

EZ-SCREEN® Type 2 Light Screen Instruction Manual

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Original Instructions



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About This Document

Important . . . Read This Before Proceeding!

It is the responsibility of the machine designer, controls engineer, machine builder and/or maintenance electrician to apply and maintain this product in full compliance with all applicable regulations and standards. The product can provide the required safeguarding function only if it is properly installed, properly operated, and properly maintained. This manual attempts to provide complete installation, operational, and maintenance instruction. *Reading the manual completely is highly recommended.* Please direct any questions regarding the application or use of the product to the Banner Engineering Applications at the locations listed here.

For more information regarding U.S. and international institutions that provide safeguarding application and safeguarding product performance standards, see the following sections.



WARNING: User Responsibility

The user is responsible to:

- Carefully read, understand and follow the information in all documentation for this product.
- Perform a risk assessment of the specific machine guarding application.
- Determine what safeguarding devices and methods are appropriate per the requirements defined in EN ISO 13849-1 and other appropriate standards.
- Create and confirm each configuration and then verify that the entire safeguarding system (including input devices and output devices) is operational and working as intended.
- Periodically re-verify as needed, that the entire safeguarding system is working as intended.

Failure to follow any of these recommendations can potentially create a dangerous condition that may lead to serious injury or death.

Use of Warnings and Cautions

This manual contains numerous WARNING and CAUTION statements:

- Warnings refer to situations that could lead to significant or serious personal injury or death.
- Cautions refer to situations that could lead to slight personal injury or potential damage to equipment.

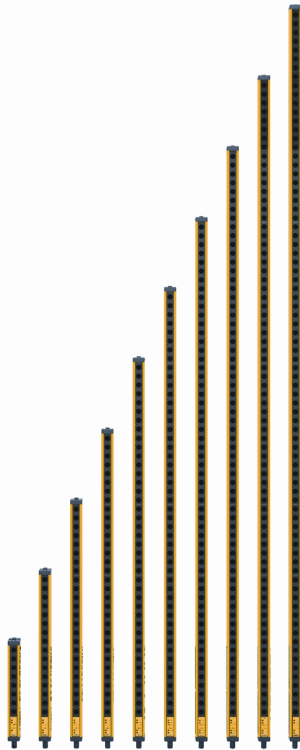
Warnings are intended to remind the machine designer, control engineer, machine builder, maintenance electrician, or end user how to avoid misapplication of this product and effectively apply the EZ-SCREEN Type 2 to meet the various safeguarding application requirements. You must read and abide by the warnings.

EC Declaration of Conformity (DOC)

Banner Engineering Corp. herewith declares that the **EZ-SCREEN Type 2 Light Screen** is in conformity with the provisions of the Machinery Directive (Directive 2006/42/EC) and all essential health and safety requirements have been met. For more information, visit www.bannerengineering.com/EZSCREEN.

Introduction

Features



- An optoelectronic safeguarding device
- Creates a screen of synchronized, modulated infrared sensing beams. Choose from 10 sizes, in 150 mm (6") increments: defined areas from 150 mm to 1.8 m (6" to 71")
- Compact package for smaller production machines
- Models available with Trip or Latch output operation (automatic or manual start/restart)
- 30 mm (1.18") resolution
- Remote Test input terminals for simulating a "blocked" condition
- Operating range up to 15 m (50')
- Type 2 per IEC 61496-1/-2; Category 2 PLd per EN ISO 13849-1
- FMEA tested according to IEC 61496-1, Type 2 requirements
- Receiver LEDs provide system status and emitter/receiver alignment indications
- Highly immune to EMI, RFI, ambient light, weld flash, and strobe light
- Two-piece design
- Vibration-tolerant, factory burned-in emitter and receiver circuitry for toughness and dependability

System Description



NOTE: A "System" as referred to in this manual may be defined as an emitter and its receiver, plus their cabling.

Banner EZ-SCREEN Type 2 emitters and receivers provide a redundant, microprocessor-controlled, opposed-mode optoelectronic "curtain of light," or "light screen." EZ-SCREEN Type 2 typically is used for point-of-operation safeguarding, and is suited to safeguard a variety of lower-risk machinery.

The EZ-SCREEN Type 2 is a two-piece ("two-box") system – comprising an emitter and a receiver, but no external controller. The external device monitoring (EDM) function ensures the fault detection capability required by EN ISO 13849-1 Category 2.

The EZ-SCREEN Type 2 emitters have a row of synchronized modulated infrared (invisible) light-emitting diodes (LEDs) in a compact metal housing. Receivers have a corresponding row of synchronized photodetectors. The light screen created by the emitter and receiver is called the "defined area"; its width and height are determined by the length of the sensor pair and the distance between them. The low-profile housing provides maximum sensing within minimum space; its defined area (sensing area) is equivalent to the height of the housing. The maximum range is 15 m (50'), which decreases if corner mirrors are used. Resolution is 30 mm (1.18")..

Both emitter and receiver feature LEDs to provide continuous indication of the System's operating status, alignment and error conditions.

In typical operation, if any part of an operator's body (or any opaque object) of more than a pre-determined cross section is detected, the solid-state Output Signal Switching Device (OSSD) safety outputs will turn OFF. These safety outputs are connected to the guarded machine's Final Switching Devices (FSDs) that control the machine primary control elements (MPCEs), which immediately stop the motion of the guarded machine.

Both OSSD outputs must be connected to the machine control so that the machine's safety-related control system interrupts the circuit or power to the MPCEs (Machine Primary Control Elements), resulting in a non-hazardous condition. Each OSSD is capable of sourcing 0.5A at +24V dc.

The OSSD safety outputs are not capable of performing a "handshake" communication with the Muteable Safety Stop Interface (MSSI) or Universal Safety Stop Interface (USSI) found on other Banner Engineering safety products.

EZ-SCREEN Type 2 is extensively FMEA (Failure Mode and Effects Analysis) tested to IEC 61496-1/-2 requirements. The design of the EZ-SCREEN Type 2 has considered all single faults such that a loss of a critical safety function will result in a stop command and a lockout condition. In the event of an accumulation of undetected faults, a remote external test (or check) is required to maintain the safety function.

Electrical connections are made through M12 (or Euro-style) quick-disconnects. An optional hookup that provides sensor interchangeability (or "swapability") – the ability to install either sensor at either QD connection – is possible. Using a parallel connection (color-for-color), the emitter cable can be connected to the receiver cable, providing the ability to swap the emitter and receiver position, similar to a popular feature of Banner MINI-SCREEN® safety light screens. This hookup option provides advantages during installation, wiring, and troubleshooting.

All models require a supply voltage of +24V dc $\pm 20\%$.

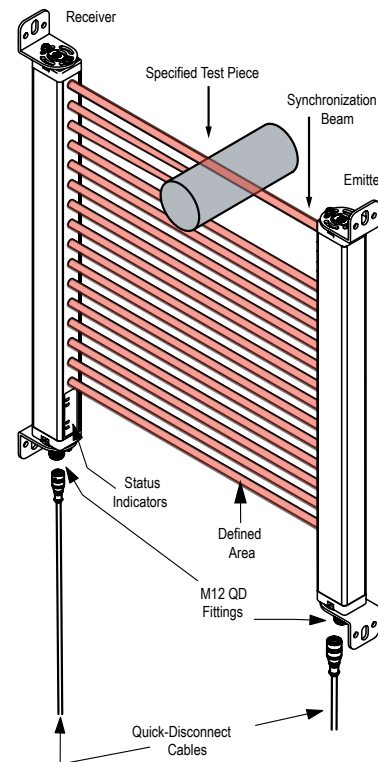


Figure 1. Banner EZ-SCREEN Type 2: emitter, receiver, and two interconnecting cables

Appropriate Applications and Limitations



WARNING: Read this Section Carefully Before Installing the System

If all mounting, installation, interfacing, and checkout procedures are not followed properly, the EZ-SCREEN Type 2 cannot provide the protection for which it was designed. The user has the responsibility to ensure that all local, state, and national laws, rules, codes, or regulations relating to the installation and use of this control system in any particular application are satisfied. Extreme care should be taken to ensure that all legal requirements have been met and that all technical installation and maintenance instructions contained in this manual are followed.

The user has the sole responsibility to ensure that this EZ-SCREEN Type 2 is installed and interfaced to the guarded machine by Qualified Persons, in accordance with this manual and applicable safety regulations.

The Banner EZ-SCREEN Type 2 is intended for lower-risk machine guarding applications and other safeguarding applications, as determined by a risk assessment. It is the user's responsibility to verify whether the safeguarding is appropriate for the application and is installed, as instructed by this manual, by a Qualified Person (as defined in the Glossary).



CAUTION: Install System Only on Appropriate Applications

Banner EZ-SCREEN Type 2 are for use only on machinery that can be stopped immediately after a stop signal is issued at any point in the machine's stroke or cycle, such as part-revolution clutched machines. Under no circumstances may the EZ-SCREEN Type 2 be used on full-revolution clutched machinery or in unsuitable applications as those listed. **If there is any doubt about whether or not your machinery is compatible with the EZ-SCREEN Type 2, contact Banner's Application Engineers at the factory.**



CAUTION: Use of EZ-SCREEN Type 2

EZ-SCREEN Type 2 meets the Type 2 requirements of IEC 61496 and Category 2 PLd requirements of EN ISO 13849-1. DO NOT use EZ-SCREEN Type 2 unless it is installed, tested, and inspected in accordance with this manual. DO NOT use EZ-SCREEN Type 2 where Control Reliability is required, or where Category 3, Category 4, or Type 4 AOPD (active opto-electronic protective device) have been mandated, or where a risk assessment has determined that frequent access by personnel to the hazard could result in an irreversible or serious injury (for example, OSHA reportable injury).

Typical use is for safeguarding in situations where the consequence of an accident will result in only slight (normally reversible) injuries that are typically treated by the normal healing processes and minor medical treatment (that is, first aid, as defined by OSHA 29CFR1904.7).

Failure to follow these instructions could result in serious bodily injury or death.

Examples: Appropriate Applications

EZ-SCREEN Type 2 are typically used, but is not limited to, the following applications (dependent on machine risk assessment):

- Small assembly equipment
- Automated production equipment
- "Table-top" robotic work cells
- Component insertion/"pick-and-place" machines
- Small packaging machines
- Equipment and process protection (non-personnel safety)
- Applications that could result in only slight (normally reversible) injuries (such as bump, bruise, knock-down, trapping but not crushing, minor cuts and abrasions, etc.)

Examples: Inappropriate Applications

EZ-SCREEN Type 2 may NOT be used with the following machinery or inappropriate applications:

- As a primary safeguard in frequently accessed hazardous situations that could result in serious injuries (normally irreversible, including death).
- In any case where Control Reliability, Category 3, Category 4, or Type 4 AOPD (active opto-electronic protective device) have been mandated. See EN ISO 13849-1, IEC 61496-1, or other appropriate standard.
- Any machine that cannot be stopped immediately after a stop signal is issued, such as single-stroke (or "full-revolution") clutched machinery.
- Any machine with inadequate or inconsistent machine response time and stopping performance.
- Any machine that ejects materials or component parts through the defined area.
- In any environment that is likely to adversely affect photoelectric sensing efficiency. For example, corrosive chemicals or fluids or unusually severe levels of smoke or dust, if not controlled, may degrade sensing efficiency.
- As a tripping device to initiate or reinitiate machine motion (PSDI applications), unless the machine and its control system fully comply with the relevant standard or regulation (see ISO 12100-2, IEC 60204-1, IEC 61496-1, or other appropriate standard).

If an EZ-SCREEN Type 2 is installed for use as a perimeter guard (that is, where a pass-through hazard may exist), the dangerous machine motion can be initiated by normal means only after the safeguarded area is clear of individuals and the EZ-SCREEN Type 2 has been manually reset.

Control Reliability and Safety Categories

To summarize the expected safety circuit performance in high-risk situations, requirements of Control Reliability (OSHA 29CFR1910.217, ANSI B11.19, and ANSI/RIA R15.06) and Category 3 and Category 4 (EN ISO 13849-1) demand that a reasonably foreseeable, single failure does not lead to the loss of the safety function, and does not prevent a normal or immediate stop from occurring. The failure or the fault must be detected at or before the next demand of safety (e.g., at the beginning or end of a cycle, or when a safeguard is actuated). The safety-related part of the control system then must issue an immediate stop command, or prevent the next machine cycle or hazardous situation until the failure or fault is corrected.

The effect of ANSI/RIA R15.06, ANSI B11.19, and EN ISO 13849-1 is to set a baseline for situations in which a minimum level of performance has been mandated or in cases where a risk assessment has determined a need for Control Reliability, Category 3 or Category 4 level of performance.

In lower-risk safety applications, safeguards and safety circuits do not require the level of performance and fault tolerance described by Control Reliability, Category 3 or Category 4. Applications involving situations that could result in a slight or normally reversible injury (e.g., only requiring first aid, as defined by OSHA 29CFR1904) can be solved by EN ISO 13849-1 Category 2.

EN ISO 13849-1 Category 2 does not require the same level of performance and fault tolerance as required by Control Reliability, Category 3 or Category 4. Safety-related parts of control systems designed to Category 2 "shall be designed so that their function(s) are checked at suitable intervals by the machine control system." This allows a single fault to lead to the loss of the safety function between the check [test] of the system, but the loss of safety function is detected by the check. By comparison, in a system designed to EN ISO 13849-1 Category 4, a single fault or an accumulation of faults will not lead to a loss of the safety function.

While EN ISO 13849-1 generally applies to the machine level, IEC61496-1/-2 specifies requirements for the design, construction and testing for two levels or "types" of active opto-electronic protective devices (AOPDs) or light curtains (light screens). "Type 2" and "Type

4" describe differing requirements to ensure that appropriate safety-related performance is achieved. The appropriate type is dependent on the overall degree of risk reduction, as determined by the machine's Risk Assessment (see ISO 14121, ANSI B11.19, ANSI/RIA R15.06).

A Type 2 AOPD relies on periodic testing to detect a failure to danger. Between tests, a single fault can result in the loss of the safety function. While this level of performance and fault tolerance is generally not allowed in Category 4 situations, it is acceptable in the lower-risk situations described by Category 2.

While the EZ-SCREEN Type 2 conducts continual internal self-tests and all single faults have been considered, the installation should provide an additional periodic test/check of the EZ-SCREEN Type 2 and its interface to ensure the integrity of the safety function (see [Manual Reset/Remote Test Input and EDM](#) on page 36). A component failure detected by periodic test/check must cause a "stop" signal to be sent to the guarded machine and put the System into a Lockout condition.

Recovery from this type of Lockout condition requires:

- Replacement of the failed component (to restore the safety function)
- The appropriate reset procedure.

Operating Features

The Banner EZ-SCREEN Type 2 Light Screen models described by this manual feature standard selectable functions:

- Trip or Latch Output (depending on model)
- External Device Monitoring (EDM) via the Test/Retest input

The System Response Time (T_r) can be determined by the model number on the emitter and receiver.

Trip/Latch Output

Whether a receiver features Trip or Latch Output determines whether the System will enter RUN mode automatically after power-up, or if it will require a manual reset first. If the System has Trip Output, other measures must be taken to prevent a pass-through hazard.

For Latch Output models, the EZ-SCREEN EZ-SCREEN EZ-SCREEN Type 2 requires a manual reset for the OSSD outputs to turn ON, after power is applied and all beams are clear.

- For Trip Output models, the OSSD outputs will turn ON after power is applied and the receiver passes its internal self-test/synchronization and recognizes that all beams are clear. Trip Output models will also automatically reset after all beams are cleared.
- For Latch Output models, the EZ-SCREEN Type 2 requires a manual reset for the OSSD outputs to turn ON, whenever power is applied and all beams are clear.



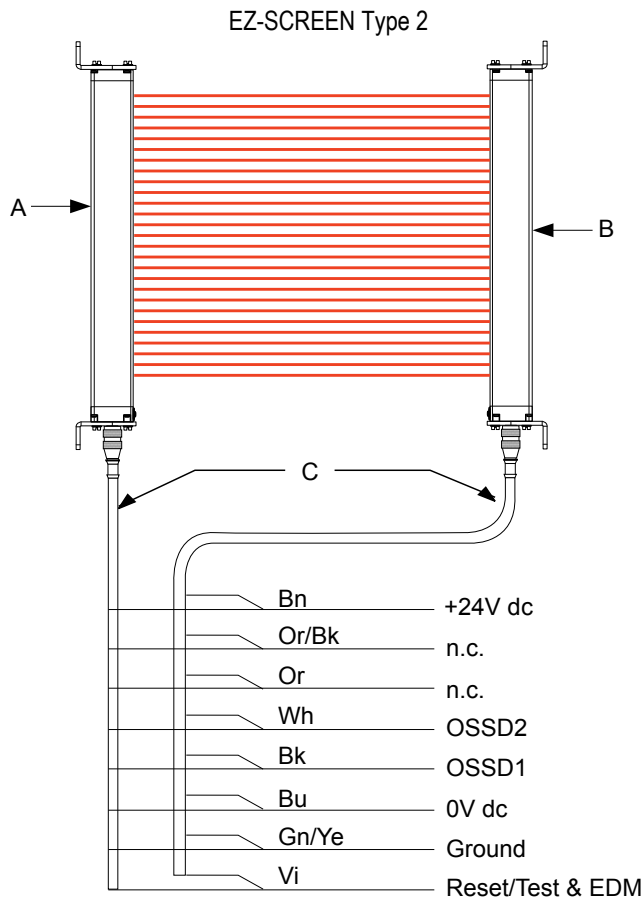
WARNING: Use of Trip/Latch Output

Application of power to the EZ-SCREEN Type 2, the clearing of the defined area, or the reset of a Latch condition **MUST NOT** initiate dangerous machine motion. Machine control circuitry must be designed so that one or more initiation devices must be engaged (i.e., a conscious act) to start the machine – in addition to the EZ-SCREEN Type 2 going into RUN mode. Failure to follow these instructions could result in an increased risk of harm.

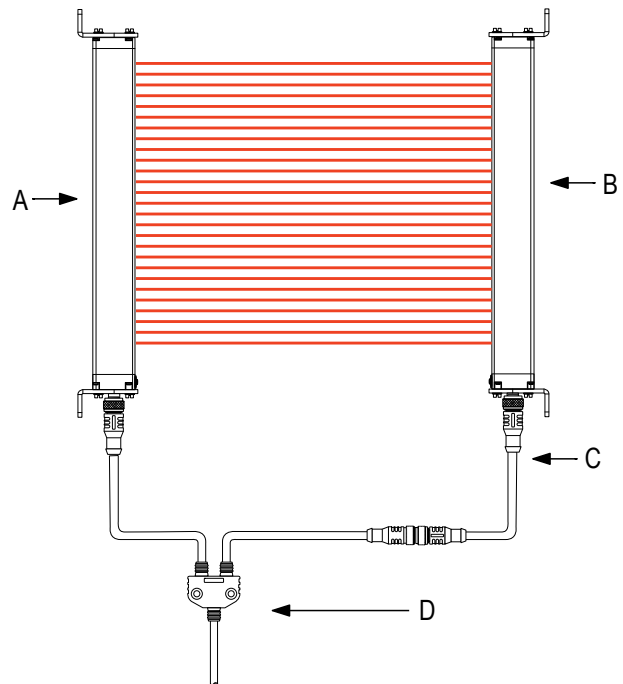
Wiring Options for Emitter/Receiver Swapability

Each EZ-SCREEN Type 2 sensor can be connected to its own power supply or, color-for-color to the other sensor's cable. The color-for-color hookup allows the emitter and receiver positions to be interchanged without rewiring (functionality known as sensor "swapability"). Model CSB.. splitter cordsets and DEE2R.. double-ended cables facilitate interconnection between an EZ-SCREEN Type 2 receiver and emitter, providing a single "homerun" cable for optional swappable hookup.

Individual Cordsets



Splitter Cordsets



Key	Description
A	Emitter
B	Receiver
C	QDE-8..D Cordsets

Key	Description
A	Emitter
B	Receiver
C	DEE2R.. Cordsets
D	CSB.. Cordsets

Manual Reset/Remote Test Input and EDM

A single input provides the means to reset the system from a latch or lockout condition, to externally test the light screen and its interface, and to monitor external devices (EDM) for proper operation. If the System is in Run condition with outputs ON, operating the switch results in a test. If the System is Latched or Locked Out, operating the switch results in a reset.

External Device Monitoring (EDM)

This feature allows the EZ-SCREEN Type 2 system to monitor the status of external devices such as MPCEs. The EDM used in this system is similar to Power Monitoring employed by MINI-SCREEN safety light screens. A normally closed and a normally open contact from each monitored device are wired in series-parallel to detect if one of the devices fails.

Status Indicators

Status indicators on both the emitter and receiver are clearly visible on each sensor's front panel.

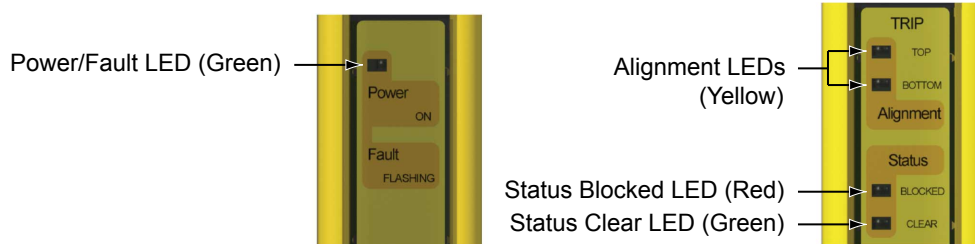


Figure 2. EZ-SCREEN Type 2 emitter and receiver status indicators

Mechanical Installation

The effective use of the EZ-SCREEN Type 2 as a safety guarding device depends on two things:

- the suitability of the application
- the proper mechanical and electrical installation and interfacing to the guarded machine.



WARNING: Read this Section Carefully Before Installing the System

If all mounting, installation, interfacing, and checkout procedures are not followed properly, the EZ-SCREEN Type 2 cannot provide the protection for which it was designed. The user has the responsibility to ensure that all local, state, and national laws, rules, codes, or regulations relating to the installation and use of this control system in any particular application are satisfied. Extreme care should be taken to ensure that all legal requirements have been met and that all technical installation and maintenance instructions contained in this manual are followed.

The user has the sole responsibility to ensure that this EZ-SCREEN Type 2 is installed and interfaced to the guarded machine by Qualified Persons, in accordance with this manual and applicable safety regulations.

This section has two main subsections:

- Considerations in designing the layout of the application
- Mounting the hardware

Pre-Installation Considerations

This subsection describes important considerations before you begin installing the EZ-SCREEN Type 2. The two primary factors that influence the layout of the EZ-SCREEN Type 2 System's mechanical installation the most are the Safety Distance (See [Calculating the Safety Distance \(Minimum Distance\)](#) on page 13) and eliminating pass-through hazards (see [Reducing or Eliminating Pass-Through Hazards](#) on page 17). Additionally, you will find information on the following in this section:

- Emitter and receiver orientation (see [Emitter and Receiver Orientation](#) on page 21)
- Dealing with the affects of adjacent reflective surfaces (see [Adjacent Reflective Surfaces](#) on page 19)
- Using corner mirrors (see [Use of Corner Mirrors](#) on page 20)
- Installing multiple systems (see [Installation of Multiple Systems](#) on page 21)

Calculating the Safety Distance (Minimum Distance)

Safety Distance (D_s), also called Minimum Distance (S), is the minimum distance required between the defined area and the closest reachable hazard point. The distance is calculated so that when an object or a person is detected (by blocking a sensing beam), the EZ-SCREEN Type 2 will send a stop signal to the machine, causing it to stop by the time the person can reach any machine hazard point.

The distance is calculated differently for domestic U.S. and European installations. Both methods take into account several factors, including a calculated human speed, the total system stopping time (which itself has several components), and the depth penetration factor. After the distance has been determined, record the calculated distance on the Daily Checkout Card



WARNING: Proper Safety Distance

Banner EZ-SCREEN Type 2 emitters and receivers must be mounted at a distance from the nearest hazard such that an individual cannot reach the hazard before cessation of hazardous motion or situation. Failure to establish and maintain the minimum distance could result in increased risk of harm.

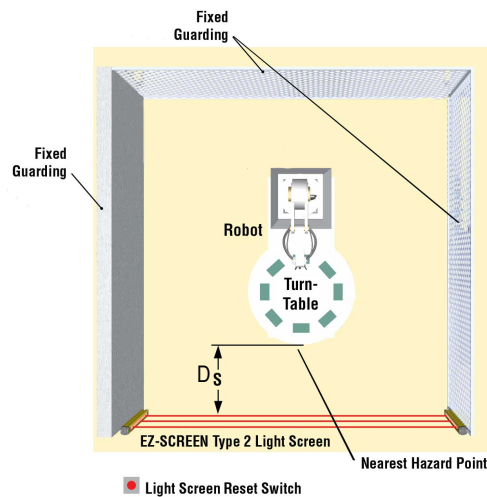


Figure 3. Safety distance and hard guarding

EZ-SCREEN Type 2 Models With Response Times

Models (see note below)	Defined Area Height	Number of Beams	Response Time (Tr)
LS2..30-150Q8	150 mm (5.9")	8	11 ms
LS2..30-300Q8	300 mm (11.8")	16	13 ms
LS2..30-450Q8	450 mm (17.7")	24	14 ms
LS2..30-600Q8	600 mm (23.6")	32	16 ms
LS2..30-750Q8	750 mm (29.5")	40	17 ms
LS2..30-900Q8	900 mm (35.4")	48	19 ms
LS2..30-1050Q8	1050 mm (41.3")	56	21 ms
LS2..30-1200Q8	1200 mm (47.2")	64	22 ms
LS2..30-1350Q8	1350 mm (53.1")	72	24 ms
LS2..30-1500Q8	1500 mm (59")	80	25 ms
LS2..30-1650Q8	1650 mm (65")	88	27 ms
LS2..30-1800Q8	1800 mm (70.9")	96	29 ms



NOTE: The .. in the model numbers is one of the following:

- E = Emitter
- TR = Trip-Output Receiver
- LR = Latch-Output Receiver
- TP = Trip-Output Emitter/Receiver Pair
- LP = Latch-Output Emitter/Receiver Pair

Pair model numbers end in **88** (for example, **LS2TP30-150Q88**) to indicate that both the transmitter and receiver have an 8-pin connector.

Formula and Examples

The Safety (separation) distance formula for U.S. applications:

$$Ds = K \times (Ts + Tr) + Dpf$$

The minimum distance formula for European applications:

$$S = (K \times T) + C$$

where:

U.S. Applications	European Applications
<p>Ds</p> <p>the safety distance, in mm (inches).</p> <p>K</p> <p>1600 mm per second (or 63" per second), the OSHA 29CFR1910.217, ANSI B11.19, ANSI/RIA R15.06 recommended hand-speed constant (See Note 1 below)</p> <p>Ts</p> <p>the overall stop time of the machine (in seconds) from the initial "stop" signal to the final ceasing of all motion, including stop times of all relevant control elements (e.g., IM-T... Interface Modules) and measured at maximum machine velocity (See Note 3 below).</p> <p>Tr</p> <p>the maximum response time, in seconds, of the EZ-SCREEN Type 2 emitter/receiver pair (depending on model).</p> <p>Dpf</p> <p>the added distance – in this case, 78 mm (3") – due to depth penetration factor as prescribed in OSHA 29CFR1910.217, ANSI B11.19, ANSI/RIA R15.06 for U.S. applications .</p>	<p>S</p> <p>the minimum distance, in mm, from danger zone to light screen center line; minimum allowable distance is 100 mm (175 mm for non-industrial applications), regardless of calculated value.</p> <p>K</p> <p>hand-speed constant (see Note 2); 2000 mm/s (for minimum safety distances ≤ 500 mm) 1600 mm/s (for minimum safety distances > 500 mm)</p> <p>T</p> <p>the overall machine stopping response time (in seconds), from the physical initiation of the safety device and the machine coming to a stop (or the hazard removed). This can be broken down into two parts: Ts and Tr where T = Ts + Tr</p> <p>C</p> <p>the additional distance, in mm, based on intrusion of hand or object towards danger zone prior to actuation of a safety device.</p> <p>Calculate using the formula:</p> $C = 8 \times (d - 14)$ <p>where d is the resolution of the light curtain (for d < 40 mm). For EZ-SCREEN Type 2, d = 30 mm and C = 128 mm (5").</p>

Notes:

1. The OSHA-recommended hand speed constant **K** has been determined by various studies and, although these studies indicate speeds of 1600 mm/sec. (63"/sec.) to more than 2500 mm/sec. (100"/sec.), they are not conclusive determinations. Consider all factors, including the physical ability of the operator, when determining the value of **K** to be used.
2. The recommended hand speed constant **K**, derived from data on approach speeds of the body or parts of the body as stated in ISO 13855.
3. **Ts** is usually measured by a stop-time measuring device. If the machine manufacturer's specified stop time is used, at least 20% should be added to allow for possible clutch/ brake system deterioration. This measurement must take into account the slower of the two MPCE channels, and the response time of all devices or controls that react to stop the machine. See Notice Regarding MPCEs. If all devices are not included, the calculated separation distance (**Ds**) will be too short and serious injury could result.

Examples

Example: U.S. Applications, Model LS2..30-600

K	= 63" per second (the hand speed constant set by OSHA)
Ts	= 0.32 (0.250 second is specified by the machine manufacturer; plus 20% safety factor; plus 20 ms for interface module IM-T-9A response)
Tr	= 0.016 second (the specified response time of an LS2..30-600 EZ-SCREEN Type 2)
Dpf	= 3"

Substitute the numbers into the formula as follows:

$$Ds = K \times (Ts + Tr) + Dpf$$

$$Ds = 63 \times (0.32 + 0.016) + 3 = 24.2"$$

Mount the EZ-SCREEN Type 2 emitter and receiver so that no part of the defined area will be closer than 24.2" to the closest reachable hazard point on the guarded machine.

Example: European Applications, Model LS2..30-600

K	= 1600 mm per second
T	= 0.336 (0.250 second specified by machine manufacturer; plus 20% safety factor; plus 20 ms interface module response), plus 0.016 second (the specified LS2..30-600 response time)
C	= 8 x (30-14) = 128 mm

Substitute the numbers into the formula as follows:

$$S = (K \times T) + C$$

$$S = (1600 \times 0.336) + 128 = 665.6 \text{ mm}$$

Mount the EZ-SCREEN Type 2 emitter and receiver so that no part of the defined area will be closer than 665.6 mm to the closest reachable hazard point on the guarded machine.



WARNING: Determine Correct Stop Time

Stop time (Ts) must include the response time of all devices or controls that react to stop the machine. If all devices are not included, the calculated safety distance (Ds) will be too short. This can lead to an increased risk of harm. Be sure to include the stop time of all relevant devices and controls in your calculations.

If required, each of the two Machine Primary Control Elements (MPCE1 and MPCE2) must be capable of immediately stopping the dangerous machine motion, regardless of the state of the other. These two channels of machine control need not be identical, but the stop time performance of the machine (Ts, used to calculate the safety distance) must take into account the slower of the two channels.

Reducing or Eliminating Pass-Through Hazards

A *pass-through* hazard is associated with applications where personnel may pass through a safeguard (which issues a stop command to remove the hazard), and then continues into the guarded area, such as in perimeter guarding. Subsequently, their presence is no longer detected, and the related danger becomes the unexpected start or restart of the machine while personnel are within the guarded area.

In the use of light screens, a pass-through hazard typically results from large safety distances calculated from long stopping times, large minimum object sensitivities, reach-over, reach-through, or other installation considerations. A pass-through hazard can be generated with as little as 75 mm (3") between the defined area and the machine frame or hard guarding.

Eliminate or reduce pass-through hazards whenever possible. While it is recommended to eliminate the pass-through hazard altogether, this may not be possible due to machine layout, machine capabilities, or other application considerations.

One solution is to ensure that personnel are continually sensed while within the hazardous area. This can be accomplished by using supplemental safeguarding, such as described by the ANSI B11.19 of safety requirements or other appropriate standards.

An alternate method is to ensure that once the safeguarding device is tripped it will latch, and will require a deliberate manual action to reset. This method of safeguarding relies upon the location of the reset switch as well as safe work practices and procedures to prevent an unexpected start or restart of the guarded machine.



WARNING: Use of EZ-SCREEN Type 2 for Perimeter Guarding

If an EZ-SCREEN Type 2 is installed in an application that results in a pass-through hazard (e.g., perimeter guarding), either the EZ-SCREEN Type 2 System or the Machine Primary Control Elements (MPCEs) of the guarded machine must cause a Latched response following an interruption of the defined area.

The reset of this Latched condition may only be achieved by actuating a reset switch that is separate from the normal means of machine cycle initiation.

Lockout/Tagout procedures per ANSI Z244.1 may be required, or additional safeguarding, as described by ANSI B11.19 safety requirements or other appropriate standards, must be used if a passthrough hazard can not be eliminated or reduced to an acceptable level of risk. **Failure to observe this warning could result in an increased risk of harm.**

Supplemental Safeguarding

As described in [Calculating the Safety Distance \(Minimum Distance\)](#) on page 13, the EZ-SCREEN Type 2 must be properly positioned such that an individual can not reach through the defined area and access the hazard point before the machine has stopped.

Additionally, the hazard can not be accessible by reaching around, under, or over the defined area. To accomplish this, supplemental guarding (mechanical barriers, such as screens or bars), as described by ANSI B11.19 safety requirements or other appropriate standards, must be installed. Access will then be possible only through the defined area of the EZ-SCREEN Type 2 System or through other safeguarding that prevents access to the hazard (see [Figure 4. An example of supplemental safeguarding](#) on page 17).

The mechanical barriers used for this purpose are typically called "hard guarding"; there must be no gaps between the hard guarding and the defined area. Any openings in the hard guarding must comply with the safe opening requirements of ANSI B11.19 or other appropriate standard.

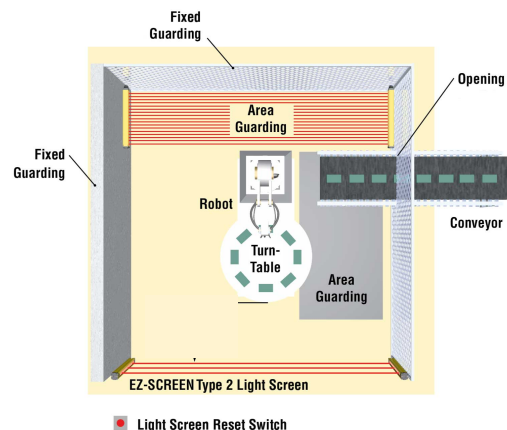


Figure 4. An example of supplemental safeguarding

Figure 4. An example of supplemental safeguarding on page 17 shows an example of supplemental safeguarding inside a robotic work cell. The EZ-SCREEN Type 2, in conjunction with the hard guarding, is the primary safeguard. Supplemental safeguarding (such as a horizontal-mounted safety light screen as an area guard) is required in areas that can not be viewed from the reset switch (i.e., behind the robot and the conveyor). Additional supplemental safeguarding may be required to prevent clearance or trapping hazards (for example, the safety mat as an area guard between the robot, the turntable, and the conveyor).



WARNING: The Hazard Must Be Accessible Only through the Defined Area

The installation of the EZ-SCREEN Type 2 System must prevent any individual from reaching around, under, over or through the defined area and into the hazard without being detected. Mechanical barriers (for example, hard guarding) or supplemental safeguarding may be required to comply with this requirement, and is described by ANSI B11.19 safety requirements or other appropriate standards.

Other Considerations

Reset Switch Location

A key-actuated reset switch provides some operator or supervisory control, as the key can be removed from the switch and taken into the guarded area. However, this does not prevent unauthorized or inadvertent resets due to spare keys in the possession of others, or additional personnel entering the guarded area unnoticed. When considering where to locate the reset switch, follow the guidelines in the Warning below.



WARNING: Reset Switch Location

When considering where to locate the reset switch, you must follow the guidelines outlined in this section.

If any areas within the guarded area are not visible from the reset switch, additional safeguarding must be provided, as described by the ANSI B11.19 series or other appropriate standards.

Failure to follow these instructions could result in an increased risk of harm

All reset switches must be:

- Outside the guarded area
- Located to allow the switch operator a full, unobstructed, view of the entire guarded area while the reset is performed
- Out of reach from within the guarded area
- Protected against unauthorized or inadvertent operation (such as through the use of rings or guards).



Important: Resetting a safeguard must not initiate hazardous motion. Safe work procedures require a start-up procedure to be followed and the individual performing the reset to verify that the entire hazardous area is clear of all personnel, before each reset of the safeguard is performed. If any area can not be observed from the reset switch location, additional supplemental safeguarding must be used: at a minimum, visual and audible warnings of machine start-up.

Adjacent Reflective Surfaces



WARNING: Avoid Installation Near Reflective Surfaces

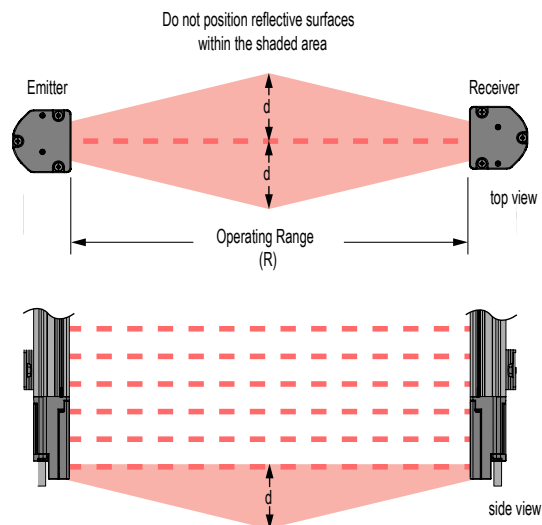
Avoid locating the defined area near a reflective surface; it could reflect sensing beam(s) around an object in the defined area, and prevent its detection by the EZ-SCREEN Type 2.

Reflections will result in incomplete guarding and could result in an increased risk of harm.

A reflective surface located adjacent to the defined area may deflect one or more beams around an object in the defined area. In the worst case, an optical short circuit may occur, allowing an object to pass undetected through the defined area.

This reflective surface may result from shiny surfaces or glossy paint on the machine, the workpiece, the work surface, the floor or the walls. Beams deflected by reflective surfaces are discovered by performing the trip test and the periodic checkout procedures. To eliminate problem reflections:

- If possible, relocate the sensors to move the beams away from the reflective surface(s), being careful to maintain adequate separation distance.
- Otherwise, if possible, paint, mask or roughen the shiny surface to reduce its reflectivity.
- Where these are not possible (as with a shiny workpiece), mount the sensors in such a way that the receiver's field of view and/or the emitter's spread of light are restricted.
- Repeat the trip test (see [Trip Test](#) on page 32) to verify that these changes have eliminated the problem reflection(s). If the workpiece is especially reflective and comes close to the defined area, perform the trip test with the workpiece in place.



For 0.2 to 3 m (8" to 10') Operating range:

$d = 0.26 \text{ m (10")}$

For Operating range > 3 m (> 10'):

$d = 0.0875 \times R \text{ (m or ft)}$

Figure 5. Adjacent reflective surfaces

Use of Corner Mirrors

EZ-SCREEN Type 2 Systems may be used with one or more corner mirrors. The use of glass-surface corner mirrors reduces the maximum specified emitter/receiver separation by approximately 8 percent per mirror, as follows:

SSM and MSM Series Glass-Surface Mirrors	
Corner Mirrors	Max. Emitter / Receiver Range
1	13.8 m (45')
2	12.7 m (42')
3	11.7 m (38')
4	10.8 m (35')

Mirrors are not allowed for applications that would allow personnel undetected access into the safeguarded area.

If mirrors are used, the difference between the angle of incidence from the emitter to the mirror and from the mirror to the receiver must be between 45° and 120° . If placed at a sharper angle, as shown in the example, an object in the light screen may deflect beam(s) to the receiver, preventing the object from being detected (that is, "false proxing"). Angles greater than 120° result in difficult alignment and possible optical short circuits.



WARNING: Avoid Retroreflective Installation

Do not install emitters and receivers in "retroreflective" mode, with less than a 45° angle of incidence, as shown.

Sensing could be unreliable in this configuration; an increased risk of harm could result.

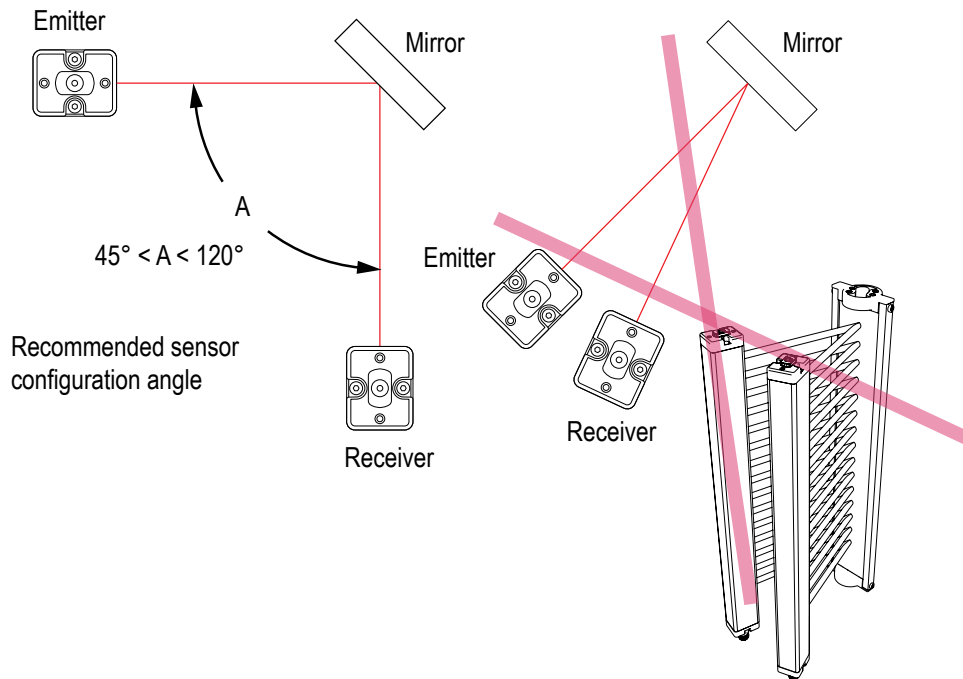


Figure 6. Never use EZ-SCREEN Type 2 sensors in a retroreflective mode.

Emitter and Receiver Orientation

The emitter and receiver must be mounted parallel to each other and aligned in a common plane, with both cable ends pointing in the same direction. Never mount the emitter with its cable end oriented opposite the cable end of the receiver. If this occurs, voids in the light screen may allow objects or personnel to pass through the defined area undetected.

The emitter and receiver may be oriented in a vertical or horizontal plane, or at any angle between horizontal and vertical, as long as they are parallel and their cable ends point in the same direction. Verify that the light screen completely covers all access to the hazard point that is not already protected by hard guarding or other supplemental guarding.

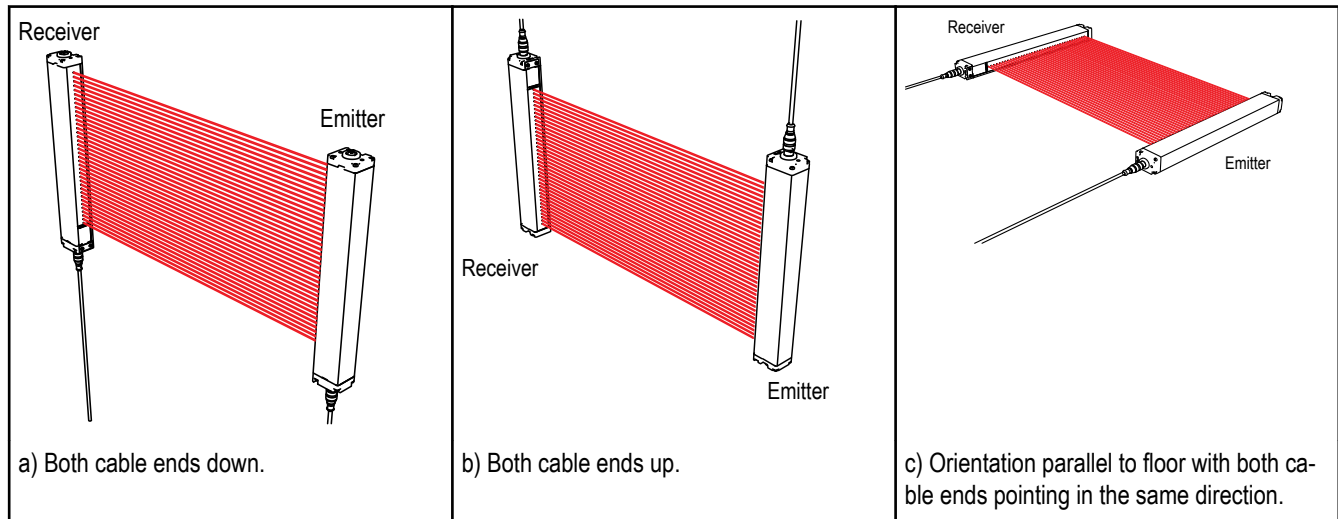


Figure 7. Examples of Correct Emitter/Receiver Orientation

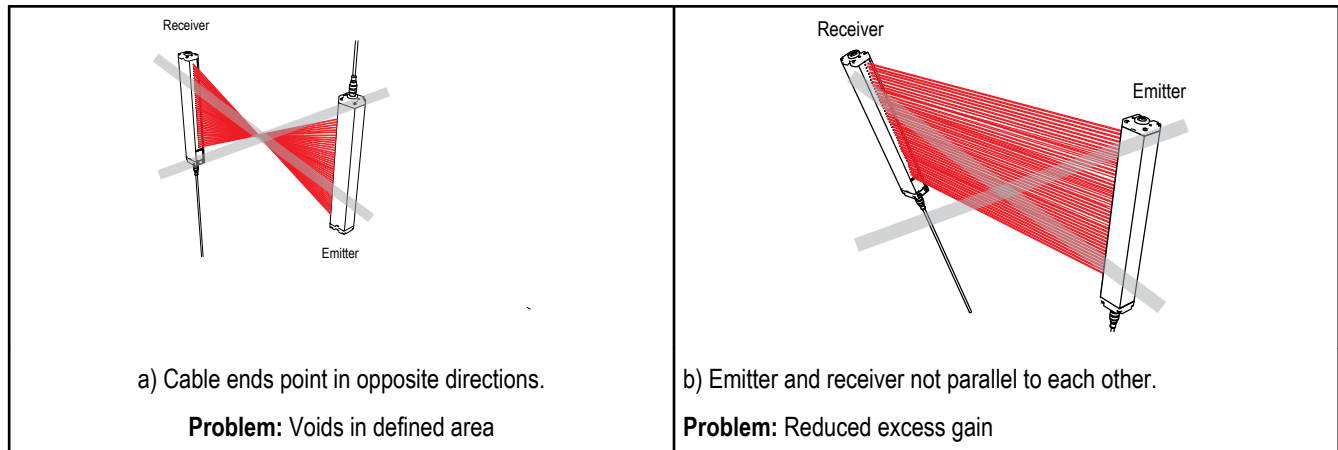


Figure 8. Examples of incorrect Emitter/Receiver Orientation

Installation of Multiple Systems

Whenever two or more EZ-SCREEN Type 2 emitter and receiver pairs are adjacent to one another, optical crosstalk may potentially take place between systems. To minimize optical crosstalk, alternate the positions of emitters and receivers, (see [Figure 9. Installation of multiple systems](#) on page 22).

When two or more systems are installed in the same plane (as shown in [Figure 9. Installation of multiple systems](#) on page 22), optical crosstalk may occur between sensor pairs whose emitter and receiver lenses are oriented in the same direction. In this situation, eliminate optical crosstalk by mounting these sensor pairs exactly in line with each other within one plane, or by adding a mechanical barrier between the pairs.

**WARNING: Proper Orientation of System Emitters and Receivers**

EZ-SCREEN Type 2 System emitters and receivers must be installed with their corresponding cabled ends pointing in the same direction (for example, both cabled ends facing up). Failure to orient them properly will impair the performance of the EZ-SCREEN Type 2 System and will result in incomplete guarding, and could result in an increased risk of harm.

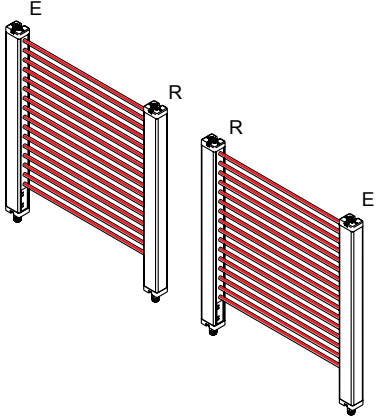
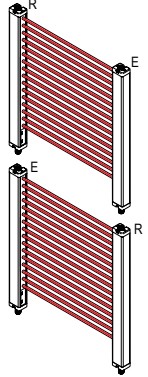
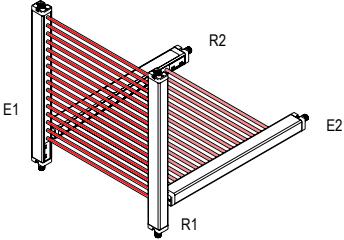
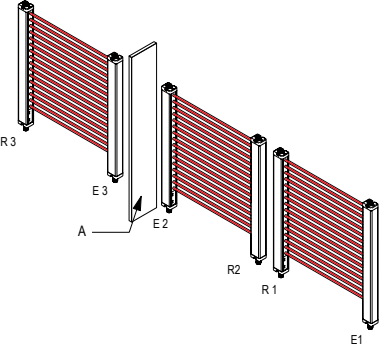
 <p>E = Emitter R = Receiver</p> <p>a. Two systems in a horizontal plane</p>	 <p>E = Emitter R = Receiver</p> <p>b. Two or three systems stacked (or alternate receiver/emitter positions)</p>
 <p>E1 = Vertical Emitter E2 = Horizontal Emitter R1 = Vertical Receiver R2 = Horizontal Receiver</p> <p>c. Two systems at right angles</p>	 <p>A = Opaque Shield E1 = Emitter #1 E2 = Emitter #2 E3 = Emitter #3 R1 = Receiver #1 R2 = Receiver #2 R3 = Receiver #3</p> <p>d. Multiple systems</p>

Figure 9. Installation of multiple systems

**WARNING: Synchronization**

In situations where multiple systems are mounted closely together, or where a secondary emitter is in view (within $\pm 5^\circ$), within range of an adjacent receiver; a receiver may synchronize to the signal from the wrong emitter, reducing the safety function of the light screen.

**WARNING: Multiple Pairs of Sensors**

Do not connect multiple pairs of sensors to one Interface Module (for example, IM-T-9A/-11A) or otherwise parallel OSSD outputs.

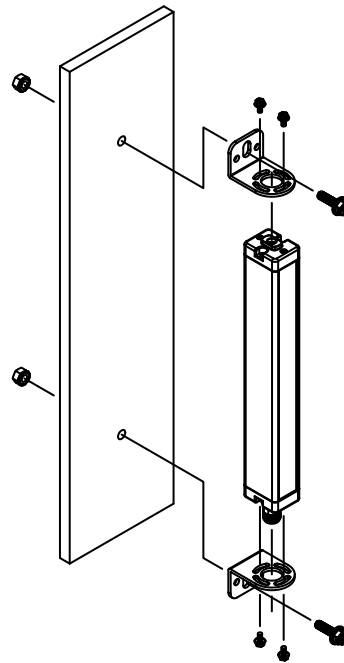
Connection of multiple OSSD safety outputs to a single device can result in an increased risk of harm, and is prohibited.

Mounting System Components

Overview of Emitter/Receiver Mounting Hardware

Mounting Hardware

The EZ-SCREEN standard end-cap mounting bracket hardware is supplied with each emitter and receiver. Brackets are designed to mount directly to MSA Series stands using the hardware with the supplied stands.



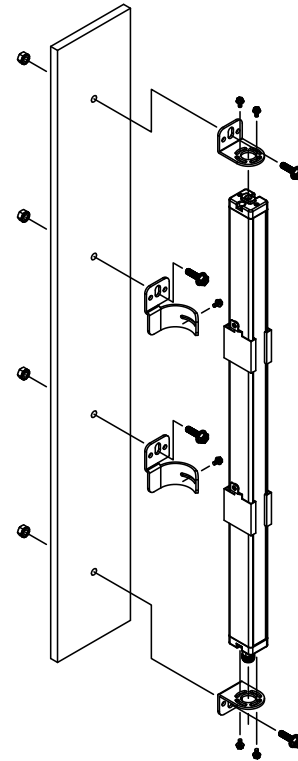
Using Center Mounting Brackets

Center mounting brackets are supplied with longer sensors and must be used whenever the sensors are subject to shock or vibration. The sensors are designed to be mounted with up to 450 mm (18") distance between brackets:

- Sensors 600 to 900 mm (24" to 36") long are supplied with one center bracket, which should be centered on the sensor.
- Sensors 1050 to 1350 mm (42" to 54") long are supplied with two center brackets, which should be positioned 1/3 of the sensor's length from each sensor end.
- Sensors 1500 to 1800 mm (59" to 71") long are supplied with three center brackets

To install each bracket:

1. Spread the clamp and snap over the back of the sensor so that the clamp is securely fastened to the sensor without blocking any beams.
2. Compress the foam spacer and slide the clamp along the length of the sensor housing to align the clamp with the center mounting bracket as shown in Figure 3-9. Three separate mounting holes are provided on the clamp to allow for all possible mounting configurations.
3. Connect the clamp to the center bracket using the M3 screw supplied.
4. Loosen all the mounting screws to the sensor, align the sensors and then tighten the end screws. Finally, tighten the M3 screw joining the clamp to the center mounting bracket.



Mounting and Initial Alignment of Emitter/Receiver Pairs

Emitter/receiver pairs may be spaced from 0.2 to 15 m (8" to 50') apart. The maximum distance between an emitter and its receiver is reduced if corner mirrors are used. The supplied brackets (when mounted to the sensor end caps) allow $\pm 30^\circ$ rotation.

To mount each emitter/receiver pair:

1. From a common point of reference (ensuring the calculated safety distance), make measurements to locate the emitter and receiver in the same plane with their midpoints directly opposite each other.



Important: The connector ends of both sensors must point in the same direction (see [Emitter and Receiver Orientation](#) on page 21).

2. Mount the emitter and receiver mounting brackets using the supplied M6 bolts and Keps nuts, or user-supplied hardware.
3. Mount the emitter and receiver in their brackets; position their windows directly facing each other.
4. Measure from a reference plane (for example, a level building floor) to the same point(s) on the emitter and receiver to verify their mechanical alignment.
5. Use a carpenter's level, a plumb bob, or the optional LAT-1 Laser Alignment Tool or check the diagonal distances between the sensors, to achieve mechanical alignment.

Verifying Initial Emitter/Receiver Alignment

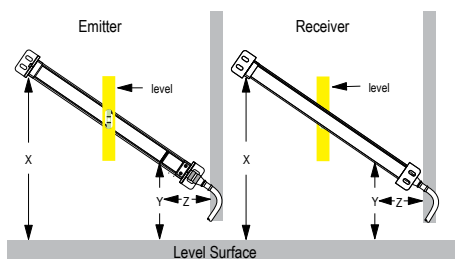
As you mount the sensors, make sure that

- The emitter and receiver are directly opposite each other.
- Nothing is interrupting the defined area (marked on the sensors).
- The defined 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).

Angled or Horizontal Installations

Verify that the

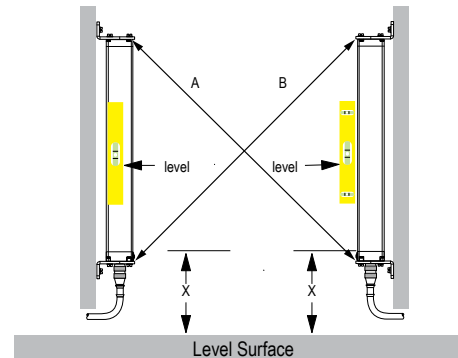
- Distance X at the emitter and receiver are equal.
- Distance Y at the emitter and receiver are equal.
- Distance Z at the emitter and receiver are equal from parallel surfaces.
- Vertical face (that is, the lens) is level/plumb.
- Defined area is square. Check diagonal measurements if possible; see Vertical Installations, at right.



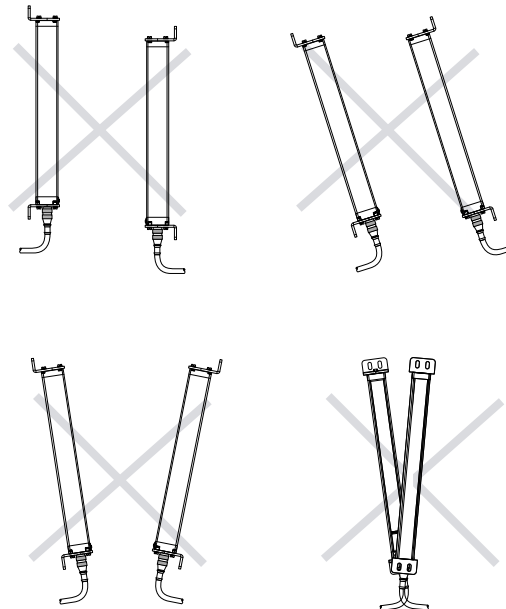
Vertical Installations

Verify that the

- Distance X at the emitter and receiver are equal.
- Both sensors are level/plumb (check both the Distance Z at the emitter and receiver are equal from side and face).
- Defined area is square. Check diagonal measurements if possible (Diagonal A = Diagonal B).



NOTE: Make sure that the emitter and receiver are not tilted front-to-back or side-to-side as shown.



Electrical Installation and Testing

As with the previous section, it is important that you read, understand and follow the electrical installation and testing procedure as described in the following subsections.



WARNING: Read this Section Carefully Before Installing the System

If all mounting, installation, interfacing, and checkout procedures are not followed properly, the EZ-SCREEN Type 2 cannot provide the protection for which it was designed. The user has the responsibility to ensure that all local, state, and national laws, rules, codes, or regulations relating to the installation and use of this control system in any particular application are satisfied. Extreme care should be taken to ensure that all legal requirements have been met and that all technical installation and maintenance instructions contained in this manual are followed.

The user has the sole responsibility to ensure that this EZ-SCREEN Type 2 is installed and interfaced to the guarded machine by Qualified Persons, in accordance with this manual and applicable safety regulations.

The following are the main steps to electrically install the EZ-SCREEN Type 2 components and interface with the guarded machine:

1. Apply power to each emitter/receiver pair (see [Initial Electrical Connections](#) on page 27).
2. Perform an Initial Checkout Procedure (see [Initial Checkout Procedure](#) on page 28).
3. Make all electrical interface connections to the guarded machine (see [Electrical Connections to the Guarded Machine](#) on page 34).
4. Perform a commissioning checkout procedure (see [Commissioning Checkout](#) on page 38).

Routing Cordsets

Connect the QD connectors and route the sensor cables to the junction box, electrical panel, or other enclosure in which the Interface Module, the redundant mechanically linked interposing relays, FSDs, or other safety-related parts of the control system are located. This must be done per local wiring code for low-voltage dc control cables and may require installation of electrical conduit. See [Cordsets](#) on page 57 for selection of Banner-supplied cordsets.

The EZ-SCREEN Type 2 is designed and manufactured to be highly resistant to electrical noise and to operate reliably in industrial settings. However, extreme electrical noise may cause a random Trip or Latch condition; in extreme cases, a Lockout is possible. Emitter and receiver wiring is low voltage; routing the sensor wires alongside power wires, motor/servo wires, or other high-voltage wiring may inject noise into the EZ-SCREEN Type 2 System. It is good wiring practice (and may be required by code) to isolate emitter and receiver cables from high-voltage wires, avoid routing cables close to “noisy” wiring, and provide a good connection to earth ground.

Sensor QD cabling and any interconnect wiring should meet the following specifications. The wires used should have an insulation temperature rating of at least 90°C (194°F).

Maximum Machine Interface cable length versus total current draw (including both OSSD loads)				
Cable Size	Current Draw			
	0.5A	0.75A	1.0A	1.25A
0.823 mm ² (18 AWG)	375'	250'	188'	148'
0.518 mm ² (20 AWG)	240'	160'	120'	95'
0.326 mm ² (22 AWG)*	150'	100'	75'	59'



NOTE: Cable length includes power (+24V dc) and return (0V dc) wires at +25°C, and is intended to ensure that adequate power is available to the EZ-SCREEN Type 2 System when the supply is operating at +24V dc - 10%.

Initial Electrical Connections



WARNING: Proper Electrical Hookup

Electrical hookup must be made by Qualified Personnel and must comply with NEC (National Electrical Code) and local standards.

Connection of other wiring or equipment to the EZ-SCREEN Type 2 System could result in an increased risk of harm.

Lockout/tagout procedures may be required (refer to OSHA1910.147, ANSI Z244-1, or the appropriate standard for controlling hazardous energy). Following relevant electrical standards and wiring codes, such as the NEC, NFPA79 or IEC60204-1, always connect earth ground (green/yellow wire). Do not operate the EZ-SCREEN Type 2 System without an earth ground connection.

Make the electrical connections in the order described in this section. Do not remove end-caps; no internal connections are to be made. All connections are made through the M12 Eurostyle quick-disconnects.

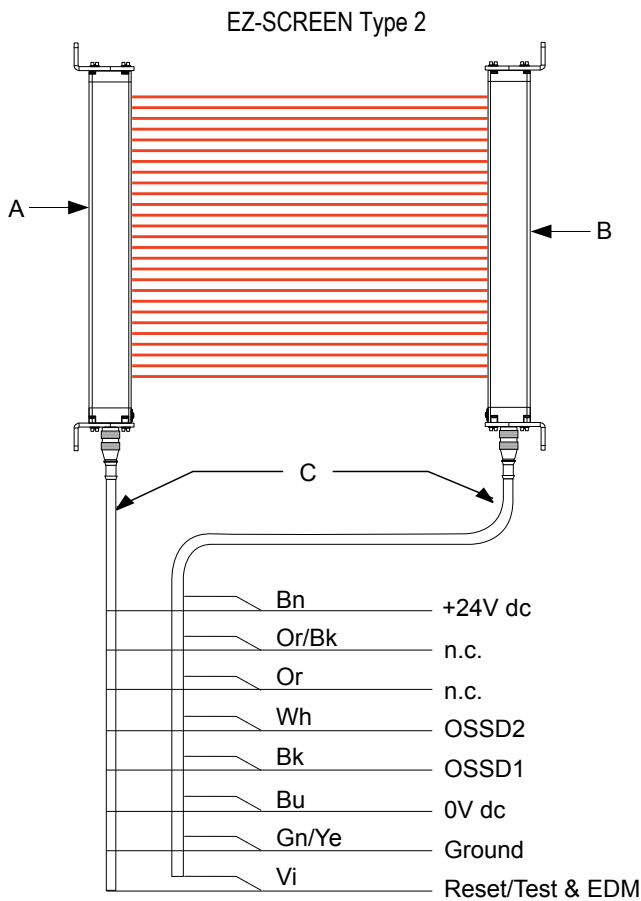
Emitter Cordset	Receiver Cordset
<p>EZ-SCREEN Type 2 emitters have an 8-pin cordset, but only three conductors are required:</p> <ul style="list-style-type: none"> • Brown = +24V dc • Blue = 0V dc • Green/Yellow = GND 	<p>Do not connect any wires to the machine control circuits (that is, OSSD outputs) at this time.</p> <p>For the initial checkout, only the following EZ-SCREEN Type 2 receiver conductors should be connected:</p> <ul style="list-style-type: none"> • Brown = +24V dc • Blue = 0V dc • Green/Yellow = GND <p>Additionally, connect the external reset switch, if used, or test signal contact to the Reset/Test wire (violet) and to 24V dc.</p>



NOTE: The reset switch must be a normally closed switch that is held open for approximately 1/4 second, then closed to accomplish the reset. The switch must be capable of switching 10 to 30V dc at 30 mA.

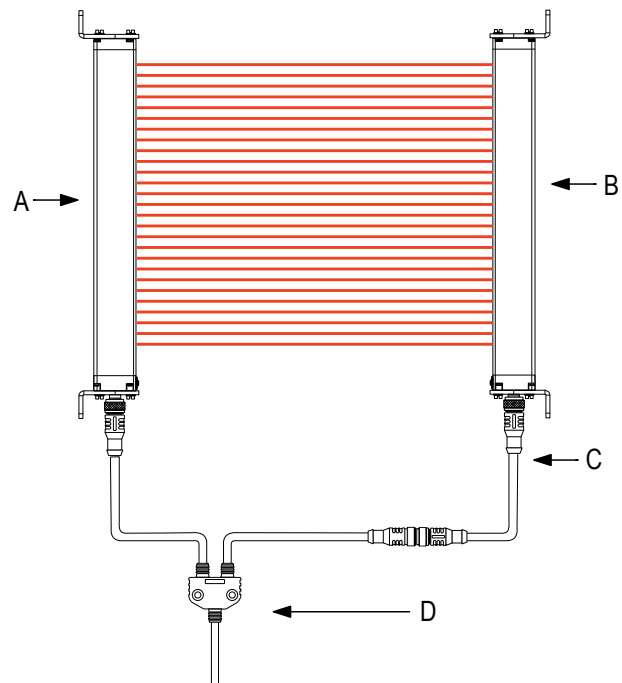
The other wires are for an optional hookup that allows for parallel connection (color-for-color) to the receiver cable. This optional hookup provides for sensor interchangeability (or swapability) that facilitates installing either sensor at either QD connection. Besides providing similar cabling, this wiring scheme is advantageous during installation, wiring, and troubleshooting.

Individual Cordsets



Key	Description
A	Emitter
B	Receiver
C	QDE-8..D Cordsets

Splitter Cordsets



Key	Description
A	Emitter
B	Receiver
C	DEE2R.. Cordsets
D	CSB.. Cordsets

Initial Checkout Procedure

The initial checkout procedure must be performed by a Qualified Person. It must be performed only after configuring the system and after connecting the emitter and receiver.

The procedure is performed on two occasions:

- To ensure proper installation when the System is first installed
- To ensure proper System function whenever any maintenance or modification is performed on the System or on the machinery being guarded by the System.

Configuring the System for Initial Checkout

For the initial checkout, the EZ-SCREEN Type 2 System must be checked without power being available to the guarded machine. Final interface connections to the guarded machine cannot take place until the light screen system has been checked out. This may require lockout/tagout procedures (refer to OSHA1910.147, ANSI Z244-1, or the appropriate standard for controlling hazardous energy). These connections will be made after the initial checkout procedure has been successfully completed.

Verify that:

- Power has been removed from (or is not available to) the guarded machine, its controls or actuators; and
- The machine control circuit or the Interface Module is not connected to the OSSD outputs at this time (permanent connections will be made later).

Initial Power-Up

Inspect the area near the light screen for reflective surfaces, including work pieces and the guarded machine. Reflective surfaces may cause light beams to reflect around a person in the light screen, preventing the person from being detected and not stopping the machine motion.

Eliminate the reflective surfaces as possible by relocating them, painting, masking or roughening them. Remaining problem reflections will become apparent during the trip test.

1. Verify that power is removed from the EZ-SCREEN Type 2 System and from the guarded machine and that the OSSD safety outputs are not connected. Remove all obstructions from the light screen.
2. Leaving power to the guarded machine OFF, make power and earth ground connections on both the emitter and receiver cables and then power up the EZ-SCREEN Type 2 System (only).
3. Verify that input power is present to both emitter and receiver. At least one indicator on both emitter and receiver should be ON and the start-up sequence should cycle.

4. Watch both the emitter and the receiver LED indicators to determine light screen alignment status.

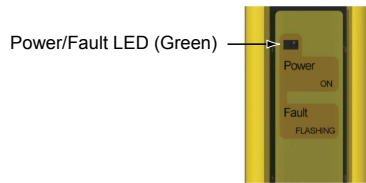


Figure 10. Emitter Status Indicators

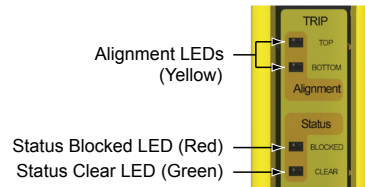


Figure 11. Receiver Status Indicators

Lockout Condition

On the emitter, the green Power indicator is flashing or on the receiver, the red Status Blocked indicator is flashing. See [Troubleshooting and Lockout Conditions](#) on page 47 for diagnostic information.

Normal Operating Mode

On the emitter, the green Power indicator is ON.

Test Mode

On the receiver, the red Status Blocked indicator is ON and the green Status Clear indicator is flashing. Test input open.

Test Mode, input fault

On the receiver, the red Status Blocked indicator is ON and the green Status Clear indicator is ON. Test input open at power-up.

Latch Condition, all optical beams clear

On the receiver, the red Status Blocked indicator is ON and both yellow Alignment indicators are flashing. For Latch Output receivers, the outputs are ON only when all beams are clear and after a manual reset. If a reset routine can cause a Clear (Run) condition, optimize the alignment as described in [Optical Alignment](#) on page 31. If a Clear (Run) condition can not be achieved, see “Blocked condition” below.

Clear (Run) Condition

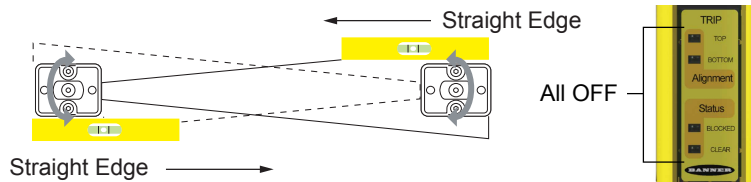
On the receiver, the green Status Clear indicator is ON Green, and both yellow Alignment indicators are ON. To optimize alignment and maximize excess gain, slightly loosen the four sensor mounting screws and rotate one sensor left and right, noting the positions where the red Status Blocked indicator turns ON; repeat with the other sensor (see [Optical Alignment](#) on page 31). Center each sensor between those two positions and tighten the end cap mounting screws, making sure to maintain the positioning as the screws are tightened. The sensor lenses should directly face each other. Proceed to Trip Test ([Trip Test](#) on page 32) once optimum optical alignment is verified.

A Blocked Condition

On the receiver, the red Status Blocked indicator is ON, and both yellow Alignment indicators are ON or OFF. To remedy, perform the [Optical Alignment](#) on page 31 procedure.

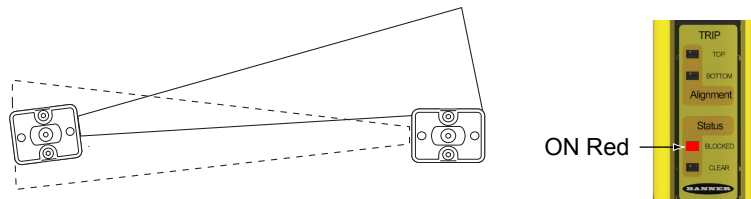
Optical Alignment

1. Verify sensor mounting.
2. Verify optimal alignment, adjusting sensor rotation with power ON:
 - a. Verify that the emitter and receiver are pointed squarely at each other. Use a straight edge (for example, a level) to determine the direction the sensor is facing. The sensor face must be perpendicular to the optical axis.

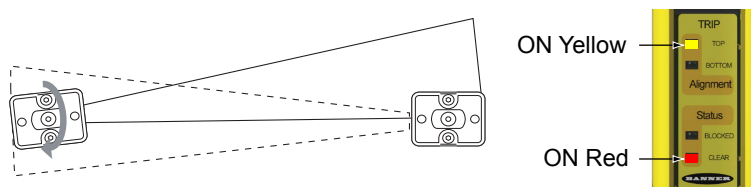


NOTE: At power-up, all indicators are tested (flash).

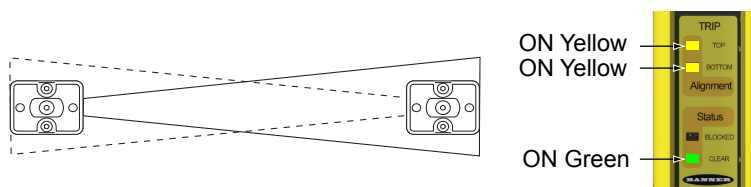
- b. If the synchronization beam is not aligned, the Status Blocked indicator is Red and both Alignment indicators will be OFF.



- c. If the Green Status and Yellow Alignment indicators are ON, go to step "d". If not, rotate each sensor (one at a time) left and right until the Status Clear indicator comes ON Green. As the sensor rotates out of alignment, the Status Blocked indicator will come ON Red.

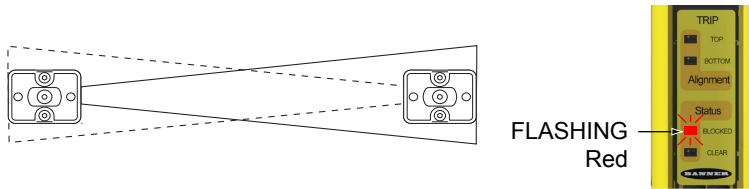


- d. To optimize alignment, note the position where the Status Blocked indicator comes ON Red when the sensor is rotated both left and right. Center the sensor between the two positions, and tighten the end cap mounting screws, making sure the positioning does not drift as the screws are tightened.



For situations where alignment is difficult, a LAT-1-LS Laser Alignment Tool can be used to assist or confirm alignment by providing a visible red dot along the sensor's optical axis.

- e. If, at any time, the Status Blocked indicator begins to flash Red, the System has entered a Lockout condition. See [Troubleshooting and Lockout Conditions](#) on page 47 for further information.



Optical Alignment Procedure with Mirrors

EZ-SCREEN Type 2 sensors may be used with one or more corner mirrors for guarding more than one side of an area. The MSM... and SSM... rear-surface glass mirrors are rated at 85% efficiency. Thus, excess gain and sensing range are reduced when using mirrors; see [Use of Corner Mirrors](#) on page 20.

In addition to the standard optical alignment procedure, verify:

1. That the emitter, receiver, and all mirrors are level and plumb
2. The middle of the defined area and the center point of the mirrors are approximately the same distance from a common reference point, such as the same height above a level floor. Ensure that there are equal amounts of mirror surface above and below the defined area such that the optical beams are not passing below or above the mirror.

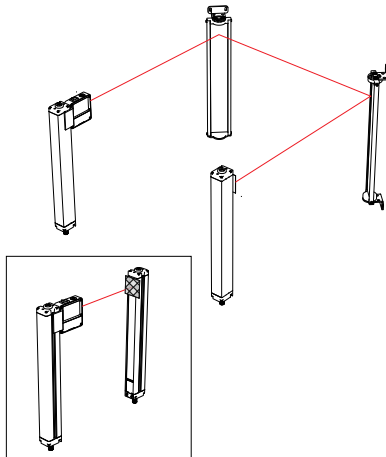


Figure 12. Optical alignment using the LAT-1-LS

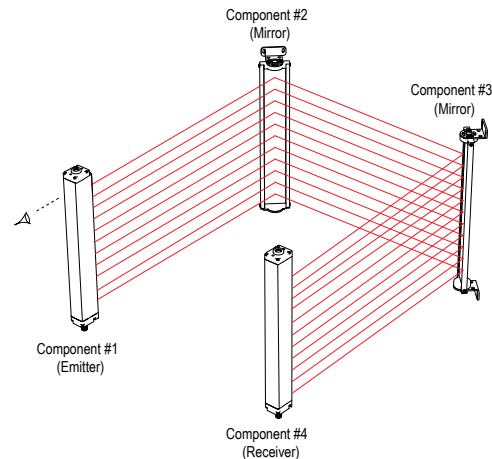


Figure 13. Corner Mirror Alignment

During any adjustments, allow only one individual to adjust any one item at any one time.



NOTE: A LAT-1-LS Laser Alignment Tool is very helpful by providing a visible red dot along the optical axis. See [Figure 12. Optical alignment using the LAT-1-LS](#) on page 32 and Banner Safety Applications Note SA104 (P/N 57477) for further information.

Trip Test

After optimizing the optical alignment, perform the trip test to verify the detection capability of the EZ-SCREEN Type 2 System. This test will also verify correct sensor orientation and identify optical short circuits. Once the installation has passed the trip test, the safety outputs may be connected and the commissioning checkout may be performed (initial installations only).

1. Use the 30 mm specified test piece supplied with the receiver.

2. Verify that the System is in RUN mode with the Status Clear indicator ON steady Green. A manual reset may be required in Latch mode.
3. Pass the specified test piece through the defined area in three paths: near the emitter, near the receiver, and midway between the emitter and receiver.
4. During each pass, while the test piece is interrupting the defined area, verify:
 - Trip Output Operation: The Status Blocked indicator must turn ON Red and remain ON for as long as the test piece remains in the defined area (and the Status Clear indicator OFF during the same time). If not, the installation has failed the trip test. When the test piece is removed from the defined area, the Status Clear indicator must turn ON Green and the Status Blocked indicator must go OFF.
 - Latch Output Operation: The Status Blocked indicator must turn ON Red and remain ON for as long as the test piece remains in the defined area (and the Status Clear indicator OFF during the same time). Both Yellow indicators must remain ON steady, unless the top or bottom beam is blocked. If the top (synch) beam is blocked, both Alignment indicators will go OFF.

If the Yellow Alignment indicators begin to flash at any time while the test piece is interrupting the defined area, the installation has failed the trip test. Check for correct sensor orientation and reflective surfaces. Do not continue until the situation is corrected. In Latch Output Operation, the Status Blocked indicator will remain ON until a manual reset is performed (both Yellow Alignment indicators will be flashing).
5. If mirrors are used in the application: Test the defined area on each leg of the sensing path (for example, emitter to mirror, between mirror and receiver, see [Figure 15. Trip Test with corner mirror](#) on page 33).

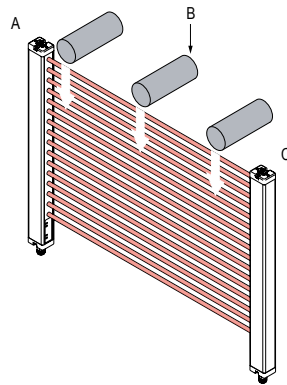


Figure 14. Trip Test

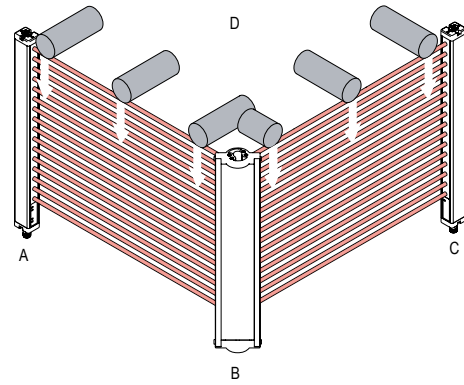


Figure 15. Trip Test with corner mirror

A	Emitter
B	Test Piece
C	Receiver

A	Emitter
B	Mirror
C	Receiver
D	Test Piece

6. If the EZ-SCREEN Type 2 System passes all checks during the trip test, go on to [EZ-SCREEN Type 2 Electrical Interface to the Guarded Machine](#) on page 34.

**WARNING: If Trip Test Indicates a Problem**

If the EZ-SCREEN Type 2 System does not respond properly to the trip test, do not attempt to use the System.

If this occurs, the System cannot be relied on to stop dangerous machine motion when a person or object enters the defined area.

Increased risk of harm could result.

Electrical Connections to the Guarded Machine

Make the electrical connections as described in the following sections ([OSSD Output Connections](#) on page 34 to [FSD Interfacing Connections](#) on page 35 as required by each individual application.

Lockout/tagout procedures may be required (refer to OSHA 1910.147, ANSI Z244-1, or the appropriate standard for controlling hazardous energy). Follow relevant electrical standards and wiring codes, such as the NEC, NFPA79 or IEC 60204-1.

Supply power and the external reset switch should already be connected. The EZ-SCREEN Type 2 must also have been aligned and passed the Initial Checkout, as described in [Initial Checkout Procedure](#) on page 28.

The final connections to be made are:

- OSSD outputs
- FSD interfacing
- MPCE connections

OSSD Output Connections

Both the Output Signal Switching Device (OSSD) outputs must be connected to the machine control so that the machine's safety-related control system interrupts the circuit or power to the Machine Primary Control Element(s) (MPCE), resulting in a non-hazardous condition.

Final Switching Devices (FSDs) typically accomplish this when the OSSDs go to an OFF state.

Refer to the output specifications in [Specifications and Accessories](#) on page 52 and the warning below before making OSSD output connections and interfacing the EZ-SCREEN Type 2 to the machine.



CAUTION: Shock Hazard

Always disconnect power from the EZ-SCREEN Type 2 and the guarded machine before making any connections or replacing any component. **Use extreme caution to avoid electrical shock at all times.**

**WARNING: Interfacing of Both OSSDs**

Both of the OSSD (Output Signal Switching Device) outputs must be connected to the machine control so that the machine's safety-related control system interrupts the circuit to the machine primary control element(s), resulting in a non-hazardous condition.

Never wire an intermediate device(s) (e.g., PLC, PES, or PC) that can fail in such a manner that there is the loss of the safety stop command, OR in such a manner that the safety function can be suspended, overridden, or defeated, unless accomplished with the same or greater degree of safety.

**WARNING: OSSD Interfacing**

To ensure proper operation, the EZ-SCREEN Type 2 output parameters and machine input parameters must be considered when interfacing the EZ-SCREEN Type 2 OSSD outputs to machine inputs.

Machine control circuitry must be designed so that the maximum open ground leakage current must not result in an ON condition.

Failure to properly interface the Safety Outputs to the guarded machine could result in serious bodily injury or death.

FSD Interfacing Connections

FSDs (Final Switching Devices) can take many forms, though the most common are forced-guided, mechanically linked relays or an interface module. The mechanical linkage between the contacts allows the device to be monitored by the External Device Monitoring circuit for certain failures.

Depending on the application, the use of FSDs can facilitate controlling voltage and current that differs from the OSSD outputs of the EZ-SCREEN Type 2. FSDs can also be used to control an additional number of hazards by creating multiple safety stop circuits.

Protective Stop (Safety Stop) Circuits

A protective stop (safety stop) allows for an orderly cessation of motion for safeguarding purposes, which results in a stop of motion and removal of power from the MPCEs (assuming this does not create additional hazards). A protective stop circuit typically comprises a minimum of two normally open (N.O.) contacts from forced-guided, mechanically linked relays, which are monitored (through Power Monitoring) to detect certain failures in order to prevent the loss of the safety function. Such a circuit can be described as a "safe switching point." Typically, protective stop circuits are either single-channel, which is a series connection of at least two N.O. contacts; or dual-channel, which is a separate connection of two N.O. contacts. In either method, the safety function relies on the use of redundant contacts to control a single hazard (if one contact fails ON, the second contact will arrest the hazard and prevent the next cycle from occurring). See [EZ-SCREEN Generic FSDs Wiring](#) on page 41.

The interfacing of the protective stop circuits must be accomplished so that the safety function can not be suspended, overridden, or defeated, unless accomplished in a manner at the same or greater degree of safety as the machine's safety related control system that includes the EZ-SCREEN Type 2.

The normally open safety outputs from an interface module provide a series connection of redundant contacts that form protective stop circuits for use in either single-channel or dual-channel control. See [Generic Wiring — Interface Module \(2-Channel EDM, Manual Reset\)](#) on page 42.

Dual-Channel Control

Dual-channel control provides the ability to electrically extend the safe switching point beyond the FSD contacts. With proper monitoring, this method of interfacing is capable of detecting certain failures in the control wiring between the safety stop circuit and the MPCEs. These failures include a short-circuit of one channel to a secondary source of energy or voltage, or the loss of the switching ability of one of the FSD outputs. Such failures could lead to the loss of redundancy — or to a complete loss of safety, if not detected and corrected.

The possibility of a failure to the wiring increases as the physical distance between the FSD safety stop circuits and the MPCEs increase, as the length or the routing of the interconnecting wires increases, or if the FSD safety stop circuits and the MPCEs are located in different enclosures. For this reason, dual-channel control with EDM monitoring should be used in any installation where the FSDs are located remotely from the MPCEs.

Single-Channel Control

Single-channel control uses a series connection of FSD contacts to form a safe switching point. After this point in the machine's safety-related control system, failures can occur that would result in the loss of the safety function (such as a short-circuit to a secondary source of energy or voltage).

For this reason, single-channel control interfacing should be used only in installations where FSD safety stop circuits and the MPCEs are mounted within the same control panel, adjacent to each other, and are directly connected to each other; or where the possibility of such a failure can be excluded. If this can not be achieved, then dual-channel control should be used.

Methods to exclude the possibility of these failures include, but are not limited to:

- Physically separating interconnecting control wires from each other and from secondary sources of power.
- Routing interconnecting control wires in separate conduit, runs, or channels.
- Locating all elements (modules, switches, and devices under control) within one control panel, adjacent to each other, and directly connected with short wires.
- Properly installing multi-conductor cabling and multiple wires through strain relief fittings. (Over-tightening of a strain-relief can cause short-circuits at that point.)
- Using positive-opening or direct-drive components, installed and mounted in a positive mode.

Machine Primary Control Elements

Each of the two Machine Primary Control Elements (MPCE1 and MPCE2) must be capable of immediately stopping the dangerous machine motion, irrespective of the state of the other. These two channels of machine control need not be identical, but the stop time performance of the machine (T_s , used to calculate the safety distance, see [EZ-SCREEN Calculating Safety Distance](#) on page 13) must take into account the slower of the two channels. Some machines offer only one Primary Control Element. For such machines, it may be necessary to duplicate the circuit of the single MPCE, by adding a second. Refer to [Generic Wiring to FSDs \(manual reset\)](#) on page 41 and [Generic Wiring — Interface Module \(2-Channel EDM, Manual Reset\)](#) on page 42, or consult the machine manufacturer for additional information.

Manual Reset/Remote Test Input and EDM

A means is provided for the connection of an external remote test switch or contact (typically a normally open, held closed). Cycling this switch “turns OFF” both OSSD outputs.

A single input provides the means to reset the system from a latch or lockout condition, to externally test the light screen and its interface, and to monitor external devices (EDM) for proper operation. If the System is in Run condition with outputs ON, operating the switch results in a test. If the System is Latched or Locked Out, operating the switch results in a reset. If this input is connected to 0V dc or left floating, the System goes to a lockout condition on power-up. (See [Troubleshooting and Lockout Conditions](#) on page 47 for clearing lockouts.)

Connect the receiver's reset/test wire (pin 8) to the supply voltage (see [Generic Wiring to FSDs \(manual reset\)](#) on page 41 and [Generic Wiring — Interface Module \(2-Channel EDM, Manual Reset\)](#) on page 42) via the reset switch. The switch should be a normally closed (N.C.) reset switch, or contacts of the Machine Control Test circuit (typically a normally open contact held or energized closed), or the monitoring contacts of the external device(s) being verified. One switch could be used for the Reset and Test functions, or they can be separate switches. However, all switches should be mounted as specified for a reset switch (see [Reset Switch Location](#) on page 18).

Manual Reset/System Test Procedure

To operate the switch (and perform a manual reset or a system test), open the normally closed (N.C.) switch for a minimum of 1/4 second and then close it.

Manual Reset

From a Latched or Lockout condition, operating the switch results in a manual reset. Safe work procedures must require that a start-up procedure is followed and that the individual performing the reset of the guarding device verifies that the entire hazardous area is clear of all personnel, before performing each reset. If any area can not be observed from the reset switch location, additional supplementary guarding must be used: at minimum, visual and audible warnings of machine start-up.

Resetting a safe guarding device must not initiate hazardous motion.

Remote (External) Test

When in RUN mode, opening this switch for more than 1/4 second will initiate a Test cycle that turns OFF the OSSD outputs and generates an internal self-test.

- Automatic (Machine) Test: An external switch, typically a normally open contact that is held closed, is used to externally generate a test cycle of the EZ-SCREEN Type 2 and its interface. Depending on the application this switch can be a limit-style switch, a hard contact from a relay, or an output from the machine control logic.
- Manual Test: A normally closed (N.C.) momentary type switch used for manual reset can also be used to manually initiate a test cycle. This remote Test input may be useful for EZ-SCREEN Type 2 System setup and to verify machine control circuit operation.



WARNING: Test Function

A machine or automatic test of the EZ-SCREEN Type 2 and its interface may be required as determined by a risk assessment and appropriate standard (for example, ISO 14121 and EN ISO 13849-1). **Failure to test the safeguarding function at appropriate intervals can lead to the loss of the safety function.**

External Device Monitoring Hookup

It is strongly recommended that one normally closed and one normally open, forced-guided monitoring contact of each FSD and MPCE be connected to the Monitoring circuit (see [Generic Wiring to FSDs \(manual reset\)](#) on page 41 and [Generic Wiring — Interface Module \(2-Channel EDM, Manual Reset\)](#) on page 42). If this is done, proper operation of the MPCEs will be verified.

Receiver quick disconnect pin 8 provides connection for external device monitoring. External Device Monitoring (EDM) must be wired in one of two configurations: Power Monitoring or No EDM.

- Power Monitoring is a series-parallel connection of monitor contacts that are forced-guided (mechanically linked) from each device controlled by the EZ-SCREEN. The monitoring contacts should transition within 200 milliseconds of the OSSD outputs switching ON or OFF. If the transition results in an open condition on pin 8 (Reset/Test input) longer than 200 ms, a Test cycle will turn OFF the OSSD outputs. Refer to [Generic Wiring to FSDs \(manual reset\)](#) on page 41 and [Generic Wiring — Interface Module \(2-Channel EDM, Manual Reset\)](#) on page 42 for Power Monitoring hookup.

- No Monitoring. Use this configuration initially, in order to perform the initial checkout; see [EZ-SCREEN Type 2 Light Screen Initial Checkout](#) on page 28. If No Monitoring is selected, the user must ensure that any single failure of the external devices does not result in a hazardous condition and, in such a case, a successive machine cycle will be prevented. To configure the System for No Monitoring, simply do not interface the Power Monitoring circuit (i.e., the four forced-guided normally open contacts from each device) and connect directly to +24V dc.



CAUTION: EDM Monitoring

If the system is configured for "No Monitoring," it is the user's responsibility to ensure that this does not create a hazardous situation.

Preparing for System Operation

After the initial trip test has been accomplished, and the OSSD safety outputs and EDM connections have been made to the machine to be controlled, the EZ-SCREEN Type 2 is ready for testing in combination with the guarded machine.

The operation of the EZ-SCREEN Type 2 with the guarded machine must be verified before the combined System and machine may be put into service. To do this, a Qualified Person must perform the Commissioning Checkout Procedure described in [Commissioning Checkout](#) on page 38.

Commissioning Checkout

Perform this checkout procedure as part of System installation (after the System has been interfaced to the guarded machine), or whenever changes are made to the System (either a new configuration of the EZ-SCREEN Type 2 or changes to the machine). A Qualified Person must perform the procedure; checkout results should be recorded and kept on or near the guarded machine as required by applicable standards.

To prepare the System for this checkout:

1. Examine the guarded machine to verify that it is of a type and design compatible with the EZ-SCREEN Type 2 System. See [Examples: Inappropriate Applications](#) on page 8 for a list of misapplications.
2. Verify that the minimum safety distance from the closest danger point of the guarded machine to the defined area is not less than the calculated distance, per [Calculating the Safety Distance \(Minimum Distance\)](#) on page 13 of this manual.
3. Verify that:
 - Access to any dangerous parts of the guarded machine is not possible from any direction not protected by the EZ-SCREEN Type 2 System, hard guarding, or supplemental safeguarding.
 - It is not possible for a person to stand between the defined area and the dangerous parts of the machine.
 - Supplemental safeguarding and hard guarding, as described by the appropriate safety standards, are in place and functioning properly in any space (between the defined area and any hazard) which is large enough to allow a person to stand undetected by the EZ-SCREEN Type 2.
4. Verify that all reset switches are mounted outside and in full view of the guarded area, out of reach of anyone inside the guarded area, and that means of preventing inadvertent use is in place.
5. Examine the electrical wiring connections between the EZ-SCREEN Type 2 FSD outputs and the guarded machine's control elements to verify that the wiring meets the requirements stated in [FSD Interfacing Connections](#) on page 35.
6. Inspect the area near the defined area (including work pieces and the guarded machine) for reflective surfaces (see [Adjacent Reflective Surfaces](#) on page 19). Remove the reflective surfaces if possible by relocating them, painting, masking or roughening them. Remaining problem reflections will become apparent during the Trip Test in step 10.
7. Apply power to the EZ-SCREEN Type 2 System. Verify that power to the guarded machine is OFF. Remove all obstructions from the defined area. Latch Output models: (Manual Power-Up), both Alignment indicators will be flashing Yellow. Perform a manual reset (open the reset switch for 1/4 second, then close it).

8. Observe the Status and Alignment indicators:

- Lockout: Status Blocked flashing Red
- Blocked: Status Blocked ON Red Alignment indicators ON, OFF, or one of each Status Clear OFF
- Clear: Status Clear ON Green Alignment indicators both ON Status Blocked OFF
- Latch: (defined Status Blocked ON Red Alignment indicators flashing Yellow area clear) Status Clear OFF

9. A Blocked condition indicates that one or more of the beams is misaligned or interrupted. To correct this situation see the Alignment procedure in [Optical Alignment](#) on page 31. If the System is in a Latch condition, perform a manual reset.

10. Once the Green and Yellow Status indicators are ON, perform the trip test (described in [Trip Test](#) on page 32) on each sensing field to verify proper System operation and to detect possible optical short circuits or reflection problems. Do not continue until the EZ-SCREEN Type 2 passes the trip test.

Do not expose any individual to any hazard during the following checks.

**WARNING: Before Applying Power to the Machine**

Verify that the guarded area is clear of personnel and unwanted materials (such as tools) before applying power to the guarded machine. Failure to do so could result in serious bodily injury or death.

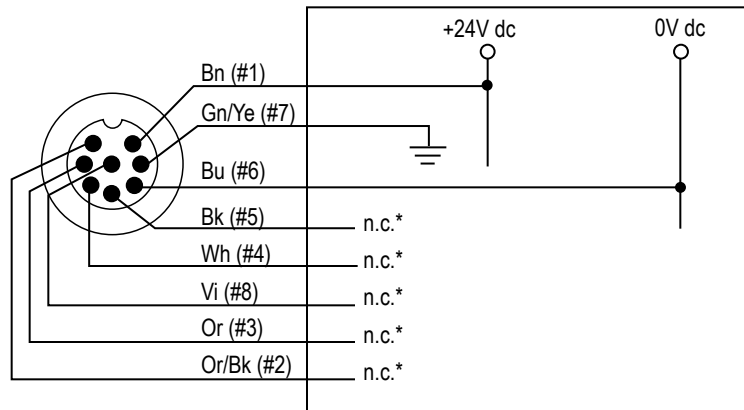
11. Apply power to the guarded machine and verify that the machine does not start up. Interrupt (block) the defined area with the supplied test piece and verify that it is not possible for the guarded machine to be put into motion while the beam(s) is blocked.
12. Initiate machine motion of the guarded machine and, while it is moving, use the supplied test piece to block the defined area. Do not attempt to insert the test piece into the dangerous parts of the machine. Upon blocking any beam, the dangerous parts of the machine should come to a stop with no apparent delay. Remove the test piece from the beam; verify that the machine does not automatically restart, and that the initiation devices must be engaged to restart the machine.
13. Remove electrical power to the EZ-SCREEN Type 2. Both OSSD outputs should immediately turn OFF, and the machine should not be capable of starting until power is re-applied to the EZ-SCREEN Type 2.
14. Test the machine stopping response time, using an instrument designed for that purpose, to verify that it is the same or less than the overall system response time specified by the machine manufacturer. (Banner's applications engineering department can recommend a suitable instrument.) Do not continue operation until the entire checkout procedure is complete and all problems are corrected.

**WARNING: Do Not Use Machine Until System Is Working Properly**

If all of these checks cannot be verified, do not attempt to use the safety system that includes the EZ-SCREEN Type 2 and the guarded machine until the defect or problem has been corrected (see Troubleshooting). Attempts to use the guarded machine under such conditions could result in serious bodily injury or death.

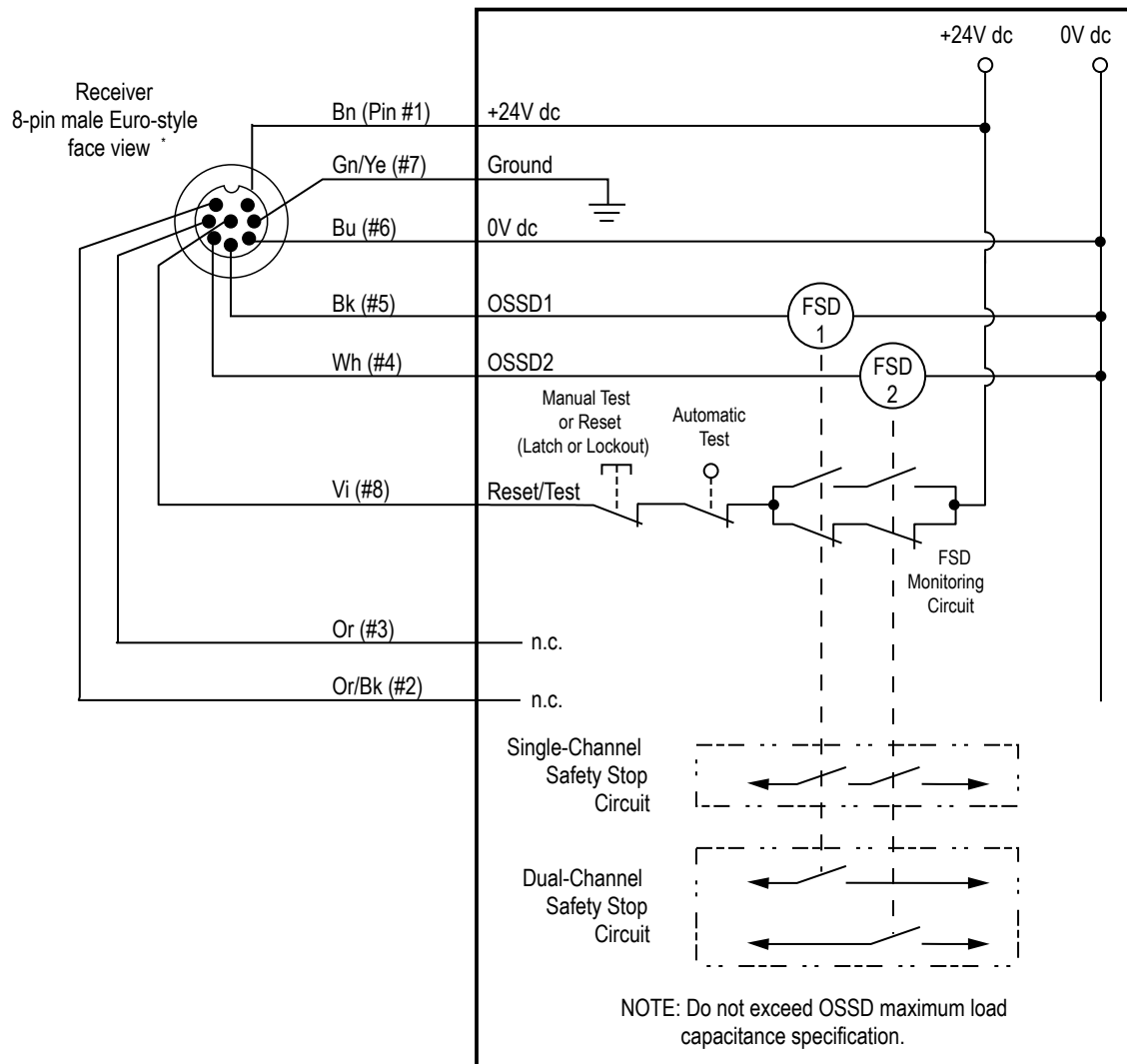
Reference Wiring Diagrams

Generic Emitter Wiring Diagram



NOTE: Pins 2, 3, 4, 5, and 8 are not connected or are connected in parallel to the same color wire from the receiver cable.

Generic Wiring to FSDs (manual reset)



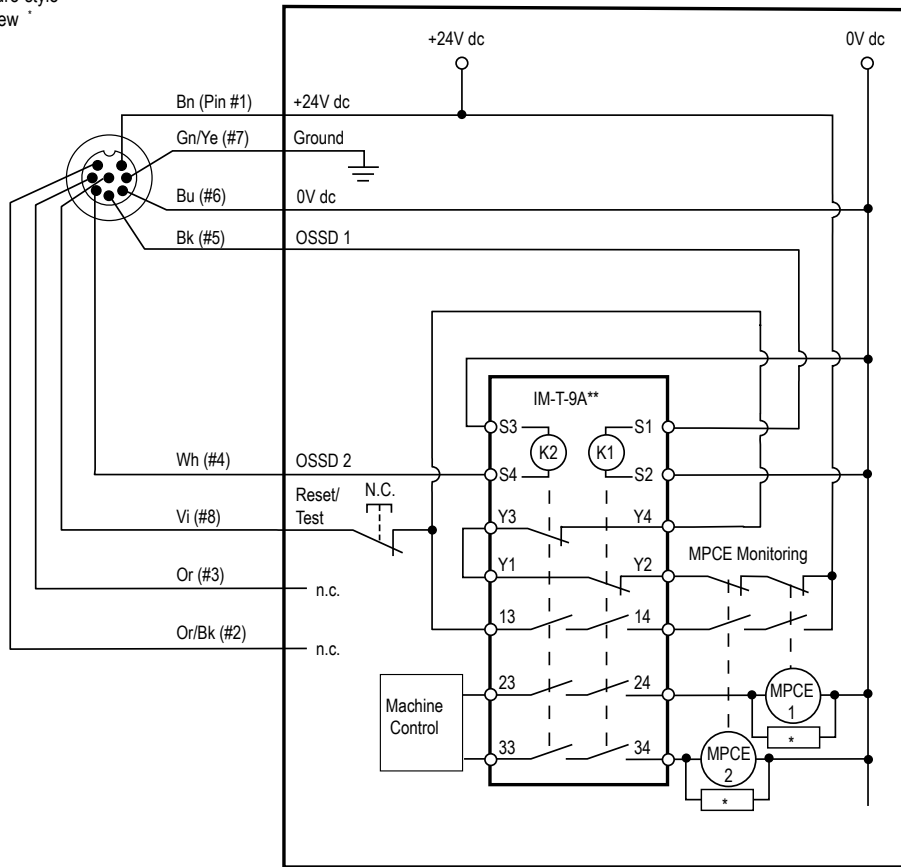
*See [Single-Ended \(Machine Interface\) Cordsets](#) on page 57 for available cordsets



NOTE: Pins 2 and 3 are not connected, or are connected in parallel to the same color wire from the emitter cordset and properly terminated.

Generic Wiring — Interface Module (2-Channel EDM, Manual Reset)

Receiver
8-pin male Euro-style
face view



NOTE:

- Pins 2 and 3 are not connected, or are connected in parallel to the same color wire from the emitter cord-set and properly terminated.
- Installation of transient (arc) suppressors across the coils of MPCE1 and MPC2 is recommended.
- See [Single-Ended \(Machine Interface\) Cordsets](#) on page 57 for available cordset information

Other interfacing modules and solutions are available, see [Accessories](#) on page 57.



WARNING: Use of Transient Suppressors

If transient suppressors are used, they **MUST** be installed across the coils of the machine control elements. NEVER install suppressors directly across the contacts of the IM-T-..A Module. It is possible for suppressors to fail as a short circuit. If installed directly across the contacts of the IM-T-..A Module, a short-circuit suppressor will create an unsafe condition

System Operation

Security Protocol

Certain procedures for installing, maintaining and operating the EZ-SCREEN Type 2 must be performed by either Designated Persons or Qualified Persons.

A Designated Person is identified and designated in writing, by the employer, as being appropriately trained and qualified to perform system resets and the specified checkout procedures on the EZ-SCREEN Type 2. The Designated Person is empowered to:

- Perform manual resets and hold possession of the reset key (see [Reset Procedures](#) on page 43), and
- Perform the Daily Checkout Procedure.

A Qualified Person, by possession of a recognized degree or certificate of professional training, or by extensive knowledge, training and experience, has successfully demonstrated the ability to solve problems relating to the installation of the EZ-SCREEN Type 2 System and its integration with the guarded machine. In addition to everything for which the Designated Person is empowered, the Qualified Person is empowered to:

- Install the EZ-SCREEN Type 2 System
- Perform all checkout procedures
- Make changes to the internal configuration settings
- Reset the System following a Lockout condition

Reset Procedures

Resetting the System

System resets are performed using an external reset switch. This switch must be located outside the guarded area, and must not be within reach from within the guarded area (see [Reset Switch Location](#) on page 18). Its location should provide a clear view of the entire safeguarded area. If any hazardous areas are not in view from the switch location, additional means of safeguarding must be provided. The switch should be protected from accidental or unintended actuation (for example, through the use of rings or guards).

If supervisory control of the reset switch is required, a key switch may be used, with the key kept in the possession of a Designated or Qualified Person. Using a key switch will also provide some level of personal control, since the key may be removed from the switch. This will hinder a reset while the key is under the control of an individual, but must not be relied upon solely to guard against accidental or unauthorized reset. Spare keys in the possession of others or additional personnel entering the safeguarded area unnoticed may create a hazardous situation.

Receiver Resets

The EZ-SCREEN Type 2 receiver has a Reset input, pin 8 (Violet wire), that allows the System to be manually reset.

Receiver manual resets are required in the following situations:

- Trip Output operation – only after a System Lockout (see Section 5 for causes).
- Latch Output operation – at power-up, after each Latch condition occurs, and after a System Lockout.

Reset Procedure

To reset the receiver, open the reset switch for 1/4 second, then close it.

Emitter Resets

In the rare occurrence that an emitter requires a reset, power the sensor down, then power it up. Emitter resets are needed only if a Lockout occurs.

Status Indicators

The emitter has one LED and the receiver has four, to provide an ongoing indication of light screen and system operation. In normal operation, the status indicators are as described below and as shown in [Figure 16. Status Indicator behavior during the trip test](#) on page 45. Additional LED condition combinations indicate errors or faults; refer to [Troubleshooting and Lockout Conditions](#) on page 47.

Emitter

Power/Fault Indicator: Green LED indicates whether power is applied or a Fault condition exists.

Emitter				
Indicator	Color	ON	Flashing	OFF
Power/Fault	Green	Power is applied	Fault indication	No Power

Receiver

Alignment Indicators

Two Yellow Alignment indicators (Top and Bottom) tell the alignment status of the top and bottom beams in the light screen. This is helpful for sensor alignment: first align the Top beam (the sync beam), then the bottom beam. The Alignment indicators also flash together to indicate a manual reset is needed (Latch output models).

Receiver				
Indicator	Color	ON	Flashing	OFF
Top Alignment	Yellow	Top (sync) beam is aligned and clear	(Both together) System is aligned; waiting for manual reset (Latch models)	Top (sync) beam is blocked or misaligned
Bottom Alignment	Yellow	Bottom beam is aligned and clear		Bottom beam is blocked or misaligned; sync beam possibly blocked

Status Indicators

Two Status indicators (Blocked and Clear) work together to indicate the status of the light screen.

Receiver				
Indicator	Color	ON	Flashing	OFF
Clear Status	Green	Light screen aligned and clear; outputs ON	Test mode (with Red ON)	Light screen blocked; outputs OFF
Blocked Status	Red	Light screen blocked; outputs OFF	Lockout	Light screen aligned and clear; outputs ON

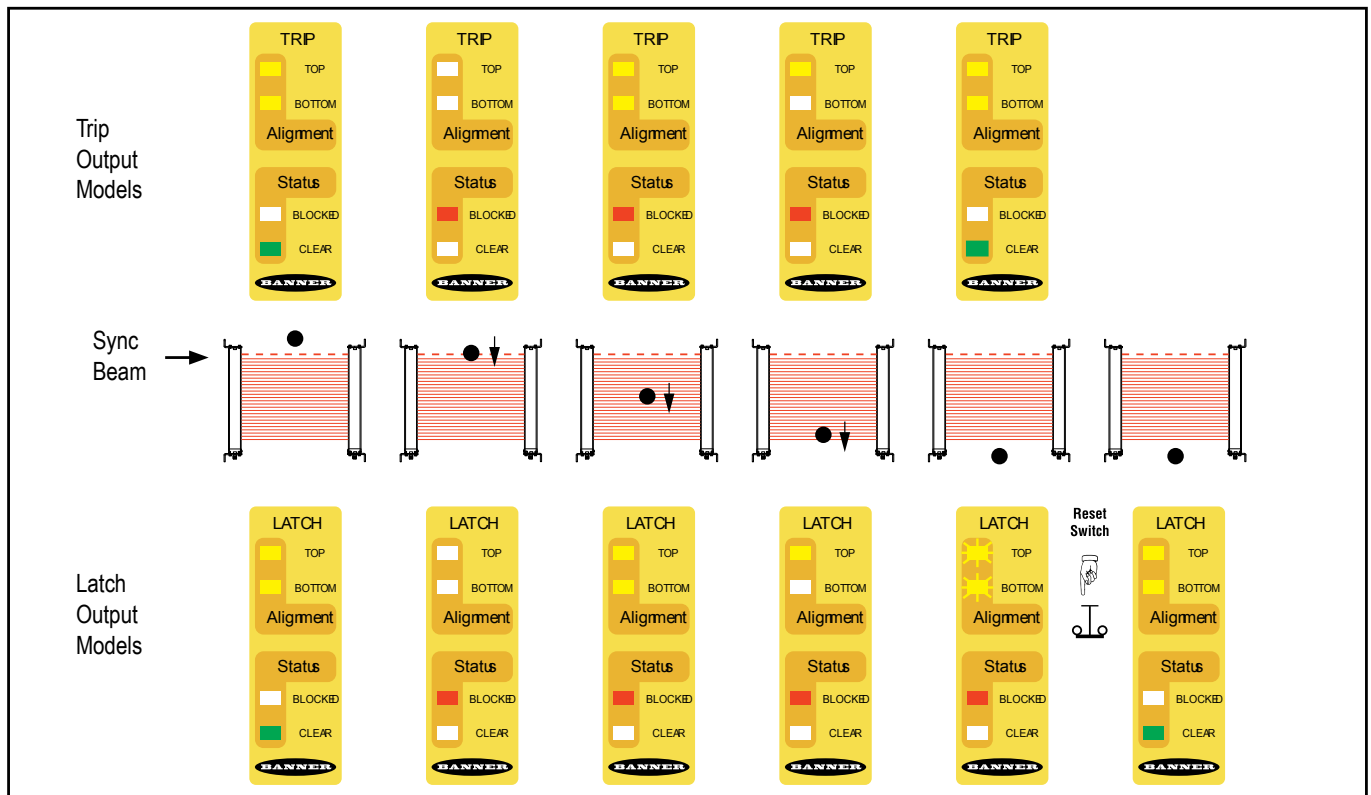


Figure 16. Status Indicator behavior during the trip test

Normal Operation

System Power-Up

Apply power and verify that the Status Blocked LED is OFF, and Status Clear LED is ON Green.

Trip Output Systems: When power is applied, each sensor will conduct self-tests to detect critical internal faults and prepare for operation. (If either sensor detects a critical fault, scanning ceases, the receiver outputs remain OFF and diagnostic information is displayed via the LEDs; see [Troubleshooting and Lockout Conditions](#) on page 47.) If no faults are detected, the receiver will look for an optical sync pattern from the emitter. If the receiver is aligned and receiving the proper sync pattern, it enters RUN mode and begins scanning to determine the blocked or clear status of each beam. No manual reset operation is required.

Latch Output Systems: When power is applied, each sensor will conduct self-tests to detect critical internal faults and prepare for operation. (If either sensor detects a critical fault, scanning ceases, the receiver outputs remain OFF and diagnostic information is displayed via the LEDs; see [Troubleshooting and Lockout Conditions](#) on page 47.) If no faults are detected, the receiver will look for an optical sync pattern from the emitter. If the receiver is aligned and receiving the proper sync pattern, it begins scanning to determine the blocked or clear status of each beam. When all beams are aligned, the Yellow Alignment indicators will flash to indicate the System is waiting for a manual reset. After a valid manual reset, the System enters Run mode and begins scanning.

Run Mode

Trip Output Systems: If any beams become blocked while the System is running, the receiver outputs turn OFF within the stated System response time (see [EZ-SCREEN Type 2 Models With Response Times](#) on page 14). When all the beams become clear, the receiver outputs come back ON. No resets of any kind are needed. All required machine control resets are provided by the machine control circuit.

Latch Output Systems: If any beams become blocked while the System is running, the receiver outputs turn OFF within the stated System response time (see [EZ-SCREEN Type 2 Models With Response Times](#) on page 14). When all the beams become clear, the receiver

Clear Status indicator be ON Green and the Alignment indicators will flash, indicating the System is waiting for a manual latch reset. When a valid reset signal is received and all beams remain clear, the receiver outputs turn ON.

Internal Faults (Lockouts): If either sensor detects a critical fault, scanning ceases, the receiver outputs turn OFF and diagnostic information is displayed via the LEDs. See [Troubleshooting and Lockout Conditions](#) on page 47 for resolution of error/fault conditions.

Manual Reset Procedure

Open the reset switch for at least 1/4 second, then close it.

Periodic Checkout Requirements

To ensure continued reliable operation, the System must be checked out periodically.

At every shift change, power-up and machine setup change, the Daily checkout should be performed; this checkout may be performed by a Designated or Qualified Person.

Semi-annually, the System and its interface to the guarded machine should be thoroughly checked out; this checkout must be performed by a Qualified Person ([Checkout Procedure Schedule](#) on page 51). A copy of these test results should be posted on or near the machine.

Whenever changes are made to the System (either a new configuration of the EZ-SCREEN Type 2 System or changes to the machine), the Commissioning Checkout should be performed (see [EZ-SCREEN Type 2 Commissioning Checkout](#)).



WARNING: Verify Proper Operation

The EZ-SCREEN Type 2 can do the job for which it was designed only if it and the guarded machine are operating properly, both separately and together. It is the user's responsibility to verify this, on a regular basis, as instructed in Sections 6.3 and 6.4. Failure to correct such problems can result in an increased risk of harm.

Before the system is put back into service, it must be verified that the EZ-SCREEN Type 2 System and the guarded machine perform exactly as outlined in the checkout procedures and any problem(s) are found and corrected.

Troubleshooting and Maintenance

Troubleshooting and Lockout Conditions

Evaluate status indicators per [Status Indicators](#) on page 44.

A Lockout condition causes all of the EZ-SCREEN Type 2 OSSD outputs to turn or remain OFF, sending a stop signal to the guarded machine. Each sensor provides diagnostic information, via the LEDs, to assist in the identification of the cause(s) of lockouts. Lockout conditions are indicated as shown in [Table 1: Troubleshooting](#) on page 48.

Recovery Procedures

To recover from a Lockout condition, correct all errors and perform sensor resets as indicated below.

Receiver (System Reset)

Open the Reset switch for 1/4 second and then close it, or (for Trip Output models not using a reset button) power the sensor down, wait a second or two, then power it up.

Emitter Reset

Power the sensor down, wait a second or two, and then power it up (in the unlikely event that an emitter reset is needed).



WARNING: Lockouts and Power Failures

Power failures and Lockout conditions are indication of a problem and must be investigated immediately by a Qualified Person. Attempts to continue to operate machinery by bypassing the EZ-SCREEN Type 2 System or other safeguards is dangerous and could result in an increased risk of harm.



WARNING: Shut Down Machinery Before Servicing

The machinery to which the EZ-SCREEN Type 2 System is connected must not be operating at any time during major service or maintenance. This may require lockout/tagout procedures (refer to OSHA1910.147, ANSI Z244-1, or the appropriate standard for controlling hazardous energy). Servicing the EZ-SCREEN Type 2 while the hazardous machinery is operational could result in serious bodily injury or death.

Table 1: Troubleshooting

Display	LED Status	Possible Cause and Appropriate Action
Emitter		
Power/Fault	Green flashing	Emitter Failure <ul style="list-style-type: none"> • Check power supply for low or erratic voltage, or excessive electrical noise. • Verify that the sensor has a good earth ground. If condition continues, contact Factory.
Power/Fault	Green OFF	Power Supply Failure <ul style="list-style-type: none"> • Check power supply.
Receiver		
Alignment Top Bottom Status Blocked Clear	Yellow flashing Yellow flashing Red flashing Green OFF	Output Fault <ul style="list-style-type: none"> • Check output connections. • Check for a short between OSSD1 and OSSD2 or to a secondary source of power. • In the event of connection to a capacitive load greater than 0.1 μF, contact Factory. • Open Reset/Test for at least 1/4 second and close. If condition continues, contact Factory
Alignment Top Bottom Status Blocked Clear	Yellow flashing Yellow OFF Red flashing Green OFF	Optical Fault <ul style="list-style-type: none"> • Open Reset/Test for at least 1/4 second and close. • Check for optical interference or noise. If condition continues, contact Factory.
Alignment Top Bottom Status Blocked Clear	Yellow OFF Yellow OFF Red flashing Green OFF	Internal Fault <ul style="list-style-type: none"> • Open Reset/Test for at least 1/4 second and close. • Check power supply for low or erratic voltage, or excessive electrical noise. • Verify that the sensor has a good earth ground. If condition continues, contact Factory.
Alignment Top Bottom Status Blocked Clear	Yellow OFF Yellow OFF Red ON Green ON	Reset/Test Input Fault <ul style="list-style-type: none"> • Reset/Test input open at power-up. • Switch device OFF, verify Reset/Test input is connected to +24V dc (e.g., the reset button or switch is closed) and reapply power.
Alignment Top Bottom Status Blocked Clear	Yellow OFF Yellow OFF Red ON Green flashing	Test Mode <ul style="list-style-type: none"> • Reset/Test input is open.
Alignment Top Bottom Status Blocked Clear	Yellow OFF Yellow OFF Red OFF Green OFF	Power Supply Failure <ul style="list-style-type: none"> • Check power supply.

Electrical and Optical Noise

The EZ-SCREEN Type 2 is designed and manufactured to be highly resistant to electrical and optical noise and to operate reliably in industrial settings. However, serious electrical and/or optical noise may cause a random Trip or Latch condition. In very extreme electrical noise cases, a Lockout is possible. In order to minimize the effects of transitory noise, the EZ-SCREEN Type 2 will respond to noise only if the noise is detected on multiple consecutive scans.

If random nuisance Trips occur, check the following:

- Poor connection between the sensor and earth ground
- Optical interference from adjacent light screens or other photoelectrics
- Sensor input or output wires routed too close to “noisy” wiring.

Sources of Electrical Noise

Checking for sources of electrical noise: It is very important that the light screen sensors have a good earth ground. Without this, the System can act like an antenna and random Trips and Lockouts can occur.

All EZ-SCREEN Type 2 wiring is low voltage; running these wires alongside power wires, motor/servo wires, or other highvoltage wiring, can inject noise into the EZ-SCREEN Type 2. It is good wiring practice (and may be required by code) to isolate EZ-SCREEN Type 2 wires from high-voltage wires.

The Banner model BT-1 Beam Tracker (see [Alignment Aids](#) on page 65) is a very good tool for detecting electrical noise. It can be used to detect electrical transient spikes and surges. Cover the lens of the BT-1 with electrical tape to block optical light from getting into the receiver lens. Press the “RCV” button on the BT-1 and position the Beam Tracker on the wires going to the EZ-SCREEN Type 2 or any other nearby wires. Noise caused by the switching of inductive loads should be addressed by installing proper transient suppression across the load.

Sources of Optical Noise

Checking for sources of optical noise: Turn off the emitter, completely block the emitter, or open the Test input, then use a Banner BT-1 Beam Tracker to check for light at the receiver. Press the “RCV” button on the BT-1 and move it across the full length of the receiver’s sensing window. If the BT-1’s indicator lights, check for light from other sources (other safety light screens, screens or points, or standard photoelectric sensors) by “tracking down” the emitted light from them.

Servicing and Maintenance

Cleaning

EZ-SCREEN Type 2 emitters and receivers are constructed of aluminum with a yellow painted finish and are rated IP65. Lens covers are acrylic. Emitters and receivers are best cleaned using mild detergent or window cleaner and a soft cloth. Avoid cleaners containing alcohol, as they may damage the acrylic lens covers.

Warranty Service

Banner Limited Warranty

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application of the Banner product.

The EZ-SCREEN Type 2 is designed for reliability. Do not open the emitter or receiver housings, other than to access for configuration. They contain no field-replaceable components. If repair is necessary, do not attempt to repair an emitter or receiver yourself; return the unit to the factory.

Should it become necessary to return a component to the factory, please do the following:

1. Contact the Banner Factory Application Engineering group at the address or numbers listed below:

Banner Engineering Corp.
Application Engineering Group
9714 Tenth Avenue North
Minneapolis, MN 55441

Phone: 763.544.3164
Toll-Free (US Only): 888.373.6767
email: sensors@bannerengineering.com

They will attempt to troubleshoot the system from your description of the problem. If they conclude that a component is defective, they will issue an RMA (Return Merchandise Authorization) number for your paperwork, and give you the proper shipping address.

2. Pack the component(s) carefully. Damage which occurs during return shipping is not covered by warranty.

Limited Warranty

Disposal

Devices that are no longer in use should be disposed of according to the applicable national and local regulations.

Checkout Procedure Schedule

This section lists the schedule of checkout procedures, and describes where each procedure is documented. Checkouts must be performed as describes, and results should be recorded and kept in the appropriate place (for example, near the machine, and/or in a technical file).

Schedule of Checkouts

Checkout Procedure	When to Perform	Where to Find the Procedure	Who Must Perform the Procedure
Trip Test	<ol style="list-style-type: none"> 1. At Installation 2. Any time the System, the guarded machine, or any part of the application is altered. 	Trip Test on page 32	Qualified Person
Commissioning Checkout	<ol style="list-style-type: none"> 1. At Installation 2. Whenever changes are made to the System (for example, either a new configuration of the EZ-SCREEN Type 2 or changes to the guarded machine. 	Commissioning Checkout on page 38	Qualified Person
Shift/Daily Checkout	<ol style="list-style-type: none"> 1. At each shift change. 2. Whenever the System is powered up and machine setup change. <p>During continuous machine run periods, this checkout should be performed at intervals not to exceed 24 hours.</p>	<p>Daily Checkout Card (Banner P/N 122450)</p> <p>A copy of checkout results should be recorded and kept in the appropriate place (for example, near or on the machine, in the machine's technical file).</p>	Designated Person or Qualified Person
Semi-Annual Checkout	<p>Every six months following system installation, or whenever changes are made to the system (either a new configuration fo the EZ-SCREEN Type 2 or changes to the machine).</p>	<p>Semi-Annual Checkout Card (Banner P/N 122451)</p> <p>A copy of checkout results should be recorded and kept in the appropriate place (for example, near or on the machine, in the machine's technical file).</p>	Qualified Person

Specifications and Accessories

An EZ-SCREEN Type 2 System includes a compatible emitter and receiver (equal length; available separately or in pairs), and two cables. Mounting hardware is included with each emitter and receiver. Interfacing solutions include IM-T-... modules, or redundant positively guided contactors; see [Interface Modules](#) on page 60.

Specifications

General Specifications

Short Circuit Protection

All inputs and outputs are protected from short circuits to +24V dc or dc common.*

Electrical Safety Class

III (per IEC 61140: 1997)

Operating Range

0.2 to 15 m (8" to 50') — Range decreases with use of mirrors and/or lens shields:

- Lens shields — approximately 10% less range per shield.
- Glass-surface mirrors — approximately 8% less range per mirror

See the specific mirror data sheet for more information.

Resolution

30 mm (1.18")

Effective Aperture Angle (EAA)

Meets Type 2 requirements per IEC 61496-2, Section 5.2.9
± 5° @ 3 m

Ambient Light Immunity

> 10,000 lux at 5° angle of incidence

Strobe Light Immunity

Immune as per IEC 61496-2

Response Time

Dependent on number of beams (see [EZ-SCREEN Type 2 Models With Response Times](#) on page 14)

Enclosure

Extruded aluminum housing with yellow polyester powder finish standard and well-sealed, rugged die-cast zinc end caps, acrylic lens cover.

Rating

IEC IP65

Operating Conditions

Temperature: I 0° to +55° C (+32° to 131°F)

Max. Relative Humidity: 95% maximum relative humidity (non-condensing)

Shock and Vibration

Components have passed vibration and shock tests according to IEC 61496-1. This includes vibration (10 cycles) of 10-55 Hz at 0.35 mm (0.014") single amplitude (0.70 mm peak-to-peak) and shock of 10 g for 16 milliseconds (6,000 cycles).

Certifications



Safety Ratings

Type 2 per IEC 61496-1,-2; Category 2 PLd per EN ISO 13849-1; SIL2 per IEC 61508

	8 Beams	96 Beams
MTTF _d (EN ISO 13849-1)	284.14 yr.	47.65 yr.
Mission Time, T _m	20 years	
PFH (h ⁻¹) (IEC 61508)	6.9 x 10 ⁻⁸	6.5 x 10 ⁻⁷

*The external voltage supply must be capable of buffering brief mains interruptions of 20 ms, as specified in IEC/EN 60204-1.

Emitter Specifications

Supply Voltage at the Device*

24V dc $\pm 20\%$ (use a PELV-rated power supply according to EN IEC 60950)

Supply Current

50 mA max.

Wavelength of Emitter Elements

Infrared LEDs, 950 nm at peak emission

*The external voltage supply must be capable of buffering brief mains interruptions of 20 ms, as specified in IEC/EN 60204-1.

Receiver Specifications

Supply Voltage at the Device*

24V dc $\pm 20\%$ (use a PELV-rated power supply according to EN IEC 60950)

Supply Current (no load) (V_{in})

90 mA max., exclusive of OSSD1 and OSSD2 loads (up to an additional 0.5A each)

EDM Input

"Power Monitoring" accomplished via Reset/Remote Test input

Reset Input / Remote Test Input

Connect to +24V dc via a normally closed (N.C.) reset switch

Auto Rest (Trip Output) Models: Test/Reset

Manual Rest (Latch Output) Models: Test/Restart/Reset

Output Signal Switching Devices (OSSDs)

Two redundant solid-state 24V dc, 0.5 A max. sourcing OSSD (Output Signal Switching Device) safety outputs. (Use optional interface modules for ac or larger dc loads.)

Not compatible with the Banner "Safety Handshake."

ON-State voltage: $> V_{in} - 1.5V$ dc

OFF-State voltage: 0.2V dc max.

Max. load capacitance: 100 nF

Min. load resistance: 48 Ω

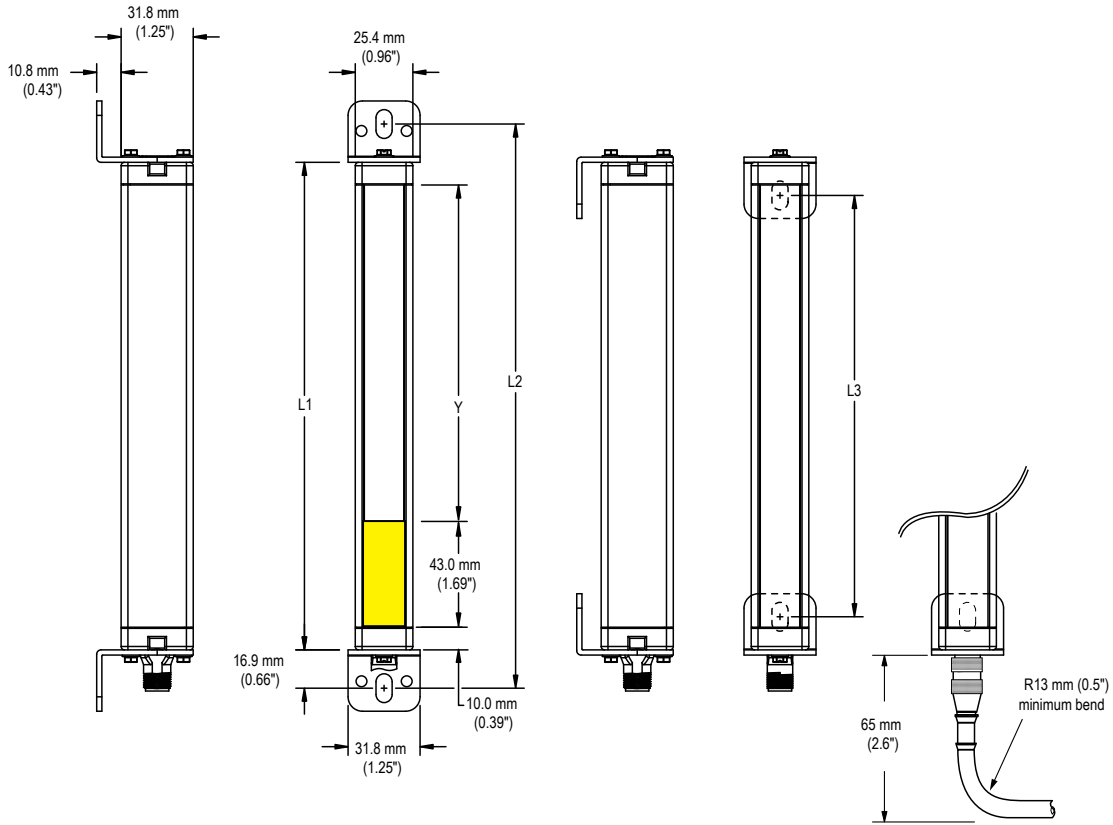
Open ground leakage current: 0.65 mA max.

OSSD test pulse width: 200-250 microseconds typical

OSSD test pulse period: 260 milliseconds typical

*The external voltage supply must be capable of buffering brief mains interruptions of 20 ms, as specified in IEC/EN 60204-1.

Emitter and Receiver Dimensions



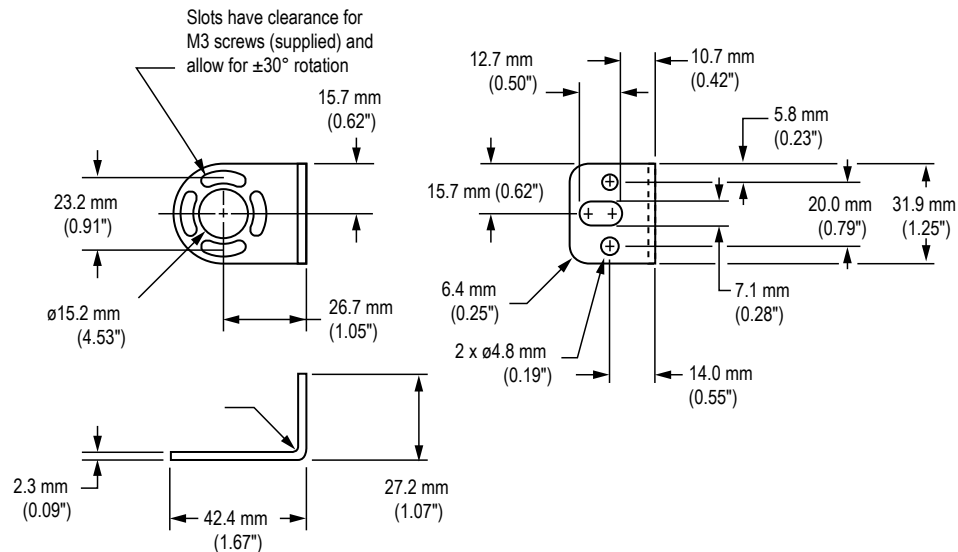
Emitter or Receiver Model	Housing Length L1	Distance Between Bracket Holes L2 L3		Defined Area† Y
LS2..-150	215 mm (8.5")	249 mm (9.8")	186 mm (7.3")	150 mm (5.9")
LS2..-300	365 mm (14.4")	349 mm (13.7")	336 mm (13.2")	300 mm (11.8")
LS2..-450	515 mm (20.3")	549 mm (21.6")	486 mm (19.1")	450 mm (17.7")
LS2..-600	665 mm (26.2")	699 mm (27.5")	636 mm (25.0")	600 mm (23.6")
LS2..-750	815 mm (32.1")	849 mm (33.4")	786 mm (30.9")	750 mm (29.5")
LS2..-900	964 mm (38.0")	998 mm (39.3")	935 mm (36.8")	900 mm (35.4")
LS2..-1050	1114 mm (43.9")	1148 mm (45.2")	1085 mm (42.7")	1050 mm (41.3")
LS2..-1200	1264 mm (49.8")	1298 mm (51.1")	1235 mm (48.6")	1200 mm (47.2")
LS2..-1350	1414 mm (55.7")	1448 mm (57.0")	1385 mm (54.6")	1350 mm (53.1")
LS2..-1500	1563 mm (61.5")	1597 mm (62.9")	1534 mm (60.4")	1500 mm (59.1")
LS2..-1650	1713 mm (67.4")	1747 mm (68.8")	1684 mm (66.3")	1650 mm (65.0")
LS2..-1800	1863 mm (73.3")	1897 mm (74.7")	1834 mm (72.2")	1800 mm (70.9")

Bracket Dimensions

The following are end cap and center bracket dimensions for brackets supplied with each EZ-SCREEN Type 2 emitter or receiver. All brackets have a thickness of 2.3 mm, and are black zinc plated with a chromate dip finish. Bracket mounting hardware is included.

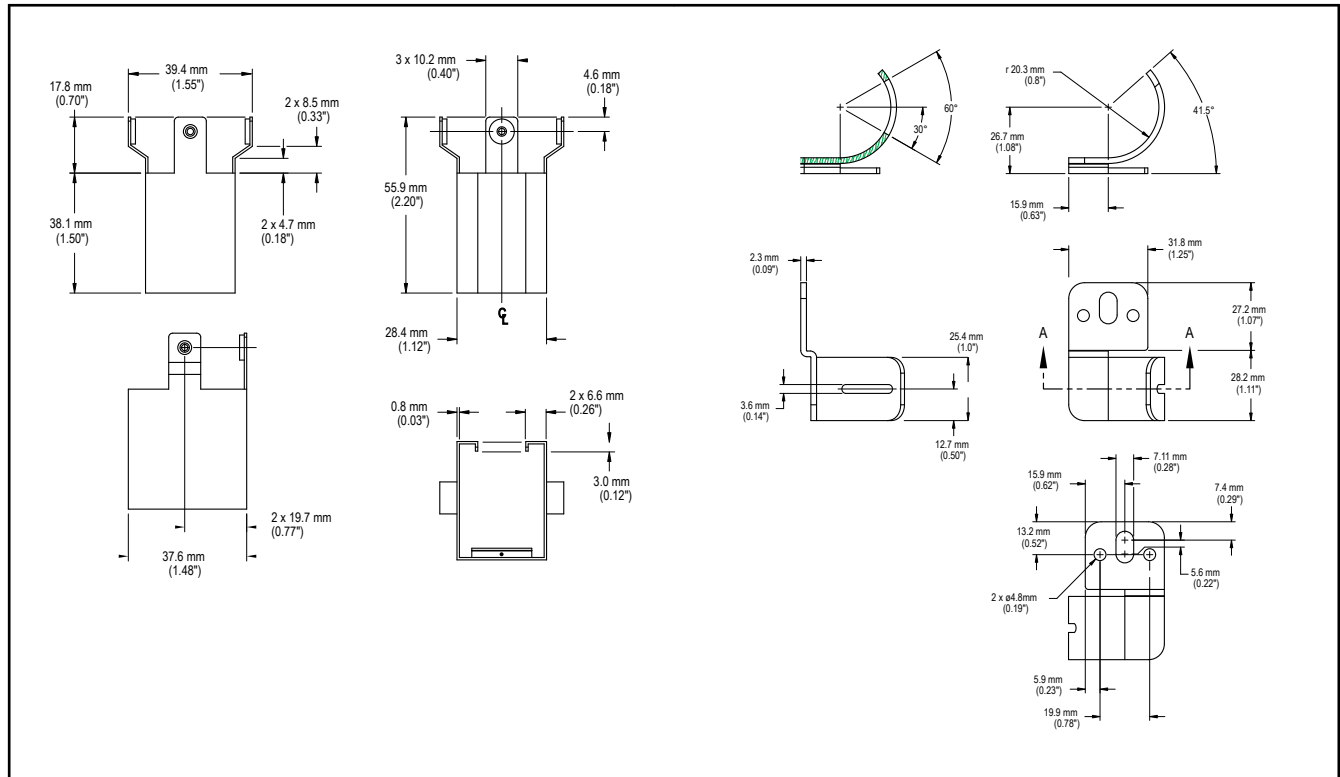
Standard End Cap Brackets

Model USMB-1



Standard Center Brackets

Model Number	Description
USCMB-1	1 bracket is included for sensors 600-900 mm long
USCMB-2	2 brackets are included for sensors 1050-1350 mm long
USCMB-3	3 brackets are included for sensors 1500-1800 mm long



Accessories

Additional interfacing solutions and accessories continue to be added; refer to www.bannerengineering.com for a current list.

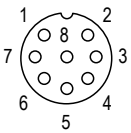
Cordsets

Single-Ended (Machine Interface) Cordsets

Single-Ended (Machine Interface) Cordsets (one cable for each emitter and receiver).

Overmold and cables are PVC-jacketed. Cables are unterminated on one end to interface with guarded machine.

Model Number	Length	Wire	Termination
Emitter and Receiver Cables			
QDE-815D	5 m (15')	22 gauge	8-pin Euro-style female connector on one end; cut to length
QDE-825D	8 m (25')		
QDE-850D	15 m (50')		
QDE-875D	23 m (75')		
QDE-8100D	30 m (100')		

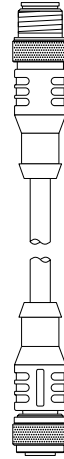
QDE-8..D Pinout/Color Code			European M12 Specification*			Connector (female face view)
Pin	Color	Function	Pin	Color	Function	
1	Bn	+24V dc	1	Wh	+24V dc	
2	Or/Bk	n.c.	2	Bn	n.c.	
3	Or	n.c.	3	Gn	n.c.	
4	Wh	OSSD #2	4	Ye	OSSD #2	
5	Bk	OSSD #1	5	Gy	OSSD #1	
6	Bu	0V dc	6	Pk	0V dc	
7	Gn/Ye	Gnd/Chassis	7	Bu	Gnd/Chassis	
8	Vi	Reset	8	Rd	Reset	

*The European M12 Specification pin assignment and color codes are listed for reference only. You must verify the suitability of these cables for each application.

Double-Ended Cables

Double-ended cables are generally used to interconnect with a bulkhead connector (see below). They are also useful for extending either the branch or trunk cables of a model CSB splitter cordset (see [Splitter Cordsets](#) on page 59).

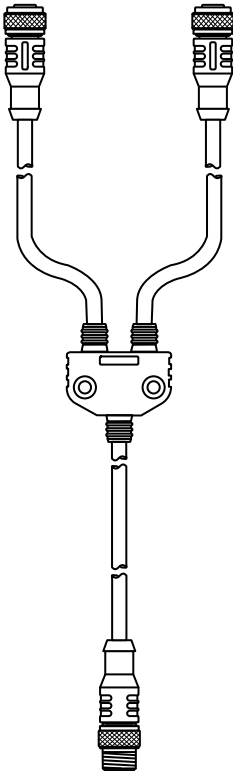
Model Number	Length	Wire	Termination
For 8-Pin Emitters and Receivers*			
DEE2R-81D	0.5 m (1')	22 gauge	8-pin Double-ended cables, M12/Euro-style connectors, female to male (rotateable)
DEE2R-83D	1 m (3')		
DEE2R-88D	2.4 m (8')		
DEE2R-815D	4.5 m (15')		
DEE2R-825D	8 m (25')		
DEE2R-850D	15 m (50')		
DEE2R-875D	23 m (75')		
DEE2R-8100D	30 m (100')		



Bulkhead Connector		
Model Number	Description	
PMEF-810D	Connector for panel connection of EZ-SCREEN Type 2 emitter and receiver cables. 8-pin Euro-style female connector with 3 m (10') wires cut to length (Banner color code); 22 gauge.	

Splitter Cordsets

Model CSB splitter cordsets allow easy interconnection between an EZ-SCREEN Type 2 8-pin receiver and its 8-pin emitter, providing a single “homerun” cable for the optional “swapable” hookup (see Figure 3-11). The model DEE2R-.. double-ended cables described on page 8 may be used to extend the lengths of the QD trunk, branch #1, or branch #2. (Branch #1 and branch #2 cable sections are 300 mm/1' long.) The model QDE-8..D single-ended cables may be used to extend the QD trunk for cut-to-length applications.

Model Number	Length	Wire	
CSB-M1281M1281	300 mm (1') Trunk	22 AWG/ 0.33 mm ²	
CSB-M1288M1281	2.5 m (8') Trunk		
CSB-M12815M1281	5 m (15') Trunk		
CSB-M12825M1281	8 m (25') Trunk		
CSB-UNT825M1281	8 m (25') Trunk (unterminated)		

Pin #1 (+24V dc)		Pin #1 (+24V dc)
Pin #2 (n.c.)		Pin #2 (n.c.)
Pin #3 (n.c.)		Pin #3 (n.c.)
Pin #4 (OSSD#2)		Pin #4 (OSSD#2)
Pin #5 (OSSD#1)		Pin #5 (OSSD#1)
Pin #6 (0V dc)		Pin #6 (0V dc)
Pin #7 (GND)		Pin #7 (GND)
Pin #8 (RESET)		Pin #8 (RESET)
M12 Male		M12 Female
or		
unterminated		
		Pin #1 (+24V dc)
		Pin #2 (n.c.)
		Pin #3 (n.c.)
		Pin #4 (OSSD#2)
		Pin #5 (OSSD#1)
		Pin #6 (0V dc)
		Pin #7 (GND)
		Pin #8 (RESET)
		M12 Female

Interface Modules

Provide forced-guided, mechanically-linked relay (safety) outputs for the EZ-SCREEN System. See Banner data sheet p/n 62822 for more information.

Interface module (3 N.O. redundant-output 6 amp contacts)	IM-T-9A
Interface module (2 N.O. redundant-output 6 amp contacts, plus 1 N.C. auxiliary contact)	IM-T-11A

Contactors

If used, two contactors per EZ-SCREEN Type 2 System are required.


10 amp positive-guided contactor 3 N.O., 1 N.C.	11-BG00-31-D-024
18 amp positive-guided contactor 3 N.O., 1 N.C. (N.C. contact rated @ 10 amps)	BF1801L024

Lens Shield

Constructed of 1.5 mm clear polycarbonate; attach to sensor using supplied adhesive-backed Neoprene foam strips.









NOTE: The total range decreases by approximately 10% per shield.

Sensor Defined Area Height	Lens Shield Model	Lens Shield Length	
150 mm	LSS-150	210 mm (8.3")	
300 mm	LSS-300	360 mm (14.2")	
450 mm	LSS-450	510 mm (20.1")	
600 mm	LSS-600	660 mm (26.0")	
750 mm	LSS-750	810 mm (31.9")	
900 mm	LSS-900	959 mm (37.8")	
1050 mm	LSS-1050	1109 mm (43.7")	
1200 mm	LSS-1200	1259 mm (49.6")	
1350 mm	LSS-1350	1409 mm (55.5")	
1500 mm	LSS-1500	1558 mm (61.3")	
1650 mm	LSS-1650	1708 mm (67.2")	
1800 mm	LSS-1800	1858 mm (73.1")	

EZ-LIGHT™ for EZ-SCREEN®

Provides clear, 360° indication of the of the EZ-SCREEN receiver's output status. Use with a CSB splitter cable an doptional DEE2R double-ended cables. See data sheet p/n 121901 for more information.

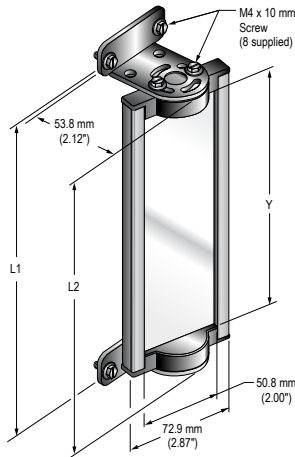
Models		Construction	Connector	LED Function	Inputs
	M18RGX8PW8*	Nickel-plated brass housing, M18x1 thread; thermoplastic lens Fully encapsulated IP67	8-pin Euro-style Integral QD	Red/Green indication follows OSSD output of the EZ-SCREEN receiver ON Red: Power ON Beam Blocked or Lockout ON Green: Power ON Beam Clear	PNP (Sourcing)
	T18RGX8PQ8	Thermoplastic polyester housing, thermoplastic lens Fully encapsulated IP67			
	T30RGX8PQ8				
	K30LRGX8PQ8	Polycarbonate housing, 30 mm thermoplastic dome, 22 mm base mount Fully encapsulated, IP67			
	K50LRGX8PQ8	Polycarbonate housing, 50 mm thermoplastic dome, 30 mm base mount Fully encapsulated, IP67			
	K80LRGX8PQ8	Polycarbonate housing, 50 mm thermoplastic dome, flat or DIN mount Encapsulated electronics, IP67			

*Available in a kit that includes one M18 EZ-LIGHT, one SMB18A mounting bracket, and hardware for mounting to the side channel of an EZ-SCREEN housing (kit model number **EZA-M18RGX8PQ8**).

MSA Series Stands (Base Included)*

Stand Model	Pole Height	Useable Stand Height	Overall Stand Height	
MSA-S24-1	610 mm (24")	483 mm (19")	616 mm (24.25")	
MSA-S42-1	1067 mm (42")	940 mm (37")	1073 mm (42.25")	
MSA-S66-1	1676 mm (66")	1550 mm (61")	1682 mm (66.25")	
MSA-S84-1	2134 mm (84")	2007 mm (79")	2140 mm (84.25")	

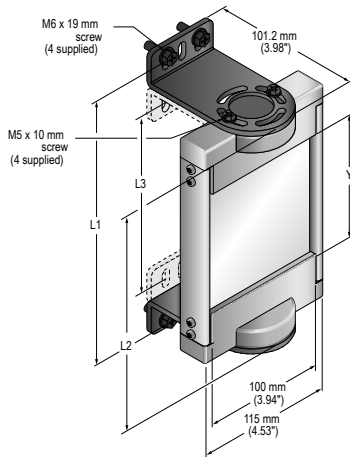
*Available without a base by adding the suffix **NB** to the model number (for example, **MSA-S42-1NB**).

MSM Series Corner Mirrors

Rear-surface glass mirrors rated at 85% efficiency. The total sensing range decreases by approximately 8% per mirror. See mirror data sheet P/N 43685 or the Banner Safety catalog for further information

Defined Area Length	Mirror Model	Reflective Area Y	Mounting 1	Mounting L2
150 mm (5.9")	MSM8A	267 mm (10.5")	323 mm (12.7")	292 mm (11.5")
300 mm (11.8")	MSM12A	356 mm (14")	411 mm (16.2")	381 mm (15")
450 mm (17.7")	MSM20A	559 mm (22")	615 mm (24.2")	584 mm (23")
600 mm (23.6")	MSM24A	660 mm (26")	716 mm (28.2")	686 mm (27")
750 mm (29.5")	MSM32A	864 mm (34")	919 mm (36.2")	889 mm (35")
900 mm (35.4")	MSM36A	965 mm (38")	1021 mm (40.2")	991 mm (39")
1050 mm (41.3")	MSM44A	1168 mm (46")	1224 mm (48.2")	1194 mm (47")
1200 mm (47.2")	MSM48A	1270 mm (50")	1326 mm (52.2")	1295 mm (51")

SSM Series Corner Mirrors



- Rear-surface glass mirrors rated at 85% efficiency. The total sensing range decreases by approximately 8% per mirror. See mirror data sheet P/N 61934 or the Banner Safety catalog for further information.
- Stainless steel reflective surface models also available. See data sheet 67200.
- Robust construction, two mounting brackets and hardware included.
- EZA-MBK-2 adapter bracket is required for use with MSA Series stand, see pages 8 and 10







NOTE: Brackets may be inverted from the positions shown, decreasing dimension L1 by 58 mm (2.3").


Defined Area Length	Mirror Model	Reflective Area Y	Mounting 1	Mounting L2
150 mm (5.9")	SSM-200	200 mm (7.9")	278 mm (10.9")	311 mm (12.2")
300 mm (11.8")	SSM-375	375 mm (14.8")	486 mm (19.1")	453 mm (17.8")
450 mm (17.7")	SSM-550	550 mm (21.7")	661 mm (26.0")	628 mm (24.7")
600 mm (23.6")	SSM-675	675 mm (26.6")	786 mm (31.0")	753 mm (29.6")
750 mm (29.5")	SSM-825	825 mm (32.5")	936 mm (36.9")	903 mm (35.6")
900 mm (35.4")	SSM-975	975 mm (38.4")	1086 mm (42.8")	1053 mm (41.5")
1050 mm (41.3")	SSM-1100	1100 mm (43.3")	1211 mm (47.7")	1178 mm (46.4")
1200 mm (47.2")	SSM-1275	1275 mm (50.2")	1386 mm (54.6")	1353 mm (53.3")
1350 mm (53.1")	SSM-1400	1400 mm (55.1")	1511 mm (59.5")	1478 mm (58.2")
1500 mm (59.0")	SSM-1550	1550 mm (61.0")	1661 mm (65.4")	1628 mm (64.1")
1650 mm (65.0")	SSM-1750	1750 mm (68.9")	1861 mm (73.3")	1828 mm (72.0")
1800 mm (70.9")	SSM-1900	1900 mm (74.8")	2011 mm (79.2")	1978 mm (77.9")

Accessory Mounting Brackets

See Section 2.4 for standard brackets. Contact factory for more information. Order one EZA-MBK-.. bracket per sensor, two per pair.

Model	Description	
USMB-5	<ul style="list-style-type: none"> • Retrofit mounting bracket for STI MPT21. • 2.3 mm thickness, black zinc-plated, chromate dip finish. • Mounting hardware included: 1 kit required per emitter or receiver. 	
USMB-6	<ul style="list-style-type: none"> • Universal mounting bracket kit. • 2.3 mm thickness, black zinc-plated, chromate dip finish. • Mounting hardware included: 1 kit required per emitter or receiver. 	
EZA-MBK-2	Adapter bracket for SSM series mirror and MSA series stands	
USMB-8	<ul style="list-style-type: none"> • Mounting plate for 90° sensor direction. • Low profile. • Black anodized aluminum. • Uses two M4 screws (user supplied) for through-hole mounting. • 1 kit required per emitter or receiver. 	

Alignment Aids

Model	Description	
LAT-1-LS	Self-contained visible-beam laser tool for aligning any EZ-SCREEN Type 2 emitter/receiver pair. Includes retroreflective target material and mounting clip.	
LSA-LAT-2	Replacement adaptor (clip) hardware for LS2.. models	
LSA-LAT-1	Clip-on retroreflective LAT target	
BRT-THG-2-100	2" retroreflective tape, 100'	
BT-1	Beam Tracker	

Replacement Parts

Description		Model Number
Keyed reset switch		MGA-KSO-1
Replacement key		MGA-K-1
30 mm test piece		STP-14
Standard end bracket kit with hardware (includes 2 end brackets and hardware to mount to MSA Series stands.		USMB-1
Center bracket kit (includes bracket(s) and hardware to mount to MSA Series stands	1 bracket, for 600-900 mm long sensors	USCMB-1
	2 brackets, for 1050-1500 mm long sensors	USCMB-2
	3 brackets, for 1650-1800 mm long sensors	USCMB-3

Documentation

Description	Part Number
EZ-SCREEN Type 2 System Instruction Manual	122452
Checkout Procedure Card (Daily)	122450
Checkout Procedure Card (Semi-Annual)	122451

Standards and Regulations

The list of standards below is included as a convenience for users of this Banner product. Inclusion of the standards below does not imply that the product complies specifically with any standard, other than those specified in the Specifications section of this manual.

U.S. Application Standards

ANSI B11.0 Safety of Machinery, General Requirements, and Risk Assessment	ANSI B11.15 Pipe, Tube, and Shape Bending Machines
ANSI B11.1 Mechanical Power Presses	ANSI B11.16 Metal Powder Compacting Presses
ANSI B11.2 Hydraulic Power Presses	ANSI B11.17 Horizontal Extrusion Presses
ANSI B11.3 Power Press Brakes	ANSI B11.18 Machinery and Machine Systems for the Processing of Coiled Strip, Sheet, and Plate
ANSI B11.4 Shears	ANSI B11.19 Performance Criteria for Safeguarding
ANSI B11.5 Iron Workers	ANSI B11.20 Manufacturing Systems
ANSI B11.6 Lathes	ANSI B11.21 Machine Tools Using Lasers
ANSI B11.7 Cold Headers and Cold Formers	ANSI B11.22 Numerically Controlled Turning Machines
ANSI B11.8 Drilling, Milling, and Boring	ANSI B11.23 Machining Centers
ANSI B11.9 Grinding Machines	ANSI B11.24 Transfer Machines
ANSI B11.10 Metal Sawing Machines	ANSI/RIA R15.06 Safety Requirements for Industrial Robots and Robot Systems
ANSI B11.11 Gear Cutting Machines	ANSI NFPA 79 Electrical Standard for Industrial Machinery
ANSI B11.12 Roll Forming and Roll Bending Machines	ANSI/PMMI B155.1 Package Machinery and Packaging-Related Converting Machinery — Safety Requirements
ANSI B11.13 Single- and Multiple-Spindle Automatic Bar and Chucking Machines	
ANSI B11.14 Coil Slitting Machines	

OSHA Regulations

OSHA Documents listed are part of: Code of Federal Regulations Title 29, Parts 1900 to 1910	OSHA 29 CFR 1910.147 The Control of Hazardous Energy (lock-out/tagout)
OSHA 29 CFR 1910.212 General Requirements for (Guarding of) All Machines	OSHA 29 CFR 1910.217 (Guarding of) Mechanical Power Presses

International/European Standards

ISO 12100 Safety of Machinery – General Principles for Design — Risk Assessment and Risk Reduction	ISO 14119 (EN 1088) Interlocking Devices Associated with Guards – Principles for Design and Selection
ISO 13857 Safety Distances . . . Upper and Lower Limbs	

ISO 13850 (EN 418) Emergency Stop Devices, Functional Aspects – Principles for Design	IEC 60204-1 Electrical Equipment of Machines Part 1: General Requirements
ISO 13851 (EN 574) Two-Hand Control Devices – Functional Aspects – Principles for Design	IEC 61496 Electro-sensitive Protection Equipment
ISO 62061 Functional Safety of Safety-Related Electrical, Electronic and Programmable Control Systems	IEC 60529 Degrees of Protection Provided by Enclosures
ISO 13849-1 (EN 954-1) Safety-Related Parts of Control Systems	IEC 60947-1 Low Voltage Switchgear – General Rules
ISO 13855 (EN 999) The Positioning of Protective Equipment in Respect to Approach Speeds of Parts of the Human Body	IEC 60947-5-1 Low Voltage Switchgear – Electromechanical Control Circuit Devices
	IEC 60947-5-5 Low Voltage Switchgear – Electrical Emergency Stop Device with Mechanical Latching Function

Sources of Standards and Regulations

These and other standards are available from:

OSHA Documents: <http://www.osha.gov> (Tel: 202.512.1800)

American National Standards Institute (ANSI): <http://www.ansi.org> (Tel: 212.642.4900)

Robotics Industries Association (RIA): <http://www.robotics.org> (Tel: 734.994.6088)

National Fire Protection Association (NFPA): <http://www.nfpa.org> (Tel: 800.344.3555)

NSSN National Resource for Global Standards : <http://www.nssn.org/> (Tel: 212.642.4980)

IHS Standards Store: <http://www.global.ihs.com/> (Tel: 303.397.7956, 800.854.7179)

Document Center: <http://www.document-center.com/home.cfm> (Tel: 650.591.7600)

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Glossary

The following terms are used in this manual. Where possible, definitions are from the U.S. and international product performance standards that govern the design of the Safety Controller. For more definitions, visit the online learning segment under Support and Training at www.bannerengineering.com.

Automatic reset:

The safety input device control operation setting where the assigned Safety Output will automatically turn on when all of its associated input devices are in the Run state. No manual reset operation is required for the Safety Output to turn on when controlled only by safety input devices configured for Automatic Reset. When Automatic Reset is selected, the input device may be said to be configured to run in Trip mode.

Change of state (COS):

The change of an input signal when it switches from Run-to-Stop or Stop-to-Run state. Dual-channel input signals, have two possible configurable COS settings describe the signal disparity limits that can exist between channels before a fault condition is registered: simultaneous and concurrent. If simultaneity is a requirement or a concern for the application, the user has to ensure that he made the right selection during configuration.

Closed-Open debounce time:

Time to bridge a jittery input signal or bouncing of input contacts to prevent nuisance tripping of the Controller. Adjustable from 6 ms to 100 ms. Default is 50 ms for mute sensors, 6 ms for other devices. A longer closed-open debounce time will also affect and increase the response time of the system and/or the machine response time.

Code validation:

The configuration code file inspection process automatically performed by the Controller to verify that the configuration code has not been corrupted or altered in any way.

Commissioning:

The process of operationally checking a Safety Controller installation on a working machine, in order to verify that the control system is working properly.

Complementary Contacts:

Two sets of contacts which are always in opposite states.

Concurrent:

The setting that permits an indefinite signal disparity between channels, without going into a fault condition. A fault condition is created if the Stop signal changes back to a Run signal before its allied signal changes to the Stop state. Both signals must change from the STOP state to the RUN state before the dual-channel device is considered to be in the RUN state.

Configurable:

Describes a control device that has pre-defined and pre-tested operational parameters that can be selected or enabled, in order to accommodate a variety of control application requirements.

Configuration:

A selected set of pre-defined and pre-tested input and output device properties and logic relationships that define the operating algorithm that the Safety Controller uses to control hazardous machine motion.

Confirmation:

The two-step process where a new or modified configuration is sent to a Controller for code validation, and a copy of the validated code is sent back from the Controller to the PCI for manual parameter (I/O and System settings) verification.

Designated Person:

A person or persons identified and designated in writing, by the employer, as being appropriately trained and qualified to perform a specified checkout procedure.

Diverse-redundancy:

The practice of using components, circuitry or operation of different designs, architectures or functions to achieve redundancy and to reduce the possibility of common mode failures.

Dual-channel:

Having redundant signal lines for each safety input or Safety Output.

Enable a mute time limit:

As soon as a mute sensor is mapped to a safety input device, a default time limit of 30s will show up in the properties window. This time limit can be disabled by unchecking the 'Enable Time Limit' box. This extends the time for the mutable safety device to be muted to infinite.

IEC:

International Electrotechnical Commission

Input/output mapping:

The configurable logic association, created during the configuration process, between the state of the input signals and the corresponding state of the output signals. After an Input is assigned to control one or more outputs, it is said to have been mapped to these outputs and that the outputs have been mapped to this input.

ISO:

International Organization for Standardization

Machine response time:

The time between the activation of a machine stopping device and the instant when the dangerous parts of the machine reach a safe state by being brought to rest.

Manual reset:

The safety input device control operation setting where the assigned Safety Output will turn ON only after a manual reset is performed and if the other associated input devices are in their Run state. When Manual Reset is selected, the input device may be said to be configured to run in Latch mode; meaning that the controlled output has latched to the OFF state and requires a manual reset to turn back ON. This reset is sometimes called a manual latch reset.

OFF signal:

The Safety Output signal that results when at least one of its associated input device signals changes to the Stop state. In this manual, the Safety Output is said to be OFF or in the OFF state when the signal is 0V dc nominally.

ON signal:

The Safety Output signal that results when all of its associated input device signals change to the Run state. In this manual, the Safety Output is said to be ON or in the ON state when the signal is 24V dc nominally.

Open-Closed debounce time:

Time to bridge a jittery input signal or bouncing of input contacts to prevent unwanted start of the machine. Adjustable from 10 ms to 500 ms. Default is 50 ms. A longer open-closed debounce time will also affect the recovery time of the Controller.

Pass-through hazard

A "pass-through hazard" is associated with applications where personnel may pass through a safeguard (which issues a stop command to remove the hazard), and then continues into the guarded area, such as in perimeter guarding. Subsequently, their presence is no longer detected, and the related danger becomes the unexpected start or restart of the machine while personnel are within the guarded area.

PELV:

Protected extra-low voltage power supply, for circuits with earth ground. Per IEC 61140: "A PELV system is an electrical system in which the voltage cannot exceed ELV (25 V ac rms or 60 V ripple free dc) under normal conditions, and under single-fault conditions, except earth faults in other circuits."

Qualified Person:

A person who, by possession of a recognized degree or certificate of professional training, or who, by extensive knowledge, training and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work.

Run Signal:

The input signal monitored by the Controller that, when detected, causes one or more Safety Outputs to turn ON, if their other associated input signals are also in the Run state. In this manual, either the input device or the device signal is said to be in the Run state.

Safety-rated device:

A device that is designed to an applicable safety standard and when properly applied, reduces the level of risk.

SELV:

Separated or safety extra-low voltage power supply, for circuits without earth ground. Per IEC 61140: "A SELV system is an electrical system in which the voltage cannot exceed ELV (25 V ac rms or 60 V ripple free dc) under normal conditions, and under single-fault conditions, including earth faults in other circuits."

Simultaneous:

The setting that permits a signal disparity between channels within the input device for a limited time, without going into a fault condition. If a signal disparity exists for more than 3 seconds, then a fault condition occurs.

Single-channel:

Having only one signal line for a safety input or Safety Output.

Start up test:

For certain safety devices, like safety light screens or safety gates, it can be an advantage to test the device on power up at least one time for proper function. If 'Start up Test' has been selected for a safety light screen and the light screen is clear at power up, it would be necessary to cycle the light screen one time (from ON to OFF and back to ON), even if the Controller has been configured for auto power up.

Stop Signal:

The input signal monitored by the Controller that, when detected, causes one or more Safety Outputs to turn OFF. In this manual, either the input device or device signal is said to be in the Stop state.

System Reset:

The term used to describe a manual system reset operation required for one or more Safety Outputs to turn ON after Controller power-up, when configured for manual power-up, and lockout (fault detection) situations.

UL:

Underwriter's Laboratory

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