

AUTOMOTIVE

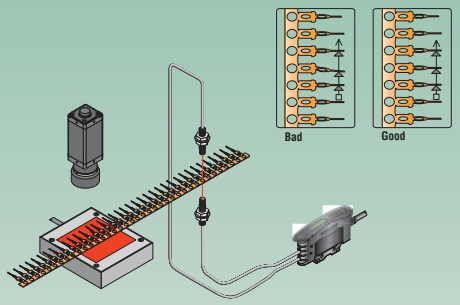
Objective: Verify cloth assembly on a rubber tire.

Sensor Models: PresencePLUS Pro Vision Sensor, 25 mm lens (LCF25LR), LEDIA80X80W area light, Infrared Filter (FLTI)

Operation: The PresencePLUS Pro Vision Sensor is verifying that the cloth belting is added to the rubber for a tire assembly. The PresencePLUS Pro is mounted 6˝ above the web of material. An Average Gray Scale tool is used to determine if the gray cloth is over the black rubber. If the gray scale level is too low, then the PresencePLUS Pro stops the web for an operator to investigate.

See page 170.

PRESENCEPLUS® PRO VISION SENSORS



GAP (PITCH) MEASUREMENT

ELECTRONICS

Objective: To inspect stamped metal pins for critical flaws.

Sensor Model: Two PresencePLUS Pro vision sensors, LCF25R lens, LEDRB70X70W light source, opposed-mode fiber optic sensor used as a trigger.

Operation: A roll of thin metal stock passes through a stamping machine, where it is stamped into individual, but connected, pins, It is critical that the pins be straight and spaced at specified intervals, for later steps in the manufacturing process. A fiber optic sensor detects the guide holes along one side of the metal stock, and triggers the PresencePLUS Pro camera to capture an image. Using the Object Tool, the PresencePLUS Pro System locates the last edge of one pin and the leading edge of the next pin, and measures the gap (or “pitch”).

See page 170.

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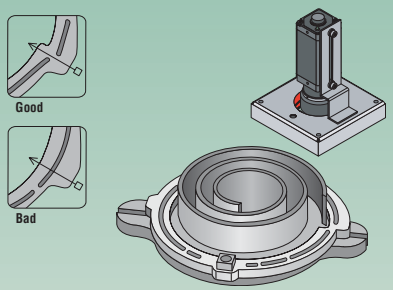
PRESENCEPLUS® PRO VISION SENSORS



ASSEMBLY VERIFICATION, AIR COMPRESSOR

AUTOMOTIVE

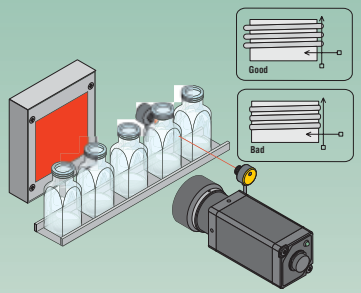
Objective: To verify that a ring was assembled correctly.

Sensor Model: PresencePLUS Pro vision sensor, with LCF08 lens, LEDRR140W light source, PLC used as a trigger.

Operation: The ring to be assembled can be accidentally placed 180 degrees our of position. When assembled correctly, the ring can slide back and forth on the work surface, therefore, the PresencePLUS Pro locates the part with a Locate tool before verifying its orientation. The trigger sensor signals the PresencePLUS Pro camera to capture an image, and the System analyzes the image to detect whether or not the part is positioned correctly to receive another component. In this case, if part is in the wrong orientation, the PresencePLUS Pro, using the Edge tool, will not detect the predetermined edge, and warn the operator.

See page 170.

PRESENCEPLUS® PRO VISION SENSORS



THREAD SIZE DETECTION

PACKAGING

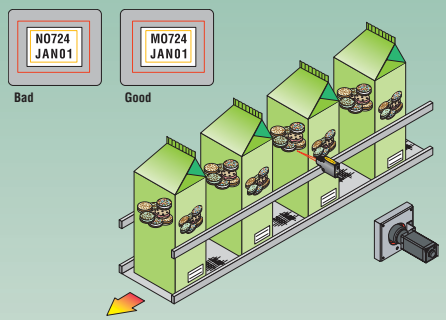
Objective: To verify that threads on the necks of bottles are completely formed.

Sensor Models: PresencePLUS Pro Vision Sensor, with LCF16 lens, LEDRB70X70W light source, photoelectric sensor used as a trigger.

Operation: Bottles on an assembly line sometimes have neck threads that do not form completely, making their bottle caps unable to seal properly. The PresencePLUS Pro Vision Sensor finds the neck of the bottle using the Locate tool, and using the Edge tool, checks that the threads are present at a predetermined distance from the neck surface. If the threads are too short, the Edge tool will not detect the threads and the PresencePLUS Pro will fail the part.

See page 170.

PRESENCEPLUS® PRO VISION SENSORS



DATE/LOT CODE VERIFICATION

PACKAGING

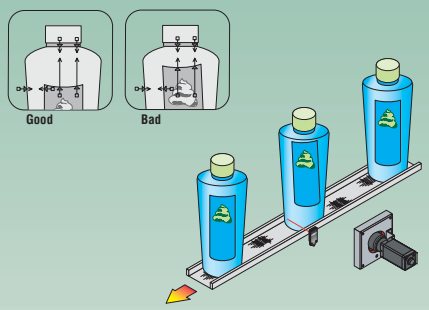
Objective: To verify that the correct date/lot code is printed on cookie boxes.

Sensor Models: PresencePLUS Pro Vision Sensor, with LCF16 lens, LEDRR80X80W ring light source, convergent photoelectric sensor used as a trigger.

Operation: An ink jet printer prints a date code and lot number to a designated location on each cookie box. When triggered by a convergent beam sensor, the PresencePLUS Pro inspects the printed characters and compares them to the date code and lot number that it was taught as “good.” If any character is different or is missing (in this case, the sensor detects that the “M” changed to an “N”), the sensor rejects the box.

See page 170.

PRESENCEPLUS® PRO VISION SENSORS



LABEL POSITIONING

PACKAGING

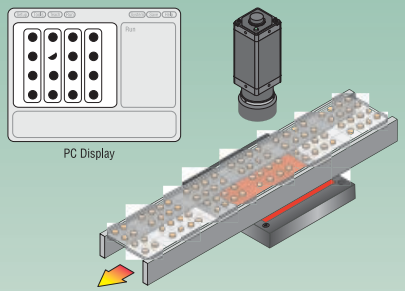
Objective: To verify the correct placement of the label on a bottle of shaving gel.

Sensor Models: PresencePLUS Pro Vision Sensor, with LCF16 lens, LEDRR70X70W light source, photoelectric sensor used as a trigger.

Operation: Bottles of shaving gel are conveyed past the PresencePLUS Pro sensor, which will verify that the label is present, and that it is positioned correctly. Using the Edge and Measure tools, the PresencePLUS Pro measures the distance from the top of the label to the neck of the bottle in two locations, verifying height and straightness, and measures the distance from one side of the label to the side of the bottle, verifying side-to-side location.

See page 170.

PRESENCEPLUS® PRO VISION SENSORS



PHARMACEUTICAL

BLISTER PACKAGE VERIFICATION

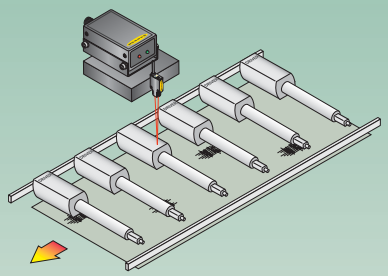
Objective: To verify that a tablet is present in each blister pocket, and that no broken tablets or foreign material are in the web.

Sensor Models: PresencePLUS Pro Vision Sensor, LEDRB100X200N backlight, PLC for trigger.

Operation: Tablets are positioned into blister pockets on a web. The PresencePLUS Pro vision sensor is used to verify that each blister pocket contains an unbroken tablet, and no foreign material. Four Blob tools are used, each examining a row of four tablets. A good image is taught to be four identically shaped and sized tablets. If the image is any condition other than the good images being taught, the PresencePLUS Pro vision sensor sends a signal to the PLC, which stops the machine, allowing the operator to intervene.

See page 170.

PRESENCEPLUS® PIXEL-COUNTING SENSORS



AUTOMOTIVE

STAMPED LOGO INSPECTION

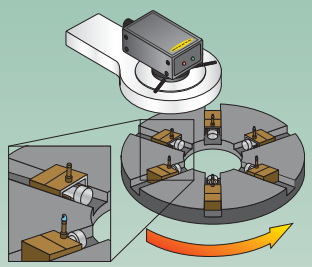
Objective: To verify the presence and quality of a logo stamped into a metal part.

Sensor Models: P2B65Q PresencePLUS2, LEDR140 LED ring light, WORLD-BEAM QS18VN6CV45

Operation: Metal steering linkage assemblies are conveyed past the PresencePLUS2 sensor, which inspects for the presence and the quality of a stamped logo. The PresencePLUS2 sensor lens and attached LED ring light are positioned so that the impressions of a stamped logo create shadows which are seen by the sensor as black pixels. Linkage assemblies which register less than the programmed number of black pixels are rejected.

See page 188.

PRESENCEPLUS® PIXEL-COUNTING SENSORS



AUTOMOTIVE

GREASE PRESENCE VERIFICATION

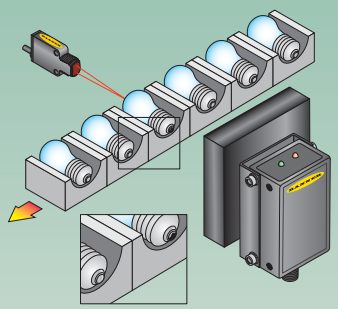
Objective: To verify the presence of a spot of grease on the tip of a post.

Sensor Models: P2B65Q PresencePLUS2, HFFBB ultraviolet ring lamp.

Operation: Automotive assemblies are indexed into position directly below the lens of a PresencePLUS2 sensor. The grease has a filler which fluoresces brightly under the ultraviolet light source. The PresencePLUS2 inspection sensor detects a 70% increase in white pixels when the grease is present on the tip of the post. NOTE: the red filter is removed for this application.

See page 188.

PRESENCEPLUS® PIXEL-COUNTING SENSORS



ELECTRONICS

LIGHT BULB BASE INSPECTION

Objective: To verify that a black plastic covering has been removed from the base of the light bulbs, prior to packaging the bulbs.

Sensor Models: P2B65Q PresencePLUS, LEDR140 LED ring light, MINI-BEAM2 QS12VN6CV20.

Operation: The convergent beam sensor is positioned so that it triggers the inspection sensor when the base of each bulb is centered in its field of view. The PresencePLUS Pixel-Counting sensor is programmed to sense a clean bulb base as entirely white pixels. If any plastic remains on the base, black pixels are detected, and the bulb is rejected from the packaging line.

See page 188.

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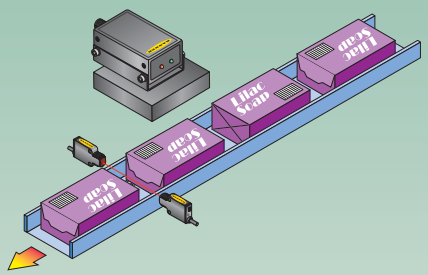
PRESENCE PLUS® PIXEL-COUNTING SENSORS

PACKAGING



PRODUCT ORIENTATION

Objective: Orient bars of soap in the same direction for grouped packaging.

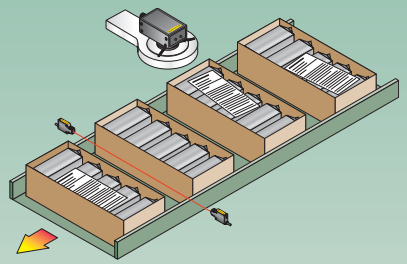
Sensor Models: P2B65Q PresencePLUS2, LEDR140 LED ring light, MINI-BEAM2 QS126E and QS12VN6R

Operation: Soap is cellophane-wrapped in bundles of three bars. It is necessary to arrange the three bars in each stack in the same orientation. The region of interest (ROI) of the PresencePLUS2 sensor includes a UPC code, which offers a high white pixel count, as compared to the same location on a bar which passes in the reversed orientation. Bars which are sensed with a low white pixel count are diverted from the packaging line.

See page 188.

PRESENCE PLUS® PIXEL-COUNTING SENSORS

PACKAGING



MISSING INSTRUCTION CARD INSPECTION

Objective: To verify the presence of an instruction card laying on top of products in an open carton.

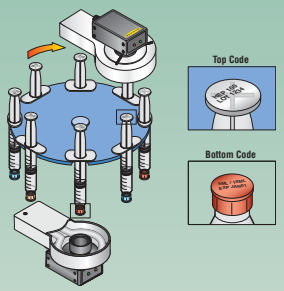
Sensor Models: P2B65Q PresencePLUS, HFFW5100 fluorescent ring light, MINI-BEAM2 QS126E & QS12VN6R

Operation: Cartons are conveyed past the PresencePLUS2 inspection sensor, which inspects for the presence or absence of a printed instruction card. Cards appear mostly white to the PresencePLUS2 sensor. The metallic pouches reflect most of the light from the ring light away from the sensor and, therefore, appear mostly black. The PresencePLUS2 sensor registers over 50% fewer white pixels when a card is missing, and issues a reject command to the packaging machine.

See page 188.

PRESENCE PLUS® PIXEL-COUNTING SENSORS

PHARMACEUTICAL



LOT CODE PRESENCE INSPECTION

Objective: To verify the presence of lot and date code information on the cap and plunger of a syringe assembly.

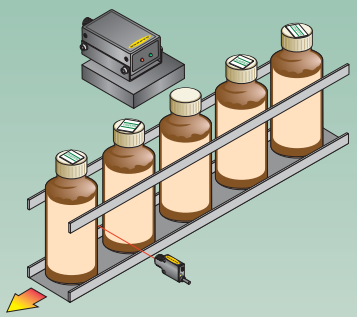
Sensor Models: Two P2B65Q PresencePLUS2, two HFFW5100 fluorescent ring lights, triggered by the indexing wheel.

Operation: Syringe assemblies are indexed into position for inspection of date and lot code information. One PresencePLUS2 verifies the presence of the lot code printed on the plunger, and the other PresencePLUS2 sensor verifies the presence of size and date code information printed on the end cap. Missing information results in a low black pixel count. One of the PresencePLUS2 sensors issues a reject signal for each syringe with missing information.

See page 188.

PRESENCE PLUS® PIXEL-COUNTING SENSORS

PHARMACEUTICAL



MISSING COUPON INSPECTION

Objective: To verify the presence of a coupon attached to bottle caps.

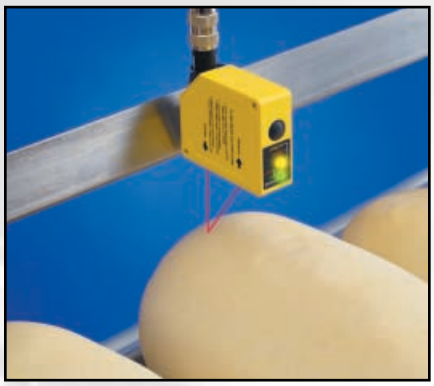
Sensor Models: P2B65Q PresencePLUS2, LEDR140 LED ring light, MINI-BEAM2 QS12VN6CV20.

Operation: When the trigger sensor "sees" the leading edge of a cough syrup bottle, the PresencePLUS2 sensor captures an image of the bottle cap. The cap appears mostly black to the sensor. The coupon, when present, registers a high white pixel count. The inspection sensor is mounted on an adjustable arm, which allows many different bottle sizes to be run on this inspection line. Use of a convergent beam trigger sensor allows bottles to pass the inspection point with zero gap between them.

See page 188.

L-GAGE® Laser Gauging Sensors

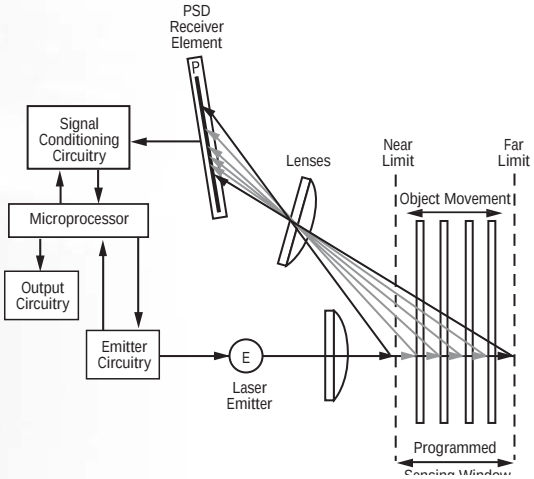
Principals of Operation



Optical triangulation

An emitter transmits visible laser light through a lens, towards a target. The laser light beam from the emitter bounces off the target, scattering some of its light through another lens to the sensor's PSD (Position Sensitive Device) receiver element. The target's distance from the receiver determines the angle at which the light travels to the receiver element. This angle, in turn, determines where the received light will fall along the PSD receiver element.

The position of the light on the PSD receiver element is processed through analog and/or digital electronics to calculate the appropriate output value. The analog output varies in proportion to the target's position within the user-programmed analog window limits. The discrete (switched) output energizes whenever the target is located between the user-programmed discrete window limits. Analog and discrete window limits may be the same, or programmed independently.

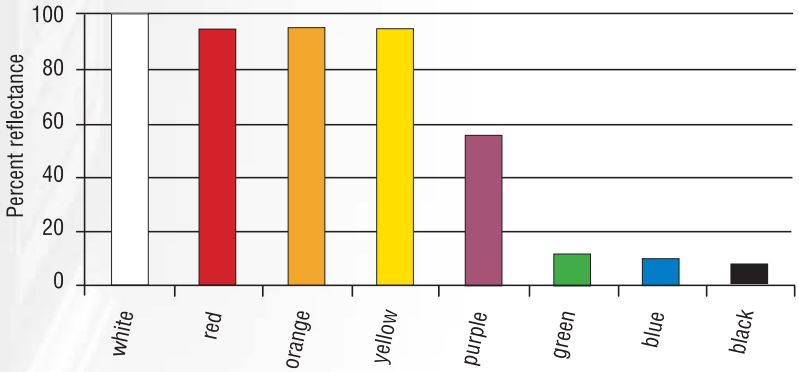


Color effects

The color of the object being measured can affect the resolution and accuracy of the readings. White, red, yellow, and orange targets will reflect more light than green, blue, or black targets. The resolution specifications listed in this catalog are for white targets. The resolution for dark targets may be up to four times less than for white targets.

The graph below shows the relative amount of received light that is reflected from various target colors. The resolution is roughly affected according to the square of the received light. For example, reducing the amount of light by a factor of nine will degrade the resolution by a factor of three.

Relative reflected light from a red LED light source



Target requirements

Banner triangulation sensors depend on the diffuse reflections of light from the target. A diffuse reflection is one in which the light tends to scatter equally in all directions from the target. If the target surface is mirror-like, then light will tend to reflect in only one direction. The LT3, LG5, LG10 and Q50 series sensors will not work with mirror-like surfaces.

The triangulation sensors also require a non-porous, opaque surface for accurate operation. Measurement errors will result from semi-transparent targets such as clear plastic, or from porous materials such as foam.

Metal surfaces

Bare metal surfaces, even though they may be somewhat diffuse, typically do not exhibit consistent reflectivity across their surfaces; consequently, the repeatability from one point on a metal surface to another, even at the same distance from the sensor will degrade. This effect varies from metal to metal and is dependent upon surface finish. Therefore, we recommend bench-testing a sample of the metal in order to estimate the expected repeatability for the application.

Total expected measurement error

Keep in mind that the overall expected accuracy of an analog sensor is the combination of several performance parameters, not simply the sensor's resolution. For example, consider an LG5 Laser Gage measuring the position of a dark colored plastic part, at medium response speed, in an environment that varies +/- 3°C. The individual errors would be:

Resolution	48 µm (4 x 12 µm, the resolution of a white target)
Linearity	60 µm
Temp effect	21 µm (7µm/°C x 3°C)

Since these errors are independent, they may be combined using the Root-Sum-of-Squares (RSS) method as follows:

Total expected error = $\sqrt{48^2 + 60^2 + 21^2}$ = 80 µm

LT3 Series- long-range time-of-flight laser distance gauging sensors.

Advanced time-of-flight technology at less cost.

The L-GAGE LT3 Laser Distance-Gauging Sensor utilizes "time-of-flight" technology to provide precise, long-distance gauging at the speed of light. The microprocessor-controlled laser distance-gauging sensor features a unique design that provides exceptional accuracy and range at much lower cost than competitive laser-gauging devices. Precise performance and low price make the LT3 an ideal solution for a variety of precision inspection applications.

- Accurate diffuse-mode models with ranges to 5 m
- 50 m range with retroreflective models
- One million pulses per second
- Reliable detection of angled targets

Analog & discrete outputs, or dual-discrete models.

The LT3 can include both a discrete (switched) output and an analog output in the same unit, with independently programmable window limits. For additional flexibility, the analog output is available in a choice of 4 to 20 mA or 0 to 10V. You can also choose models with two discrete outputs, selectable PNP (sourcing) or NPN (sinking).

Compact, self-contained design.

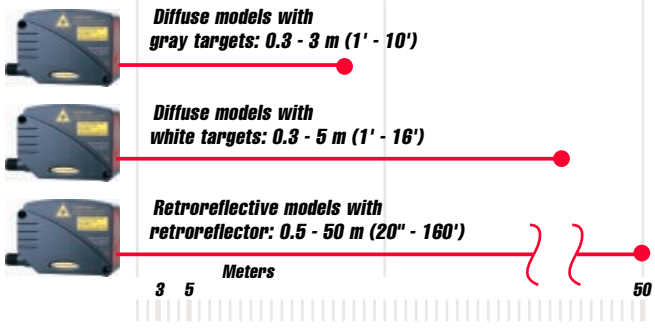
The LT3 was designed to conserve production space and decrease setup time. The self-contained system measures just 68.5 mm high, by 35.3 mm wide, by 87.0 mm deep, allowing it to fit and function in smaller spaces than competitive systems.

Simple 3-step programming.

LT3 programming is as easy as I, 2, 3, and complete programming instructions (3 short sentences) are conveniently printed right on the side of the sensor.

- Push-button TEACH-mode programming sets custom sensing windows
- Remote programming for added security and convenience

LT3 Sensing Ranges



LT3 Series Models

Models	Sensing Mode	Laser Class	Sensing Distance	Cable*	Supply Voltage	Discrete Output	Analog Output	Data Sheet†
LT3BD	Diffuse	Class 2	0.3 to 5 m (12" to 16') for 90% reflectivity white card (see Specifications on page 38 for more information.)	8-wire, 2 m (6.5') cable	12 to 24V dc	Dual NPN or PNP Selectable	None	68503
LT3BDQ				8-pin Euro-style swivel QD				
LT3PU		Class 2		8-wire, 2 m (6.5') cable	12 to 24V dc	PNP	0 to 10V dc	65742
LT3PUQ				8-pin Euro-style swivel QD				
LT3NU		Class 2		8-wire, 2 m (6.5') cable	12 to 24V dc	NPN	0 to 10V dc	
LT3NUQ				8-pin Euro-style swivel QD				
LT3PI		Class 2		8-wire, 2 m (6.5') cable	12 to 24V dc	PNP	4 to 20 mA	
LT3PIQ				8-pin Euro-style swivel QD				
LT3NI		Class 2		8-wire, 2 m (6.5') cable	12 to 24V dc	NPN	4 to 20 mA	
LT3NIQ				8-pin Euro-style swivel QD				
LT3BDLV	Retroreflective	Class 1	0.5 to 50 m** (20" to 160') for reflector BRT-TVHG-8x10P (see Specifications on page 38 for more information.)	8-wire, 2 m (6.5') cable	12 to 24V dc	Dual NPN or PNP Selectable	None	68503
LT3BDLVQ				8-pin Euro-style swivel QD				
LT3PULV		Class 1		8-wire, 2 m (6.5') cable	12 to 24V dc	PNP	0 to 10V dc	68504
LT3PULVQ				8-pin Euro-style swivel QD				
LT3NULV		Class 1		8-wire, 2 m (6.5') cable	12 to 24V dc	NPN	0 to 10V dc	
LT3NULVQ				8-pin Euro-style swivel QD				
LT3PILV		Class 1		8-wire, 2 m (6.5') cable	12 to 24V dc	PNP	4 to 20 mA	
LT3PILVQ				8-pin Euro-style swivel QD				
LT3NILV		Class 1		8-wire, 2 m (6.5') cable	12 to 24V dc	NPN	4 to 20 mA	
LT3NILVQ				8-pin Euro-style swivel QD				

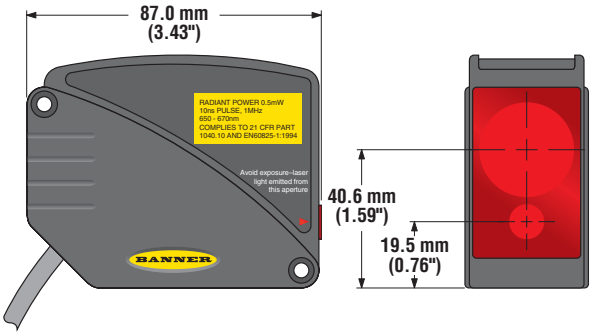
* 9 m (30') cables are available by adding suffix "**W/30**" to the model number of any cabled sensor (e.g., **LT3BD W/30**). A model with a QD connector requires a mating cable; see page 41.

** Retroreflective range specified using included model BRT-TVHG-8X10P high-grade target.

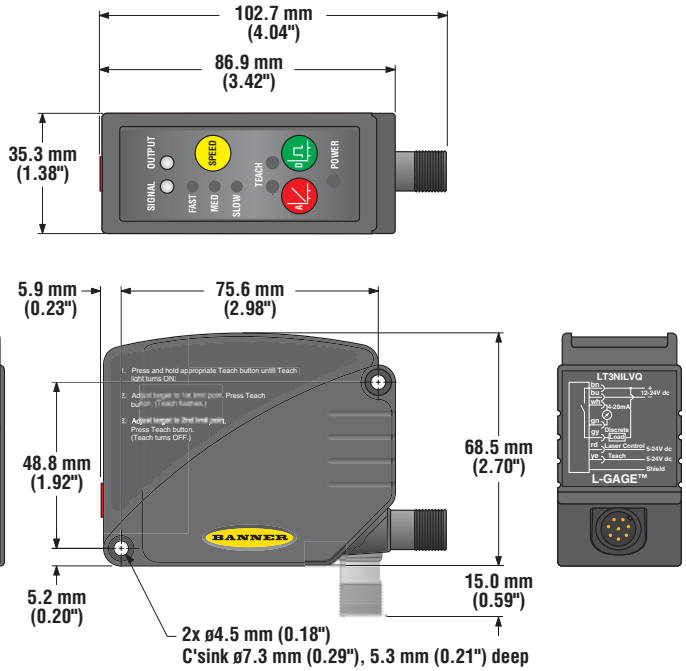
† Data sheets may be downloaded at www.bannerengineering.com.

LT3 Series Dimensions

Cabled Models



Swivel Quick-Disconnect Models



Mounting Hardware:
M4 x 0.7 x 40 socket-head cap screw
M4 x 0.7 hex nut with captured toothed lock washer
M3 short arm hex key

LT3 Series Specifications

Sensing Beam	**Typical beam dia**: 6 mm @ 3 m **Typical laser lifetime**: 75,000 hours **Diffuse**: 658 nm visible red IEC and CDRH Class 2 laser; 0.5 mW max. radiant output power. **Retroreflective Mode**: 658 nm visible red IEC and CDRH Class 1 laser, 0.15 mW max. radiant output power.
Sensing Range	**Diffuse Mode:** **90% White card:** 0.3 to 5 m; **18% Gray card:** 0.3 to 3 m; **6% Black card:** 0.3 to 2 m; **Retroreflective Mode:** 0.5 to 50 m (using supplied target)
Supply Voltage	12 to 24V dc (10% maximum ripple); 108 mA max. @24V dc or [2600/V dc] mA
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Delay at Power-up	1 second; outputs do not conduct during this time
Output Rating	**Discrete (switched) output:** 100 mA maximum **Off-state leakage current:** < 5µA **Output saturation NPN:** < 200 mV @ 10 mA and < 600 mV @100 mA **Output saturation PNP:** < 1.2V at 10 mA; < 1.6V at 100 mA **Analog voltage output:** 2.5 kΩ minimum load impedance **Analog current output:** 1kΩ max. @24V; max. load resistance = [Vcc-4.5/0.02 Ω]
Output Configuration	**Discrete (switched)**: SPST solid-state switch; choose NPN (current sinking) or PNP (current sourcing) models **Analog output:** 0 to 10V dc or 4 to 20 mA
Output Protection	Protected against short circuit conditions

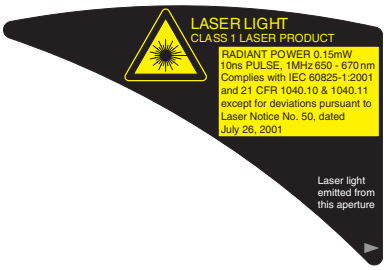
LT3 Series Specifications (cont'd)

Output Response Time	**Discrete output** **Fast:** 1 ms ON and OFF **Medium:** 10 ms ON and OFF **Slow:** 100 ms ON and OFF **Diffuse Analog Voltage output (-3 dB)** **Fast:** 450 Hz (1 ms average/1 ms update rate) **Medium:** 45 Hz (10 ms average/2 ms update rate) **Slow:** 4.5 Hz (100 ms average/4 ms update rate) **Retroreflective Analog Voltage output (-3 dB)** **Fast:** 114 Hz (6 ms average/ 1 ms update rate) **Medium:** 10 Hz (48 ms average/ 1 ms update rate) **Slow:** 2.5 Hz (192 ms average/ 1 ms update rate)
Resolution/Repeatability	See graph on page 40.
Color Sensitivity (typical)	**Diffuse models:** 90% white to 18% gray: <10 mm; 90% white to 6% black: < 20 mm. See graph on page 40.
Linearity	**Retroreflective models:** ± 60 mm from 0.5 to 50 m (0.12% of full scale) (Specified @24V dc, 22° C using supplied BRT-TVHG-8X20P retroreflector) **Diffuse models:** ± 30 mm from 0.3 to 1.5 m; ± 20 mm from 1.5 to 5 m. (Specified @24V dc, 22° C using a 90% reflectance white card)
Discrete Output Hysteresis	**Diffuse Mode** **Fast:** 10 mm **Medium:** 5 mm **Slow:** 3 mm **Retroreflective Mode** **Fast:** 20 mm **Medium:** 10 mm **Slow:** 6 mm
Temperature Effect	**Diffuse Mode:** < 2 mm / °C **Retroreflective Mode:** < 3 mm/°C
Minimum Window Size	**Diffuse Mode:** 20 mm **Retroreflective mode:** 40 mm
Remote TEACH Input	18 kΩ minimum (65 kΩ at 5V dc)
Remote TEACH	**To teach:** Connect yellow wire to +5 to 24V dc **To disable:** Connect yellow wire to 0 to +2V dc (or open connection)
Adjustments	**Response speed:** Push button toggles between fast, medium and slow (see Output Response Time) **Window limits (analog or discrete):** TEACH-mode programming of near and far window limits. Limits may also be taught remotely via TEACH input. **Analog output slope:** The first limit taught is assigned to minimum output current or voltage (4 mA or 0V dc)
Laser Control	Connect red wire to +5 to 24V dc to enable laser beam; connect to 0 to +1.8V dc (or open connection) to disable; 100 millisecond delay upon enable, when sensor is powered.
Indicators	**Green Power ON LED:** Indicates when power is ON, overloaded output and laser status **Yellow Output LED:** Indicates when discrete load output is conducting **Red Signal LED:** Indicates target is within sensing range and the condition of the received light signal **Yellow Speed LED:** Indicates the response speed setting **Red/Yellow TEACH LEDs:** In programming mode; indicate active output(s)
Construction	**Housing:** ABS/polycarbonate blend **Window**: Acrylic **Quick-disconnect:** ABS/polycarbonate blend
Environmental Rating	IP67, NEMA 6
Connections	2 m (6.5') or 9 m (30') shielded 7-conductor (with drain) PVC-jacketed attached cable or 8-pin Euro-style quick-disconnect
Operating Conditions	**Temperature**: 0° to +50°C (+32° to +122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	• For best accuracy, allow 30-minute warm-up before programming or operating • Retroreflective performance specifications are based on use with supplied BRT-TVHG-8X10P high grade target. Results may vary with other retroreflective target materials.
Certifications	Contact factory for more information.

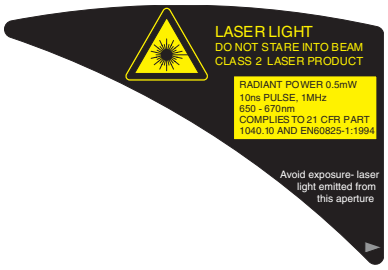
LT3 Series Model Selection

Laser Classes

Class 1 Labels

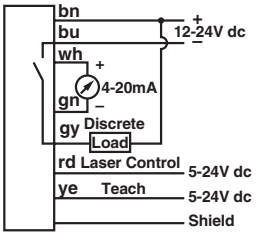


Class 2 Labels

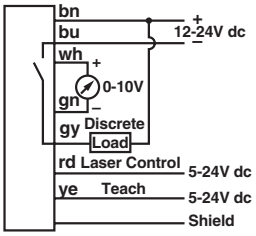


Hookups for LT3 Series with Analog and Discrete Outputs

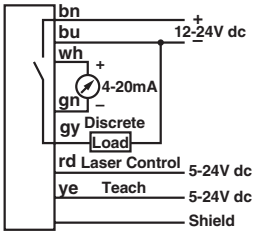
Analog Current and NPN



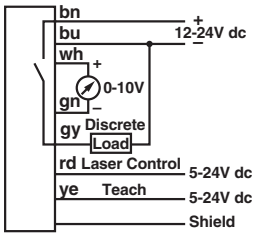
Analog Voltage and NPN



Analog Current and PNP



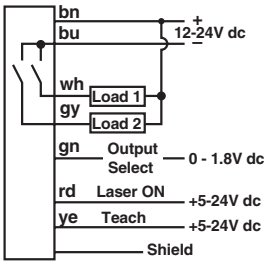
Analog Voltage and PNP



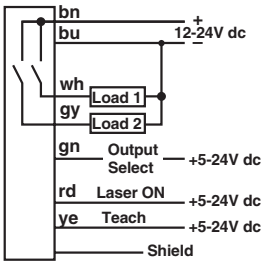
NOTE: Hookups are the same for either integral or QD cable.

Hookups for LT3 Series with Two Discrete Outputs

NPN Hookup



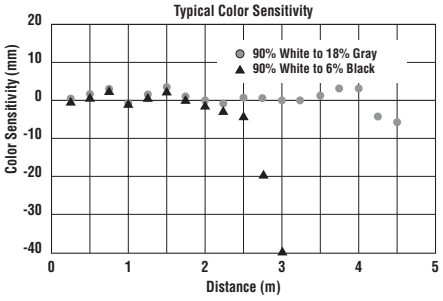
PNP Hookup



NOTE: Hookups are the same for either integral or QD cable.

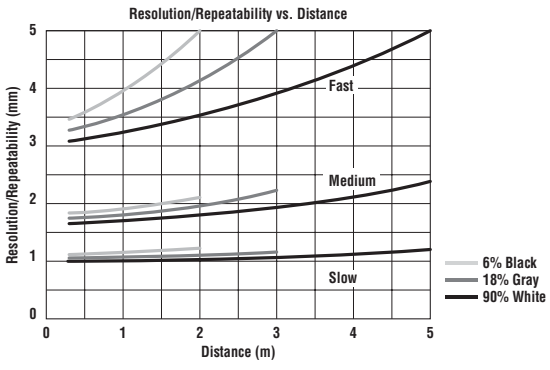
LT3 Series Color Sensitivity

Diffuse Mode

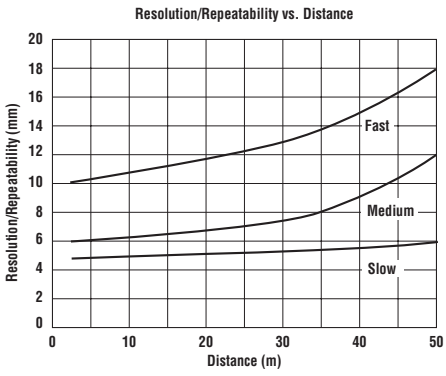


LT3 Resolution/Repeatability

Diffuse Mode

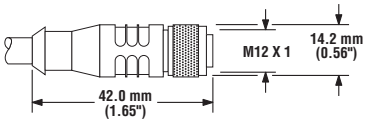
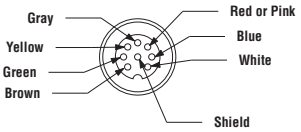


Retroreflective Mode



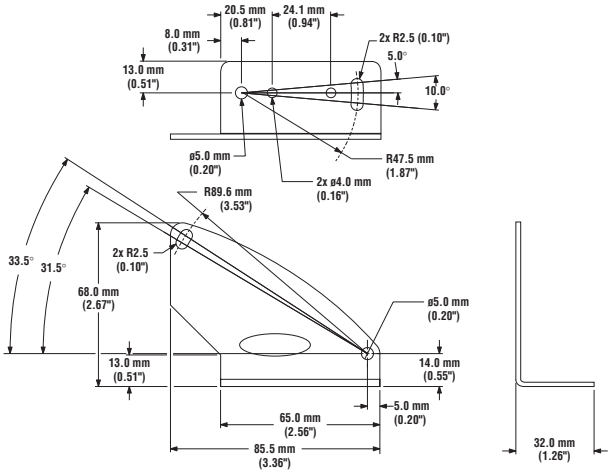
Euro-Style Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40° to +90°C (-40° to +194°F)
Voltage Rating: 250V ac/300V dc

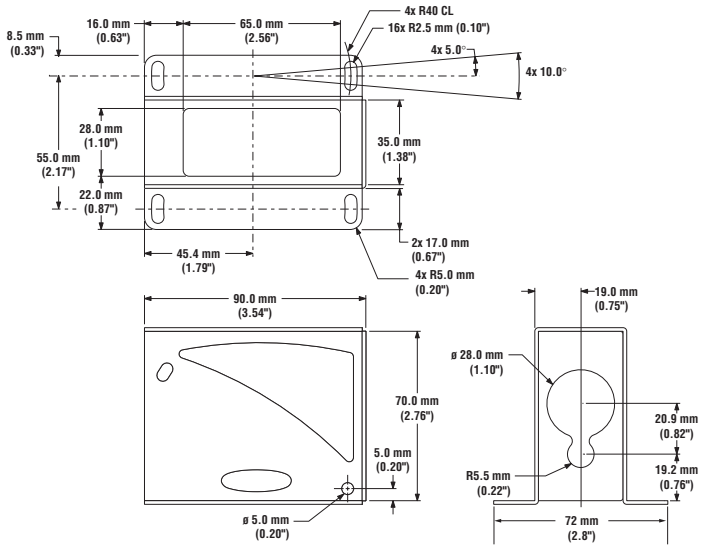
Style	Model	Length	Dimensions	Pin-out (female view)
8-Pin Euro Straight	**MQDC-806** **MQDC-815** **MQDC-830**	2 m (6.5') 5 m (15') 9 m (30')		

Mounting Brackets

SMBLT31
- Right-angle bracket
- 300 series stainless steel



SMBLT32
- Full bracket
- 304 series stainless steel
- Mounting hardware included



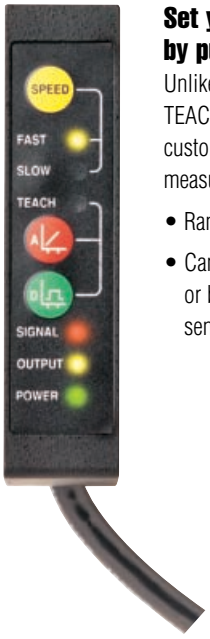
LG Series- short-range precision laser measurement.

Extremely compact, self-contained design.
The Banner LG Series replaces large, two-piece laser gauging sensors with a completely self-contained, compact housing measuring only 55 mm x 82 mm x 20 mm.

- One-piece sensor conserves production space
- Easier to wire, decreases setup time
- Provides a highly accurate solution at a much lower cost
- Does not contact parts it measures, so can be used with moving processes, hot parts and sticky parts

Ultra-precise & flexible, with analog & discrete outputs.
Advanced digital signal processing algorithms make the LG Series Class 2 modulated visible laser gauging sensor a powerhouse of performance for a wide range of measurement applications.

- Features an outstanding maximum resolution of 3 µm (0.000l") for flat white targets
- Ultra-narrow beam resolves precision distance, height or thickness measurement and gauging applications
- Lets you pick the exact range you need with the push of a button
- Discrete (switched) and analog outputs in the same unit, each independently programmable



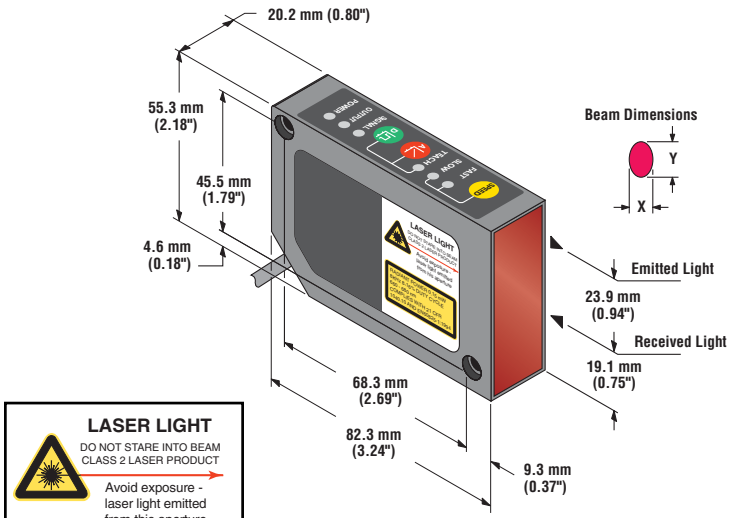
Set your own custom-sized sensing windows by pushing a button.
Unlike older, inflexible, fixed-range technology, Banner's TEACH-mode programming allows you set your own custom-sized sensing windows anywhere within the measuring range, using just one push button.

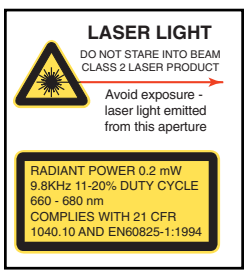
- Ranges include: 45 mm to 60 mm or 75 mm to 125 mm
- Can be programmed for analog output, discrete output or both simultaneously with independently controlled sensing window limits

LG Series Models							
Models	**Sensing Distance**	**Beam Size**	**Cable***	**Supply Voltage**	**Discrete Output**	**Analog Output**	**Data Sheet†**
LG5A65PU	45 to 60 mm (1.77 to 2.36")	At 53 mm: 0.4 mm x 0.6 mm (0.016" x 0.024") Focus 70 mm (2.8")	8-wire, 2 m (6.5') cable	12-30V dc	PNP	0-10V dc	59071
LG5A65PUQ			8-pin Euro-style QD				
LG5A65PI			8-wire, 2 m (6.5') cable			4-20 mA	59786
LG5A65PIQ			8-pin Euro-style QD				
LG5A65NU			8-wire, 2 m (6.5') cable		NPN	0-10V dc	59071
LG5A65NUQ			8-pin Euro-style QD				
LG5A65NI			8-wire, 2 m (6.5') cable			4-20 mA	59786
LG5A65NIQ			8-pin Euro-style QD				
LG5B65PU	45 to 60 mm (1.77 to 2.36")	At 53 mm: 0.1 mm (0.004") Focus 53 mm (2.1")	8-wire, 2 m (6.5') cable	12-30V dc	PNP	0-10V dc	59071
LG5B65PUQ			8-pin Euro-style QD				
LG5B65PI			8-wire, 2 m (6.5') cable			4-20 mA	59786
LG5B65PIQ			8-pin Euro-style QD				
LG5B65NU			8-wire, 2 m (6.5') cable		NPN	0-10V dc	59071
LG5B65NUQ			8-pin Euro-style QD				
LG5B65NI			8-wire, 2 m (6.5') cable			4-20 mA	59786
LG5B65NIQ			8-pin Euro-style QD				
LG10A65PU	75 to 125 mm (2.95 to 4.92")	At 125 mm: 0.6 mm x 0.8 mm (0.024" x 0.031") Focus 180 mm (7.1")	8-wire, 2 m (6.5') cable	12-30V dc	PNP	0-10V dc	59071
LG10A65PUQ			8-pin Euro-style QD				
LG10A65PI			8-wire, 2 m (6.5') cable			4-20 mA	59786
LG10A65PIQ			8-pin Euro-style QD				
LG10A65NU			8-wire, 2 m (6.5') cable		NPN	0-10V dc	59071
LG10A65NUQ			8-pin Euro-style QD				
LG10A65NI			8-wire, 2 m (6.5') cable			4-20 mA	59786
LG10A65NIQ			8-pin Euro-style QD				

* 2 m cables are standard. 9 m (30') cables are available by adding suffix "W/30" to the model number of any cabled sensor (e.g., LG10A65U w/30). A model with a QD connector requires a mating cable. See page 46 for more information.
† Data sheets may be downloaded at www.bannerengineering.com.

LG Series Dimensions





Beam Dimensions (typical)			
Focal Point†	**Distance**	**Beam Width (X)**	**Beam Height (Y)**
LG5 Series			
53 mm (2.1")	45 mm	0.3 mm	0.5 mm
	53 mm	0.1 mm	0.1 mm
	60 mm	0.3 mm	0.5 mm
70 mm (2.8")	45 mm	0.6 mm	0.9 mm
	53 mm	0.4 mm	0.6 mm
	60 mm	0.3 mm	0.4 mm
LG10 Series			
180 mm (7.1")	75 mm	1.1 mm	1.5 mm
	100 mm	0.8 mm	1.1 mm
	125 mm	0.6 mm	0.8 mm

† The Focal Point is the distance measured from the lens (front of sensor) at which the diameter of the laser image is smallest.

LG Series Model Selection

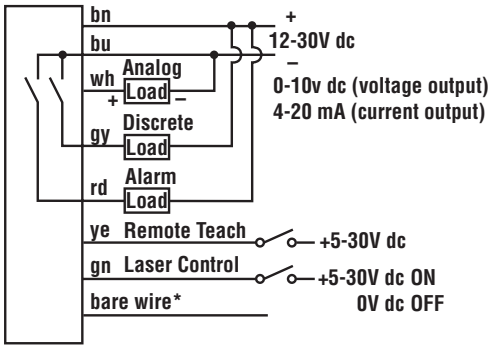
LG Series Specifications

Sensing Beam	670 nm visible red IEC and CDRH Class 2 laser; 0.25 mW max. radiant output power
Supply Voltage	12 to 30V dc (10% maximum ripple); 50 mA max @ 24V dc (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient overvoltages
Delay at Power-up	1.25 second
Output Configuration	**Discrete (switched) & alarm outputs:** SPST solid-state switch; choose NPN (current sinking) or PNP (current sourcing) models **Analog output:** 4 to 20 mA or 20 to 4 mA (current sourcing), 0 to 10V dc or 10 to 0V dc (voltage sourcing)
Output Ratings	**Discrete (switched) and Alarm outputs:** 100 mA maximum **OFF-state leakage current:** less than 5 microamps **Output saturation voltage** **PNP outputs:** less than 1.2 volts at 10 mA and less than 1.6 volts at 100 mA **NPN outputs:** less than 200 millivolts at 10 mA and less than 600 millivolts at 100 mA **Analog Current output:** 1 kΩ max @ 24V dc, max load resistance = [(Vcc - 4.5)/0.02]Ω (current sourcing) **Analog Voltage output:** 2.5 kΩ minimum load impedance (voltage sourcing)
Output Protection	Discrete and alarm outputs are protected against continuous overload and short circuit
Output Response Time	**Discrete Outputs (ON and OFF)** **Fast:** 2.0 milliseconds **Medium:** 10 milliseconds **Slow:** 100 milliseconds **Analog Output (-3dB)** **Fast:** 450 Hz (1 millisecond average with 1 millisecond update rate) **Medium:** 45 Hz (10 millisecond average with 2 millisecond update rate) **Slow:** 4.5 Hz (100 millisecond average with 5 millisecond update rate)
Analog Resolution and Repeatability of Discrete Trip Point*	**LG5:** **Fast:** < 40 µm @ 50 mm; **Medium:** < 12 µm @ 50 mm; **Slow:** < 3 µm @ 50 mm **LG10:** **Fast:** < 150 µm @ 100 mm; **Medium:** < 50 µm @ 100 mm; **Slow:** < 10 µm @ 100 mm
Analog Linearity* *Resolution and linearity specified @ 24V dc, 22° C, using a white ceramic test surface (see Application Notes)	**LG5:** +/- 60 µm (+/- 0.002") over 45 to 60 mm sensing window; +/- 10 µm (+/- 0.0003") over 49 to 51 mm sensing window **LG10:** +/- 200 µm (+/- 0.008") over 75 to 125 mm sensing window; +/- 20 µm (+/- 0.0008") over 95 to 100 mm sensing window
Minimum Window Size (Analog or Discrete)	**LG5:** 1.5 mm (0.06") **LG10:** 5 mm (0.2")
Hysteresis (Discrete Output)	**LG5:** < 0.2 mm (0.008") **LG10:** < 1.0 mm (0.04")
Color Sensitivity (typical)	**LG5:** < 75 µm (0.003") for white to dark grey ceramic target **LG10:** < 100 µm (0.004") for white to dark grey ceramic target
Temperature Effect	**LG5:** +/- 7 µm/°C **LG10:** +/- 25 µm/°C
Remote TEACH and Laser Control Input Impedance	18 kΩ minimum (65 kΩ minimum at 5V dc)
Laser Control	**To enable laser:** Connect green wire to +5 to 30V dc **To disable laser:** Connect green wire to 0 to +2V dc (or open connection) 250 millisecond delay upon enable/disable
Remote TEACH	**To teach:** Connect yellow wire to +5 to 30V dc **To disable:** Connect yellow wire to 0 to +2V dc (or open connection)
Adjustments	Response speed: Push button toggles between Slow, Medium, and Fast (see Output Response Time) **Window limits (analog or discrete):** TEACH-mode programming of near and far window limits. Limits may also be taught remotely **Analog output slope:** The first limit taught is assigned to the minimum analog output (0V dc or 4 mA).
Indicators	**Green Power ON LED:** Indicates when power is ON, overloaded output and laser status. **Yellow Output LED:** Indicates when discrete load output is conducting. **Red Signal LED:** Indicates when target is within sensing range and the condition of the received light signal. **Tri-color Red/Green/Yellow TEACH LED:** Indicates sensor is ready for programming each limit (indicates red for analog output, green for discrete, and yellow for simultaneous analog and discrete.) **Yellow Fast/Slow LEDs:** Combination of 2 lights ON or OFF indicates 1 of 3 response speeds

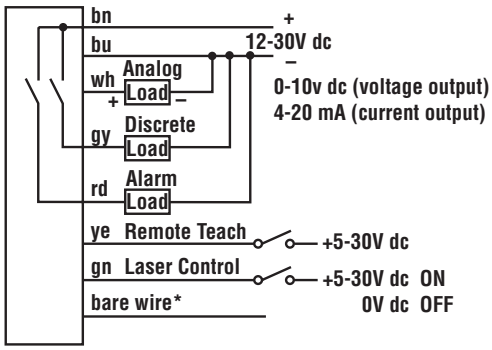
LG Series Specifications (cont'd)	
Construction	**Housing:** Zinc alloy die-cast, plated and painted finish **Cover plate:** aluminum with painted finish **Lens:** acrylic
Environmental Rating	IP67, NEMA 6
Connections	2 m (6.5') or 9 m (30') 7-conductor shielded PVC-jacketed attached cable, or 150 mm (6") 8-pin Euro-style pigtail quick-disconnect. Mating QD cables are purchased separately. See page 46.
Operating Conditions	**Temperature:** -10° to +50° C (+14° to 122° F) **Maximum relative humidity:** 90% at 50° C, non-condensing
Vibration and Mechanical Shock	**Vibration:** 60 Hz, 30 minutes, 3 axes **Shock:** 30G for 11 milliseconds, half sine wave, 3 axes
Application Notes	For comparison, a white ceramic test surface has approximately 91% of the reflectivity of a white Kodak test card with a matte finish. A dark gray ceramic test surface has approximately 11% of the reflectivity of a white Kodak test card with a matte finish. (Allow 15-minute warm-up for maximum linearity.)
Certifications	CE

LG Series Hookups

NPN Hookup



PNP Hookup

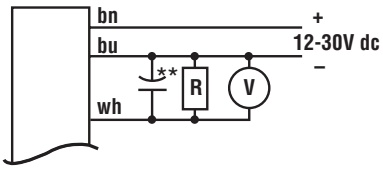


NOTES: Hookups are the same for either integral or QD cable

*The bare shield wire is connected internally to the sensor housing and should be connected as follows:

1) If the sensor housing is mounted so that it is in continuity with both the machine frame and earth ground, connect the bare wire (also) to earth ground.
2) If the sensor housing is mounted so that it is insulated from the machine frame, connect the bare wire to -V dc (together with the blue wire).
3) If the sensor is mounted so that it is in continuity with the machine frame, but not with earth ground, do not connect the bare wire (i.e. cut off the bare wire).

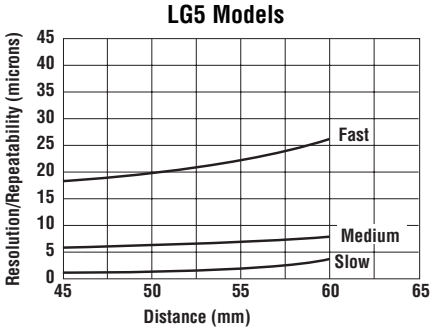
Conversion from Current to Voltage Output

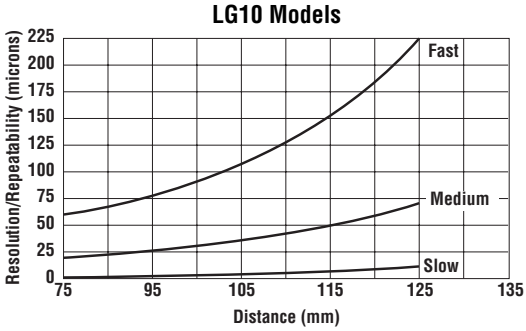


****NOTE:** For best results, install a small amount of capacitance (e.g., 0.1 µf) in parallel with the load resistor

Typical Voltage Response	
Value of R	**Output Voltage**
250Ω	1 to 5V
500Ω	2 to 10V

LG Series Resolution/Repeatability (with respect to sensor speed setting; typical, using a white ceramic target

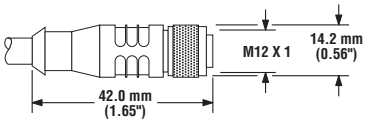
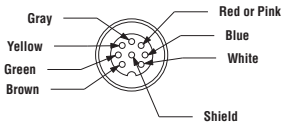




Accessories

Euro-Style Quick-Disconnect Cables

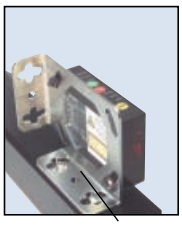
Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40° to +90°C (-40° to +194°F)
Voltage Rating: 250V ac/300V dc

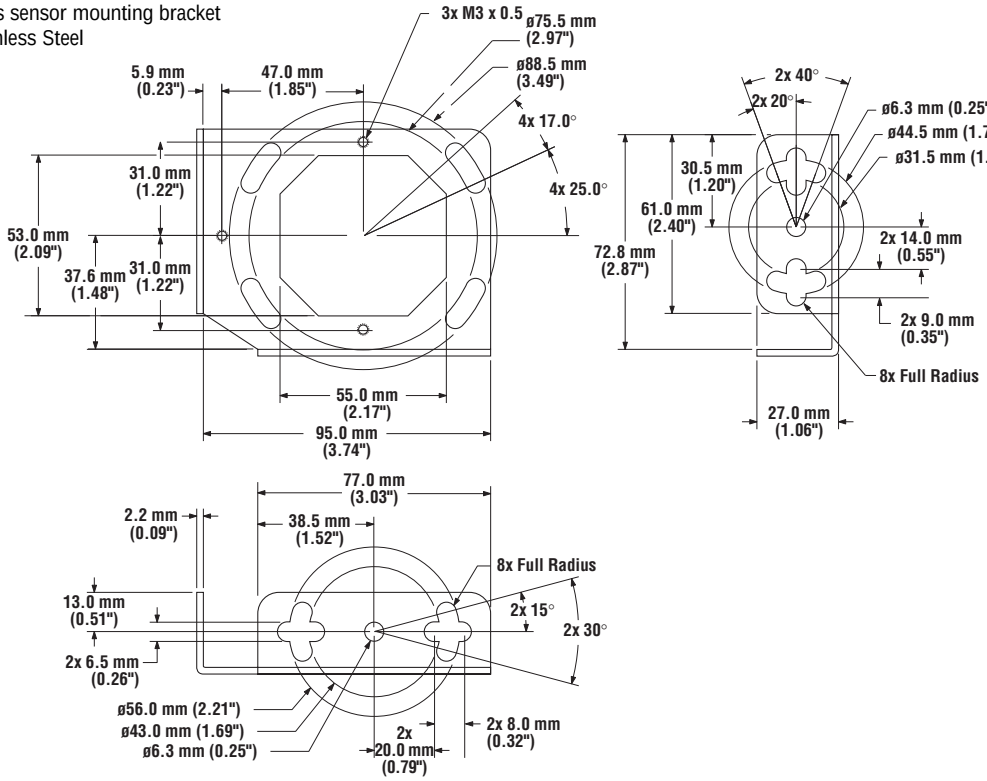
Style	Model	Length	Dimensions	Pin-out (female view)
8-Pin Euro Straight	**MQDC-806** **MQDC-815** **MQDC-830**	2 m (6.5') 5 m (15') 9 m (30')		

LG Series Mounting Brackets

SMBLG

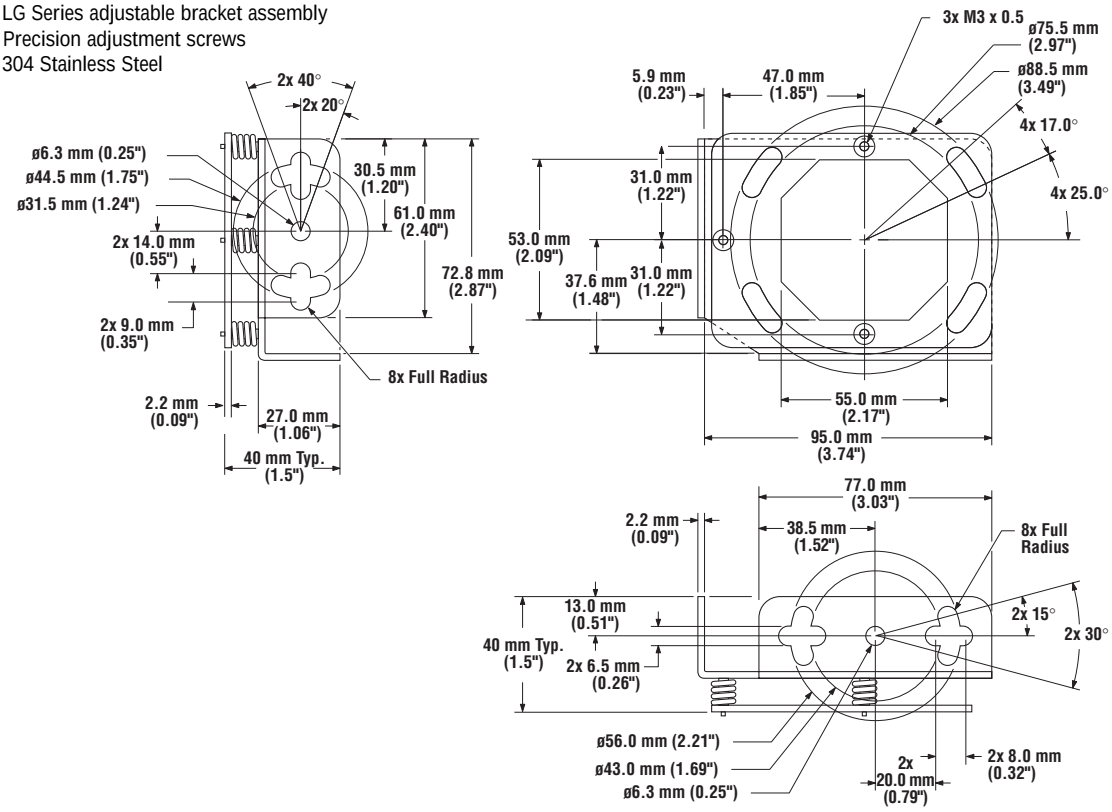
- LG Series sensor mounting bracket
- 304 Stainless Steel





SMBLGA

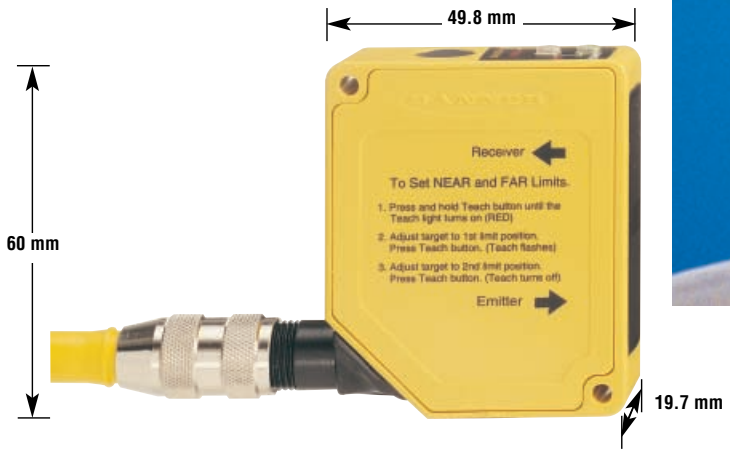
- LG Series adjustable bracket assembly
- Precision adjustment screws
- 304 Stainless Steel



Q50 Series- low cost LED-based distance measurement.

A low-cost alternative to laser measurement sensors.
The compact, self-contained L-GAGE Q50 triangulation sensor combines laser-like performance with LED safety and economy. The Q50 features analog outputs with programmable sensing window limits, and a unique tightly collimated emitter that enables it to operate in tight spaces or on small targets. The Q50 is an appealing laser alternative for many applications, including dry-bulk level measurement, package filling, roll-diameter measurement, loop control and dimensional measurement.

Patented scalable analog output.
- Automatically scale the analog output over the width of the programmed sensing window
- Streamlines setup and maximizes resolution in electrically noisy environments
- 4-20 mA (current sourcing) or 0-10V (voltage sourcing) output configurations
- Discrete output versions available



The compact size of the Q50 Series offers added application flexibility.

Reliable sensing for varied targets.
- 50 mm–300 mm range visible red beam models
- 50 mm–400 mm range infrared beam models
- Sensor linearity <1% of full scale

Programmable features.
- TEACH-mode programming
- No potentiometer adjustments
- Analog output slope can be positive or negative
- Selectable (4 milliseconds to 64 milliseconds) output response speed
- Remote location programming for maximum security and convenience

Q50 Series Discrete Output Models

Models	Range	Cable*	Supply Voltage	Beam	Output	Response Time	Data Sheet†
Q50AVN	50 to 150 mm (2.0" to 5.9")	5-wire, 2 m (6.5') cable	12 to 30V dc	Visible Red LED	Complementary NPN	48 ms	67417
Q50AVNQ		5-pin Euro-style QD					
Q50AVNY		5-wire, 2 m (6.5') cable				4 ms	
Q50AVNYQ		5-pin Euro-style QD					
Q50AVP		5-wire, 2 m (6.5') cable			Complementary PNP	48 ms	
Q50AVPQ		5-pin Euro-style QD					
Q50AVPY		5-wire, 2 m (6.5') cable				4 ms	
Q50AVPYQ		5-pin Euro-style QD					
Q50AN	50 to 200 mm (2.0" to 7.9")	5-wire, 2 m (6.5') cable	12 to 30V dc	Infrared LED	Complementary NPN	48 ms	67417
Q50ANQ		5-pin Euro-style QD					
Q50ANY		5-wire, 2 m (6.5') cable				4 ms	
Q50ANYQ		5-pin Euro-style QD					
Q50AP		5-wire, 2 m (6.5') cable			Complementary PNP	48 ms	
Q50APQ		5-pin Euro-style QD					
Q50APY		5-wire, 2 m (6.5') cable				4 ms	
Q50APYQ		5-pin Euro-style QD					
Q50BVN	100 to 300 mm (3.9" to 11.8")	5-wire, 2 m (6.5') cable	12 to 30V dc	Visible Red LED	Complementary NPN	48 ms	65741
Q50BVNQ		5-pin Euro-style QD					
Q50BVNY		5-wire, 2 m (6.5') cable				4 ms	
Q50BVNYQ		5-pin Euro-style QD					
Q50BVP		5-wire, 2 m (6.5') cable			Complementary PNP	48 ms	
Q50BVPQ		5-pin Euro-style QD					
Q50BVPY		5-wire, 2 m (6.5') cable				4 ms	
Q50BVPYQ		5-pin Euro-style QD					
Q50BN	100 to 400 mm (3.9" to 15.7")	5-wire, 2 m (6.5') cable	12 to 30V dc	Infrared LED	Complementary NPN	48 ms	65741
Q50BNQ		5-pin Euro-style QD					
Q50BNY		5-wire, 2 m (6.5') cable				4 ms	
Q50BNYQ		5-pin Euro-style QD					
Q50BP		5-wire, 2 m (6.5') cable			Complementary PNP	48 ms	
Q50BPQ		5-pin Euro-style QD					
Q50BPY		5-wire, 2 m (6.5') cable				4 ms	
Q50BPYQ		5-pin Euro-style QD					

Q50 Series Analog Output Models

Models	Range	Cable*	Supply Voltage	Beam	Output	Response Time	Data Sheet†
Q50AVI	50 to 150 mm (2.0" to 5.9")	5-wire, 2 m (6.5') cable	15 to 30V dc	Visible Red LED	4 to 20 mA	4 ms or 64 ms selectable	67416
Q50AVIQ		5-pin Euro-style QD					
Q50AVU		5-wire, 2 m (6.5') cable			0 to 10V		
Q50AVUQ		5-pin Euro-style QD					
Q50AI	50 to 200 mm (2.0" to 7.9")	5-wire, 2 m (6.5') cable	15 to 30V dc	Infrared LED	4 to 20 mA	4 ms or 64 ms selectable	67416
Q50AIQ		5-pin Euro-style QD					
Q50AU		5-wire, 2 m (6.5') cable			0 to 10V		
Q50AUQ		5-pin Euro-style QD					
Q50BVI	100 to 300 mm (3.9" to 11.8")	5-wire, 2 m (6.5') cable	15 to 30V dc	Visible Red LED	4 to 20 mA	4 ms or 64 ms selectable	64323
Q50BVIQ		5-pin Euro-style QD					
Q50BVU		5-wire, 2 m (6.5') cable			0 to 10V		
Q50BVUQ		5-pin Euro-style QD					
Q50BI	100 to 400 mm (3.9" to 15.7")	5-wire, 2 m (6.5') cable	15 to 30V dc	Infrared LED	4 to 20 mA	4 ms or 64 ms selectable	64323
Q50BIQ		5-pin Euro-style QD					
Q50BU		5-wire, 2 m (6.5') cable			0 to 10V		
Q50BUQ		5-pin Euro-style QD					

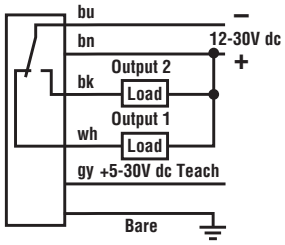
* 9 m (30') cables are available by adding suffix "W/30" to the model number of any cabled sensor (e.g., **Q50AVN W/30**).
A model with a QD connector requires a mating cable. See page 55 for more information.
† Data sheets may be downloaded at www.bannerengineering.com.

Q50 Series Discrete Output Specifications

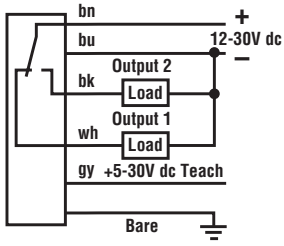
Sensing Beam	**Wave length:** **Q50..V:** 685 nm (typical) **Q50..:** 880 nm (typical) **Beam Size:** **Q50..V:** 20 mm dia. (max.) **Q50..:** 20 mm dia. (max.)
Sensing Range	**Q50AV:** 50 to 150 mm (2.0" to 5.9") **Q50A:** 50 to 200 mm (2.0" to 7.9") **Q50BV:** 100 to 300 mm (3.9" to 11.8") **Q50B:** 100 to 400 mm (3.9" to 15.7")
Supply Voltage	12 to 30V dc (10% maximum ripple); 70 mA max. (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient overvoltages
Delay at Power-up	2 seconds
Output Rating	Complementary Discrete Output 150 mA maximum, per output **OFF-state leakage current:** Less than 10 micro-amps **ON-state saturation voltage:** Less than 1V @ 10 mA and less than 1.5V @ 100 mA
Output Configuration	SPDT (complementary) solid-state dc switch. Choose NPN (current sinking) or PNP (current sourcing) outputs.
Output Protection	Protected against false pulse on power-up and continuous overload or short circuit of outputs.
Output Response Time	2-second delay on power-up: **Fast:** 4 ms ON, 4 ms OFF **Slow:** 48 ms On, 48 ms OFF
Output Hysteresis	See Figure 1 and 3 (page 51)
Sensing Repeatability	**Slow Response (Q50..):** 0.5% of sensing distance **Fast Response (Q50..Y):** 1.0% of sensing distance
Color Sensitivity (typical)	See Figure 2 and 4
Remote and Speed Input Impedance	15 kΩ
Temperature Effect	**Q50B.. models:** From 0° to 50°C: -0.25 mm/°C From -10° to 55°C: -0.35 mm/°C **Q50A.. models:** From 0° to 50°C: 0.08 mm/°C From -10° to 55°C: 0.11 mm/°C
Remote TEACH Input	**To Teach:** Connect gray wire to +5 to 30V dc **To Disable:** Connect gray wire to 0 to +2V dc (or open connection)
Adjustments	**Sensing Window Limits:** TEACH-mode programming of near and far window limits may be set using the Teach push button or remotely via the gray Teach wire.
Indicators	**Range LED Indicator (green/red)** **Green** — Target is within sensing range **Red** — Target is outside sensing range **Flashing Green** — Outputs are overloaded **OFF** — Sensor Power OFF **Teach/Output LED Indicator (yellow/red)** **Yellow** (window limits) — Target is within taught window limits **Yellow** (fixed field) — Target is closer than cutoff limit **OFF** — Target is outside taught window limits **Red** — Sensor is in TEACH mode
Ambient Light Immunity	< 10,000 LUX
Construction	**Housing:** Molded ABS/Polycarbonate **Window:** Lens: Acrylic **Hardware:** M3 hardware is included
Environmental Rating	IEC IP67, NEMA 6P
Connections	2 m or 9 m 5-conductor PVC-covered attached cable or 5-pin Euro-style quick-disconnect
Operating Conditions	**Temperature:** -10° to +55°C (+14° to +131°F) **Maximum relative humidity:** 90% at +50°C (non-condensing)
Vibration and Mechanical Shock	All models meet Mil. Std. 202F requirements. Method 201A (Vibration: 10 to 60Hz max. double amplitude 0.06", maximum acceleration 10G). Also meets IEC 947-5-2 requirements: 30G, 11 ms duration, half sine wave.
Application Notes	Allow 15-minute warm-up for maximum performance
Certifications	CE

Q50 Series Discrete Output Hookups

NPN Cabled Hookups

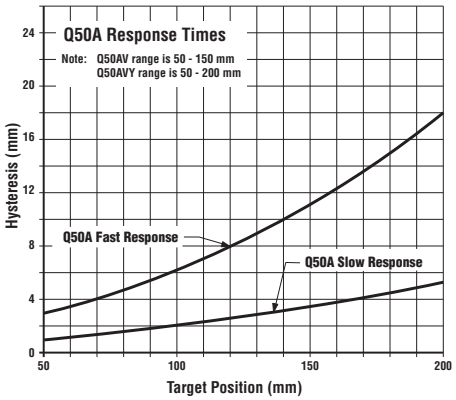


PNP Cabled Hookups



NOTE: Hookups are the same for either integral or QD cable

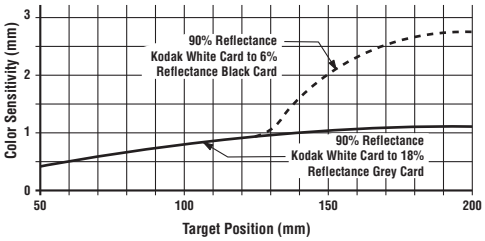
Figure 1 – Q50A Discrete Series Hysteresis



Q50A Hysteresis vs. Position

NOTES: Surface color does not affect hysteresis (6% black to 90% white reflectance surfaces).

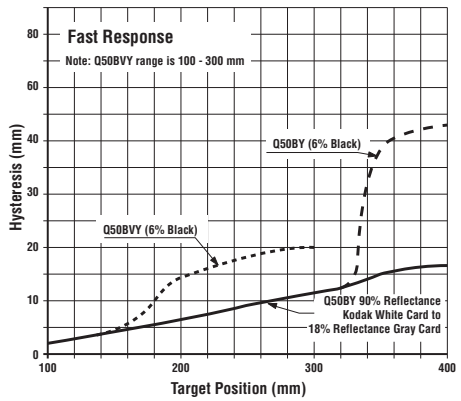
Figure 2 – Q50A Discrete Series Color Sensitivity



Q50A color sensitivity (This represents the expected change in output when the target color is changed from a 90% reflectance Kodak White Card to a 6%, 13% or 18% reflectance surface.)

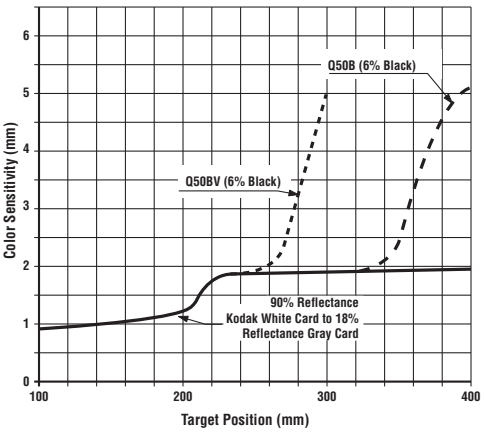
NOTES: Color sensitivity is independent of response time
Q50A..(infrared models) span is 50-200 mm
Q50AV.. (visible red models) span is 50-150 mm

Figure 3 – Q50B Discrete Series Hysteresis



Q50B Hysteresis vs. Position

Figure 4 – Q50B Discrete Series Color Sensitivity



Q50B color sensitivity (This represents the expected change in output when the target color is changed from a 90% reflectance Kodak White Card to a 6%, 13% or 18% reflectance surface.)

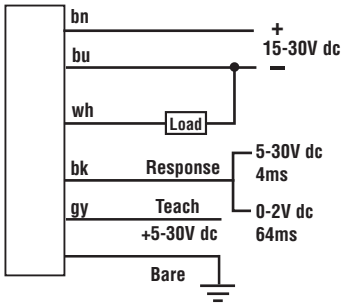
NOTES: Color sensitivity is independent of response time
Q50B..(infrared models) span is 100-400 mm
Q50BV.. (visible red models) span is 100-300 mm

Q50 Series Analog Output Specifications

Sensing Beam	**Wave length:** **Q50..V:** 685 nm (typical) **Q50..:** 880 nm (typical) **Beam Size:** **Q50..V:** 20 mm dia. (max.) **Q50..:** 20 mm dia. (max.)
Sensing Range	**Q50AV:** 50 to 150 mm (2.0" to 5.9") **Q50A:** 50 to 200 mm (2.0" to 7.9") **Q50BV:** 100 to 300 mm (3.9" to 11.8") **Q50B:** 100 to 400 mm (3.9" to 15.7")
Supply Voltage	15 to 30V dc (10% maximum ripple); 70 mA max. (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient overvoltages
Delay at Power-up	2 seconds
Output Configuration	Depending on model 4-20 mA current sourcing models: 1 kΩ max. load @ 24V dc. Max. load = [(Vcc -4.5)/0.02]Ω 0-10V voltage sourcing models: 15 mA max.
Output Protection	Protected against short circuit conditions
Output Response Time	**Analog Output** — **Average Interval** — **Update Rate** — **-3 dB Frequency Response** **Fast:** 4 ms 1 ms 112 Hz **Slow:** 64 ms 4 ms 7 Hz
Resolution	See Figure 5 and 7 for typical value **Q50B models:** **Target Distance:** 200 mm, **Slow Response:** 1 mm (max), **Fast Response:** 4 mm (max) **Q50A models:** **Target Distance:** 100 mm, **Slow Response:** 0.5 mm (max), **Fast Response:** 2 mm (max)
Linearity	**Q50B.. models:** ±3 mm **Q50A.. models:** ±1.5 mm
Color Sensitivity (typical)	See Figure 6 and 8
Temperature Effect	**Q50B.. models:** From 0° to 50°C: -0.25 mm/°C From -10° to 55°C: -0.35 mm/°C **Q50A.. models:** From 0° to 50°C: 0.08 mm/°C From -10° to 55°C: 0.11 mm/°C
Remote and Speed Input Impedance	15 kΩ
Remote Teach Input	**To Teach:** Connect gray wire to +5 to 30V dc **To Disable:** Connect gray wire to 0 to +2V dc (or open connection)
Adjustments	**Fast Speed:** Connect black wire to +5 to 30V dc **Slow Speed:** Connect black wire to 0 to +2V dc (or open connection)
Indicators	**Range LED Indicator (green/red)** **Green** — Target is within sensing range **Red** — Target is outside sensing range OFF — Sensor Power OFF **Teach/Output LED Indicator (yellow/red)** **Yellow** — Target is within taught window limits **OFF** — Target is outside taught window limits **Red** — Sensor is in TEACH mode
Ambient Light Immunity	< 10,000 LUX
Construction	**Housing:** Molded ABS/Polycarbonate **Hardware:** M3 hardware is included. **Window Lens:** Acrylic
Environmental Rating	IEC IP67, NEMA 6P
Connections	2 m or 9 m 5-conductor PVC-covered attached cable or 5-pin Euro-style quick-disconnect
Operating Conditions	**Temperature:** -10° to +55°C (+14° to +131°F) **Maximum relative humidity:** 90% at +50°C (non-condensing)
Vibration and Mechanical Shock	All models meet Mil. Std. 202F requirements. Method 201A (Vibration: 10 to 60Hz max. double amplitude 0.06", maximum acceleration 10G). Also meets IEC 947-5-2 requirements: 30G, 11 ms duration, half sine wave.
Application Notes	Allow 15-minute warm-up for maximum performance
Certifications	Contact factory for more information.

Q50 Series Analog Output Hookups

Cabled Models



Quick-Disconnect Models

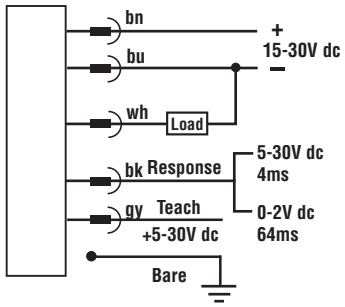
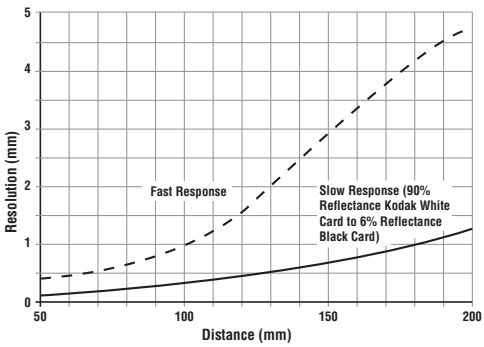


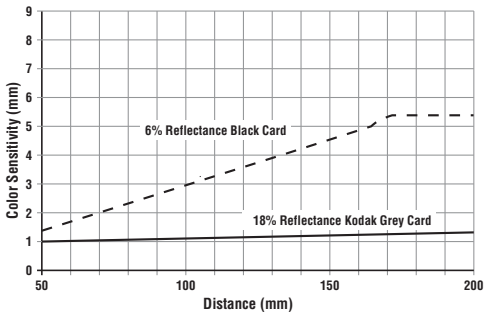
Figure 5 – Q50A Analog Series Resolution



Q50A resolution

NOTE: Resolution is independent of color (90% Kodak White Card to 6% Black)

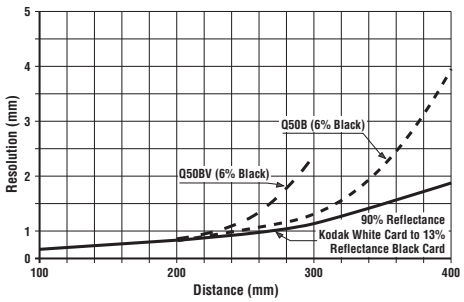
Figure 6 – Q50A Analog Series Color Sensitivity



Q50A color sensitivity (This represents the expected change in output when the target color is changed from a 90% reflectance Kodak White Card to a 6%, 13% or 18% reflectance surface.)

NOTES: Color sensitivity is independent of response time
Q50A (infrared models) span is 50-200 mm
Q50AV (visible models) span is 50-150 mm

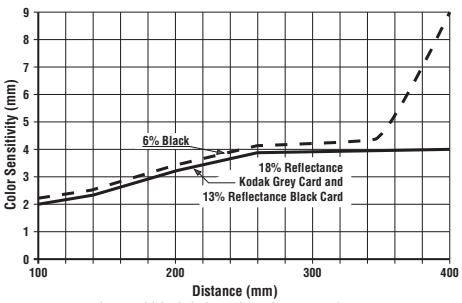
Figure 7 – Q50B Analog Series Resolution



Q50B resolution

NOTES: Slow response performance shown; with fast response, resolution is 4 times larger.

Figure 8 – Q50B Analog Series Color Sensitivity

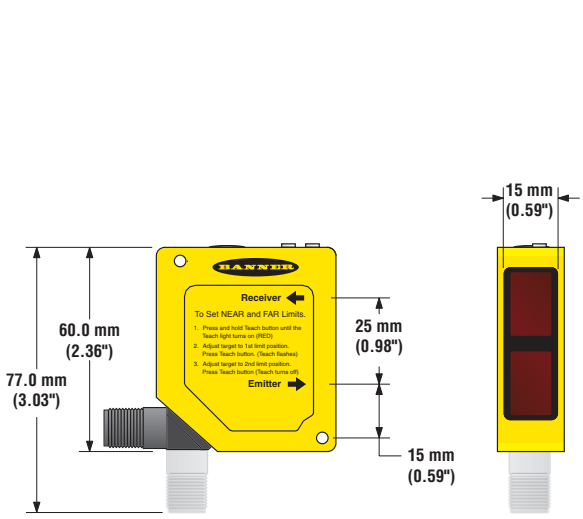


Q50B color sensitivity (This represents the expected change in output when the target color is changed from a 90% reflectance Kodak White Card to a 6%, 13% or 18% reflectance surface.)

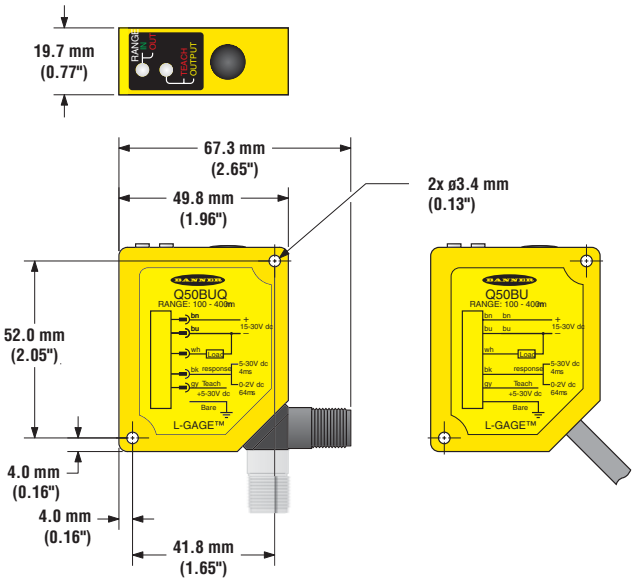
NOTES: Color sensitivity is independent of response time
Q50B (infrated models) span is 100-400 mm
Q50BV (visible red models) span is 100-300 mm

Q50 Series Dimensions

Swivel Quick-Disconnect Models

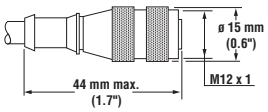
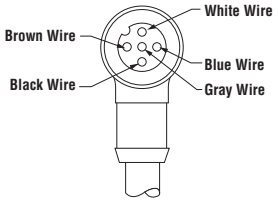
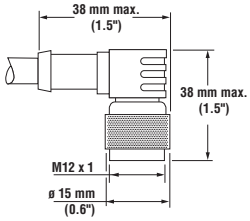


Cabled Models



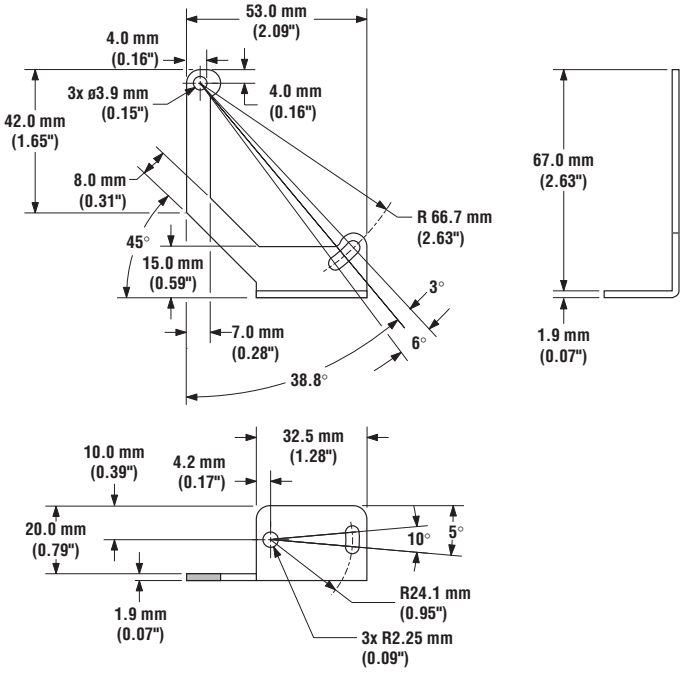
Euro-Style Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40° to +90°C (-40° to +194°F)
Voltage Rating: 250V ac/300V dc

Style	Model	Length	Dimensions	Pin-out
5-Pin Euro Straight	**MQDEC2-506** **MQDEC2-515** **MQDEC2-530**	2 m (6.5') 5 m (15') 9 m (30')		
5-Pin Euro Right-angle	**MQDEC2-506RA** **MQDEC2-515RA** **MQDEC2-530RA**	2 m (6.5') 5 m (15') 9 m (30')		

Mounting Brackets

SMBQ50
- Right-angle bracket
- 14-ga., 304 Stainless Steel



QC50 Series - true color sensor accurately detects color and intensity.

Excellent color discrimination.

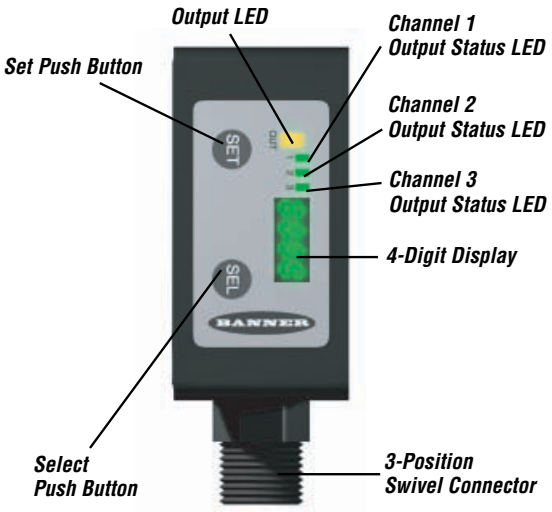
Modulated white LED light source electronically filters reflected light color to red, green, and blue components —offering most accurate color detection. Standard color mark sensing methods only detect light to dark contrast.

- Mathematically calculates reflected energy to determine precise color
- User defined set points (including tolerance)
- Reliably differentiate colors and color plus intensity
- Use for batch sorting or tint discrimination of colors within the same color range

Extraordinary versatility.

Choose gated or windowed sensing and one of 6 OFF-delay timer options applied to each channel for enhanced programmability of 1, 2, or 3 colors. Options include:

- Channel selection
- Sensing mode
- One of 10 tolerance levels
- Three separate NPN or PNP outputs — one for each color channel



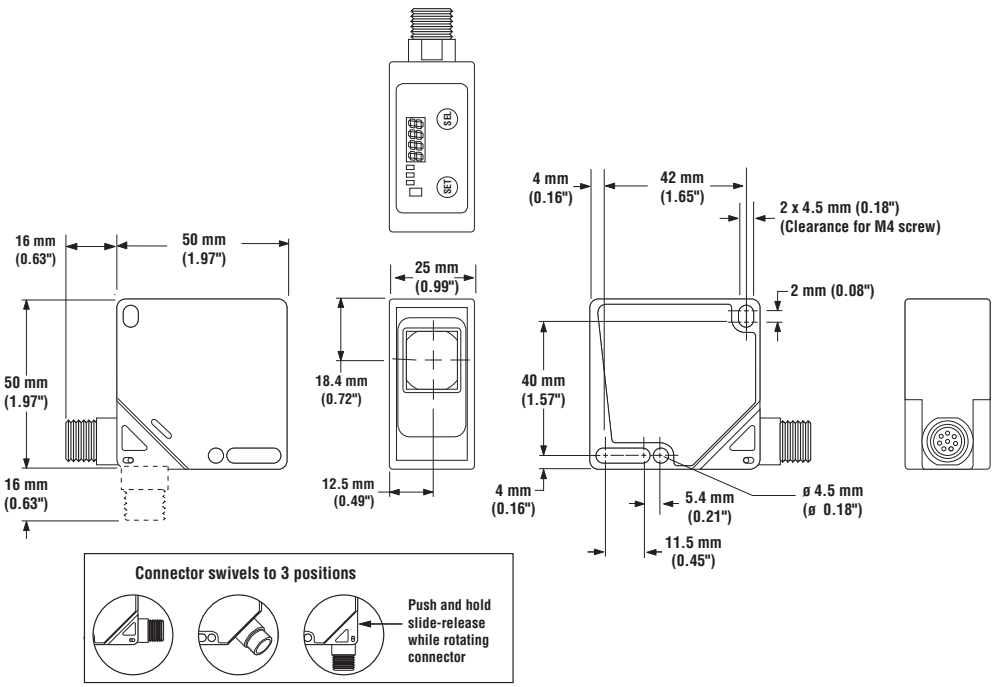
Exceptional value and functionality.

- Best sensor value in the color sensing category
- Sensing data can be stored in the sensor's non-volatile memory
- Four LEDs and a 4-digit numerical display indicate configuration and operating status
- Easy connection with 8-pin quick-disconnect with versatile 3-position swivel connector
- Compact size and completely self-contained design offer cost effective solution for numerous applications including error proofing, product verification, product match, and batch sorting in automotive, pharmaceutical, packaging, printing, textile, ceramics and other industries

QC50 Series Models					
Models	**Range**	**Cable/Connector**	**Supply Voltage**	**Output Type**	**Data Sheet†**
QC50A3N6XDWQ	20 mm (0.8") typical; varies according to sensor configuration	8-pin Euro-style (M12) swivel QD connector	10 to 30V dc	NPN, 3 channels	111523
QC50A3P6XDWQ				PNP, 3 channels	111523

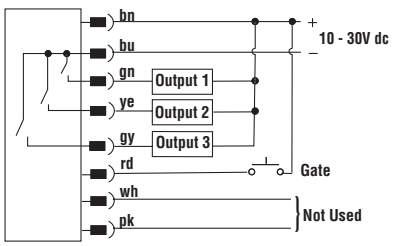
† Data sheets may be downloaded at www.bannerengineering.com.

QC50 Series Dimensions

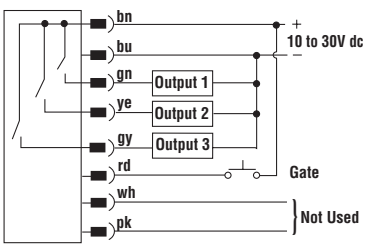


QC50 Series Hookups

NPN Hookup



PNP Hookup

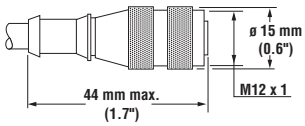
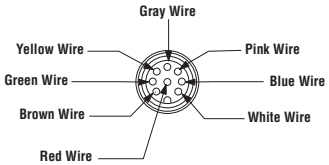


QC50 Series Model Selection

QC50 Series Specifications	
Sensing Beam	Pulsed white LED (400 to 700 nm)
Sensing Receiver	Solid-state photodiode device with R, G, B filters
Sensing Range	20 mm (0.8")
Supply Voltage	10 to 30V dc, 2 V pp max ripple 40 mA max @ 24V dc (excluding output current)
Supply Protection Circuitry	Protected against reverse polarity, over-voltage, and transient voltage
Output Configuration	3 PNP or 3 NPN outputs, depending on model 30V dc max. **Saturation voltage:** < 2V
Output Ratings	100 mA maximum load, each output
Output Protection	Protected against output short-circuit, continuous overload, transient over-voltages, and false pulse on power-up
Output Response Time	335 microseconds NOTE: 500 ms delay at power-up; outputs do not conduct during this time. **Gate ON-time:** 335 microseconds **Gate OFF-time:** 170 microseconds
Data Retention	EEPROM nonvolatile memory
Minimum Spot Diameter	4 mm (0.2")
Ambient Light Rejection	According to EN 609475-2
Adjustments	2 push buttons (Set and Select) • Color and intensity programming • Manual adjustment of color channels, sensing mode and tolerance level
Indicators	**4-Digit LCD Display:** indicates sensing mode, run status, tolerance level, output status **Yellow Output LED:** ON when any output is conducting **3 Green Channel Output Status LEDs:** ON when its corresponding output is conducting
Construction	ABS shock-resistant housing; glass window and lens
Environmental Rating	IEC IP67
Connections	8-pin Euro-style (M12) swivel quick-disconnect fitting; 2 m (6.5'), 5 m (15') or 9 m (30') quick-disconnect cable available separately. See page 59.
Operating Conditions	**Temperature:** -10° to +55°C (+14° to 131°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Shock Resistance	Approx. 50 G; 3 shocks per axis
Vibration	1.5 mm (0.06") amplitude; 10 to 55 Hz frequency; 2 hours for each X, Y, Z axis
Certifications	CE and UL/CSA approvals pending. Contact factory.

Euro-Style Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40° to +90°C (-40° to +194°F)
Voltage Rating: 250V ac/300V dc

Style	Model	Length	Dimensions	Pin-out
8-Pin Euro Straight	**MQDC2S-806** **MQDC2S-815** **MQDC2S-830**	2 m (6.5') 5 m (15') 9 m (30')		

L-GAGE®

PicoDot® Series- laser precision with sharp cutoff field of view.

Ultra-precise beam for ultra-precision sensing.

The PicoDot is a convergent or retroreflective mode laser sensor with discrete outputs for precision presence detection, inspection or counting applications.

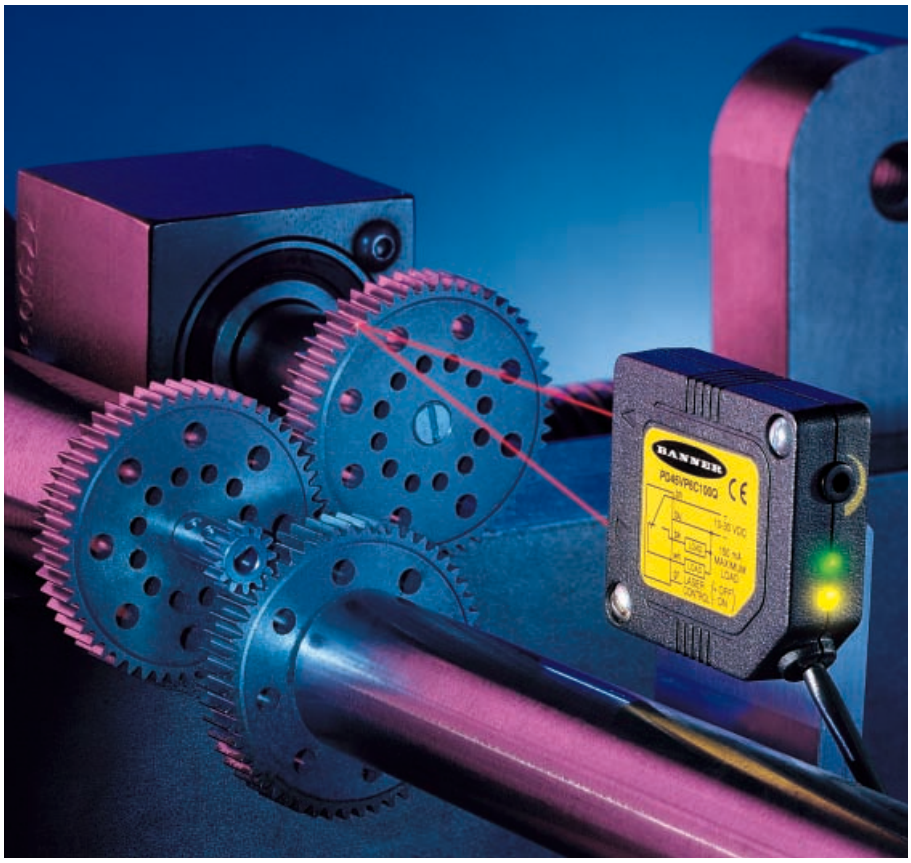
- Uses extremely focused laser beam to form a point only 0.25 mm in diameter
- Clearly differentiates narrowest of objects: edges of semiconductor wafers, connector pins and ultra-miniature parts
- Available in four convergent mode ranges or up to 10.6 m in retroreflective mode

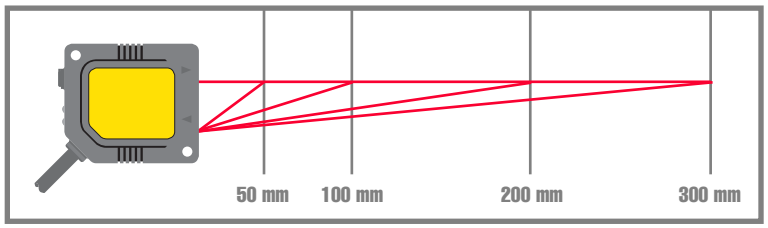
Lightning-fast response.

- Sensing response time of only 0.2 millisecond
- Operates from 10 to 30V dc with either NPN (sinking) or PNP (sourcing) output
- Ideal for use in high-speed applications such as lead or pin counting

Standard or ruggedized housings.

- Ruggedized models feature environmentally sealed housings that enable them to deliver laser power and precision to applications in harsh environments, requiring protection from dust/dirt, gases, rain, snow, sleet, hosedown, heavy splash, and occasional submersion
- Standard models perform well in most environments and their lightweight housing is ideal for robotic end effector, semiconductor wafer mapping as well as precise long-range and high-speed sensing





Focal distance of 50 mm, 100 mm, 200 mm; or 300 mm; ignores any object beyond maximum sensing distance

The Banner WORLD-BEAM® QS30LD also offers laser precision sensing but offers the convenience of user programmable TEACH setup.

For more information go to www.bannerengineering.com.

PicoDot Series Convergent Mode Models

Models	Focus	Cable*	Supply Voltage	Output Type	Housing Rating	Data Sheet†
PD45VN6C50 **PD45VN6C50Q**	50 mm (2.0") Spot Size at Focus: 0.25 mm (0.01")	2 m (6.5') 5-pin Euro QD pigtail	10-30V dc	NPN	IP54, NEMA 3	65029
PD49VN6C50 **PD49VN6C50Q**		2 m (6.5') 5-pin Euro QD pigtail		NPN	IP67, NEMA 6	67450
PD45VP6C50 **PD45VP6C50Q**		2 m (6.5') 5-pin Euro QD pigtail		PNP	IP54, NEMA 3	65029
PD49VP6C50 **PD49VP6C50Q**		2 m (6.5') 5-pin Euro QD pigtail		PNP	IP67, NEMA 6	67450
PD45VN6C100 **PD45VN6C100Q**	102 mm (4.0") Spot Size at Focus: 0.25 mm (0.01")	2 m (6.5') 5-pin Euro QD pigtail	10-30V dc	NPN	IP54, NEMA 3	46356
PD49VN6C100 **PD49VN6C100Q**		2 m (6.5') 5-pin Euro QD pigtail		NPN	IP67, NEMA 6	67450
PD45VP6C100 **PD45VP6C100Q**		2 m (6.5') 5-pin Euro QD pigtail		PNP	IP54, NEMA 3	46356
PD49VP6C100 **PD49VP6C100Q**		2 m (6.5') 5-pin Euro QD pigtail		PNP	IP67, NEMA 6	67450
PD45VN6C200 **PD45VN6C200Q**	203 mm (8.0") Spot Size at Focus: 0.25 mm (0.01")	2 m (6.5') 5-pin Euro QD pigtail	10-30V dc	NPN	IP54, NEMA 3	46356
PD49VN6C200 **PD49VN6C200Q**		2 m (6.5') 5-pin Euro QD pigtail		NPN	IP67, NEMA 6	67450
PD45VP6C200 **PD45VP6C200Q**		2 m (6.5') 5-pin Euro QD pigtail		PNP	IP54, NEMA 3	46356
PD49VP6C200 **PD49VP6C200Q**		2 m (6.5') 5-pin Euro QD pigtail		PNP	IP67, NEMA 6	67450
PD45VN6C300 **PD45VN6C300Q**	305 mm (12.0") Spot Size at Focus: 0.25 mm (0.01")	2 m (6.5') 5-pin Euro QD pigtail	10-30V dc	NPN	IP54, NEMA 3	Consult factory
PD49VN6C300 **PD49VN6C300Q**		2 m (6.5') 5-pin Euro QD pigtail		NPN	IP67, NEMA 6	
PD45VP6C300 **PD45VP6C300Q**		2 m (6.5') 5-pin Euro QD pigtail		PNP	IP54, NEMA 3	
PD49VP6C300 **PD49VP6C300Q**		2 m (6.5') 5-pin Euro QD pigtail		PNP	IP67, NEMA 6	

PicoDot Series Polarized Retroreflective Mode Models

Models	Sensing Distance**	Cable*	Supply Voltage	Output Type	Housing Rating	Data Sheet†
PD45VN6LLP **PD45VN6LLPQ**	0.2 m to 10.6 m (8" to 35')	2 m (6.5') 5-pin Euro QD pigtail	10-30V dc	NPN	IP54, NEMA 3	58607
PD49VN6LLP **PD49VN6LLPQ**		2 m (6.5') 5-pin Euro QD pigtail		NPN	IP67, NEMA 6	67450
PD45VP6LLP **PD45VP6LLPQ**		2 m (6.5') 5-pin Euro QD pigtail		PNP	IP54, NEMA 3	58607
PD49VP6LLP **PD49VP6LLPQ**		2 m (6.5') 5-pin Euro QD pigtail		PNP	IP67, NEMA 6	67450

* 9 m (30') cables are available by adding suffix "W/30" to the model number of any cabled sensor (e.g., **PD45VN6C100 W/30**). A model with a QD connector requires a mating cable. See page 64 for more information.

** Tested using a BRT-36X40BM retro target (included with each sensor). Actual range depends on the efficiency and size of the retroreflective target. Some targets have produced ranges up to 40 m (130').

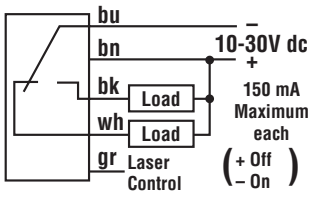
† Data sheets may be downloaded at www.bannerengineering.com.

PicoDot® Series Model Selection

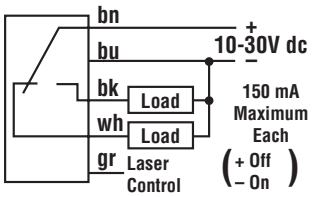
PicoDot Series Specifications	
Sensing Beam	Visible red Class 2 laser, 640-680 nm
Range	**C50 models:** 25 to 58 mm (1 to 2.5"); focus at 50 mm ± 5 mm (2.0" ± 0.2") **C100 models**: 25 to 115 mm (1 to 4.5"); focus at 102 mm ± 5 mm (4.0 ± 0.2") **C200 models:** 25 to 216 mm (1 to 8.5"); focus at 203 mm ± 5 mm (8.0 ± 0.2") **C300 models:** 25 to 317 mm (1 to 12.5"); focus at 305 mm ± 5 mm (12" ± 0.2") **LLP models:** 0.2 to 10.6 m (8" to 35'), using supplied retroreflective target
Supply Voltage	10 to 30V dc (10% maximum ripple) at less than 20 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity, over voltage, and transient voltages
Output Configuration	SPDT (complementary) solid-state switch; Choose NPN (current sinking) or PNP (current sourcing) models **Light operate:** Normally-open output conducts when the sensor sees its own modulated light **Dark operate:** Normally-closed output conducts when the sensor sees dark
Output Ratings	150 mA maximum (each output) **Off-state leakage current**: < 1 microamp at 30V dc; **On-state saturation voltage:** < 0.3V at 10 mA dc; <0.8V at 150 mA dc
Output Protection	Protected against continuous overload or short-circuit of outputs; Overload trip point ≥ 220mA
Output Response Time	0.2 milliseconds "on" and "off"; 4 consecutive pulses "on" after an "off" condition 4 consecutive pulses "off" after an "on" condition
Repeatability	50 microseconds
Adjustments	12-turn slotted brass GAIN (sensitivity) adjustment potentiometer (clutched at both ends of travel)
Extinguishing Wire	Gray wire held "low" for laser operation; "high" to turn laser off; Low ≤ 1.0V dc; High ≥ +V-4.0V dc (<30V dc) or disconnect wire. 100 ms delay upon enable/disable.
Indicators	**Two LEDs:** Green and Yellow **GREEN glowing steadily** = power to sensor is "on" **YELLOW glowing steadily** = light is sensed; normally open output is conducting **GREEN Blinking** = power overloaded **YELLOW Blinking** = marginal return signal
Construction	**PD45 models:** Housings are KJB heat-resistant ABS, UL94-VO rated; acrylic lens cover **PD49 models:** Housings are sealed, heat-resistant ABS/polycarbonate alloy
Environmental Rating	**PD45 models:** NEMA 3, IEC IP54 **PD49 models:** NEMA 6, IEC IP67
Connections	2 m (6.5') or 9 m (30') attached cable, or 5-pin Euro-style 150 mm (6") pigtail quick-disconnect fitting; mating cables for QD models are ordered separately. See page 64.
Operating Conditions	**Temperature:** -10° to +45°C (+14° to 113°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Weight	**PD45 models:** **Sensor only:** 22g (0.8 oz) **Sensor plus 2 m cable:** 62g (2.2 oz) **PD49 models:** **Sensor only:** 28g (1 oz) **Sensor plus 2 m cable:** 68g (2.4 oz)
Application Notes	False pulse may occur < 1 second after power-up
Certifications	CE

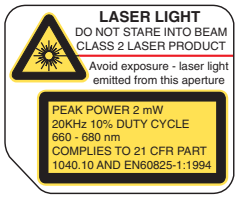
PicoDot Hookups

NPN Hookup



PNP Hookup

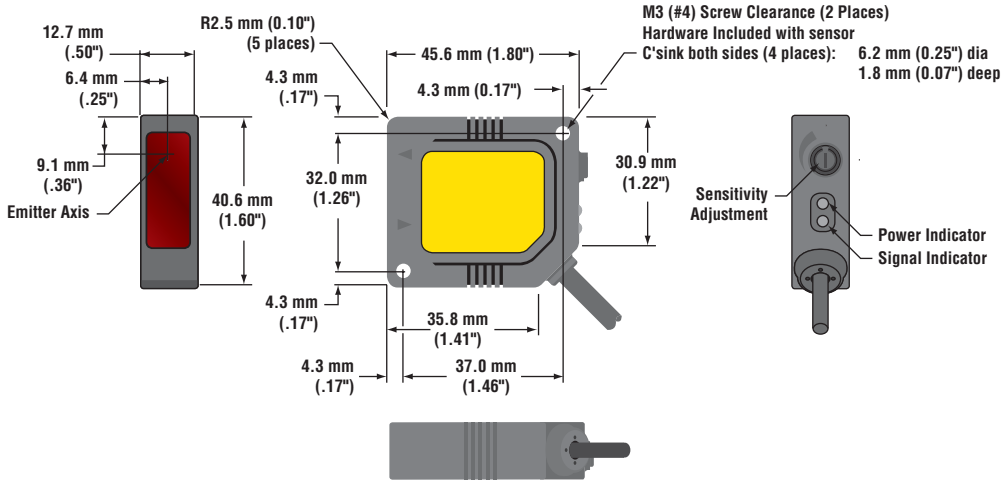




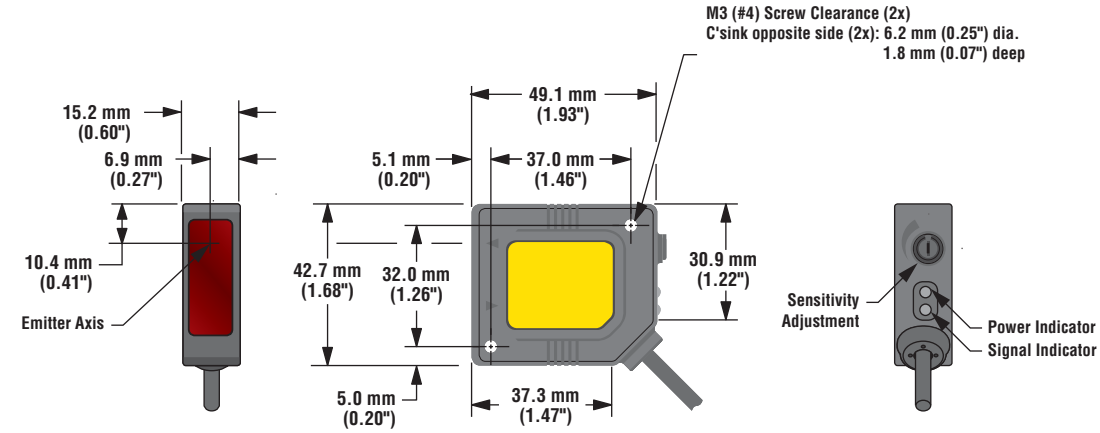
NOTE: Hookups are the same for either integral or QD cable

PicoDot Dimensions

PD45 Standard Models



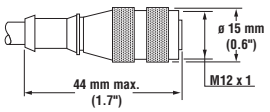
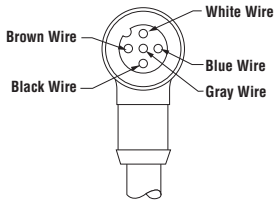
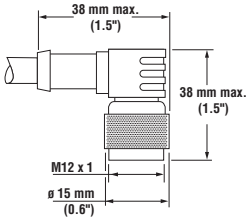
PD49 Ruggedized Models



Mounting hardware included with Sensor (2) Each:
- M3 x 0.05 20 mm SS Cap Screws
- M3 Hex Nuts
- M3 Lock Washers
- M3Flat Washers

Euro-Style Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40° to +90°C (-40° to +194°F) **Voltage Rating:** 250V ac/300V dc

Style	Models	Length	Dimensions	Pin-out
5-Pin Euro Straight	**MQDC1-506** **MQDC1-515** **MQDC1-530**	2 m (6.5') 5 m (15') 9 m (30')		
5-Pin Euro Right-angle	**MQDC1-506RA** **MQDC1-515RA** **MQDC1-530RA**	2 m (6.5') 5 m (15') 9 m (30')		

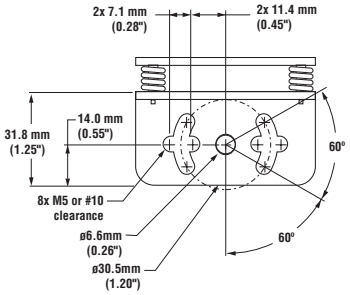
Retroreflectors

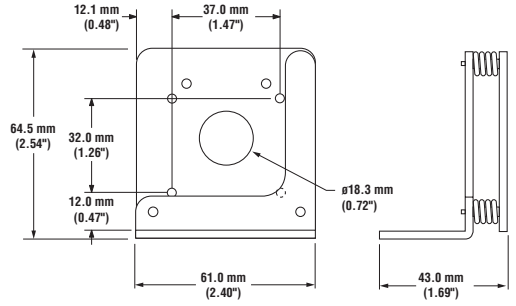
Models	Description		Data Sheet†
BRT-36X40BM	• High-resolution corner-cube (micro-prism) reflector; 1.2 reflectivity factor* • 0.2 to 10.6 m (8" to 35') range	• Maximum temperature 50°C (120°F) • Included with sensor	67450
BRT-2X2	• Corner-cube reflector • 1.0 reflectivity factor* • 0.6 to 39.6 m (2' to 130') range	• Maximum temperature 50°C (120°F)	
BRT-THG	• Retroreflective tape, 0.7 reflectivity factor* • Many sizes and configurations available; see catalog	• 0.2 to 6.1 m (8" to 20') range • Maximum temperature 60°C (140°F)	

* Reflectivity factor when compared with standard BRT-3 reflector
† Data sheets may be downloaded at www.bannerengineering.com.

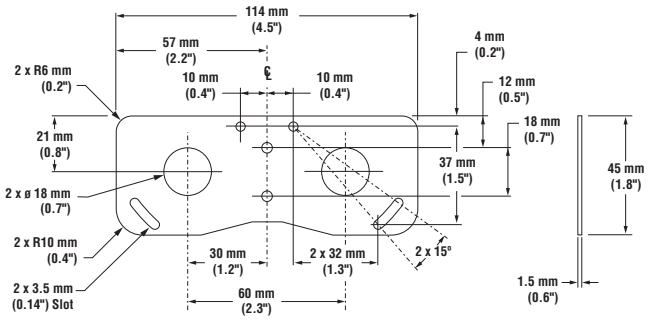
Mounting Brackets

SMB46A
- 2-piece 12-gauge, stainless steel bracket assembly with precision sensor alignment adjustment
- Includes 2 mm hex key



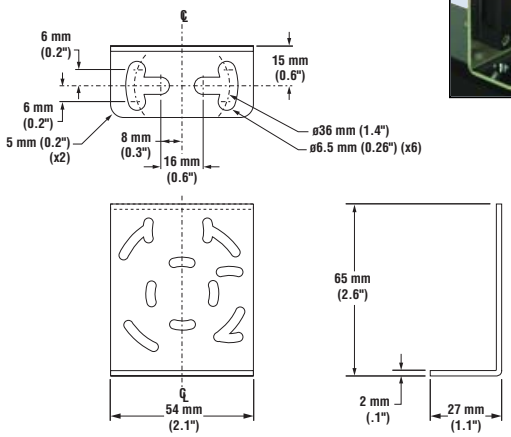


SMB46DF
- 14-gauge 316 stainless steel

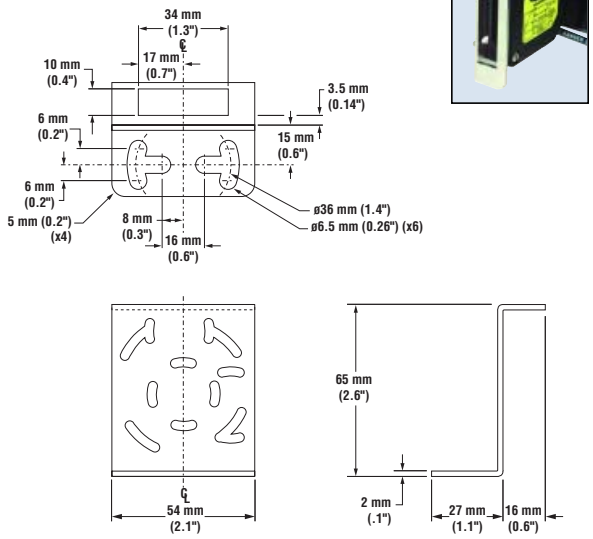


Mounting Brackets

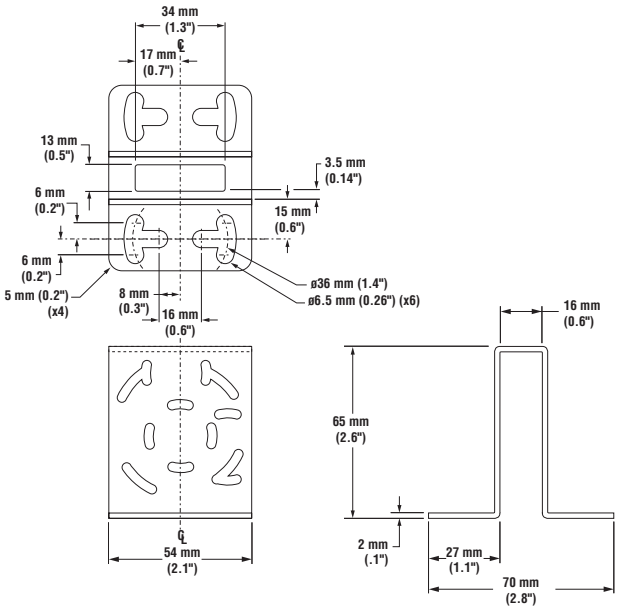
SMB46L
- "L" bracket
- 303 Stainless Steel



SMB46S
- "S" bracket
- 14-gauge 316 stainless steel



SMB46U
- "U" bracket
- 14-gauge 316 stainless steel



L-GAGE®

U-GAGE® Ultrasonic Sensors

Principals of Operation

Temperature effects

The speed of sound is dependent upon the chemical composition of the gas in which it is traveling, the pressure of the gas, and the temperature of the gas. For most ultrasonic applications, the composition and pressure of the gas are relatively fixed, while the temperature is not. In air, the speed of sound varies with temperature, according to the following approximation:

$C_{ft/s} = 49\sqrt{460 + T}$

$C_{ft/s}$ = speed of sound in ft/s

T = temperature in ˚F

Or, in metric units,

$C_{m/s} = 20\sqrt{273 + T}$

$C_{m/s}$ = speed of sound in m/s

T = temperature in ˚C

The speed of sound changes roughly 1% per 10°F (6°C). Some of Banner's ultrasonic sensors are available with temperature compensation. Temperature compensation will reduce the error due to temperature by about $^2/_3$. Also, keep in mind that if the sensor is measuring across a temperature gradient, the compensation technique will be less effective.

Principle of Operation

Ultrasonic sensors emit a pulse of ultrasonic energy which travels through air at the speed of sound. A portion of this energy is reflected off of the target and travels back to the sensor. The sensor measures the total time required for the energy to reach the target and return to the sensor and infers the distance from the sensor to the target by the following:

$$D = \frac{c\,t}{2}$$

D = distance from the sensor to the target

c = Speed of sound in air, approximately 1.1 ft/ms (0.34 m/s)

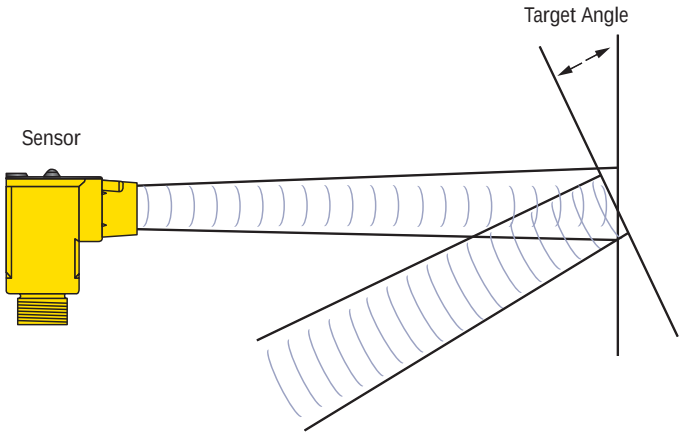
t = transit time for the ultrasonic pulse

To improve accuracy, an ultrasonic sensor may average the results of several pulses before updating the output value.

Target angle

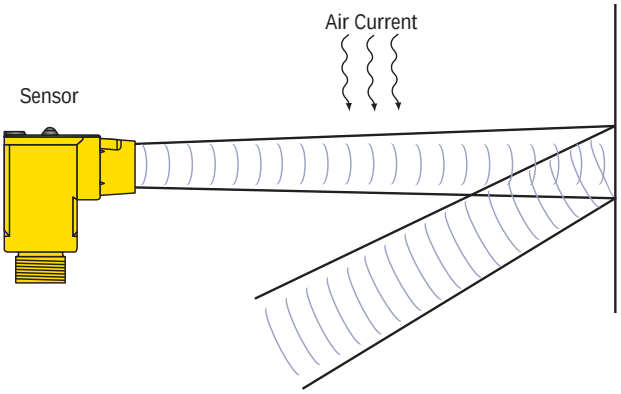
A flat target that is perpendicular to the beam axis will reflect the most sound energy back to the sensor. As the target angle increases, the amount of energy received by the sensor decreases. At some point, the sensor will not be able to “see” the target.

For most ultrasonic sensors, the target angle should be 10 degrees, or less.



Air currents

Air currents due to wind, fans, pneumatic equipment, or other sources can deflect or disturb the path of the ultrasonic energy, such that the sensor will fail to recognize the correct location of the target. In some cases, a deflector or shield can be added to minimize this effect. In other cases, an optical sensor, such as the Q50, might provide a better solution.



QT50U Series- long-range ultrasonic sensor.

Enhanced long-range sensing.

- Extended sensing range of 8 m
- Ultrasonic dead-zone is just 2.5% of the total sensing range compared to 10% for comparable products
- Available in analog or discrete models
- Retro-sonic sensing mode eliminates dead zone

Designed for challenging applications.

With its completely sealed, shock resistant housing, the QT50U is ideal for level monitoring of both liquids and solids. A narrow sensing beam detects targets at long range within confined areas such as a storage tank, without interference from the tank walls.

- Analog unit provides continuous monitoring
- Dual discrete option offers independent near and far limits for both outputs – ideal for use in a an application requiring high-and-low limit sensing

Engineered for flexibility.

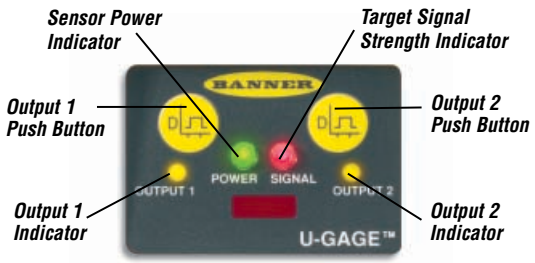
An advanced microprocessor and 8-pin DIP switch offer a multitude of configurations —all in the same analog or discrete unit.

- 8-pin DIP switch for easy device configuration
- Temperature compensation circuitry for greatest sensing accuracy
- Retro-sonic mode has no dead-zone and detects objects of any size, shape and orientation
- AC voltage models available soon – contact factory or visit www.bannerengineering.com for more information

Push-button programming.

Push-button or remote TEACH-mode programming simplifies setup. Highly visible LEDs indicate status during set up and operation.

Discrete model shown.



QT50U Series Models					
Models	**Range**	**Cable***	**Supply Voltage****	**Output**	**Data Sheet†**
QT50ULB	200 mm to 8 m (8" to 26')	5-wire, 2 m (6.5') cable	10 to 30V dc	Selectable: 0 to 10V dc or 4 to 20 mA	70137
QT50ULBQ		5-pin Mini-style QD			
QT50ULBQ6		5-pin Euro-style QD			
QT50UDB	200 mm to 8 m (8" to 26')	5-wire, 2 m (6.5') cable	10 to 30V dc	Dual NPN or PNP selectable	110112
QT50UDBQ		5-pin Mini-style QD			
QT50UDBQ6		5-pin Euro-style QD			

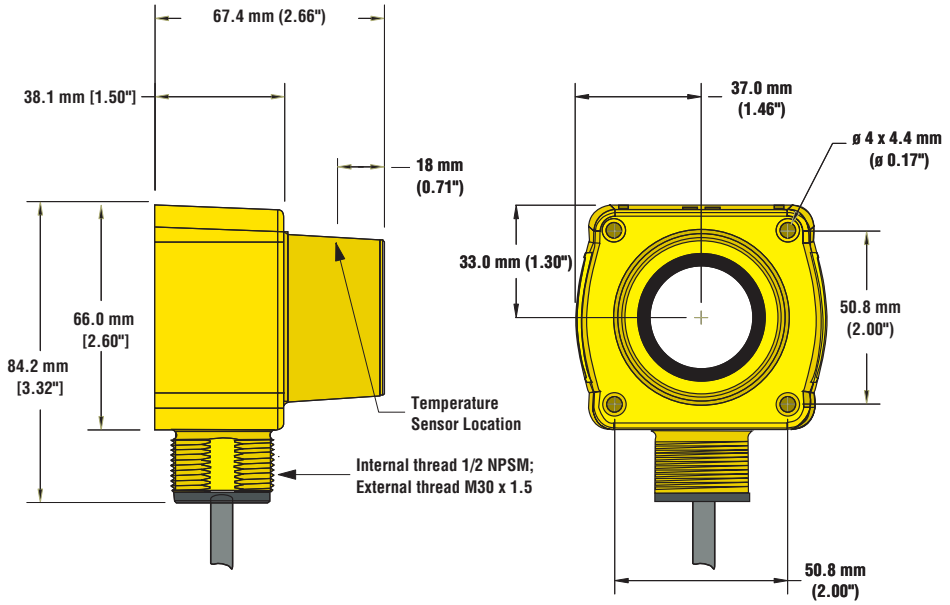
* NOTES:
- 9 m (30') cables are available by adding suffix "w/30" to the model number of a cabled sensor (e.g., **QT50ULB W/30**).
- A model with a QD connector requires a mating cable. See page 72 for more information.

** AC voltage models available soon – contact factory for more information.

† Data sheets may be downloaded at www.bannerengineering.com.

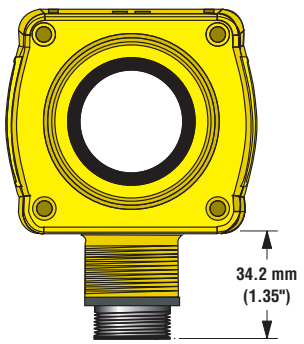
QT50U Series Dimensions

Cabled Models

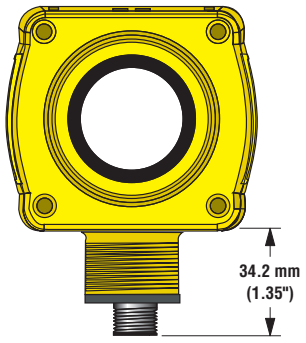


Quick-Disconnect Models

5-Pin Mini-Style QD



5-Pin Euro-Style QD

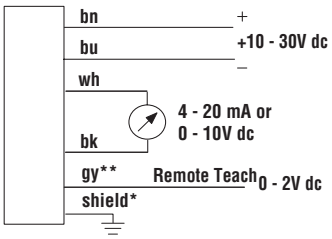


QT50U Series Model Selection

QT50U Series Specifications	
Sensing Range	200 mm to 8 m (8" to 26')
Supply Voltage	10 to 30V dc (10% maximum ripple); 60 mA max. (exclusive of load) AC voltage available soon – contact factory for more information
Ultrasonic Frequency	75 kHz, rep. rate 96 ms
Supply Protection Circuitry	Protected against reverse polarity and transient overvoltages
Output Protection	Protected against short circuit conditions
Delay at Power-up	1.5 seconds
Output Configuration	**Analog models:** **Voltage Sourcing:** 0 to 10V dc **Current Sourcing:** 4 to 20 mA **Dual Discrete models:** Dual PNP or NPN, selectable via DIP switch and hookup; 150 mA., each output
Temperature Effect	**Uncompensated:** 0.2% of span/°C **Compensated:** 0.02% of span/°C
Linearity (Analog Models)	+/- 0.2% of span from 200 to 8000 mm; +/- 0.1% of span from 500 to 8000 mm
Resolution/Repeatability	1.0 mm
Hysteresis	5 mm
Output Response Time	100 ms to 2300 ms.
Minimum Window Size	20 mm
Adjustments	**Sensing window limits:** TEACH-Mode programming of near and far window limits may be set using the push buttons or remotely via TEACH input.
Indicators	**All models:** **Green Power On LED:** Indicates power is ON **Red Signal LED:** Indicates target is within sensing range, and the condition of the received signal. **Analog models:** **Teach/Output indicator (bicolor Yellow/Red):** Yellow – Target is within taught limits OFF – Target is outside taught window limits Red – Sensor is in TEACH mode **Dual Discrete models:** **Teach/Output indicator (Yellow/Red):** Yellow Target is within taught limits OFF Target is outside taught window limits Red Sensor is in TEACH mode
Remote TEACH	See data sheet p/n 70137 (Analog) and p/n 110112 (Discrete)
Construction	**Transducer:** Ceramic/Epoxy composite **Housing:** ABS/Polycarbonate **Membrane Switch:** Polyester **Lightpipes:** Acrylic
Environmental Rating	Leakproof design is rated IEC IP67; NEMA 6P
Connections	2 m (6.5') or 9 m (30') shielded 5-conductor (with drain) PVC jacketed attached cable or 5-pin Euro-style quick-disconnect or 5-pin Mini-style quick-disconnect
Operating Conditions	**Temperature:** -20° to +70° C (-4° to +158° F) **Maximum relative humidity:** 100%
Vibration and Mechanical Shock	All models meet Mil Std. 202F requirements. Method 201A (vibration: 10 to 60Hz max., double amplitude 0.06", maximum acceleration 10G). Also meets IEC 947-5-2 requirements: 30G 11 ms duration, half sine wave
Application Notes	• Objects passing inside the specified near limit (200 mm) may produce a false response • For best accuracy, allow 30 minute warm-up before programming or operating
Certifications	Contact factory for more information.

QT50U Analog Series Hookups

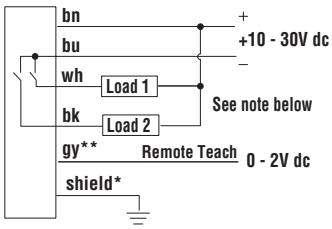
Cabled Models



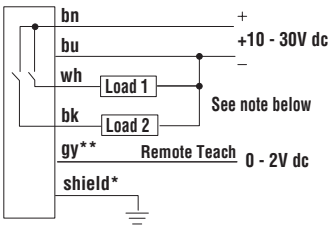
QT50U Dual Discrete Series Hookups

Cabled Models

Setup for NPN



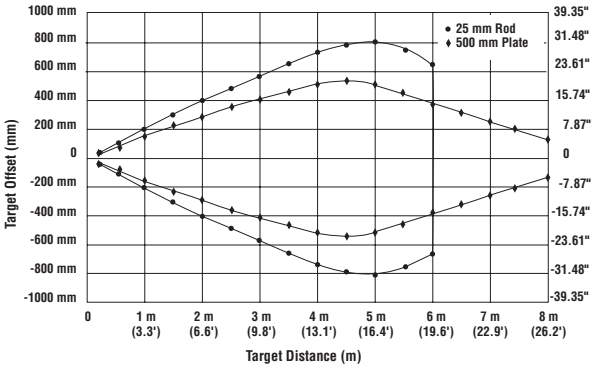
Setup for PNP



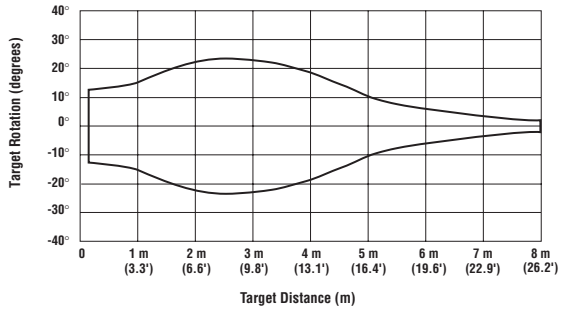
NOTE: Hookups are the same for either integral or QD cable.
NPN or PNP hookup must agree with DIP-switch settings (see data sheet p/n 110112 at www.bannerengineering.com)
* It is recommended that the shield wire be connected to either earth ground or DC common.
** Wire is yellow for Mini-style QD

QT50U Performance Curves

QT50U Effective Beam Pattern

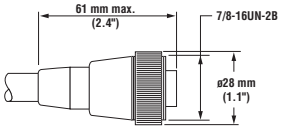
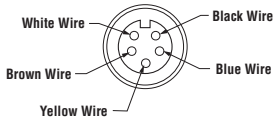
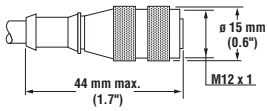
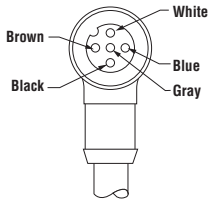
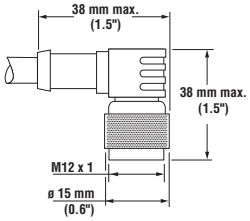


QT50U (with 500 mm Plate) Maximum Target Rotation Angle



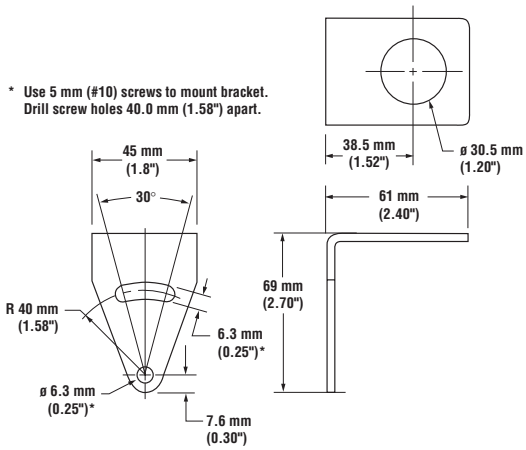
Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded (18 AWG for Mini-style), PVC insulation, gold-plated contacts
Temperature: Euro-style: -40° to +90°C (-40° to +194°F) Mini-style: -40° to +80°C (-40° to +176°F)
Voltage Rating: 250V ac/300V dc

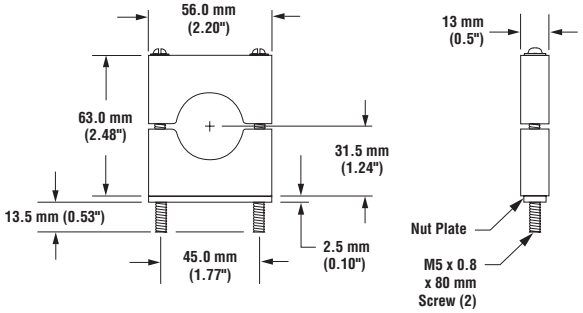
Style	Model	Length	Dimensions	Pin-out
5-Pin Mini Straight w/shield	**MBCC2-506** **MBCC2-512** **MBCC2-530**	2 m (6.5') 4 m (12') 9 m (30')		
5-Pin Euro Straight w/shield	**MQDEC2-506** **MQDEC2-515** **MQDEC2-530**	2 m (6.5') 5 m (15') 9 m (30')		
5-Pin Euro Right-angle w/shield	**MQDEC2-506RA** **MQDEC2-515RA** **MQDEC2-530RA**	2 m (6.5') 5 m (15') 9 m (30')		

Mounting Brackets

SMB30A
- Angled-mount bracket
- Stainless steel



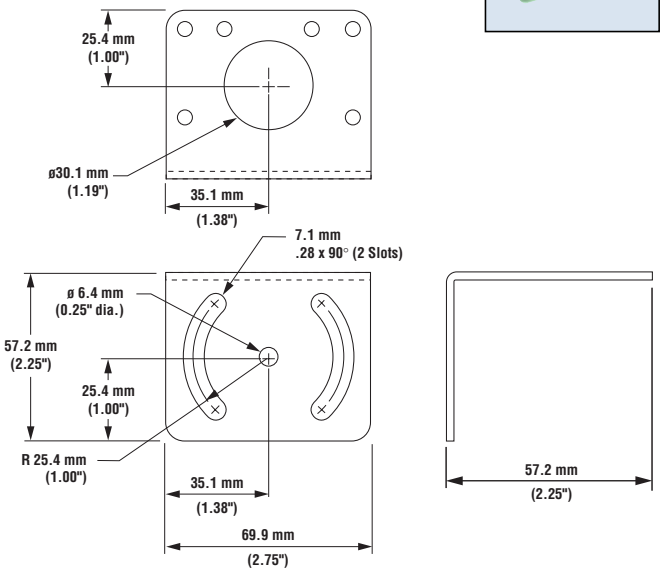
SMB30C
- 30 mm split clamp, black reinforced thermoplastic polyester
- Stainless steel hardware included



Mounting Brackets

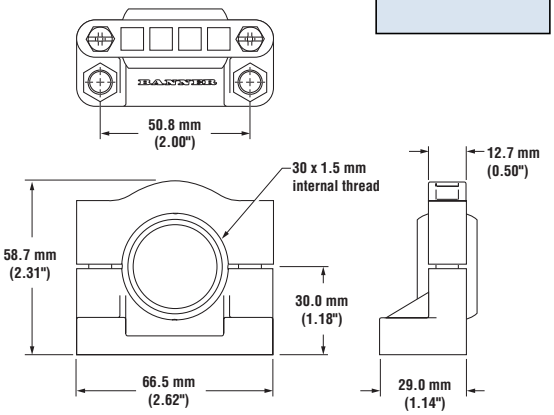
SMB30MM

- 30 mm, 11-gauge, stainless steel bracket with curved mounting slots for versatility and orientation
- Clearance for M6 (1/4") hardware



SMB30SC

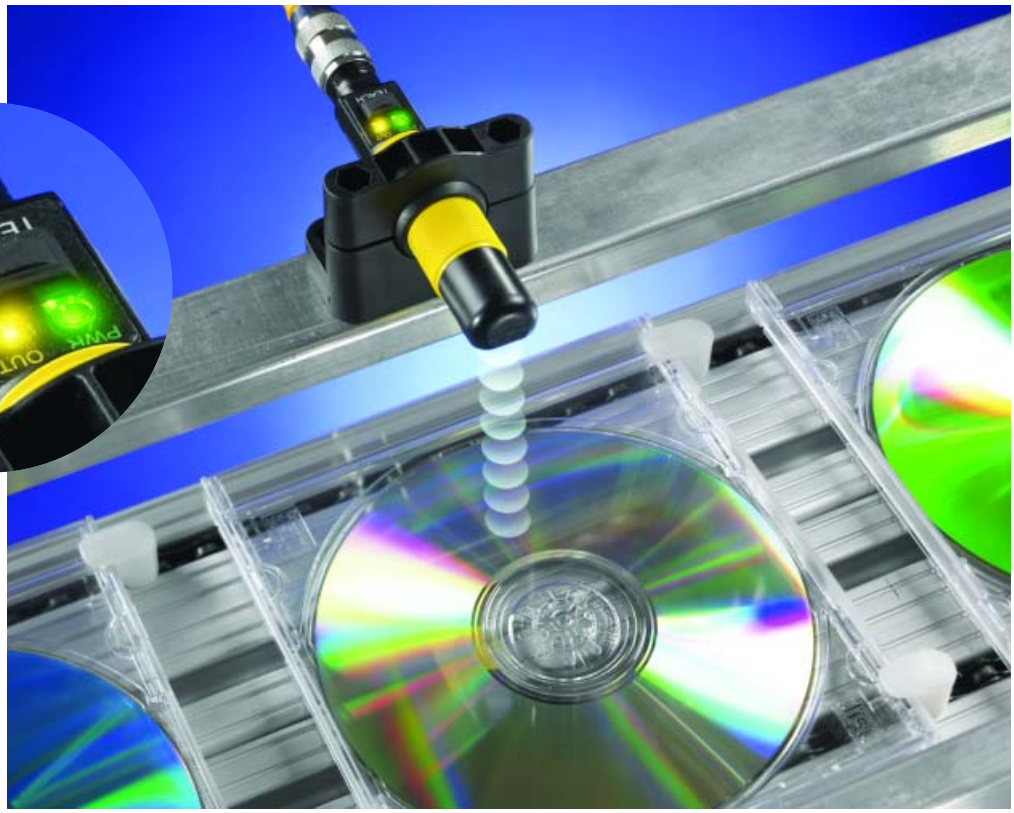
- 30 mm split clamp with swivel, black reinforced thermoplastic polyester
- Stainless steel hardware included



S18U Series- compact ultrasonic sensor with integrated push-button programming.

Includes on-board diagnostics.

The industry's first compact ultrasonic sensor to feature push-button TEACH programming and diagnostic LEDs —on the sensor housing.
Not limited by its small size, the high accuracy S18U is unaffected by target color and has all the features of much larger sensors.



- Integrated Diagnostic LEDs and push-button programming
- Minimal dead-zone
- Retro-sonic sensing mode
- Temperature compensation circuitry
- Programmable background suppression
- Analog or discrete versions

Two emitter styles.

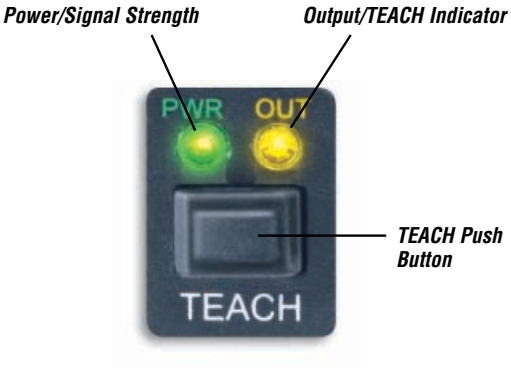
- Available in straight or right-angle emitter versions with a wide variety of mounting hardware for enhanced sensing versatility.
- Ideal for packaged goods or material handling applications
- Use for bottling or small container liquid level detection and control
- 30 to 300 mm range

Straight

Right Angle

Integrated Push-button Programming.

Program the unit with its integrated TEACH-mode push button or remote TEACH wire. Bright LEDs indicate status during setup and offer visual diagnostics during operation. Configure a set sensing window, background suppressed sensing or retro-sonic mode where any object regardless of shape, angle or size will be detected.



S18U Series Models						
Models	**Range**	**Cable***	**Supply Voltage**	**Output**	**Housing Configuration**	**Data Sheet†**
S18UUA	30 mm to 300 mm (1.2" to 11.8")	5-wire, 2 m (6.5') cable	10 to 30V dc	0 to 10V dc	Straight	110738
S18UUAQ		5-in Euro-style QD				
S18UIA		5-wire, 2 m (6.5') cable		4 to 20 mA		
S18UIAQ		5-in Euro-style QD				
S18UUAR	30 mm to 300 mm (1.2" to 11.8")	5-wire, 2 m (6.5') cable	10 to 30V dc	0 to 10V dc	Right-Angle	110738
S18UUARQ		5-in Euro-style QD				
S18UIAR		5-wire, 2 m (6.5') cable		4 to 20 mA		
S18UIARQ		5-in Euro-style QD				
S18UBA	30 mm to 300 mm (1.2" to 11.8")	5-wire, 2 m (6.5') cable	10 to 30V dc	Bipolar NPN/PNP	Straight	108964
S18UBAQ		5-in Euro-style QD				
S18UBAR		5-wire, 2 m (6.5') cable			Right-Angle	
S18UBARQ		5-in Euro-style QD				

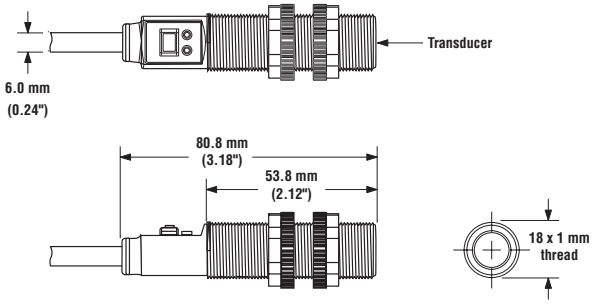
*NOTES:
- 9 m (30') cables are available by adding suffix "W/30" to the model number of any cabled sensor (e.g., **S18UUA W/30**). A model with a QD connector requires a mating cable. See page 78 for more information.

† Data sheets may be downloaded at www.bannerengineering.com.

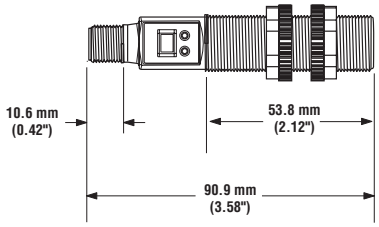
S18U Series Dimensions

Straight Housing

Cabled Models

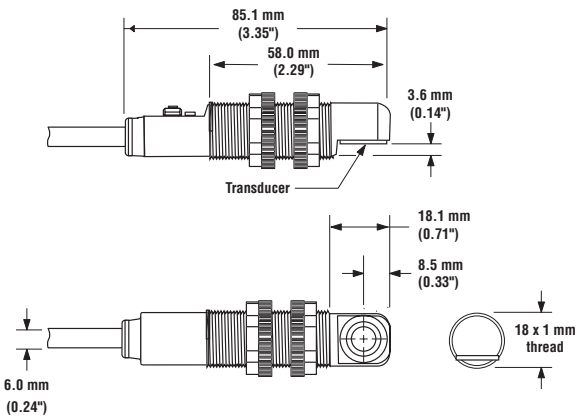


Quick-Disconnect Models

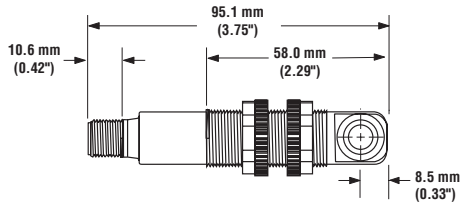


Right-Angle Housing

Cabled Models



Quick-Disconnect Models

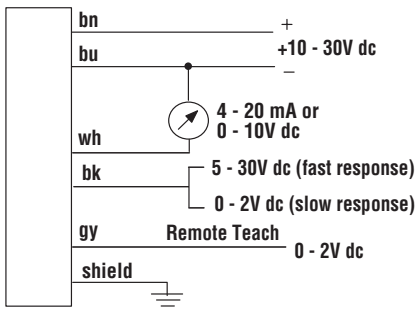


S18U Series Model Selection

S18U Series Specifications	
Supply Voltage	10 to 30V dc (10% maximum ripple): 65 mA max. (exclusive of load)
Sensing Range	30 to 300 mm (1.2" to 11.8")
Supply Protection Circuitry	300 kHz, rep. rate 2.5 ms
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	**Analog:** 0 to 10V dc or 4 to 20 mA, depending on model **Discrete:** SPST solid-state switch conducts when target is sensed within sensing window; One NPN (current sinking) and one PNP (current sourcing) output in each model.
Output Protection	Protected against short circuit conditions
Output Ratings	**Analog:** **Analog Voltage Output:** 2.5 kΩ minimum load resistance Minimum supply for a full 10V output is 12V dc (for supply voltages between 10 and 12, V out max is at least V supply -2) **Analog Current Output:** 1 kΩ max @ 24V input Max load resistance = (Vcc-4)/0.02 ohms **Discrete:** 100 mA maximum **OFF-state leakage current:** < 5 microamps; **NPN saturation:** < 200 mV @ 10 mA and < 600 mV @ 100 mA **PNP saturation:** < 1.2V @ 10 mA and < 1.6V @ 100 mA
Output Response Time	**Analog:** 30 milliseconds: Black wire at 0-2V dc (or open) **Discrete:** 5 milliseconds 2.5 milliseconds: Black wire at 5-30V dc
Delay at Power-up	300 milliseconds
Temperature Effect	0.02% of distance/ °C
Temperature Warmup Drift	Less than 1.7% of sensing distance upon power-up
Repeatability/Resolution	0.5 mm
Minimum Window Size	5 mm
Switching Hysteresis (Discrete Output Models)	0.7 mm
Adjustments	**Sensing window limits:** TEACH-Mode programming of near and far window limits may be set using the push-button or remotely via TEACH input.
Indicators	**Range Indicator (Red/Green)** **Green** — Target is within sensing range **Red** — Target is outside sensing range **OFF** — Sensing power is OFF **Teach/Output Indicator (Yellow/Red)** **Yellow** — Target is within taught limits **OFF** — Target is outside taught window limits **Red** — Sensor is in TEACH mode
Remote TEACH Input	**Impedance:** 12 kΩ
Construction	**Threaded Barrel:** Thermoplastic polyester **Push Button Housing:** ABS/PC **Push Button:** Santoprene **Lightpipes:** Acrylic
Environmental Rating	Leakproof design is rated IEC IP67; NEMA 6P
Connections	2 m (6.5') or 9 m (30') shielded 5-conductor (with drain) PVC jacketed attached cable or 5-pin Euro-style quick-disconnect (see page 78 for quick-disconnect cable options)
Temperature Conditions	**Temperature:** -20° to +60° C (-4° to +140° F) **Maximum relative humidity:** 100%
Vibration and Mechanical Shock	All models meet Mil. Std. 202F requirements. method 201A (vibration: 10 to 60Hz max., double amplitude 0.06", maximum acceleration 10G). Also meets IEC 947-5-2 requirements: 30G 11 ms duration, half sine wave
Application Notes	Objects passing inside the specified near limit may produce a false response.
Certifications	Contact factory for more information.

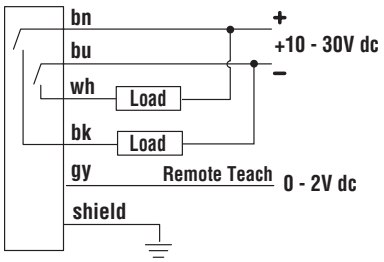
S18U Analog Output Hookups

Cabled Models



S18U Discrete Output Hookups

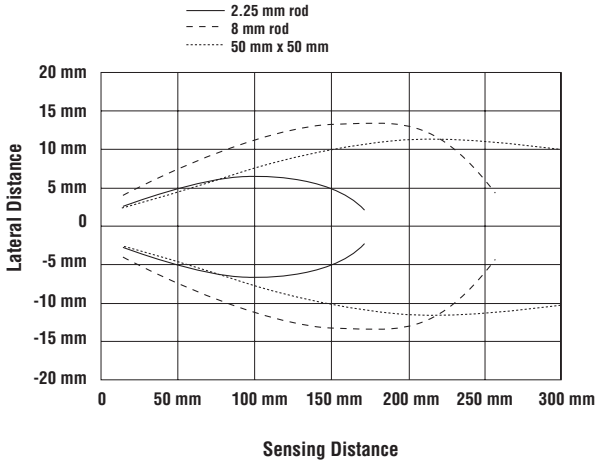
Cabled Models



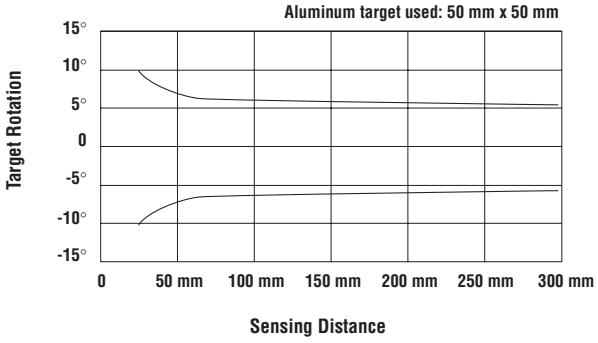
NOTE: Hookups are the same for either integral or QD cable
* It is recommended that the shield wire be connected to either earth ground or DC common

S18U Performance Curves

S18U Effective Beam Pattern

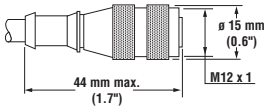
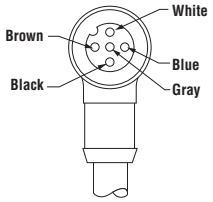
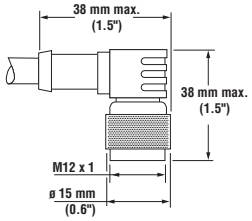


S18U (with 500 mm Plate) Maximum Target Rotation Angle



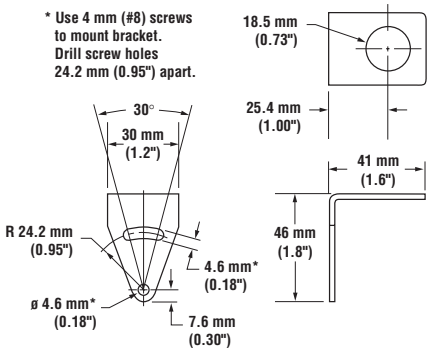
Euro-Style Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40° to +90°C (-40° to +194°F)
Voltage Rating: 250V ac/300V dc

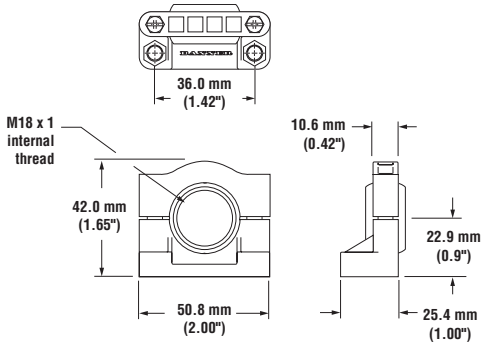
Style	Model	Length	Dimensions	Pin-out
5-Pin Straight w/shield	**MQDEC2-506** **MQDEC2-515** **MQDEC2-530**	2 m (6.5') 5 m (15') 9 m (30')		
5-Pin Right-angle w/shield	**MQDEC2-506RA** **MQDEC2-515RA** **MQDEC2-530RA**	2 m (6.5') 5 m (15') 9 m (30')		

Mounting Brackets

SMB18A
- 11-gauge, stainless steel right-angle bracket
- Curved mounting slot for versatility and orientation

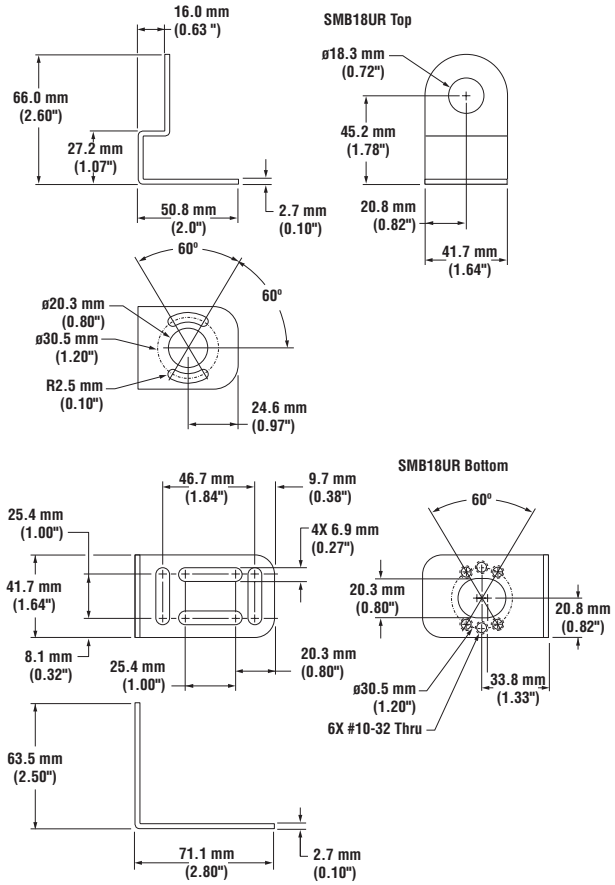


SMB18SF
- 18 mm swivel bracket
- Black thermoplastic polyester
- Includes stainless steel mounting hardware



Mounting Brackets

SMB18UR
- 2-piece universal swivel bracket for 18 mm sensors
- 300 series stainless steel
- Includes stainless steel swivel locking hardware



T30U Series- analog and discrete outputs in the same sensor.

Incredible versatility.

The U-GAGE T30U sets new standards for ultrasonic sensor versatility by including both switched (discrete) and analog outputs in the same unit.

- Two models: NPN or PNP discrete output, plus a 0-10V dc or 4-20 mA sourcing analog in the same sensor

Dual-discrete output models.

- Two NPN or two PNP discrete outputs
- Outputs are independently programmable
- Models available for direct liquid level control (pump in/pump out)

Patented, ultra-short T-shaped package.

The T30U is the shortest 30 mm diameter ultrasonic sensor available, and is less than half the length of comparable competitive sensors.

- Four LED indicators keep you constantly informed of programming and operating status
- Red LED flashes in direct proportion to the received signal strength
- Two yellow LEDs indicate the target is within the operating window limits
- Includes digital filtering for immunity to random and electrical noise, in addition to transient voltage and reverse polarity protection

Push-button TEACH-mode programming is faster, easier & more secure.

The T30U allows you to simply push buttons to set accurate, custom-sized sensing windows anywhere within a 150 mm to 1 m or 300 mm to 2 m range.

- Three-step, “no manual required” programming using sealed push buttons—big improvement over complicated “complex code” required by other sensors
- Users also can program the sensor from a remote location using an external switch, computer or controller for added security and convenience

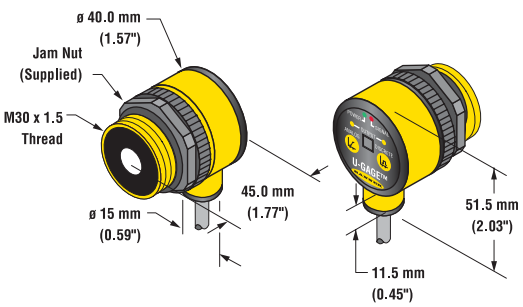
T30U Series Models								
Models	**Range**	**Frequency**	**Cable***	**Supply Voltage`**	**Discrete Output(s)**	**Analog Output**	**Response Time**	**Data Sheet†**
T30UINA	150 mm to 1 m (5.9 to 39")	228 kHz	2 m (6.5'	12 to 24V dc	NPN	4 to 20 mA Sourcing	48 ms	57438
T30UINAQ			5-pin Euro QD					
T30UIPA			2 m (6.5'		PNP			
T30UIPAQ			5-pin Euro QD					
T30UUNA	150 mm to 1 m (5.9 to 39")	228 kHz	2 m (6.5'	15 to 24V dc	NPN	0 to 10V dc Sourcing	48 ms	57438
T30UUNAQ			5-pin Euro QD					
T30UUPA			2 m (6.5'		PNP			
T30UUPAQ			5-pin Euro QD					
T30UINB	300 mm to 2 m (11.8 to 79"	128 kHz	2 m (6.5'	12 to 24V dc	NPN	4 to 20 mA Sourcing	96 ms	57438
T30UINBQ			5-pin Euro QD					
T30UIPB			2 m (6.5'		PNP			
T30UIPBQ			5-pin Euro QD					
T30UUNB	300 mm to 2 m (11.8 to 79"	128 kHz	2 m (6.5'	15 to 24V dc	NPN	0 to 10V dc Sourcing	96 ms	57438
T30UUNBQ			5-pin Euro QD					
T30UUPB			2 m (6.5'		PNP			
T30UUPBQ			5-pin Euro QD					
T30UDNA	150 mm to 1 m (5.9 to 39")	228 kHz	2 m (6.5'	12 to 24V dc	Dual NPN	None	48 ms	59200
T30UDNAQ			5-pin Euro QD					
T30UDPA			2 m (6.5'		Dual PNP			
T30UDPAQ			5-pin Euro QD					
T30UDNB	300 mm to 2 m (11.8 to 79")	128 kHz	2 m (6.5'	12 to 24V dc	Dual NPN	None	96 ms	59200
T30UDNBQ			5-pin Euro QD					
T30UDPB			2 m (6.5'		Dual PNP			
T30UDPBQ			5-pin Euro QD					
T30UHNA	150 mm to 1 m (5.9" to 39")	228 kHz	2 m (6.5'	12 to 24V dc	Pump/Level Control Dual NPN	None	50 ms	Consult factory
T30UHNAQ			5-pin Euro QD					
T30UHNB	300 mm to 2 m (11.8 to 79"	128 kHz	2 m (6.5'				100 ms	
T30UHNBQ			5-pin Euro QD					
T30UHPA	150 mm to 1 m (5.9" to 39")	228 kHz	2 m (6.5'	12 to 24V dc	Pump/Level Control Dual PNP	None	50 ms	Consult factory
T30UHPAQ			5-pin Euro QD					
T30UHPB	300 mm to 2 m (11.8 to 79"	128 kHz	2 m (6.5'				100 ms	
T30UHPBQ			5-pin Euro QD					

* 9 m (30') cables available by adding suffix "W/30" to the model number of any cabled sensor. A model with a QD connector requires a mating cable. See page 84 for more information.

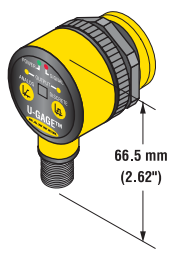
† Data sheets may be downloaded at www.bannerengineering.com.

T30U Dimensions

Cabled Models



Quick-Disconnect Models



T30U Series Model Selection

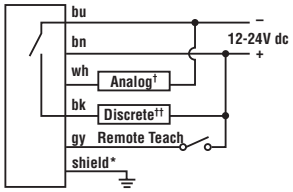
T30U Series Specifications

Proximity Mode Range	**"A" suffix models:** 150 mm (5.9") min. near limit; 1 m (39") max. far limit. **"B" suffix models:** 300 mm (11.8") min. near limit; 2 m (79") max. far limit.
Supply Voltage	**Current-sourcing analog output models:** 12 to 24V dc (10% max. ripple) at 90 mA, exclusive of load **Voltage-sourcing analog output models:** 15 to 24V dc (10% max. ripple) at 90 mA, exclusive of load **Dual Discrete output models:** 12 to 24V dc (10% max. ripple) at 90 mA, exclusive of load
Ultrasonic Frequency	**Short Range:** 228 kHz, **Long Range:** 128 kHz.
Supply Protection Circuitry	Protected against reverse polarity and transient voltages.
Output Configuration	**Discrete (switched) output:** SPST solid-state switch conducts when target is sensed within sensing window; choose NPN (current sinking) or PNP (current sourcing) models. **Analog output:** Choose 0 to 10V dc sourcing or 4 to 20 mA sourcing output models; output slope may be selected via TEACH sequence.
Output Ratings	**Discrete (switched) output:** 100 mA maximum per sensor. **Off-state leakage current:** less than 10 microamps. **On-state saturation voltage:** less than 1V at 10 mA and less than 1.5V at 100 mA. **Analog Output:** **Voltage sourcing:** 0 to 10V dc (at 1K ohm minimum resistance). **Current sourcing:** 4 to 20 mA, 1 ohm to Rmax. $R_{max} = \frac{V_{supply} - 7V}{20\ mA}$
Output Protection	Protected against continuous overload and short-circuit; transient over-voltage; no false pulse on power-up.
Output Response Time	**Discrete output:** **"A" suffix models:** 48 milliseconds **"B" suffix models:** 96 milliseconds **Analog output:** **"A" suffix models:** 48 milliseconds average, 16-millisecond update **"B" suffix models:** 96 milliseconds average, 32-millisecond update **Dual Discrete:** **"A" suffix models:** 48 milliseconds **"B" suffix models:** 96 milliseconds
Sensing Performance (Specified using a 10 cm x 10 cm aluminum target at 25˚C under fixed sensing conditions.)	**Analog sensing resolution or discrete output repeatability: ±0.25% of measured distance ["A" suffix (.5 mm min); "B" suffix (1 mm min)]** **Analog linearity:** ±0.5% of full-scale span **Minimum window size:** 10 mm (0.4") **Hysteresis of discrete output:** 2.5 mm (0.10") **Temperature effect:** 0.2% of sensing distance per 0°C
Adjustments	**Sensing window limits (analog or discrete):** TEACH-mode programming of near and far window limits may be set using membrane push buttons on sensor or remotely via TEACH input. Window limits may be programmed separately, or together. **Analog output slope:** the first limit taught is assigned to the minimum output value (4 mA or 0V).
Indicators	**Four status LEDs: In RUN mode:** Green { ON= Power ON, RUN mode / Flashing= Discrete output is overloaded } Red Flashing= Relative received signal strength Yellow analog ON= Target is inside window limits Yellow discrete ON= Output conducting **In Program mode:** Green OFF= PROGRAM mode Red Flashing= Relative received signal strength Yellow { ON= Ready for first window limit / Flashing= Ready for second limit / OFF= Not teaching this output }
Construction	Molded reinforced thermoplastic polyester housing.
Environmental Rating	Leakproof design is rated IEC IP67; NEMA 6P.
Connections	2 m (6.5') or 9 m (30') 5-conductor PVC-covered attached cable, or 5-pin Euro-style quick-disconnect fitting.
Operating Conditions	**Temperature:** -20° to +70° C (-4° to 158° F) **Maximum relative humidity:** 100%
Vibration and Mechanical Shock	All models meet Mil. Std. 202F requirements. Method 201A (Vibration: 10 to 60Hz max., double amplitude 0.06",maximum acceleration 10G). Also meets IEC 947-5-2 requirements: 30G, 11 ms duration, half sine wave.
Application Notes	Objects passing inside the specified near limit will produce a false response. NOTE: For more information about out-of-range and signal loss response of the analog output, see product literature.
Certifications	CE

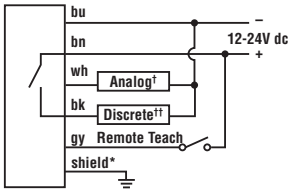
T30U Series Hookups

Analog-Discrete Models

NPN

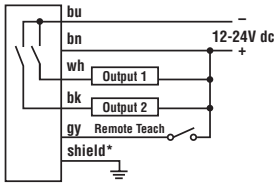


PNP

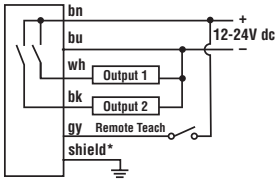


Dual Discrete Models

NPN



PNP



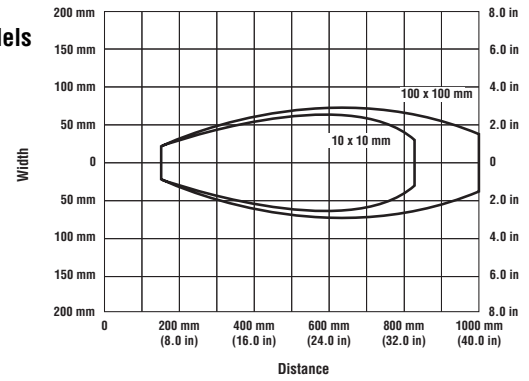
NOTE: Hookups are the same for either integral or QD cable

† 4-20 mA or 0-10V dc
†† 100 mA maximum
* It is recommended that the shield wire be connected to either earth ground or DC common.

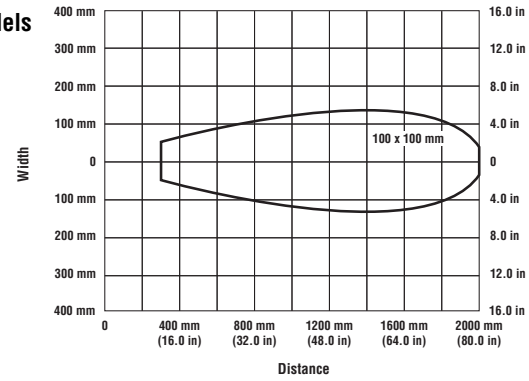
T30U Series Performance Curves

T30U Effective Beam with Plate Target (Typical)

1-Meter Models

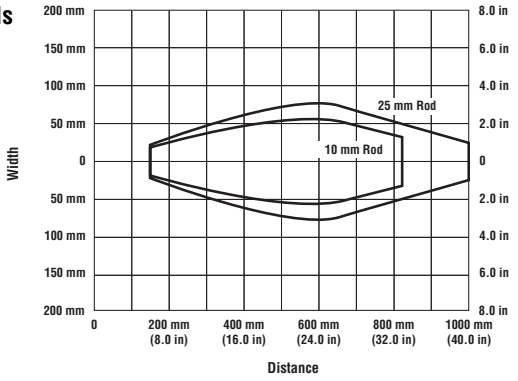


2-Meter Models

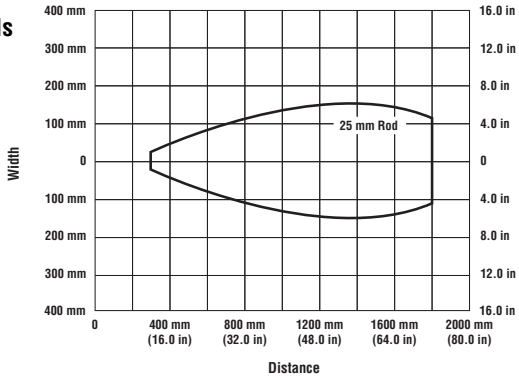


T30U Effective Beam with Rod Target (Typical)

1-Meter Models

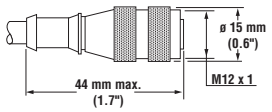
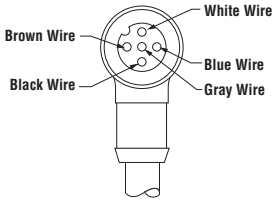
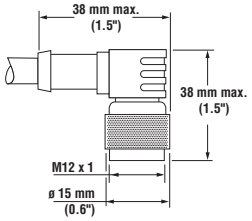


2-Meter Models



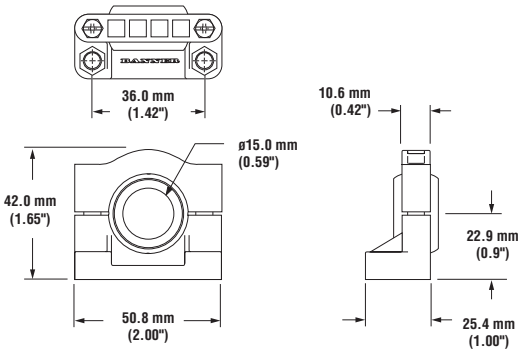
Euro-Style Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40° to +90°C (-40° to +194°F)
Voltage Rating: 250V ac/300V dc

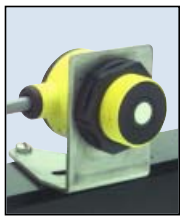
Style	Model	Length	Dimensions	Pin-out
5-Pin Straight w/shield	**MQDEC2-506** **MQDEC2-515** **MQDEC2-530**	2 m (6.5') 5 m (15') 9 m (30')		
5-Pin Right-angle w/shield	**MQDEC2-506RA** **MQDEC2-515RA** **MQDEC2-530RA**	2 m (6.5') 5 m (15') 9 m (30')		

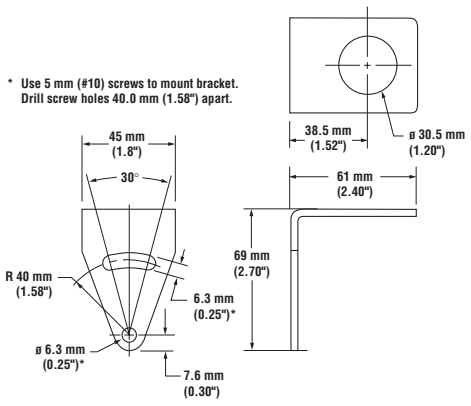
Mounting Brackets

SMB1815SF
- Swivel with set screws for mounting sensor by its cable hub
- Black reinforced thermoplastic polyester
- Stainless steel hardware included



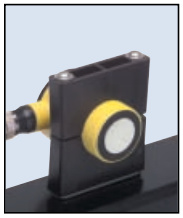
SMB30A
- Angled-mount bracket
- Stainless steel

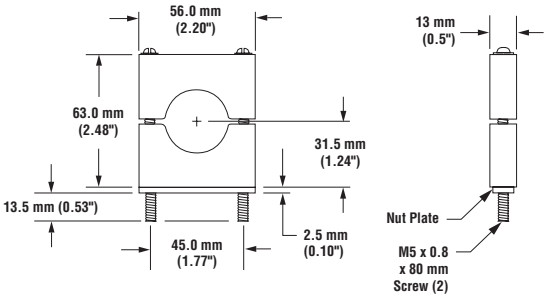




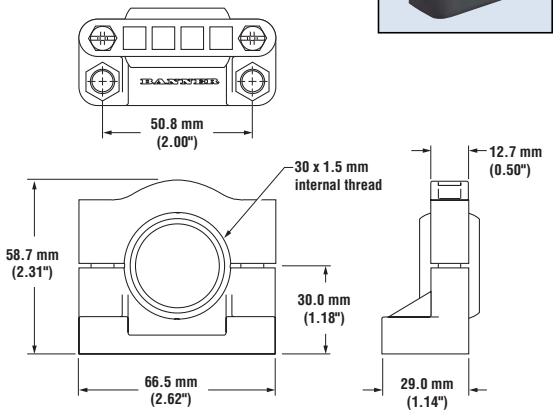
Mounting Brackets

SMB30C
- 30 mm split clamp, black reinforced thermoplastic polyester
- Stainless steel hardware included





SMB30SC
- 30 mm split clamp with swivel, black reinforced thermoplastic polyester
- Stainless steel hardware included



Q45U Series– highest flexibility ultrasonic sensing.

Simply push one button...

- One button sets up operating window limits from 100 mm to 3000 mm
- Microprocessor-controlled, "TEACH" mode limits are set by placing the target at one of the desired limits and clicking the push button, then placing the target at the second limit and clicking again.

Selectable response modes and times.

Q45U Sensors with discrete output are programmable for either ON/OFF presence detection or HIGH/LOW level control.

- ON/OFF control mode energizes solid state, normally-open (NO) or normally-closed (NC) output when target is detected within or outside sensing window
- HIGH/LOW mode energizes output when first window limit is reached, and output stays energized until target reaches second window limit
- Meets logic needs for fill-level, web tensioning control and similar applications
- Response time is also programmable from 20 ms to 640 ms (1-32 cycles), using DIP switches beneath sensor's hinged, acrylic cover
- Analog units include potentiometer to set response times from 40 ms to 1.28 seconds

Remote programming (analog units).

- For convenience, Q45U can be wired directly to an external switch, controller or computer to set window limits, performing same function as push button
- Ideal for inaccessible locations such as roll diameter detection for overhead cranes

Program storage cards.

- Master window-limit programs can be set up and stored on circuit cards for fastest and easiest possible setup when changing sensing parameters or applications
- Simply insert Q45UML card and power up sensor to download new sensing window limits

Q45U Series Models

Models	Range	Temperature Compensation	Cable*	Supply Voltage	Output Type	Response Time	Data Sheet†
Q45UBB63DA	100 mm to 1.4 m (4 to 55")	No	2 m (6.5')	12 to 24V dc	**Discrete:** Bipolar NPN/PNP	Programmable for 20, 40, 160, or 640 ms	44177
Q45UBB63DAQ			5-pin Mini QD				
Q45UBB63DAQ6			5-pin Euro QD				
Q45UBB63DAC	100 mm to 1.4 m (4 to 55")	Yes	2 m (6.5')			Programmable for 20, 40, 160, or 640 ms	44177
Q45UBB63DACQ			5-pin Mini QD				
Q45UBB63DACQ6			5-pin Euro QD				
Q45UBB63BC	250 mm to 3 m** (9.8 to 118")	Yes	2 m (6.5')			Programmable for 40, 80, 320, and 1280 ms	48454
Q45UBB63BCQ			5-pin Mini QD				
Q45UBB63BCQ6			5-pin Euro QD				
Q45ULIU64ACR	100 mm to 1.4 m (4 to 55")	Yes	2 m (6.5')	15 to 24V dc	**Analog:** Selectable 0 to 10V dc or 4 to 20 mA sourcing	Adjustable from 40 ms to 1280 ms	47818
Q45ULIU64ACRQ			5-pin Mini QD				
Q45ULIU64ACRQ6			5-pin Euro QD				
Q45ULIU64BCR	250 mm to 3 m** (9.8 to 118")	Yes	2 m (6.5')			Adjustable from 80 ms to 2560 ms	48456
Q45ULIU64BCRQ			5-pin Mini QD				
Q45ULIU64BCRQ6			5-pin Euro QD				

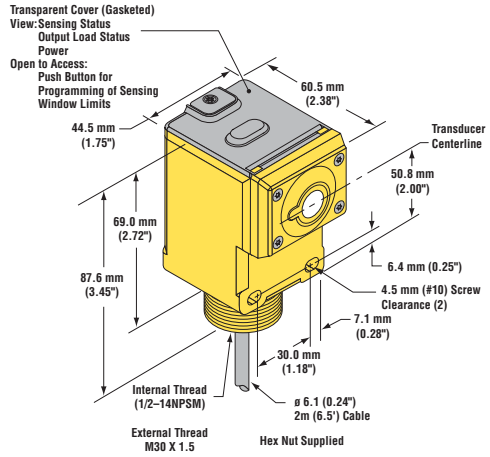
* 9 m (30') cables available by adding suffix "W/30" to the model number of any cabled sensor (e.g., **Q45UBB63DA W/30**). A model with a QD connector requires a mating cable. See page 90 for more information.

** Note: The far limit may be extended as far as 3.9 m (12.8') for good acoustical targets–hard surfaces with area > 100 cm^2.

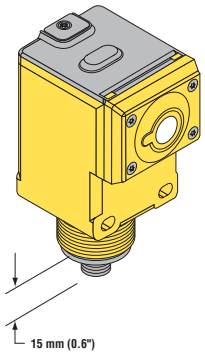
† Data sheets may be downloaded at www.bannerengineering.com.

Q45U Series Dimensions

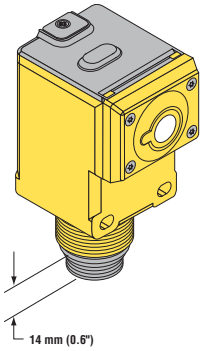
Cabled Models



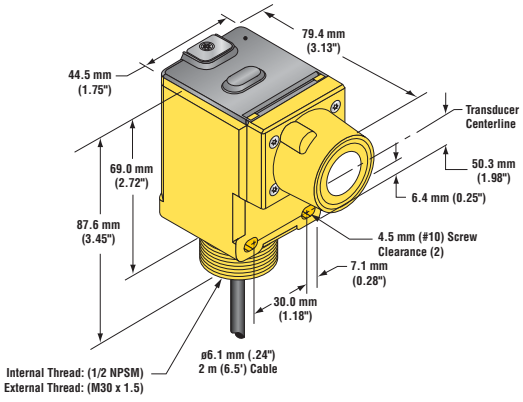
5-Pin Euro-style QD Models ("Q6" model suffix)



5-Pin Mini-style QD Models ("Q" model Suffix)



Q45U Sensor Long Range



Q45U Series Model Selection

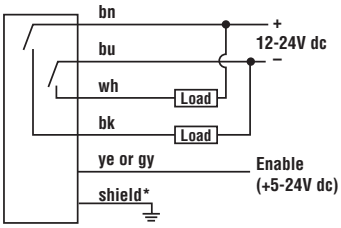
Q45U Series Specifications

Proximity Mode Range	**Near limit:** 100 mm (4.0") min **Long Range:** Near limit: 250 mm (9.8") min **Far limit:** 1.4 m (55") max **Long Range:** Far limit: 3.0 m (118") max Note: The far limit may be extended on long range units, as far as 3.9 m for good acoustical targets (hard surfaces with area > 100 cm^2)
Supply Voltage and Current	**Discrete:** 12 to 24V dc (10% maximum ripple) at 100 mA, exclusive of load. **Analog:** 15 to 24V dc (10% maximum ripple) at 100 mA, exclusive of load.
Ultrasonic Frequency	**Long Range:** 128 kHz **Short Range:** 230 kHz
Supply Protection Circuitry	Protected against reverse polarity and transient voltages.
Output Configuration	**Discrete:** One current sourcing (PNP) and one current sinking (NPN) open-collector transistor. **Analog:** One voltage sourcing and one current sourcing; one or the other output is enabled by internal programming switch #2.
Output Rating	150 mA maximum (each) **Discrete:Off-state leakage current:** <25 microamp at 24V dc **On-state saturation voltage:** <1.5V at 10 mA; <2.0V at 150 mA **Analog:Voltage sourcing:** 0 to 10V dc, 10 mA maximum, **Current sourcing:** 4 to 20 mA, 1 to 500 ohm impedance
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short-circuit of outputs.
Performance Specifications	**Short Range** / **Long Range** **Analog resolution or discrete repeatability:** 0.1% of sensing distance (0.25 mm min.) / 0.1% of sensing distance (0.5 mm min.) **Linearity:** 1% of full scale / 1% of full scale **Temperature effect:** 0.05% of sensing distance/°C with temp. comp. 0.2% of sensing distance/°C without temp. comp. / 0.05% of sensing distance/°C **Minimum window size:** 10 mm / 25 mm **Hysteresis (discrete output):** 5 mm / 10 mm
Output Configuration	The following may be selected by a 4-position DIP switch located on top of the sensor, beneath a transparent o-ring sealed acrylic cover: **Discrete:** **Switch 1:** Output normally open/normally closed (pump in/pump out) **Switch 2:** High/Low level control mode or on/off presence sensing mode **Switch 3 & 4:** Response speed selection (digital filter) **Analog:** **Switch 1:** Output slope positive or output slope negative **Switch 2:** Current output mode or voltage output mode **Switch 3:** Loss of echo min/max mode or loss of echo Hold Mode **Switch 4:** Loss of echo min/max default output value
Indicators	**Three status LEDs:** **GREEN** glowing steadily = power to sensor is "on" **GREEN** flashing = output is overloaded **YELLOW** glowing steadily = outputs are conducting (Yellow LED also indicates programming status during setup mode) **RED** flashing = indicates relative strength of received echo **Analog: Three status LEDs:** **GREEN** glowing steadily = power to sensor is "on" **GREEN flashing = current output fault detected** (indicates that the 4-20mA current path to ground has been opened **YELLOW** glowing steadily = target is sensed within the window limits (Yellow LED also indicates programming status during setup mode) **RED** flashing = indicates relative strength of received echo 5-segment moving dot LED indicates the position of the target within the sensing window.
Construction	Molded PBT polyester thermoplastic polyester housing, o-ring sealed transparent acrylic top cover, and stainless steel hardware.Q45U sensors are designed to withstand 1200 psi washdown. The base of cabled models has a 1/2"-14NPS internal conduit thread.
Environmental Rating	Leakproof design is rated IEC IP67; NEMA 6P
Connections	2 m (6.5') or 9 m (30') attached cable, or 5-pin Mini-style or 5-pin Euro-style QD fitting (Analog short range only).
Operating Conditions	**Temperature:** -25° to +70°C (-13° to +158°F) **Maximum relative humidity:** 100%

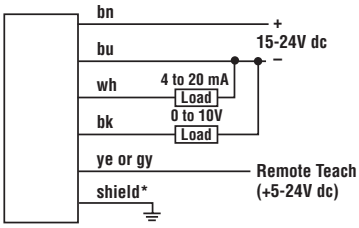
Q45U Series Specifications (cont'd)	
Vibration and Mechanical Shock	All models meet Mil. Std. 202F requirements. Method 201A (Vibration: 10 to 60Hz max., double amplitude 0.06-inch, maximum acceleration 10G). Method 213B conditions H & I (Shock: 75G with unit operating; 100G for non-operation) Also meets IEC 947-5-2 requirements: 30G, 11 ms duration, half sine wave.
Application Notes	**Short Range: Minimum target size:** 10 mm x 10 mm aluminum plate at 500 mm (20") 35 mm x 35 mm aluminum plate at 1.4 m (55") **Long Range: Minimum target size:** 50 mm x 50 mm aluminum plate at 3 m (118") **Discrete:** Enable/Disable; Connect yellow wire to +5 to 24V dc to enable sensor and 0 to +2V dc to disable sensor. When the sensor is disabled, the last output state is held until the sensor is re-enabled. The wire must be held to the appropriate voltage for at least 40 ms for the sensor to enable or disable.
Certifications	CE

Q45U Series Hookups

Q45U Discrete Models



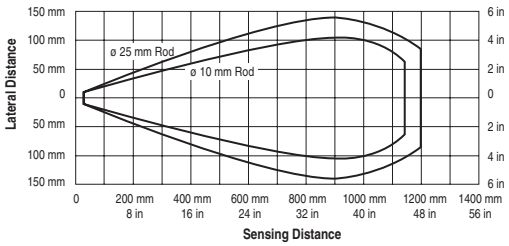
Q45U Analog Models



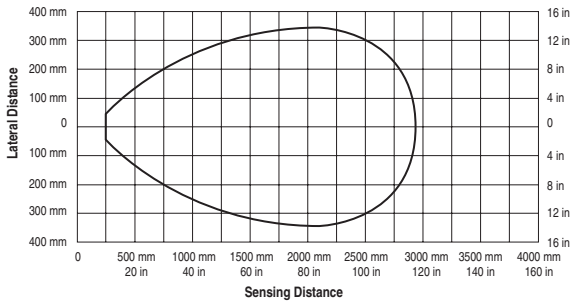
NOTE: Hookups are the same for either integral or QD cable
* It is recommended that the shield wire be connected to either earth ground or DC common.

Q45U Response Curves

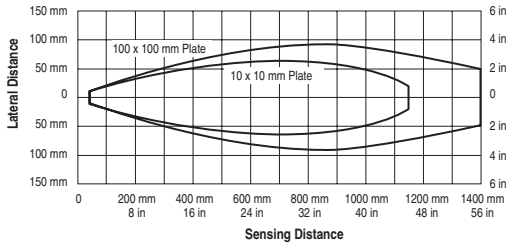
Short Range Ultrasonic Sensor Q45U Effective Beam with Rod Target (Typical)



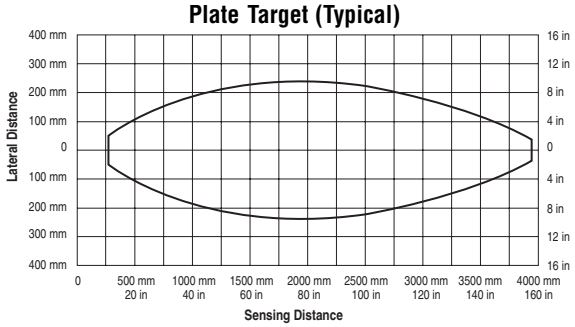
Long Range Ultrasonic Sensor Q45U Effective Beam with 2.5 cm Rod Target (Typical)



Short Range Ultrasonic Sensor Q45U Effective Beam with Plate Target (Typical)

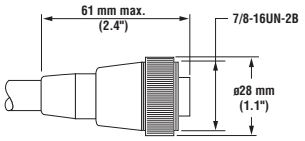
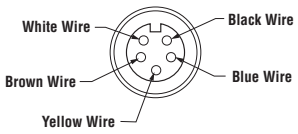
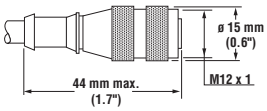
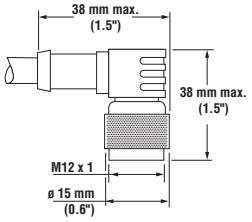
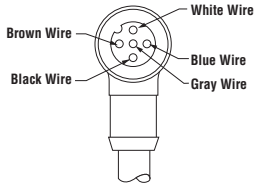


Long Range Ultrasonic Sensor Q45U Effective Beam with 100 mm x 100 mm Plate Target (Typical)



Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded (18 AWG for Mini-style), PVC insulation, gold-plated contacts
Temperature: Euro-style: -40° to +90°C (-40° to +194°F) Mini-style: -40° to +80°C (-40° to +176°F)
Voltage Rating: 250V ac/300V dc

Style	Model	Length	Dimensions	Pin-out
5-Pin Mini Straight w/shield	**MBCC2-506** **MBCC2-512** **MBCC2-530**	2 m (6.5') 4 m (12') 9 m (30')		
5-Pin Euro Straight w/shield	**MQDEC2-506** **MQDEC2-515** **MQDEC2-530**	2 m (6.5') 5 m (15') 9 m (30')		
5-Pin Euro Right-angle w/shield	**MQDEC2-506RA** **MQDEC2-515RA** **MQDEC2-530RA**	2 m (6.5') 5 m (15') 9 m (30')		

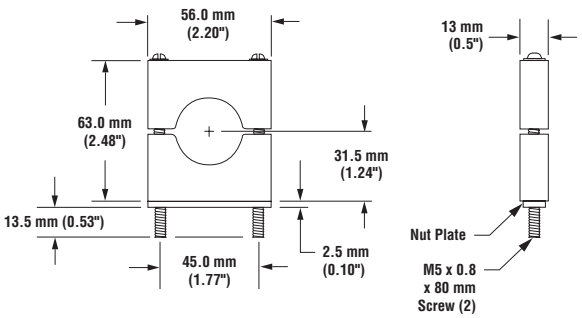
Quick-Disconnect (QD) Option

Q45U Ultrasonic sensors are sold with either a 2 m (6.5') or a 9 m (30') attached cable, or with a 5-pin Mini-style QD cable fitting or a 5-pin Euro-style QD cable fitting. QD sensors are identified by the letters "Q" in their model number suffix.

Mounting Brackets

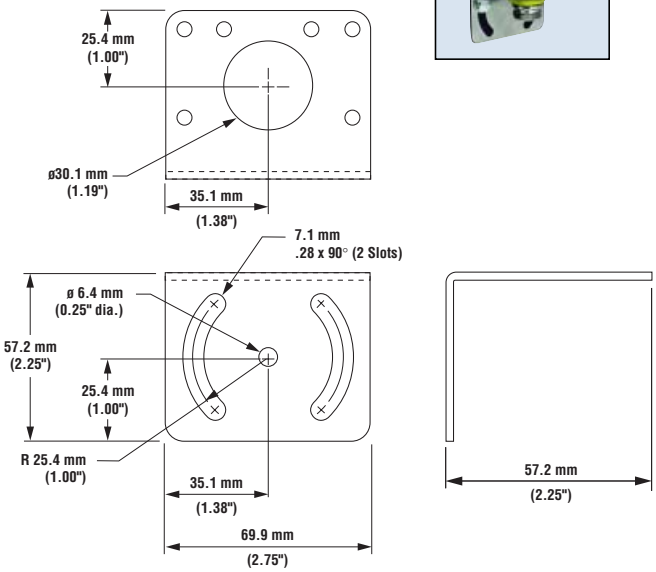
SMB30C

- 30 mm split clamp, black reinforced thermoplastic polyester
- Stainless steel hardware included



SMB30MM

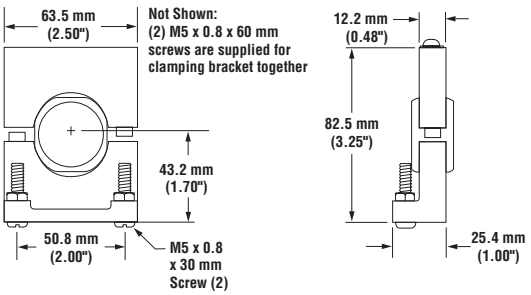
- 30 mm, 11-gauge, stainless steel bracket with curved mounting slots for versatility and orientation
- Clearance for M6 (1/4") hardware



Mounting Brackets

SMB30S

- 30 mm swivel, black PBT polyester bracket
- Stainless steel mounting hardware included

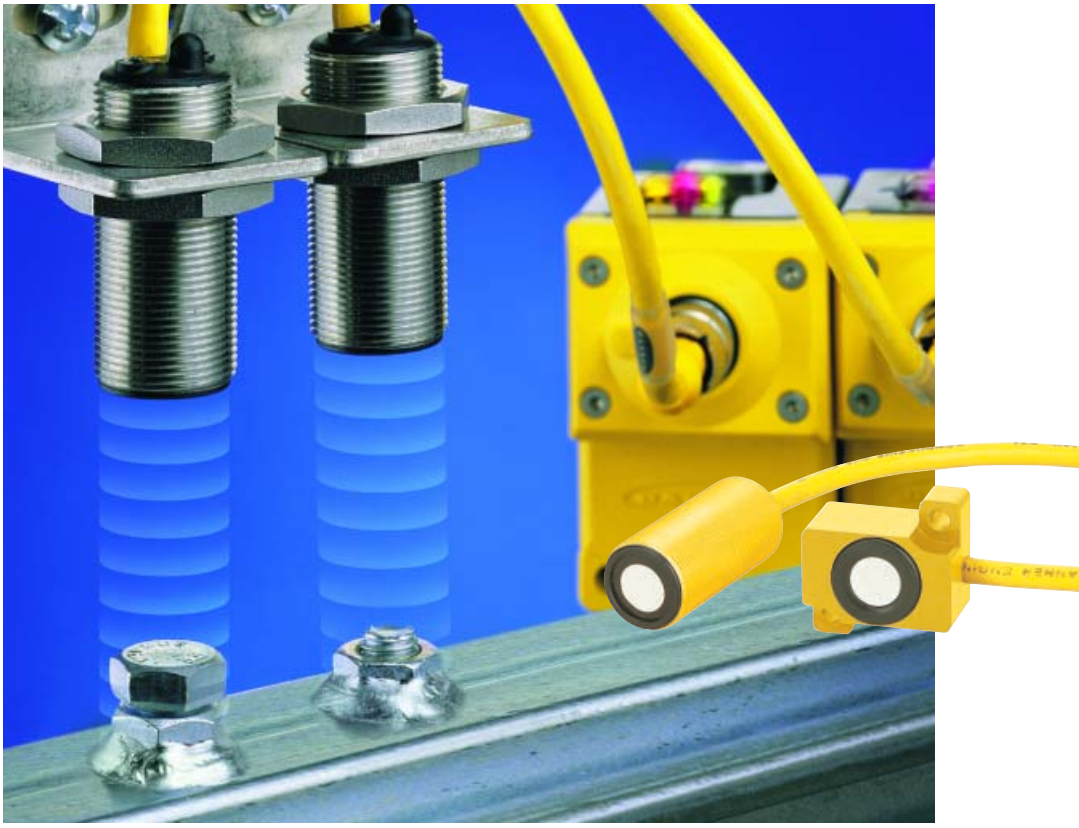


Q45UR Series-
remote ultrasonic sensing.

Precise switched or analog sensing for hard-to-access & difficult applications.

Q45UR remote ultrasonic sensors are available with a choice of three remote sensing heads to access applications with limited space or difficult environments. The new remote sensors offer the same advanced features as standard Q45U models.

- Available in analog and discrete output models
- 50 mm to 250 mm sensing range
- Resolution/repeatability ±0.2% of sensing distance



Set custom sensing "windows" with the push of a button.

TEACH-mode programming enables you to program exact sensing ranges and sensing windows quickly and easily for precision sensing applications and targets located in confined areas.

Discrete output models

- Program windows under 5 mm by pushing one button and adjusting DIP switches
- Larger windows can be programmed by "teaching" individual window limits

Analog output models

- Custom sensing windows from 5-200 mm
- 0.1-0.5 mm resolution, within 50-250 mm range

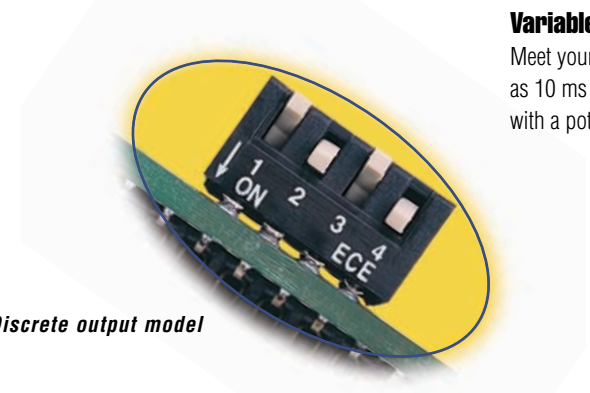
18 mm barrels or compact cubical sensing heads.

The rugged remote sensor heads are available in a stainless steel or plastic 18 mm (0.72") diameter threaded barrel housing, or an ultra-compact, Flat-Pak plastic model.

- Built-in temperature compensation
- Rated IEC IP65 and NEMA 4
- Wide operating temperature range: -25°C to +70°C (-13°F to +158°F)

Variable response times.

Meet your need for response by setting various response times from as fast as 10 ms to up to 320 ms utilizing DIP switches (discrete output models), or with a potentiometer adjustment (analog output models).



Discrete output model

Q45UR Remote Series Models

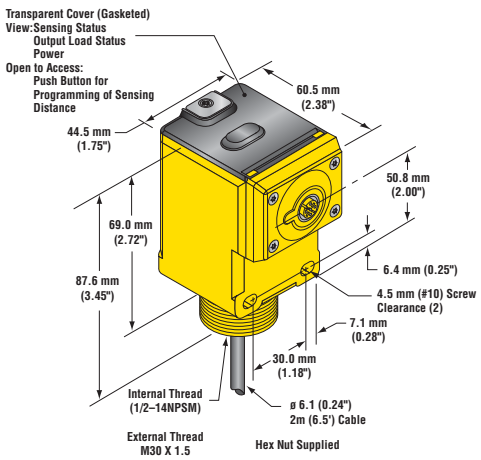
Kit Models	Kit Includes Controller Model	Kit Includes Sensor Model	Sensor Range	Controller Cable*	Supply Voltage	Controller Output	Data Sheet†
Q45UR3BA63CK	Q45UR3BA63C	 M18C2.0 Stainless Steel Barrel	50 to 250 mm (2 to 10")	2 m (6.5')	12 to 24V dc	Discrete: Bipolar NPN/PNP	59321
Q45UR3BA63CQK	Q45UR3BA63CQ			5-pin Mini QD			
Q45UR3BA63CQ6K	Q45UR3BA63CQ6			5-pin Euro QD			
Q45UR3BA63CKQ	Q45UR3BA63C	 Q13C2.0 Flat-Pak	50 to 250 mm (2 to 10")	2 m (6.5')	12 to 24V dc		
Q45UR3BA63CQKQ	Q45UR3BA63CQ			5-pin Mini QD			
Q45UR3BA63CQ6KQ	Q45UR3BA63CQ6			5-pin Euro QD			
Q45UR3BA63CKS	Q45UR3BA63C	 S18C2.0 Molded Barrel	50 to 250 mm (2 to 10")	2 m (6.5')	12 to 24V dc		
Q45UR3BA63CQKS	Q45UR3BA63CQ			5-pin Mini QD			
Q45UR3BA63CQ6KS	Q45UR3BA63CQ6			5-pin Euro QD			
Q45UR3LIU64CK	Q45UR3LIU64C	 M18C2.0 Stainless Steel Barrel	50 to 250 mm (2 to 10")	2 m (6.5')	15 to 24V dc	Analog: Selectable 0 to 10V dc or 4 to 20 mA Sourcing	59323
Q45UR3LIU64CQK	Q45UR3LIU64CQ			5-pin Mini QD			
Q45UR3LIU64CQ6K	Q45UR3LIU64CQ6			5-pin Euro QD			
Q45UR3LIU64CKQ	Q45UR3LIU64C	 Q13C2.0 Flat-Pak	50 to 250 mm (2 to 10")	2 m (6.5')	15 to 24V dc		
Q45UR3LIU64CQKQ	Q45UR3LIU64CQ			5-pin Mini QD			
Q45UR3LIU64CQ6KQ	Q45UR3LIU64CQ6			5-pin Euro QD			
Q45UR3LIU64CKS	Q45UR3LIU64C	 S18C2.0 Molded Barrel	50 to 250 mm (2 to 10")	2 m (6.5')	15 to 24V dc		
Q45UR3LIU64CQKS	Q45UR3LIU64CQ			5-pin Mini QD			
Q45UR3LIU64CQ6KS	Q45UR3LIU64CQ6			5-pin Euro QD			

* 9m (30') cables are available by adding suffix "W/30" to the model number of any cabled sensor (e.g., Q45UR3BA63C W/30). A model with a QD connector requires a mating cable. See page 97 for more information.

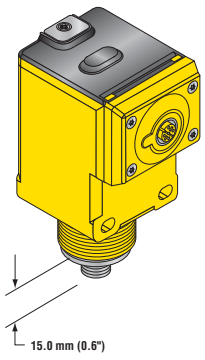
† Data sheets may be downloaded at www.bannerengineering.com.

Q45UR Series Dimensions

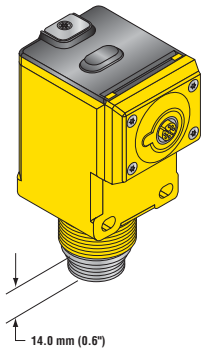
Cabled Models



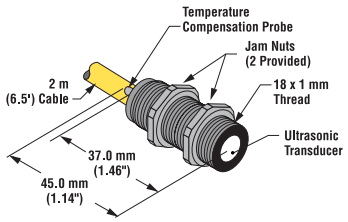
5-Pin Euro-style QD Models ("Q6" model suffix)



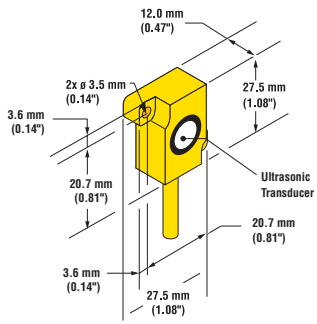
5-Pin Mini-style QD Models ("Q" model Suffix)



M18C2.0 & S18C2.0 Remote Sensor



Q13 Remote Sensor



Q45UR High-Gain Controllers

Product P/N	Version
63060	Q45UR3BA63CQ6-63060 Discrete
63667	Q45UR3LIU64CQ6-63667 Analog

NOTE:
Special High-Gain controllers are available for small object detection.

Q45UR Remote Series Model Selection

Q45UR Remote Series Specifications

Range for Nominal Sensing Position	**Near Limit:** 50 mm (2") min **Far Limit:** 250 mm (10") max
Supply Voltage and Current	**Discrete:** 12 to 24V dc (10% maximum ripple) at 100 mA, exclusive of load **Analog:** 15 to 24V dc (10% maximum ripple) at 100 mA, exclusive of load
Ultrasonic Frequency	400 kHz
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	**Discrete:** Bipolar; one current sourcing (PNP) and one current sinking (NPN) open collector transistor **Analog:** One voltage sourcing and one current sourcing; one or the other output is enabled by internal programming switch #2
Output Rating	**Discrete:** 150 mA maximum (each output) **OFF-state leakage current:** <25 microamps at 24V dc **ON-state saturation voltage:** <1.5V at 10 mA; <2.0V at 150 mA **Analog:** **Voltage Sourcing:** 0 to 10V dc, 10 mA maximum **Current Sourcing:** 4 to 20 mA, 1 to 500 ohm impedance
Output Protection Circuitry	Both outputs are protected against continuous overload and short circuit
Performance Specifications	**Discrete:** **Response Speed:** 40 or 160 milliseconds (switch selectable) **Repeatability*:** ±0.2% of measured distance **Linearity*:** 1% of full scale **Temperature stability:** ±0.03% of the window limit positions per ˚C from 0˚ to 50˚C (±0.05% per ˚C over remainder of operating temperature range) **Sensing window width:** 5 mm to 200 mm, when independent near and far limits are taught; 1, 2, 3, or 4 mm (switch selectable), when a sensing distance set point is taught **Hysteresis:** 0.5 mm **Ultrasonic beam angle:** ±3.5˚ **Analog:** **Resolution*:** 0.2% of sensing distance at 320 ms response 0.4% of sensing distance at 10 ms response **Linearity*:** 1% of full scale **Temperature stability:** ±0.03% of sensing distance per ˚C from 0° to 50˚C (±0.05% per ˚C over remainder of operating temperature) **Ultrasonic beam angle:** ±3.5˚ * Repeatability and analog resolution and linearity are specified using a 50 mm x 50 mm (2" x 2") aluminum plate at 22°C under fixed sensing conditions (Analog: using the 4-20 mA output @ 15V dc)
Adjustments	**Discrete:** The following may be selected by a 4-position DIP switch located on top of the controller, beneath a transparent O-ring sealed acrylic cover and beneath the black inner cover **Switch 1:** Output normally open (output is energized when target is within sensing window limits), or normally closed (output is energized when target is outside sensing window limits) **Switches 2 & 3:** Sensing window size (1 mm, 2 mm, 3 mm or 4 mm) **Switch 4:** Response speed selection (40 or 160 ms) **Analog:** Push-button TEACH-mode programming of window limits. The following may be selected by a 4-position DIP switch located on top of the controller, beneath a transparent O-ring sealed acrylic cover and beneath the black inner cover **Switch 1:** Output slope: output value increases or decreases with distance **Switch 2:** Output mode: current output or voltage output **Switches 3 & 4:** Response to loss of echo **Response Speed Adjustment:** Single-turn potentiometer selects six response values from 10 to 320 milliseconds

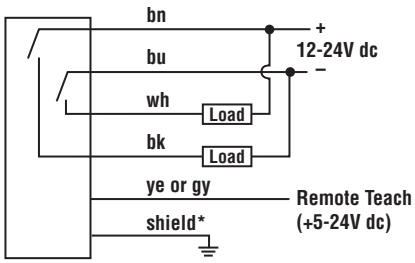
Q45UR Remote Series Specifications (cont'd)

Indicators	**Discrete: Three status LEDs:** GREEN ON steadily = Power to controller is ON GREEN flashing = Output is overloaded YELLOW ON steadily = Output are conducting (Yellow also indicates programming status during setup) RED flashing = Relative strength of received echo 5-segment moving dot LED indicates the position of the target within the sensing window **Analog: Three status LEDs:** GREEN ON steadily = Power to controller is ON GREEN flashing = Current output fault detected (indicates that the 4-20mA current path to ground has been opened) YELLOW ON steadily = Target is sensed within the window limits (Yellow LED also indicates programming status during setup mode) RED flashing = Relative strength of received echo 5-segment moving dot LED indicates the position of the target within the sensing window
Construction	**Controller:** Molded thermoplastic polyester housing, o-ring sealed transparent acrylic top cover, and stainless steel hardware **Sensors:** **M18C2.0:** Stainless steel M18 threaded barrel housing and jam nuts, ULTEM® polyetherimide front cover, ceramic transducer, TEXIN® polyurethane rear cover **S18C2.0:** Thermoplastic polyester S18 threaded barrel housing and jam nuts, ULTEM® polyetherimide front cover, ceramic transducer, TEXIN® polyurethane rear cover **Q13C2.0:** Molded 30% glass reinforced thermoplastic polyester housing, ceramic transducer, fully epoxy-encapsulated
Environmental Rating	**Controller:** IEC IP67; NEMA 6P **Sensor:** IEC IP65; NEMA 4
Connections	**Controller:** 2m (6.5') or 9 m (30') attached cable, or 5-pin Mini-style or Euro-style quick-disconnect fitting **Sensor:** 2m (6.5') attached PVC cable terminated with 4-pin Euro-style quick-disconnect fitting for connection to controller
Operating Conditions	**Controller and sensor:** -25° to +70°C (-13° to +158°F) **Maximum relative humidity:** 85% (non-condensing)
Vibration and Mechanical Shock	All models meet Mil. Std. 202F requirements. Method 201A Vibration: 10 to 60Hz max., double amplitude 0.06" (maximum acceleration 10G). Method 213B conditions H & I (Shock: 75G with unit operating; 100G for non-operation). Also meets IEC 947-5-2 requirements: 30G, 11 ms duration, half sine wave.
Application Notes	**Discrete:** The TEACH-mode function of the controller is used to set the sensing distance set point. The sensing window size is set using DIP switches #2 and #3. The sensing distance set point is centered within the sensing widow. The size of the sensing window may be adjusted at any time, with or without power applied, and without re-teaching the sensing distance set point. The controller has non-volatile memory which remembers the last sensing distance set point setting if power is removed and later reapplied. The sensing distance set point may be programmed via the Remote Teach input (see hookup diagrams). Acceptable target angle is within ±5° of normal for a smooth, flat target; target rotation does affect the apparent target location with respect to the sensor. **Analog:** The controller has non-volatile memory which remembers the last sensing distance set point setting if power is removed and later reapplied. The sensing distance set point may be programmed via the Remote Teach input (see hookup diagrams). Acceptable target angle is within ±5° of normal for a smooth, flat target; target rotation does affect the apparent target location with respect to the sensor.
Certifications	CE

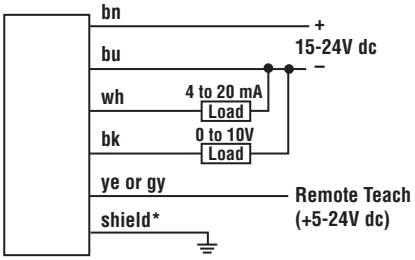
ULTEM® is a registered trademarks of General Electric
TEXIN® is a registered trademark of Bayer Corporation

Q45UR Series Controller Hookups

Q45UR Discrete Models

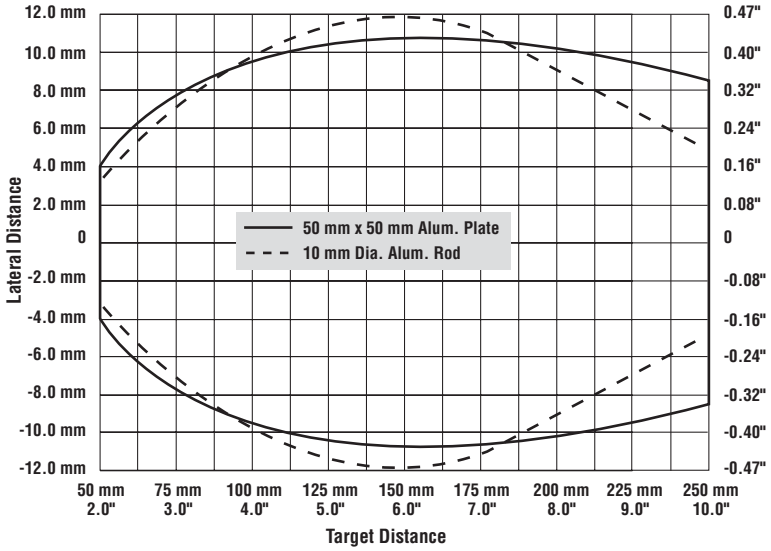


Q45UR Analog Models



NOTE: Hookups are the same for either integral or QD cable
* It is recommended that the shield wire be connected to either earth ground or DC common.

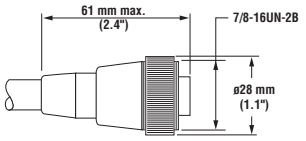
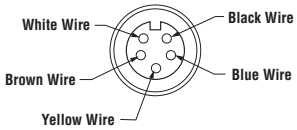
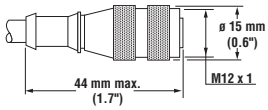
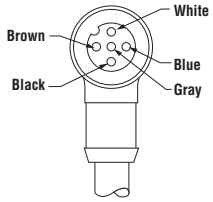
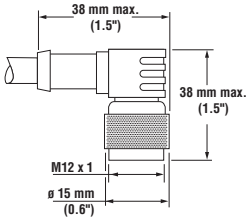
Q45UR Response Curve



NOTE: The pattern displayed for the 50 mm x 50 mm Aluminum plate is referenced to the EDGE of the plate.
The pattern displayed for the 10 mm dia. Aluminum rod is referenced to the CENTER of the rod.

Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded (18 AWG for Mini-style), PVC insulation, gold-plated contacts
Temperature: Euro-style: -40° to +90°C (-40° to +194°F) Mini-style: -40° to +80°C (-40° to +176°F)
Voltage Rating: 250V ac/300V dc

Style	Model	Length	Dimensions	Pin-out
5-Pin Mini Straight w/shield	**MBCC2-506** **MBCC2-512** **MBCC2-530**	2 m (6.5") 4 m (12") 9 m (30")		
5-Pin Euro Straight w/shield	**MQDEC2-506** **MQDEC2-515** **MQDEC2-530**	2 m (6.5') 5 m (15') 9 m (30')		
5-Pin Euro Right-angle w/shield	**MQDEC2-506RA** **MQDEC2-515RA** **MQDEC2-530RA**	2 m (6.5') 5 m (15') 9 m (30')		

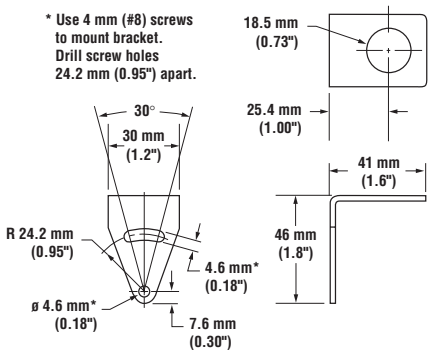
Quick-Disconnect (QD) Option

Q45UR Ultrasonic controllers are sold with either a 2 m (6.5') or a 9 m (30') attached cable, or with a 5-pin Mini-style QD cable fitting or a 5-pin Euro-style QD cable fitting. QD controllers are identified by the letters “Q” in their model number suffix.

Sensor Mounting Brackets

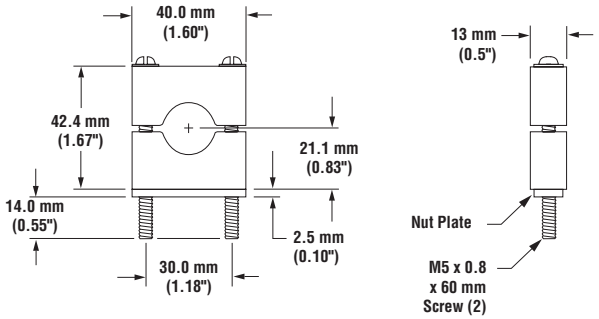
SMB18A

- 12-gauge, stainless steel, right-angle mounting bracket with a curved mounting slot for versatility and orientation
- Clearance for M4 (#8) hardware



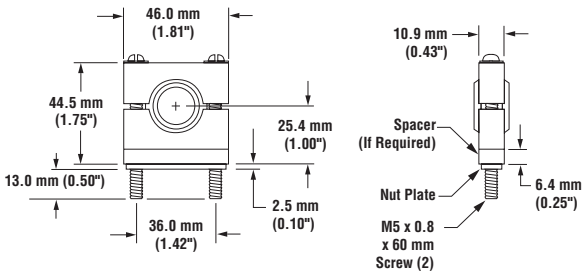
SMB18C

- 18 mm split clamp black PBT polyester bracket
- Stainless steel mounting hardware included



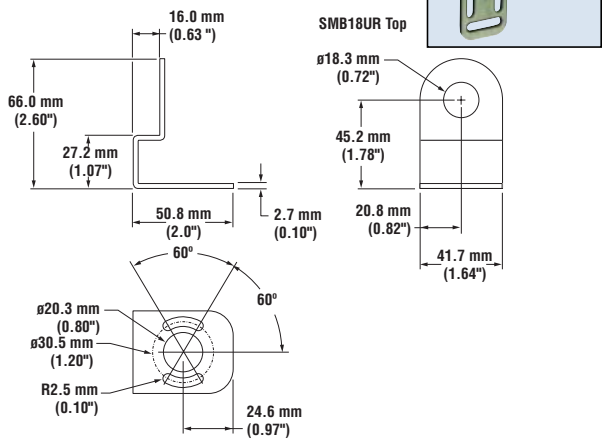
SMB18S

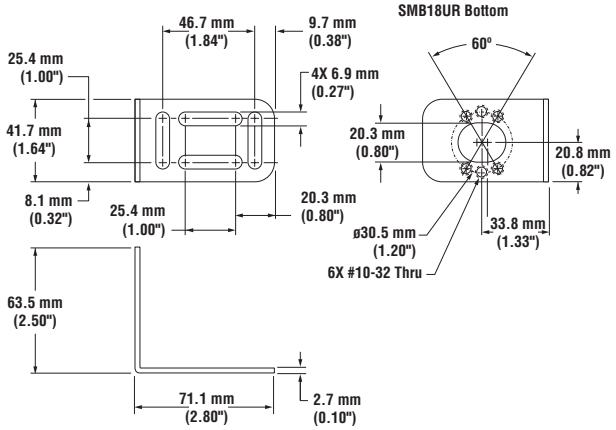
- 18 mm swivel, black PBT polyester bracket
- Stainless steel mounting hardware included



SMB18UR

- 2-piece universal swivel bracket for 18 mm sensors
- 300 series stainless steel
- Includes stainless steel swivel locking hardware

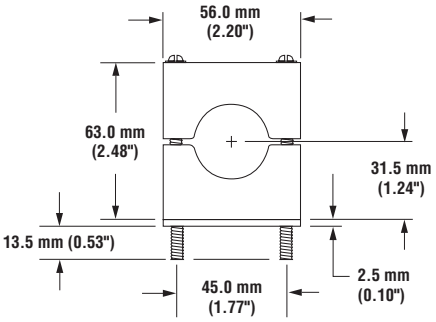


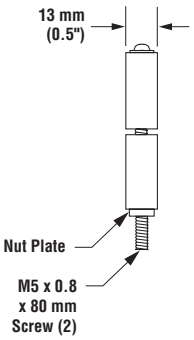


Controller Mounting Brackets

SMB30C

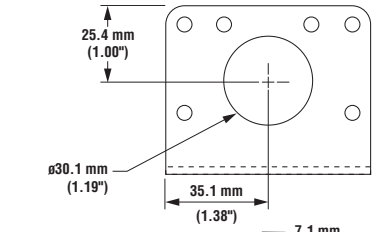
- 30 mm split clamp, black reinforced thermoplastic polyester
- Stainless steel hardware included

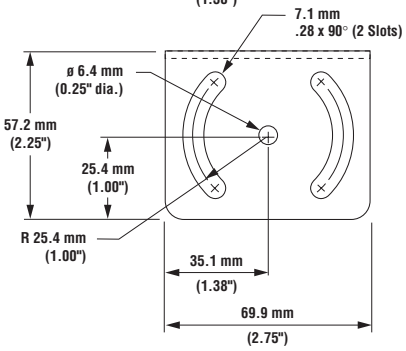


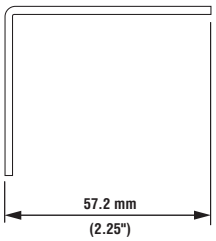


SMB30MM

- 30 mm, 11-gauge, stainless steel bracket with curved mounting slots for versatility and orientation
- Clearance for M6 (1/4") hardware

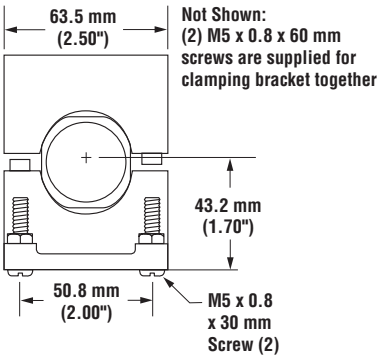


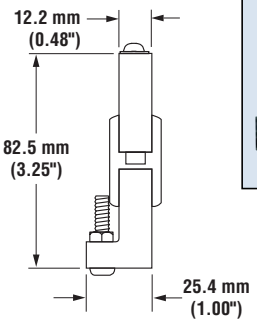




SMB30S

- 30 mm swivel, black PBT polyester bracket
- Stainless steel mounting hardware included





U-GAGE®

T18U Series- opposed dual range ultrasonic sensing for extraordinary reliability.

Reliable sensing of clear materials.

- High frequency acoustic emitter and tuned receiver are ideal for sensing under bright lighting and for reliably detecting clear materials such as glass
- Operate from 12 to 30V dc with current-sinking (NPN) or current-sourcing (PNP) complementary outputs to interface with a wide variety of loads

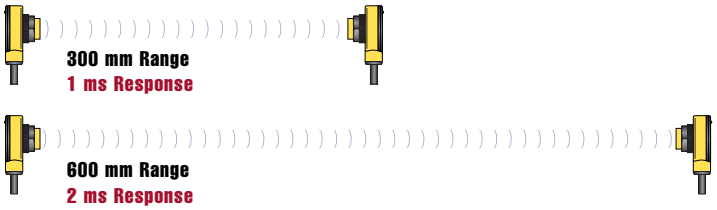
Dual ranges & response times.

Choice of two ranges and two response times in the same units, for the ultimate in versatility. Options include:

- Response time of 2 ms and range of 600 mm for longer ranges
- Reverse the polarity and achieve ultra-fast response of 1 ms with a range of 300 mm for high-speed applications such as counting

Popular patented housing.

- T-style right-angle sensor package with 18 mm threaded mounting hub allows more versatile mounting, using less space
- Measures only 40 mm in diameter and 30 mm deep. Choose 4-pin Euro-style quick disconnect for fast changeout, or prewired units

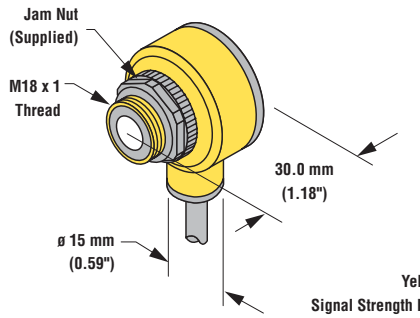


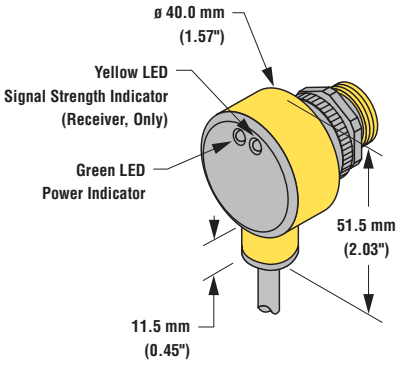
T18U Series Models							
Models*		**Range**	**Cable****	**Supply Voltage**	**Output Type**	**Response Time**	**Data Sheet†**
T186UE	Emitter	Normal resolution: 600 mm (24") High resolution: 300 mm (12")	2 m (6.5')	12 to 30V dc	—	Normal resolution: 2 ms or High resolution: 1 ms	40124
T186UEQ	Emitter		4-pin Euro QD				
T18VN6UR	Receiver		2 m (6.5')		Complementary NPN		
T18VN6URQ	Receiver		4-pin Euro QD				
T18VP6UR	Receiver		2 m (6.5')		Complementary PNP		
T18VP6URQ	Receiver		4-pin Euro QD				

* Sensor pair requires one emitter and one receiver.
** 9 m (30') cables available by adding suffix "W/30" to the model number of any cabled sensor (e.g., **T18VN6UR W/30**). A model with a QD connector requires a mating cable. See page 104 for more information.
† Data sheets may be downloaded at www.bannerengineering.com.

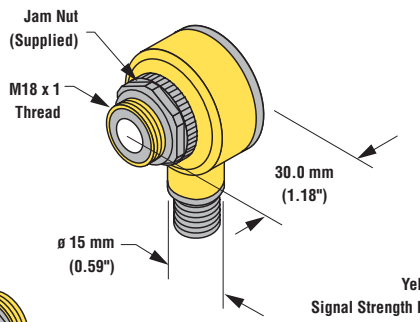
T18U Series Dimensions

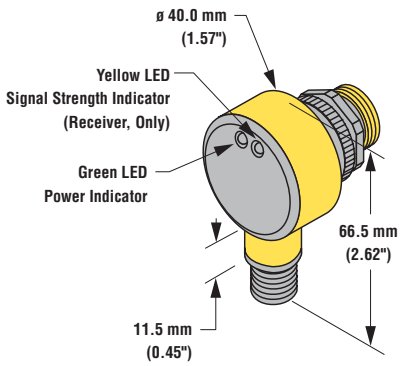
Cabled Models





Euro-Style QD Models





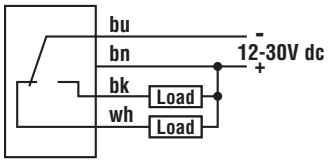
T18U Series Model Selection

T18U Series Specifications	
Sensing Beam	Ultrasonic, 230 kHz
Sensing Range (no minimum range)	**NORMAL resolution mode:** to 24" (60 cm) **HIGH resolution mode:** to 12" (30 cm)
Supply Voltage	12 to 30V dc, 10% maximum ac ripple. 50 mA (emitters); 35 mA (receivers), exclusive of output load.
Minimum spacing (adjacent pairs)	5 cm for emitter-to-receiver separations of up to 15 cm. Add 1 cm of adjacent-pair spacing for every 10 cm of emitter-to receiver spacing beyond 15 cm.
Receiver Output Configuration	**T18VN models:** NPN sinking, N.O. and N.C. (complementary) **T18VP models:** PNP sourcing, N.O. and N.C. (complementary)
Receiver Output rating	150 mA maximum each output at 25°C, derated to 100 mA at 70° C (derate =1mA per °C). Both outputs may be used simultaneously. **On-state saturation voltage:** < 1.5 at 10 mA; < 2.0 V at 150 mA **Off-state leakage current:** < 1 microamp at 30V dc **Output protection:** Overload and short-circuit protected. No false pulse upon receiver power-up: false pulse protection causes a 100 millisecond delay upon power-up.
Response Time	**NORMAL resolution mode:** 2 milliseconds "on" and "off" **HIGH resolution mode:** 1 millisecond "on" and "off"
Rep Rate	**NORMAL resolution mode:** 125 Hz maximum **HIGH resolution mode:** 200 Hz maximum
Mechanical Sensing Repeatability at 12 inch (30 cm) range	**NORMAL resolution mode:** < 2 mm (< 0.08") **HIGH resolution mode:** < 1 mm (< 0.04")
Beam Angle (-3dB full angle)	15 ± 2°
Indicators	Emitters have a green LED for dc power "on". Receivers have two LED's, one yellow and one green. Indications are as follows: **Green glowing steadily** = dc power "on" **Green flashing** = output overloaded **Yellow flashing** = sonic signal received (flash rate is proportional to received signal strength; flash is from full to half intensity).
Construction	Patented T-style yellow PBT polyester housing with black PBT polyester back cover. Transducer housing is threaded M18 x 1. Mating jam nut is supplied for mounting. Acoustic face is epoxy reinforced. Circuitry is epoxy-encapsulated. Rated NEMA 6P, IEC IP67.
Cabling Options	**Emitters:** 6.5' long (2 m) attached PVC- covered 2-wire cable or 4-pin euro-style quick-disconnect fitting. **Receivers:** 6.5' long (2 m) attached PVC-covered 4-wire cable or 4-pin euro-style quick-disconnect fitting. 30' long cables are available by request. Mating Euro-style quick-disconnect cables are also available. See page 104.
Vibration and Mechanical Shock	Meets Mil.Std 202F requirements. Method 201A (Vibration: frequency 10 to 60 Hz, max., and double amplitude 0.06-inch, maximum acceleration 10G). Method 213B conditions H&I (Shock: 75G with unit operation;100G for non-operation) Also meets IEC 947-5-2 requirements: 30G, 11 ms duration, half sine wave.
Operating Temperature	-40° to +70°C (-40° to 158° F)
Certifications	CE

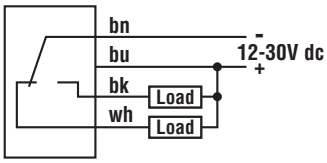
T18U Series Hookups

Receiver Hookups (NPN sinking; T18VN6 models)

NORMAL Resolution



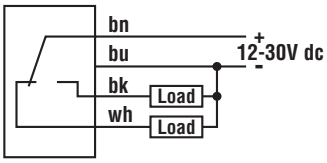
HIGH Resolution



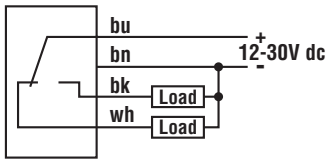
Sensor range is greater, and resolution lower, when using the NORMAL resolution hookups. Range is less, and resolution higher, when using the HIGH resolution hookups.
Wire colors are the same for cabled and quick-disconnect models. See next page for QD cable information. All emitters use the hookup below.

Receiver Hookups (PNP sourcing; T18VP6 models)

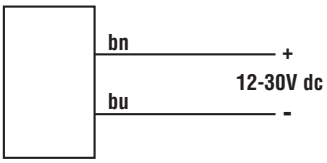
NORMAL Resolution



HIGH Resolution

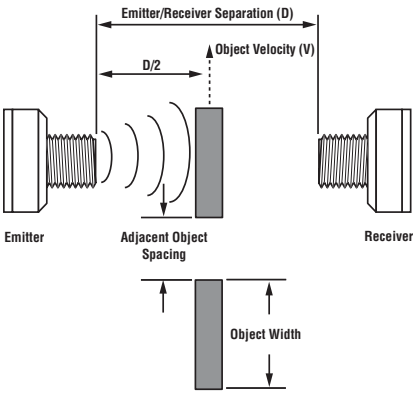


Emitter Hookup



NOTE: Hookups are the same for either integral or QD cable

Minimum Object Width and Minimum Object Spacing



These figures reflect the following assumption:

1) Objects have square (not radiused) corners
2) Sensors are optimally aligned
3) Objects pass through the sensing area midway between the emitter and receiver (i.e. at D/2)*
4) Operating conditions are stable, with minimal air turbulence

*In general, the minimum object width and minimum object spacing will decrease if the object (or space) to be detected is passed closer to the emitter or the receiver.

Individual results may differ, based on ambient operation conditions, alignment, and the geometry of the objects to be detected.

T18U Series Minimum Object Width (Typical)

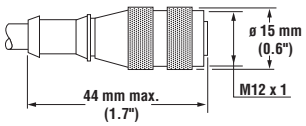
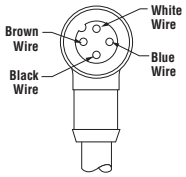
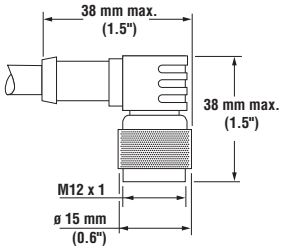
Resolution Mode	Emitter/Receiver Separation (D)	Velocity = 0 in/sec	Velocity = 50 in/sec	Velocity = 100 in/sec
Normal	6" (15 cm)	1.00" (25.4 mm)	1.40" (35.6 mm)	1.50" (38.1 mm)
Normal	12" (30 cm)	1.25" (31.8 mm)	2.00" (50.8 mm)	2.00" (50.8 mm)
Normal	24" (60 cm)	1.00" (25.4 mm)	1.75" (44.5 mm)	1.75" (44.5 mm)
High	6" (15 cm)	0.60" (15.2 mm)	0.75" (19.1 mm)	0.80" (20.3 mm)
High	12" (30 cm)	0.50" (12.7 mm)	0.75" (19.1 mm)	1.00" (25.4 mm)

T18U Series Minimum Adjacent Object Spacing (Typical)

Resolution Mode	Emitter/Receiver Separation (D)	Velocity = 0 in/sec	Velocity = 50 in/sec	Velocity = 100 in/sec
Normal	6" (15 cm)	0.03" (0.8 mm)	0.04" (1.0 mm)	0.05" (1.3 mm)
Normal	12" (30 cm)	0.10" (2.5 mm)	0.15" (3.8 mm)	0.20" (5.1 mm)
Normal	24" (60 cm)	0.35" (8.9 mm)	0.40" (10.2 mm)	0.50" (12.7 mm)
High	6" (15 cm)	0.13" (3.3 mm)	0.15" (3.8 mm)	0.17" (4.3 mm)
High	12" (30 cm)	0.40" (10.2 mm)	0.45" (11.4 mm)	0.45" (11.4 mm)

Euro-Style Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40° to +90°C (-40° to +194°F)
Voltage Rating: 250V ac/300V dc

Style	Model	Length	Dimensions	Pin-out
4-Pin Euro Straight	**MQDC-406** **MQDC-415** **MQDC-430**	2 m (6.5') 5 m (15') 9 m (30')		
4-Pin Euro Right-angle	**MQDC-406RA** **MQDC-415RA** **MQDC-430RA**	2 m (6.5') 5 m (15') 9 m (30')		

Quick-Disconnect

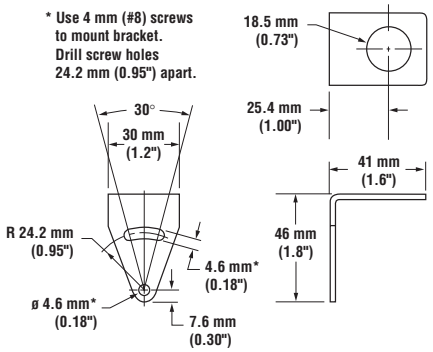
T18U Series quick-disconnect sensor models use Euro-style quick-disconnect cables. Quick-disconnect sensor models are identified by the letter "Q" in their model number suffix.

All T18U Series quick-disconnect models use 4-wire cable (emitters do not use the black and white wires). Cables are available with either a straight connector or a right-angle connector.

Mounting Brackets

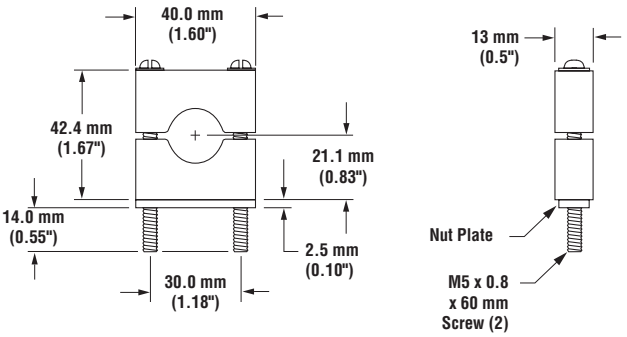
SMB18A

- 11-gauge, stainless steel right-angle bracket
- Curved mounting slot for versatility and orientation



SMB18C

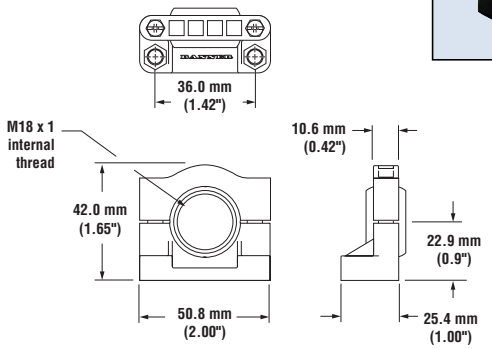
- 18 mm split clamp bracket
- Black thermoplastic polyester
- Includes stainless steel mounting hardware



Mounting Brackets

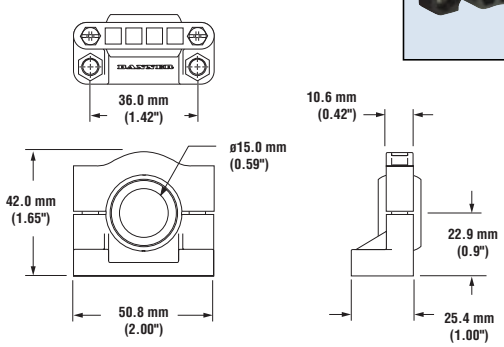
SMB18SF

- 18 mm swivel bracket
- Black thermoplastic polyester
- Includes stainless steel mounting hardware



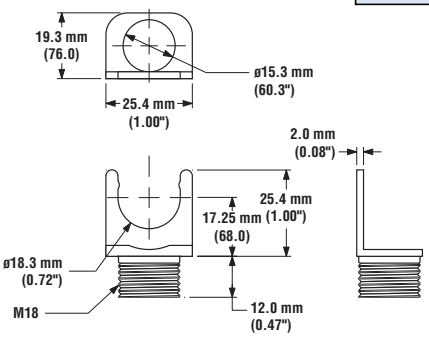
SMB1815SF

- Swivel with set screws for mounting sensor by its cable hub
- Black reinforced thermoplastic polyester
- Stainless steel hardware included



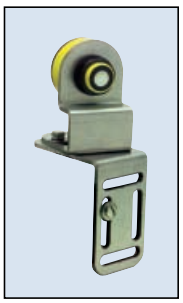
SMBT18Y

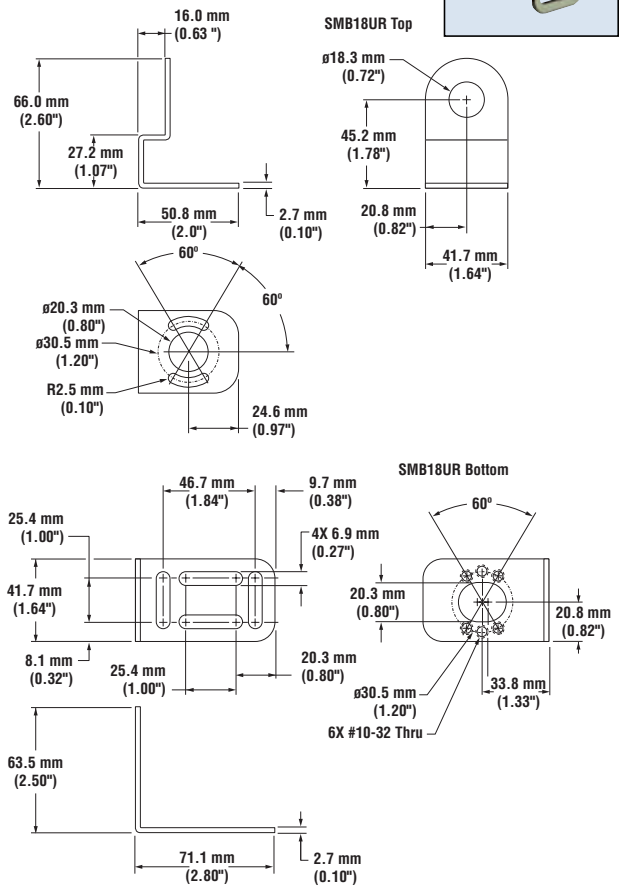
- Die-cast bracket for mounting into 18 mm holes
- Metal hex nut included
- Accommodates Euro-style QD connectors and cabled versions



SMB18UR

- 2-piece universal swivel bracket for 18 mm sensors
- 300 series stainless steel
- Includes stainless steel swivel locking hardware





SONIC OMNI-BEAM™ Series–
a proven ultrasonic sensing solution.

Adjustable sensing window.
- To easily adjust sensing window width and near limit, adjust 15-turn potentiometers while observing LEDs, or a dc voltmeter for analog units
- Sensing range is 100 mm to 660 mm; window size is 80 mm to 560 mm

KAPTON® Protected Transducer.
Protected from hostile environments with a rugged polyimide film seal.

Modular AC or DC Input.
Sensor head is easily coupled to modular power blocks, providing the supply voltage you need—105 to 130V ac, 210 to 250V ac or 18 to 30 V dc.

Analog output models.
- Output voltage is proportional to the distance of the sensor from the target object within the sensing window
- Output value can be voltage or current, and can be programmed to increase (positive slope) or decrease (negative slope) with increasing distance of the target from the sensor

Simplified setup with 10 element LED array.
Moving dot LEDs visually display the relative position of the target within the sensing window.
- Makes initial setup fast and easy
- Provides continuous display of sensor performance

ON/OFF and HIGH/LOW control modes (switched output models).
ON/OFF presence detection or HIGH/LOW level control modes are switch selectable, meeting the logic needs for presence detection as well as fill-level, web tensioning control and similar applications.

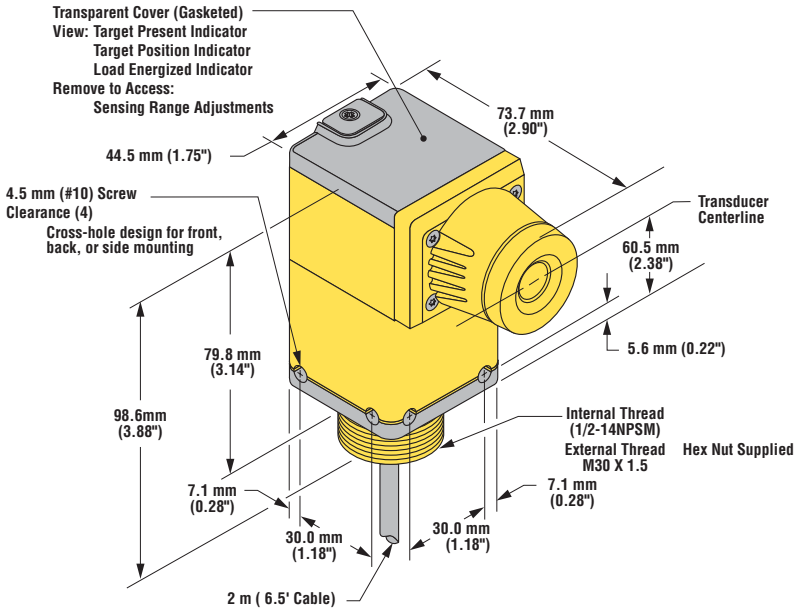
Sonic OMNI-BEAM Sensor Head Model					
Models	**To Complete Sensor**	**Range**	**Supply Voltage**	**Output Type**	**Data Sheet†**
OSBUSR	Select power block from chart, below	100 to 660 mm (4" to 26")	Provided by Power Block	Provided by Power Block	03536

Sonic OMNI-BEAM Power Block Models					
Models	**Cable***	**Supply Voltage**	**Response Time**	**Output Type**	**Data Sheet†**
OPBT5 **OPBT5QD**	2 m (6.5') 5-pin Mini QD	18 to 30V dc	**Discrete Output:** Programmable for 25, 75, 250, or 750 ms	**Discrete:** SPDT Electromechanical Relay	31486
OPBA5 **OPBA5QD**	2 m (6.5') 5-pin Mini QD	105 to 130V ac			None
OPBB5 **OPBB5QD**	2 m (6.5') 5-pin Mini QD	210 to 250V ac			None
OPBT3 **OPBT3QD**	2 m (6.5') 5-pin Mini QD	15 to 30V dc	**Analog Output:** 25 ms	**Analog:** 0 to 10V dc and 10-0V dc	03579
OPBA3 **OPBA3QD**	2 m (6.5') 5-pin Mini QD	105 to 130V ac			03548
OPBB3 **OPBB3QD**	2 m (6.5') 5-pin Mini QD	210 to 250V ac			03550

* 9 m (30') cables available by adding suffix "W/30" to the model number of any cabled sensor (e.g., OPBT5 W/30). A model with a QD connector requires a mating cable. See page 110 for more information.
† Data sheets may be downloaded at www.bannerengineering.com.

Sonic OMNI-BEAM Dimensions

(The model OSBUSR sensor head module and the power block module are sold separately.)



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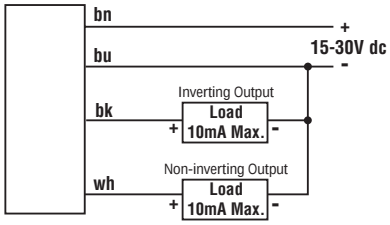
Sonic OMNI-BEAM™ Model Selection

Sonic OMNI-BEAM Specifications	
Supply Voltage and Current Power Block	**Relay output power blocks** 18 to 30V dc 105 to 130V ac (50/60Hz) 210 to 250V ac (50/60Hz) **Analog output power blocks** 15 to 30V dc 105 to 130V ac (50/60Hz) 210 to 250V ac (50/60Hz)
Sensor Supply Voltage	Supplied by OMNI-BEAM Power Block
Supply Protection Circuitry	Protected against transient voltages. DC models are protected against reverse polarity
Sensing Range	4 to 26" (100 to 660 mm)
Window Size	3 to 22" (80 to 560 mm) in depth, adjustable
Ultrasonic Frequency	215 kHz
Output	**Relay output power blocks (SPDT electromechanical relay)** One form "C" SPDT relay, silver nickel alloy contacts. **Maximum voltage:** 250V ac or 30V dc (resistive load) **Maximum current:** 7 amps (resistive load) **Minimum load:** 5V dc at 10 milliamps **Mechanical life:** 50,000,000 operations **Electrical life:** 100,000 operation (at full-rated resistive load) Protected against false pulse on power-up **Analog output power blocks** **Two solid-state outputs:** 0 to +10V dc sourcing and + 10 to 0V dc sourcing. Outputs may be used simultaneously. Maximum load for dc powered models is 10 mA each output. Outputs of ac powered models may also be used simultaneously, but total load may not exceed 10 mA. Protected against short-circuit and overload
Response Time	**With relay output power block:** Programmable for 1, 3, 10 or 30 consecutive sensing cycles for target presence/absence verification (25ms/cycle) **With analog output power block:** 25 milliseconds
Limit Adjustments (all models)	Near and far window limits are independently adjustable using 15-turn clutched potentiometers (with slotted brass elements), located beneath a gasketed cover on top of the sensor. A small, flat-bladed screwdriver is required for adjustment NOTE: Always set near limit first (by adjusting the NEAR control); the far limit is set by adjusting the WIDTH control
Operating Modes	**With relay output power block** 1) ON/OFF mode. Output relay energizes when target is within the sensing window 2) HIGH/LOW mode. Output relay energizes when target moves beyond the far limit, and de-energizes when target moves inside the near limit **With analog output power block** Power block analog voltage output is proportional to the position of a target object detected within the sensing window. The relationship between the 0 to 10V dc analog voltage output and target distance is selectable, and may be either positive or negative
Status Indicators	**With relay output power block** LED indicators for TARGET PRESENT and LOAD (relay energized). Ten-element moving-dot display indicates relative position of the target within the sensing window **With analog output power block** LED indicators for TARGET PRESENT. Ten-element moving-dot display indicates relative position of the target within the sensing window and approximate analog voltage output
Performance Specifications	**Linearity:** 1% of full scale **Analog sensing resolution or discrete output repeatability:** 0.25% of sensing distance **Temperature effect:** 0.2% of sensing distance/1°C
Power Block Connections	Six-foot attached PVC-covered cable, or integral threaded standard quick-disconnect connector. Twelve-foot long mating quick-disconnect cables are sold separately
Construction	**Sensor Housing:** molded PBT thermoplastic polyester. Top view window: transparent acrylic polycarbonate: Sensor seal: KAPTON® polyimide type HN film. Hardware: stainless steel. When assembled, all components are fully gasketed and rated NEMA 4 **Power Block:** Reinforced PBT polyester housing with epoxy-encapsulated circuitry
Environmental Rating	Meets IEC IP66 and NEMA 1, 2, 3, 3S, 4, 12 and 13 standards when sensor is assembled to power block
Operating Conditions	**Temperature:** 0˚ to 50˚ C (+32˚ to 122˚ F) **Maximum relative humidity:** 90% (non-condensing)
Certifications	CE

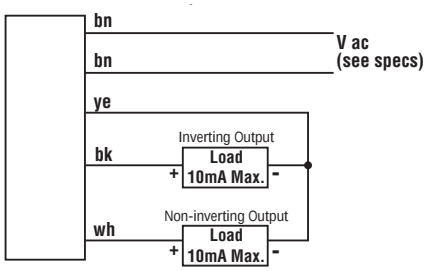
KAPTON® is a registered trademark of Dupont Co.

Sonic OMNI-BEAM Power Block Hookups

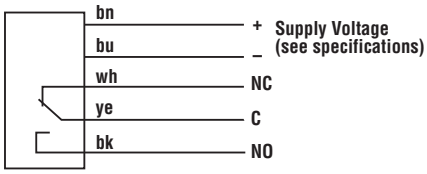
OPBT3 DC Power Blocks



OPBA3 and OPBB3 AC Power Blocks



OPBT5, OPBA5 and OPBB5 Switched Output Models



NOTE: Hookups are the same for either integral or QD cable

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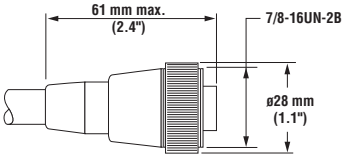
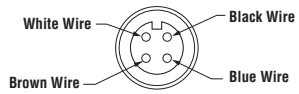
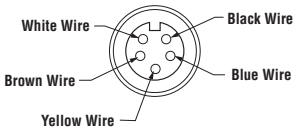
Sonic OMNI-BEAM™ Accessories

Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded (18 AWG for Mini-style), PVC insulation, gold-plated contacts
Temperature: -40° to +80°C (-40° to +176°F)
Voltage Rating: 250V ac/300V dc

Style	Model	Length	Dimensions	Pin-out
4-Pin Mini Straight (for use with model OPBT3QD)	**MBCC-406** **MBCC-412** **MBCC-430**	2 m (6.5') 4 m (12') 9 m (30')		
5-Pin Mini Straight	**MBCC-506** **MBCC-512** **MBCC-530**	2 m (6.5') 4 m (12') 9 m (30')		
5-Pin Mini w/shield	**MBCC2-506** **MBCC2-512** **MBCC2-530**	2 m (6.5') 4 m (12') 9 m (30')		

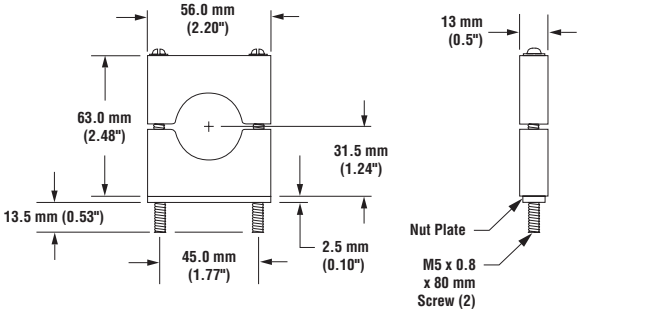
Quick-Disconnect (QD) Option

Sonic OMNI-BEAM Analog power blocks are sold with either a 2 m (6.5') or 9 m (30') attached PVC-covered cable, or with a 4- or 5-pin Mini-style QD cable fitting. Sonic OMNI-BEAM quick-disconnect power blocks are identified by the letters "QD" in their model number suffix.

Mounting Brackets

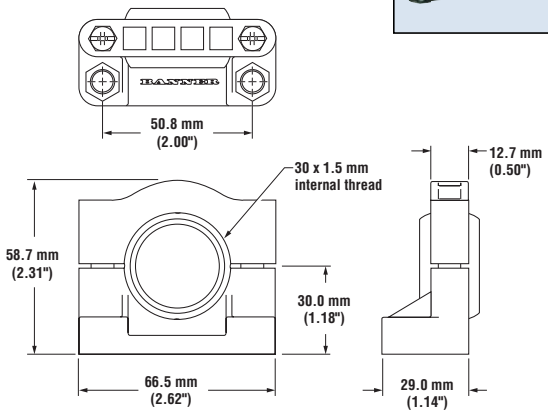
SMB30C

- 30 mm split clamp, black reinforced thermoplastic polyester
- Stainless steel hardware included



SMB30SC

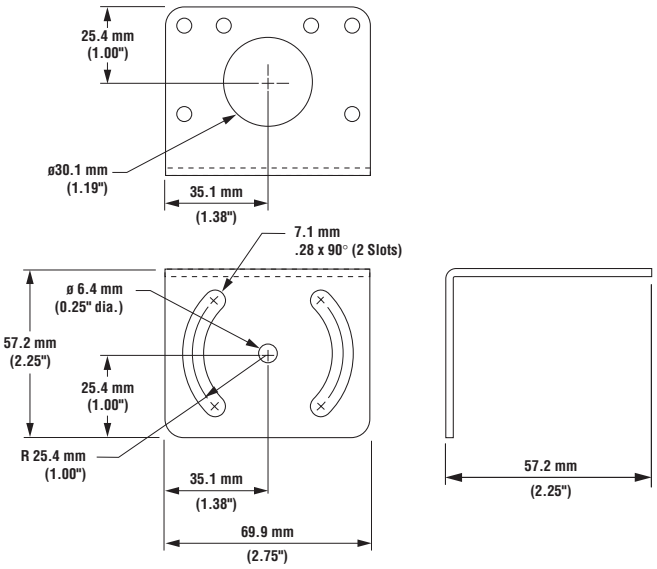
- 30 mm split clamp with swivel, black reinforced thermoplastic polyester
- Stainless steel hardware included



Mounting Brackets

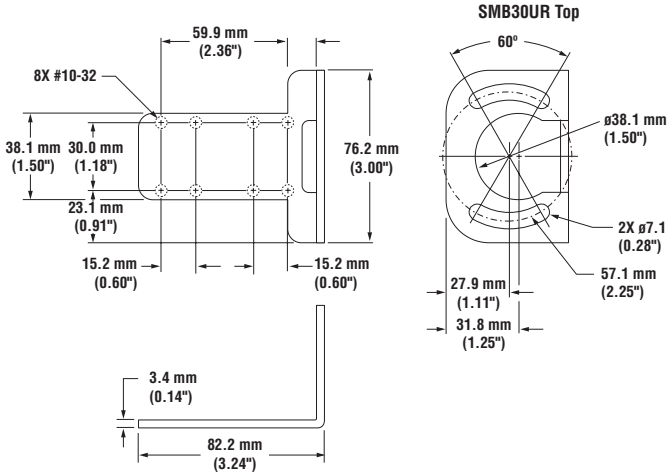
SMB30MM

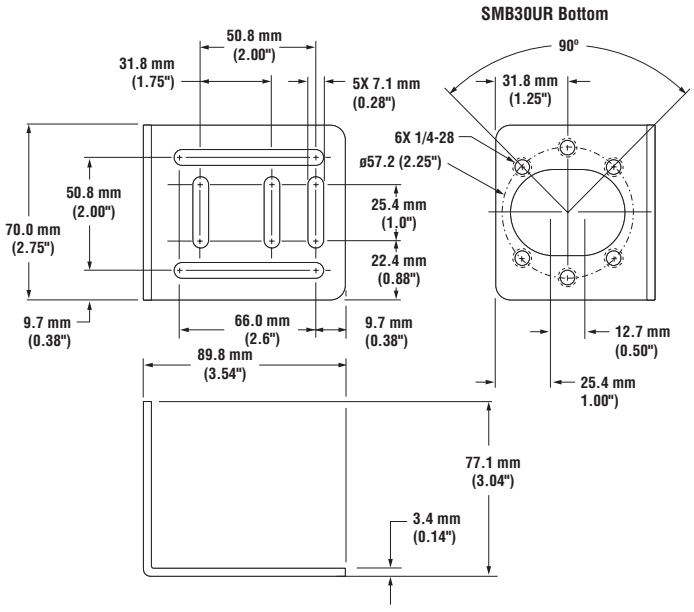
- 30 mm, 11-gauge, stainless steel bracket with curved mounting slots for versatility and orientation
- Clearance for M6 (1/4") hardware



SMB30UR

- 2-piece universal swivel bracket for limit-switch style sensors
- 300 series stainless steel





U-GAGE®

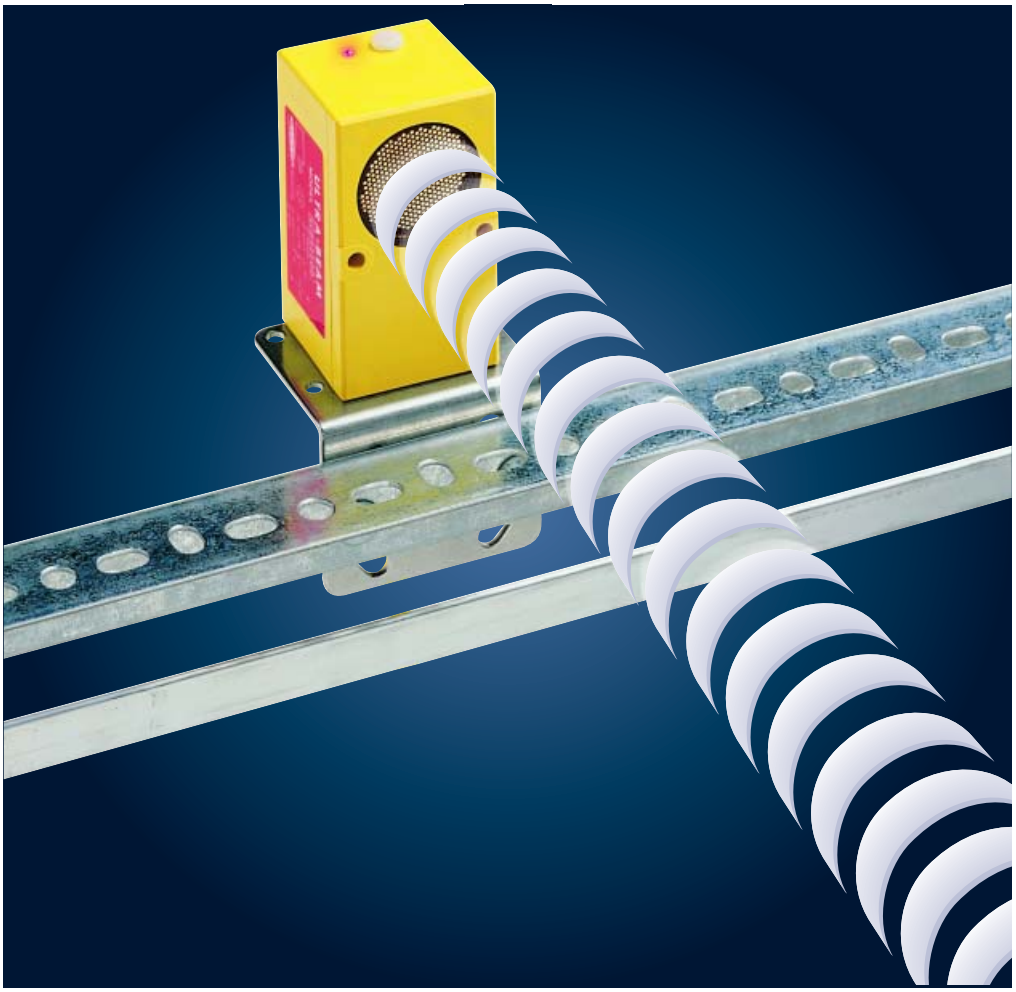
ULTRA-BEAM™ Series-
electrostatic ultrasonic sensing.

Long 0.5 m to 6 m range.

- Electrostatic transducer provides economical, reliable, close or long-distance sensing independent of color or texture of target object
- Adjustable sensing window in analog output units can be 300 mm to 5.6 m wide and adjusted using NULL and SPAN adjustments on top of unit

Rugged construction.

- Electrostatic transducer with metal mesh protective screen
- Housing is molded PBT polyester with epoxy-encapsulated circuitry, meeting many sensing requirements, rated NEMA 1, 3, and 12



Switched AC and DC electromechanical or analog outputs.

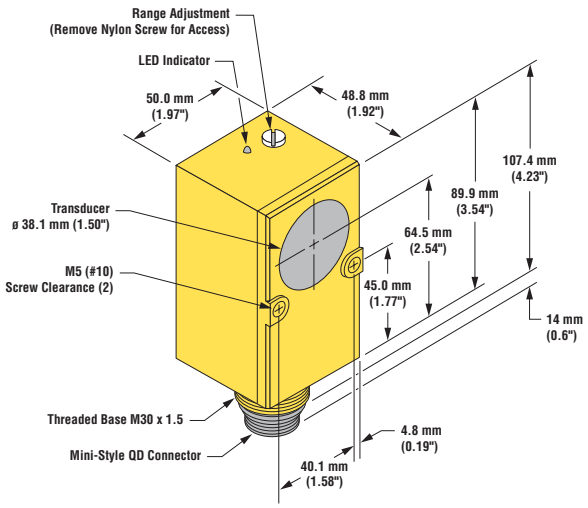
- Switched unit has simple range adjustment to limit response to background objects
- Analog units offer 0 to +10V dc sourcing and 0 to 20 mA dc sinking outputs, positive or negative slope
- Easily interfaced to variable speed DC drives, microprocessors and PLCs

ULTRA-BEAM Models					
Models	**Range**	**Cable***	**Supply Voltage**	**Output Type**	**Data Sheet†**
SU925QD-24	500 mm to 6 m (20" to 20')	5-pin Mini QD	18 to 30V dc	SPDT E/M Relay	03535
SUA925QD		5-pin Mini QD	105 to 130V ac		03420
SUB925QD		5-pin Mini QD	210 to 250V ac		
SU923QD	500 mm to 6 m (20" to 20')	4-pin Mini QD	18 to 30V dc	Analog 0-10V dc or 0-20 mA	03488
SUA923QD		5-pin Mini QD	105 to 130V ac		
SUB923QD		5-pin Mini QD	210 to 250V ac		

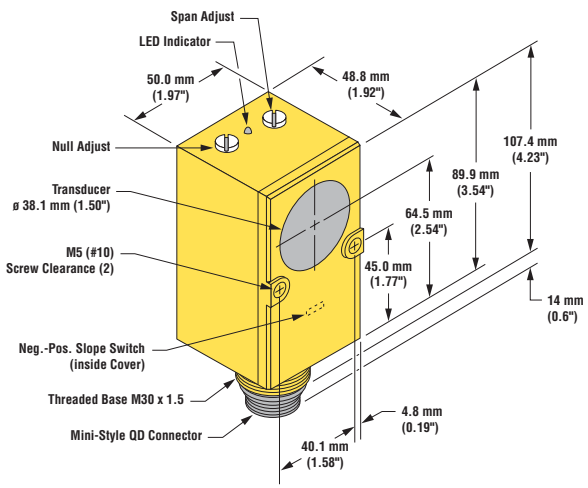
* Models with a QD connector require a mating cable. See page 115 for more information.
† Data sheets may be downloaded at www.bannerengineering.com.

ULTRA-BEAM Dimensions

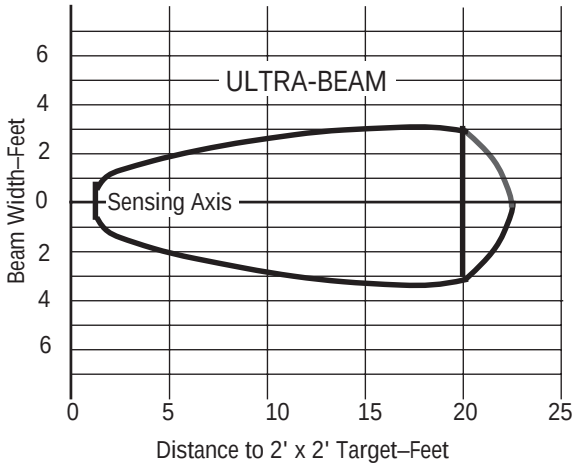
Switched Output



Analog Output



ULTRA-BEAM Response Pattern



NOTES:
1) Response pattern is drawn for the maximum range setting of the ULTRA-BEAM.
2) Response pattern is drawn for a 2-square foot solid surface.
3) Symmetry of the pattern may be assumed in all sensing planes.
4) The rounded portion of the curve past the 20 foot point indicates an area where sensing is unreliable. Effective range is from 20 inches to 20 feet (0.5 to 6 meters).

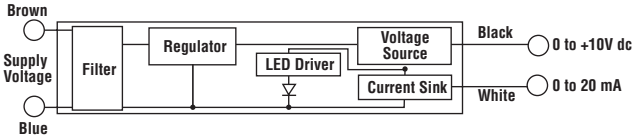
ULTRA-BEAM™ Model Selection

ULTRA-BEAM Specifications

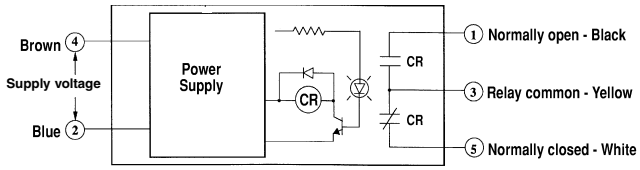
Proximity Mode Range	**Near limit:** 500 mm (20") min. **Far limit:** 6 m (20') max.
Supply Voltage	**Model SU..QD..:** 18 to 30V dc, 5VA (4VA for SU925QD-24) **Model SUA..QD:** 105 to 130V ac (50/60Hz), 5VA (6VA for SUA925QD) **Model SUB..QD:** 210 to 260V ac (50/60Hz), 5VA (6VA for SUB925QD)
Sensing Range	0.5 to 6 m (20 to 240") at 20˚C Minimum required target area is 1 square foot (0.1 square meter) for each 10' (3 m) of sensing range.
Ultrasonic Frequency	50 kHz
Supply Protection Circuitry	Protected against transient voltages; model SU923QD is protected against reverse polarity.
Outputs	**Two analog solid-state outputs:** 0 to +10V dc (sourcing); minimum 500Ω load 0 to 20mA dc (sinking); 4.0V dc maximum voltage drop. Both outputs may be set for either "positive slope" or "negative slope" **E/M relay:** One form "C" SPDT relay, silver-nickel alloy contacts. Capacity: 150 watts of 600 VA maximum power (resistive load). Maximum voltage: 250V ac or 30V dc (resistive load). Maximum current: 5 amps (resistive load). Minimum load: 5V dc @ 100 milliamps. Mechanical life: 10,000,000 operations. NOTE: install suitable value metal oxide varistor (MOV) across contact(s) used to switch an inductive load.
Response Time	100 milliseconds
Analog Resolution or Discrete Repeatability	0.5% of sensing distance
Switching Hysteresis	E/M relay models only: 5% of range setting
Linearity	1% of full scale range
Temperature Effect	0.2% of sensing distance/deg C
Indicator LED	**Analog models:** Top-mounted red LED indicator lights whenever power is applied to the sensor, and pulses at a 0 to 10Hz rate which is proportional to analog output voltage (sourcing output) and current (sinking output) **E/M relay output models:** Red LED indicator on top of sensor lights when object is sensed (when output relay is energized).
Construction	Rugged molded PBT polyester housing; epoxy-encapsulated circuitry; electrostatic transducer a with metal mesh protective screen; mounting nut, lockwasher and mounting bolts are supplied.
Environmental rating	IP54, NEMA 1, 3 & 12
Connections	4-pin or 5-pin Mini-style quick-disconnect (QD) fitting (depending on model); order mating cable, separately. See page 115.
Operating Conditions	**Temperature:** 0˚ to + 50˚C (+32˚ to +122˚F) **Maximum relative humidity:** 90% (non-condensing)
Sensing Window Adjustments	**Analog models:** Sensing window depth is adjustable from 12" to 220" via two top-mounted 15-turn clutched potentiometers with slotted brass elements (NULL and SPAN adjustments). This adjustable window may be placed anywhere within the 20" to 240" sensing range. **E/M relay models:** 15-turn clutched potentiometer with slotted brass element, located under o-ring gasketed access screw on top of sensor. Use small, flat screwdriver to adjust.
Certifications	CE Except 925 SERIES

ULTRA-BEAM Functional Schematic and Hookup Information

923 Series

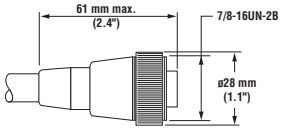
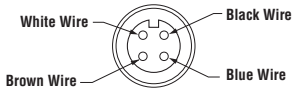
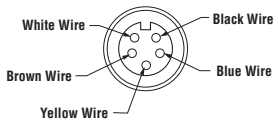


925 Series



Quick-Disconnect Cables

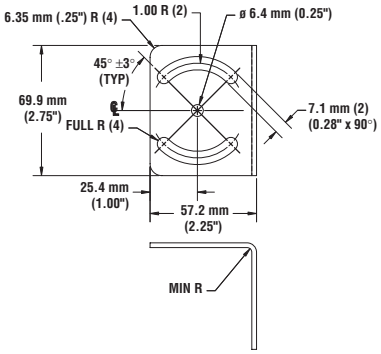
Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded (18 AWG for Mini-style), PVC insulation, gold-plated contacts
Temperature: -40° to +80°C (-40° to +176°F)
Voltage Rating: 250V ac/300V dc

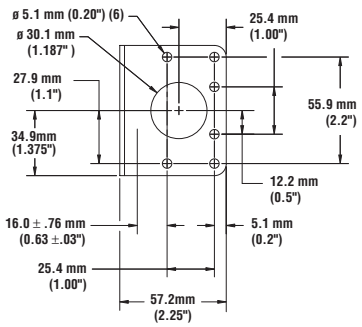
Style	Model	Length	Dimensions	Pin-out
4-Pin Mini Straight w/shield	**MBCC-406** **MBCC-412** **MBC2-430**	2 m (6.5') 4 m (12') 9 m (30')		
5-Pin Mini Straight w/shield	**MBCC2-506** **MBCC2-512** **MBCC2-530**	2 m (6.5') 4 m (12') 9 m (30')		

Mounting Brackets

SMB900

- 11-gauge, stainless steel bracket with curved mounting slots for versatility and orientation
- Clearance for M6 (1/4") hardware

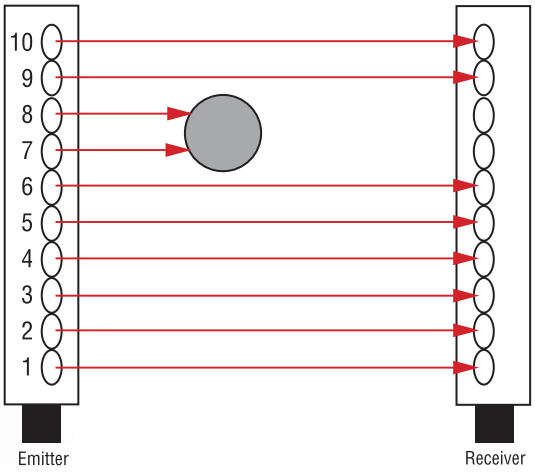




A-GAGE® Measuring Light Screen Systems

Principals of Operation

Banner light screens are comprised of pairs of photoelectric emitters and receivers, the emitters packaged in one housing, the receivers in another. An object that is placed between the emitter and receiver will block the light from some of these emitters from reaching their corresponding receivers. Banner measuring light screens use synchronous scanning to identify which of these pairs, or channels, is blocked. Synchronous scanning takes place by enabling one emitter channel to pulse light while simultaneously directing its corresponding receiver to look for a signal. Once the result of this event is known, the next channel is enabled, and so on until an entire scan is completed. The system records which channels are blocked and which are clear, and then outputs a signal, either analog or discrete, based on user-defined criteria.



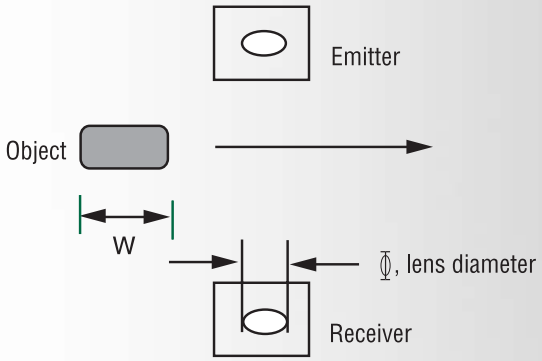
Sensor Response time

The time required for an array system to “see” an object varies depending on which channel is blocked, when the object blocks a particular channel, and when that particular channel is scanned. The result is that the minimum response time is equal to 1 ms; the maximum response time is equal to twice the scan time. The scan time, in turn, varies according to array length and scanning mode, and is specified in the data sheet.

Banner’s MINI-ARRAY® and High-Resolution MINI-ARRAY use a separate controller, while the BEAM-ARRAY can be used with or without a separate controller, depending upon which output functions are required.

Maximum part speed

The maximum speed of a passing part is a function of the part size, the lens diameter, and the maximum response time of the system.



$$\text{Maximum Part Speed} = \frac{W - \text{Ø}}{T}$$

W = part size

T = maximum scan time for the system

Ø = effective lens diameter

The lens diameters for Banner's A-GAGE systems are listed below.

Light screen	Ø
Hi-Res MINI-ARRAY®	3 mm
3/8" MINI-ARRAY	8 mm
3/4" MINI-ARRAY	10 mm
BEAM-ARRAY	5 mm

Minimum object detection

The minimum object detection size is a function of the lens diameter for an individual channel and the spacing between channels. The minimum object detection size is defined as the smallest diameter rod that can be detected reliably.

Measuring modes

Banner's measuring light screens can be configured, with a simple Windows setup program, for several measuring modes for both analog and discrete outputs. For example, the output can be based on the

- First beam blocked
- Last beam blocked
- Total number of beams blocked
- First beam made
- Last beam made
- Total number of beams made
- Center beam of several blocked beams (useful for web guiding applications)
- Number of transitions from blocked to made (useful in counting applications)
- Highest number of contiguous beams blocked (useful when several objects may be passing through the measuring zone as in a conveying application)

Low contrast applications

Low contrast applications, such as detecting translucent or clear web material, can be accomplished in some cases. Contact your Banner sales office for more information regarding low contrast applications.

MINI-ARRAY® Series - inspection and profiling light screens.

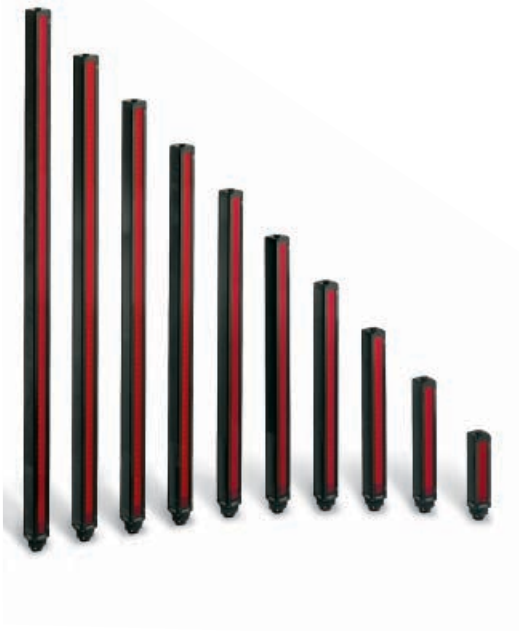
A compact workhorse for inspection & profiling.

The programmable MINI-ARRAY measuring light screen system is ideal for inspection and profiling applications. Each system consists of a controller module, emitter/receiver pair, and cables. Programmable controller modules offer a selection of measurement modes, scanning modes, and output configurations.

- Compact 38 mm square sensors
- Choice of controllers (see selection chart)
- Controller output in discrete (switched), analog, or serial data (ASCII or binary), or DeviceNet™
- Advanced configuration software supplied
- 16 discrete output version available

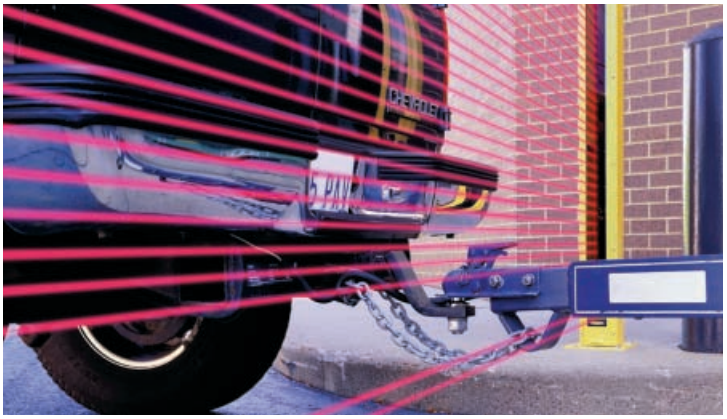
Choose from 10 emitter/receiver heights.

- 10 array lengths, from 130 mm to 1.8 m
- Choice of 2.5 mm, 9.5 mm or 19 mm beam spacing
- Status indicators are visible from three sides



Optional built-in DeviceNet™ fieldbus.

Two controller models provide the user with the ability to centrally monitor and control the operation status and diagnostics of several light screens at once over a DeviceNet control network. MINI-ARRAY communications are available through DeviceNet, and can be utilized through change of state or polled communication protocol.



A choice of heated enclosures for severe environments.

The MINI-ARRAY is available with heated enclosures for outdoor applications such as tollbooth vehicle scanning and similar uses. The heated enclosures are available in 1.2 m, 1.5 m and 1.8 m array lengths, in both painted aluminum and stainless steel materials for all environments. Optional power supplies are available for the heated enclosures.

MINI-ARRAY Series Controller Models (one required per system)

Controller Model	Supply Voltage	Inputs	Solid-State Discrete Outputs	Analog Outputs	Serial Output	Data Sheet†
MAC-1	16 to 30V dc	1 Sensor pair/ 1 Gate	1 Reed & 1 NPN	–	RS-232 & RS-485	43298
MACN-1			2 NPN	–		
MACP-1			2 PNP	–		
MACV-1			1 NPN	(2) 0-10V Sourcing	RS-232	
MACI-1			1 NPN	(2) 4-20 mA Sinking		
MAC16N-1	16 to 30V dc	1 Sensor pair/ 1 Gate	16 NPN	–	RS-232	43298
MAC16P-1			16 PNP	–		
MACNXDN-1*	16 to 30V dc	1 Sensor pair/ 1 Gate	2 NPN	–	–	59437
MACPXDN-1*			2 PNP	–	–	

* DeviceNet™ models
† Data sheets may be downloaded at www.bannerengineering.com.

MINI-ARRAY Series Emitter (E) and Receiver (R) Sensor Models

Housing Length**	Cable	19.1 mm (0.75") Beam Spacing (16 Beams/Ft)					9.7 mm (0.38") Beam Spacing (32 Beams/Ft)					
		Models*	Total Beams	Array Length	Minimum Object Size	Range	Models†	Total Beams	Array Length	Minimum Object Size	Range	Data Sheet†
201 mm (7.9")	5-pin Mini-style QD cable (ordered separately, see page 128)	**BMEL616A** **BMRL616A**	8 8	143 mm (5.6")	38.1 mm (1.5") Interlaced Mode: 25.4 mm (1.0")	0.9 to 17 m (3 to 55')	**BMEL632A** **BMRL632A**	16 16	133 mm (5.2")	19.1 mm (0.75") Interlaced Mode: 12.7 mm (0.50")	0.6 to 6.1 m (2 to 20')	43298
356 mm (14.0")		**BMEL1216A** **BMRL1216A**	16 16	295 mm (11.6")			**BMEL1232A** **BMRL1232A**	32 32	286 mm (11.2")			
505 mm (19.9")		**BMEL1816A** **BMRL1816A**	24 24	448 mm (17.6")			**BMEL1832A** **BMRL1832A**	48 48	438 mm (17.2")			
659 mm (26.0")		**BMEL2416A** **BMRL2416A**	32 32	600 mm (23.6")			**BMEL2432A** **BMRL2432A**	64 64	591 mm (23.2")			
810 mm (31.9")		**BMEL3016A** **BMRL3016A**	40 40	752 mm (29.6")			**BMEL3032A** **BMRL3032A**	80 80	743 mm (29.2")			
963 mm (37.9")		**BMEL3616A** **BMRL3616A**	48 48	905 mm (35.6")			**BMEL3632A** **BMRL3632A**	96 96	895 mm (35.2")			
1115 mm (43.9")		**BMEL4216A** **BMRL4216A**	56 56	1057 mm (41.6")			**BMEL4232A** **BMRL4232A**	112 112	1048 mm (41.2")			
1267 mm (49.9")		**BMEL4816A** **BMRL4816A**	64 64	1210 mm (47.6")		0.9 to 14 m (3 to 45')	**BMEL4832A** **BMRL4832A**	128 128	1200 mm (47.2")		0.6 to 4.6 m (2 to 15')	
1572 mm (61.9")		**BMEL6016A** **BMRL6016A**	80 80	1514 mm (59.6")			**BMEL6032A** **BMRL6032A**	160 160	1505 mm (59.2")			
1877 mm (73.9")		**BMEL7216A** **BMRL7216A**	96 96	1819 mm (71.6")			**BMEL7232A** **BMRL7232A**	192 192	1810 mm (71.2")			

* "E" and "R" in models numbers denotes "Emitter" and "Receiver" respectively. Sold separately.
** Housing length is same for both 3/4" and 3/8" beam spacing models
† Data sheets may be downloaded at www.bannerengineering.com.

MINI-ARRAY® Measuring Light Screen Model Selection

MINI-ARRAY Series Controller Specifications	
Power Requirements	16 to 30V dc @1.25 amps max. (see current requirements for sensors); controller alone, (without sensors connected) requires 0.1 amp.
Inputs	MINI-ARRAY sensor input (5 connections); emitter and receiver wire in parallel to five terminals Gate Input- Optically-isolated, requires 10 to 30V dc (7.5K input impedance) for gate signal
Discrete Outputs	**MAC-1:** Output 1(OUT 1)-Reed relay contact rated 125V ac/dc max., 10 VA max. resistive load (non-inductive). Output 2 (ALARM)-Open collector NPN transistor rated 30V dc max., 150 mA max, short-circuit protected; may be configured as a second data analysis output, a system alarm output, or a scan trigger output for a parallel array OFF-STATE Leakage Current: <10uA @ 30V dc ON-STATE Saturation Voltage: <1 Volt @ 10 mA, <1.5 Volt @ 150 mA **MACN-1:** (2) Open collector NPN transistor outputs **MACP-1:** (2) Open collector PNP transistor outputs; transistor rated 30V dc max. 150 mA max, short circuit protected; may be configured as a second data analysis output, a system alarm output, or a scan trigger output for a parallel array **Off-state leakage current:** <10µA @30V dc **On-state saturation voltage:** <1 Volt @10 mA, <1.5Volt @150 mA **MACV-1/MACI-1:** Alarm- Open collector NPN transistor rated 30V dc max. 150 mA max, short circuit protected; may be configured as a data analysis output, a system alarm output, or a scan trigger output for a parallel array **Off-state leakage current:** <10µA @30V dc **On-state saturation voltage:** <1 Volt @10 mA, <1.5Volt @150 mA **MAC16P-1:** Sixteen open collector PNP transistor outputs **MAC16N-1:** Sixteen open collector NPN transistor outputs 30V dc max,150 mA max., short circuit protected **Off-state leakage current:** <10 microamps **On-state saturation voltage:** <1 Volt @ 10 mA;<1.9V @ 150 mA
Serial Data Outputs	RS-232, ASCII or binary data format **Baud Rate:** 9600, 19.2K, or 38.4K, 8 data bits, 1 start bit, 1 stop bit, even parity Clear data may be suppressed Header string may be suppressed in binary format **MAC-1:** Up to 15 controllers may be given unique address for RS485 party line
Analog Outputs	**MACV-1:** 0-10 Volts sourcing adjustable Null and Span (20 mA current limit) **MACI-1:** 4-20 mA current sinking adjustable Null and Span (16 to 30V input) **Resolution:** Span/(Number of sensor channels) **Linearity:** 0.1% of Full Scale **Temp. Var.:** 0.01% of Full Scale/°C
Controller Programming	**All Models:** Via RS232 PC-compatible computer running Windows® 95, 98, NT or 2000 operating system and using Banner supplied software
Sensor Scan Time	**Sensor Scan Time:** 55 microseconds per beam, plus controller processing time. **Controller Scan Time:** **MACV-1 & MACI-1:** 1.5 millisecond processing time per scan. This timing assumes a straight scan, continuous, and TBB mode **MAC-1, MACN-1, MACP-1:** 1 ms processing time **MAC16N-1 & MAC16P-1:** 2.3 to 7ms processing time
System Response Time	Outputs are not active for 5 seconds after system power up. Maximum response time for the system is two sensor scan cycles. A scan cycle includes a sensor scan plus any serial data transmission. Serial transmission (if activated) follows every sensor scan.

MINI-ARRAY Series Controller Specifications (cont'd)

Status Indicators	The following status LEDs are located on the top surface of the module: **MACV-1 & MACI-1:** VOUT (red)- (also called IOUT) Indicates that the analog outputs are active **MAC-1, MACN-1 & MACP-1:** OUT 1 (red)-Indicates that output 1 is energized **MAC16N-1 & MAC16P-1:** OUT (red)-Indicates that at least one output is active ALARM (red)- Indicates that Output 2 is active/MAC16N-1 & MAC16P-1: Indicates output 16 is active GATE (red)- Indicates voltage is applied to GATE input ALIGN (green)- Indicates sensor aligned (excess gain >1x) DIAG1 (green)- Indicates power is applied to the module DIAG2 (red)- Indicates receiver failure DIAG3 (red)- Indicates emitter failure
Construction	Polycarbonate
Environmental Rating	NEMA 1 (IP20)
Operating Conditions	**Temperature:** -20° to +70°C (-4 to +158°F) **Maximum relative humidity:** 95% (non-condensing)
Certifications	CE UL LISTED

Condition	DIAG1 (Green)	DIAG2 (Red)	DIAG3 (Red)
Normal condition	on	off	off
Receiver error	on	on	off
Emitter error	on	off	on

MINI-ARRAY Series Controller with DeviceNet™ Specifications

DeviceNet Configurations	**Vendor code:** 12 (Banner Corp.) **Device type:** 110 **Product code:** 1 (MACNXDN-1) 2 (MACPXDN-1) **Connection types supported:** Explicit Message, Poll, COS **Network address:** 0-63 (network configured), default = 63 **Baud rate supported:** 125K, 250K, 500K (network configured), default = 125K
Output Configurations	**MACPXDN-1:** Two PNP discrete (switched) **MACNXDN-1:** Two NPN discrete (switched)
Power Requirements*	Controller, emitter and receiver: 16 to 30V dc @ 1.2 A max. (typical: 0.5 A @ 16V dc)
DeviceNet Power*	11 to 25V dc - supplied by DeviceNet BUS Network
Inputs	**Sensor input:** Emitter and receiver wire in parallel to five terminals. **Gate input:** Optically isolated, requires 10 to 30V dc (7.5kΩ impedance) for gate signal
Discrete Outputs	**NPN outputs:** Open collector NPN transistor rated at 30V dc max., 150 mA max. **PNP outputs:** Open collector PNP transistor rated at 30V dc max., 150 mA max. **All discrete outputs:** **OFF-state leakage current:** < 10 µA @ 30V dc **ON-state saturation voltage:** < 1V @ 10 mA and < 1.5V @ 150 mA
System Programming	Via DeviceNet interface and supplied EDS files.
System Status Indicators	**Output (steady red):** Output #1 energized. **Alarm (flashing red):** Output #2 energized. **Gate (steady red):** Gate input status. **Alignment (steady green):** Proper emitter/receiver alignment and a clear, unblocked light screen (ON) when green or green/yellow receiver LEDs are ON. **Diag 1 (green), Diag 2 (red), Diag 3 (red):** Used in combination to display System status
Network Status Indicator	**Bi-colored (red/green) LED visible on the control module front panel indicates network status:** **Steady Green:** On-line, connected to master **Flashing Green:** On-line, address and baud rate OK **Steady Red:** Critical network fault or duplicate node address detected **Flashing Red:** Connection timeout **OFF:** No network power or off-line
Construction	Polycarbonate housing; mounts to flat surface or directly onto 35-mm DIN rail
Environmental Rating	NEMA 1 (IP20)
Operating Conditions	**Temperature:** -20° to +70°C (-4° to 158°F) **Maximum relative humidity:** 95% @ 50°C (non-condensing)
***Application Note**	The controller must be powered up before the DeviceNet connection in every power-up situation for proper operation

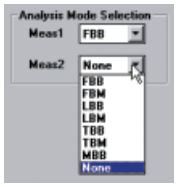
System Configuration

Many options, yet easy to program

The software included with the control module makes it easy to configure the **MINI-ARRAY** using your PC-compatible computer*. Simply load the software, access the program, and access the Edit PSF Configuration screen, shown below. Each option is easily selectable, using your mouse and the pop-up menu-style selections.

**Running Windows® 95, 98, NT or 2000*

Analysis (Measurement) Mode Selection
Choose the measurement option that best tells you the size and/or position of objects as they relate to the array.



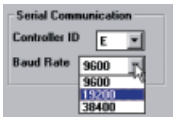
Control Mode Selection

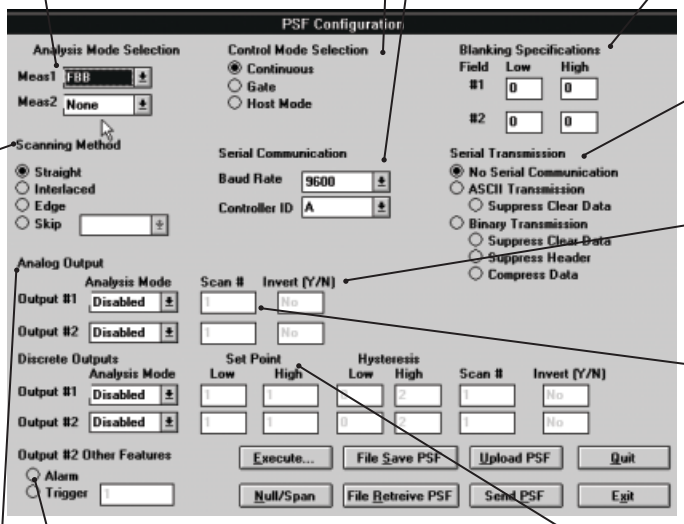
Continuous Mode: The control module constantly polls the array for status.

Gate Mode: The control module polls the array for status when prompted by an input from a Gate sensor.

Host Mode: The control module polls the array for status when prompted by a host controller.

Serial Communication
Changes the identification and baud rate of the controller being configured.





Blanking
Allows either 1 or 2 areas of the array to be blind to the activity of the area specified.

Serial Transmission
Choose ASCII, binary or no serial communication

Invert
Allows output to be normally open (No) or normally closed (Yes)

Scan #: (1-9) Analog outputs are updated with an average value of the data received during the selected number of scans; discrete outputs respond only if the received data is identical for all of the selected number of consecutive scans.

Scanning Method

Straight scan polls each beam sequentially to determine the target object's overall size. This is the most accurate and precise measurement, but also the most time-consuming.

Interlaced alternates a straight scan with a slanted beam scan to improve optical resolution in the center one third of the sensing range.

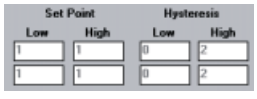
Edge activates only the beams located near the top edge of the object in the light screen to reduce sensing response time.

Skip - one to seven beams skipped reduces response time. Minimum object detection size increases proportionally to the number of beams skipped

Analog and Discrete Output Assignment
Assigns an analysis (measurement) mode to each output.

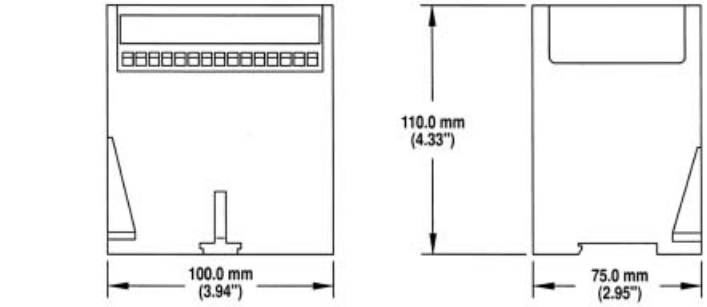
Alarm/Trigger
Output 2 may instead be programmed to serve as a trigger input for another MINI-ARRAY or ALARM for the self-diagnostic circuitry.

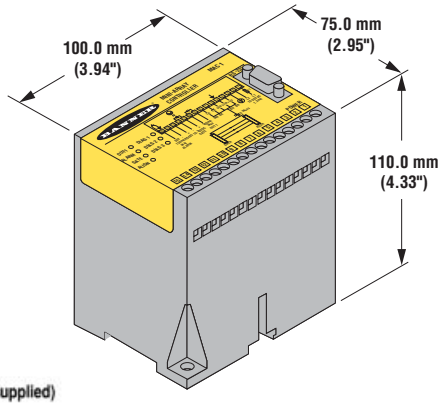
Set Point and Hysteresis Selection
Assigns the set point to determine where within the array the output(s) will respond and hysteresis values to smooth output response.

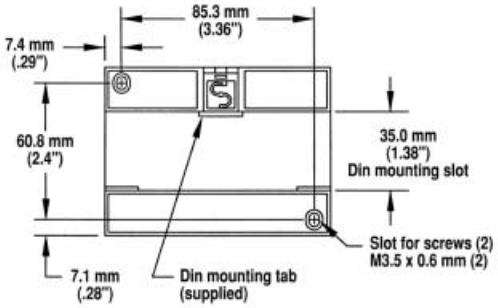


Downloadable Software
To test and verify software, download MINI-ARRAY version 1.3 (43989.exe) or Multiple (16) Output version 1.0 (59114_10.exe) at www.bannerengineering.com.

MINI-ARRAY Series Controller Module Dimensions







Combo Head (Phillips/Slotted) Screws
M3.5 x 0.6 mm x 14 mm (2) (#6 x .5" equivalent) (supplied)

M3.5 Washers (2) (#6 equivalent) (supplied)
M3.5 mm x 0.6 mm Nuts (2) (#6 equivalent) (supplied)

Recommended torque is
16-20 in-lbs on mounting screws

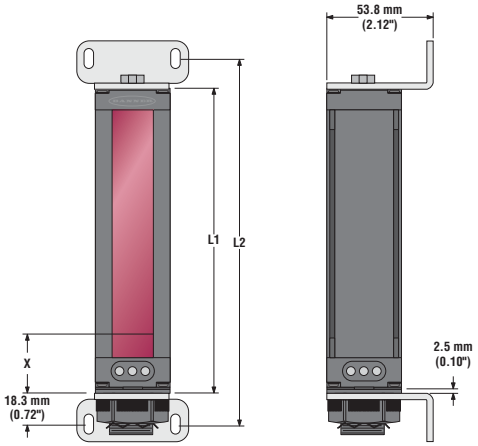
Control Box Mounting

The controller module must be installed inside an enclosure which has a NEMA (or IEC) rating suitable for the operating environment.

The controller is supplied with M3.5 x 0.6 hardware for direct mounting to a surface, or the module may be mounted onto standard 35 mm DIN rail.

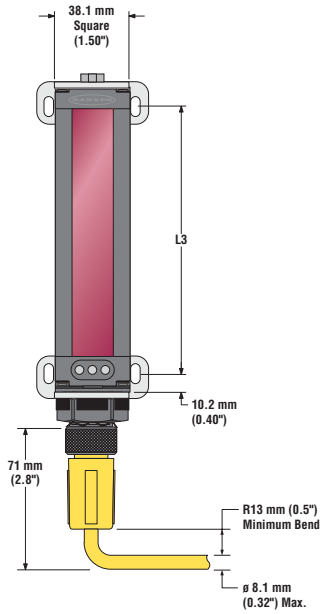
MINI-ARRAY Series Emitter and Receiver Mounting Hardware Dimensions

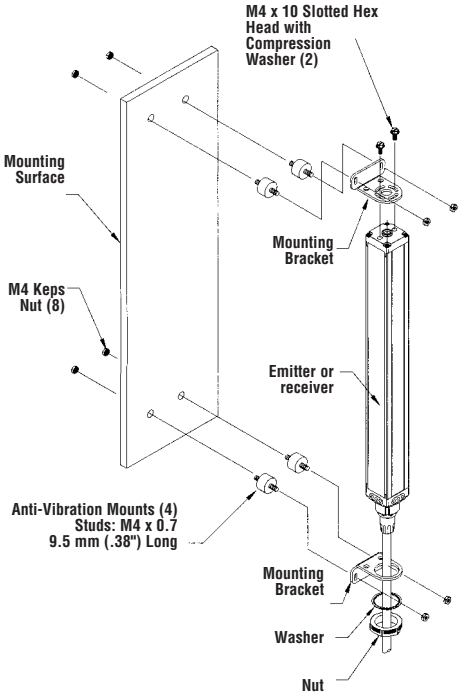
With mounting bracket flanges "out"



X (Distance to First Optical Channel)	
3/4"	38.1 mm (1.50")
3/8"	42.9 mm (1.69")

With mounting bracket flanges "in"





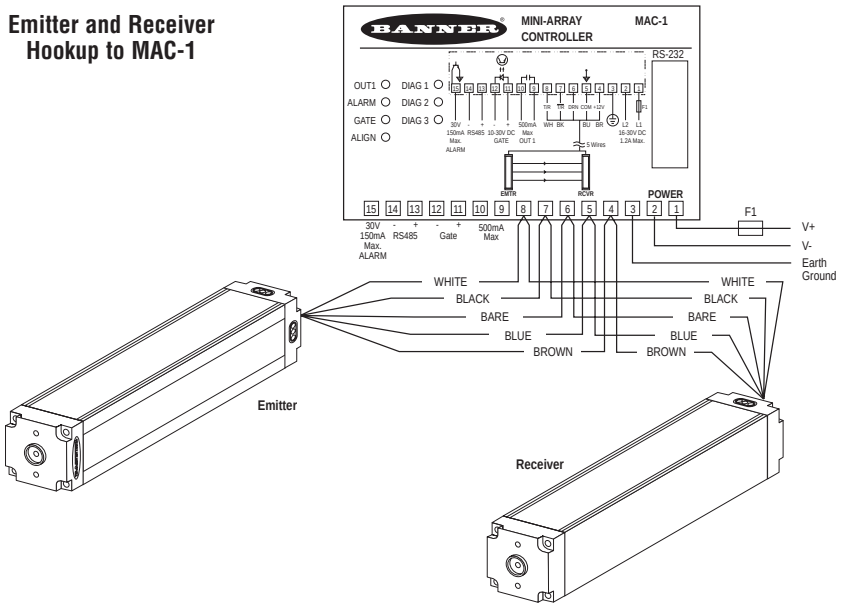
Emitter/Receiver Models	Housing Length	Distance Between Bracket Holes	
	L1	L2	L3
BMEL6..A Emitter **BMRL6..A** Receiver	201 mm (7.9")	233.9 mm (9.21")	177.0 mm (6.97")
BMEL12..A Emitter **BMRL12..A** Receiver	356 mm (14.0")	389.7 mm (15.35")	332.8 mm (13.10")
BMEL18..A Emitter **BMRL18..A** Receiver	505 mm (19.9")	538.7 mm (21.22")	481.8 mm (18.97")
BMEL24..A Emitter **BMRL24..A** Receiver	659 mm (26.0")	693.2 mm (27.31")	636.3 mm (25.05")
BMEL30..A Emitter **BMRL30..A** Receiver	810 mm (31.9")	843.5 mm (33.23")	786.6 mm (30.97")
BMEL36..A Emitter **BMRL36..A** Receiver	963 mm (37.9")	997.4 mm (39.29")	940.5 mm (37.00")
BMEL42..A Emitter **BMRL42..A** Receiver	1115 mm (43.9")	1148 mm (45.2")	1091 mm (43.0")
BMEL48..A Emitter **BMRL48..A** Receiver	1267 mm (49.9")	1301 mm (51.9")	1244 mm (49.0")
BMEL60..A Emitter **BMRL60..A** Receiver	1572 mm (61.9")	1606 mm (63.2")	1549 mm (61.0")
BMEL72..A Emitter **BMRL72..A** Receiver	1877 mm (73.9")	1910 mm (75.2")	1853 mm (73.0")

MINI-ARRAY Series Emitter and Receiver Specifications

Emitter/Receiver Range Max range is specified at the point where 3x excess gain remains.	**3/8" beam spacing** **Sensors < 4':** 0.6 to 6.1 m (2' to 20') **Sensors > 4':** 0.6 to 4.6 m (2' to 15') **3/4" beam spacing** **Sensors < 4':** 0.9 to 17 m (3' to 55') **Sensors > 4':** 0.9 to 14 m (3' to 45')
Minimum Object Sensitivity	**3/8" Beam Spacing** **Straight, Edge Modes:** 19.1 mm (0.75") **Interlaced Mode:** 12.7 mm (0.5")* **With DeviceNet Controller:** **Straight, Edge Modes:** 19.1 mm (0.75") **Skip Mode:** Multiply the above by the number of skipped beams, plus 1 **Interlaced Mode:** 12.7 mm (0.5")* **3/4" Beam Spacing** **Straight, Edge Modes:** 38.1 mm (1.5") **Interlaced Mode:** 25.4 mm (1.0")* With DeviceNet Controller: **Straight, Edge Modes:** 38.1 mm (1.5") **Skip Mode:** Multiply the above by the number of skipped beams, plus 1 **Interlaced Mode:** 25.4 mm (1.0")* *Assumes sensing is in the middle 1/3 of sensing range.
Sensor Scan Time	55 microseconds per beam, plus 1 ms post process time per scan. **DeviceNet:** Post process time will vary, based on the number of channels interrogated during each scan.
Power Requirements †Maximum current is for a 6' sensor.	**3/8" beam spacing** 12V dc ±2%, supplied by controller **Emitter:** 0.10 A @ 12V dc **Receiver spacing:** 0.75 A @ 12V dc† **3/4" beam spacing** 12V dc ±2%, supplied by controller **Emitter:** 0.10 A @ 12V dc **Receiver spacing:** 0.50 A @ 12V dc†
Connections	Sensors connect to controller using 5-conductor quick-disconnect cables (one each for emitter and receiver), ordered separately. Use only Banner cables, which incorporate a "twisted pair" for noise immunity. Cables measure 8.1 mm (0.32") dia. and are shielded and PVC-jacketed. Conductors are 20 gauge (0.9 mm). Emitter and receiver cables may not exceed 75 m (250') long, each.
Status Indicators	**Emitter:** Red LED lights to indicate proper emitter operation **Receiver:** Green indicates sensors aligned (> 3x excess gain) Yellow indicates marginal alignment of one or more beams (1 x <excess gain < 3x) Red indicates sensors misaligned or one or more beam(s) blocked
Construction	Aluminum, with black anodized finish; acrylic lens cover
Environmental Rating	NEMA 4, 13 (IP65)
Operating Conditions	**Temperature:** -20° to +70°C (-4° to +158°F) **Maximum relative humidity:** 95% at 50°C (non-condensing)

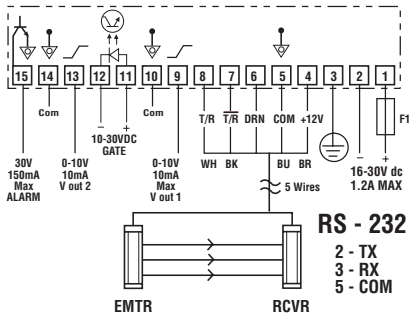
MINI-ARRAY Series Emitter and Receiver Hookup Information

Emitter and Receiver Hookup to MAC-1

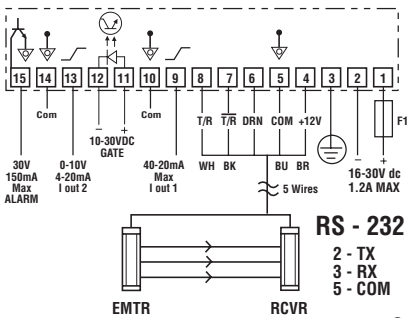


MINI-ARRAY Series Emitter and Receiver Hookups

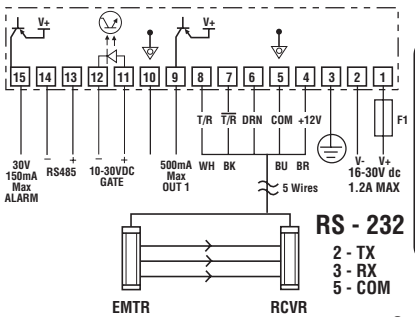
Emitter and Receiver Hookup to MACV-1



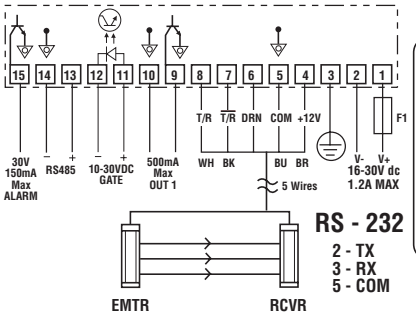
Emitter and Receiver Hookup to MACI-1



Emitter and Receiver Hookup to MACP-1

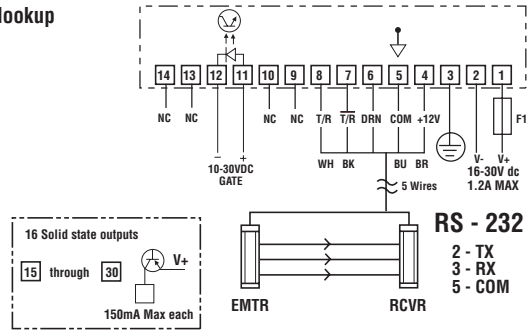


Emitter and Receiver Hookup to MACN-1

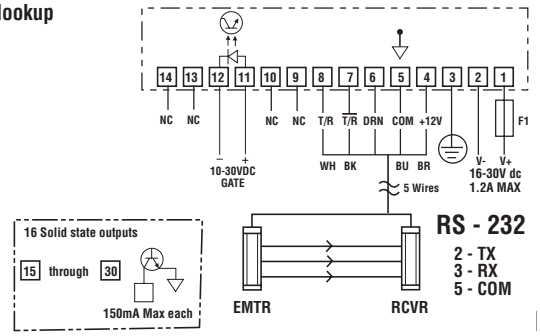


MINI-ARRAY Series Controller with 16 Discrete Outputs Hookups

MAC16P-1 Hookup



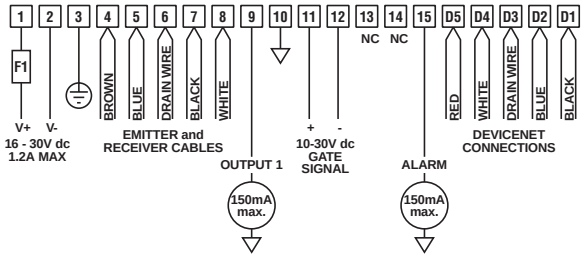
MAC16N-1 Hookup



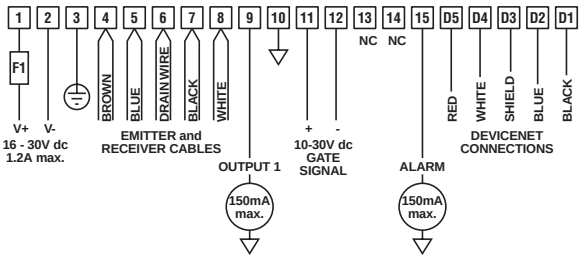
Output 1 = Pin 16
Output 2 = Pin 17
Output 3 = Pin 18
Output 4 = Pin 19
Output 5 = Pin 20
Output 6 = Pin 21
Output 7 = Pin 22
Output 8 = Pin 23
Output 9 = Pin 24
Output 10 = Pin 25
Output 11 = Pin 26
Output 12 = Pin 27
Output 13 = Pin 28
Output 14 = Pin 29
Output 15 = Pin 30
Output 16 = Pin 15

MINI-ARRAY Series with DeviceNet Hookups

MACNXDN-1 Hookup



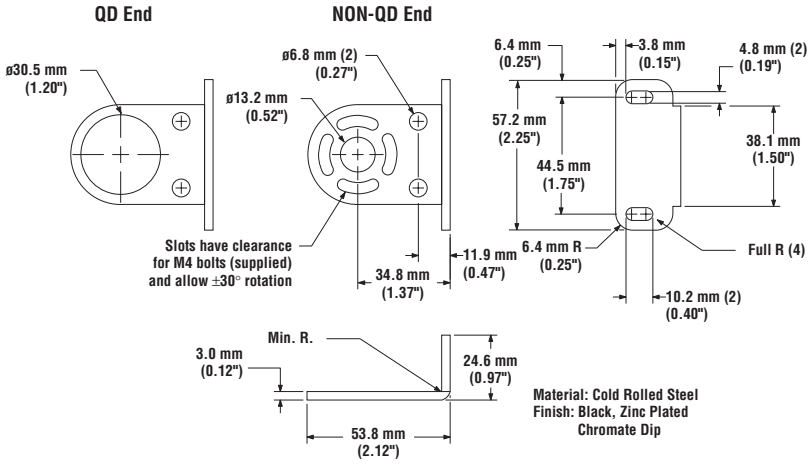
MACPXDN-1 Hookup



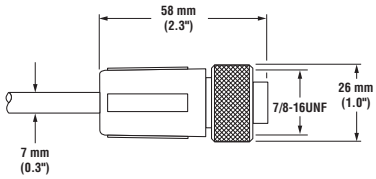
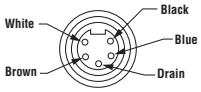
Mounting Brackets

MSMB-3

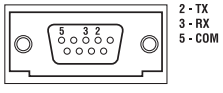
- One pair of brackets is supplied with each emitter and receiver
- 11-gauge, black zinc-plated chromate dip finish



Quick-Disconnect Cables (two required per system)

Model	Length	Termination	Dimensions	Pin-out
QDC-515C **QDC-525C** **QDC-550C**	5 m (15') 8 m (25') 15 m (50')	5-pin shielded Mini-style Female connector on one end		Female Connector (sockets) 
MAQDC-575C **MAQDC-5100C** **MAQDC-5125C** **MAQDC-5150C**	22 m (75') 30 m (100') 38 m (125') 46 m (150')			

MINI-ARRAY Serial Cable

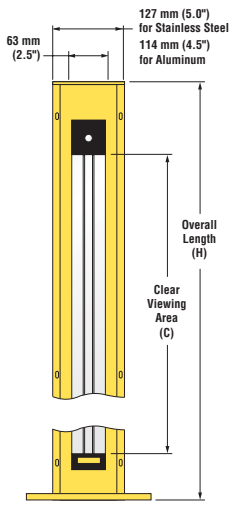
Model	Cable	DB-9 Pin #	Function	Diagram	Data Sheet†
MASC	2 m (6.5')	2	Transmit (TX)	RS-232  DB-9 connections between the control module and the PC	55216
		3	Receive (RX)		
		5	Ground (GRD)		

† Data sheets may be downloaded at www.bannerengineering.com.

MINI-ARRAY Series Heated Enclosures

Models	Description			Overall Enclosure Height (H)	Clear Window Height (C)	Data Sheet†
	Material	Finish*	Array Length			
BMHE4A/BMHL4G	Aluminum Enclosure	Painted	4'	1.7 m (66.5")	1.5 m (59")	
BMHE5A/BMHL5G	Aluminum Enclosure	Painted	5'	2.0 m (78.5")	1.8 m (71")	
BMHE6A/BMHL6G	Aluminum Enclosure	Painted	6'	2.2 m (86.5")	2.0 m (79")	
BMHE4SS/BMHL4GSS	Stainless Steel Enclosure	Painted	4'	1.7 m (67.5")	1.5 m (60")	
BMHE5SS/BMHL5GSS	Stainless Steel Enclosure	Painted	5'	2.0 m (79.5")	1.8 m (72")	55557
BMHE6SS/BMHL6GSS	Stainless Steel Enclosure	Painted	6'	2.2 m (87.5")	2.0 m (80")	
BMHE4SSN/BMHL4GSSN	Stainless Steel Enclosure	Non-painted	4'	1.7 m (67.5")	1.5 m (60")	
BMHE5SSN/BMHL5GSSN	Stainless Steel Enclosure	Non-painted	5'	2.0 m (79.5")	1.8 m (72")	
BMHE6SSN/BMHL6GSSN	Stainless Steel Enclosure	Non-painted	6'	2.2 m (87.5")	2.0 m (80")	

* Standard color is Federal Safety Yellow (Federal Standard color# 23538). Contact Factory for other colors.
† Data sheets may be downloaded at www.bannerengineering.com.



MINI-ARRAY Series Power Supplies for Heated Enclosures

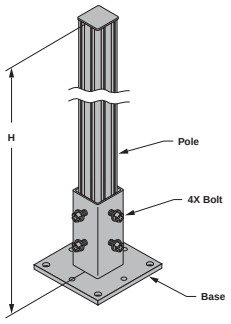
Model	Used for	Primary	Secondary
BMHPS4	Two BMHE4 Enclosures	105 to 130V ac	23V ac
BMHPS5	Two BMHE5 Enclosures	105 to 130V ac	27V ac
BMHPS6	Two BMHE6 Enclosures	105 to 130V ac	35V ac
BMHPS14	One BMHE4 Enclosure	105 to 130V ac	23V ac
BMHPS15	One BMHE5 Enclosure	105 to 130V ac	27V ac
BMHPS16	One BMHE6 Enclosure	105 to 130V ac	30V ac

MSA Series Stands (Base is included)*

MSA Series stands are made of strong extruded and anodized aluminum. They are easy to assemble and solidly support MINI-ARRAY sensors. Their dual-channel design allows accurate sensor height adjustments.

Model	Height (H)	Emitter/Receiver Models	Data Sheet†
MSA-S24-1	610 mm (24")	Up to models BMEL(RL)12..A	
MSA-S42-1	1067 mm (42")	Up to models BMEL(RL)30..A	43687
MSA-S66-1	1676 mm (66")	Up to models BMEL(RL)48..A	

* Available without a base by adding the suffix "**NB**" to model number, e.g. **MSA-S42-1NB**.
† Data sheets may be downloaded at www.bannerengineering.com.



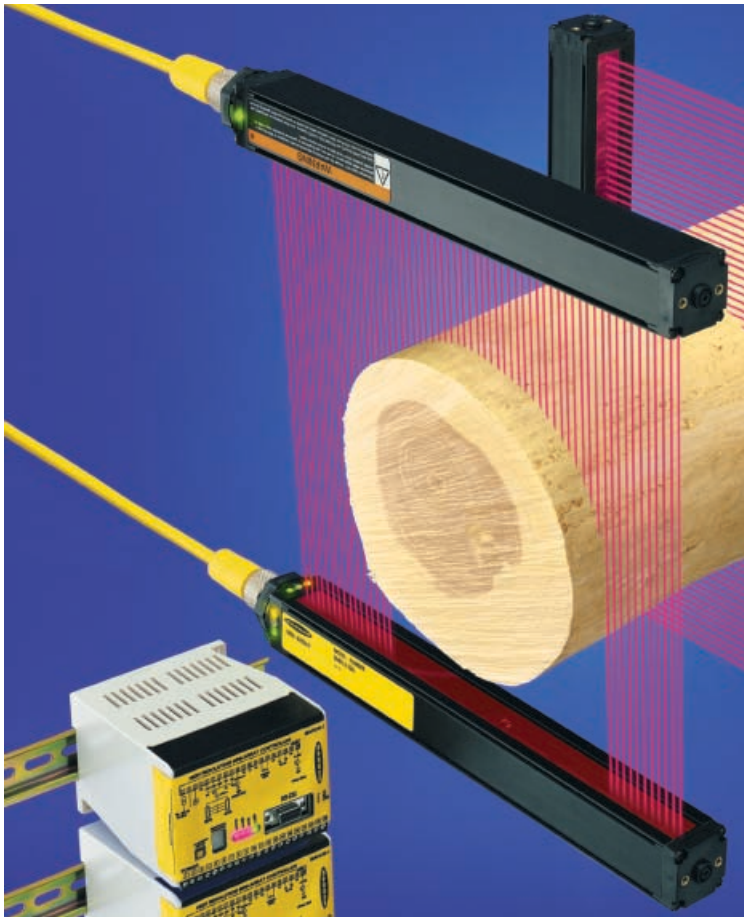
High-Resolution MINI-ARRAY® Series-
industry's highest resolution sensing light screen.

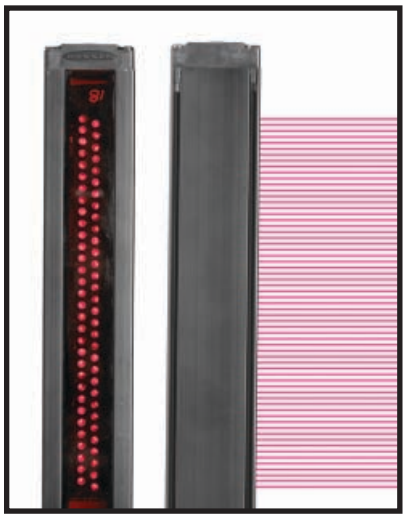
Excellent range & easy alignment.
The High-Resolution MINI-ARRAY features a 2 m range with easy, forgiving alignment and a unique, TEACH setup routine that equalizes the gain of each sensing channel to the optimum level and automatically blanks any blocked areas along the length of the light curtain.

Ultra-precise monitoring & inspection.
High-resolution MINI-ARRAY systems excel in high-speed, precise monitoring and inspection applications, including on-the-fly sizing, profiling, precision edge and center guiding, hole detection and similar applications. A system consists of a high-resolution emitter/receiver pair, one of four compact controller modules and quick-disconnect cables. Setup software allows system configuration via desktop PC.

- Reliable 2.5 mm minimum detection throughout the array
- Controllers available with discrete and analog outputs
- Programmable blanking, hysteresis, and serial communication modes
- Unique sensing mode reliability detects variable object size at a high resolution while maintaining fast response speed

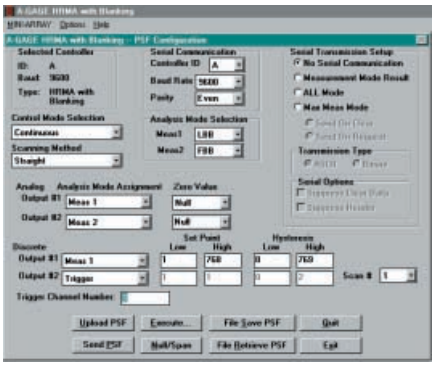
A choice of 12 array heights to fit your precision measurement applications.
- Models from 163 mm to 1951 mm
- 7 measurement modes, 3 scanning methods





120 beams per foot.
Unique staggered LED array allows for industry's tightest sensing tolerance.

Many options, yet easy to program.
The software included with the control module makes it easy to configure the MINI-ARRAY using your PC-compatible computer. Simply load the software, access the program, perform the "Ping" procedure to select the desired controller, and access the Edit PSF Configuration screen. Each option is easily selectable, using your mouse and the pop-up menu-style selections.



High-Resolution MINI-ARRAY Series Controller Models (one required per system)

Controller Model	Supply Voltage	Inputs	Solid-State Discrete Outputs	Analog Outputs	Serial Output	Data Sheet†
MAHCVP-1	16 to 30V dc	1 Sensor pair/ 1 Gate	2 PNP	(2) 0-10V Sourcing	RS-232 & RS-485	64118
MAHCVN-1			2 NPN	(2) 0-10V Sourcing		
MAHCIP-1			2 PNP	(2) 4-20 mA Sinking		
MAHCIN-1			2 NPN	(2) 4-20 mA Sinking		

† Data sheets may be downloaded at www.bannerengineering.com.

High-Resolution MINI-ARRAY Series Emitter & Receiver Models-128 Beams/Ft

2.5 mm (0.10)" Beam Spacing

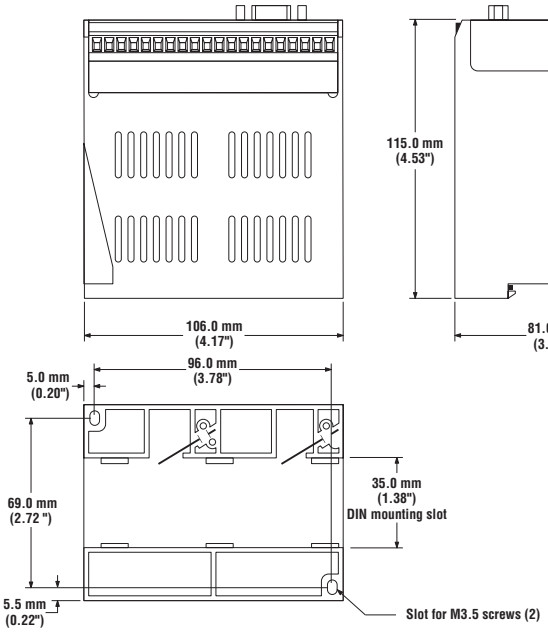
Models*	Cable	Housing Length	Total Beams	Array Length	Minimum Object Size	Range	Data Sheet†
MAHE6A MAHR6A	5-pin Mini-style QD cable (ordered separately, see page 136)	233 mm (9.2")	64	163 mm (6.4")	2.5 mm (0.10")	0.4 to 1.8 m (15 to 72")	64118
MAHE13A MAHR13A		396 mm (15.6")	128	325 mm (12.8")			
MAHE19A MAHR19A		559 mm (22.0")	192	488 mm (19.2")			
MAHE26A MAHR26A		721 mm (28.4")	256	650 mm (25.6")			
MAHE32A MAHR32A		884 mm (34.8")	320	813 mm (32.0")			
MAHE38A MAHR38A		1046 mm (41.2")	384	975 mm (38.4")			
MAHE45A MAHR45A		1212 mm (47.7")	448	1138 mm (44.8")			
MAHE51A MAHR51A		1374 mm (54.1")	512	1300 mm (51.2")			
MAHE58A MAHR58A		1537 mm (60.5")	576	1463 mm (57.6")			
MAHE64A MAHR64A		1700 mm (66.9")	640	1626 mm (64.0")			
MAHE70A MAHR70A		1862 mm (73.3")	704	1788 mm (70.4")			
MAHE77A MAHR77A		2025 mm (79.7")	768	1951 mm (76.8")			

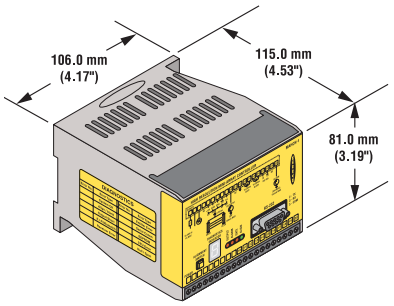
* "E" and "R" in models numbers denotes "Emitter" and "Receiver" respectively. Sold separately.
† Data sheets may be downloaded at www.bannerengineering.com.

High-Resolution MINI-ARRAY® Measuring Light Screen Model Selection

High-Resolution MINI-ARRAY® Series Controller Specifications	
Power Requirements	16 to 30V dc @ 1.0 A (typical: 0.5 A @ 16V dc)
Inputs	**Sensor input:** Emitter and receiver wire in parallel to five terminals. **Gate input:** Optically isolated, requires 10 to 30V dc (7.5kΩ impedance) for gate signal **Remote alignment input:** Optically isolated, requires 10 to 30V dc (7.5kΩ impedance) for alignment sequence signal
Discrete (Switched) Outputs	**NPN outputs:** Open collector NPN transistor rated at 30V dc max., 150 mA max. **PNP outputs:** Open collector PNP transistor rated at 30V dc max., 150 mA max. **All discrete outputs: OFF-state leakage current:** < 10 µA @ 30V dc **ON-state saturation voltage:** < 1V @ 10 mA and < 1.5V @ 150 mA
Analog Outputs	**Voltage-sourcing outputs:** 0 to 10V dc (25 mA current limit) **Current-sinking outputs:** 4 to 20 mA (16 to 30V dc input) **Resolution:** Span / Number of sensing channels **Linearity:** 0.1% of full scale **Temperature variation:** 0.01% of full scale per °C
Serial Data Outputs	RS-232 or RS-485 interface. (Up to 15 control modules may be given unique addresses on one RS-485 party line.) ASCII or binary data format 9600, 19.2K, or 39.4K baud rate 8 data bits, stop bit, and even, odd or no parity
Output Configuration	**MAHCVP-1:** Two PNP discrete (switched), two 0-10V voltage sourcing **MAHCVN-1:** Two NPN discrete (switched), two 0-10V voltage sourcing **MAHCIP-1:** Two PNP discrete (switched), two 4-20 mA current sinking **MAHCIN-1:** Two NPN discrete (switched), two 4-20 mA current sinking
System Programming	Via RS-232 interface to PC-compatible computer running Windows® 95, 98, NT or 2000 and using software supplied with each control module.
Status Indicators	**Output 1(red):** Lights to indicate Discrete Output #1 is active **Alarm (red):** Lights to indicate Discrete Output #2 is active **Gate (red):** Lights to indicate GATE is active **Align (green):** Lights to indicate emitter and receiver are aligned **Diagnostics indicator:** (Key on controller side label) Identifies System errors and status
Construction	Polycarbonate housing; mounts to flat surface or directly onto 35-mm DIN rail
Environmental Rating	NEMA 1 (IP20)
Operating Conditions	**Temperature:** 0˚ to + 50˚C (+32˚ to 122˚F) **Max. relative humidity:** 95% @ 50˚C (non-condensing)
Certifications	CE

High-Resolution MINI-ARRAY Series Controller Dimensions





System Configuration

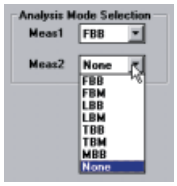
Many options, yet easy to program.

The software included with the control module makes it easy to configure the **High-Resolution MINI-ARRAY** using your PC-compatible computer*. Simply load the software, access the program, perform the "Ping" procedure to select the desired controller, and access the Edit PSF Configuration screen, shown below. Each option is easily selectable, using your mouse and the pop-up menu-style selections.

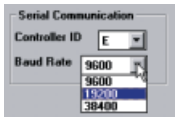
**Running Windows® 95, 98, NT or 2000*

Selected Controller
Identifies the specific control module being configured.

Analysis (Measurement) Mode Selection
Choose the measurement option that best tells you the size and/or position of objects as they relate to the array.



Serial Communication
Changes the identification and baud rate of the controller being configured.



Serial Transmission

Specifies the type of data transmitted from the control module to its host after each scan.

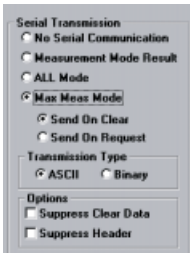
Measurement Mode Result: Data transmitted will reflect the Analysis Mode selections.

All Mode: Transmits all data.

Max. Meas. Mode: Sends only the largest measurement in each measuring event, to decrease transmission size and speed response. Choose to send when the array is clear or send at the host's request.

Transmission Type: ASCII or Binary, defines the format in which the data will be sent.

Serial Options: Suppress Clear Data or Suppress Header to decrease transmission size and speed response.

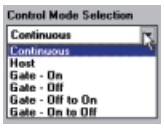


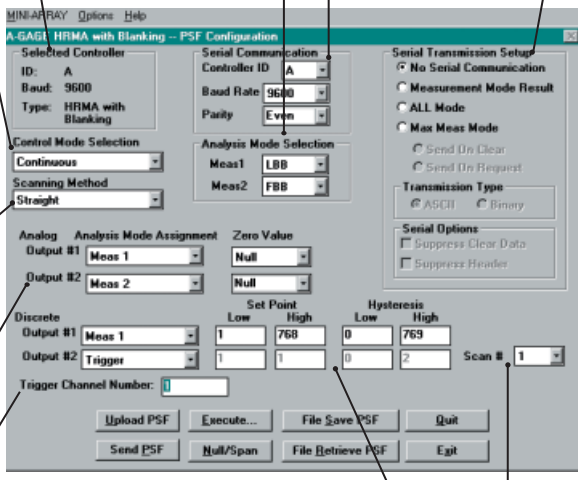
Control Mode Selection

Continuous Mode: The control module constantly polls the array for status.

Host Mode: The control module polls the array for status when prompted by a host controller.

Gate Mode: The control module polls the array for status when prompted by an input from a Gate sensor.



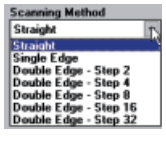


Scanning Method

Straight scan polls each beam sequentially to determine the target object's overall size. This is the most accurate and precise measurement, but also the most time-consuming.

Single Edge scan requires the target object to block beam 1 (closest to the sensors' cabled ends), then conducts a time-saving binary search to "hunt" for the target's overall height (one variable edge).

Double Edge scan conducts a binary search of the entire array to "hunt" for the target's overall width (two variable edges).

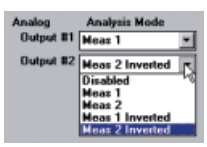


Trigger/Trigger Channel Number
May be used to trigger (or gate) the scan sequence of another **A-GAGE High-Resolution MINI-ARRAY** controller; in straight scanning mode, it defines when during each scan discrete Output #2 will change state.

Scan #: (1-9) Analog outputs are updated with an average value of the data received during the selected number of scans; discrete outputs respond only if the received data is identical for all of the selected number of consecutive scans.

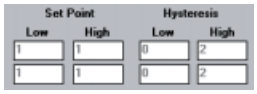
Analog and Discrete Output Assignment

Assigns an analysis (measurement) mode to each output.



Alarm: Causes the control module to turn on discrete Output #2 whenever the System detects a sensing error or if the optical signal becomes marginal.

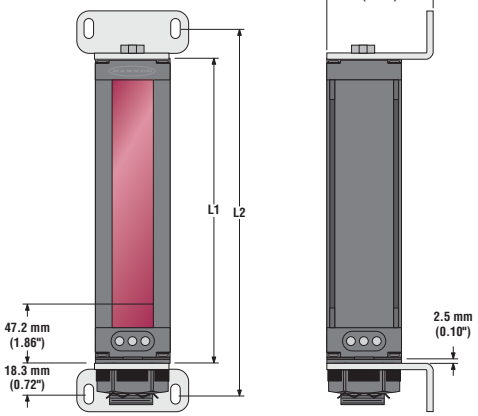
Set Point and Hysteresis Selection
Assigns the set point to determine where within the array the output(s) will respond and hysteresis values to smooth output response.



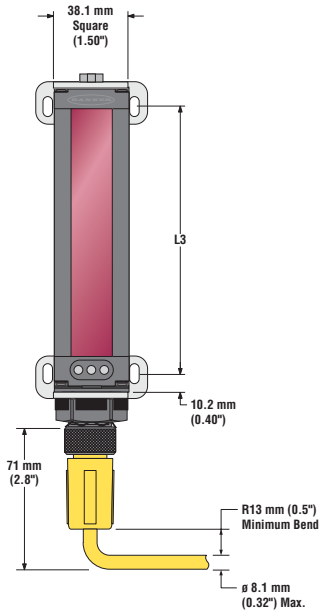
Downloadable Software
To test and verify software, download High-Resolution MINI-ARRAY with blanking version 1.0 (61330.exe) at www.bannerengineering.com.

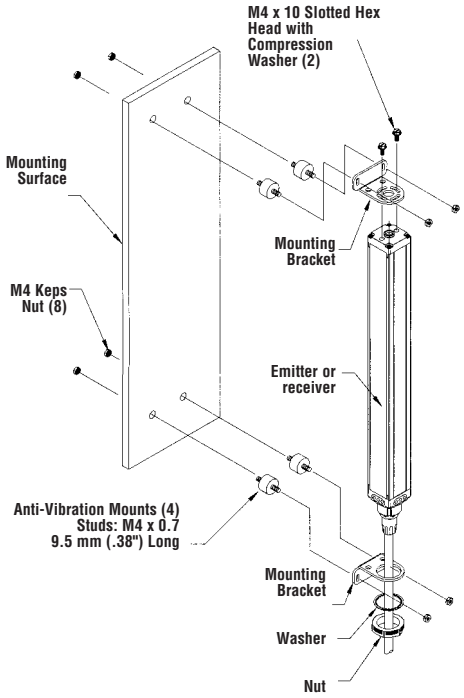
MINI-ARRAY Series Emitter and Receiver Mounting Hardware Dimensions

With mounting bracket flanges "out"



With mounting bracket flanges "in"



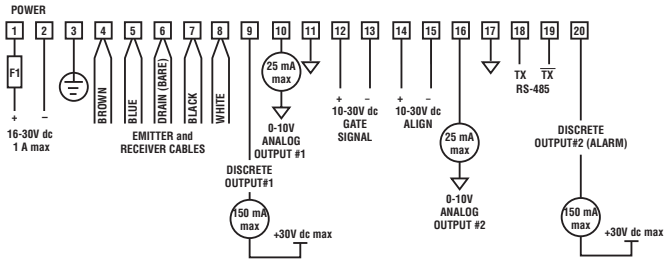


Emitter/Receiver Models	Housing Length	Distance Between Bracket Holes	
	L1	L2	L3
MAHE6A Emitter **MAHR6A** Receiver	236 mm (9.2")	268 mm (10.5")	211 mm (8.3")
MAHE13A Emitter **MAHR13A** Receiver	399 mm (15.6")	430 mm (16.9")	373 mm (14.7")
MAHE19A Emitter **MAHR19A** Receiver	561 mm (22.0")	593 mm (23.3")	536 mm (21.1")
MAHE26A Emitter **MAHR26A** Receiver	724 mm (28.4")	756 mm (29.7")	699 mm (27.5")
MAHE32A Emitter **MAHR32A** Receiver	887 mm (34.8")	918 mm (36.2")	861 mm (33.9")
MAHE38A Emitter **MAHR38A** Receiver	1049 mm (41.2")	1081 mm (42.6")	1024 mm (40.3")
MAHE45A Emitter **MAHR45A** Receiver	1215 mm (47.7")	1246 mm (49.1")	1189 mm (46.8")
MAHE51A Emitter **MAHR51A** Receiver	1377 mm (54.1")	1409 mm (55.5")	1352 mm (53.2")
MAHE58A Emitter **MAHR58A** Receiver	1540 mm (60.5")	1572 mm (61.9")	1515 mm (59.6")
MAHE64A Emitter **MAHR64A** Receiver	1703 mm (66.9")	1734 mm (68.3")	1677 mm (66.0")
MAHE70A Emitter **MAHR70A** Receiver	1865 mm (73.3")	1897 mm (74.7")	1840 mm (72.4")
MAHE77A Emitter **MAHR77A** Receiver	2028 mm (79.7")	2060 mm (81.1")	2003 mm (78.8")

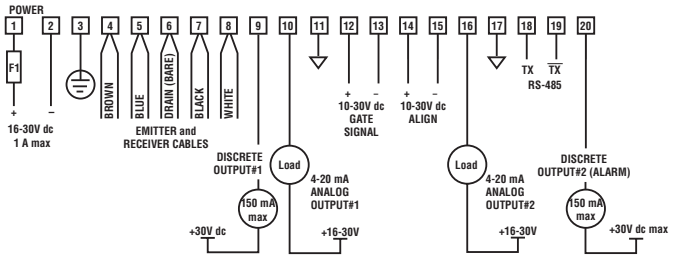
High-Resolution MINI-ARRAY® Series Emitter and Receiver Specifications	
Emitter/Receiver Range	380 mm to 1.8 m (15" to 6')
Minimum Object Sensitivity	2.5 mm (0.1")
Sensor Scan Time	1.8 milliseconds to 58.4 milliseconds, depending on scanning method and sensor length plus 1 ms post processing time for controller.
Power Requirements	12V dc ±2%, supplied by controller
Connections	Sensors connect to controller using two 5-conductor quick-disconnect cables (one each for emitter and receiver), ordered separately. Use only Banner cables, which incorporate a "twisted pair" for noise immunity. Cables measure 8.1 mm (0.32") in diameter and are shielded and PVC-jacketed. Conductors are 20 gauge (0.9 mm). Emitter and receiver cables may not exceed 75 m (250') long, each.
Status Indicators	**Emitter:** Red LED lights to indicate proper emitter operation **Receiver:** Green indicates sensors aligned Yellow indicates marginal alignment of one or more beams Red indicates sensors misaligned or one or more beam(s) blocked
Construction	Aluminum, with black anodized finish; acrylic lens cover
Environmental Rating	NEMA 4, 13 (IP65)
Operating Conditions	**Temperature:** 0° to +50°C (+32° to 122°F) **Maximum relative humidity:** 95% at 50°C (non-condensing)

High-Resolution MINI-ARRAY Series Controller Hookups

MAHCVN-1 Hookup

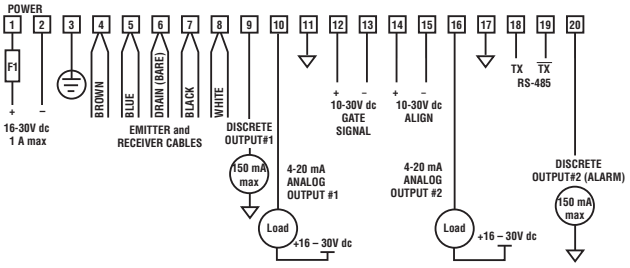


MAHCIN-1 Hookup



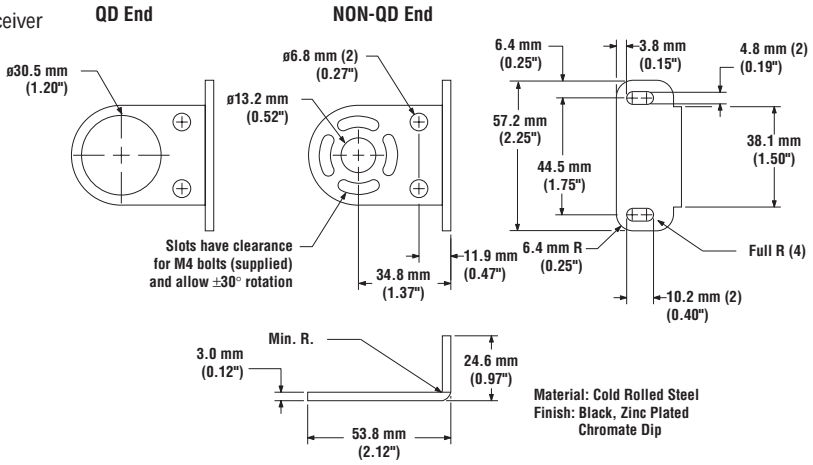
MAHCVP-1 Hookup

MAHCIP-1 Hookup

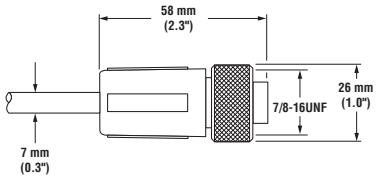
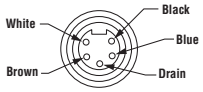


Mounting Brackets

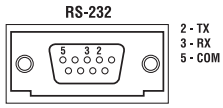
MSMB-3
- One pair of brackets is supplied with each emitter and receiver
- 11-gauge, black zinc-plated chromate dip finish



Quick-Disconnect Cables (two required per system)

Model	Length	Termination	Dimensions	Pin-out
QDC-515C **QDC-525C** **QDC-550C**	5 m (15') 8 m (25') 15 m (50')	5-pin shielded Mini-style Female connector on one end		Female Connector (sockets) 
MAQDC-575C **MAQDC-5100C** **MAQDC-5125C** **MAQDC-5150C**	22 m (75') 30 m (100') 38 m (125') 46 m (150')			

MINI-ARRAY Serial Cable

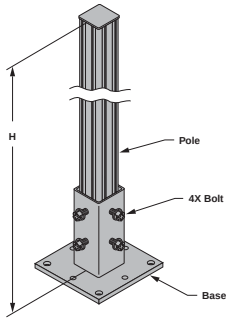
Model	Cable	DB-9 Pin #	Function	Diagram	Data Sheet†
MASC	2 m (6.5')	2	Transmit (TX)	 DB-9 connections between the control module and the PC	55216
		3	Receive (RX)		
		5	Ground (GRD)		

† Data sheets may be downloaded at www.bannerengineering.com.

MSA Series Stands (Base is included)*

MSA Series stands are made of strong extruded and anodized aluminum. They are easy to assemble and solidly support MINI-ARRAY sensors. Their dual-channel design allows accurate sensor height adjustments.

Model	Height (H)	Emitter/Receiver Models	Data Sheet†
MSA-S24-1	610 mm (24")	Up to models BMEL(RL)12..A	43687
MSA-S42-1	1067 mm (42")	Up to models BMEL(RL)30..A	
MSA-S66-1	1676 mm (66")	Up to models BMEL(RL)48..A	



* Available without a base by adding the suffix "**NB**" to model number, e.g. **MSA-S42-1NB**.
† Data sheets may be downloaded at www.bannerengineering.com.

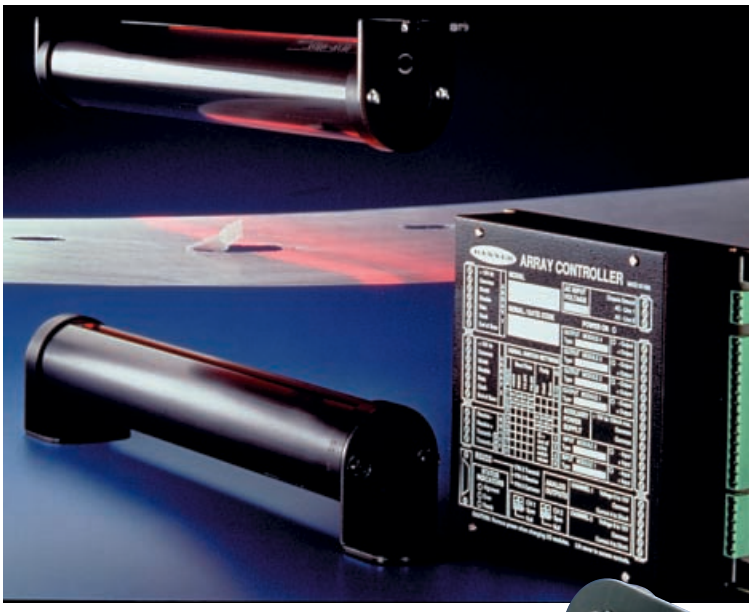
Notes

BEAM-ARRAY™ Series-
rugged design for hostile environments.

Multiplexed arrays for heavy industry.

BEAM-ARRAY measuring light screens are multiplexed emitter/receiver arrays which boast an extremely rugged design for use in hostile industrial environments, as found in lumber production and similar industries. An optional controller allows you to set multiple scanning response configurations, and provides output options to suit nearly any application (see selection chart).

- Sensor separation up to 3 m
- Minimum object detection size of 11.4 mm
- Receivers offer three outputs:
  - Analog: 0 to +10V dc sourcing
  - "Trip": logic level output for "all light" condition
  - Serial data: serial RS232 data stream



A choice of four array lengths.

Versatile BEAM-ARRAY sensors are available in four array lengths to meet varying application needs. BEAM-ARRAY sensors used as "stand alone" devices offer 0 to +10V dc analog output or a logic-level "trip" output. Sensor pairs respond to programmed scan analysis information when wired to controllers with discrete (switched) and analog outputs.

- Four array lengths from 300 mm to 1.2 m
- 6.4 mm beam spacing

Extra rugged, rock solid.

Constructed of 2 1/4" diameter tubular aluminum with epoxy-encapsulated circuitry, BEAM-ARRAY emitters and receivers offer unmatched durability. Factory burn-in procedures assure toughness and reliability

Easier mounting and alignment.

Robust emitters and receivers install easily with right-angle mounting brackets that allow the tubes to rotate during alignment. Anti-vibration mounts are also included. Because the BEAM-ARRAY has more power than competitive units, alignment is easier. System alignment is usually accomplished by simply mounting the emitter and receiver opposite each other, saving significant installation time.

BEAM-ARRAY™ Measuring Light Screen Model Selection

BEAM-ARRAY Series Controller Models

Models	Supply Voltage	Inputs	Outputs	Notes	Data Sheet†
BC2A	105 to 125V dc	2 Sensor pair 1 Gate 1 Encoder	4 discrete & 2 analog	Gate and Encoder inputs and discrete outputs require optional I/O modules	03575 & 03576
BC2B	210 to 250V ac		4 discrete & 2 analog		03575 & 03576
BC1T	15 to 20V dc	1 Sensor pair 1 Gate	RS-232C serial	Wiring via 11-pin relay socket (model **RS-11**)	03577

† Data sheets may be downloaded at www.bannerengineering.com.

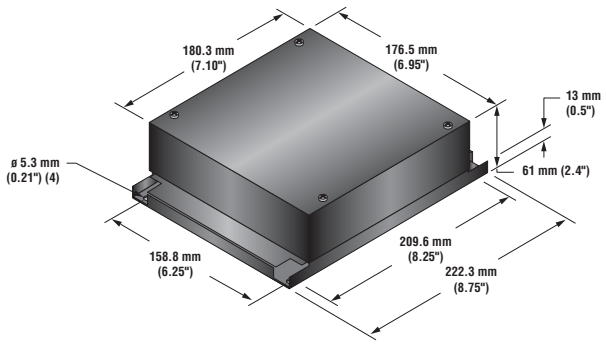
BEAM-ARRAY Series Measuring Light Screen Sensor Models

Models*	Total Beams	Housing Length	Array Length	Supply Voltage	Minimum Object Size	Range	Cable	Output	Data Sheet†
BME148A **BMR148A**	48	391 mm (15.4")	305 mm (12.0")	15 to 20V dc	11.4 mm (0.45")	3 m (10')	9-pin, 5 m (15') QD cable (supplied)	Analog 0 to 10V dc or Switched trip or Serial RS232 (Use of controller is optional)	03526
BME248A **BMR248A**	96	696 mm (27.4")	610 mm (24.0")						
BME348A **BMR348A**	148	823 mm (32.4")	914 mm (36.0")						
BME448A **BMR448A**	192	1306 mm (51.4")	1219 mm (48.0")						

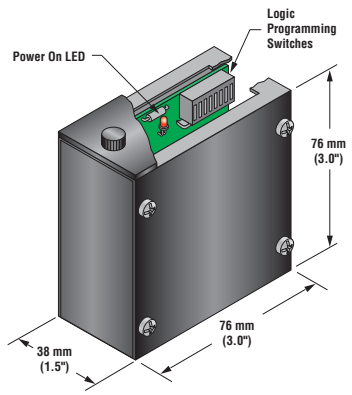
* "E" and "R" in models numbers denotes "Emitter" and "Receiver" respectively. Sold separately.
† Data sheets may be downloaded at www.bannerengineering.com.

BEAM-ARRAY Series Dimensions

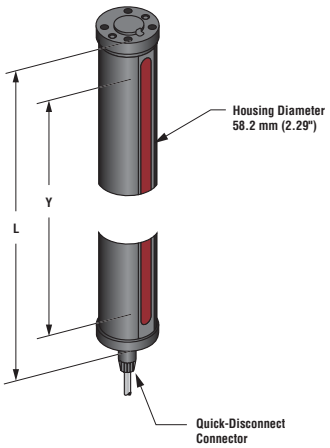
BC2A & BC2B Controller



BC1T Controller



BEAM-ARRAY Emitter or Receiver



Models		Sensor Height (L)	Array Height (Y)	Total Beams
BME148E **BME148R**	Emitter Receiver	391 mm (15.4")	305 mm (12.0")	48
BME248E **BME248R**	Emitter Receiver	696 mm (27.4")	610 mm (24.0")	96
BME348E **BME348R**	Emitter Receiver	1001 mm (39.4")	914 mm (36.0")	144
BME448E **BME448R**	Emitter Receiver	1306 mm (51.4")	1219 mm (48.0")	192

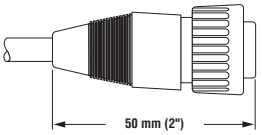
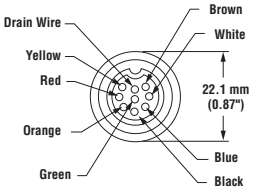
BEAM-ARRAY™ Measuring Light Screen Model Selection

BEAM-ARRAY™ Series Controller Specifications	
Power Requirements	**Model BC2A:** 105-125V ac (25 watts) **Model BC2B:** 210-250V ac (25 watts) **Model BC1T:** 15-20V dc (60 mA) – Power Supply model PSBA-120 is recommended.
Auxiliary Power Output	**BC2A & BC2B:** +15V dc at 100 mA maximum is available at a terminal strip to power a gate sensor and/or encoder.
Inputs	**BC2A & BC2B:** 2 - BEAM-ARRAY sensor inputs (internally connected in series), 1 - Gate input, 1 - Encoder input. Gate and encoder inputs use optically-isolated, single-channel ac or dc input I/O modules (order separately). Output side of module interfaces to the BEAM-ARRAY Controller at TTL voltage levels. **BC1T:** Inputs for one pair of BEAM-ARRAY sensors; GATE sensor input. GATE input signal may be derived from a mechanical switch closure or a sensor output. BEAM-ARRAY scanning begins when the GATE goes "high" (>3V dc, but not greater than 30V dc), and ceases when the GATE input is brought "low" (<1V dc).
Discrete Data Outputs	**BC2A & BC2B:** Discrete (ON/OFF) outputs use optically-isolated, single-channel ac or dc output I/O modules (order separately). Input side of module interfaces to the BEAM-ARRAY Controller at TTL voltage levels. DC output module is sink or source. Banner offers two module models for use as discrete output modules: model BCD280A3 ac output, switches 24-280V ac (3A maximum), model BCD60T3 dc output, switches 5-60V dc (3A maximum) Compatible plug-in I/O modules, with a wide range of output capabilities, are also available from various manufacturers.
Analog Data Outputs	**BC2A & BC2B:** Analog outputs are configurable for either voltage sourcing or current sinking applications, and have two potentiometer adjustments: NULL and SPAN. In the voltage sourcing configuration, NULL is adjustable from -4 to +2V dc and SPAN is adjustable to provide a voltage swing of 1 to 10V dc. In the current sinking configuration NULL is adjustable from 0 to 4 mA and SPAN is adjustable to sink up to 20 mA.
Sensor Scan Time	4 milliseconds per foot of BEAM-ARRAY length.
Serial Output	(See Communications Capabilities below)
Communication Capabilities	**BC2A & BC2B:** The BEAM-ARRAY Controller communicates with a PC-compatible computer for programming, scan data handling or direct scanning control, and with a PLC for direct scanning control and scan data acquisition. The following are included: Built-in RS-232C serial interface with selectable baud rates (4800, 9600 and 19200). Built-in RS-422 and RS-485 serial interfaces with selectable baud rates (4800, 9600, 19200 and 76800). There is a provision for up to 16 addressable units under EIA-485. **Serial data output:** Analysis mode data for selected analysis mode(s) is available at the serial interfaces and may be sent to a PLC or host computer for monitoring or analysis by user-supplied software. BEAM-ARRAY scanning and data handling may be controlled from a host computer by user-supplied software via the RS-232C interface, or by PLC via the RS-422 or RS-485 interface. **BC1T:** The BEAM-ARRAY Serial Control Module includes a built-in RS-232C serial interface and communicates in binary format with a computer or Programmable Logic Controller (PLC) for scan date acquisition. Binary data byte is 8 bits, plus start and parity plus.
Indicators	**BC2A & BC2B:** Green "Power-On" indicator lights whenever power is applied to the BEAM-ARRAY Controller Status indicators light for ALIGNMENT, READY and ERROR conditions. Red "Output" indicator LEDs for each of the four discrete data outputs light while the output is energized. **BC1T:** Red "Power-On" indicator lights whenever power is applied to the BC1T Serial Control Module.
Adjustments	**BC2A & BC2B:** Internal DIP switch for serial interface baud rate selection, parity selection, and instrument identification number selection. **BC1T:** Internal DIP switches for RS-232C serial interface baud rate, parity, scan control mode and measurement mode selection.
Configuration Considerations	All software necessary for user-configuring of the BEAM-ARRAY Controller is included. Scan parameter (PSF) configuration may be accomplished from any PC-compatible computer. Alternatively, the BEAM-ARRAY Controller may be configured by Banner at the factory, per the user's specifications, before shipment.
Maximum Cable Length	**BC2A & BC2B:** 50' (BEAM-ARRAY Controller to BEAM-ARRAY Sensors). Standard cable BMQD-815 is 15' long. 50' cables are available by special order. The Controller to computer (or PLC) RS-232C serial cable length should not exceed 50'.
Base	**BC1T:** 11-pin male relay-style base; mates with Banner model RS-11 socket (sold separately).
Environmental Rating	NEMA 1 (IP10)
Connections	For hookup information, see data sheet p/n 03576 or 03577 at www.bannerengineering.com.
Operating Conditions	**Temperature:** 0° to + 50° (+32° to +122°F). **Maximum relative humidity:** 90% at 50°C (non-condensing).

BEAM-ARRAY Series Opposed Multiplexed Emitter and Receiver Array Specifications	
Supply Voltage and Current	15 to 20V dc at 250 mA (will supply 1 emitter unit and 1 receiver unit, regardless of array length) Proper power supply polarity must be observed to avoid damage to units.
Output Configuration	**Three outputs:** 0 to +10V dc sourcing analog output capable of 20 mA max., continuous. Switched "trip" output logic level: 0V dc whenever one or more light beams are blocked, +6V dc when all beams are established (20 mA maximum continuous, short circuit protected) Serial RS232 data stream output.
Logic Level Input/Output Requirements	Voltage high = +3 to 12V dc; Voltage low = +0.8 to -12V dc.
Output Protection Circuitry	Protected against short circuit of outputs.
Emitter/Receiver Configuration	**Emitter:** Infrared 880 nm LEDs on 0.25 in centers (48 LEDs per foot of emitter array length). **Receiver:** Phototransistors on 6.4 mm (0.25) in centers (48 phototransistors per foot of receiver array length).
Indicators	An "All Beams Visible" red LED lights when all light beams in the array are established ("seen" by their receiver phototransistor). Located behind scanning window at the "cable" end of the receiver phototransistor array.
Scan Time & Timing Logic	Internal clock (factory-set to scan at a rate of 4 milliseconds per foot of array length) or customer-supplied external clock. External clock may not run at faster than 0.1 millisecond per step (10 kHz).
Resolution	11.4 mm (0.45") maximum (smallest profile reliably sensed).
Maximum Object Speed	For reliable detection (assuming 25 mm (1") diameter opaque sphere): 6 m per second (20' per second) per foot of array length.
Construction	Housing is black anodized aluminum; Brackets are 11-gauge cold-rolled black zinc-chromate finished steel; Fasteners are black zinc-chromate finished steel. Brackets, fasteners and anti-vibration mounts are supplied. Mounting posts are not included.
Environmental Rating	NEMA 4, IEC IP66
Connections	PVC-jacketed 8-conductor 5 m (15') cables; 9-pin molded QD connector on one end (8 wires plus shield). One model BMQD815 cable is provided with each emitter or receiver unit ordered.
Operating Conditions	**Temperature:** 0° to +50°C (32° to +122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing).
Certifications	CE

BEAM-ARRAY™ Measuring Light Screen Accessories

Quick-Disconnect Cables

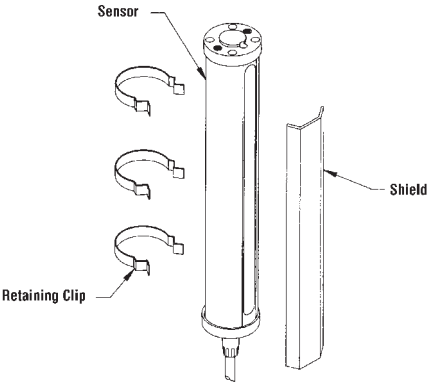
Model	Style	Length	Dimensions	Pin-out
BMQD-815	9-Pin	5 m (15')		

NOTE: This cable is supplied with each BEAM-ARRAY sensor

Lens Shield Kits

Lens kits are replaceable protective covers for the lenses of BEAM-ARRAY Light Screens. The shields are constructed of clear LEXAN® polycarbonate, and are supplied with corrosion-protected steel retaining clips. Shields may be installed or removed without disturbing sensor alignment.
Note: When shields are installed on both the emitter and receiver, excess gain is reduced by 36 percent and maximum operating range is reduced by 20 percent.

Models	Protective-Shield	No. of Clips
MGS6A	152 mm (6")	2
MGS12A	305 mm (12")	2
MGS18A	457 mm (18")	3
MGS24A	610 mm (24")	3
MGS30A	762 mm (30")	4
MGS36A	914 mm (36")	4
MGS42A	1067 mm (42")	5
MGS48A	1219 mm (48")	5
MGS54A	1372 mm (54")	6
MGS60A	1524 mm (60")	6
MGS66A	1676 mm (66")	7
MGS72A	1829 mm (72")	7



LEXAN® is a registered trademark of General Electric Co.

BEAM-ARRAY I/O Modules

BEAM-ARRAY I/O modules are used to interface a BC2A or BC2B BEAM-ARRAY controller to external input devices and loads. The module simply plugs into the BEAM-ARRAY controller in the designated area. Hookup to the external circuit is made via terminals on the barrier strips of the BEAM-ARRAY controller.

Input Modules

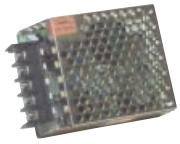
Model	Input Voltage	Input Current	Description
BCM30T	4 to 28V dc	30 mA at 28V dc	Provides optically-isolated input for dc gate and encoder devices. Interfaces contact closures that switch any voltage between 4 and 28V dc. **Max. allowable leakage:** 2 mA at 1 volt **Input resistance:** 900 ohms
BCM140A	90 to 140V ac	11 mA (rms)	Provides optically-isolated input for devices that switch 90 to 140V ac. Allowable input current for output off-state: 2 mA (rms) **Frequency range:** 50/60 Hz **Input impedance:** 20 kΩ min., 24 kΩ max.

Output Modules

Model	Load Voltage	Load Current	Surge Current	Off-state Leakage	Switching Response
BCD60T3	5 to 60V dc	0.02 to 3 amps	5 amps (1 sec)	1.0 mA max. at 60V	100 µs ON; 750 µs OFF
BCD280A3	24 to 280V ac	0.02 to 3 amps	80 amps (1 cycle)	5 mA (rms) at 240V ac (rms)	8.3 ms ON/OFF

BEAM-ARRAY Series Power Supply

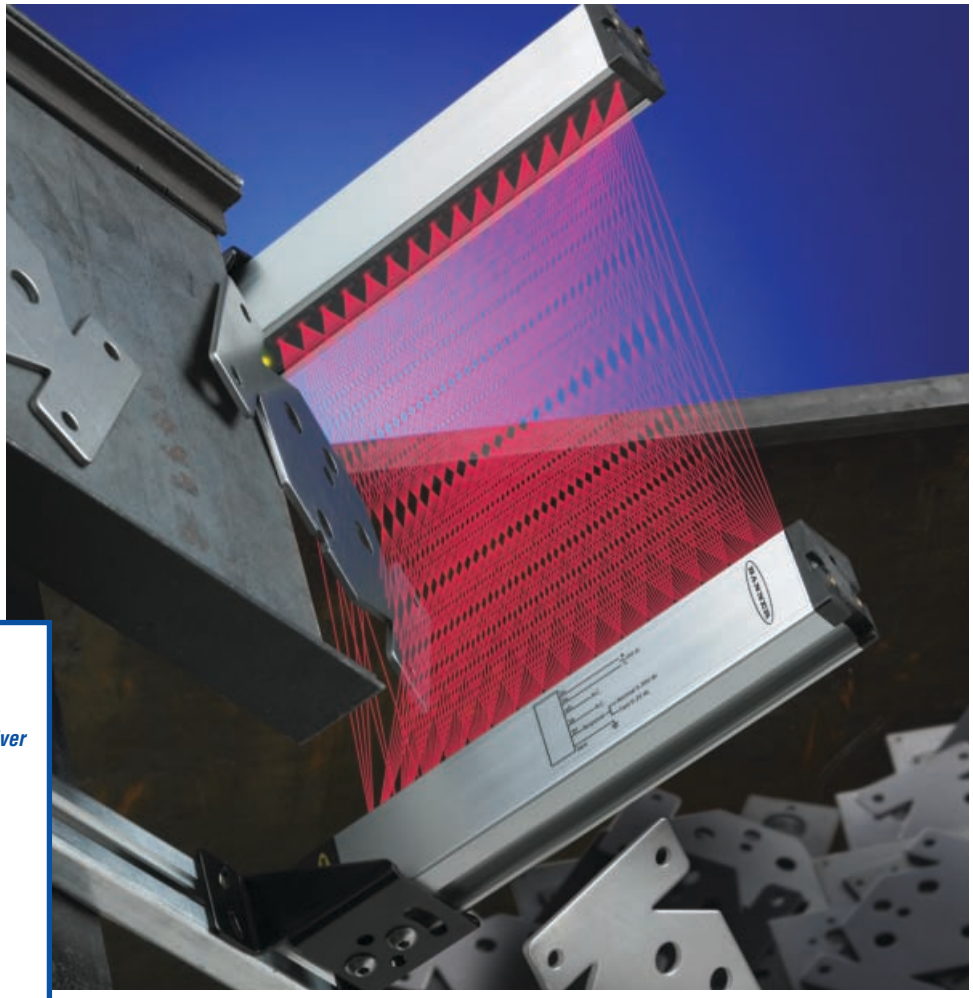
Model	Description
PSBA-120	• Small light-weight switching type power supply • 85 to 130V ac input, 50/60 Hz, 21 watts • Regulated 15V dc output (±1V dc); 1 amp max. • Easily powers two BEAM-ARRAY systems • Safe, rugged, closed-frame construction; UL and CSA certified



BEAM-ARRAY Series Socket

Model	Description
RS-11	• 11-pole round-pin screw terminal relay socket which is used to make electrical connections to BC1T module • Provides in-line clamp screw terminals which will accept from one #24 AWG up to two #14 wires at each pin • May be mounted directly to a panel plate or via standard 35mm DIN-rail track • UL recognized and CSA approved

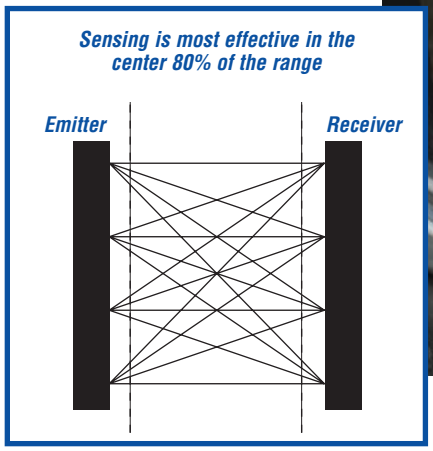
LX Series light screens-high-speed detection of the smallest objects other systems miss.



Unique beam pattern for highest sensing accuracy.

Special synchronized multiple-beam infrared LED emitters and receivers generate a precise optical cross-hatched pattern with extraordinary minimum object sensitivity.

- Minimum object detection of 5.6 mm
- Detects extremely low-profile objects
- Ideal for die-protection, small part or pill counting, parcel handling and variable height detection applications



LX Series optical crosshatch pattern

Industry's fastest response speed.

A hassle free, reliable, easy to mount high-speed light screen.

- 0.8 to 3.2 milliseconds response speed
- Slowest response speed is faster than comparable products
- Enable automated systems to operate at peak efficiency

A variety of lengths to select from.

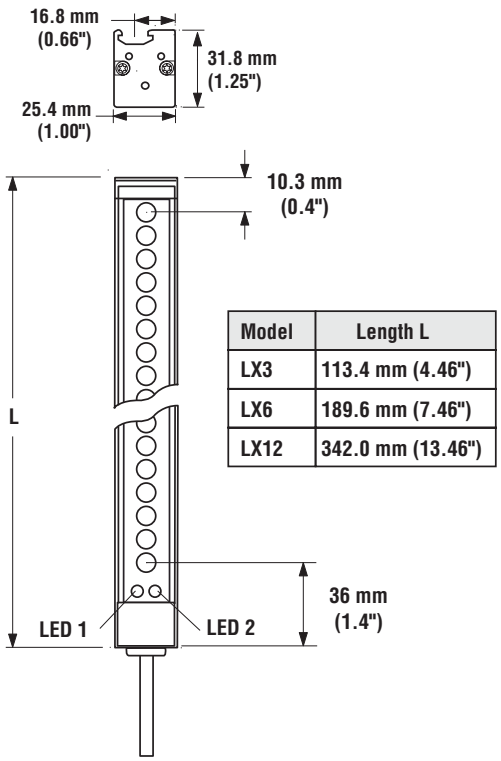
- 3", 6" or 12" lengths
- Short range or standard range models
- Sensing distances from 75 mm to 2 m
- Rugged silver anodized housing
- Integrated mounting channel offers unique mounting flexibility

LX Series Models

	Models		Normal Range	Reduced Range	Sensing Array Length	Cable*	Supply Voltage	Output Type	Data Sheet†
Standard Models	LX3E	Emitter	300 mm to 2 m (12" to 6.5') Minimum Object Detection Size 9.5 mm dia.	150 to 750 mm (6" to 3') Minimum Object Detection Size 9.5 mm dia.	67 mm (2.6")	2 m (6.5') 5-wire Integral cable	10 to 30V dc	Bipolar NPN/PNP	108865
	LX3R	Receiver							
	LX6E	Emitter			143 mm (5.6")				
	LX6R	Receiver							
	LX12E	Emitter			295 mm (11.6")				
	LX12R	Receiver							
Short-Range Models	LX3ESR	Emitter	100 to 200 mm (4"-8") Minimum Object Detection Size 5.6 mm dia.	75 to 150 mm (3" to 6") Minimum Object Detection Size 5.6 mm dia.	67 mm (2.6")	2 m (6.5') 5-wire Integral cable	10 to 30V dc	Bipolar NPN/PNP	108865
	LX3RSR	Receiver							
	LX6ESR	Emitter			143 mm (5.6")				
	LX6RSR	Receiver							
	LX12ESR	Emitter			295 mm (11.6")				
	LX12RSR	Receiver							

* Integral cable models only listed: for 5-pin Euro-style 150 mm (6.5") QD pigtail, add suffix "Q" to model number (e.g., **LX3EQ**). QD models require a mating cable. See page 147 for more information.
† Data sheets may be downloaded at www.bannerengineering.com.

LX Series Dimensions



Model	Length L
LX3	113.4 mm (4.46")
LX6	189.6 mm (7.46")
LX12	342.0 mm (13.46")

Note: (2) T-nuts and (2) M5-0.8x8 screws are included with each sensor

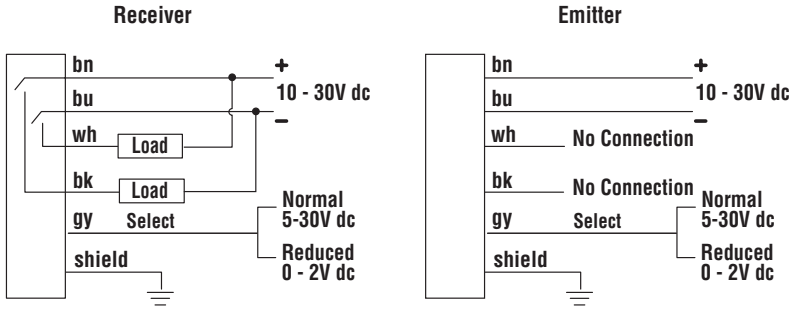
LX Series Model Selection

LX Series Specifications

Sensing Range	**Normal (see hookups)** / **Reduced** **Short-range models:** 100 to 200 mm (4" to 8") / 75 to 150 mm (3" to 6") **Standard-range models:** 300 mm to 2 m (1' to 6.5') / 150 mm to 600 mm (6" to 30")
Supply Voltage and Power	10 to 30V dc (10% maximum ripple) at less than 1 wat each for emitter and receiver (exclusive of load)
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	150 mA maximum each output **Off-state leakage current:** < 5 microamp **Output saturation voltage (PNP output):** < 1 volt at 10 mA and < 1.5 volts at 100 mA **Output saturation voltage (NPN output):** < 0.5 volts at 10 mA and < 0.6 volts at 100 mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs
Output Response Time	**LX3:** 0.8 ms ON-time; 6 m OFF-time (5 ms off-delay) **LX6:** 1.6 ms ON-time; 7 m OFF-time (5 ms off-delay) **LX12:** 3.2 ms ON-time; 8.5 m OFF-time (5 ms off-delay)
Minimum Object Detection Size	Smallest diameter rod that can be detected in sensing range: 5.6 mm (0.22") or 9.5 mm (0.32"), depending on model.
Indicators	**Emitter:** **LED1 (green)** **ON:** Power ON, good sensor **OFF:** Emitter hardware failure; **LED2 (red)** **ON:** Reduced range **OFF:** Normal range **Flashing:** Emitter hardware failure **Receiver:** **LED1 (yellow)** **ON:** Output conducting **OFF:** Output not conducting; **LED2 (bicolor green/red)** **Green:** Normal range **Red:** Reduced range **Flashing Red:** Receiver hardware failure
Construction	Aluminum housing, plastic endcaps, acrylic lens window
Environmental Rating	IEC IP65, NEMA 6
Connections	2 m (6.5') 5-conductor (with drain) pvc-jacketed attached cable or 5-pin Euro-style 150 mm (6") pigtail QD, depending on model
Operating Conditions	**Temperature:** -20° to +70°C (-4° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	i) The best sensing resolution occurs within the center 80 percent of the sensing area, between the emitter and receiver. ii) Low-profile packages can be reliably detected. iii) Outputs are energized whenever the light screen is interrupted.
Certifications	CE

LX Series Hookups

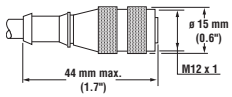
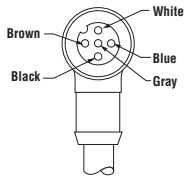
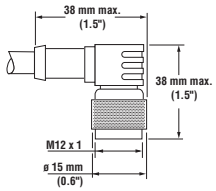
Cabled Models



NOTE: Hookups are the same for either integral or QD cable.

Quick-Disconnect (QD) Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40° to +90°C (-40° to +194°F) **Voltage Rating:** 250V ac/300V dc

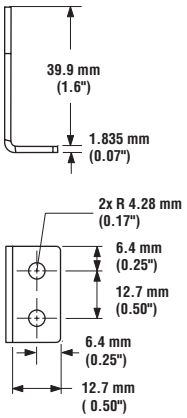
Style	Model	Length	Dimensions	Pin-out
5-Pin Euro Straight w/shield	**MQDEC2-506** **MQDEC2-515** **MQDEC2-530**	2 m (6.5') 5 m (15') 9 m (30')		
5-Pin Euro Right-Angle w/shield	**MQDEC2-506RA** **MQDEC2-515RA** **MQDEC2-530RA**	2 m (6.5') 5 m (15') 9 m (30')		

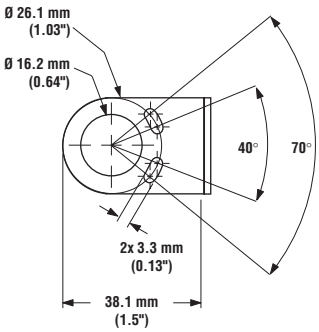
LX Series Lens Shields

Lens Shield Model Number	Fits LX Series Sensor Model	Description
LXS3	**LX3**	Self-adhesive polycarbonate lens shields protect sensor lens window from impact or weld flash. When shields are installed on both emitter and receiver, excess gain is reduced by 36% (max. operating range reduces by 20%).
LXS6	**LX6**	
LXS12	**LX12**	

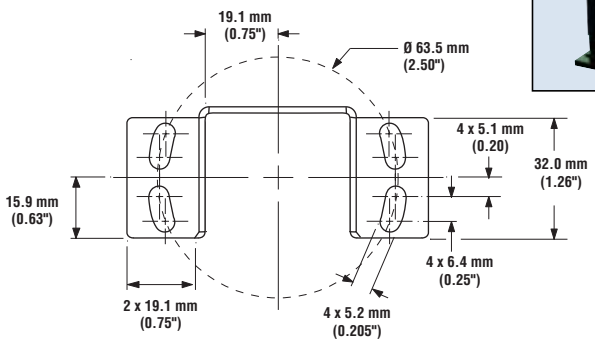
Mounting Brackets

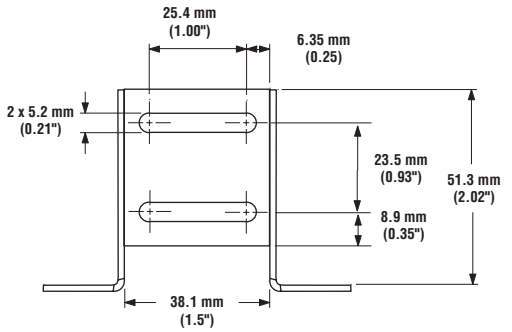
SMBLX
- End-cap brackets; set of 2
- Zinc-plated cold rolled steel





SMBLXR
- Back-mount bracket for secure one-end mounting
- Zinc-plated cold rolled steel



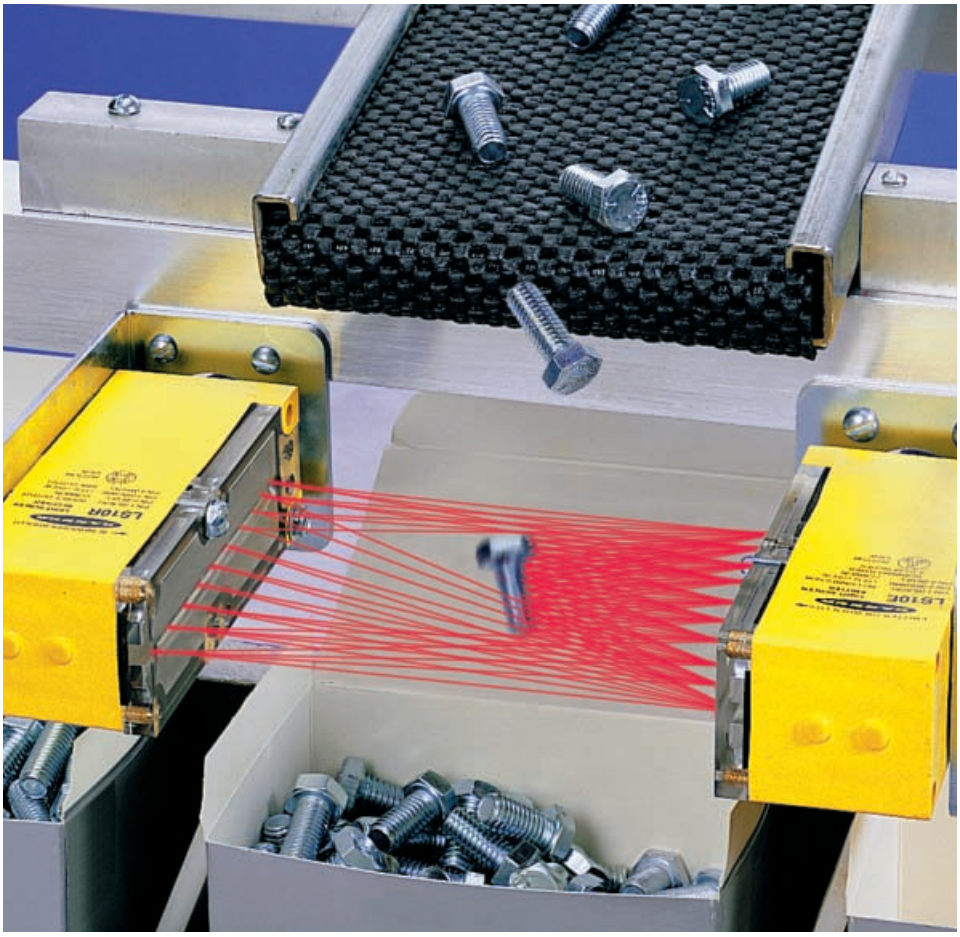


LS Series- a proven, reliable system for small parts detection.

Ideal for ejection verification and counting.

LS Series part sensing light screens offer an economical and reliable solution for small part detection, including verifying machine-ejected parts, and part counting applications.

- Light screen area measures 90 mm
- Choice of three models (with different sensing resolutions)
- Self-contained emitter and receiver
- Field replaceable lenses
- Rugged limit-switch style housings
- Epoxy-encapsulated circuitry
- Strobed, modulated infrared array for ambient light immunity
- Fast, 1-millisecond response
- 5-millisecond pulse stretcher for small fast moving parts
- Simultaneous use of bipolar (NPN plus PNP) receiver outputs



Field replaceable lenses for maintaining beam accuracy in abusive environments.

Choose from three resolutions & ranges.

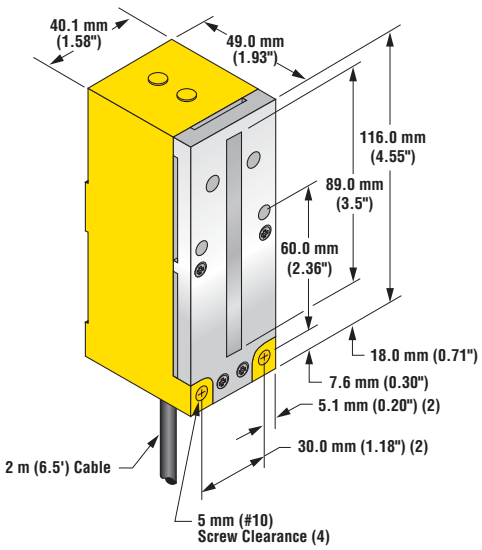
LS Series light screens are available with three ranges, from 100 mm to 2.29 m, to solve your small parts detection applications. LS Series light screens detect objects with minimum resolutions of 5.6 mm, 7.6 mm or 25 mm to 38 mm, depending on model.

LS Series Models						
Models	**Range**	**Cable***	**Supply Voltage**	**Output Type**	**Minimum Resolution**	**Data Sheet†**
LS4EL	0.46 to 2.29 m (18 to 90")	2 m (6.5') cable	10 to 30V dc	Bipolar NPN/PNP Dark operated	25 to 38 mm (1.0 to 1.5") Depending upon location of object within light screen	39673
LS4RL		2 m (6.5') cable				
LS4ELQ		4-pin Mini-style QD				
LS4RLQ		4-pin Mini-style QD				
LS10ESR	100 to 200 mm (4 to 8")	3-pin Mini-style QD	12 to 30V dc	Bipolar NPN/PNP Dark operated	5.6 mm (0.22")	03557
LS10ESRQDH		4-pin Euro-style QD				
LS10RSR		4-pin Mini-style QD				
LS10RSRQDH		4-pin Euro-style QD				
LS10E	100 to 1220 mm (4 to 48")	3-pin Mini-style QD			7.6 mm (0.30")	
LS10EQDH		4-pin Euro-style QD				
LS10R		4-pin Mini-style QD				
LS10RQDH		4-pin Euro-style QD				
LS10EL-38434	600 to 1800 mm (24 to 72")	4-pin Mini-style QD	12 to 30V dc	Bipolar NPN/PNP Dark operated	12.2 mm (.45")	
LS10RL-38435		4-pin Mini-style QD				

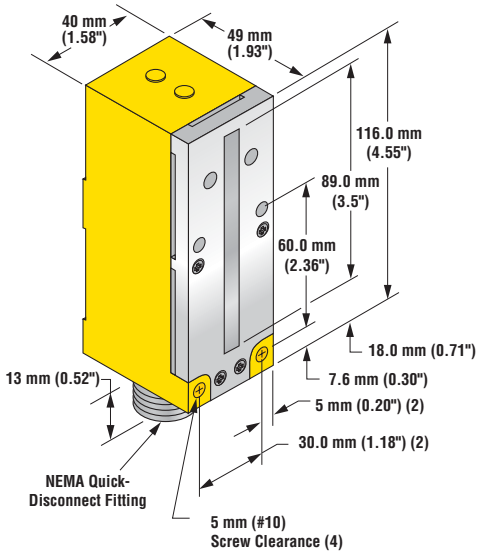
* Models with a QD connector require a mating cable. See page 152 for more information.
† Data sheets may be downloaded at www.bannerengineering.com.

LS Series Dimensions

LS Series with Attached Cable



LS Series with Quick-Disconnect (Mini-style shown)



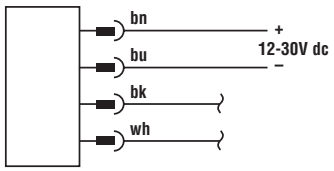
For Replacement Lens Assemblies, contact your Banner Representative.

LS Series Model Selection

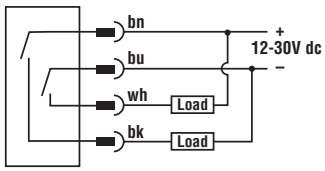
LS Series Specifications	
Sensing Range	**LS4 models:** 18 to 90" (0.46 m to 2.29 m) **LS10 models:** 4 to 72" (100 to 1800 mm), depending on model
Sensing Beam	Infrared, 880 nm
Supply Voltage and Current	**LS4 models:** 10 to 30V dc at less than 40 mA (emitter) and 30 mA (receiver) - exclusive of load **LS10 models:** 12 to 30V dc (10% maximum ripple) at less than 70 mA (emitter) or 45 mA (receiver) – exclusive of load
Supply Protection Circuitry	Protected against reverse polarity
Output Configuration	**Bipolar:** One current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Rating	125 mA maximum both outputs **Off-state leakage current:** < 1 microamp **Output saturation voltage (PNP output):** < 1 volt at 10 mA and < 2 volts at 150 mA **Output saturation voltage (NPN output):** < 200 millivolts at 10 mA and < 1 volt at 150 mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs
Response Time	Receiver will respond to a “dark” signal of 1 millisecond or longer duration; a 5-millisecond pulse stretcher (OFF Delay) is included to improve interfacing reliability; successive parts must have at least 10 millisecond separation.
Repeatability	30 microseconds (light-to-dark)
Resolution	**LS4 models:** 25 mm to 38 mm (1" to 1.5"), depending upon the location of the object within the curtain **LS10 models:** 5.6 mm (0.22"), 7.6 mm (0.30") or 12.2 mm (.45"), depending on model The best sensing resolution occurs near the center of the sensing area, midway between the emitter and receiver.
Indicators	**Power (emitter only):** lights when power is applied **Alignment (receiver only):** lights when light screen is interrupted
Construction	Reinforced PBT polyester housing, acrylic lenses, and stainless steel hardware
Environmental Rating	NEMA 1, 2, 3, 12 and 13; IEC IP54
Connections	3-pin or 4-pin Mini-style, 4-pin Euro-style quick-disconnect or 2 m (6.5') PVC covered attached cable (depending on model)
Operating Conditions	**Temperature:** 0° to +50°C (+32° to 122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE

LS10 Series Hookups

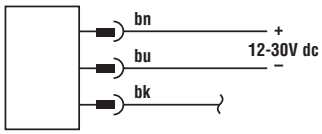
LS10 Emitter with Quick-Disconnect 4-pin



LS10 Receiver with Quick-Disconnect 4-pin

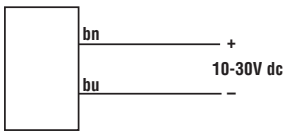


LS10 Emitter with Quick-Disconnect 3-pin Mini-style

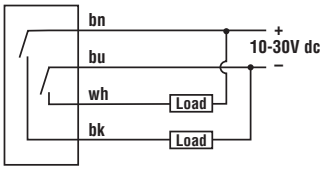


LS4 Series Hookups

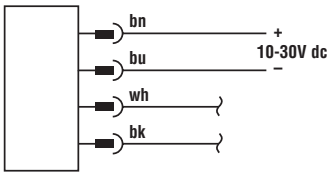
LS4 Emitter with Attached Cable



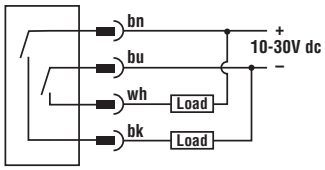
LS4 Receiver with Attached Cable



LS4 Emitter with Quick-Disconnect 4-pin Mini-style

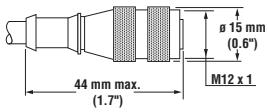
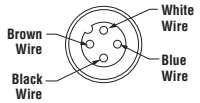
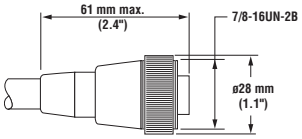
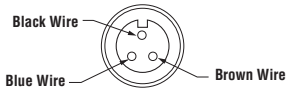
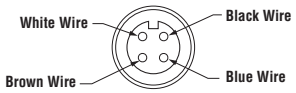


LS4 Receiver with Quick-Disconnect 4-pin Mini-style



Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded (18 AWG for Mini-style), PVC insulation, gold-plated contacts
Temperature: Euro-style: -40° to +90°C (-40° to +194°F) Mini-style: -40° to +80°C (-40° to +176°F)
Voltage Rating: 250V ac/300V dc

Style	Model	Length	Dimensions	Pin-out
4-Pin Euro Straight	**MQDC-406** **MQDC-415** **MQDC-430**	2 m (6.5') 5 m (15') 9 m (30')		
3-Pin Mini Straight	**MBCC-306** **MBCC-312** **MBCC-330**	2 m (6.5') 4 m (12') 9 m (30')		
4-Pin Mini Straight	**MBCC-406** **MBCC-412** **MBCC-430**	2 m (6.5') 4 m (12') 9 m (30')		

Replacement Lens Assemblies

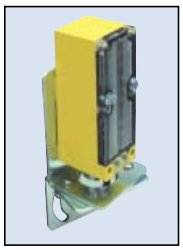
LS Series lens assemblies are field-replaceable.

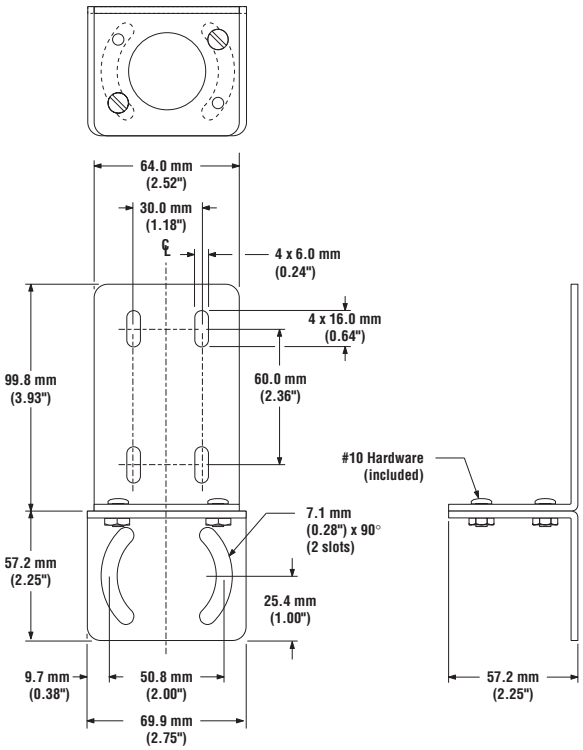
Models	Description
UC-LS10	Replacement lens for LS10E and LS1OR
UC-LS10SR	Replacement lens for LS10ESR and LS10RSR
UC-LS4EL	Replacement lens for LS4EL and LS4ELQ
UC-LS4RL	Replacement lens for LS4RL and LS4RLQ

Mounting Brackets

SMBLS

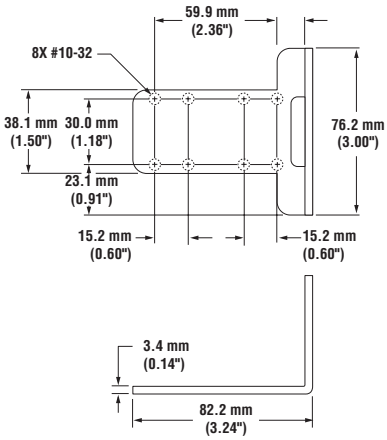
- Two 11-gauge zinc plated steel, right-angle brackets fasten together so they can rotate relative to each other
- Assembly hardware and cable gland are included



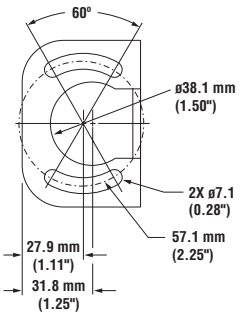


SMB30UR

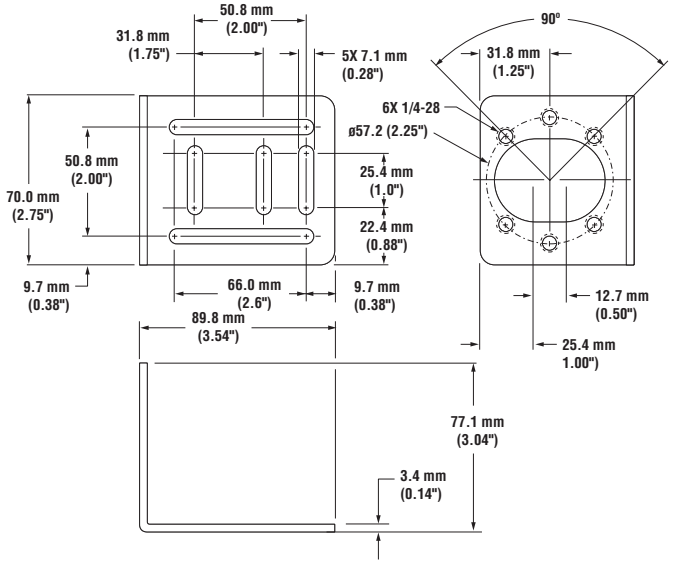
- 2-piece universal swivel bracket for limit-switch style sensors
- 300 series stainless steel



SMB30UR Top



SMB30UR Bottom



BMLV Series- ruggedized retroreflective object detection.

Dependable sensing of larger objects.

The BMLV system, used to detect larger objects in larger areas, consists of a single sensor used with a retroreflective target mounted on the opposite side of the sensing area.

- Senses objects ≥ 50 mm at a distance of .6 m from the sensor or senses objects ≥ 125 mm at a distance of 2.1 m from the sensor
- Sensor/target separation ≤ 3 m (with Banner high-grade retro tape)
- Solid-state Bi-Modal™ output offers NPN or PNP
- Light-operate or dark-operate programming
- Rugged extruded aluminum sensor housing
- Quick and simple installation and alignment

Six screen heights to solve your applications.

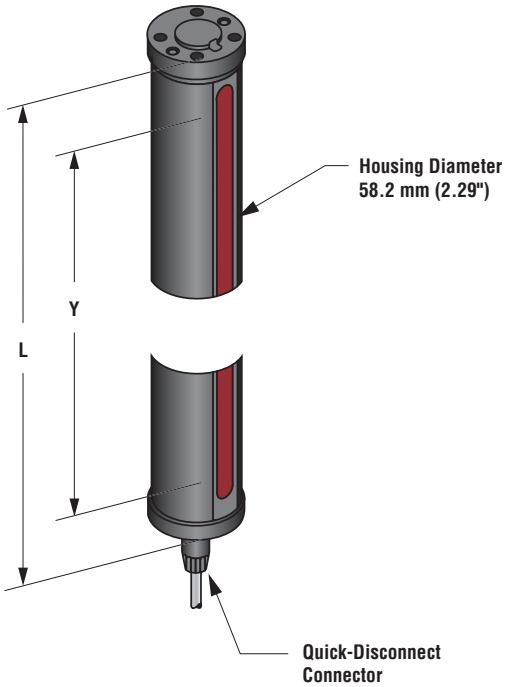
You have a choice of light screen heights including models with LED array heights of 305 mm, 610 mm, 914 mm, 1219 mm, 1524 mm, and 1829 mm. Simply choose the model that best matches your application.

Banner offers a broad range of reflective targets for use with their retroreflective mode products.

BMLV Series Models								
Models	Array Height	Total Beams	Minimum Object Size	Range	Cable*	Supply Voltage	Output Type	Data Sheet†
BMLV18C	305 mm (12.0")	8	50 mm (2")	0.3 to 3 m (1 to 10')	4-pin Mini-style QD	10 to 30V dc	Bi-Modal™ NPN or PNP depending on power supply hookup polarity	31096
BMLV28C	610 mm (24.0")	16						
BMLV38C	914 mm (36.0")	24						
BMLV48C	1219 mm (48.0")	32						
BMLV58C	1524 mm (60.0")	40						
BMLV68C	1829 mm (72.0")	48						

* Models with a QD connector require a mating cable. See page 157 for more information.
† Data sheets may be downloaded at www.bannerengineering.com.

BMLV Series Dimensions



Models	Sensor Height (L)	Array Height (Y)
BMLV18C	391 mm (15.4")	305 mm (12.0")
BMLV28C	696 mm (27.4")	610 mm (24.0")
BMLV38C	1001 mm (39.4")	914 mm (36.0")
BMLV48C	1306 mm (51.4")	1219 mm (48.0")
BMLV58C	1610 mm (63.4")	1524 mm (60.0")
BMLV68C	1915 mm (75.4")	1829 mm (72.0")

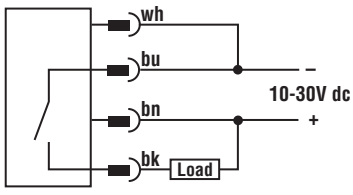
For BMLV Light Screens:
i) BMLV Series models come standard with a 4-pin Mini-style quick-disconnect cable.
ii) A model with a QD connector requires an accessory mating cable.

BMLV Series Model Selection

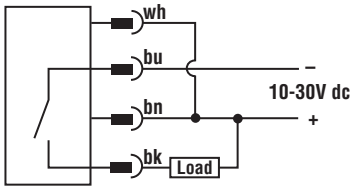
BMLV Series Specifications	
Range	10' to target of BRT-THG-3 high-grade retroreflective tape (3" wide; length must be the length of the sensor plus 6")
Sensing Beam	Visible red (650 nm)
Supply Voltage and Current	10 to 30V dc at 85 mA per foot of array length (exclusive of load) 10% maximum ripple. Power supply model PSBA-120 is recommended.
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bi-Modal™ output (PNP sourcing or NPN sinking). Selection of sourcing or sinking configuration is determined by the sensor's power supply hookup polarity (see hookup diagrams)
Output Rating	Output is rated at 200 mA (continuous) in either sourcing or sinking mode **Output saturation voltage:** < 1 volt at 10 mA and less than 2 volts at full rated load **Output leakage current:** < 10 microamps
Output Protection Circuitry	Outputs are protected against false pulse on power-up, inductive load transients and continuous overload or short-circuit of outputs. Circuitry is designed for a high level of RFI interference immunity
Output Response Time	20 milliseconds "on", 10 milliseconds "off" (NOTE: There is a 100 millisecond delay on power-up: outputs are non-conducting during this time.)
Beam Configuration	Eight retroreflective beams per foot of sensing window height
Resolution	Minimum width of object required to break beam: 50 mm (2")
Indicators	Red LED indicator is located behind the scanning window at the cable end of the sensor. The indicator lights when all beams are established (i.e. when all receivers "see" the light from their associated emitters returned from the retroreflective target), and goes "off" when one or more beams are blocked.
Construction	Housing is black anodized aluminum
Environmental Rating	NEMA 4; IEC IP66
Connections	4-pin Mini-style Quick-Disconnect (QD) connector is standard.
Operating Conditions	**Temperature:** 0° to +50°C (32° to +122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE

BMLV Series Hookups

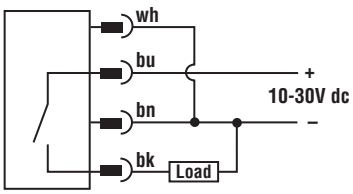
Current Sinking, Dark Operate



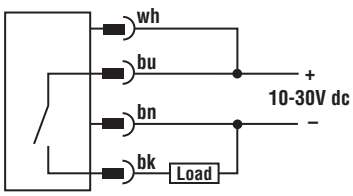
Current Sinking, Light Operate



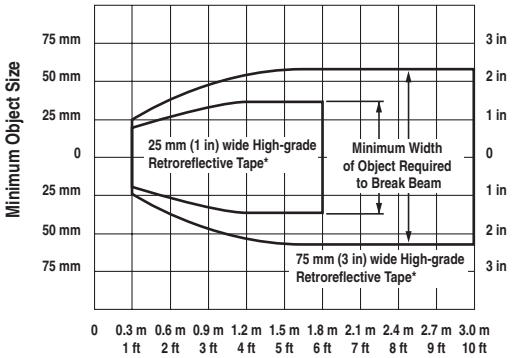
Current Sourcing, Dark Operate



Current Sourcing, Light Operate



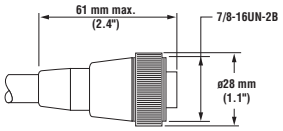
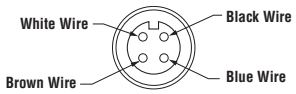
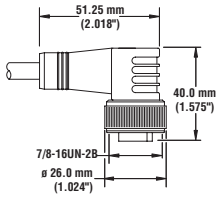
BMLV Series Resolution Versus Range



* Target must be 150 mm (6 in) longer than the sensor

Mini-Style Quick-Disconnect Cables

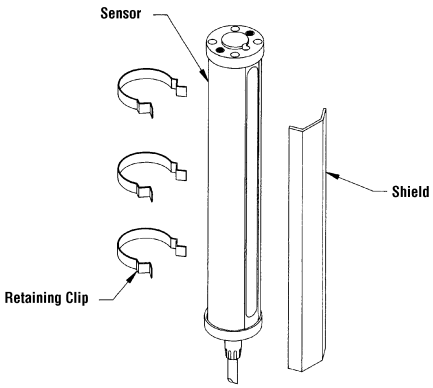
Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 18 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40° to +80°C (-40° to +176°F)
Voltage Rating: 250V ac/300V dc

Style	Model	Length	Dimensions	Pin-out
4-Pin Mini Straight	**MBCC-406** **MBCC-412** **MBCC-430**	2 m (6.5') 4 m (12') 9 m (30')		
4-Pin Mini Right-angle	**MBCC-412RA** **MBCC-430RA**	4 m (12') 9 m (30')		

Lens Shield Kits

Lens kits are replaceable protective covers for the lenses of BMLV Part Sensing Light Screens. The shields are constructed of clear LEXAN® polycarbonate, and are supplied with corrosion-protected steel retaining clips. Shields may be installed or removed without disturbing sensor alignment.
Note: When shields are installed on both the emitter and receiver, excess gain is reduced by 36 percent and maximum operating range is reduced by 20 percent.

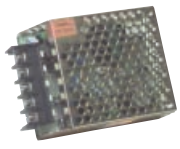
Models	Protective-Shield	For BMLV model:
MGS24A	610 mm (24")	BMLV18C
MGS12A	305 mm (12")	BMLV28C
MGS36A	914 mm (36")	BMLV38C
MGS48A	1219 mm (48")	BMLV48C
MGS60A	1524 mm (60")	BMLV58C
MGS72A	1829 mm (72")	BMLV68C



LEXAN® is a registered trademark of General Electric Co.

Power Supply

Model	Description
PSBA-120	• Small light-weight switching type power supply • 85 to 130V ac input, 50/60 Hz, 21 watts • Regulated 15V dc output (±1V dc); 1 amp max. • Easily powers two BMLV systems • Safe, rugged, closed-frame construction; UL and CSA certified



Retroreflective Tape

Model	Description
BRT-THG-3-100	• 75 mm (3") wide, high-grade micro corner-cube tape • Made of flexible synthetic resin • Sold in 2.5 m (100") lengths

PVA Series- parts verification array.

Take the guesswork out of sequential parts assembly.

With Banner's Parts Verification Array (PVA) to light their way, assemblers never need to guess "what's next." Highly-visible job lights on each emitter and receiver guide assemblers through the correct part-gathering sequence, reducing the occurrence of missed parts and parts assembled in the wrong order.

- Increased quality percentages/decreased production costs
- Also functions as a part sensor for objects > 35 mm diameter

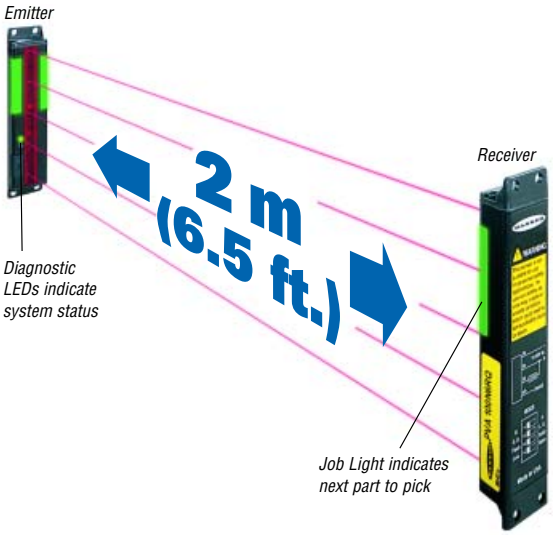
Simple, two-component light screen system eliminates the controller.

The PVA saves installation time, wiring costs and maintenance compared with more complex systems that require a sync wire or controller box.

- Emitter and receiver interface easily with existing process controller
- Diagnostic LEDs indicate setup and system errors at a glance

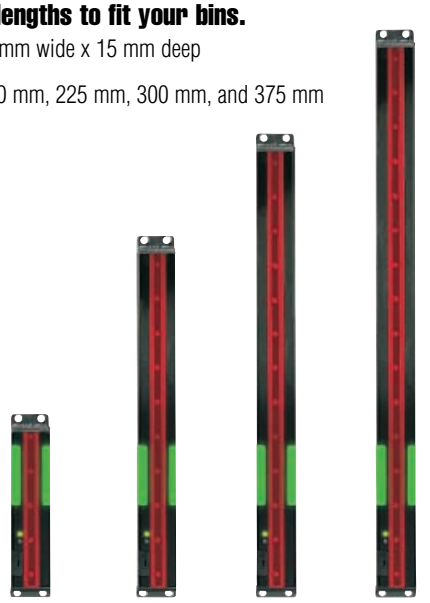
Long 2 m (6.5') range.

The PVA system's long operating range, up to 2 m, and wide field of view makes alignment easy.



Choose from four lengths to fit your bins.

- Compact system, 30 mm wide x 15 mm deep
- Available lengths: 100 mm, 225 mm, 300 mm, and 375 mm

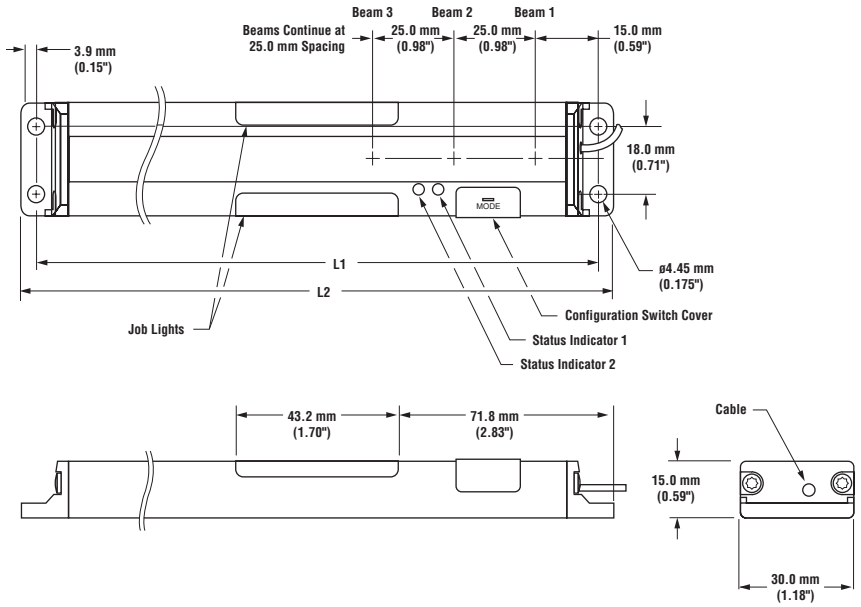


Parts Verification Array Series Models

Models	Description	Array Length & Response Time	Cable*	Supply Voltage	Job Light Input	Receiver Output	Minimum Resolution	Data Sheet†
PVA100N6	Emitter/Receiver Pair	100 mm (4") Long, 5 Beams 20 ms	2 m (6.5') Unterminated	12 to 30V dc	0V dc	NPN	35 mm	52088
PVA100N6E	Emitter							
PVA100N6R	Receiver							
PVA100P6	Emitter/Receiver Pair			12 to 30V dc	+5 to 30V dc	PNP	35 mm	
PVA100P6E	Emitter							
PVA100P6R	Receiver							
PVA100N6Q	Emitter/Receiver Pair		2 m (6.5') terminated with 4-pin Euro-style QD	12 to 30V dc	0V dc	NPN	35 mm	
PVA100N6EQ	Emitter							
PVA100N6RQ	Receiver							
PVA100P6Q	Emitter/Receiver Pair			12 to 30V dc	+5 to 30V dc	PNP	35 mm	
PVA100P6EQ	Emitter							
PVA100P6RQ	Receiver							
PVA225N6	Emitter/Receiver Pair	225 mm (9") Long, 10 Beams 40 ms	2 m (6.5') Unterminated	12 to 30V dc	0V dc	NPN	35 mm	52088
PVA225N6E	Emitter							
PVA225N6R	Receiver							
PVA225P6	Emitter/Receiver Pair			12 to 30V dc	+5 to 30V dc	PNP	35 mm	
PVA225P6E	Emitter							
PVA225P6R	Receiver							
PVA225N6Q	Emitter/Receiver Pair		2 m (6.5') terminated with 4-pin Euro-style QD	12 to 30V dc	0V dc	NPN	35 mm	
PVA225N6EQ	Emitter							
PVA225N6RQ	Receiver							
PVA225P6Q	Emitter/Receiver Pair			12 to 30V dc	+5 to 30V dc	PNP	35 mm	
PVA225P6EQ	Emitter							
PVA225P6RQ	Receiver							
PVA300N6	Emitter/Receiver Pair	300 mm (12") Long, 13 Beams 52 ms	2 m (6.5') Unterminated	12 to 30V dc	0V dc	NPN	35 mm	52088
PVA300N6E	Emitter							
PVA300N6R	Receiver							
PVA300P6	Emitter/Receiver Pair			12 to 30V dc	+5 to 30V dc	PNP	35 mm	
PVA300P6E	Emitter							
PVA300P6R	Receiver							
PVA300N6Q	Emitter/Receiver Pair		2 m (6.5') terminated with 4-pin Euro-style QD	12 to 30V dc	0V dc	NPN	35 mm	
PVA300N6EQ	Emitter							
PVA300N6RQ	Receiver							
PVA300P6Q	Emitter/Receiver Pair			12 to 30V dc	+5 to 30V dc	PNP	35 mm	
PVA300P6EQ	Emitter							
PVA300P6RQ	Receiver							
PVA375N6	Emitter/Receiver Pair	375 mm (15") Long, 16 Beams 64 ms	2 m (6.5') Unterminated	12 to 30V dc	0V dc	NPN	35 mm	52088
PVA375N6E	Emitter							
PVA375N6R	Receiver							
PVA375P6	Emitter/Receiver Pair			12 to 30V dc	+5 to 30V dc	PNP	35 mm	
PVA375P6E	Emitter							
PVA375P6R	Receiver							
PVA375N6Q	Emitter/Receiver Pair		2 m (6.5') terminated with 4-pin Euro-style QD	12 to 30V dc	0V dc	NPN	35 mm	
PVA375N6EQ	Emitter							
PVA375N6RQ	Receiver							
PVA375P6Q	Emitter/Receiver Pair			12 to 30V dc	+5 to 30V dc	PNP	35 mm	
PVA375P6EQ	Emitter							
PVA375P6RQ	Receiver							

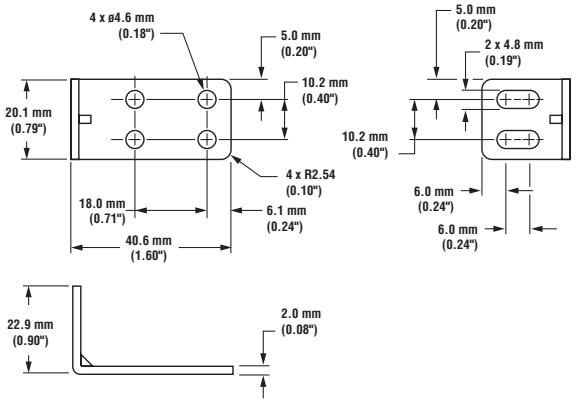
*Cable diameter is 3.3 mm (0.13") on all models.
† Data sheets may be downloaded at www.bannerengineering.com.

Parts Verification Array Series Emitter and Receiver Dimensions



Number of Beams	L1	L2
5	130.0 mm (5.12")	137.8 mm (5.43")
10	258.5 mm (10.18")	266.4 mm (10.49")
13	333.5 mm (13.13")	341.4 mm (13.44")
16	408.5 mm (16.09")	416.6 mm (16.10")

Parts Verification Array Series Bracket Dimensions (2 supplied with each sensor*)



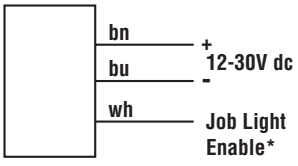
* Also available separately in pairs; p/n SMBPVA1 (see Accessories, page 162 for more information).

Parts Verification Array Series Specifications

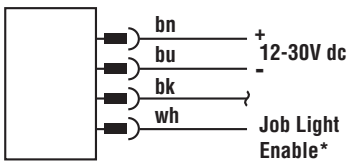
Beam Spacing	25.0 mm (0.98")
Sensing Height	100 mm (3.9"), 225 mm (8.9"), 300 mm (11.8"), or 375 mm (14.8"), depending on emitter and receiver models
Supply Voltage and Current	12 to 30V dc (10% maximum ripple) at less than 62 mA for the emitter and 50 mA for the receiver (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity
Output Configuration	Receivers have one solid-state dc output, programmable for light or dark operate: **Models PVA…N6R** have current sinking (NPN) open-collector transistor **Models PVA…P6R** have current sourcing (PNP) open-collector transistor
Output Rating	150 mA maximum **Off-state leakage current:** < 2 microamps **On-state saturation voltage:** < 1V dc at 10 mA and less than 1.5V dc at 100 mA
Output Response Time	**Sensor Size** / **Standard** / **With Crosstalk from Adjacent Units** 100 mm / 20 ms / 30 ms max 225 mm / 40 ms / 60 ms max 300 mm / 52 ms / 78 ms max 375 mm / 64 ms / 96 ms max
Output Protection Circuitry	Protected against false pulse at power-up and continuous overload or short circuit of outputs
Sensing Resolution	35 mm (1.4") minimum diameter
Status Indicators	**Emitter:** One green LED to indicate power ON/OFF One red LED to indicate frequency selected **Receiver:** One green LED to indicate power ON/OFF One yellow LED to indicate output state **Emitter & Receiver:** Both have two highly visible "job lights" which are turned ON and OFF by applying an external signal to the white wire. The job lights may be programmed for steady or flashing green.
Construction	Black painted aluminum housing; acrylic lenses; PBT polyester end caps; thermoplastic elastomer programming switch cover; stainless steel mounting brackets and hardware
Environmental Rating	NEMA 2; IEC IP62
Connections	**Emitter:** 3-conductor PVC-jacketed 2 m (6.5') cable which is either unterminated or terminated with a 4-pin Euro-style quick-disconnect connector, depending on model. Cable diameter is 3.3 mm (0.13"). **Receiver:** 4-conductor PVC-jacketed 2 m (6.5') cable which is either unterminated or terminated with a 4-pin Euro-style quick-disconnect connector, depending on model. Cable diameter is 3.3 mm (0.13").
Operating Temperature	0° to +50°C (+32° to 122°F)
Certifications	CE

Parts Verification Array Series Hookups

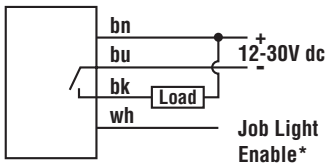
Emitter with Unterminated Cable



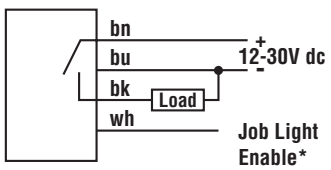
Emitter with Quick-Disconnect (4-Pin Euro-Style)



Receiver with NPN (Sinking) Output



Receiver with PNP (Sourcing) Output



NOTE: Receiver hookups are functionally the same for either cabled or quick-disconnect models.
NOTE: Blue wire (dc common) is internally connected to emitter and receiver housings.

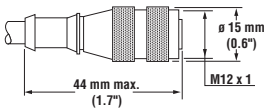
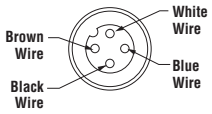
*See Programming information or job light enable input requirements

Quick-Disconnect (QD) Option
All models feature integral 2 m (6.5') long, 3.3 mm (0.13") dia. PVC-jacketed cables. Models whose model numbers end in "Q" are terminated with quick-disconnect (QD) Euro-style 4-pin connectors; other models have unterminated ends. See page 162 for information on optional mating QD cables.

Part Sensing

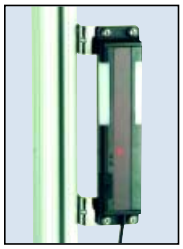
Euro-Style Quick-Disconnect Cables

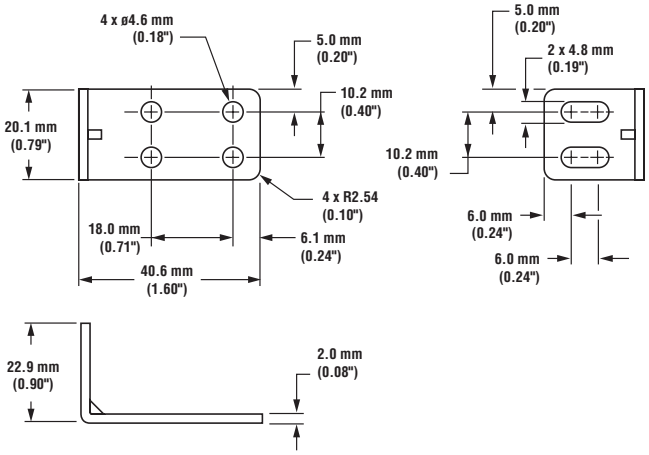
Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 20 or 22 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40° to +90°C (-40° to +194°F)
Voltage Rating: 250V ac/300V dc

Style	Model	Length	Dimensions	Pin-out
4-Pin Euro Straight	**MQDC-406** **MQDC-415** **MQDC-430**	2 m (6.5') 5 m (15') 9 m (30')		

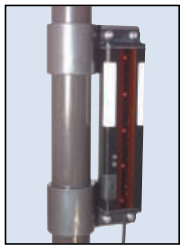
Mounting Brackets

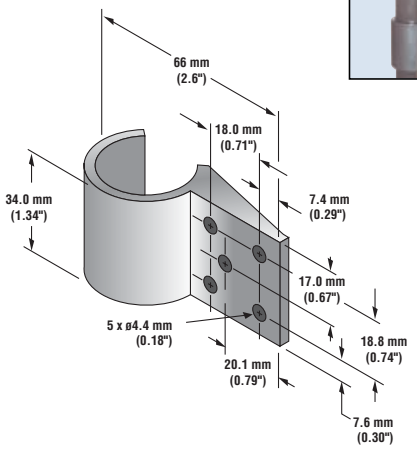
SMBPVA1
- Set of 4 molded brackets
- Brackets snap onto 28 mm pipe
- Request data sheet P/N 54752 for more information





SMBPVA2
- Set of 4 molded brackets
- Brackets snap onto 28 mm pipe
- Request data sheet P/N 54752 for more information



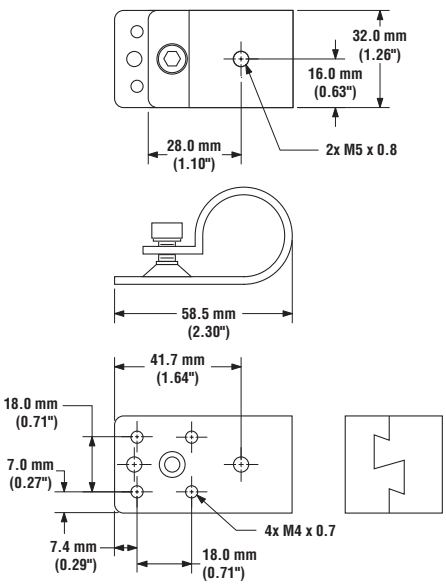


Hardware (included with each sensor)

P/N	Includes
50532	4 Stainless steel Phillips panhead machine screws (M4 x 0.7 x 12)
	4 Stainless steel hex nuts (M4 x 0.7)
	4 Stainless steel lock washers (M4 x 0.7)
	4 Stainless steel lock washers (M4 x 0.7)
	1 Plastic screwdriver (3.6 cm/ 1/4" long)

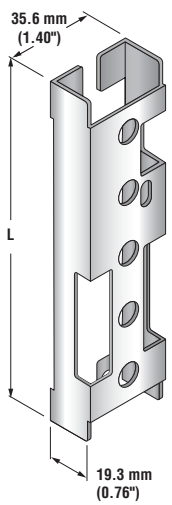
Mounting Brackets

SMBPVA6
- Set of 4 metal brackets
- Brackets clamp onto 28 mm pipe
- Request data sheet P/N 64900 for more information

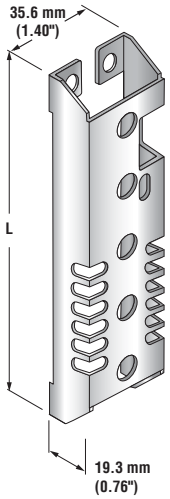


Heavy-Duty Protective Brackets
- Protects sensors against impact
- Set of 2
- Heavy-duty cold-rolled steel, zinc finish (PVA photo shown with SMBPVA5 bracket)

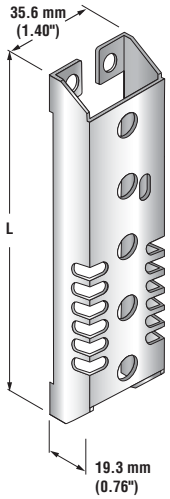
Model	Used With	"L"
SMBPVA5	PVA100	139.7 mm
SMBPVA5A	PVA100	139.7 mm
SMBPVA5AB	PVA100	139.7 mm
SMBPVA10	PVA225	268.2 mm
SMBPVA10A	PVA225	268.2 mm
SMBPVA10AB	PVA225	268.2 mm
SMBPVA13	PVA300	343.3 mm
SMBPVA13A	PVA300	343.3 mm
SMBPVA13AB	PVA300	343.3 mm
SMBPVA16	PVA375	418.2 mm
SMBPVA16A	PVA375	418.2 mm
SMBPVA16AB	PVA375	418.2 mm



Standard



SMBPVA..A



SMBPVA..AB

VTB Series - verification optical touch buttons.

Cost-effective touch buttons provide ultra-bright visual instruction for sequential parts assembly.

With ultra-bright illuminated bases, Banner's Verification Touch Buttons (VTB) lead assemblers through an assembly sequence in the correct order. VTB buttons mount near bins in a workstation. As the assembler removes each part, he or she touches the corresponding VTB button to signal the controller to switch the job light for the picked bin OFF, verify that the correct part has been taken, and activate the job light of the next bin to pick in the sequence.

- Reduces occurrence of parts missed or assembled out of order
- Increases assembler efficiency
- Costs far less than alternative bin-picking notification products
- Also can be used as an automated "call for parts" system. Users touch a bin's VTB button when parts run low, lighting the VTB base to notify the supplier

Clear communication in any language.

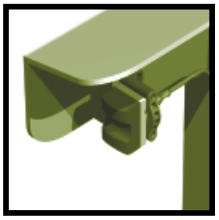
- Visual "illuminated" instruction eliminates communication barriers
- Multilingual workforces learn new assembly procedures quickly

Ergonomic design promotes repetitive-injury free operation.

VTB outputs require no physical force and activate when a finger inserted in the "touch area" breaks an infrared beam. The ergonomically designed buttons increase production quality and efficiency, without the hand, wrist, and arm stress associated with repeated mechanical switch operation.

- No physical pressure required to operate
- Replace capacitive touch switches and mechanical push buttons

Top Mount, with Field Cover in Place

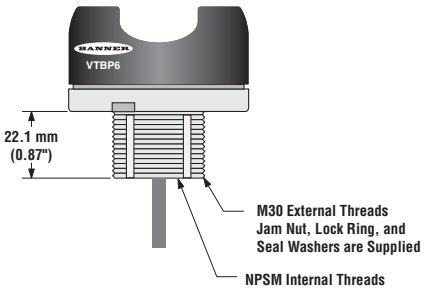

Side Mount, Shielded by Mounting Bracket

VTB Series Models						
Models	**Cable***	**Upper Housing**	**Supply Voltage**	**Output Type**	**Job Light Input**	**Data Sheet†**
VTBN6 **VTBN6Q**	4-wire 2 m (6.5') integral cable 4-Pin Euro-style QD	Polysulfone	12 to 30V dc	NPN	0V dc	67570
VTBN6L **VTBN6LQ**	4-wire 2 m (6.5') integral cable 4-Pin Euro-style QD	Polycarbonate				
VTBP6 **VTBP6Q**	4-wire 2 m (6.5') integral cable 4-Pin Euro-style QD	Polysulfone		PNP	+10 to 30V dc	67570
VTBP6L **VTBP6LQ**	4-wire 2 m (6.5') integral cable 4-Pin Euro-style QD	Polycarbonate				

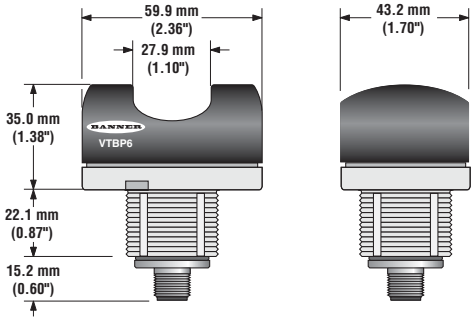
*NOTE: 9 m (30') cables are available by adding suffix "**W/30**" to the model number of any cabled VTB (e.g., **VTBN6 W/30**). QD models require an accessory QD cable. See page 166 for more information.
† Data sheets may be downloaded at www.bannerengineering.com.

VTB Series Dimensions

Cabled Models

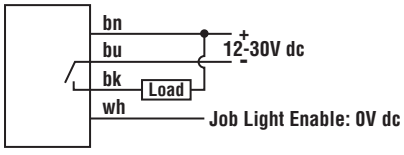


Quick-Disconnect Models

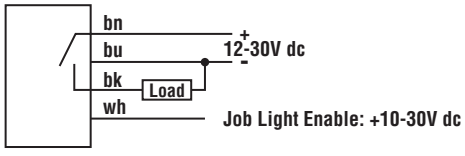


VTB Series Hookups

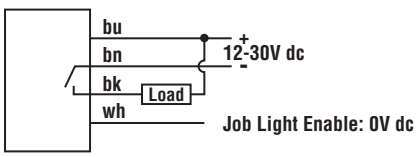
NPN (Sinking) Output Models
Standard Hookup — solid job light



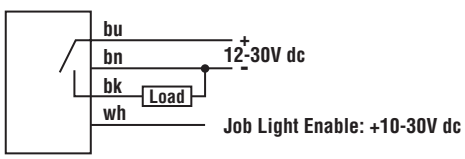
PNP (Sourcing) Output Models
Standard Hookup — solid job light



NPN (Sinking) Output Models
Alternate Hookup — flashing job light



PNP (Sourcing) Output Models
Alternate Hookup — flashing job light



NOTE: Hookups are functionally the same for either cabled or quick-disconnect models.

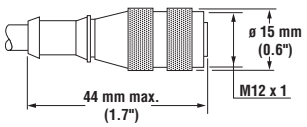
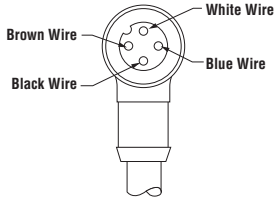
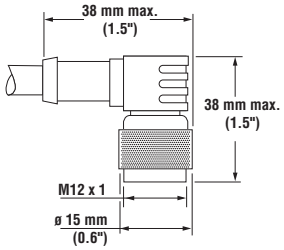
Part Sensing

VTB Verification Optical Touch Buttons Model Selection

VTB Series Specifications	
Supply Voltage and Current	12 to 30V dc (10% maximum ripple) Less than 120 mA max current @ 12V dc (exclusive of load) Less than 70 mA max current @ 30V dc (exclusive of load)
Supply Protection Circuitry	Protected against transient voltages (fast-transient and over-voltage) and reverse polarity
Output Configuration	Choose 1 current sinking (NPN) open collector transistor or 1 current sourcing (PNP) open collector transistor, depending on model
Output Rating	**Maximum load:** 150 mA **On-state saturation voltage:** < 1.5V @ 150 mA **Off-state leakage current:** < 10 µA
Output Protection	All models protected against false pulse on power-up (outputs held OFF for 1 second at power-up). Models with solid-state outputs have overload and short-circuit protection.
Response Time	100 milliseconds ON/OFF
Indicators	**2 red LED indicators:** Power ON and Output Conducting **Base:** Lights green as a job light when input line is enabled
Construction	Totally encapsulated, non-metallic enclosure. Black polysulfone or red polycarbonate upper housing (see Application Note below); translucent white polycarbonate base. Electronics fully epoxy-encapsulated.
Environmental Rating	Meets NEMA standards 1, 3, 4, 4X, 12 and 13; IEC IP66
Connections	PVC-jacketed 2 m (6.5') cables or 4-pin Euro-style QD fitting, depending on model. Accessory QD cables required for QD models. Integral 9 m (30') cables are also available; see Accessories, below.
Ambient Light Immunity	Up to 120,000 lux (direct sunlight)
EMI/RFI Immunity	Immune to EMI and RFI noise sources, per IEC 947-5-2.
Operating Conditions	**Temperature:** -20° to +50°C (-4° to +122°F) **Maximum relative humidity:** 90% @ +50°C (non-condensing)
Application Notes	**Environmental considerations for models with polysulfone upper housings:** The polysulfone upper housing will become brittle with prolonged exposure to outdoor sunlight. Window glass effectively filters longer wavelength ultraviolet light and provides excellent protection from sunlight. Avoid contact with strong alkalis. Clean periodically using mild soap solution and a soft cloth. **Environmental considerations for models with polycarbonate upper housings:** Avoid prolonged exposure to hot water and moist high-temperature environments above 66ºC (150ºF). Avoid contact with aromatic hydrocarbons (such as xylene and toluene), halogenated hydrocarbons and strong alkalis. Clean periodically using mild soap solution and a soft cloth.
Application Notes	CE c UL US

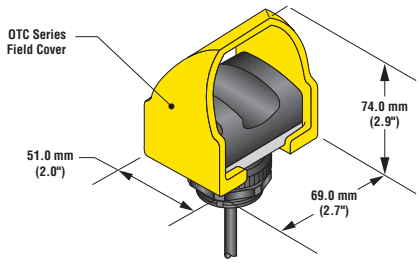
Accessories

Quick-Disconnect (QD) Cables

Style	Model	Length	Dimensions	Pin-out
4-Pin Euro Straight	**MQDC-406** **MQDC-415** **MQDC-430**	2 m (6.5') 5 m (15') 9 m (30')		
4-Pin Euro Right-angle	**MQDC-406RA** **MQDC-415RA** **MQDC-430RA**	2 m (6.5') 5 m (15') 9 m (30')		

Field Covers

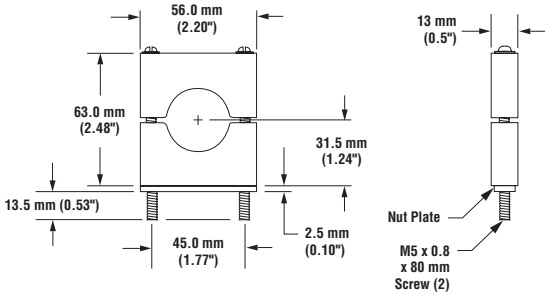
Field covers are designed to prevent inadvertent activation of optical touch buttons due to objects (loose clothing, debris, etc.) which might accidentally block their sensing beams. Field covers are constructed of rugged polypropylene and are highly resistant to abrasion and to damage by most chemicals.

Model	Description	Dimensions
OTC-1-BK **OTC-1-GN** **OTC-1-RD** **OTC-1-YW**	Black cover Green cover Red cover Yellow cover	 

Mounting Brackets

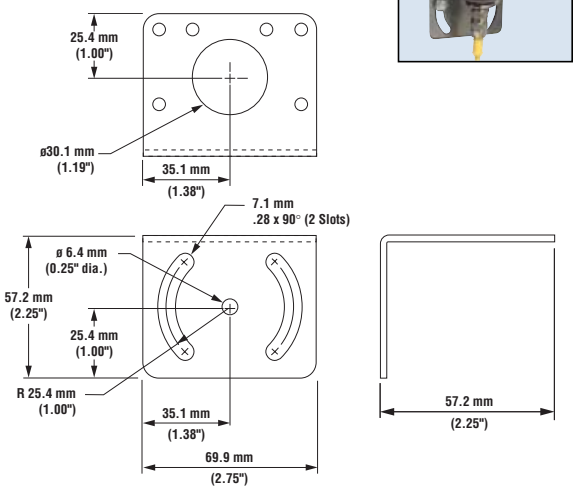
SMB30C

- 30 mm split clamp, black reinforced thermoplastic polyester
- Stainless steel hardware included



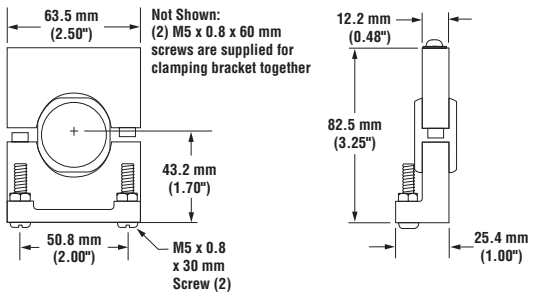
SMB30MM

- 30 mm, 11-gauge, stainless steel bracket with curved mounting slots for versatility and orientation
- Clearance for M6 (1/4") hardware



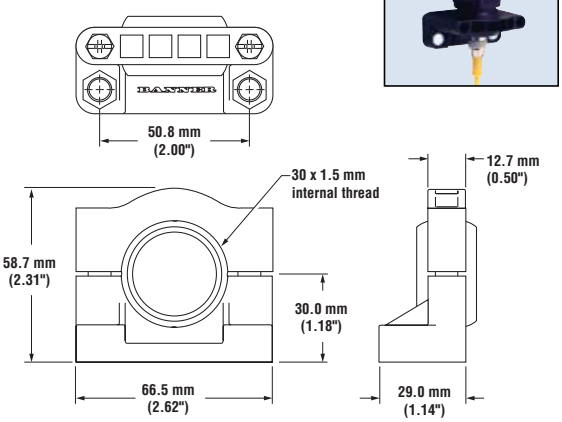
SMB30S

- 30 mm swivel, black PBT polyester bracket
- Stainless steel mounting hardware included



SMB30SC

- 30 mm split clamp with swivel, black reinforced thermoplastic polyester
- Stainless steel hardware included



Part Sensing

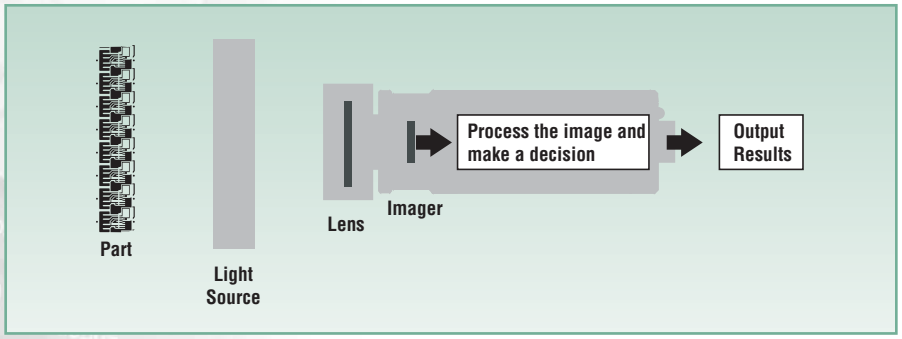
PresencePLUS Vision Sensors

Principals of Operation

PresencePLUS vision sensors are used to automate complex visual inspections, which, until now, have required prohibitively expensive vision systems. Many industries use vision sensors to perform visual inspections, including: automotive, electronic, packaging, and pharmaceutical.

Visual inspection is a three-step process. First, a camera acquires an image of the part. Next, the vision sensor analyzes the image. Finally, the vision sensor determines if the inspection passes or fails, and reports the results to the manufacturing line, where the part is either passed to the next process or rejected and removed.

The following is a diagram of a generic vision sensor inspection.



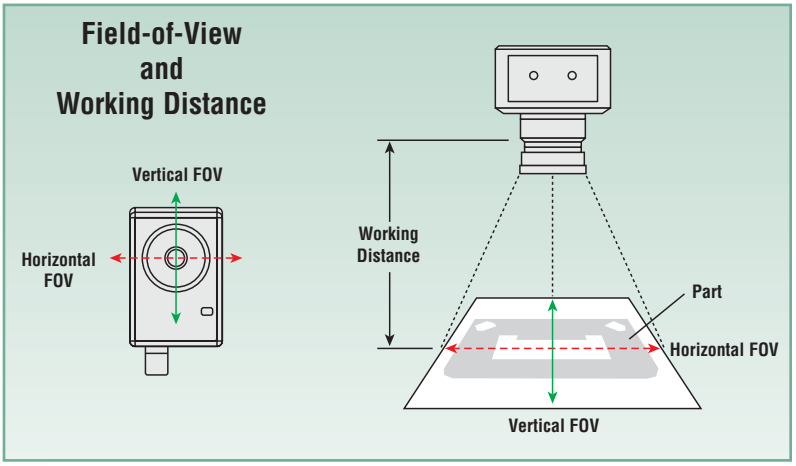
Lighting

The light source is a critical component of any vision inspection system. Lighting is the most powerful tool for creating contrast to amplify the feature of interest, while minimizing other features of the part. Selecting the best light source will depend on the shape, surface texture, color and opacity of the part. The PresencePLUS Lighting Guide (P/N 69951) will help in deciding which light to choose. Go to www.bannerengineering.com to download a copy of the PresencePLUS Lighting Guide.

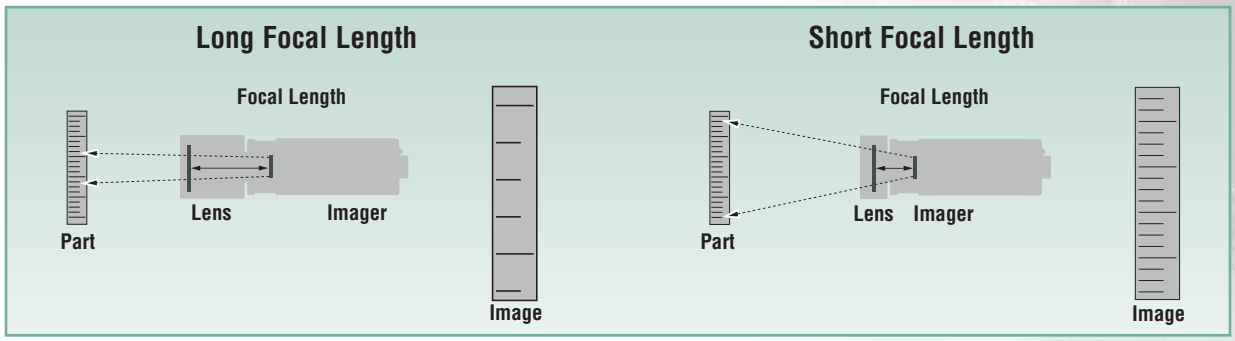
Lens

The lens focuses the light onto the camera's imager. PresencePLUS sensors use standard C-mount lenses. The main consideration for selecting a lens is focal length. To determine the focal length, the Field of View (FOV) and working distance must be determined.

The Field of view (FOV) is the area of the inspection captured on the camera's imager. The working distance is the distance between the back of the lens and the target object.



The focal length is the distance between the rear nodal point of the lens (the point where the light rays exit the rear of the lens) and the camera's imager, and is specified in millimeters. A longer focal length will "zoom in" to produce a small FOV and a shorter focal length will "zoom out" and produce a larger FOV.



To determine the proper lens for your application, use the PresencePLUS Lens Guide (P/N 69950). Go to www.bannerengineering.com to download a copy of the PresencePLUS Lens Guide.

Imager

The imager consists of an array of tiny light sensitive cells that covert the target into an image. The size of the imager is measured in number of pixels. A standard imager size is 640 x 480 (horizontal x vertical) pixels. The number of pixels, the pixel size and the FOV determine the resolution of the inspection.

Resolution Calculation

Maximum horizontal resolution = Horizontal FOV ÷ 640 pixels
Maximum vertical resolution = Vertical FOV ÷ 480 pixels
Example:

Assume horizontal FOV is 3.0" wide.

Maximum resolution = 3.0" ÷ 640 pixels = .005"

Image inspection

The vision sensor uses Regions of Interest (ROI) to inspect specific features on the part. Each ROI uses an algorithm (vision tool) to inspect the feature. The following are common vision tools:

- Edge detection
- Pattern matching
- Average gray scale calculation
- BLOB (Binary Large Object) detection
- Object detection

Using the above vision tools, the vision sensor can perform the following functions:

- Critical gauging
- Part detection
- Complete assembly verification
- Part locating
- Part orientation
- Flaw detection
- Position inspection
- Shape analysis
- Color verification
- Part identification

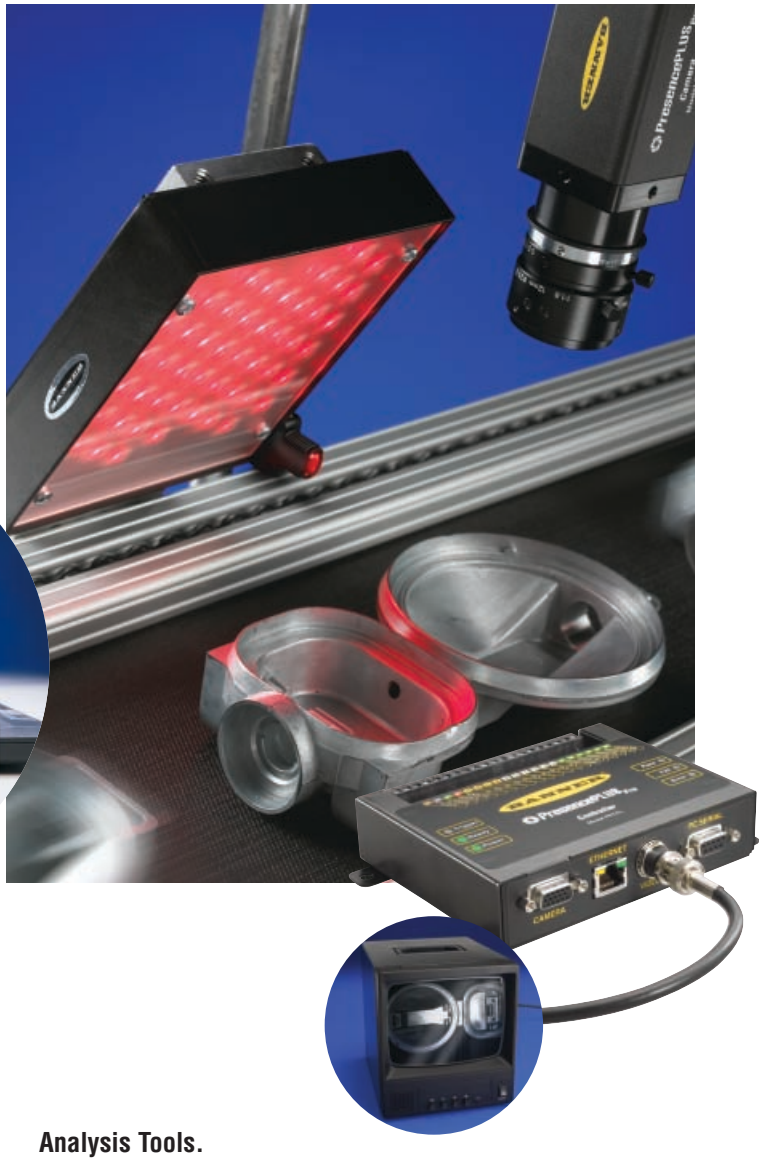
In addition to vision tools, location tools are used to find the part in the field of view, and to adjust the placement of the vision tools, accordingly. To see a sampling of PresencePLUS application examples, go to pages 30 to 33 of this catalog, or go online at www.bannerengineering.com to view our entire library of application examples.

*Presence*PLUS® *Pro* – a value priced vision sensor with features that rival more expensive systems.

A full-function vision sensor.

The all-new PresencePLUS Pro provides advanced, camera-based visual inspections at a price you'll find hard to believe. Banner has transformed costly, complex machine vision systems into a simple, easy-to-use and affordable sensor that solves real-world applications. The sensor captures images and analyzes them, using one or more vision tools, to generate judgement results.

- Ethernet, serial and flexible I/O in the same full-featured sensor
- Accommodates configurable inputs (NPN/PNP), configurable outputs (NPN/PNP)
- Allows stored inspections to be selected



Easy to install and operate.

You can quickly set up an inspection that correctly tests and rejects bad parts on your production line. PresencePLUS Pro sets up using a remote PC; after setup, inspections are stored in the system and can run without the need for the PC. Inspection can be viewed without a PC using the PresencePLUS Pro's live video output.

All the tools you need.

Locational Tools.

These tools compensate for translational and rotational movement.

Locate Tool. Determines translation and rotation by detecting relative movement of edges.

Pattern Find Tool. Determines translation and rotation by detecting relative movement of a pattern.

Vision Tools.

These tools perform the "image analysis" function.

Gray Scale Tool. Determines the average gray scale value.

Blob Tool. Determines the presence, connectivity, and location of selected features.

Edge Tool. Determines the presence, number, classification, and location of edges.

Object Tool. Determines the presence, number, classification, size, and location of objects.

Pattern Count Tool. Determines the presence, number, and location of a pattern(s).

Analysis Tools.

These tools measure or evaluate the results of the Vision Tools.

Measure Tool. Measures distance between two prescribed points. These points can be either edges or centroid locations.

Test Tool. Evaluates results of selected vision and analysis tools to determine whether an inspection passes or fails. It also performs logical operations and activates outputs.

Communication Tool. Sends results of selected location, vision and analysis tools over the Ethernet or RS-232 serial communication ports.

PRESENCE PLUS® *PRO* VISION SYSTEM

A Banner PresencePLUS Pro System is comprised of a controller, a camera, an interconnect cable, a communication cable (serial or Ethernet), a light source, a lens, software (on CD or downloaded from web) and a Quickstart Guide. These components can be purchased individually to create a system to meet your specific needs, or in kits (see page 172). Listed below are the minimum required components for a PresencePLUS Pro System. Optional components are also available (see below) to enhance and/or fill more specific needs.

Required Components (must purchase one from each category)

Quickstart Guide

Order p/n 68369 or download it at www.bannerengineering.com.

CD-ROM with free software

Order p/n 69952 or download it at www.bannerengineering.com.

Camera

Model	Description
PPCAM	Camera

Standard C-Mount Lenses

(see Accessories, pages 174-175, for more choices)

Model	Description
LCF08	8 mm lens with focus locking
LCF12	12 mm lens with focus locking
LCF16	16 mm lens with focus locking

Controller

Model	Description
PPCTL	Controller

Lighting (see Lighting Section, page 178, for more choices)

Model	Description
LEDRA80X80W	Red LED area light (80 x 80 mm)
LEDRR80X80W	Red LED ring light (80 x 80 mm)
LEDRB70X70W	Red LED backlight, diffused (70 x 70 mm)

Interconnect Cables* (camera to controller)

Model	Description
PPC06	2 m (6.5') cordset, straight
PPC23	7 m (23') cordset, straight
PPC32	10 m (32') cordset, straight
PPC06RA	2 m (6.5') cordset, right-angle
PPC23RA	7 m (23') cordset, right-angle
PPC32RA	10 m (32') cordset, right-angle

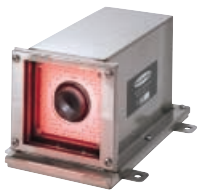
*See page 174 for cable drawings.

Communications Cables

Model	Description
DB9P06	2 m (6.5') Cordset, DB9 Male to DB9 Female Serial Cable
DB9P15	5 m (15') Cordset, DB9 Male to DB9 Female Serial Cable
DB9P30	9 m (30') Cordset, DB9 Male to DB9 Female Serial Cable
STP07	2.1 m (7') RJ45 Cat5e Shielded Ethernet Cable
STP25	7.6 m (25') RJ45 Cat5e Shielded Ethernet Cable
STPX07	2.1 m (7') RJ45 Cat5e Crossover Shielded Ethernet Cable
STPX25	7.6 m (25') RJ45 Cat5e Crossover Shielded Ethernet Cable

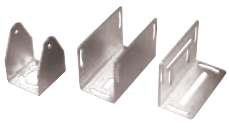
Optional Components

Monitor
(see page 175)



Camera Enclosures
(see page 175)

Filters
(see page 175)



Brackets
(see pages 176 and 177)

PRESENCEPLUS PRO KITS

Below are available Solution Kit Models. Solution kits include a sensor, 8, 12 or 16 mm lens, 2 or 7 m (6.5' or 23') cable, and visible red LED light source. Kits also include the serial or Ethernet cable to connect to a Windows PC, a CD-ROM, containing the PresencePLUS Pro software, and a Quickstart Guide. Basic kits include a camera, controller, interconnect cables, Quickstart Guide and a CD-ROM. For applications requiring other lensing or lighting, choose a Basic kit and order the lens (see pages 174 and 175) and light separately (see page 178).

PresencePLUS Pro Kit Model Scheme

Example: P P K 0 6 0 8 A E

Camera and Controller:
PresencePLUS Pro Kit

Interconnect Cable Length:
06 = 2 meters
23 = 7 meters

Lens:
08 = LCF08 (Lens 8 mm)
12 = LCF12 (Lens 12 mm)
16 = LCF16 (Lens 16 mm)

Lights:
A = LEDRA80X80W (Area Light, 80 mm x 80 mm)
B = LEDRB70X70W (Backlight, 70 mm x 70 mm)
R = LEDRR80X80W (Ring Light, 80 mm x 80 mm)

Controller to PC Interface:
S = Serial DB9P06 Cordset 2 m (6.5'), DB9 Male to DB9 Female
E = Ethernet STPX07 Cordset Cat5e Crossover Shielded RJ45 2.1 m (7')

PresencePLUS Pro Solution Kits

Solution Kits listed, are only a partial listing; see Model Scheme, above to order other kits.

PresencePLUS Pro Solution Kits*

Models	Lens	Light Source	Interconnect Cable**, Camera to Controller	PC Interface Cable, Controller to PC
PPK0608RE	8 mm	Ring Light	2 m (6.5')	Cat5e 2 m (6.5') Crossover RJ45 Ethernet
PPK0612RE	12 mm			
PPK0616RE	16 mm			
PPK0608AE	8 mm	Area Light	2 m (6.5')	Cat5e 2 m (6.5') Crossover RJ45 Ethernet
PPK0612AE	12 mm			
PPK0616AE	16 mm			
PPK0608BE	8 mm	Back Light	2 m (6.5')	Cat5e 2 m (6.5') Crossover RJ45 Ethernet
PPK0612BE	12 mm			
PPK0616BE	16 mm			

* In addition to the above, the Solution Kit also includes a CD-ROM and Quickstart Guide.
** For 7 m (23') cable, change fourth and fifth numbers in model number from "06" to "23" (e.g., **PPK2308BE**)

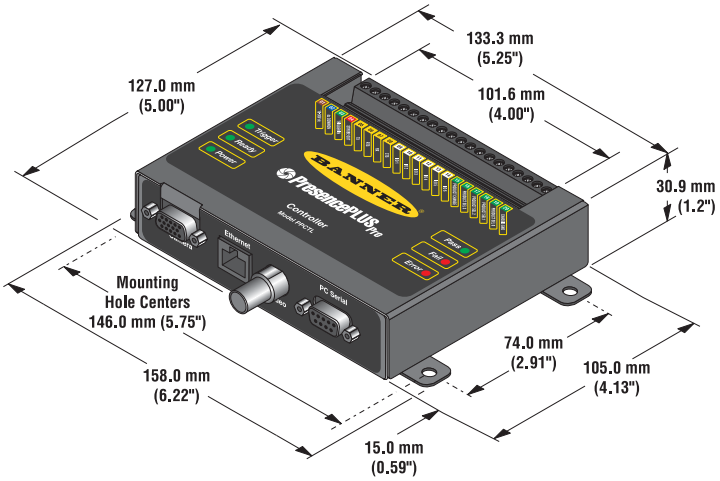
PresencePLUS Pro Basic Kits†

Models	Camera	Controller	Interconnect Cable, Camera to Controller
PPK06	PPCAM	PPCTL	2 m (6.5')
PPK23	PPCAM	PPCTL	7 m (23')

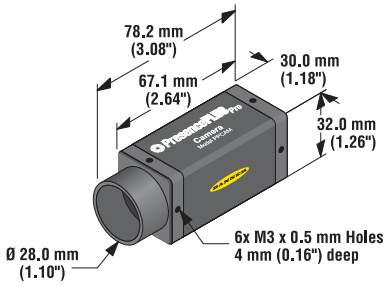
† In addition to the above, the Basic Kit includes a CD-ROM and Quickstart Guide.

*Presence*PLUS *Pro* Dimensions

Controller PPCTL



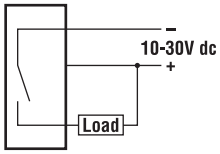
Camera PPCAM



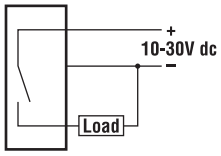
*Presence*PLUS *Pro* Vision Controller Specifications - Model PPCTL	
Supply Voltage and Current	10-30V dc; 1.5 A max. (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Memory	Stores up to 12 inspection files
Output Configuration	NPN (sinking) or PNP (sourcing) software selectable
Output Rating	150 mA max, each output **OFF-state leakage current:** < 100 µA **ON-state saturation voltage:** < 1V at 50 mA (NPN); < 2V at 50 mA (PNP)
Input Specifications	NPN: ON, < 3V **OFF-state voltage:** > 10V at 4 mA max. PNP: ON > (+V–2)V at 1 mA max. **OFF-state voltage:** < 3V at 6 mA max.
Indicators	**8 LEDs:** Trigger, Ready, Power, Pass, Fail, Error, Ethernet Connection, Ethernet Data Transfer
Display Options	PC and NTSC video
Discrete I/O	1 Trigger IN (pin 3) 1 Strobe OUT (pin 4) 6 Programmable I/O (pins 9-14) 1 Product Change IN (pin 15) 4 Product Select IN (pins 16-19)
Communication	1 RJ-45 Ethernet-connection for running PresencePLUS Pro software and/or output inspection results 1 RS-232 DB-9 port for running PresencePLUS Pro software and/or output inspection results 1 RS-232 wired connection to output inspection results
Construction	Steel with black zinc plating
Weight	Approx. 0.55 kg (1.2 lbs)
Environmental Rating	NEMA 1, IEC IP20
Operating Conditions	**Temperature:** 0° to +50°C (+32° to +122°F) **Maximum relative humidity:** 90% (non-condensing)
Certifications	CE

*Presence*PLUS *Pro* Controller Output Hookups - NPN or PNP is software selectable

NPN

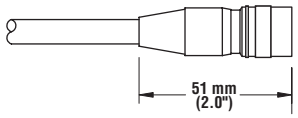


PNP

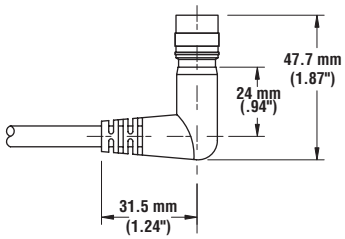


*Presence*PLUS *Pro* Interconnect Cables

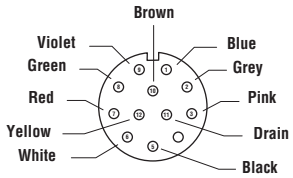
Straight Cable



Right-Angle



Pin-out



*Presence*PLUS *Pro* Vision Camera Specifications - Model PPCAM	
Imager Size	307,200 (640 x 480) pixels
Pixel Size	7.4 x 7.4 microns
Levels of Gray Scale	256
Imager	4.8 x 3.6 mm, 6 mm diagonal (1/3" CCD)
Exposure Time	0.10 ms to 3600 ms
Acquisition	Frames per second: 30 max.
Interface	LVDS
Lens Mount	Standard C-mount (1" - 32 UN)
Construction	Black anodized aluminum
Max. Cable Length	10 m (32')
Weight	Approx. 0.09 kg (0.2 lbs)
Environmental Rating	NEMA 1, IEC IP20
Operating Conditions	**Temperature:** 0° to +50°C (+32° to +122°F) **Maximum relative humidity:** 90% (non-condensing)
Certifications	CE UL LISTED

Accessories

Standard Lenses

Standard C-mount lenses for PresencePLUS cameras

Models	Description
LCF04	4 mm Lens
LCF08	8 mm Lens with focus locking
LCF12	12 mm Lens with focus locking
LCF16	16 mm Lens with focus locking
LCF25R	25 mm Lens, adjustable aperture
LCF25LR	25 mm Lens with focus locking, adjustable aperture
LCF50L1R	50 mm Lens with focus locking, adjustable aperture
LCF50L2R	50 mm Lens with focus locking, metal housing, adjustable aperture*
LCF75LR	75 mm Lens with focus locking, metal housing, adjustable aperture*
LEK	C-Mount Lens Extension Kit

* Too wide to use with LEDRR80X80W ring light

High-Performance Lenses

The high-performance lens has less image distortion and greater depth of field than the equivalent standard lens. Use the high performance lens for gauging and pattern matching applications. All high-performance lenses have adjustable apertures.

Models	Description
LCF06LT	6.5 mm Lens with adjustable aperture and **without** focus adjustability
LCF08LT	8 mm Lens with focus locking and adjustable aperture
LCF12LT	12 mm Lens with focus locking and adjustable aperture
LCF16LT	16 mm Lens with focus locking and adjustable aperture
LCF25LT	25 mm Lens with focus locking and adjustable aperture
LCF50LT	50 mm Lens with focus locking and adjustable aperture
LCF75LT	75 mm Lens with focus locking and adjustable aperture
LEK	C-Mount Lens Extension Kit

Monitor

Supply Voltage and Current: 100-240V ac, 50/60 Hz; 0.5 A
Horizontal Resolution: > 1000 TV lines (center), > 800 TV lines (corners)
Weight: Approx. 6 kg (13.2 lbs)
Operating Temperature: -10° to +55°C (+14° to +130°F)
Maximum relative humidity: 95% (non-condensing)

Models	Description
PPM9	9" (diagonal measure) Black & White, Metal, NTSC Video Monitor

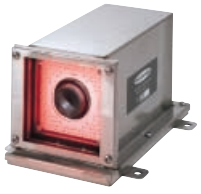
Monitor Cables

Models	Description
BNC06	2 m (6.5') Cordset, Coaxial with Male BNC on Both Ends
BNC15	5 m (15') Cordset, Coaxial with Male BNC on Both Ends
BNC30	9 m (30') Cordset, Coaxial with Male BNC on Both Ends

Camera Enclosure Kits

Models	Description	Data Sheet†
PPE4-G	Heavy-duty stainless steel enclosure kit for PresencePLUS Pro Camera and Ring Light - glass viewport; NEMA 4 rated	111362
PPE4-P	Heavy-duty stainless steel enclosure kit for PresencePLUS Pro Camera and Ring Light - polycarbonate viewport; NEMA 4 rated	

† Download data sheets at www.bannerengineering.com.



Filters

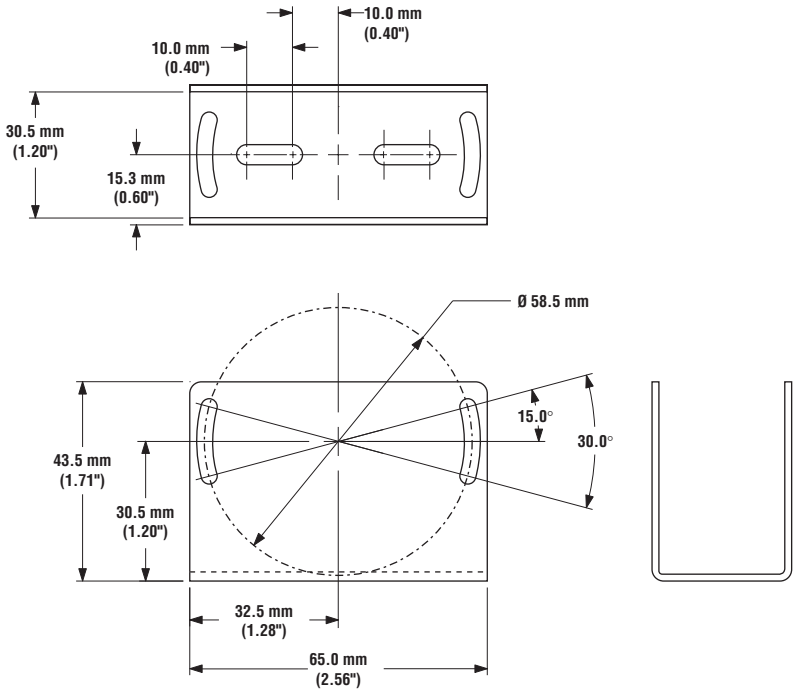
Models	Color	Description	Data Sheet†
FLTI	Infrared (≥ 760 nm)	Blocks visible light and passes infrared light	69461
FLTUV	Ultraviolet	Clear protective UV filter for high-performance lenses	none
FLTR	Red (≥ 600 nm)	Improves quality by helping to reduce ambient light; it passes red & infrared light	69628
LEDRRPFK	–	Polarizing filter kit for LEDRR80X80W	108945

† Download data sheets at www.bannerengineering.com.

PresencePLUS Pro Camera Mounting Brackets

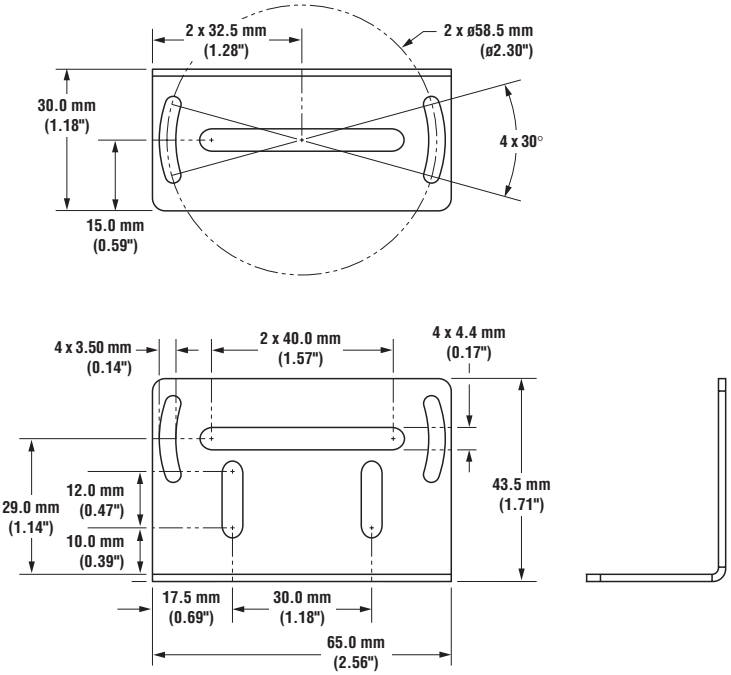
SMBPPLU

- Long U-bracket



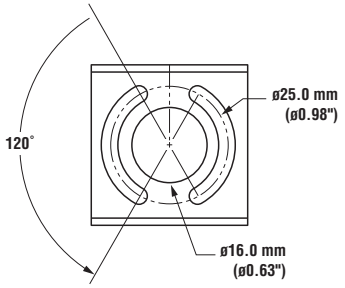
SMBPPRA

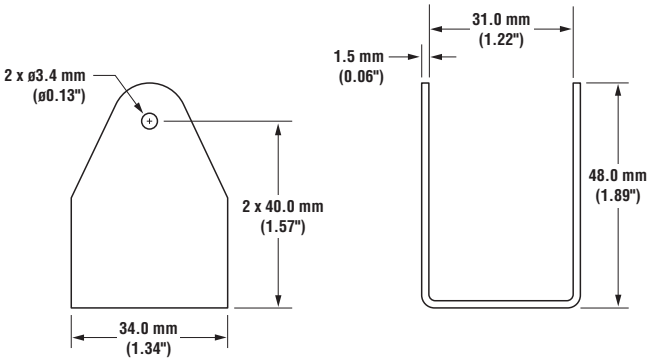
- Right-angle bracket



PresencePLUS Pro Camera Mounting Brackets

SMBPPU
- U-bracket



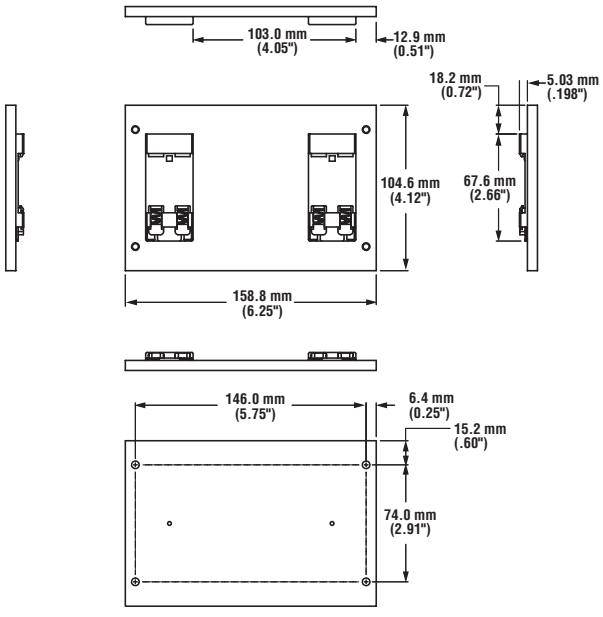


PresencePLUS Pro Camera Mounting Brackets	
Models	**Description**
SMBPPK	Flexible knuckle bracket
SMBPPKB	Flexible knuckle bracket base
SMBPPKE3	Flexible knuckle bracket 3" extension
SMBPPKE6	Flexible knuckle bracket 6" extension

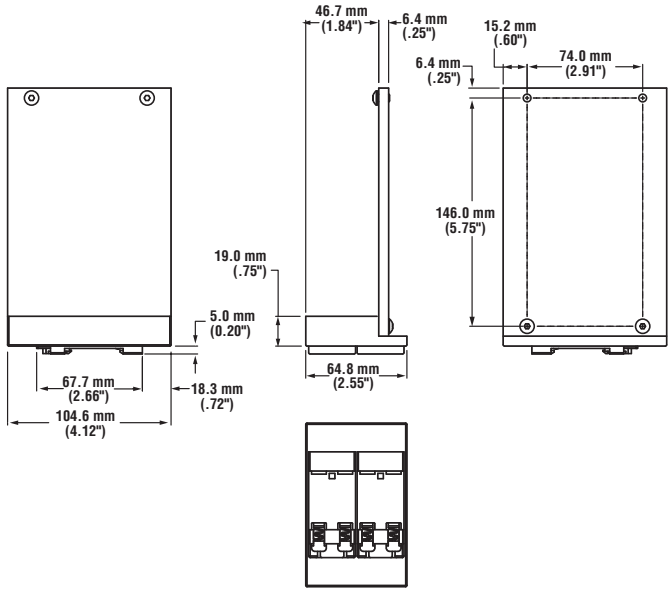
For more detailed information on these brackets, please visit www.bannerengineering.com or contact the factory.

PresencePLUS Pro Controller Mounting Brackets

SMBPPDH
- DIN Rail mounting bracket

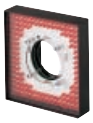
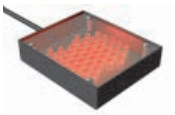
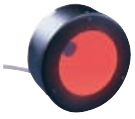
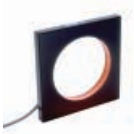


SMBPPDE
- Edge-mount DIN Rail mounting bracket

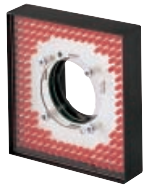


Banner's Lighting Accessories provide one-stop-shopping support and convenience for an entire vision sensing solution. Banner's extensive line of standard and specialty lights offer illumination solutions for the vast majority of lighting applications.

PresencePLUS Lighting Selection Guide

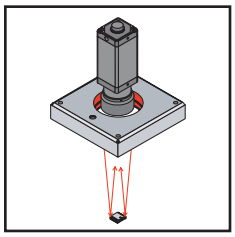
	Description	Application Examples	Page
	**Ring Lights** Mount directly to the sensor for easy setup, and illuminate any object directly in front of the sensors.	• Verify date or lot codes on labels • Detect label presence • Double sheet protection	179
	**Area Lights** Provide an even illumination in a concentrated area.	• Use as a dark-field illuminator • Detect notches in ceramic rings • Detect dents in metal tubing • Verify printing on reflective surfaces • Distinguish between rough and smooth surfaces	180
	**Backlights** Placed behind the target, directly facing the sensor and have a highly diffused surface and uniform brightness, with a lower intensity than other lights.	• Creates a silhouette of the part • Detect foreign material on a clear web • Sort parts by size and shape • Measure spacing between the leads of an IC chip • Measure the height of a cap on a clear bottle • Inspect for cracks or holes in sheet material	181
	**On-Axis Lights** Provide even, diffused illumination for flat, reflective surfaces.	• Detect markings on brushed metal surface • Verify date codes on reflective surfaces	182
	**Highly-Diffused Lights** Provide soft illumination from multiple directions, minimizing glare and shadows.	• Verify date-code ink on curved metallic surfaces, such as soda can bottoms • Read printing on clear plastic • Verify printing on plastic bottles	183
	**Low-Angle Ring Lights** Light is directed nearly perpendicular to the direction of an inspection, enhancing the contrast of surface features.	• Detect etching in glass, metal or plastic • Count solder balls • Detect missing material and roundness in the opening of a plastic bottle • Detect surface texture on metal sheets	184
	**Multi-Lights** Light intensity of each axis is independently adjustable.	• Detect markings on wrinkled metallic surfaces • Verify surface quality and printing on an IC chip	184

Ring Lights



Model LEDR140 shown

- Provides easy illumination for small objects
- Reduces shadows on images with protrusions
- Centers the light on the image
- Can be mounted directly to the camera
- Models available with red, white, ultraviolet or infrared lights
- Minimum useful life of 50,000 hours (LED only)
- Polarizing filter kits available
- LED and fluorescent models available

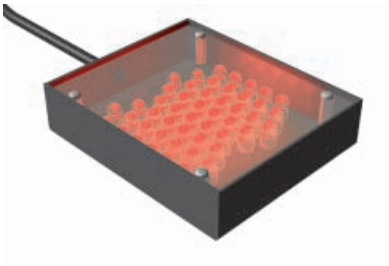


Standard PresencePLUS Ring Lights

Models	Description	Data Sheet†
HFFBB*	UV fluorescent ring light ,110V ac, North American plug	63238
HFFW5100*	Fluorescent ring lamp, 110V ac, North American plug	57388
HFFW5100A220*	Fluorescent ring lamp, 220V ac, European plug	63237
LEDR140**	Red LED ring light (powered by model P2B65Q)	57805
LEDRR80X80W***	Red LED ring light, strobed (80 x 80 mm)	none
LEDIR80X80W***	Infrared LED ring light, strobed (80 x 80 mm)	110593

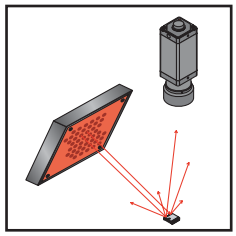
* Replacement bulbs available, see page 186.
** Used with PresencePLUS Pixel-Counting Sensor only; optional polarizing filter model LEDRPFK available for reducing glare
*** Used with PresencePLUS Pro Sensor only; optional polarizing filter model LEDRRPFK available for reducing glare
† Data sheets may be downloaded at www.bannerengineering.com.

Area Lights



Model LEDRA80X80W shown

- Creates shadows to detect changes in depth
- Illuminates specific surface angles for detection
- Avoids glare of reflective surfaces when directed at an angle away from lens
- Provides lighting at distances greater than 12"
- Choose models with red, white, blue or infrared lights
- Useful life of 10,000 to 60,000 hours, depending on model



Standard PresencePLUS Area Lights

Models	Description	Data Sheet†
LEDIA80X80W	Infrared LED long-range area light, lightly diffused, strobed (80 x 80 mm)	110606
LEDRA80X80W	Red LED area light, lightly diffused, strobed (80 x 80 mm)	69907
LEDRA80X80	Red LED area light, lightly diffused, strobed (80 x 80 mm) (powered by model P2B65Q)	63220

Specialty* PresencePLUS Area Lights

Illumination Area	Models	Description	Data Sheet†
40 mm dia.	**LEDRA40N-D**	Red LED spot light, diffused, 12V dc	66101
	LEDRA40N-F	Red LED spot light w/focusing lens, 12V dc	
	LEDRA40N	Red LED spot light, 12V dc	
	LEDWA40N	White LED spot light, 12V dc	
50 x 50 mm	**LEDRA50X50N**	Red LED area light, 12V dc	67423
	LEDIA50X50N	Infrared LED area light, 12V dc	
	LEDWA50X50N	White LED area light, 12V dc	
	LEDBA50X50N	Blue LED area light, 12V dc	
75 x 75 mm	**LEDRA75X75N**	Red LED area light, 12V dc	67424
	LEDIA75X75N	Infrared LED area light, 12V dc	
	LEDBA75X75N	Blue LED area light , 12V dc	
	LEDWA75X75N	White LED area light, 12V dc	
100 x 100 mm	**LEDRA100X100N**	Red LED area light, 12V dc	67425
	LEDIA100X100N	Infrared LED area light, 12V dc	
	LEDBA100X100N	Blue LED area light, 12V dc	
	LEDWA100X100N	White LED area light, 12V dc	

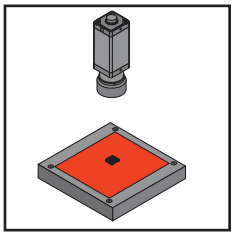
*NOTE: Specialty lights are not stocked and are non-returnable; they require an external power supply (see page 186)

† Data sheets may be downloaded at www.bannerengineering.com.

BACKLIGHTS

Model LEDRB70X70W shown

- Shows the diameter of rounded target objects
- Shows through-holes in target objects
- Choose models with red, white, blue, or infrared lights
- Useful life of 10,000 to 60,000 hours, depending on model



Standard PresencePLUS Backlights

Models	Description	Data Sheet†
LEDRB70X70W	Red LED backlight, diffused, strobed (70 x 70 mm)	69906
LEDRB70X70	Red LED backlight, diffused, strobed (70 x 70 mm) (powered by model P2B65Q)	63193

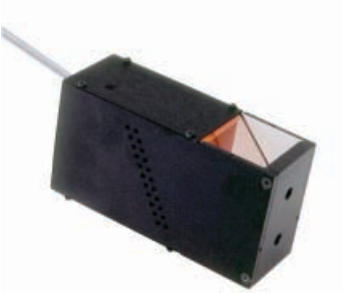
Specialty* PresencePLUS Backlights

Illumination Area	Models	Description	Data Sheet†
50 x 50 mm	**LEDRB50X50N**	Red LED backlight,diffused, 12V dc	67426
	LEDIB50X50N	Infrared LED backlight, diffused, 12V dc	
	LEDBB50X50N	Blue LED backlight, diffused, 12 dc	
	LEDWB50X50N	White LED backlight, diffused, 12V dc	
75 x 75 mm	**LEDRB75X75N**	Red LED backlight, diffused, 12V dc	67427
	LEDIB75X75N	Infrared LED backlight, diffused, 12V dc	
	LEDBB75X75N	Blue LED backlight, diffused, 12V dc	
	LEDWB75X75N	White LED backlight, diffused, 12V dc	
100 x 100 mm	**LEDRB100X100N**	Red LED backlight, diffused, 12V dc	67428
	LEDIB100X100N	Infrared LED backlight, diffused, 12V dc	
	LEDBB100X100N	Blue LED backlight, diffused, 12V dc	
	LEDWB100X100N	White LED backlight, diffused, 12V dc	
50 x 200 mm	**LEDRB50X200N**	Red LED backlight, diffused (50 x 200 mm), 12V dc	67429
	LEDRB50X200N-H	Red LED backlight, diffused, high output, 12V dc	67430
	LEDRB50X200N-NH	Red LED backlight, non-diffused, high output, 12V dc	
100 x 200 mm	**LEDRB100X200N**	Red LED backlight, diffused, 12V dc	67431
	LEDIB100X200N	Infrared LED backlight, diffused, 12V dc	

*NOTE: Specialty lights are not stocked and are non-returnable; they require an external power supply (see page 186)

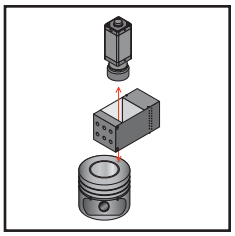
† Data sheets may be downloaded at www.bannerengineering.com.

On-Axis Lights



Model LEDR050N shown

- Provides more even illumination than a ring light
- Provides collimated illumination in same optical path as camera
- Provides even illumination on flat reflective material
- Fills in the light void that is created by a ring light
- Shiny surfaces perpendicular to camera appear illuminated, while surfaces at an angle appear dark
- Choose models with red, white, blue, or infrared lights
- Useful life of 10,000 to 60,000 hours, depending on model



Standard PresencePLUS On-Axis Lights

Models	Description	Data Sheet†
LEDRO50N	Red LED on-axis light (50 x 50 mm), 12V dc	67438

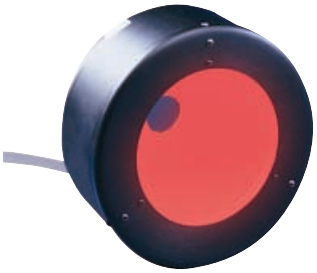
Specialty* PresencePLUS On-Axis Lights

Illumination Area	Models	Description	Data Sheet†
25 mm dia.	**LEDRO25N**	Red LED on-axis light , 12V dc	67437
	LEDBO25N	Blue LED on-axis light, 12V dc	
	LEDWO25N	White LED on-axis light, 12V dc	
50 mm dia.	**LEDRO50N-D**	Red LED on-axis light w/dust cover, 12V dc	67438
	LEDIO50N	Infrared LED on-axis light, 12V dc	
	LEDBO50N	Blue LED on-axis light, 12V dc	
	LEDWO50N	White LED on-axis light, 12V dc	
75 mm dia.	**LEDRO75N**	Red LED on-axis light, 12V dc	67439
	LEDRO75N-H	Red LED on-axis light, high output, 12V dc	
	LEDBO75N	Blue LED on-axis light, 12V dc	
	LEDWO75N	White LED on-axis light, 12V dc	
100 mm dia.	**LEDRO100N**	Red LED on-axis light, 12V dc	67440
	LEDWO100N	White LED on-axis light, 12V dc	

*NOTE: Specialty lights are not stocked and are non-returnable; they require an external power supply (see page 186)

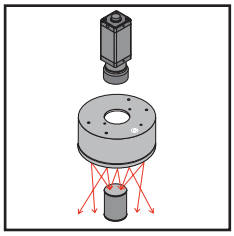
† Data sheets may be downloaded at www.bannerengineering.com.

Highly-Diffused Lights



Model LEDRD150N shown

- Minimizes glare and shadows (with a domed light, glare and shadows are almost eliminated)
- Illuminates curved surfaces softly and evenly
- Minimizes texture
- Models available with red or green LEDs
- Inspection area should be 1/3 the diameter of the dome
- Useful life of up to 60,000 hours, depending on model



Standard PresencePLUS Highly-Diffused Lights

Models	Description	Data Sheet†
LEDRD150N	Red LED dome light (150 mm dia.), 12V dc	66955

Specialty* PresencePLUS Highly-Diffused Lights

Illumination Area	Models	Description	Data Sheet†
25 mm dia.	**LEDRS25N**	Red LED highly-diffused light, 12V dc	67441
75 mm dia.	**LEDRS75N**	Red LED highly-diffused light, 12V dc	67442
	LEDGS75N	Green LED highly-diffused light, 12V dc	

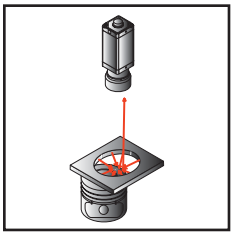
*NOTE: Specialty lights are not stocked and are non-returnable; they require an external power supply (see page 186)

† Data sheets may be downloaded at www.bannerengineering.com.

Low-Angle Ring Lights

Model LEDRI100N shown

- Highlights surface irregularities such as dust, dents, scratches, and other surface defects
- Highlights changes in elevation such as etching, solder balls and embossing
- Black anodized aluminum housing
- All models have red LEDs
- All models are 12V dc
- Useful life of up to 60,000 hours, depending on model



Standard PresencePLUS Low-Angle Ring Lights

Models	Description	Data Sheet†
LEDRI100N	Red LED low-angle ring light (100 mm dia.), 12V dc	67432

Specialty* PresencePLUS Low-Angle Ring Lights

Illumination Area	Models	Description	Data Sheet†
150 mm dia.	**LEDRI150N**	Red LED low-angle ring light, 12V dc	67433
	LEDRI150N-3	Red LED low-angle ring light, 12V dc	

*NOTE: Specialty lights are not stocked and are non-returnable; they require an external power supply (see page 186)

† Data sheets may be downloaded at www.bannerengineering.com.

Multi-Lights

Model LEDRM50N shown

- Light intensity on each axis is independently adjustable
- Red LED light provides both diffused low-angle and diffused on-axis continuous illumination
- Ideal for extremely difficult specular surfaces
- Black anodized aluminum housing
- All models are 12V dc
- Useful life of up to 60,000 hours, depending on model

Specialty* PresencePLUS Multi-Lights

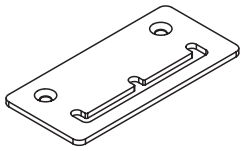
Illumination Area	Models	Description	Data Sheet†
50 mm dia.	**LEDRM50N**	Red LED low-angle & on-axis, 12V dc	67435
	LEDRM50N-H	Red LED low-angle & on-axis, high output, 12V dc	
75 mm dia.	**LEDRM75N**	Red LED low-angle & on-axis, 12V dc	67436
150 mm dia.	**LEDRC150N**	Red LED dome & on-axis multi light, 12V dc	67443
200 mm dia.	**LEDRC200N**	Red LED dome & on-axis multi light, 12V dc	67444

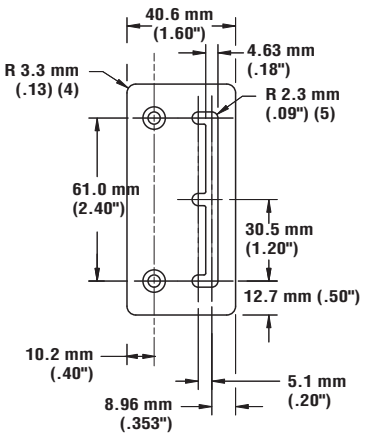
*NOTE: Specialty lights are not stocked and are non-returnable; they require an external power supply (see page 186)

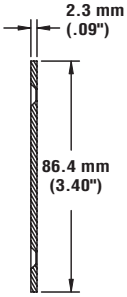
† Data sheets may be downloaded at www.bannerengineering.com.

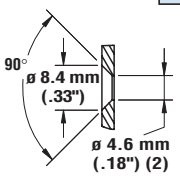
Lighting Mounting Brackets*

SMBABM
- Base-mounting bracket
- 13 ga, black zinc plated finish
- Hardware included

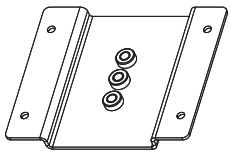


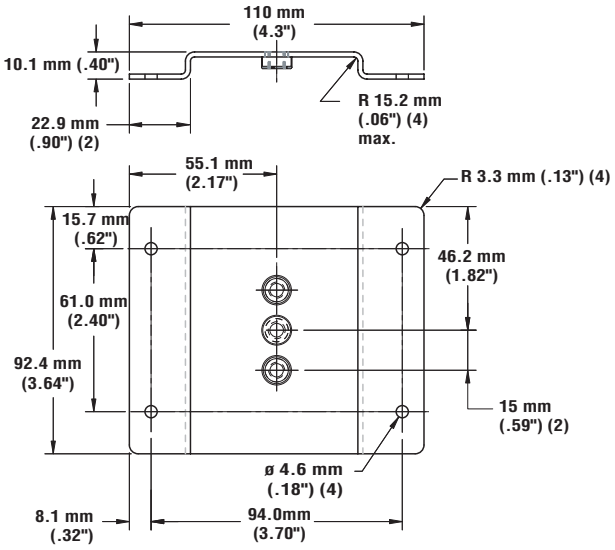






SMBACM
- Column-mounting bracket
- 13 ga, black zinc plated finish
- Hardware included





* Fits LEDRB70X70, LEDRB70X70W, LEDRA80X80, LEDRA80X80W and LEDIA80X80W lights

Continuous Power Supplies

Models	Input	Input Cord	Outputs	Output Cable	Used with	Data Sheet†
PSA-12	100-250V ac 50/60 Hz	North America (NEMA 5-15)	12V dc ±5% with voltage regulation of ±1% 3.5 A max.	1.8 m (6') Terminated with 9-pin D-sub connector (female pins)	Continuous LED Lights	67445
PSA-12E		Cont. Europe (Schuko CEE 7)				

† Download data sheets at www.bannerengineering.com.

Variable Power Supplies*

Models	Input	Input Cord	Output	Output Cable	Used with	Data Sheet†
PS2V-12	100-140V ac 60 Hz	North America (NEMA 5-15)	2-channels 6 - 12V dc 2 A max. per channel	1.8 m (6') Terminated with 9-pin D-sub connector (female pins)	Continuous LED Lights	67449
PS2V-12E	200-250V ac 50 Hz	Cont. Europe (Schuko CEE 7)				

† Download data sheets at www.bannerengineering.com.

Extension Cables*

Models	Length	Configuration	Used with
DB906	1.8 m (6')	Terminated both ends with 9-pin D-sub connector, for continuous lights (one end male pins and opposite end female pins)	Continuous LED Lights
DB910	3.0 m (10')		
DB9Y	1.8 m (6')	Y cable for powering 2 lights from one supply, for continuous lights	
DB906S	1.8 m (6')	Terminated both ends with 9-pin D-sub connector, for strobed lights (one end male pins and opposite end female pins)	Strobed LED Lights
DB910S	3.0 m (10')		
DB9YS	1.8 m (6')	Y cable for powering 2 lights from one supply, for strobed lights	

Bulbs

Models	Description
RFLBB	UV Fluorescent ring lamp replacement bulb
RFLW5100	Fluorescent ring lamp replacement bulb

* These models are not stocked and are non-returnable.

Notes:

*Presence*PLUS® Pixel-Counting Sensor - taking optical sensing to the next level.

An easy-to-use pixel-counting sensor.

PresencePLUS is the world's most user-friendly camera-based sensor. It can economically solve inspection applications as a simpler alternative to vision systems or by eliminating the need for multiple discrete sensor configurations that are often mechanically impractical.

Accurate, reliable inspection of a defined area of interest.

The PresencePLUS sensor is an advanced inspection system that captures a 256-level grayscale image of a defined area, converts the image to white and black pixels, and renders a PASS or FAIL judgement of the image by comparing the number of pixels to a reference count.

Advanced, microprocessor-based sensing functions at a price you can afford.

The PresencePLUS system offers both QUICK START setup for basic applications, and user-programmable functions to solve your more exacting applications, for an exceptionally low price. A PresencePLUS sensor starts around $1000. You can order a complete system, consisting of a CMOS pixel array with programmable microprocessor, lens, lighting, mounting bracket and cable.

Status indicators keep you informed.

Two highly-visible LEDs on top of the sensor provide sensor and judgement status information at a glance.

Configure the *Presence*PLUS with your Windows PC.

- Connects to a standard serial port on any Windows compatible PC
- User-friendly graphics & easy-to-navigate windows simplify setup
- Multiple inspection configurations can be stored for fast change-overs

Or use the convenient *Presence*PLUS PRC1 hand-held controller.

- Controller attaches to the sensor with a coiled cord for easy access
- PRC1's built-in LCD screen displays programming options, captured images, & diagnostics
- A single controller can set up multiple sensors

No PC or hand-held controller required for sensor operation.

- The PC or PRC1 controller is required only for setup and diagnostics, not sensor operation

PRESENCE PLUS® PIXEL-COUNTING SYSTEM

A Banner PresencePLUS Pixel-Counting System is comprised of a sensor, a controller (hand-held controller or PC), a serial cable (sensor to PC cable), a quick-disconnect cable, a light source, a lens, and free software (on CD or downloaded from web). In addition, the user must supply a trigger device and a power supply. These components can be purchased individually to create a system to meet your specific needs, or in kits (see page 190). Listed below are the minimum required components for a PresencePLUS Pixel-Counting system. Optional components are also available (see below) to enhance and/or fill more specific needs.

Required Components (must purchase one from each category)

CD-ROM with free software*

Order p/n 64868 or download it at www.bannerengineering.com.

Handheld Controller*

Model	Description
PPCTL	Controller (comes with MCC-6409 cord)

Standard C-Mount Lenses

(see Accessories, page 193, for more choices)

Model	Description
LCF08	8 mm lens with focus locking
LCF12	12 mm lens with focus locking
LCF16	16 mm lens with focus locking

Pixel-Counting Sensors

Model	Description
P2B65Q	Setup with Windows PC or Handheld Controller

Serial Cable*

Model	Description
P2C-07	Sensor to PC Serial 7' Cable (includes free CD ROM) - see Accessories for more information

Quick-Disconnect (QD) Cables

(see Accessories, page 193, for more information)

Model	Description
MQDC-606	2 m (6.5') QD straight
MQDC-615	5 m (15') QD straight
MQDC-630	9 m (30') QD straight
MQDC-606RA	2 m (6.5') QD right-angle
MQDC-615RA	5 m (15') QD right-angle
MQDC-630RA	9 m (30') QD right-angle

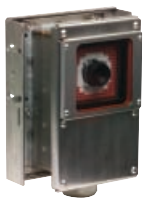
Lighting

(see Lighting Section, page 178, for more choices)

Model	Description
LEDR140	Red LED ring light, strobed (powered by model P2B65Q)
LEDRB70X70	Red LED backlight, diffused, strobed (70 x 70 mm) (powered by model P2B65Q)
LEDRA80X80	Red LED area light, strobed (80 x 80 mm) (powered by model P2B65Q)

* Model P2B65Q Pixel-Counting Sensor requires either the serial cable and CD-ROM or the hand-held controller for programming.

Optional Components

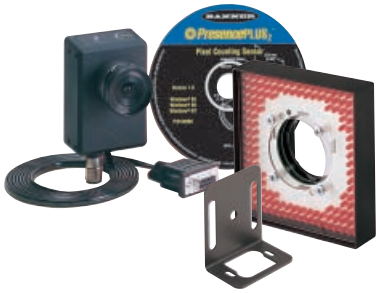


Sensor Enclosures
(see page 194)

Filters
(see page 194)

Brackets
(see pages 194 and 195)

*PRESENCE*PLUS® PIXEL-COUNTING KITS



Below is a PresencePLUS Pixel-Counting Kit Model Scheme to assist you in creating a PresencePLUS Pixel-Counting System kit, or you can choose complete kits (listed below). All Banner kits include a sensor, 8, 12 or 16 mm lens, 2, 5 or 9 m (6.5', 15' or 30') cable, visible red LED light source, and base-mounting bracket. Specific kits also include the serial cable to connect to a Windows PC, with a free CD containing the PresencePLUS Pixel-Counting Sensor software. Simply select the kit with the components that best suit your application.

*Presence*PLUS Pixel Counting Kit Model Scheme

Example: P 2 B 6 5 Q | 0 6 | 0 8 | D | C

Sensor

Cable Length:
06 = 2 meters
15 = 5 meters
30 = 9 meters

Lens:
08 = LCF08 (Lens 8 mm)
12 = LCF12 (Lens 12 mm)
16 = LCF16 (Lens 16 mm)

Lights:
A = LEDRA80X80 (Area Light, 80 mm x 80 mm)
B = LEDRB70X70 (Backlight, 70 mm x 70 mm)
D = LEDR140 (Ring Light)

Controller to PC Interface:
C = No Controller or Software
P = Software and PC Serial Cable

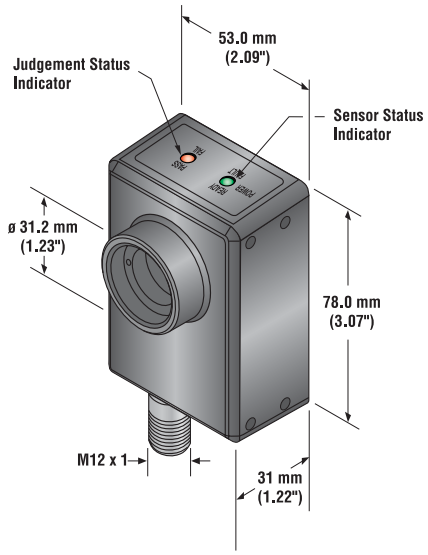
*Presence*PLUS Kits with Software

Model	Lens	Light Source	Cable
P2B65Q0608DP	8 mm	LEDR140 ring light	2 m (6.5')
P2B65Q1508DP			5 m (15')
P2B65Q3008DP			9 m (30')
P2B65Q0612DP	12 mm	LEDR140 ring light	2 m (6.5')
P2B65Q1512DP			5 m (15')
P2B65Q3012DP			9 m (30')
P2B65Q0616DP	16 mm	LEDR140 ring light	2 m (6.5')
P2B65Q1516DP			5 m (15')
P2B65Q3016DP			9 m (30')
P2B65Q0608BP	8 mm	LEDRB70X70 backlight	2 m (6.5')
P2B65Q1508BP			5 m (15')
P2B65Q3008BP			9 m (30')
P2B65Q0612BP	12 mm	LEDRB70X70 backlight	2 m (6.5')
P2B65Q1512BP			5 m (15')
P2B65Q3012BP			9 m (30')
P2B65Q0616BP	16 mm	LEDRB70X70 backlight	2 m (6.5')
P2B65Q1516BP			5 m (15')
P2B65Q3016BP			9 m (30')
P2B65Q0608AP	8 mm	LEDRB80X80 area light	2 m (6.5')
P2B65Q1508AP			5 m (15')
P2B65Q3008AP			9 m (30')
P2B65Q0612AP	12 mm	LEDRB80X80 area light	2 m (6.5')
P2B65Q1512AP			5 m (15')
P2B65Q3012AP			9 m (30')
P2B65Q0616AP	16 mm	LEDRB80X80 area light	2 m (6.5')
P2B65Q1516AP			5 m (15')
P2B65Q3016AP			9 m (30')

*Presence*PLUS Kits without Software

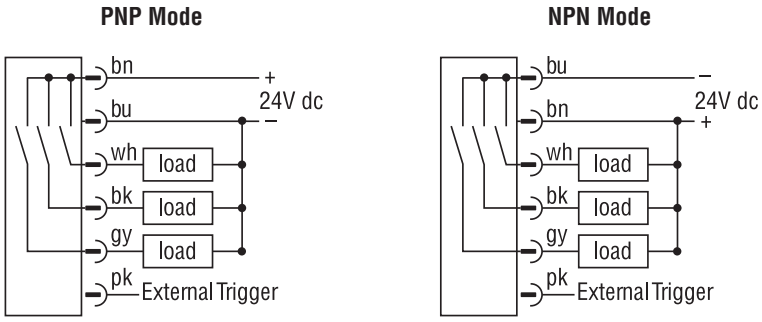
Model	Lens	Light Source	Cable
P2B65Q0608DC	8 mm	LEDR140 ring light	2 m (6.5')
P2B65Q1508DC			5 m (15')
P2B65Q3008DC			9 m (30')
P2B65Q0612DC	12 mm	LEDR140 ring light	2 m (6.5')
P2B65Q1512DC			5 m (15')
P2B65Q3012DC			9 m (30')
P2B65Q0616DC	16 mm	LEDR140 ring light	2 m (6.5')
P2B65Q1516DC			5 m (15')
P2B65Q3016DC			9 m (30')
P2B65Q0608BC	8 mm	LEDRB70X70 backlight	2 m (6.5')
P2B65Q1508BC			5 m (15')
P2B65Q3008BC			9 m (30')
P2B65Q0612BC	12 mm	LEDRB70X70 backlight	2 m (6.5')
P2B65Q1512BC			5 m (15')
P2B65Q3012BC			9 m (30')
P2B65Q0616BC	16 mm	LEDRB70X70 backlight	2 m (6.5')
P2B65Q1516BC			5 m (15')
P2B65Q3016BC			9 m (30')
P2B65Q0608AC	8 mm	LEDRB80X80 area light	2 m (6.5')
P2B65Q1508AC			5 m (15')
P2B65Q3008AC			9 m (30')
P2B65Q0612AC	12 mm	LEDRB80X80 area light	2 m (6.5')
P2B65Q1512AC			5 m (15')
P2B65Q3012AC			9 m (30')
P2B65Q0616AC	16 mm	LEDRB80X80 area light	2 m (6.5')
P2B65Q1516AC			5 m (15')
P2B65Q3016AC			9 m (30')

*Presence*PLUS Pixel-Counting Sensor Dimensions



*Presence*PLUS Pixel-Counting Sensor Specifications	
Supply Voltage and Current	22 to 26V dc; 250 mA max (exclusive of loads) The current required by the PRC1 controller is 200 mA The current required by the LEDR140, LEDRB70x70, or LEDRA80x80 is 300 mA
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Array Size	512 x 384 CMOS pixel array
Output Configuration	Three SPST solid-state contacts which may be individually programmed for function (Pass, Fail, Fail High, Fail Low, Output Ready, and Sensor Fail) mode (NPN and PNP) or type (latched and pulsed); see PresencePLUS PC Software help file for more information
Output Rating	50 mA max, each output **OFF-state leakage current:** < 100 µA **ON-state saturation voltage:** < 1V at 50 mA (NPN); < 2V at 50 mA (PNP)
Output Protection Circuitry	Protected against continuous overload or short circuit
Sensor Response Time	The outputs, IF enabled, switch within 50 milliseconds from the leading edge of the trigger input signal. Additional delay may be programmed
Trigger Input	The sensor trigger may be configured to accept either a current sinking (NPN) or current sourcing (PNP) input. **Internal pull-up (NPN) or pulldown (PNP) is provided:** **NPN mode:** ON < 2V at 3 mA maximum OFF >10V **PNP mode:** ON > 10V at 3 mA maximum OFF < 2V A 100 microsecond minimum pulse width is required for either mode.
Sensor Status Indicator	**Yellow (flashing):** Power ON, sensor initializing and executing self-diagnostics **Yellow (solid):** Power ON, sensor not in RUN mode **Green:** Power ON, sensor in RUN mode, READY to process triggers **Red:** Power is ON, sensor fault has been detected
Judgement Status Indicator	**Green:** Result of last trigger was PASS **Red:** Result of last trigger was FAIL
Lens Mount	Standard C-mount (1"-32 UN)
Construction	Housing is aluminum with anodized and painted finish
Environmental Rating	NEMA 1, IP20
Connections	6-pin Euro-style quick-disconnect fitting for connection to the MQDC-6 Series cable; cables are ordered separately. See page 193.
Operating Conditions	**Temperature:** 0° to 50°C (+32 to 122°F) **Max. relative humidity:** 90% at 50°C (non-condensing)
Operating Conditions	CE

*Presence*PLUS Pixel-Counting Sensor Hookups

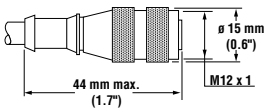
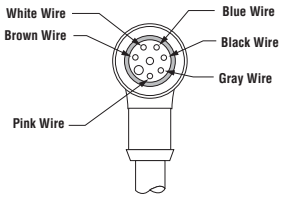
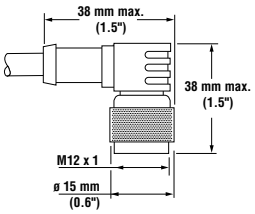


*Presence*PLUS Pixel-Counting Controller

*Presence*PLUS PRC1 Controller Specifications	
Supply Voltage and Current	22 to 26V dc; 200 mA max. supplied through connection to the P2B65Q sensor
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Display	128 x 64 pixel LCD
Construction	**Housing:** Black ABS or polystyrene **Switches:** Polyester membrane
Environmental Rating	IP20; NEMA 1
Connections	RJ11 modular jack for supplied coiled cord; extends to 4 m (12')
Operating Conditions	**Temperature:** 0° to 50°C (+32 to 122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)

Quick-Disconnect Cables

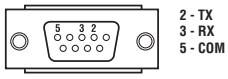
Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 22 or 20 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40° to +80°C (-40° to +176°F)
Voltage Rating: 30 V ac/36 V dc

Style	Model	Length	Dimensions	Pin-out
6-Pin Euro Straight	**MQDC-606** **MQDC-615** **MQDC-630**	2 m (6.5') 5 m (15') 9 m (30')		
6-Pin Euro Right-angle	**MQDC-606RA** **MQDC-615RA** **MQDC-630RA**	2 m (6.5') 5 m (15') 9 m (30')		

PC2-07 Serial Cable

DB-9 Pin #	RJ11 Wire Color	Function
2	Red	Transmit (TX)
3	Green	Receive (RX)
5	Yellow	Ground (GRD)

PC2-07



Standard Lenses

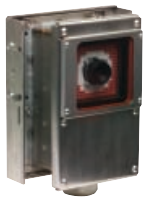
Standard C-mount lenses for PresencePLUS cameras

Models	Description
LCF04	4 mm Lens
LCF08	8 mm Lens with focus locking
LCF12	12 mm Lens with focus locking
LCF16	16 mm Lens with focus locking
LCF25R	25 mm Lens, adjustable aperture
LCF25LR	25 mm Lens with focus locking, adjustable aperture
LCF50L1R	50 mm Lens with focus locking, adjustable aperture
LCF50L2R	50 mm Lens with focus locking, metal housing, adjustable aperture*
LCF75LR	75 mm Lens with focus locking, metal housing, adjustable aperture*
LEK	C-Mount Lens Extension Kit

* Too wide to use with LEDR140 ring light

Sensor Enclosure Kits

Models	Description
PE4-G	Stainless steel enclosure kit with glass window for sensor, rated NEMA 4
PE4-P	Stainless steel enclosure kit with polycarbonate window for sensor, rated NEMA 4



Filters

Models	Color	Description	Data Sheet†
FLTI	Infrared (≥ 760 nm)	Blocks visible light and passes infrared light.	69461
FLTR	Red (≥ 600 nm)	Improves quality by helping to reduce ambient light. It passes red & infrared light.	69628
LEDRPFK	–	Polarizing filter kit for LEDR140	none

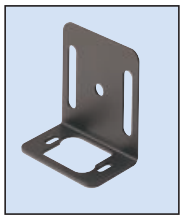
LEDRPFK Filter Kit shown

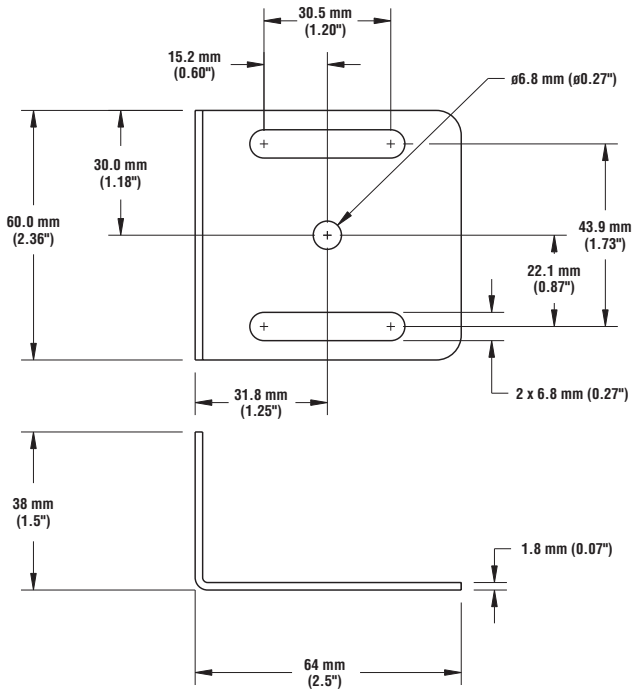
† Download data sheets at www.bannerengineering.com.

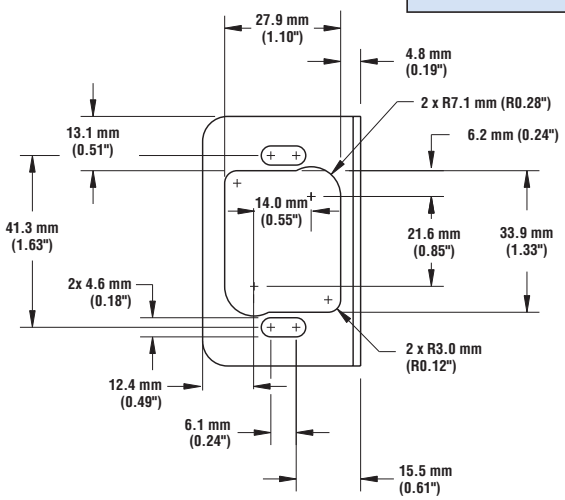
Sensor Mounting Brackets

SMBPBM

- Base-mounting bracket

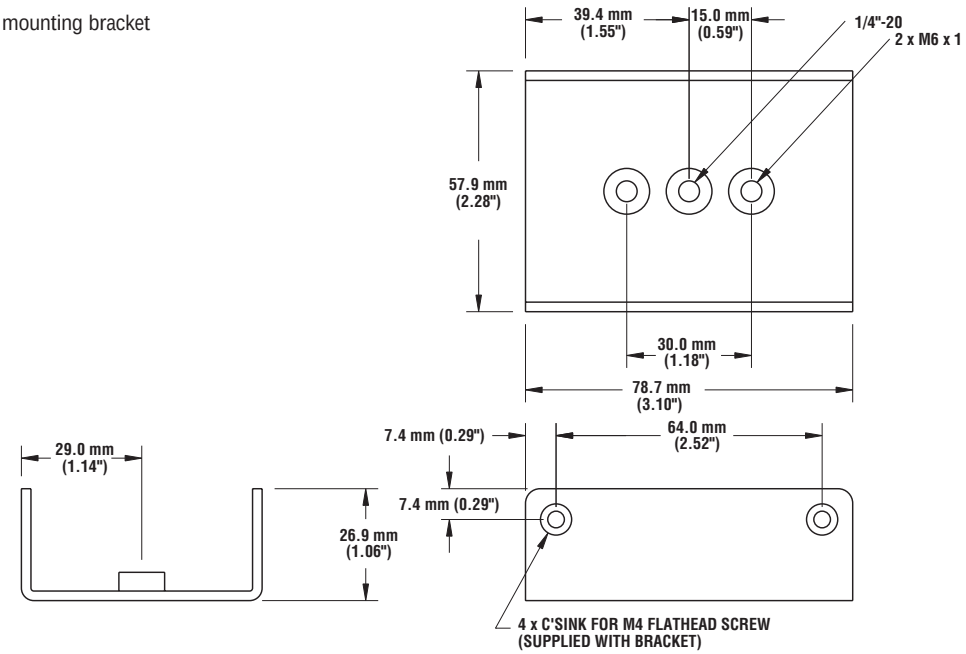






Sensor Mounting Brackets

SMBPCM
- Column mounting bracket



Accuracy

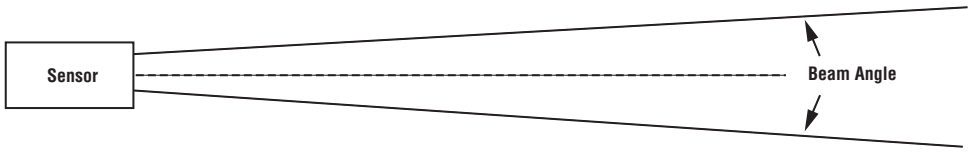
Accuracy is defined as the difference between the indicated value and the actual value at room temperature. In most cases, the accuracy is comprised of two main sources of error: the resolution and the linearity.

Analog Output

The analog output of a sensor is the continuous output of a measured variable. The format of this output may be 4 to 20 mA, 0 to 10V, or others.

Beam Angle

Ultrasonic sensors emit a cone sonic energy that diverges with distance. The angle of this beam is usually defined as the total (included) angle. Ultrasonic beams are not perfect cones. Most of the ultrasonic energy is in the center of the beam. The energy level decreases with distance away from the centerline. The beam angle is defined as the region where the energy is 50% of the energy measured on the centerline.



Color Sensitivity

For optical sensors, color sensitivity refers to the change in output when the color of a target changes. For example, the L-GAGE LG5 will typically change less than 75µm as the target changes from a bright white to a near black target (approximately 90% reflectance to 10% reflectance. Note: for very precise measurements, Banner uses precision ground ceramic targets, as opposed to Kodak standard cardboard targets.)

Deadband

Deadband refers to the region where the sensor cannot make measurements. For example, the deadband of the Q45U ultrasonic sensor is 100 mm. That is, the output is unusable when a target is in this deadband area. Mounting hardware should be positioned so that the intended target is always within the measuring range.

DeviceNet

DeviceNet is a bus-type wiring scheme, specifically for automation sensors that allows sensors, and controllers to exchange data over a single cable. It is much like the local area networks that link PCs together.

Discrete Output

Discrete outputs are on-off outputs that signal when a continuous measurement has reached a specific value. Discrete outputs are typically signaled with NPN or PNP transistors or an electromechanical relay.

Dropping Resistor

A dropping resistor, also called a load resistor, is a precision resistor used to convert a 4 to 20 mA signal to a voltage signal. The most common dropping resistor is 250 ohms +/- .025 ohms, which converts the current to a 1V to 4V signal. For good stability over temperature, the dropping resistor should have a temperature coefficient of 0.01%/deg C or better.

Frequency Response

Frequency response refers to the maximum frequencies that an analog sensor can track. All analog sensors have an inherent response time that limits their ability to measure periodic motions at high frequencies. For example, consider a laser displacement sensor with a 1.6 ms response time that is measuring runout on a rotating cylinder. Since the laser sensor is averaging data over a 1.6 ms period, it will under report the amplitude of the peak runout. This error will increase as the rotational speed increases. Typically, this error is specified as the rotational speed that will produce a -3 dB error (-3 dB equals a 30% error). For a 1.0 ms averaging time, the -3 dB frequency response is 450 Hz. At 450 Hz, a 1.0 mm displacement will be reported as 0.7 mm by the laser sensor.

For reference, note that the crankshaft of a car engine running at 3,000 rpm is only 50 Hz.

Full Scale

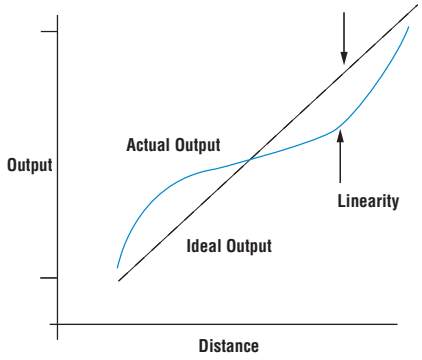
The full scale range of a sensor represents the maximum measuring range possible. For example, a laser displacement sensor that measures from 75 to 125 mm has a full scale range of 50 mm. Even if the user has configured the sensor to read from 100 to 120 mm, the full scale remains at 50 mm. This is important to keep in mind if a manufacturer lists a performance specification in terms of "% of full scale." The errors will not shrink with the calibrated measuring span, as they would if the manufacturer listed the spec in terms of "% of span."

Hysteresis

Hysteresis is commonly used to represent the difference in switching points for discrete outputs. For example, an output might turn on when a target reaches 25 mm, but will not turn off until the target is 24 mm away. Therefore there is 1 mm of hysteresis. Hysteresis is also used in regard to analog sensors to represent the difference in an output from moving upscale and moving downscale. For example, a contact probe is calibrated to output 4 to 20 mA from 0 to 10 mm. When travelling from 0 to 10 mm, the 5 mm point corresponds to an output of 11.98 mA. When travelling from 10 to 0 mm, the 5 mm point corresponds to 12.02 mA. Therefore; the hysteresis is 0.04 mA, or 0.25% of span. The analog hysteresis in electro-mechanical measuring systems is often measurable; in non-mechanical sensors, such as photoelectrics, it is most often insignificant.

Linearity

Linearity actually refers to the maximum amount of nonlinearity in the output of the sensor. It is usually defined as the maximum deviation above or below the ideal output of the sensor. See figure, at right. It should be noted that linearity errors are repeatable errors and do not affect the sensor's ability to repeatably activate discrete outputs. Furthermore, since linearity errors are repeatable, they are potentially correctable within the host system. A linearization scheme in a host system could consist of a table of actual and ideal values that serves as table for interpolation.



Measuring Range

The measuring range represents the maximum range of values that a sensor can measure.

Measuring Span

The measuring span usually refers to the actual configured values that the sensor is set up for. For example, a sensor with a measuring range of 0.2 to 1 m, is set up with a measuring span 0.5 to 0.8 m.

PID Control

PID stands for Proportional Integral Derivative control. PID control consists of a measured process variable that is compared to a set point, a controller which outputs a control signal, and a device that produces some sort of action on a process. The difference between the set point and the measured process variable is the error signal. The control signal has three components:

- P a signal proportional to the error signal
- I a signal proportional to the cumulative error (integral error = error x time)
- D a signal proportional to the rate of change of the error signal (derivative)

An example of PID control is the cruise control in a car. Assume a car is going steady at 60 mph and the cruise is set (the set point is 60 mph; the error signal is 0). The car encounters a steep hill, and speed drops to 57 mph (the error signal is 3 mph). The controller instantly tells the system to use more fuel via the "P" term. The car speeds up to 58 mph. The cumulative term of error times time grows and the control signal further increases via the "I" term. The car finally speeds up to 60 mph.The error term goes to zero. The car passes the crest of the hill and quickly speeds up. The rate of change term, "D", tells the fuel system to back off and the car settles back to its steady state, and so on.

Reference Conditions

The performance specifications for measuring sensors are typically given for reference conditions. Reference conditions are usually 20°C and 1 atmosphere of pressure. In addition, a reference target must also be described in the specifications. For laser measuring devices, a white ceramic target is often used. For ultrasonics, a square metal target is typically called out.

Repeatability

The repeatability of a sensor is the difference in the sensor's output when the same input is given multiple times. Banner typically uses repeatability to quantify the performance of a discrete sensor. For a discrete sensor, repeatability will represent the variation in switching distances for a standard target at reference conditions. For example, a laser displacement sensor is programmed to switch its output at a distance of 100 mm. The actually switching distance is measured with a micrometer twenty times. The data show a standard deviation of 0.01 mm; the two-sigma repeatability is 0.02 mm.

Resolution

Resolution is one of the most important specifications in measuring devices. It is a measure of smallest change in the position of a target that can be sensed by the measuring device. It is also a measure of the expected fluctuations in the output of a device when the target is at a fixed distance away from the sensor. For example, consider a device with a resolution of "0.2% of measuring distance" that is 100 mm away from the target. The resolution is 0.2% times 100 mm, or 0.2 mm. This means that any change greater than 0.2 mm in the position of the target will cause a measurable change in the output of the sensor. It also implies that if the target does not change position, one could expect the noise of the output signal to be less than 0.2 mm.

Sometimes a manufacturer will specify output resolution and list a specification in bits such as "12 bit." This simply means that the output portion of the circuit has a resolution of one in 2^{12} (4096). If the sensor has a measuring window of, say, 100 mm, this would equate to 100/4096 = 0.024 mm. When specifications are written this way, make sure that the rest of the circuit has a resolution smaller than the output portion of the circuit (the digital-to-analog converter). In other words, if a sensor has an output resolution of 0.02 mm, and the rest of a sensor's measuring system produces a resolution of 0.5 mm, the overall resolution is limited to 0.5 mm. Influences on resolution include response speed, target conditions, distance to target and external factors such as noise from unterminated outputs and shields or lighting, motors, etc.

Response Time

Response time is a measure of how quickly a sensor can react to a change in the input variable. It is generally reported as the time it takes for the sensor to output a signal representing 63% of the change in the input. For example, a temperature sensor at 0°C is quickly placed in 100°C water. The sensor reads 63°C after 4 seconds. Therefore, the response time of the sensor is 4 seconds.

Span

The span of a sensor is the range over which the linear output is configured. For example, an ultrasonic sensor is calibrated so that 4 mA equals 1'; 20 mA equals 8'. The span of the sensor is 7'.

Span Adjustment Range

This represents the amount of adjustability in the linear output of the sensor. For example, a laser displacement sensor might have a span adjustment range of 5 to 15 mm, meaning the 4 to 20 mA signal can be correlated to spans as small as 5 mm, or as large as 15 mm. This range is sometimes referred to as turndown ratio. In the example above, the turndown ratio is 15:5, or 3:1.

Standoff Distance

The distance from the face of the sensor to the midpoint of the measuring range.

Temperature Warm Up Drift

The error that occurs as the sensor warms from a cold power up. Allow proper warm up before programming or operating.

Temperature Effect

The temperature effect is defined as the maximum change in output per change in ambient temperature. An example of a temperature effect spec is "1% of distance per 10°C," meaning that the sensor's output will change less than 1% for every 10°C change in temperature.

Total Error

The sum of all errors associated with Accuracy (Linearity, Resolution/Repeatability), Temperature Effect and Temperature Warm Up Drift. To estimate the expected error of a measuring device, use the root sum of the squares (RSS) method to combine the individual sources of error. For example, a sensor with 3 mm resolution and 4 mm of linearity would have an expected error of $\sqrt{3^2 + 4^2}$ = 5 mm.

Update Rate

The update rate of a sensor is the rate at which a new value is outputted from the sensor. This should not be confused with response time, which is often quite slower than the update rate. For example, a sensor may compute a moving average of 10 ms worth of data that is outputted every 1 ms. In this case, the update rate is 1/1 ms, or 1KHz, while the response time would be 6 ms.

TABLE 1. English-Metric Conversion

Inch Fraction	Inch Decimal	Millimeter	Inch Fraction	Inch Decimal	Millimeter	Inch Fraction	Inch Decimal	Millimeter
---	.0039	0.1	9/32	.2812	7.144	21/32	.6562	16.669
---	.0079	0.2	19/64	.2969	7.541	---	.6693	17
---	.0118	0.3	5/16	.3125	7.938	43/64	.6719	17.066
1/64	.0156	0.397	---	.3150	8	11/16	.6875	17.462
---	.0157	0.4	21/64	.3281	8.334	45/64	.7031	17.859
---	.0197	0.5	11/32	.3438	8.731	---	.7087	18
---	.0236	0.6	---	.3543	9	23/32	.7188	18.256
---	.0276	0.7	23/64	.3594	9.128	47/64	.7344	18.653
1/32	.0312	0.794	3/8	.375	9.525	---	.7480	19
---	.0315	0.8	25/64	.3906	9.922	3/4	.750	19.050
---	.0354	0.9	---	.3937	10	49/64	.7656	19.447
---	.0394	1	13/32	.4062	10.319	25/32	.7812	19.844
3/64	.0469	1.191	27/64	.4219	10.716	---	.7874	20
1/16	.0625	1.588	---	.4331	11	51/64	.7969	20.241
5/64	.0781	1.984	7/16	.4375	11.112	13/16	.8125	20.638
---	.0787	2	29/64	.4531	11.509	---	.8268	21
3/32	.0938	2.381	15/32	.4688	11.906	53/64	.8281	21.034
7/64	.1094	2.778	---	.4724	12	27/32	.8438	21.431
---	.1181	3	31/64	.4844	12.303	55/64	.8594	21.828
1/8	.1250	3.175	1/2	.500	12.700	---	.8661	22
9/64	.1406	3.572	---	.5118	13	7/8	.875	22.225
5/32	.1562	3.969	33/64	.5156	13.097	57/64	.8906	22.622
---	.1575	4	17/32	.5312	13.494	---	.9055	23
11/64	.1719	4.366	35/64	.5469	13.891	29/32	.9062	23.019
3/16	.1875	4.762	---	.5512	14	59/64	.9219	23.416
---	.1968	5	9/16	.5625	14.288	15/16	.9375	23.812
13/64	.2031	5.159	37/64	.5781	14.684	---	.9449	24
7/32	.2188	5.556	---	.5905	15	61/64	.9531	24.209
15/64	.2344	5.953	19/32	.5938	15.081	31/32	.9688	24.606
---	.2362	6	39/64	.6094	15.478	---	.9842	25
1/4	.2500	6.350	5/8	.625	15.875	63/64	.9844	25.003
17/64	.2656	6.747	---	.6299	16	1	1.000	25.400
---	.2756	7	41/64	.6406	16.272	---	---	---

To convert millimeters to inches, multiply by 0.0394.

To convert inches to millimeters, multiply by 25.4.

Measurement Abbreviations

meter = m
millimeter = mm
micrometer (micron) = µm

Temperature Conversion

°F = (°C x $^{9}/_{5}$) + 32
°C = (°F -32) X $^{5}/_{9}$

Measurement Conversion

To convert from	To	Multiply by
Inches	Meter	0.0254
Inches	Millimeter	25.4
Inches	Micrometer	25400
Feet	Meter	0.3048
Meter	Inches	39.37
Millimeter	Inches	0.03937
Micrometer	Inches	0.0000394
Meter	Feet	3.28084

TABLE 2. Copper Wire Information

	Solid Wire Diameter American Wire or Brown and Sharpe Gage		Approximate Stranded Wire Diameter[1]		Approximate Resistance per 100 feet (30 meters)[2]
AWG	Inches	Millimeters	Inches	Millimeters	Ohms
0000	0.4601	11,687	0.522	13.26	0.0050
000	0.4097	10.406	0.464	11.79	0.0060
00	0.3648	9.266	0.414	10.52	0.0080
0	0.3249	8.252	0.368	9.35	0.010
1	0.2893	7.348	0.328	8.33	0.012
2	0.2576	6.543	0.292	7.42	0.016
3	0.2294	5.827			0.020
4	0.2043	5.189	0.232	5.89	0.025
5	0.1819	4.620			0.030
6	0.1620	4.115	0.184	4.67	0.040
7	0.1443	3.665			0.050
8	0.1285	3.264	0.147	3.73	0.060
9	0.1144	2.906			0.080
10	0.1019	2.588	0.116	2.95	0.10
11	0.0907	2.304			0.13
12	0.0808	2.052	0.095	2.41	0.16
13	0.0720	1.829			0.20
14	0.0641	1.628	0.073	1.85	0.25
15	0.0571	1.450			0.32
16	0.0508	1.290	0.059	1.50	0.40
17	0.0453	1.151			0.50
18	0.0403	1.024	0.048	1.22	0.64
19	0.0359	0.912			0.80
20	0.0320	0.813	0.036	0.91	1.0
21	0.0285	0.724			1.3
22	0.0253	0.643	0.030	0.76	1.6
23	0.0226	0.574			2.0
24	0.0201	0.511	0.024	0.61	2.6
25	0.0179	0.455			3.2
26	0.0159	0.404	0.020	0.51	4.1
27	0.0142	0.361	0.018	0.46	5.2
28	0.0126	0.320	0.015	0.38	6.5
29	0.0113	0.287			8.2
30	0.0100	0.254	0.012	0.30	10
31	0.00892	0.227			13
32	0.00795	0.202	0.008	0.20	16
33	0.00708	0.180			20
34	0.00630	0.160	0.007	0.18	26
35	0.00561	0.142			33
36	0.00500	0.127	0.006	0.15	42
37	0.00445	0.113			52
38	0.00396	0.101			66
39	0.00353	0.090			83
40	0.00314	0.080			105
41	0.00280	0.071			130
42	0.00249	0.063			170
43	0.00222	0.056			210
44	0.00198	0.050			270
45	0.00176	0.045			330
46	0.00157	0.040			420

[1] Exact diameter is dependent upon the wire gage used for the strands. Diameter listed represents the most common wire type for AWG.
[2] Resistance values assume the resistivity of solid copper wire. Stranding and/or copper alloy increase the resistance values.

TABLE 3. NEMA Enclosure Ratings for Nonhazardous Locations

Standard NEMA (IEC)*	Intended Use	Accidental bodily contact	Falling dirt	Dust, lint, fibers (non-volatile)	Windblown dust	Falling liquid, light splash	Hosedown and heavy splash	Rain, snow, and sleet	Ice buildup	Oil or coolant seepage	Oil or coolant spray and splash	Occasional submersion	Prolonged submersion	Corrosive agents
NEMA 1 (IP10)	Indoor	Yes	Yes	...	...	...	...	...	...	...	...	...	...	...
NEMA 2 (IP11)	Indoor	Yes	Yes	...	...	Yes	...	...	...	...	...	...	...	...
NEMA 3 (IP54)	Outdoor	Yes	Yes	Yes	Yes	Yes	...	Yes	...	...	...	...	...	...
NEMA 3S (IP54)	Outdoor	Yes	Yes	Yes	Yes	Yes	...	Yes	Yes	...	...	...	...	...
NEMA 4 (IP56)	Indoor or Outdoor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	...	...	...
NEMA 4X (IP56)	Indoor or Outdoor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	...	...	Yes
NEMA 6 (IP67)	Indoor or Outdoor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	Yes	...	...
NEMA 6P (IP67)	Indoor or Outdoor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	Yes	Yes	Yes
NEMA 12 (IP52)	Indoor	Yes	Yes	Yes	...	Yes	...	...	...	Yes	...	...	...	...
NEMA 13 (IP54)	Indoor	Yes	Yes	Yes	...	Yes	...	...	...	Yes	Yes	...	...	...

*The IEC equivalents listed in this column are approximate: NEMA types meet or exceed the test requirements for the associated IEC classifications.

TABLE 4. IEC IP Enclosure Ratings for Nonhazardous Locations

1ST CHARACTERISTIC: Protection against contact and penetration of solid bodies

Numeral	Short Description
0	Non-protected
1	Protected against solid objects greater than 50 mm
2	Protected against solid objects greater than 12 mm
3	Protected against solid objects greater than 2.5 mm
4	Protected against solid objects greater than 1.0 mm
5	Dust protected
6	Dust-tight

2ND CHARACTERISTIC: Protection against the penetration of liquids

Numeral	Short Description
0	Non-protected
1	Protected against dripping water
2	Protected against dripping water when tilted up to 15°
3	Protected against spraying water
4	Protected against splashing water
5	Protected against water jets
6	Protected against heavy seas
7	Protected against the effects of immersion
8	Protected against submersion

TABLE 5. Relative Chemical Resistance of Sensor Housing Materials and Lenses

Housing Material	RESISTANCE TO: Industrial Solvents	Dilute Acids	Concentrated Acids	Dilute Caustic Alkalis	Concentrated Caustic Alkalis	10% Sodium Hydroxide in Steam	Sunlight and Weathering
Thermoplastic Polyester	**FAIR** Attacked by: acetone, MEK, and methylene chloride	**EXCELLENT**	**GOOD**	**POOR**	**POOR**	**POOR**	**GOOD**
Lexan® Polycarbonate	**POOR** Attacked by: acetone, MEK, and methylene chloride	**GOOD**	**FAIR**	**POOR**	**POOR**	**POOR**	**GOOD**
NORYL® Polyphenylene oxide (PPO)	**FAIR** Attacked by: chlorinated hydrocarbons[1]	**GOOD**	**FAIR**	**EXCELLENT**	**GOOD**	**GOOD**	**EXCELLENT**
Delrin® Acetal	**GOOD**	**FAIR**	**POOR**	**FAIR**	**POOR**	**FAIR**	**GOOD**
Epoxy-coated zinc-aluminumalloy	**GOOD**	**GOOD**	**FAIR**	**GOOD**	**FAIR**	**FAIR**	**EXCELLENT**
Anodized aluminum	**EXCELLENT**	**FAIR**	**POOR**	**GOOD**	**FAIR**	**FAIR**	**GOOD**
Stainless steel	**EXCELLENT**	**FAIR**	**POOR**	**EXCELLENT**	**GOOD**	**GOOD**	**GOOD**
PVC (Polyvinyl- chloride)	**FAIR** Attacked by: acetone, MEK, and methylene chloride	**GOOD**	**FAIR**	**EXCELLENT**	**EXCELLENT**	**EXCELLENT**	**GOOD**
Polyethylene	**FAIR** Attacked by: chlorinated hydrocarbons[1]	**EXCELLENT**	**EXCELLENT**	**GOOD**	**GOOD**	**GOOD**	**POOR**
Cycolac® ABS	**POOR** Attacked by: acetone, MEK, esters, ketones, & some chlorinated hydrocarbons[1]	**GOOD**	**POOR**	**GOOD**	**GOOD**	**GOOD**	**FAIR**
Lens Material	**Industrial Solvents**	**Dilute Acids**	**Concentrated Acids**	**Dilute Caustic Alkalis**	**Concentrated Caustic Alkalis**	**10% Sodium Hydroxide in Steam**	**Sunlight and Weathering**
Glass[2]	**EXCELLENT**	**GOOD**	**FAIR**	**EXCELLENT**	**GOOD**	**GOOD**	**EXCELLENT**
Acrylic[3]	**POOR**	**FAIR**	**POOR**	**GOOD**	**FAIR**	**FAIR**	**GOOD**
Polysulfone	**FAIR** Attacked by: chlorinated hydrocarbons[3]	**FAIR**	**POOR**	**FAIR**	**POOR**	**POOR**	**POOR**
Lexan® Polycarbonate	**POOR** (see **Lexan®**, above)	**GOOD**	**FAIR**	**POOR**	**POOR**	**POOR**	**GOOD**

Key to Performance

Rating	Percent Retention to Strength	Degree of Attack
Excellent	85 to 100%	Slight (or no) attack
Good	75 to 84%	Moderate attack
Fair	50 to 74%	Noticeable swelling, softening, etching, or corrosion
Poor	<50%	Severe degradation

NOTES:

NOTE 1: Chlorinated hydrocarbons include Freon, methylene chloride, trichlorethane, and trichloroethylene.

NOTE 2: Plastic lens covers are available for some sensors to meet FDA requirements.

NOTE 3: Glass covers are available for some sensors to protect the acrylic lens.

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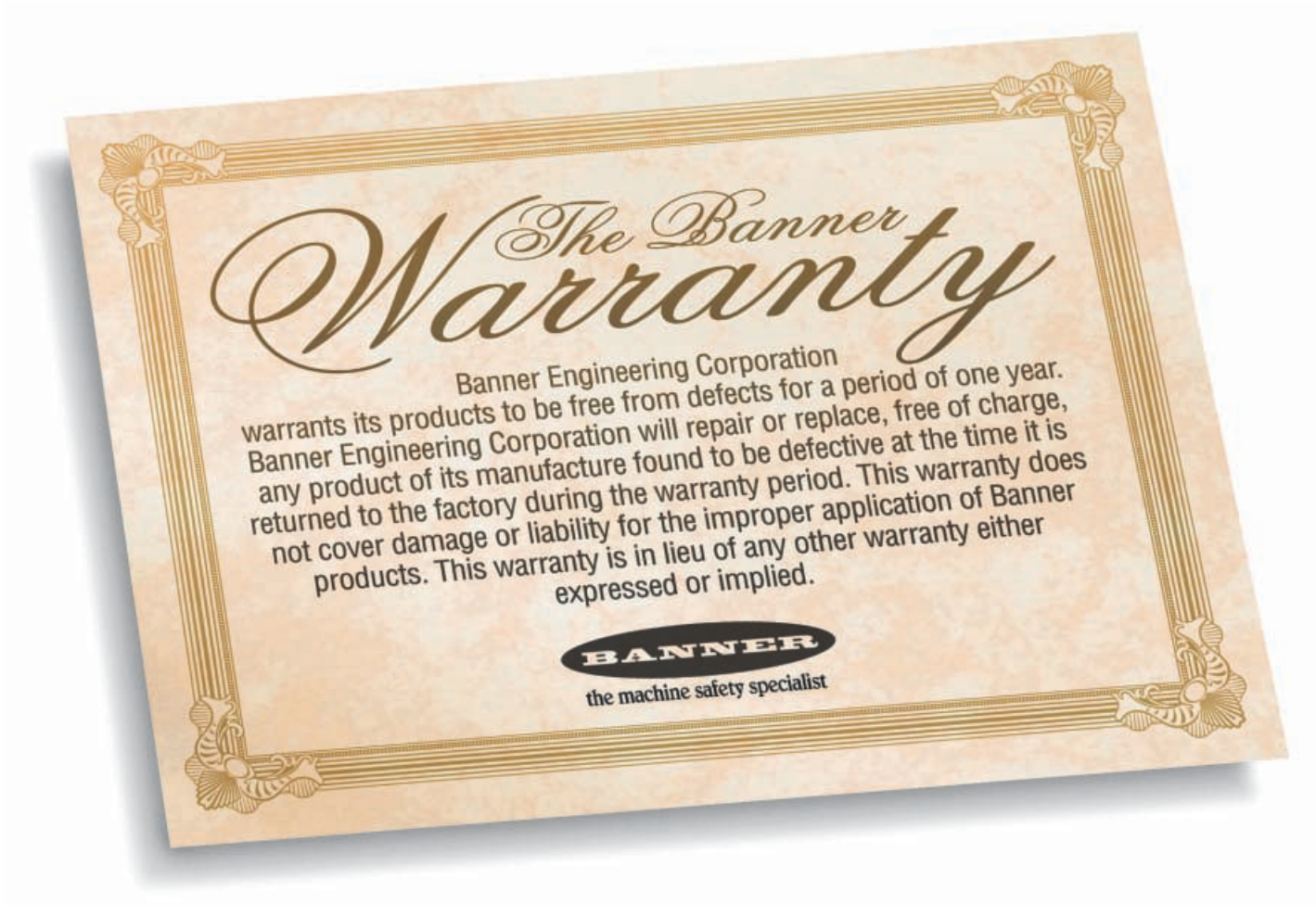

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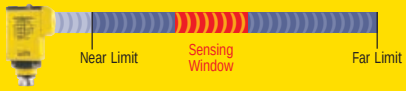

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