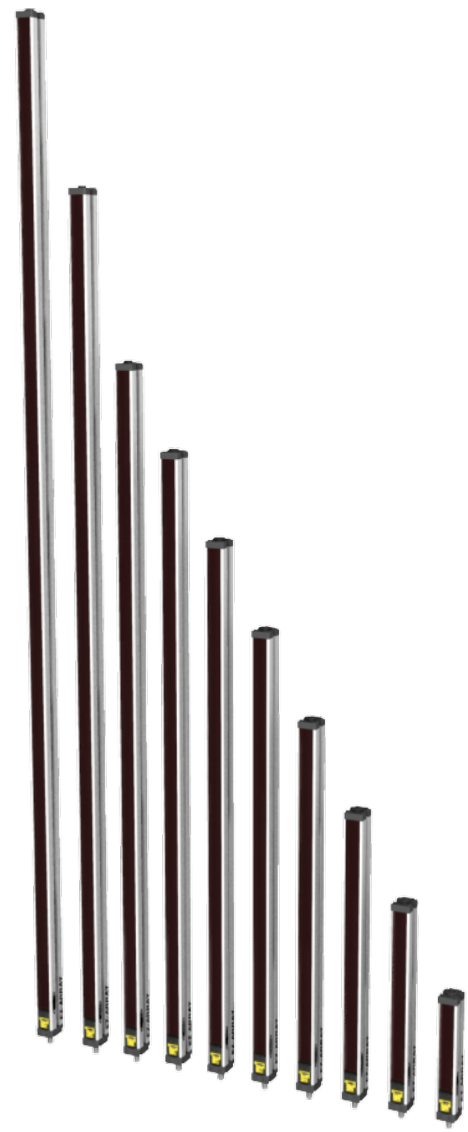
A-GAGE™ EZ-ARRAY™ QuickStart Guide

Two-piece sensing array with 2 analog and 2 discrete outputs, plus serial output

This document is a companion to Instruction Manual p/n 130426, located online and on the CD included with the EZ-ARRAY Receiver

Features

- A cost-effective measuring light curtain designed for quick and simple installations with the sophistication to handle the toughest sensing applications.
- Excels at high-speed, precise process monitoring and inspection, profiling, and web-guiding applications
- A comprehensive combination of scanning options:
  – 14 measurement (“scan analysis”) modes
  – 3 scanning methods
  – Selectable beam blanking
  – Selectable continuous or gated scan initiation
  – Selectable threshold setting for semi-transparent applications
  – 2 analog outputs, 2 discrete outputs, plus Modbus 485-RTU serial output
- Outstanding 4 meter range with 5 mm beam spacing
- Excellent 5 mm minimum object detection or 2.5 mm edge resolution, depending on scanning method
- Receiver user interface for intuitive setup of many common applications:
  – 6-position DIP switch for setting scan mode, measurement mode, analog slope, discrete output 2 option (complementary measurement or alarm operation)
  – 2 push buttons for gain method selection and alignment/blanking
  – 7 Zone LEDs for instant alignment and beam blockage information
  – 3-digit display for sensing information and diagnostics
- Software GUI available for advanced sensor setup functions
- Remote teach wire option for alignment, gain methods, inverted display, and DIP switch disable



WARNING . . . Not To Be Used for Personnel Protection

These sensors do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized output condition. Consult your current Banner Safety Products catalog for safety products which meet OSHA, ANSI and IEC standards for personnel protection.

Table of Contents

NOTE: References to Section 5 or Appendix are referring to that section in the full manual, p/n 130426, included on the CD packed with the EZ-ARRAY or found online at www.bannerengineering.com/130426

1. Overview

The A-GAGE™ EZ-ARRAY™ measuring light screen is ideal for applications such as on-the-fly product sizing and profiling, edge-guiding and center-guiding, loop tensioning control, hole detection, parts counting, and similar uses. Emitters and receivers, with arrays available in 10 lengths from 150 to 1800 mm (5.9" to 70.9") long, feature a closely spaced column of beams to provide a precise light screen for measuring applications at a working range of 400 mm to 4 m (16" to 13').

Its two-piece design makes it economical and easy to use. Controller functionality is built into the receiver housing. It can be configured for many straightforward applications simply by configuring the six-position DIP switch on the front of the receiver (the receiver user interface). For more advanced control, easy-to-use graphic user interface (GUI) software is available on the included CD to configure the sensors using a PC.

This QuickStart Guide provides setup and use instructions when the receiver interface is used. Instructions for using the GUI are in Section 5 of the full manual (p/n 130426), found on the included CD or online at www.bannerengineering.com/130426.

Installation is easy, too. The emitter and receiver housings can be side-mounted or end-cap-mounted using the included end-cap brackets; longer models also include a center bracket (see Section 3.1).

Beam synchronization is achieved via the 8-conductor sensor cables. Individual LEDs and a 3-digit diagnostic display on the receiver provide ongoing visual sensing status and diagnostic information. Comprehensive data is available to a process controller via a combination of five outputs: two analog, two discrete, and one serial.

1.1 Features

Built-in features in the EZ-ARRAY contribute to its ease of use. Many features are available using either the user-friendly receiver interface or the more advanced GUI software interface.

Built-in diagnostic programming and easy-to-see indicators on the receiver simplify physical alignment and troubleshooting (Figure 1-1); advanced diagnostics are available on the GUI.

The receiver has a bright LED that indicates overall sensing status (OK, marginal alignment, and hardware error). Two more LEDs indicate serial communication status. Seven Zone indicators each communicate the blocked / aligned status of one-seventh of the total array. A 3-digit diagnostic display provides further diagnostic information, including number of beams blocked, whether blanking is configured, and troubleshooting codes.

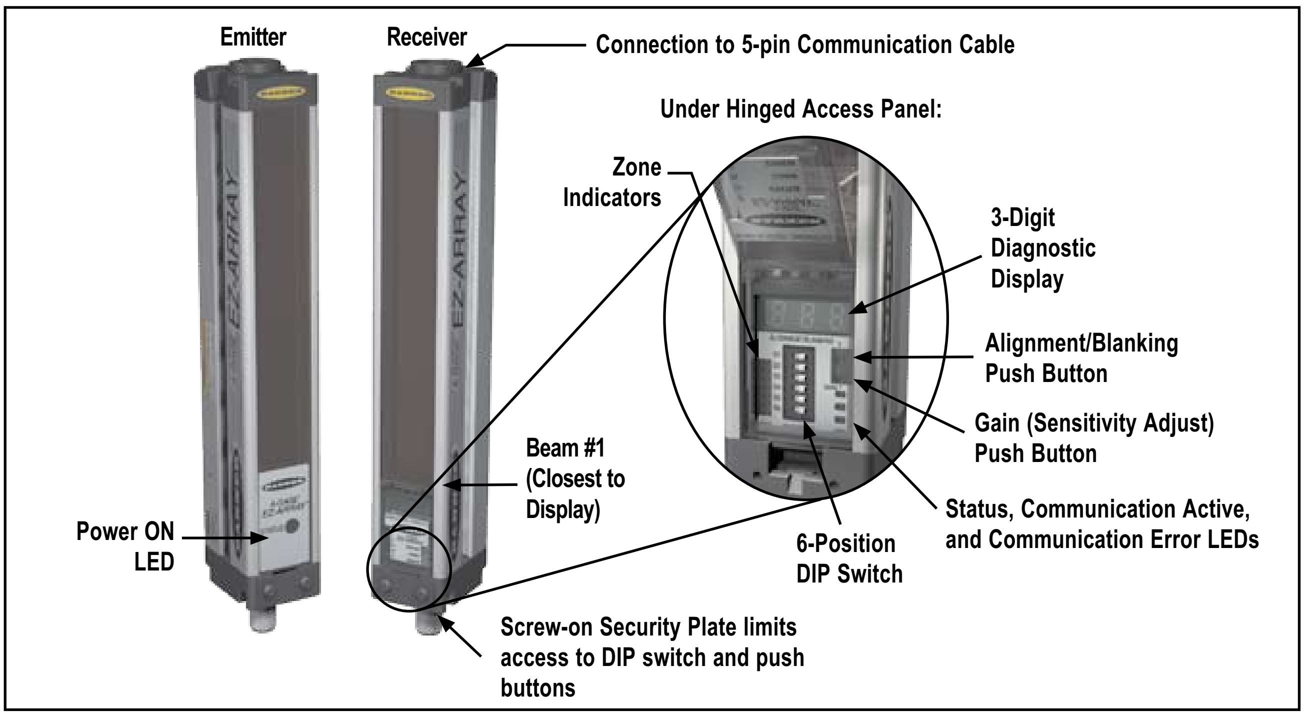


Figure 1-1. A-GAGE EZ-ARRAY features

The emitter has a red LED that signals proper operation (ON when power is applied). See Section 1.4 for more information about indicators and Section 4.6 for display codes and troubleshooting.

The Alignment routine (Section 4.2, or Section 5 of the full manual) automatically equalizes the excess gain of each beam for reliable object detection throughout the array. The Alignment routine need not be performed again unless the sensing application changes, or if the emitter and/or receiver is moved.

Programmable beam blanking accommodates machine components or other fixtures that must remain in or move through the light screen. Blanking may be set using the receiver interface, the teach wire or the GUI.

The EZ-ARRAY light screen provides a wide selection of sensing and output options, including measurement ("scan analysis") modes and scanning methods that can determine a target object's location, overall size, total height, or total width, or the number of objects. Scanning may be continuous or controlled by a gate sensor. Up to 15 systems may be networked, via modbus; see Section 5 or Appendix A of the full manual.

1.2 Configuration via DIP Switch or Supplied Software

Commonly used configuration options can be set up easily via a six-position DIP switch located behind a hinged clear access panel on the front of the receiver.

Access to the DIP switch can be prevented by using the screw-on security plate to hold the clear access panel closed or by disabling them via the GUI.

For more individualized (advanced) applications, the supplied GUI software program (which runs on a PC-compatible computer running Windows® XP or 2000; see Section 5 of the full manual for more information) may be used to configure the receiver. The menu-driven program walks the user through the many scanning and output options. After the desired options are selected, the combination of selections can be saved in an XML file, stored in the system configuration computer and recalled as needed.

The software also provides alignment and diagnostics routines. An Alignment screen displays the individual status of each beam in the light screen, as well as the total number of beams, and totals of beams blocked, made and blanked. Built-in diagnostics can be used to assess emitter and receiver hardware errors. (See Section 5.)

Outputs

All models have two analog outputs and two discrete outputs. An additional serial output communicates to the PC via a modbus RTU-485 interface.

The analog outputs are either 4–20 mA current or 0–10V voltage, depending on model (see Section 2-1). They may be configured (via DIP switch or software) for either a positive or negative slope.

Discrete output 2 is selectable (via DIP switch or software) for alarm or measurement operation. When the receiver interface is used, discrete output 1 follows the operation of analog output 1 (it conducts when the analog output senses a target is present). When the GUI is used for configuration, both discrete outputs have full configurability, including measurement mode, NPN or PNP polarity, and normally open or normally closed operation.

Gain Setting

The receiver can be set for either high-excess-gain or low-contrast operation, depending on the quality of the sensing environment, necessary sensing range and the opacity of the sensed target (see Section 4.3). For low-contrast operation, only a portion of each beam must be blocked for detection to occur.

Display Invert

For applications where the sensors must be inverted (and thus the display is not right-reading), the receiver offers a display invert feature, which inverts the diagnostic display for easy reading (see Section 4.4).

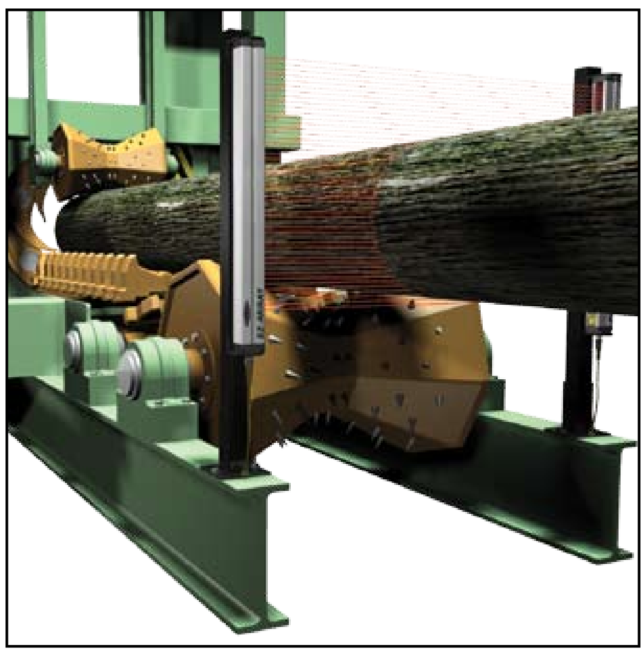


Figure 1-2. A typical A-GAGE EZ-ARRAY application

1.3 System Components

A typical A-GAGE EZ-ARRAY has four components: emitter and receiver, each with an integral quick-disconnect (QD) fitting, plus an 8-pin QD emitter cable, and one for the receiver (see Figure 1-3). For applications that use the modbus RTU-485 interface, an additional 5-wire cable is used to connect the receiver with a PC or process controller. (A PC used for configuration must run on Windows® XP or 2000.)

Sensors are available in 10 array lengths from 150 to 1800 mm (see Section 2-1). The emitter has a column of infrared light emitting diodes spaced 5 mm apart; the light is collimated and directed toward the receiver. An identical length receiver, positioned opposite the emitter, is populated with photodiodes on the same 5 mm pitch. The light from the emitter is focused on, and detected by, the receiver. This sophisticated light curtain is capable of detecting opaque cylindrical objects as small as 5 mm in diameter or measuring part edges within 2.5 mm, depending on the scanning method selected (see Section 1.6).

Figure 1-3. A-GAGE EZ-ARRAY system components

1.4 Status Indicators

Both the emitter and receiver provide ongoing visual indication of operating and configuration status.

The emitter has a red LED that signals proper operation (ON when power is applied).

The receiver has a bright Status LED that indicates overall sensing status (OK, marginal alignment, and hardware error). Two other LEDs indicate whether serial communication is active or if there is a communication error. Seven Zone indicators each communicate the blocked/aligned status of one-seventh of the total array. A 3-digit diagnostic display provides further diagnostic information: number of beams blocked, whether blanking is configured, and troubleshooting codes. See Section 4.6 for display codes and troubleshooting.

Zone Indicators (Beams Blocked Segment)

Seven LEDs represent emitter/receiver alignment status. They provide a visual aid for sensor alignment and monitoring objects within the sensor's field of view. The sensor array is partitioned into seven equal segments, each of which is represented by one of the seven LEDs. The LED closest to DIP switch S6 (see Figure 4-1) represents the group of optical channels closest to the receiver display (the "bottom" group). The LED closest to DIP switch 1 represents the far segment of channels.

These LEDs illuminate either green or red. When an LED is green, no unblanked beams are obstructed in that segment. When the LED is red, one or more beams in that segment is obstructed.

Three-Digit Display

The 3-digit display has slightly different functions during normal operation, alignment, and gain adjust modes. In normal operation the display indicates current numerical value of the measurement mode for analog output 1. The display also identifies the following activated sensor functions: blanking and locked-out user interface/electronic configuration, as shown in Figure 1-4. (For information on inverting the display, see Section 4.4 or 5.)

During blanking mode, the display reads "**n**", followed by the number of blocked beams in the array. During alignment mode, it reads "**A**", followed by the number of blocked, unblanked beams; a period follows the A ("**A.**") if blanking is configured.

During gain adjust mode, the display reads "**L**" followed by "**1**" or "**2**" to indicate the gain level. (A "**1**" represents high excess gain, and a "**2**" represents low contrast.)

If a sensing error occurs, the display reads "**c**" followed by a number that corresponds to the recommended corrective action (see Section 4.6).

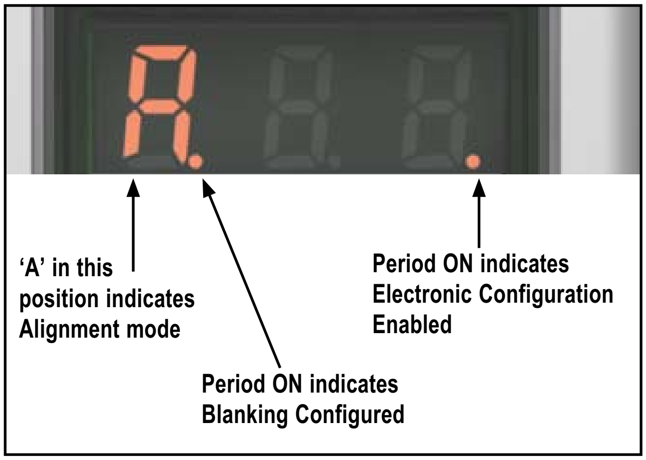


Figure 1-4. Indications provided by the 3-digit display

Blanking Indicator

The Blanking indicator will be visible (ON) whenever the user has enabled the blanking feature. It appears as a period following the first digit of the display.

Electronic Configuration Indicator

The Electronic Configuration indicator is ON when the sensor configuration is not defined by the receiver interface, but by the GUI (this is set via the GUI). When electronic configuration is enabled, the receiver interface DIP switch and push button settings are ignored.

Receiver Interface Status Indicators

The receiver has three status indicators: green/red System Status, yellow Modbus Activity, and red Modbus Error. The following table lists the indicator states.

Receiver Interface Status Indicators		
LED Indicator	**Color**	**Explanation**
System Status	Green	System is OK
	Red	Marginal Alignment or Hardware Error; check 3-digit display*
Modbus Activity	Yellow ON or Flashing	Activity detected on the modbus communication channel
Modbus Error	Red	Communication Error: Check cabling or modbus master controller

*Display shows "**c**": See Section 4.6.
Display shows only numbers: Low Gain/Marginal Alignment condition. See Section 4.6.

1.5 Control Mode Selection

The control mode determines the method used to control scanning of the light screen array. Choose from two control modes: continuous scan mode and gate mode (which itself has four options). Continuous scan is automatically selected when the receiver interface is used for configuration.

In **Continuous Scan Mode**, the receiver begins a new scan as soon as it updates the outputs from the previous scan. This is the fastest scan control method; it is used in most analog output applications and whenever continuous updating of the outputs is acceptable. It is available via either the receiver interface or the GUI.

Gate Mode can be selected via the GUI only. It uses the receiver Teach (gray) wire to provide a gate input pulse from (typically) a dc device, such as an NPN-output photoelectric sensor or a PLC discrete output. Refer to Section 5 for more information.

Gate mode has four options:

- **Gate ON:** the receiver will scan as long as the gate is active.
- **Gate OFF:** the receiver will scan whenever the gate is not active.
- **Gate rising edge:** the receiver will scan once for each gate transition from falling edge to rising edge.
- **Gate falling edge:** the receiver will scan once for each gate transition from rising edge to falling edge.

1.6 Scanning Method

The receiver may be configured for one of three scanning methods:

- Straight scan
- Single-Edge scan
- Double-Edge scan

Straight Scan is the default mode, in which all beams are scanned in sequence, from the display end to the far end of the array. This scanning method provides the smallest object detection size. Straight scan is used when low-contrast sensitivity is selected or when single-edge and double-edge scan cannot be used. The edge resolution is 5 mm (0.2"). When low-contrast sensing is selected (used when measuring semi-transparent objects), the minimum object detection size is 5 mm (0.2") diameter. When high-excess-gain sensing is selected, the minimum object detection size is 10 mm (0.4"). See Figure 1-5.

Single-Edge Scan is used to measure the height of a single object. A good application for this scanning method is box height measurement. For single-edge scan, the receiver always activates the first beam channel (or “bottom” beam, nearest the display). If the first beam is blocked, the sensor will perform a binary search to hunt for the last beam blocked. Single-edge scan works as follows:

1. The receiver scans only the first beam until that beam is blocked.
2. When the first beam is blocked, the sensor looks to see whether the middle beam is blocked or made (unblocked).
3. If the middle beam is made (unblocked), the sensor checks the bottom quarter beam; if the middle beam is blocked, the sensor checks the top quarter beam. (This is called a binary search; see Figure 1-6.)
4. The routine continues to “narrow the field” until the edge is found.

Scan Mode	Straight Scan		Single-Edge Scan	Double-Edge Scan					
				Step Size (Number of Beams)					
	Low-Contrast	High-Excess-Gain		1	2	4	8	16	32
Minimum Object Detection Size*	5 mm (0.2")	10 mm (0.4")	10 mm (0.4")	10 mm (0.4")	20 mm (0.8")	30 mm (1.2")	50 mm (2")	90 mm (3.6")	170 mm (6.8")
Edge Resolution	5 mm (0.2")	5 mm (0.2")	2.5 mm (0.1")	2.5 mm (0.1")	2.5 mm (0.1")	2.5 mm (0.1")	2.5 mm (0.1")	2.5 mm (0.1")	2.5 mm (0.1")

*MODS determined using a rod target object

Figure 1-5. The effect of scan mode/step size on minimum object detection size and edge resolution

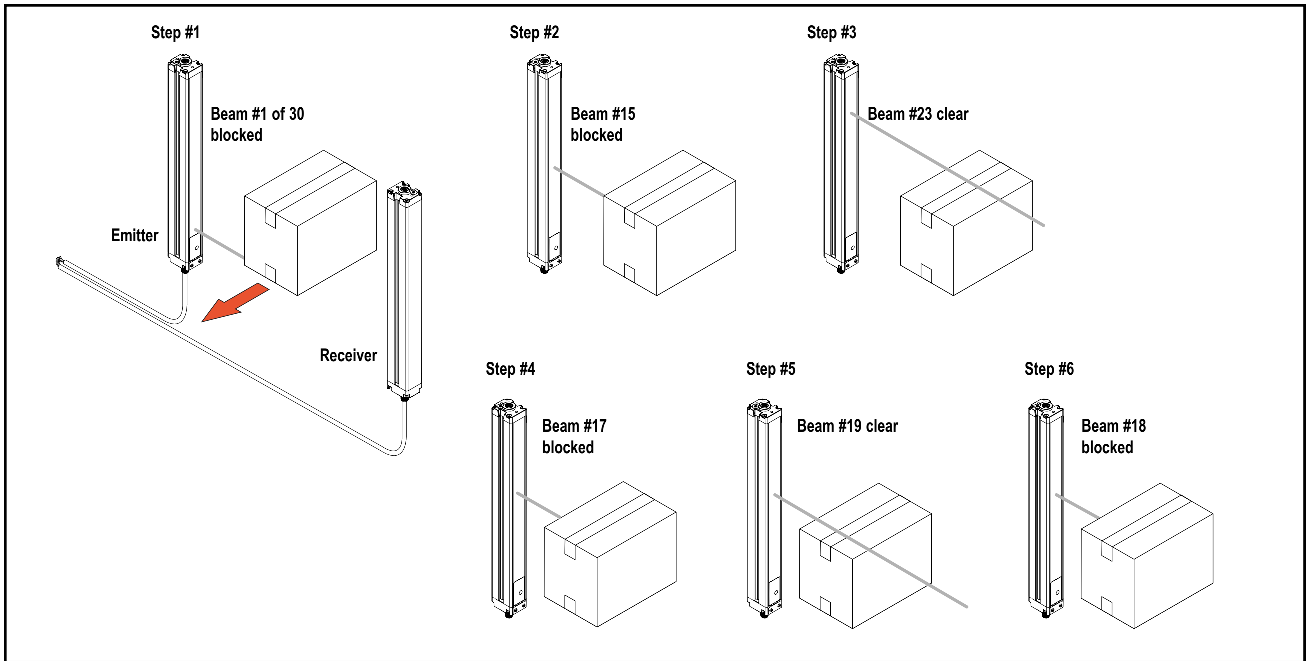


Figure 1-6. Finding an edge using a binary search (single-edge scan)

Maximum Scan Times (in milliseconds)								
Array Length	Straight Scan	Single-Edge Scan	Double-Edge Scan					
			Step 1 Beam	Step 2 Beams	Step 4 Beams	Step 8 Beams	Step 16 Beams	Step 32 Beams
150 mm (5.9")	2.8	1.5	3.4	2.8	2.5	2.4	1.9	N/A
300 mm (11.8")	5.0	1.5	5.9	4.1	3.2	2.8	2.3	2.1
450 mm (17.7")	7.1	1.6	8.5	5.5	4.2	4.0	3.2	2.5
600 mm (23.6")	9.3	1.6	11.0	6.8	4.9	4.2	4.0	2.8
750 mm (29.5")	11.4	1.7	13.5	8.1	5.7	4.6	4.5	4.5
900 mm (35.4")	13.6	1.7	16.0	9.5	6.1	4.7	4.6	4.6
1050 mm (41.3")	15.7	1.8	18.6	10.8	6.8	5.2	4.8	4.8
1200 mm (47.2")	17.9	1.8	21.1	12.2	7.4	5.5	4.9	4.9
1500 mm (59.1")	22.2	1.9	26.1	14.8	9.0	6.4	5.3	4.9
1800 mm (70.9")	26.5	2.0	31.2	17.5	10.5	7.3	6.0	5.6
NOTE: Scan times are exclusive of serial communication transmission times.								

Figure 1-7. Maximum scan times for straight, single-edge and double-edge scanning

Single-edge scan is used for single, solid objects that block the first beam. The receiver always checks the beam closest to the display first, and only if that beam is blocked does the binary search continue. Therefore, single-edge scan will not work in instances where the item to be measured does not block the first beam. Single-edge scan is also ineffective if the object does not present a continuous blocked pattern.

Single-edge scan will work only when the high-excess-gain setting is enabled. When single-edge scan is selected, the sensor object detection size will be 10 mm and edge resolution will be 2.5 mm.

Double-Edge Scan is used to detect two edges of a single object, for example, to determine box width measurements. Double-edge scan requires the selection of a step size: 1, 2, 4, 8, 16 or 32 beams. The sensor uses the steps to “skip” over beams.

Double-edge scan works as follows:

1. The sensor activates beam 1 (the beam closest to the sensor display end).
2. The sensor activates the next beam, determined by the step size. (For example, if the step size is 2, beam 3 is next; if the step size is 8, beam 9 is next.)
3. As long as the activated beam is unblocked (or “made”), the sensor will continue the stepping routine until a blocked beam is found.
4. When a blocked beam is found, a binary search is conducted to find the object’s “bottom edge.”
5. When the bottom edge is found, the sensor begins “stepping” again through the array until the sensor finds the next unblocked beam.
6. A binary search is again performed to find the second edge.

Similar to single-edge scan, double-edge scan has some restrictions: the object should provide a solid obstruction; the size of the object will determine the maximum step size (Figure 1-5). Double-edge scan can be used to detect up to three objects. Like single-edge scan, double-edge scan will work only when the high-excess-gain setting is selected. When double-edge scan is selected, the sensor object detection size will vary depending on the step size, but edge resolution will be 2.5 mm.

Sensor response time is a function of sensor length and scanning method. Maximum scan times are shown in Figure 1-7.

1.7 Gain Setting

The EZ-ARRAY provides two gain options: high excess gain and low contrast. The gain option can be selected using the push button on the receiver interface, the receiver remote teach wire, or the software GUI, and is available for straight scan applications only.

High (maximized) excess gain is best suited for detecting opaque objects and to provide reliable sensing in dirtier environments where objects to be detected are 10 mm or larger.

The low-contrast setting is excellent for sensing semi-transparent materials and for detecting objects as small as 5 mm.

When using the GUI, low-contrast sensing allows a fine-tune sensitivity setting of 15% to 50%. When using the receiver interface, low-contrast sensitivity is always 30%. The push button may be disabled, using the GUI.

1.8 Electronic Alignment Routine

The objective of the optical alignment process is to adjust the emitter light level to maximize sensor performance. Perform the alignment procedure at installation and again whenever the emitter and/or receiver is moved. The procedure can be performed using the receiver interface, the receiver remote wire or the GUI (see Section 4.2 or 5).

During the alignment procedure, the receiver polls each beam channel to measure excess gain and performs a gain adjustment for each beam. When the system exits the alignment procedure, each channel's signal strength is stored in non-volatile memory. The Alignment push button may be disabled, using the GUI.

1.9 Blanking

If a machine fixture or other equipment will block one or more beams, the affected beam channels may be blanked. The blanking option causes the receiver to ignore the status of blanked beams for measurement mode calculations. For example, if a machine fixture blocks one or more beams during sensing, the output data will be incorrect; if the beams blocked by the fixture are *blanked*, the output data will be correct. Blanking may be configured using the receiver's Alignment push button, the receiver remote wire, or the GUI.

1.10 Measurement Mode Selection

The outputs may be configured for any of fourteen measurement (scan analysis) modes, which refer to specific beam locations, quantities of beams, or edge transitions. Note that not all measurement mode options are available when the receiver interface is used for configuration. Selected modes are individually assigned to one output (see Section 4.1 or 5).

When using the GUI for configuration, the discrete outputs can have NPN or PNP polarity, be normally open or normally closed, and be assigned to any of the measurement modes. When using the receiver interface, several combinations of output configurations may be selected (see Section 4.1).

NOTE: The beams in the array are numbered in sequence, with beam 1 located nearest the emitter / receiver displays, so the "first beam," as referenced below, refers to the beam closest to the display.

"Beam Location" Modes

- **First Beam Blocked (FBB):** The location of the first beam blocked.
- **First Beam Made (FBM):** The location of the first beam made (unblocked).
- **Last Beam Blocked (LBB):** The location of the last beam blocked.
- **Last Beam Made (LBM):** The location of the Last Beam Made (unblocked).
- **Middle Beam Blocked (MBB):** The location of the middle beam blocked, midway between the first and last beams blocked.

"Beam Total" Modes

- **Total Beams Blocked (TBB):** The total number of blocked beams.
- **Total Beams Made (TBM):** The number of beams made.
- **Contiguous Beams Blocked (CBB):** The largest number of consecutively blocked beams.
- **Contiguous Beams Made (CBM):** The largest number of consecutively made beams.
- **Transitions (TRN):** The number of changes from blocked to clear and clear to blocked. For instance, if beams 6-34 are blocked, then there is a clear-to-blocked transition from beam 5 to beam 6, and a blocked-to-clear transition from beam 34 to beam 35. Transition mode can be used to count objects within the array.
- **Outside Dimension (OD):** This measurement returns the value of the distance from the first beam blocked to the last beam blocked.

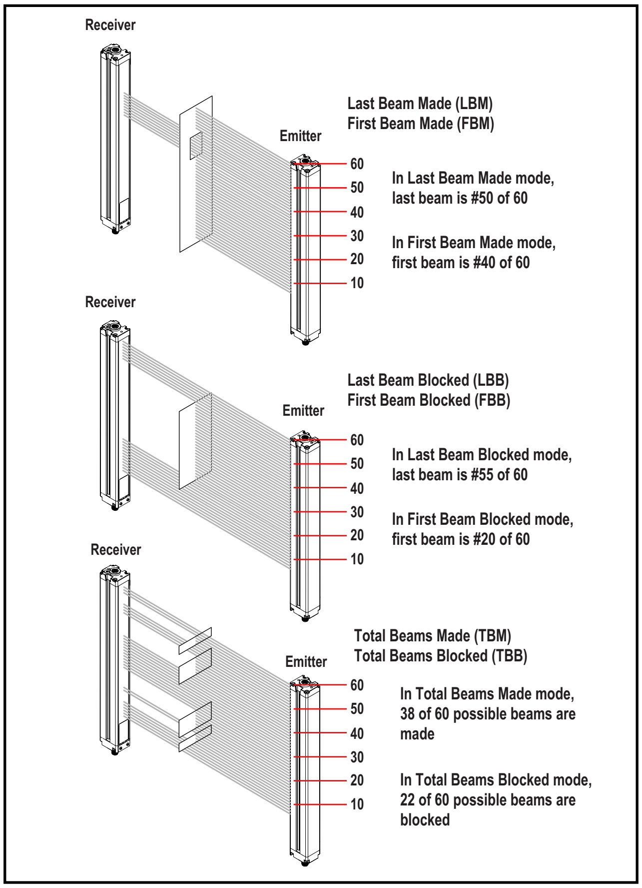


Figure 1-8. Measurement mode examples

- **Inside Dimension (ID):** This measurement returns the value of the beams made between the first beam and last beam blocked.
- **Contiguous First Beam Blocked (CFBB):** This measurement returns the value of the first beam blocked in the largest group of contiguous beams blocked.
- **Contiguous Last Beam Blocked (CLBB):** This measurement returns the value of the last beam blocked in the largest group of contiguous beams blocked.
- **Special 1, Special 2, Nap:** These measurement modes are reserved for future capabilities.

1.11 Analog Output Configuration

Analog output configuration assigns analog outputs 1 and 2 to one of the measurement modes described in Section 1.10. When the selected measurement mode involves first or last beam blocked or made (unblocked), the assigned output will vary in proportion to the beam number identified during a scan. When the measurement mode involves total beams blocked or made, that assigned output will vary in proportion to the total beams counted during a scan.

Analog outputs may have Null and Span values set in the GUI, in addition to a filter setting (to smooth the output) and Zero Value (to specify the output value when the measurement mode value is zero). See Section 5 for more information.

1.12 Discrete Output Configuration

Discrete Output 1; Receiver Interface

When the receiver interface is used for configuration, the measurement mode assigned to discrete output 1 is the same as that assigned to analog output 1. Whenever the analog output detects a target present, discrete output 1 conducts (normally open).

Discrete Output 2; Receiver Interface

Discrete output 2 (only) has two options: alarm and complementary (measurement) operation.

Alarm: Output 2 energizes whenever the receiver detects a sensor error (such as a disconnected cable) or whenever the excess gain of one or more beams becomes marginal.

Complementary (Measurement): Discrete output 2 operation is complementary to discrete output 1 (when output 1 is ON, output 2 is OFF, and vice versa).

Discrete Output Configuration; Software Interface

When the software interface is used for configuration, the discrete outputs have other options: either discrete output can be assigned to any of the measurement modes, high and low set points can be added, the outputs can be inverted, and hysteresis values can be set, as well as a scan number to smooth output performance. Discrete output 2 can be assigned to alarm mode via the GUI also. See Section 5 and the Appendix of the full manual for more information.

1.13 Serial Communication

The receiver communicates with a process controller via a modbus RTU-485 interface and at the baud rate specified in the Serial Communications box of the GUI. A number of data transmission options are available, including what data will be sent, and when. See Section 5 and the Appendix of the full manual for more information.

2. Components and Specifications

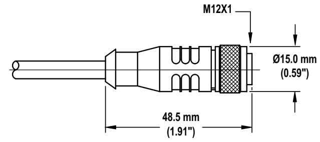
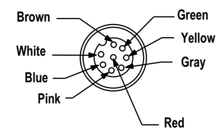
2.1 Sensor Models

Emitter/Receiver Model NPN Outputs	Emitter/Receiver Model PNP Outputs	Analog Output	Array Length Y*	Total Beams
EA5E150Q Emitter **EA5R150NIXMODQ** Receiver **EA5R150NUXMODQ** Receiver	**EA5E150Q** Emitter **EA5R150PIXMODQ** Receiver **EA5R150PUXMODQ** Receiver	– Current (4-20 mA) Voltage (0-10V)	150 mm (5.9")	30
EA5E300Q Emitter **EA5R300NIXMODQ** Receiver **EA5R300NUXMODQ** Receiver	**EA5E300Q** Emitter **EA5R300PIXMODQ** Receiver **EA5R300PUXMODQ** Receiver	– Current (4-20 mA) Voltage (0-10V)	300 mm (11.8")	60
EA5E450Q Emitter **EA5R450NIXMODQ** Receiver **EA5R450NUXMODQ** Receiver	**EA5E450Q** Emitter **EA5R450PIXMODQ** Receiver **EA5R450PUXMODQ** Receiver	– Current (4-20 mA) Voltage (0-10V)	450 mm (17.7")	90
EA5E600Q Emitter **EA5R600NIXMODQ** Receiver **EA5R600NUXMODQ** Receiver	**EA5E600Q** Emitter **EA5R600PIXMODQ** Receiver **EA5R600PUXMODQ** Receiver	– Current (4-20 mA) Voltage (0-10V)	600 mm (23.6")	120
EA5E750Q Emitter **EA5R750NIXMODQ** Receiver **EA5R750NUXMODQ** Receiver	**EA5E750Q** Emitter **EA5R750PIXMODQ** Receiver **EA5R750PUXMODQ** Receiver	– Current (4-20 mA) Voltage (0-10V)	750 mm (29.5")	150
EA5E900Q Emitter **EA5R900NIXMODQ** Receiver **EA5R900NUXMODQ** Receiver	**EA5E900Q** Emitter **EA5R900PIXMODQ** Receiver **EA5R900PUXMODQ** Receiver	– Current (4-20 mA) Voltage (0-10V)	900 mm (35.4")	180
EA5E1050Q Emitter **EA5R1050NIXMODQ** Receiver **EA5R1050NUXMODQ** Receiver	**EA5E1050Q** Emitter **EA5R1050PIXMODQ** Receiver **EA5R1050PUXMODQ** Receiver	– Current (4-20 mA) Voltage (0-10V)	1050 mm (41.3")*	210
EA5E1200Q Emitter **EA5R1200NIXMODQ** Receiver **EA5R1200NUXMODQ** Receiver	**EA5E1200Q** Emitter **EA5R1200PIXMODQ** Receiver **EA5R1200PUXMODQ** Receiver	– Current (4-20 mA) Voltage (0-10V)	1200 mm (47.2")*	240
EA5E1500Q Emitter **EA5R1500NIXMODQ** Receiver **EA5R1500NUXMODQ** Receiver	**EA5E1500Q** Emitter **EA5R1500PIXMODQ** Receiver **EA5R1500PUXMODQ** Receiver	– Current (4-20 mA) Voltage (0-10V)	1500 mm (59.1")*	300
EA5E1800Q Emitter **EA5R1800NIXMODQ** Receiver **EA5R1800NUXMODQ** Receiver	**EA5E1800Q** Emitter **EA5R1800PIXMODQ** Receiver **EA5R1800PUXMODQ** Receiver	– Current (4-20 mA) Voltage (0-10V)	1800 mm (70.9")*	360

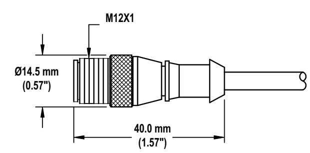
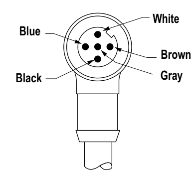
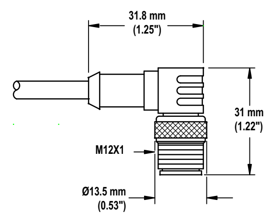
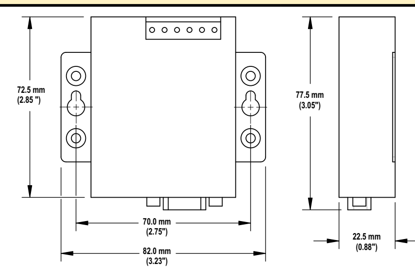
* Models with array lengths 1050 mm and longer ship with a center bracket as well as two end-cap brackets.

2.2 Cables and Connections

Quick-Disconnect Sensor Cables

Model	Description			Pinout
MAQDC-815	Straight female connector, 8-pin Euro-style	5 m (15') long		Female Connector Shown 
MAQDC-830		9 m (30') long		
MAQDC-850		15 m (50') long		

Communication Cables and Adapter

Model	Description			Pinout
Communication Cables				
MQDMC-506	Straight male connector, 5-pin Euro-style	2 m (6.5') long		Male Connector Shown 
MQDMC-515		5 m (15') long		
MQDMC-530		9 m (30') long		
MQDMC-506RA	Right-angle male connector, 5-pin Euro-style	2 m (6.5') long		
MQDMC-515RA		5 m (15') long		
MQDMC-530RA		9 m (30') long		
USB Serial Adapter			**Dimensions**	
INTUSB485-1	For connection of 5-pin communications cable to computer USB port			

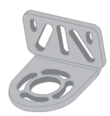
2.3 Alignment Aids

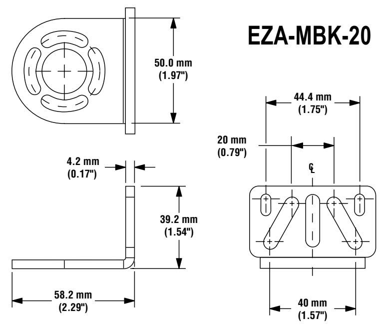
Model	Description
LAT-1-SS	Self-contained visible-beam laser tool for aligning any EZ-ARRAY emitter/receiver pair. Includes retroreflective target material and mounting clip.
EZA-LAT-SS	Replacement adaptor (clip) hardware for EZ-ARRAY models
EZA-LAT-2	Clip-on retroreflective LAT target
BRT-THG-2-100	2" retroreflective tape, 100'
BT-1	Beam Tracker

LAT-1-SS

2.4 Accessory Mounting Brackets and Stands

See Section 2.5 for standard brackets. Order one EZA-MBK-20 bracket per sensor, two per pair.

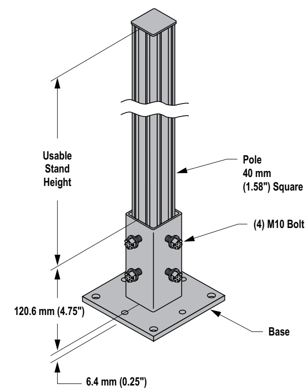
Model		Description
EZA-MBK-20		Universal adaptor bracket for mounting to engineered / slotted aluminum framing (e.g., 80/20™, Unistrut™).



MSA Series Stands (Base Included)*

Stand Model	Useable Stand Height	Overall Stand Height
MSA-S24-1	483 mm (19")	610 mm (24")
MSA-S42-1	940 mm (37")	1067 mm (42")
MSA-S66-1	1549 mm (61")	1676 mm (66")
MSA-S84-1	2007 mm (79")	2134 mm (84")

*Available without a base by adding suffix "**NB**" to the model number, e.g., **MSA-S24-1NB**.



NOTE: Standard brackets shipped with sensors connect directly to MSA series stands, using hardware included with the stands.

2.5 Replacement Parts

Description		Model
Access cover with label – receiver		**EA5-ADR-1**
Access cover security plate (includes 2 screws, wrench)		**EZA-TP-1**
Wrench, security		**EZA-HK-1**
Standard bracket kit with hardware (includes 2 end brackets and hardware to mount to MSA Series stands)	Black	**EZA-MBK-11**
	Stainless Steel	**EZA-MBK-11N**
Center bracket kit (includes 1 bracket and hardware to mount to MSA Series stands)		**EZA-MBK-12**

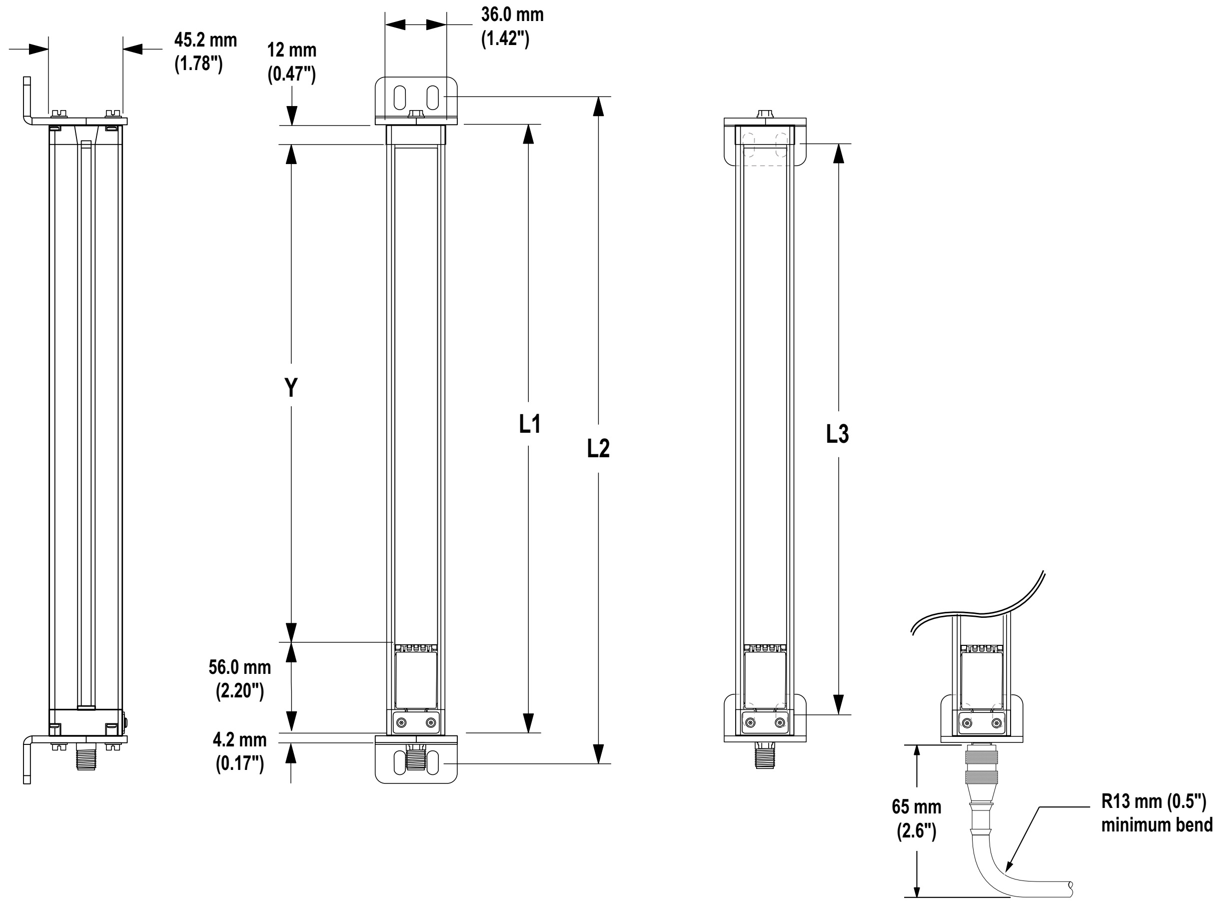
2.6 Specifications

Emitter/Receiver Range	400 mm to 4 m (16" to 13')
Field of View	Nominally ± 3°
Beam Spacing	5 mm (0.2")
Light Source	Infrared LED
Minimum Object Detection Size	**Straight Scan, Low-Contrast:** 5 mm (0.2") **Straight Scan, High-Excess-Gain:** 10 mm (0.4") See Figure 1-5 for other scan mode values; size is tested using a rod.
Sensor Positional Resolution	**Straight Scan:** 5 mm (0.2") **Double-Edge Scan:** 2.5 mm (0.1") **Single-Edge Scan:** 2.5 mm (0.1")

2.6 Specifications, continued

Supply Voltage (Limit Values)	**Emitter:** 12 to 30V dc **Receiver Analog Current Models:** 12 to 30V dc **Receiver Analog Voltage Models**: 15 to 30V dc
Supply Power Requirements	Emitter/Receiver Pair (Exclusive of Discrete Load): Less than 9 watts **Power-up delay**: 2 seconds
Teach Input (Receiver Gray Wire)	**Low:** 0 to 2 volts **High:** 6 to 30 volts or open (input impedance 22 K ohms)
Two Discrete Outputs	Solid-State NPN or PNP (current sinking or sourcing) **Rating:** 100 mA maximum each output **OFF-State Leakage Current:** NPN: less than 200 uA @ 30V dc PNP: less than 10 uA @ 30V dc **ON-State Saturation Voltage:** NPN: less than 1.6V @ 100 mA PNP: less than 2.0V @ 100 mA Protected against false pulse on power-up and continuous overload or short circuit.
Two Analog Outputs	**Voltage Sourcing:** 0 to 10V (maximum current load of 5 mA) **Current Sourcing:** 4 to 20 mA (maximum resistance load = $(V_{supply}–3)/0.020$)
Serial Communication Interface	EIA-485 Modbus RTU (up to 15 nodes per communication ring) RTU binary format **Baud Rate:** 9600, 19.2K or 38.4K 8 Data Bits, 1 Stop Bit, and Even, Odd, or 2 Stop Bits and No Parity
Scan Time	Scan times depend on scan mode and sensor length. Straight scan times range from 2.8 to 26.5 milliseconds. See Figure 1-7 for all combinations.
Status Indicators	**Emitter:** Red Status LED ON Red — Status OK Flashing at 1 hz — Error **Receiver:** 7 Zone Indicators Red — Blocked channels within zone Green — All channels clear within zone 3-digit 7-segment indicators for measurement mode / diagnostic information (see Section 1.4) Sensor Status Bi-Color Indicator LED Red — Hardware Error or Marginal Alignment (see Section 1.4) Green — OK Modbus Activity Indicator LED: Yellow Modbus Error Indicator LED: Red
System Configuration (Receiver Interface)	6-position DIP switch: Used to set scanning type, measurement modes, analog slope, and discrete output 2 function (see Section 4.1). Alternate software GUI interface provides additional options; see Section 1 and Section 5 of the full manual (p/n 130426).
Push Buttons (Receiver Interface)	Two momentary push buttons for alignment and gain level selection.
Connections	**Serial communication:** The receiver uses a PVC-jacketed, 5-conductor 22-gauge quick-disconnect cable, 5.4 mm diameter. **Other Sensor connections:** 8-conductor quick-disconnect cables (one each for emitter and receiver), ordered separately; see Section 2.2 for available lengths (may not exceed 75 meters long), PVC-jacketed cables measure 5.8 mm diameter, have shield wire; 22-gauge conductors.
Construction	Aluminum housing with clear-anodized finish; acrylic lens cover
Environmental Rating	IEC IP65
Operating Conditions	**Temperature:** –40° to +70° C (–40° to 122° F) **Maximum relative humidity:** 95% at 50° C (non-condensing)

2.7 Emitter and Receiver Dimensions

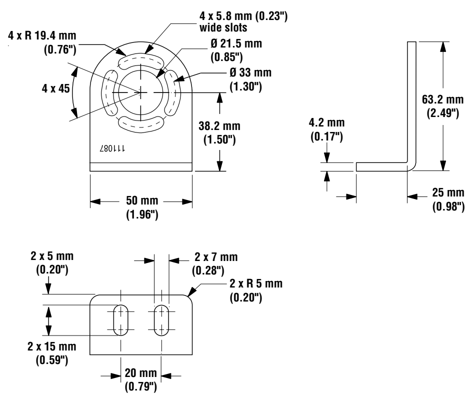


Emitter or Receiver Model	Housing Length L1	Distance Between Bracket Holes L2	L3	Defined Area† Y
EA5..150..	227 mm (8.9")	260 mm (10.2")	199 mm (7.8")	150 mm (5.9")
EA5..300..	379 mm (14.9")	412 mm (16.2")	351 mm (13.8")	300 mm (11.8")
EA5..450..	529 mm (20.8")	562 mm (22.1")	501 mm (19.7")	450 mm (17.7")
EA5..600..	678 mm (26.7")	704 mm (27.7")	650 mm (25.6")	600 mm (23.6")
EA5..750..	828 mm (32.6")	861 mm (33.9")	800 mm (31.5")	750 mm (29.5")
EA5..900..	978 mm (38.5")	1011 mm (39.8")	950 mm (37.4")	900 mm (35.4")
EA5..1050..	1128 mm (44.4")	1161 mm (45.7")	1100 mm (43.3")	1050 mm (41.3")
EA5..1200..	1278 mm (50.3")	1311 mm (51.6")	1250 mm (49.2")	1200 mm (47.2")
EA5..1500..	1578 mm (62.1")	1611 mm (63.4")	1550 mm (61.0")	1500 mm (59.1")
EA5..1800..	1878 mm (73.9")	1911 mm (75.2")	1850 mm (72.8")	1800 mm (70.9")

†Nominal measurement

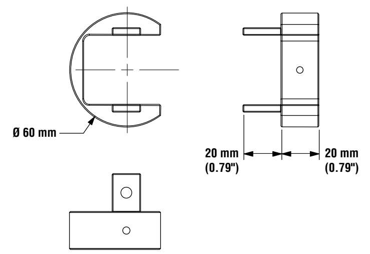
2.8 Standard Bracket Dimensions

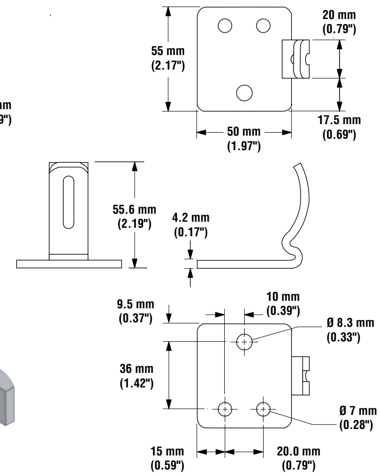
End Cap Brackets
(model EZA-MBK-11*)



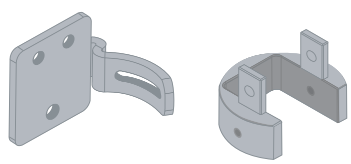
*Dimensions are identical for model EZA-MBK-11N stainless steel brackets.

Center Bracket
(model EZA-MBK-12**)





** Supplied with emitters and receivers over 1050 mm.



3. Installation and Alignment

3.1 Mounting the Emitter and Receiver

EZ-ARRAY emitters and receivers are compact and easy to handle during mounting. When mounted to the sensor end caps, the supplied mounting brackets allow ±30° rotation. Emitter/receiver pairs may be spaced from 400 mm to 4 m (16" to 13') apart.

From a common point of reference, make measurements to locate the emitter and receiver in the same plane, with their midpoints and display ends directly opposite each other. (If sensors are mounted with their display ends at the top, see Section 4.4 for directions on inverting the 3-digit display.) Mount the brackets to the emitter and receiver housings using the supplied M6 bolts and Keps nuts, or user-supplied hardware; see Figure 3-1.

Center mounting brackets must be used with longer sensors, if they are subject to shock or vibration. In such situations, the sensors are designed to be mounted with up to 900 mm unsupported distance (between brackets). Sensors 1050 mm and longer are supplied with a center bracket to be used as needed with the standard end-cap brackets.

1. Attach the center bracket to the mounting surface when mounting the end-cap brackets.
2 Attach the clamp to both slots of the housing, using the included M5 screws and T-nuts.
3. After the sensor is mounted to the end-cap brackets, attach the clamp to the center bracket using the supplied M5 screw.

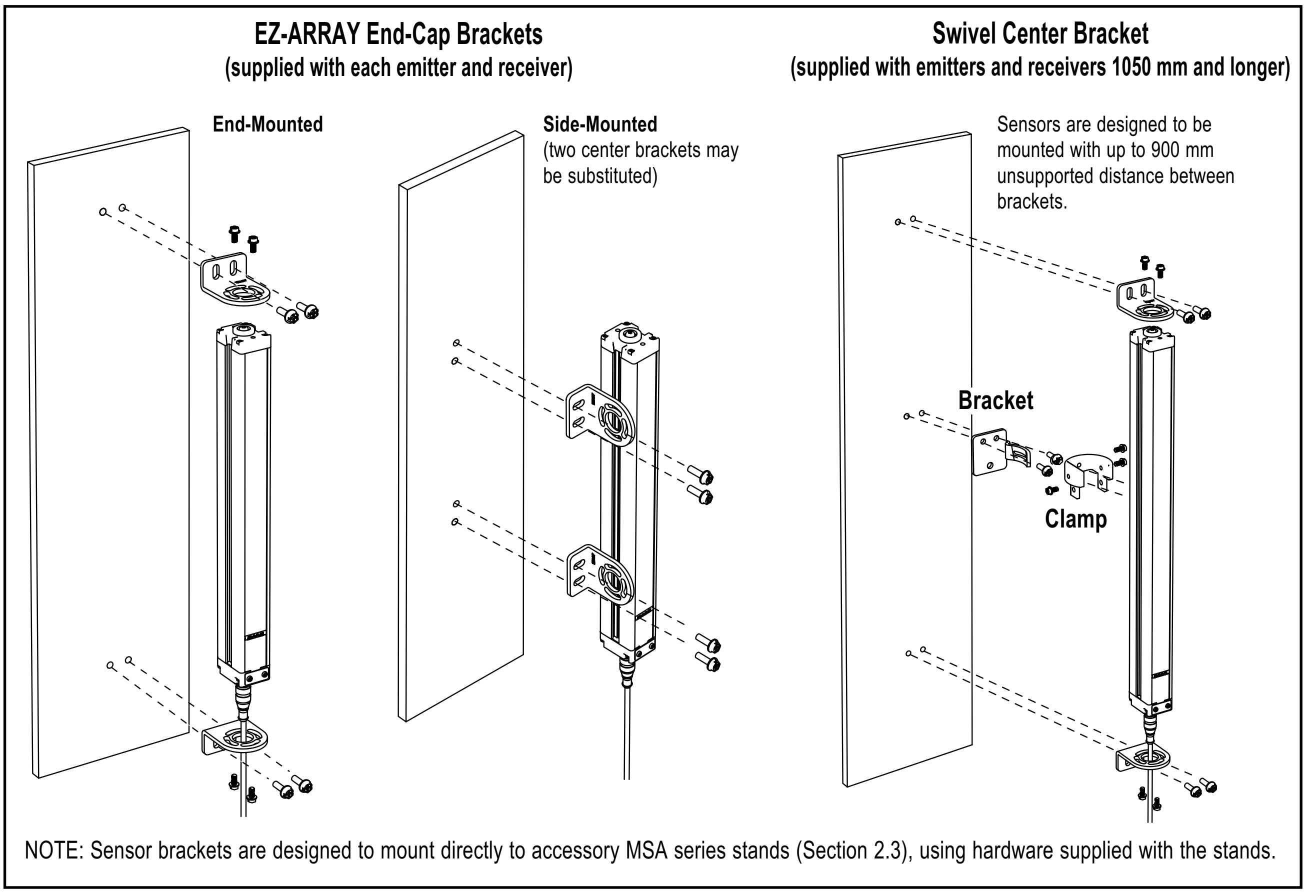


Figure 3-1. A-GAGE EZ-ARRAY emitter and receiver mounting hardware

3.2 Mechanical Alignment

Mount the emitter and receiver in their brackets and position the windows of the two units directly facing each other. Measure from one or more reference planes (e.g., the building floor) to the same point(s) on the emitter and receiver to verify their mechanical alignment. Use a carpenter's level, a plumb bob, or the optional LAT-1-SS Laser Alignment Tool, or check the diagonal distances between the sensors, to achieve mechanical alignment.

When alignment is difficult, a LAT-1-SS tool is useful to assist or confirm alignment, by providing a visible red dot along the sensor's optical axis (see Figure 3-3). Snap the LAT-1 clip onto the sensor housing, turn on its laser emitter and use a strip of retroreflective tape at the opposite sensor to see the dot.

Also check "by eye" for line-of-sight alignment. Make any necessary final mechanical adjustments, and hand-tighten the bracket hardware. See Sections 3.4 and 4.2 for further alignment information.

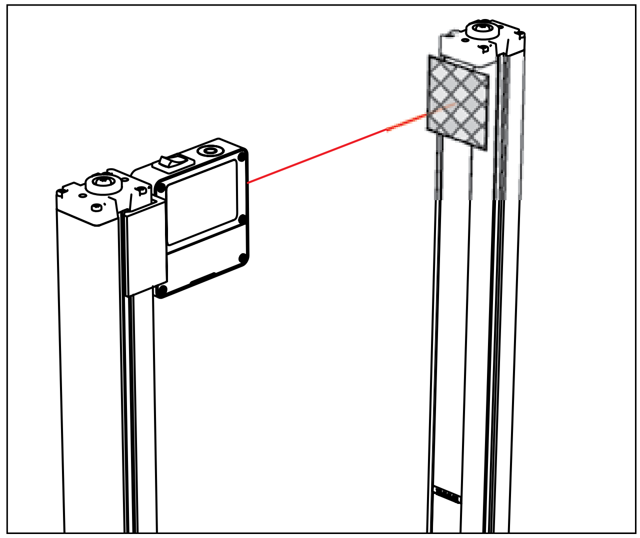
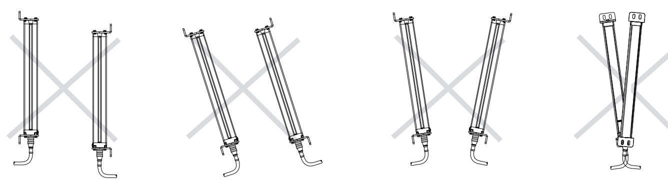
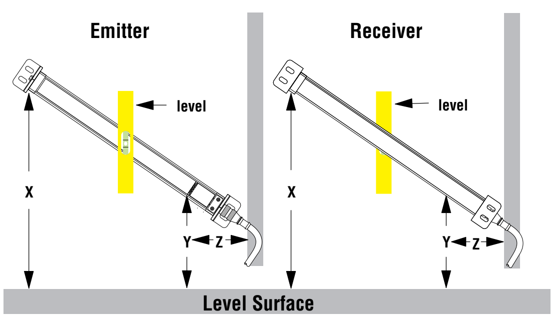


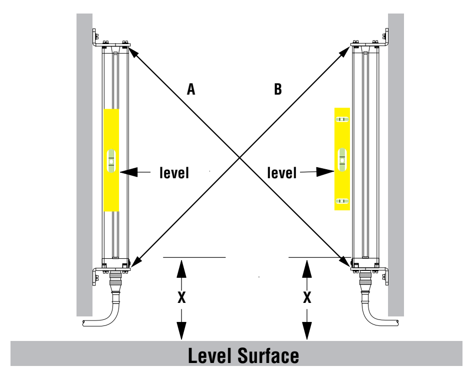
Figure 3-3. Optical alignment using the LAT-1-SS

Verify that:
- The emitter and receiver are directly opposite each other, and nothing is interrupting the beams.
- The sensing area is the same distance from a common reference plane for each sensor.
- The emitter and receiver are in the same plane and are **level/plumb and square to each other** (vertical, horizontal, or inclined at the same angle, and not tilted front-to-back or side-to-side).





Angled or Horizontal Installations – verify that:
- Distance X at the emitter and receiver are equal.
- Distance Y at the emitter and receiver are equal.
- Distance Z at the emitter and receiver are equal from parallel surfaces.
- Vertical face (i.e., the lens) is level/plumb.
- Sensing area is square. Check diagonal measurements if possible; see Vertical Installations, at right.



Vertical Installations – verify that:
- Distance X at the emitter and receiver are equal.
- Both sensors are level/plumb (check both the side and face).
- Sensing area is square. Verify diagonal measurements if possible (Diagonal A = Diagonal B).

Figure 3-2. Sensor mounting, mechanical alignment

3.3 Hookups

Refer to Figures 3-4, 3-5 and 3-6 for the appropriate hookup information.

3.3.1 Serial Connection

This connection is used only when the GUI is also used. The receiver has a Modbus RTU-485 serial interface. A separate 5-pin Euro-style connection is provided at the opposite end of the power cable connection, to electrically connect the serial communication cable to an external PC or PLC. Refer to Figure 3-4; the white wire is connected to the Modbus D1/B/+ terminal and the black wire is connected to the D0/A/— terminal.

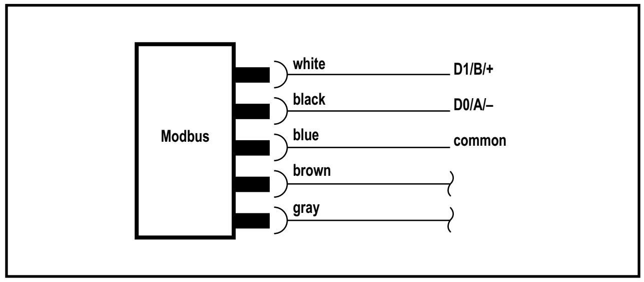


Figure 3-4. Serial communication hookup

3.3.2 Inputs

Refer to Figures 3-5 and 3-6 for standard hookup information.

Receiver gray wire: The receiver has an input that can be used as a gate input or for remote teach. To initiate remote teach functions, tie the wire through a switch to sensor common. To initiate sensor scans (gate input) using this wire, see Section 5 of the full manual for more information.

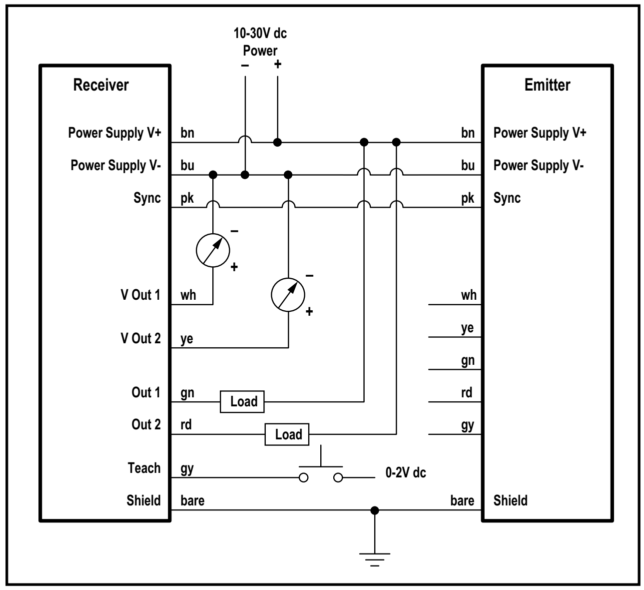


Figure 3-5. NPN hookup

3.3.3 Outputs

Refer to Figures 3-5 and 3-6 for standard hookup information and Section 2.6 Sensor Specifications for further electrical requirements.

Analog white and yellow wires: The receiver has two analog outputs. Depending on receiver model, both outputs are either voltage or current. The white wire is referenced as analog output 1; the yellow wire is referenced as analog output 2. Both analog current and voltage will source current through an external load to sensor common.

Discrete Outputs

The receiver has two discrete outputs; the green wire referenced as discrete #1, and the red wire, discrete #2. Depending on model, both outputs are either NPN or PNP. Refer to Section 2.6 Specifications for further electrical requirements.

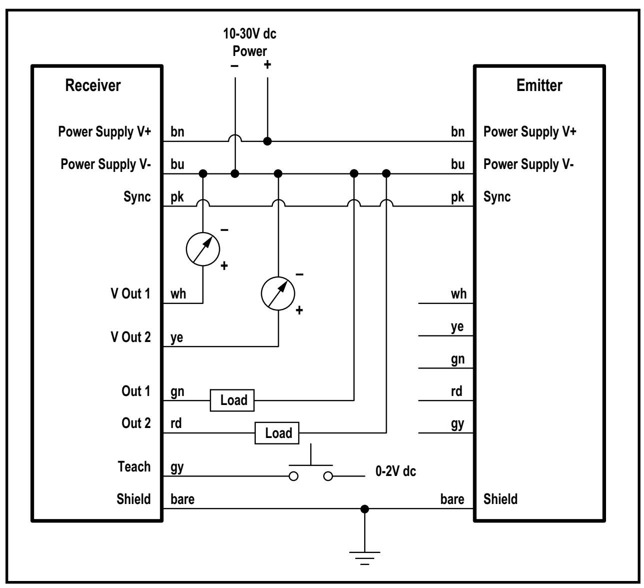


Figure 3-6. PNP hookup

3.3.4 Synch (Pink) Wire

The emitter and receiver are electrically synchronized via the pink wire. The emitter and receiver pink wires must only be electrically connected together.

3.4 Optical Alignment

After the electrical connections are made, power up the emitter and receiver. Verify that input power is present to both emitter and receiver; the emitter Status indicator and the receiver Status LED should be ON green. If the receiver Status LED is on red (and a "**c**" appears on the 3-digit display), refer to Section 4.6.

NOTE: At power-up, all Zone indicators are tested (flash red), then the number of blocked beams is displayed.

Observe the receiver indicators.

Possible Indicator Combinations

The 3-digit display shows the number of blocked beams

Zone indicator(s) red: beams in that zone blocked (not blanked)

Zone indicator(s) green: all beams in that zone made or blanked

- **Aligned and Clear (Run) condition** – the receiver Status indicator and Zone indicators all ON green. The 3-digit display reads 0.
- **Partial Alignment** – the receiver Status indicator remains ON green. Some Zone indicators are red to designate areas where the beams are not made (are out of alignment or blocked). The 3-digit display reads the number of blocked/mis-aligned beams.
- **Out of Alignment** – the receiver Status indicator remains ON green. All Zone indicators are red, to designate that some beams are blocked in each zone. The 3-digit display reads the total number of beams in the array.

Optimize Alignment and Maximize Excess Gain

Verify that the emitter and receiver are pointed squarely at each other. A straightedge (e.g., a level) can determine the direction the sensor is facing (see Figure 3-7).

Slightly loosen the sensor mounting screws and rotate one sensor to the left and right, noting the positions where the receiver Zone indicators turn from green to red; repeat with the other sensor. Center each sensor between the noted positions and tighten the end cap mounting screws, making sure to maintain the positioning. The sensor windows should directly face each other.

Once optimum optical alignment is verified, proceed to configuration, via the receiver interface, the remote teach wire or the GUI (Section 4.2 or 5 of the full manual) and complete the electronic alignment. This further alignment step adjusts the emitted light level of each beam for the application, to complete the alignment process.

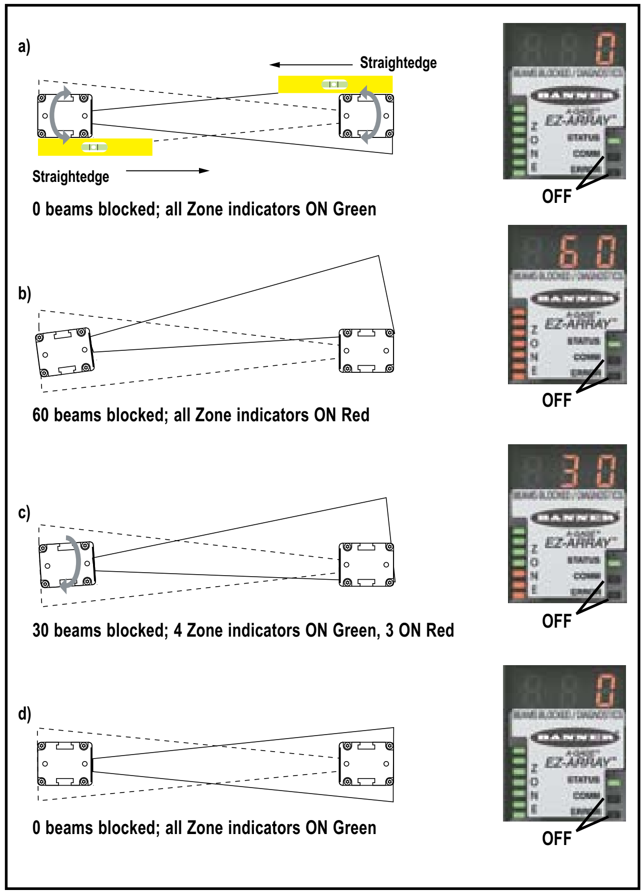


Figure 3-7. Optimizing optical alignment; 300 mm model shown

4. Using the Receiver User Interface

The receiver user interface comprises the six-position DIP switch, two push buttons, 3-digit display, and other indicators present on the receiver (see Section 1.4 for more complete status indicator information). The receiver interface enables configuration of standardized combinations of the EZ-ARRAY sensing options (output configuration, scanning methods and modes); for more advanced setup, refer to Section 5 for GUI software configuration instructions.

4.1 Configuration DIP Switch

The DIP switch can be used to configure the sensor. Access the switch by removing the screw-on security plate and lifting the clear hinged access cover. The access cover may be removed entirely (pull straight out to remove, press back in to replace) for easier access during configuration.

Some of the switches are assigned their own functions, others work together in combination (see table). Switches S1 and S2 in combination select one of four scanning modes. Switches S3 and S4 in combination select one of four measurement mode pairs (one for each analog output). Switch S5 defines the analog slope setting for both analog outputs and S6 defines whether discrete output 2 is complementary to discrete 1, or functions as an alarm (when configuration is accomplished via DIP switch, discrete output 1 conducts when analog output 1 senses the presence of a target).

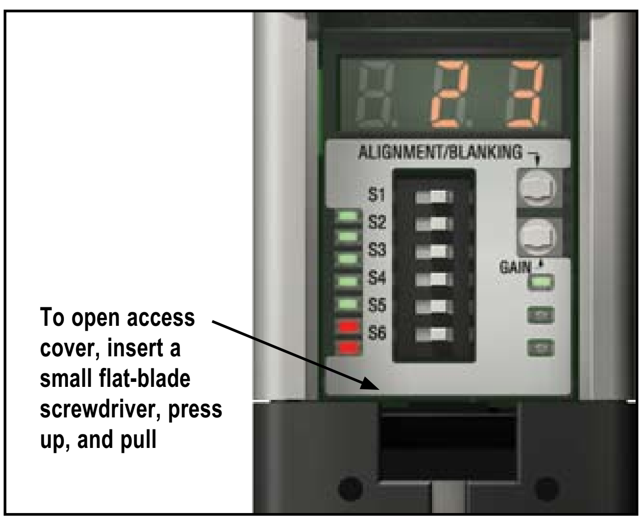


Figure 4-1. Receiver user interface. NOTE: All DIP switch positions are shown in the ON condition.

EZ-ARRAY Receiver User Interface DIP Switch Settings

Switch Settings		Result	
S1	**S2**	**Scan Mode**	
ON	ON	Straight Scan	
ON	OFF	Double-Edge, Step 1	
OFF	ON	Double-Edge, Step 4	
OFF	OFF	Single-Edge	
S3	**S4**	**Analog 1** (Value reads on 3-digit display)	**Analog 2**
ON	ON	TBB	FBB
ON	OFF	LBB	MBB
OFF	ON	OD	ID
OFF	OFF	CBB	CFBB
S5 ON		Positive Analog Slope	
S5 OFF		Negative Analog Slope	
S6 ON		Discrete 2 Complementary	
S6 OFF		Discrete 2 Alarm	

Scanning Modes (S1 and S2)

Straight Scan (S1 ON, S2 ON) is the most versatile scanning mode and can be used without the exceptions noted in the other scanning modes. Use this scanning mode when measuring semi-transparent materials and using the low-contrast sensitivity setting.

Double-Edge Step 1 (S1 ON, S2 OFF) can be used when three or fewer opaque objects are presented to the light curtain at one time. The advantage of this mode is improved sensor edge resolution (2.5 mm). The minimum object detection size is 10 mm.

Double-Edge Step 4 (S1 OFF, S2 ON) can be used when three or fewer opaque objects are presented to the light curtain and the minimum size object to be detected is 30 mm. This scanning mode ignores objects smaller than 30 mm. Like Double-Edge Step 1, the sensor edge resolution is 2.5 mm. See Figure 1-7 for sensor scan times.

Single-Edge Scan (S1 OFF, S2 OFF) can be used when a single opaque object is presented to the light curtain at one time. The object must block the “bottom” channel (the channel closest to the receiver display). Like the double-edge scans, the sensor edge resolution is 2.5 mm. The minimum object detection size is 10 mm. See Figure 1-7 for sensor scan times.

Because single-edge scan is capable only of measuring the height of an opaque object that blocks the bottom channel and all channels up to the height of the object, the pertinent measurement modes are LBB (last beam blocked) or TBB (total beams blocked). When single-edge scan is selected, the selected measurement mode will be applied to both analog outputs. Selection of OD/ID with single-edge scan will result in an error code.

Measurement Modes (S3 and S4)
The measurement modes, determined by switches S3 and S4 in combination, define what information is calculated by the sensor and sent via the analog outputs**. See Section 1.10 for measurement mode definitions**. Discrete output 1 will conduct when analog output 1 detects a target. (If single-edge scan is selected, select measurement mode LBB or TBB.)

During normal operation, the 3-Digit Diagnostic display reads out the numerical value of the specified measuring mode for analog output 1.

Analog Slope (S5)
Switch S5 defines the analog output slope. As the measurement mode values increase, the analog output voltage can either increase (positive slope, S5 ON) or decrease (negative slope, S5 OFF). Switch S5 applies the same slope to both analog outputs.

Complementary/Alarm (S6)
Switch S6 defines the operation of discrete output 2. When the receiver user interface is used, discrete output 1 is active whenever an object is detected by the sensor (normally open operation). In complementary mode (S6 ON), output 2 will always be in the opposite state of output 1. In alarm mode (S6 OFF), discrete output 2 will be active when the sensor detects a system fault. System faults include a failed emitter, mis-wiring of the emitter/receiver communication wire (the pink wire), and low excess gain (if the sensor is configured for high-contrast sensitivity).

4.2 Alignment/Blanking Button (Electronic Alignment)

The Alignment/Blanking push button is used both to maximize the alignment and to access the blanking feature. The electronic alignment routine adjusts the emitted light level to maximize sensor performance. Perform the procedure at installation and again whenever the emitter and/or receiver is moved. For GUI software alignment instructions, see Section 5.

Blanking is used to maintain sensing accuracy in applications where a fixed object (for instance a permanently mounted bracket) will block one or more beams. The sensor will ignore the blanked channels when calculating outputs from the selected measurement modes.

Push-Button Electronic Alignment and Blanking Routine
To initiate the electronic alignment procedure, use a small screwdriver to press the Alignment/Blanking button for two or more seconds. The left-hand digit of the 3-digit display will read "**A**" (representing alignment); the right two digits will show the number of beams blocked. The receiver is learning the clear condition. Rotate the sensors as required (but do not change the distance between them). When the receiver's 3-digit display shows 0 beams blocked, the sensors are adequately aligned. Press the Alignment/Blanking button again for two seconds to exit alignment mode. If all sensor light channels are clear, the EZ-ARRAY stores each channel's signal strength in non-volatile memory and reads " **- - -** " on the 3-digit display. Re-alignment is not required again, unless the emitter or receiver is moved.

If any beams are blocked during run mode, they can be blanked while the sensor is in alignment mode for more accurate measurement. If they are blocked during alignment mode, the blocked beams must be either blanked or cleared for alignment to proceed (see below). While the "**A**" is visible on the receiver display, momentarily (about 0.5 seconds max.) press the Alignment/Blanking button again. The "**A**" will change to "**n**" to indicate the sensor is ready to "learn" the blanking pattern; momentarily press the button again to exit the blanking routine. The sensor blanks the blocked beams and the display changes to "**A.**"; the period following the lefthand digit signifies blanking is active. Press the Alignment/Blanking button for two seconds to exit alignment mode. The EZ-ARRAY stores each channel's signal strength in non-volatile memory and reads " **-. - -** " on the 3-digit display to denote blanking is in use.

Flashing "000" on the 3-Digit Display
When returning to run mode, the receiver determines whether any unblanked beam channels are obstructed. If any channels are obstructed, the new alignment settings are not saved; the receiver flashes zeroes on the display three times and sensing will continue, using the previously set alignment settings. If this occurs, either clear the blocked beams and repeat the alignment routine or repeat the alignment routine and blank the blocked beams.

4.3 Gain (Sensitivity Adjust) Button

The sensor has two sensitivity levels: high excess gain and low contrast, selected by use of the Gain push button. The high-excess-gain setting is commonly used when opaque objects are sensed. The low-contrast setting is commonly used when semi-transparent objects are sensed.

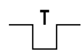
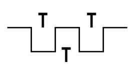
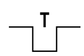
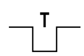
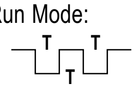
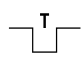
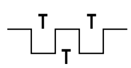
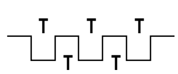
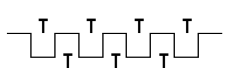
To change the sensitivity level, press and hold the button for two seconds. The left-hand digit of the 3-digit display will read "L"; the right-hand digit will read "**1**" (high excess-gain) or "**2**" (low-contrast. The sensitivity level can then be toggled between the values 1 and 2. When the desired sensitivity level is displayed, hold the Gain push button for 2 seconds and the sensor will return to run mode.

4.4 Inverting the 3-Digit Display

For instances where the sensors must be mounted in an inverted position, the 3-digit display can be can be inverted for readability. See the remote teach process below (Section 4.5). The 3-digit display can then be switched back to “normal” by repeating the process.

4.5 Remote Teach (Receiver Gray Wire)

Alignment, blanking, sensitivity, invert display and DIP switch enable/disable can be set remotely. To access this feature, connect a normally open switch between the receiver’s gray wire and dc common, or connect the gray wire to a digital input (PLC) and pulse the wire as indicated below.

		Remote Wire Procedure 0.05 sec. ≤ T ≤ 0.8 sec.	**Result**
Alignment/Blanking	**Access Alignment Mode**		“**A**” appears on 3-digit display
	Access Blanking Mode	From Alignment Mode: 	“**n**” appears on 3-digit display, along with number of blocked beams
	Exit Blanking Mode		“**A.**” appears on 3-digit display (sensor returns to alignment mode with blanking enabled)
	Exit Alignment Mode		Sensor returns to run mode
Gain Method	**Access Gain Mode**	From Run Mode: 	“**L**” appears on 3-digit display, along with number “**1**” or “**2**”, to designate gain level
	Toggle Between Gain Levels		Number changes from number “**1**” to “**2**”, back to “**1**”, etc.
	Save Gain Level and Exit	When correct level is displayed: 	Gain level is configured: “**1**” = High-excess-gain setting “**2**” = Low-contrast setting Sensor returns to run mode
Invert Display	**Invert Display**		Display inverts from previous state; sensor continues in run mode
Receiver Interface Enable/Disable	**Receiver Interface Enable/Disable**		The factory default is Receiver Interface enabled. Four-pulsing the remote line saves the current settings and disables the interface (the sensor continues to operate using the saved settings; changes made to the DIP switch will have no effect). Repeating the process enables the Receiver Interface so that settings can be changed.

4.6 Troubleshooting and Error Codes

If the receiver Status LED is red and the 3-digit display reads "**c**" followed by a number from **1** to **10**, a corrective action is needed (see below).

If the Status LED is red, but no "**c**" is visible on the 3-digit display (the scan measurement mode result is displayed), the sensor alignment is marginal. Clean the sensor windows and perform the alignment procedure as necessary.

For all corrective actions, first verify proper supply voltages and wiring connectivity. Disconnect and re-connect the sensor cable connectors to verify proper connector installation.

Error Code	Problem	Corrective Action
1	Receiver EEPROM Hard Failure	This problem is caused by a receiver failure that can not be corrected by the user. Replace the receiver.
2	Receiver Alignment/Blanking Configuration Error	Remove and re-apply sensor supply voltage. If the error code 2 is removed, electrically re-align the sensor (Section 4.2). If the error code persists, contact Banner for further problem-solving techniques.
3	Reserved for Factory	Replace the receiver.
4	Emitter or Wiring Problem	1. Verify that emitter and receiver wiring is correct (see Figures 3-5 and 3-6). 2. Check the status of the emitter Status LED. • **Emitter LED OFF:** Check the voltage across the emitter brown and blue wires. If the voltage across the emitter brown and blue wire is OK, then replace the emitter. • **Emitter Status LED flashing (approx. every 2 seconds):** Verify that the emitter/receiver synch (pink) wires are correctly installed. 3. Verify that the Synch wires are correctly installed. Check the synch wire dc voltage. If the voltage is below 1 volt or above 3 volts, then again check the synch wire for possible mis-wiring. Unplug first the receiver and then the emitter to determine the problem source.
5	Emitter Channel Error	The emitter has identified a nonfunctional optical channel. **Temporary fix:** Perform the blanking function (Section 4.2) to ignore the problem. **Permanent fix:** Replace the emitter.
6	Reserved for Factory	Replace the receiver.
7	Reserved for Factory	Replace the emitter.
8	Reserved for Factory	Replace the receiver.
9	Reserved for Factory	Replace the receiver.
10	Incompatible Scan and Measurement Mode	Some measurement modes are incompatible with some scanning modes. **Single-Edge Scan; do not use the following measurement modes:** OD, ID, FBM, LBM, TBM, CBM, Nap Detection **Double-Edge Scan; do not use the following measurement modes:** FBM, LBM, TBM, CBM, Nap Detection

Notes

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Banner Engineering Corp., 9714 Tenth Ave. No., Mpls., MN 55441 • Ph: 763.544.3164 • www.bannerengineering.com • Email: sensors@bannerengineering.com