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EZ-SCREEN® Type 2 Light Screen

Instruction Manual

Original Instructions
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122452

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1 About This Document

1.1 Important... Read This Before Proceeding!

It is the responsibility of the machine designer, controls engineer, machine builder, machine operator, and/or maintenance personnel or electrician to apply and maintain this device in full compliance with all applicable regulations and standards. The device can provide the required safeguarding function only if it is properly installed, properly operated, and properly maintained. This manual attempts to provide complete installation, operation, and maintenance instruction. *Reading the manual in its entirety is highly recommended to ensure proper understanding of the operation, installation, and maintenance.* Please direct any questions regarding the application or use of the device to Banner Engineering Corp..

For more information regarding U.S. and international institutions that provide safeguarding application and safeguarding device performance standards, see Standards and Regulations on p. 58.

WARNING:
- The user is responsible for following these instructions.
- **Failure to follow any of these responsibilities may potentially create a dangerous condition that could result in serious injury or death.**
- Carefully read, understand, and comply with all instructions for this device.
- Perform a risk assessment that includes the specific machine guarding application. Guidance on a compliant methodology can be found in ISO 12100 or ANSI B11.0.
- Determine what safeguarding devices and methods are appropriate per the results of the risk assessment and implement per all applicable local, state, and national codes and regulations. See ISO 13849-1, ANSI B11.19, and/or other appropriate standards.
- Verify that the entire safeguarding system (including input devices, control systems, and output devices) is properly configured and installed, operational, and working as intended for the application.
- Periodically re-verify, as needed, that the entire safeguarding system is working as intended for the application.

1.1.1 Use of Warnings and Cautions

The precautions and statements used throughout this document are indicated by alert symbols and must be followed for the safe use of the EZ-SCREEN Type 2 Light Screen. Failure to follow all precautions and alerts may result in unsafe use or operation. The following signal words and alert symbols are defined as follows:

Signal Word	Definition	Symbol
WARNING:	**Warnings** refer to potentially hazardous situations which, if not avoided, could result in serious injury or death.	
CAUTION:	**Cautions** refer to potentially hazardous situations which, if not avoided, could result in minor or moderate injury.	

These statements are intended to inform the machine designer and manufacturer, the end user, and maintenance personnel, how to avoid misapplication and effectively apply the EZ-SCREEN Type 2 Light Screen to meet the various safeguarding application requirements. These individuals are responsible to read and abide by these statements.

1.2 EU Declaration of Conformity (DoC)

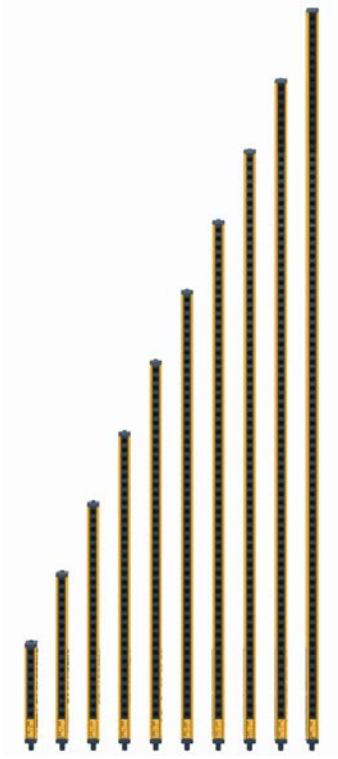
Banner Engineering Corp. herewith declares that these products are in conformity with the provisions of the listed directives and all essential health and safety requirements have been met. For the complete DoC, please go to www.bannerengineering.com.

Product	Directive
EZ-SCREEN Type 2 Light Screen	2006/42/EC

Representative in EU: Peter Mertens, Managing Director, Banner Engineering BV. Address: Park Lane, Culliganlaan 2F, bus 3,1831 Diegem, Belgium.

2 Introduction

2.1 Features



- An optoelectronic safeguarding device
- Creates a screen of synchronized, modulated infrared sensing beams; choose from 10 sizes, in 150 mm (6 in) increments and defined areas from 150 mm to 1.8 m (6 in to 71 in)
- Compact package for smaller production machines
- Models available with Trip or Latch output operation (automatic or manual start/restart)
- 30 mm (1.18 in) resolution
- Remote Test input terminals for simulating a "blocked" condition
- Operating range up to 15 m (50 ft)
- Type 2 per IEC 61496-1/-2; Category 2 PLc 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

2.2 System Description

Note: This manual refers to an emitter and its receiver, and their cabling as "a System".

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 maximum range is 15 m (50 ft), which decreases if corner mirrors are used. Resolution is 30 mm (1.18 in).

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 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.

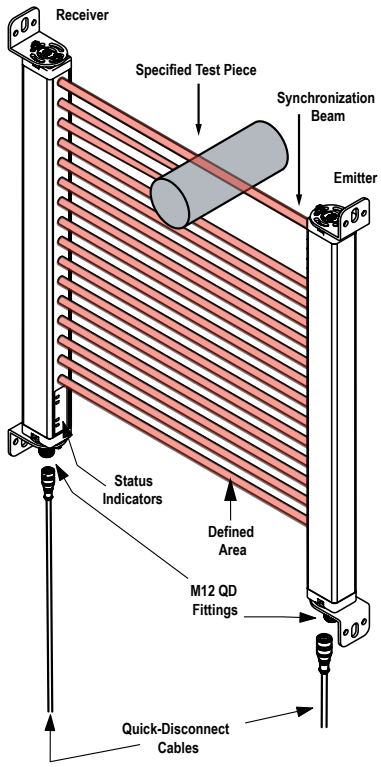
Both OSSD outputs must be connected to the machine control so that the machine’s safety-related control system interrupts the circuit or power to the MPCEs (Machine Primary Control Elements), resulting in a non-hazardous condition. Each OSSD is capable of sourcing 0.5A at +24V dc.

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. This hookup option provides advantages during installation, wiring, and troubleshooting.

All models require a supply voltage of +24V dc ±20%.

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



2.3 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 Banner device cannot provide the protection for which it was designed. The user is responsible for ensuring 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. 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 Banner device is installed and interfaced to the guarded machine by Qualified Persons [1], in accordance with this manual and applicable safety regulations. **Failure to follow these instructions could result in serious injury or death.**

The Banner EZ-SCREEN Type 2 is intended for lower-risk machine guarding 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.

The EZ-SCREEN Type 2 ability to perform its safeguarding function depends upon the appropriateness of the application and upon its proper mechanical and electrical installation and interfacing to the guarded machine. **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**.

[1] 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.

WARNING:
- **Install System Only on Appropriate Applications**
- Failure to follow these instructions could result in serious injury or death.
- Use Banner's EZ-SCREEN Type 2 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.
- If there is any doubt about whether or not your machinery is compatible with the EZ-SCREEN Type 2, contact Banner Engineering.

WARNING:
- **Use of EZ-SCREEN Type 2**
- Failure to follow these instructions could result in serious bodily injury or death.
- 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).

2.3.1 Examples: Appropriate Applications

EZ-SCREEN Type 2 are typically used for, 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.)

2.3.2 Examples: Inappropriate Applications

Do not use EZ-SCREEN Type 2 in the following 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, PL d, PL e, or Type 4 AOPD (active opto-electronic protective device) have been mandated. See EN ISO 13849-1, IEC 61496-1, or other appropriate standard
- With any machine that cannot be stopped immediately after a stop signal is issued, such as single-stroke (or full-revolution) clutched machinery
- With any machine with inadequate or inconsistent machine response time and stopping performance
- With 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 OSHA 29CFR1910.217, ANSI/NFPA 79, ANSI B11.19, ISO 12100, IEC 60204-1, IEC 61496-1, or other appropriate standard)

If an EZ-SCREEN Type 2 is installed for use as a perimeter guard (where a pass-through hazard may exist, see Reducing or Eliminating Pass-Through Hazards on p. 14), 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.

2.4 Control Reliability and Safety Categories

To summarize the expected safety circuit performance in high-risk situations, requirements of Control Reliability (OSHA 29CFR1910.217 and ANSI B11.19) and Category 3 or 4 and PL d or PL e (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 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 4 and PL d or PL e. 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 PL c.

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 12100, ANSI B11.19, or other relevant standard).

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 p. 31). 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.

2.5 Operating Features

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

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

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

2.5.1 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 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 turn on after all beams are cleared following a blocked beam.
- 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.

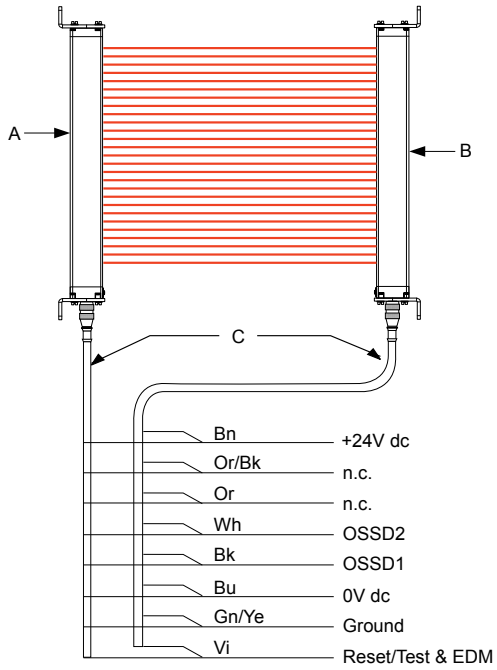
WARNING: Use of Auto (Trip) or Manual (Latch) Start/Restart

Application of power to the Banner device, the clearing of the sensing field, or the reset of a manual start/restart (latch) condition MUST NOT initiate dangerous machine motion. Machine control circuitry must be designed so that one or more initiation devices must be engaged (in a conscious act) to start the machine – in addition to the Banner device going into Run mode. **Failure to follow these instructions could result in serious injury or death**.

2.5.2 Wiring Options for Emitter/Receiver Swapability

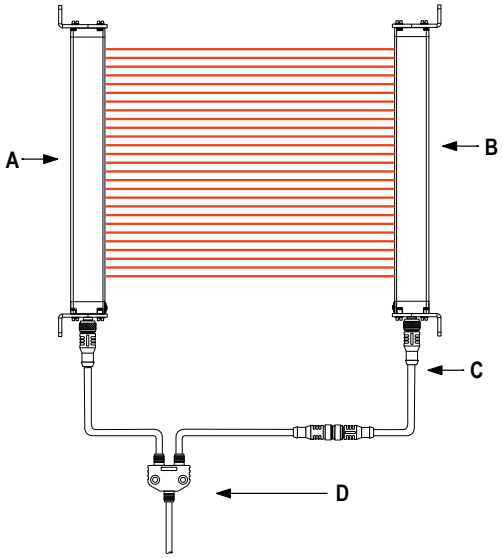
Each EZ-SCREEN Type 2 sensor can be connected to its own power supply or, color-for-color to the other sensor's cable. The color-for-color hookup allows the emitter and receiver positions to be interchanged without rewiring (functionality known as sensor " swapability"). Model CSB.. splitter cordsets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

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

2.5.3 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.

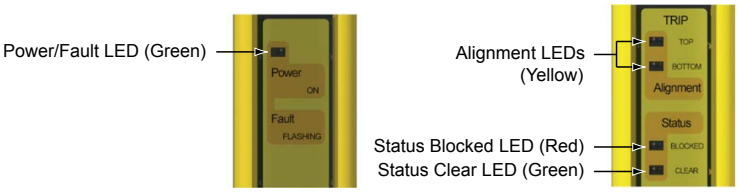
External Device Monitoring (EDM)

This feature allows the EZ-SCREEN Type 2 system to monitor the status of external devices such as MPCEs. 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.

2.5.4 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



3 Mechanical Installation

The EZ-SCREEN Type 2 system performance as a safety guarding device depends on:

- 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 Banner device cannot provide the protection for which it was designed. The user is responsible for ensuring 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. 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 Banner device is installed and interfaced to the guarded machine by Qualified Persons [2], in accordance with this manual and applicable safety regulations. **Failure to follow these instructions could result in serious injury or death.**

3.1 Mechanical Installation Considerations

The two primary factors that influence the layout of the EZ-SCREEN Type 2 system mechanical installation are the Safety Distance (Minimum Distance) and the supplemental safeguarding/eliminating pass-through hazards. Other considerations include:

- Emitter and Receiver Orientation
- Adjacent Reflective Surfaces
- Use of Corner Mirrors
- Installation of Multiple Systems

WARNING:

- **Position the System Components Carefully**
- Failure to observe this warning could result in serious injury or death.
- Position the system components such that the hazard cannot be accessed by reaching over, under, around, or through the sensing field. Additional and supplemental guarding may be required.

3.1.1 Calculating the Safety Distance (Minimum Distance)

Safety Distance (Ds), 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 sends a stop signal to the machine, causing it to stop by the time the object or person can reach any machine hazard point.

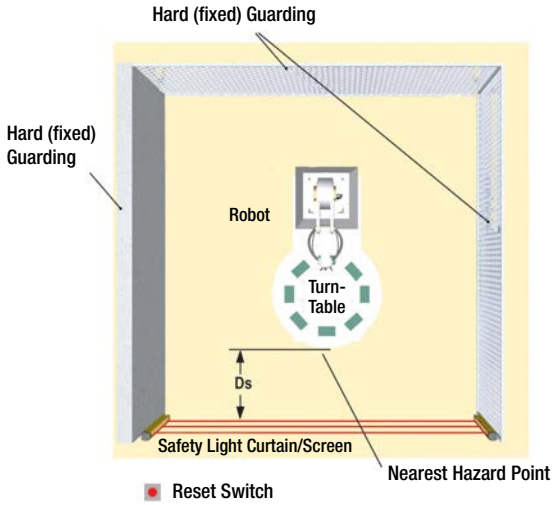
The distance is calculated differently for U.S. and European installations. Both methods take into account several factors, including a calculated human speed, the total system stopping time (which itself has several components), and the depth penetration factor. After the distance has been determined,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

WARNING:

- **Calculate the Safety Distance (Minimum Distance)**
- Failure to establish and maintain the safety distance (minimum distance) could result in serious injury or death.
- Mount the components at a distance from the nearest hazard such that an individual cannot reach the hazard before cessation of the hazardous motion or situation. Calculate this distance using the supplied formulas, as described by ANSI B11.19 and ISO 13855. Mount the components more than 100 mm (4 in) away from the hazard, regardless of the calculated value.

[2] 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.

Figure 3. Safety distance (minimum distance) and hard (fixed) guarding



Models With Response Times

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

U.S. Applications	European Applications
The Safety (Separation) Distance formula for U.S. applications:	The Minimum Distance formula for European applications:
`Ds = K × (Ts + Tr) + Dpf`	`S = (K × T) + C`

U.S. Applications	European Applications

Ds

the Safety Distance, in inches

K

1600 mm per second (or 63 in per second), the OSHA 29CFR1910.217, and ANSI B11.19 recommended hand-speed constant (see Note 1 below)

Ts

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 (for example, IM-T-.. Interface Modules) and measured at maximum machine velocity (see Note 3 below)

Tr

the maximum response time, in seconds, of the EZ-SCREEN Type 2 emitter/receiver pair (depending on model)

Dpf

the added distance due to the depth penetration factor as prescribed in OSHA 29CFR1910.217, and ANSI B11.19 for U.S. applications.

Calculate using the formula: Dpf = 3.4 × (d – 7) where d is the resolution of the light curtain (for d < 64 mm). For EZ-SCREEN Type 2, d = 30 mm and Dpf = 78 mm (3 in).

S

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

K

hand-speed constant (see Note 2 below); **2000 mm/s** (for Minimum Distances ≤ 500 mm) **1600 mm/s** (for Minimum Distances > 500 mm)

T

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**

C

the additional distance, in mm, based on intrusion of a hand or object towards the danger zone prior to actuation of a safety device. Calculate using the formula (in mm):

```
C = 8 × (d – 14)
```

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 in).

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 in/sec.) to more than 2500 mm/sec. (100 in/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.

WARNING:

- **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 or S) will be too short, which can lead to serious injury or death.
- 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.

Examples

Example: U.S. Applications, Model

K = 63 in. 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 time)

Tr = 0.016 seconds (the specified response time of an LS2..30-600 EZ-SCREEN Type 2)

Dpf = 3 in

Substitute the numbers into the formula as follows:

```
Ds = K × ( Ts + Tr ) + Dpf
```

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

Example: European Applications, Model

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 time), plus 0.016 seconds (the specified **LS2..30-600** response time)

C = 8 x (30 - 14) = 128 mm (14 mm resolution)

Substitute the numbers into the formula as follows:

```
S = (K × T ) + C
```

```
S = (1600 x 0.336) + 128 = 665.6 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.

3.1.2 Reducing or Eliminating Pass-Through Hazards

A *pass-through* hazard is associated with applications where personnel may pass through a safeguard, such as the EZ-SCREEN Type 2 Light Screen (which issues a stop command to remove the hazard), and then continues into the guarded area. This is common in access and perimeter guarding applications. 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.

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 in) between the sensing field and the machine frame or hard (fixed) 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 safety requirements in ANSI B11.19 or other appropriate standards.

An alternative 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. The EZ-SCREEN Type 2 Light Screen provides a configurable Manual Start/Restart (Latch Output) function for these applications.

WARNING:

- **Use of the Banner device for Access or Perimeter Guarding**
- Failure to observe this warning could result in serious injury or death.
- If a Banner device is installed in an application that results in a pass-through hazard (for example, perimeter guarding), either the Banner device 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.

WARNING:

- **Perimeter guarding applications**
- Failure to observe this warning could result in serious injury or death.
- Use lockout/tagout procedures per ANSI Z244.1, or use additional safeguarding as described by ANSI B11.19 safety requirements or other applicable standards if a passthrough hazard cannot be eliminated or reduced to an acceptable level of risk.

3.1.3 Supplemental Safeguarding

Properly position the EZ-SCREEN Type 2 such that an individual cannot reach through the defined area and access the hazard point before the machine has stopped.

Additionally, the hazard cannot 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 on p. 15).

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

Figure 4. An example of supplemental safeguarding

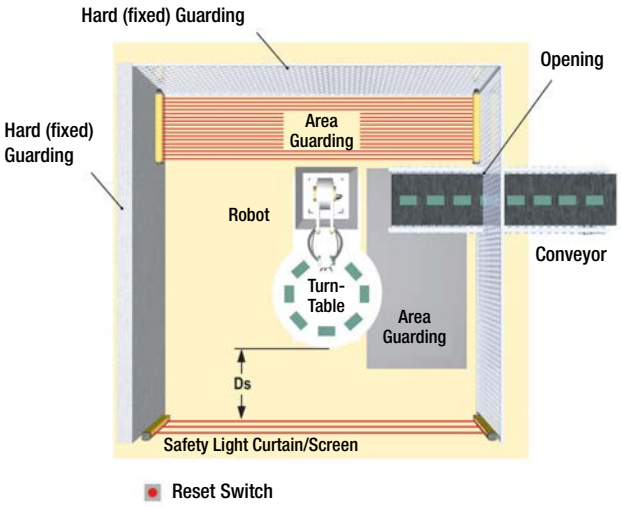


Figure 4 on p. 15 shows an example of supplemental safeguarding inside a robotic work cell. The EZ-SCREEN Type 2, in conjunction with the hard (fixed) guarding, is the primary safeguard. Supplemental safeguarding (such as a horizontal-mounted safety light screen as an area guard) is required in areas that cannot be viewed from the reset switch (for example, behind the robot and the conveyor). Additional supplemental safeguarding may be required to prevent clearance or trapping hazards (for example, a safety mat as an area guard between the robot, the turntable, and the conveyor).

WARNING:
- **The hazard must be accessible only through the sensing field**
- Incorrect system installation could result in serious injury or death.
- The installation of the EZ-SCREEN Type 2 must prevent any individual from reaching around, under, over or through the defined area and into the hazard without being detected.
- See OSHA CFR 1910.217, ANSI B11.19, and/or ISO 14119, ISO 14120 and ISO 13857 for information on determining safety distances and safe opening sizes for your guarding device. Mechanical barriers (for example, hard (fixed) guarding) or supplemental safeguarding might be required to comply with these requirements.

3.1.4 Other Considerations

Reset Switch Location

The reset switch must be mounted at a location that complies with the warning and guidelines below. 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).

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 below.

WARNING:
- **Install reset switches properly**
- Failure to properly install reset switches could result in serious injury or death.
- Install reset switches so that they are accessible only from outside, and in full view of, the safeguarded space. Reset switches cannot be accessible from within the safeguarded space. Protect reset switches against unauthorized or inadvertent operation (for example, through the use of rings or guards). If there are any hazardous areas that are not visible from the reset switches, provide additional safeguarding.

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 cannot 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:

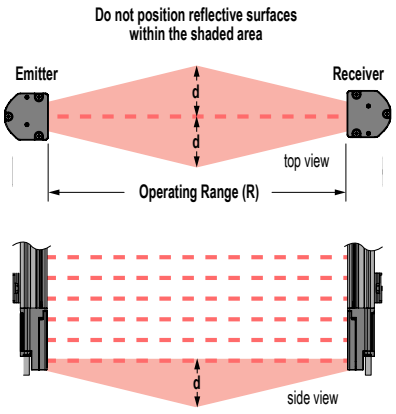
- **Do not install the system near reflective surfaces**
- Reflective surfaces could reflect the sensing beam(s) around an object or person within the defined area, preventing detection by the system. Failure to prevent reflection problems results in incomplete guarding and an optical short circuit that could result in serious injury or death.
- Do not locate the defined area near a reflective surface. Perform the trip test, as described in the product documentation, to detect such reflection(s).

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 or machine frame), determine the worst-case resolution resulting from the optical short circuit and use the corresponding depth penetration factor (Dpf or C) in the Safety Distance (Minimum Distance) formula; or mount the sensors in such a way that the receiver's field of view and/or the emitter's spread of light are restricted from the reflective surface
- Repeat the trip test (see *Trip Test* under Initial Checkout Procedure on p. 25) to verify 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

Figure 5. Adjacent Reflective Surfaces



For 0.2 to 3 m (8" to 10') Operating range: d = 0.26 m (10")
For Operating range > 3 m (>10'): d = 0.0875 x R (m or ft)

Use of Corner Mirrors

EZ-SCREEN Type 2 may be used with one or more corner mirrors. Mirrors are not allowed for applications that would allow undetected personnel access into the safeguarded area. The use of glass-surface corner mirrors reduces the maximum specified emitter/receiver separation by approximately 8 percent per mirror, as follows:

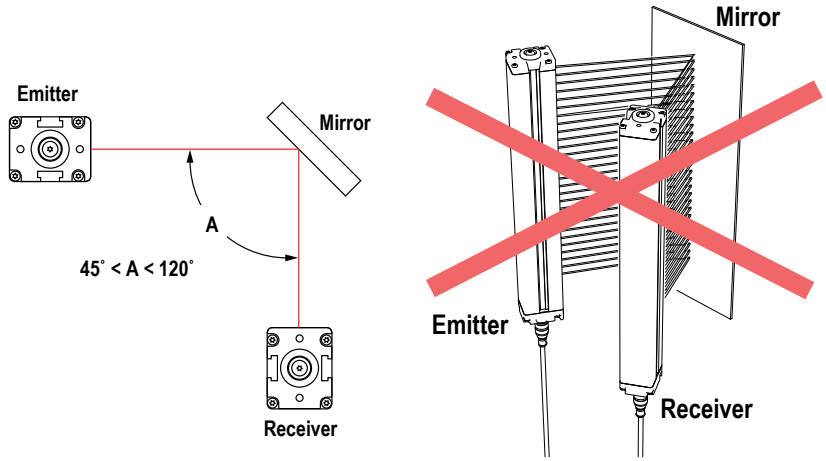
Light Screen Maximum Range					
Light Screen Series	**0 Mirrors**	**1 Mirror**	**2 Mirrors**	**3 Mirrors**	**4 Mirrors**
14 mm EZ-SCREEN® (SLS)	6 m (20 ft)	5.6 m (18.4 ft)	5.2 m (17.0 ft)	4.8 m (15.7 ft)	4.4 m (14.5 ft)
30 mm EZ-SCREEN® (SLS)	18 m (60 ft)	16.8 m (55 ft)	15.5 m (51 ft)	14.3 m (47 ft)	13.1 m (43 ft)
EZ-SCREEN® LP (SLP)	7 m (23 ft)	6.5 m (21.2 ft)	6.0 m (19.5 ft)	5.5 m (18.0 ft)	5.1 m (16.6 ft)
EZ-SCREEN® LP Basic (SLPVA)	4 m (13 ft)	3.7 m (12.1 ft)	3.4 m (11.2 ft)	3.1 ft m (10.3 ft)	2.8 m (9.2 ft)
EZ-SCREEN® LS (SLL)	12 m (39 ft)	11 m (36 ft)	10.1 m (33 ft)	9.3 m (30.5 ft)	8.6 m (28 ft)
EZ-SCREEN® LS Basic (SLLV)	8 m (26.2 ft)	7.4 m (24.3 ft)	6.8 m (22.3 ft)	6.2 m (20.3 ft)	5.7 m (18.7 ft)
EZ-SCREEN® Type 2 (LS2)	15 m (50 ft)	13.8 m (45 ft)	12.7 m (42 ft)	11.7 m (38 ft)	10.8 m (35 ft)

See the specific mirror data sheet or www.bannerengineering.com for more information.

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° (see Figure 6 on p. 17). If placed at a sharper angle, an object in the light screen may deflect beam(s) to the receiver, preventing the object from being detected, also know as false proxing. Angles greater than 120° result in difficult alignment and possible optical short circuits.

WARNING:
- **Retroreflective Mode Installation**
- Failure to follow these instructions may create unreliable sensing and may result in serious injury or death.
- Do not install emitters and receivers in retroreflective mode with less than a 45° angle of incidence. Install emitters and receivers at an appropriate angle.

Figure 6. Using EZ-SCREEN Type 2 sensors in a retroreflective mode



Emitter and Receiver Orientation

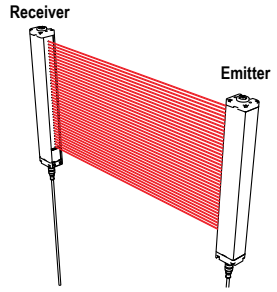
The emitter and receiver must be mounted parallel to each other and aligned in a common plane, with both machine interface cable ends pointing in the same direction. Never mount the emitter with its machine interface cable end oriented in the opposite direction of the cable end of the receiver. If this 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 to each other 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 (fixed) guarding or other supplemental guarding.

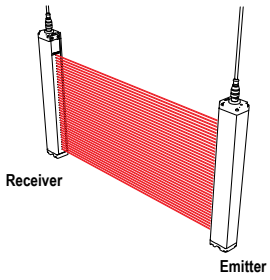
WARNING:

- **Properly install system components**
- Incorrectly orienting the system components impairs the performance of the system and results in incomplete guarding, which can result in serious injury or death.
- Install the system components with their corresponding cable ends pointing in the same direction.

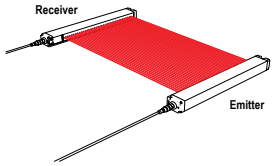
Figure 7. Examples of Correct Emitter/Receiver Orientation



Both cable ends down

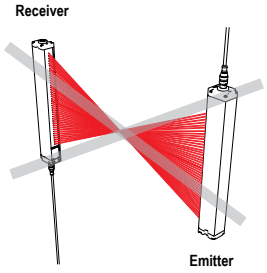


Both cable ends up



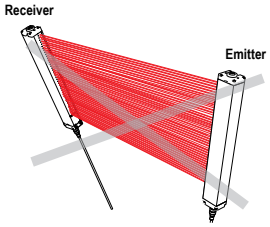
Orientation parallel to floor with both cable ends pointing in the same direction

Figure 8. Examples of Incorrect Emitter/Receiver Orientation



Cable ends point in opposite directions

Problem: Voids in defined area



Emitter and receiver not parallel to each other

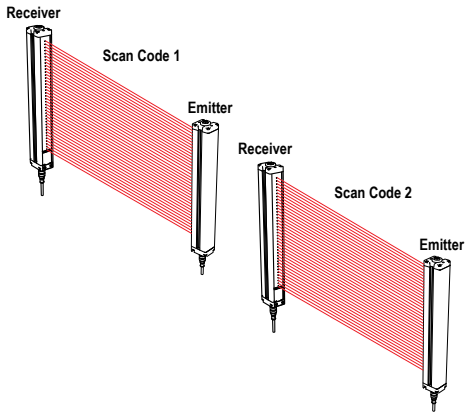
Problem: Reduced excess gain

Installation of Multiple Systems

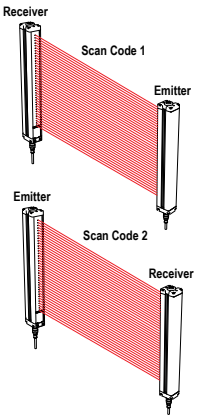
Whenever two or more EZ-SCREEN Type 2 emitter and receiver pairs are adjacent to one another, optical crosstalk may take place between the systems. To minimize optical crosstalk, alternate the positions of the emitters and receivers (see Figure 9 on p. 19).

When three or more systems are installed in the same plane (as shown in Figure 9 on p. 19), 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.

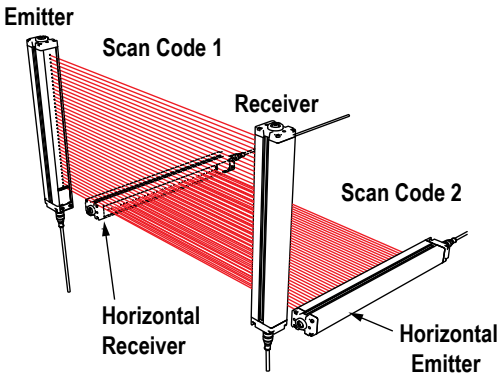
Figure 9. Installation of Multiple Systems



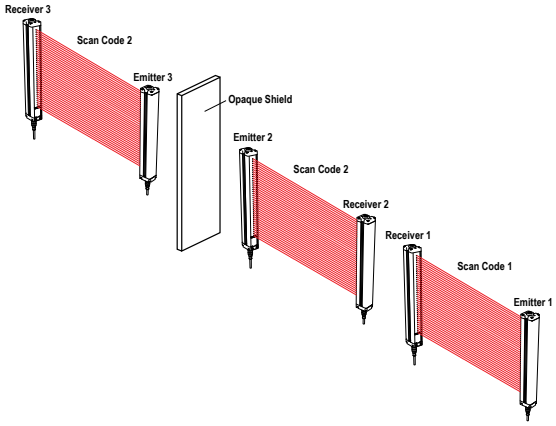
a. Two systems in a horizontal plane



b. Two or three systems stacked (or alternate receiver/ emitter positions)



c. Two systems at right angles



d. Multiple systems

WARNING:
- **Properly connect multiple pairs of sensors**
- Connecting multiple output signal switching devices (OSSD) safety outputs to one interface module or otherwise parallel OSSD outputs can result in serious bodily injury or death, and is prohibited.
- Do not connect multiple pairs of sensors to a single device.

WARNING:
- **Adjacent components can synchronize incorrectly**
- The light curtain's safety function is reduced when components are not synchronized correctly, creating an unsafe condition that could result in serious injury or death.
- When multiple systems are mounted closely together, or where a secondary emitter is in view (within ±5°) and within range of an adjacent receiver, a receiver can synchronize to the signal from the wrong emitter, reducing the safety function of the light curtain.

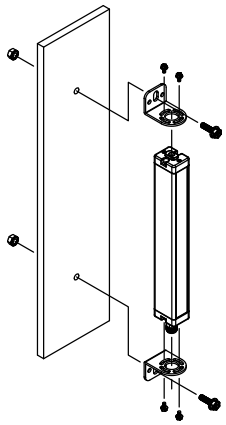
3.2 Mounting System Components

3.2.1 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.

Figure 10. Emitter and Receiver End-Cap Mounting Brackets



Using Center Mounting Brackets

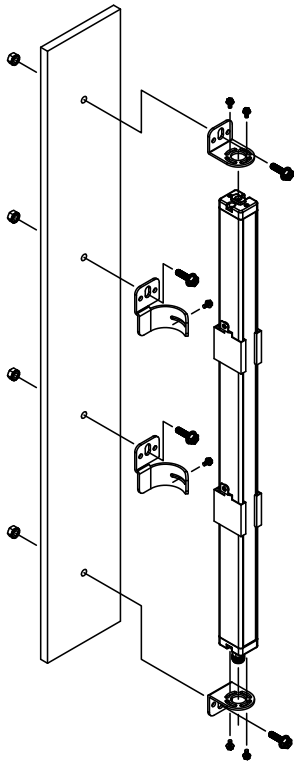
Center mounting brackets are supplied with longer sensors and must be used whenever the sensors are subject to shock or vibration. The sensors are designed to be mounted with up to 450 mm (18 in) distance between brackets:

- Sensors 600 to 900 mm (24 in to 36 in) long are supplied with one center bracket, which should be centered on the sensor.
- Sensors 1050 to 1350 mm (42 in to 54 in) 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 in to 71 in) 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 11 on p. 20. 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.

Figure 11. Emitter and Receiver Center Mounting Brackets



3.2.2 Mounting and Initial Alignment of Emitter/Receiver Pairs

Emitter/receiver pairs may be spaced from 0.2 to 15 m (8 in to 50 ft) 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 ±30° 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.

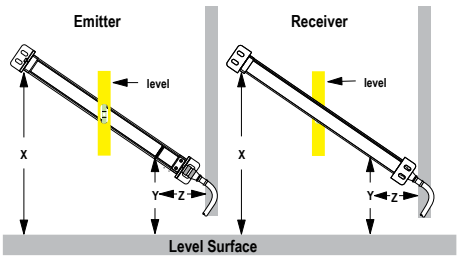
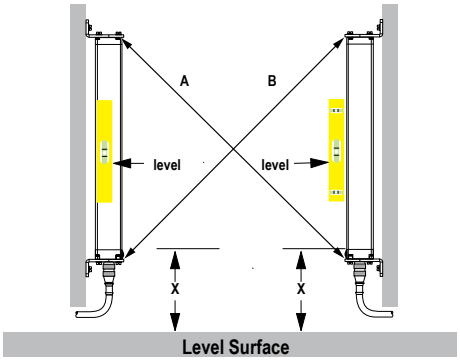
Important: The connector ends of both sensors must point in the same direction (see Emitter and Receiver Orientation on p. 17).

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.

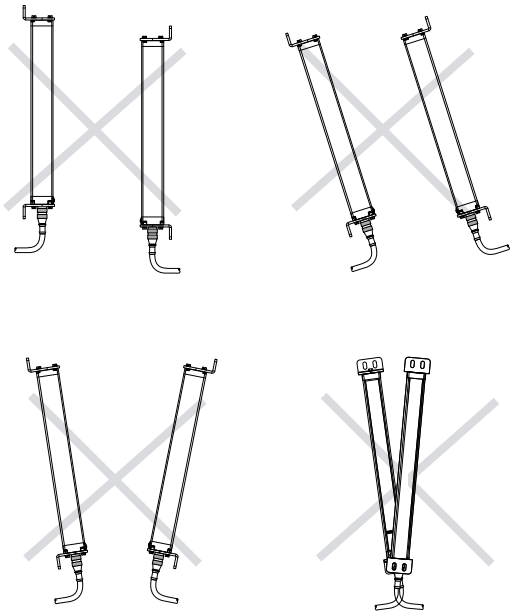
Verifying Initial Emitter/Receiver Alignment

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	Vertical 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. 	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.



4 Electrical Installation and Testing

WARNING: Read this Section Carefully Before Installing the System

If all mounting, installation, interfacing, and checkout procedures are not followed properly, the Banner device cannot provide the protection for which it was designed. The user is responsible for ensuring 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. 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 Banner device is installed and interfaced to the guarded machine by Qualified Persons [3], in accordance with this manual and applicable safety regulations. **Failure to follow these instructions could result in serious injury or death.**

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*).
2. Perform an Initial Checkout Procedure (see Initial Checkout Procedure on p. 25).
3. Make all electrical interface connections to the guarded machine (see Electrical Connections to the Guarded Machine on p. 29).
4. Perform a commissioning checkout procedure.

4.1 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 p. 49 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).

Table 1: Maximum Machine Interface cable length versus total current draw (including both OSSD loads)

Cable Size	Current Draw			
	0.5 A	**0.75 A**	**1.0 A**	**1.25 A**
0.823 mm^2 (18 AWG)	375 ft	250 ft	188 ft	148 ft
0.518 mm^2 (20 AWG)	240 ft	160 ft	120 ft	95 ft
0.326 mm^2 (22 AWG)*	150 ft	100 ft	75 ft	59 ft

Note: Cable length includes power (+24 V dc) and return (0 V 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 +24 V dc - 10%.

[3] 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.

4.2 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. **Make no more connections to the EZ-SCREEN Type 2 System than are described in this manual. Connection of other wiring or equipment to the EZ-SCREEN Type 2 System could result in serious injury or death.**

Lockout/tagout procedures may be required (refer to OSHA1910.147, ANSI Z244-1, ISO 14118, 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 the earth ground (green/yellow wire). **Do not operate the EZ-SCREEN Type 2 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 Euro-style quick-disconnects.

Emitter Cordset	Receiver Cordset
EZ-SCREEN Type 2 emitters have an 8-pin cordset, but only three conductors are required: • Brown = +24 V dc • Blue = 0 V dc • Green/Yellow = GND	**Do not connect any wires to the machine control circuits (that is, OSSD outputs) at this time.** For the initial checkout, only the following EZ-SCREEN Type 2 receiver conductors should be connected: • Brown = +24 V dc • Blue = 0 V dc • Green/Yellow = GND Additionally, connect the external reset switch, if used, or test signal contact to the Reset/Test wire (violet) and to 24 V dc.

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 30 V 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.

4.2.1 Sensor Interchangeability

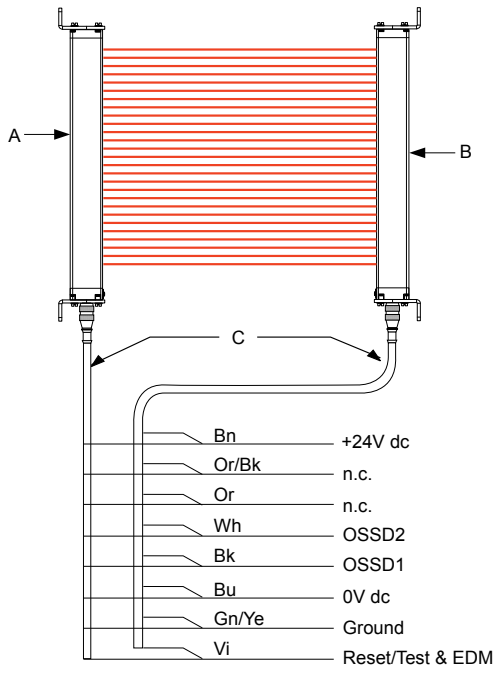
The figures and table below illustrate a wiring option that provides sensor interchangeability (or swapability)—the ability to install either sensor at either QD connection.

The resulting installation provides the ability to swap the emitter and receiver position. This wiring option provides advantages during installation, wiring, and troubleshooting.

To use this option, connect all emitter wires in parallel (color-for-color) to the receiver cable via individual wires or the CSB.. splitter cordset.

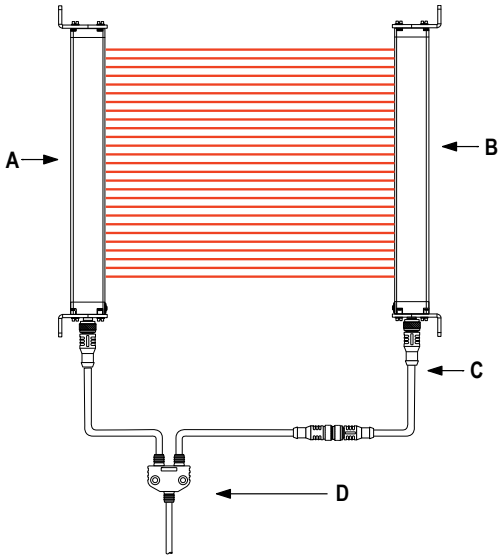
Model CSB.. splitter cordsets and DEE2R.. double-ended cordsets allow easy interconnection between an EZ-SCREEN Type 2 receiver and emitter, providing a single homerun cordset.

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

4.3 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 components.

Perform this procedure to:

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

4.3.1 Configuring the System for Initial Checkout

For the initial checkout, the EZ-SCREEN Type 2 System must be checked without power 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, ISO 14118, or the appropriate standard for controlling hazardous energy). The OSSD 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 and its controls or actuators
- The machine control circuit or the Safety/Interface Module is not connected to the OSSD outputs at this time (permanent connections will be made later)

4.3.2 Initial Power-Up

1. 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 (see Adjacent Reflective Surfaces on p. 16).
2. Eliminate the reflective surfaces as much possible by relocating, painting, masking, or roughening them. Remaining problem reflections will become apparent during the trip test.
3. 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.
4. Remove all obstructions from the light screen.
5. Leaving power to the guarded machine Off, make power and earth ground connections on both the emitter and receiver cables (see Generic Emitter Wiring Diagram on p. 33).
6. Power up the EZ-SCREEN Type 2 System only.
7. Verify that the input power is present to both the emitter and the receiver. At least one indicator on both the emitter and the receiver should be On and the start-up sequence should cycle.
8. Watch both the emitter and the receiver LED indicators to determine the light screen alignment status.

Figure 12. Emitter Status Indicators

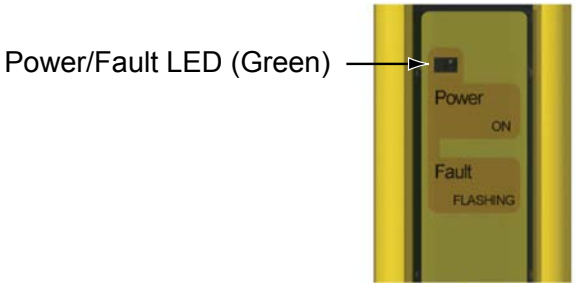
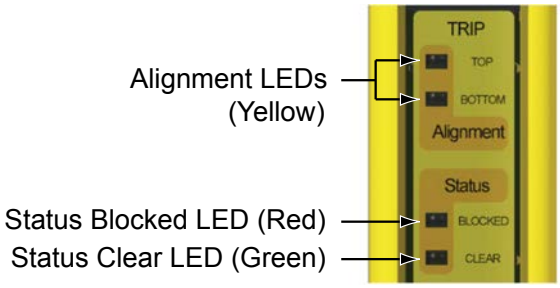


Figure 13. Receiver Status Indicators

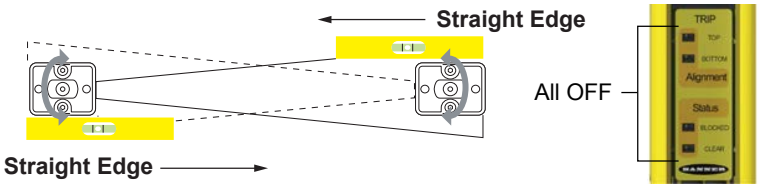


- **Lockout Condition**—on the emitter, the green Power indicator is flashing or on the receiver, the red Status Blocked indicator is flashing. See Troubleshooting and Lockout Conditions on p. 39 for diagnostic information.
- **Normal Operating Mode**—to the emitter, the green Power indicator is ON.
- **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.
- **Receiver 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 p. 26. If a Clear (Run) condition cannot 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 p. 26). 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 on p. 28 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 p. 26 procedure.

4.3.3 Optical Alignment

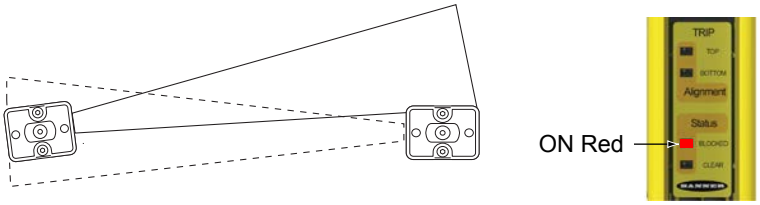
WARNING:
- **Hazard exposure**
- Failure to follow these instructions could result in serious injury or death.
- Verify that no individuals are exposed to any hazard if the output signal switching device (OSSD) outputs turn on when the emitter and receiver become aligned.

1. Verify the sensor mounting.
2. Verify the optimal alignment, adjusting the sensor rotation with the power on:
   a. Verify that the emitter and the 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.

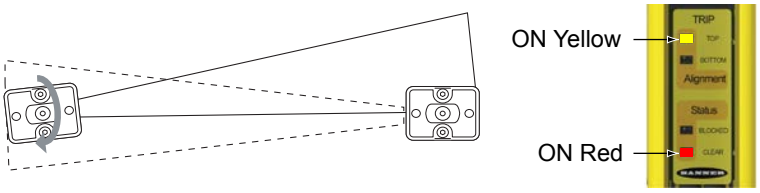


Note: At power-up, all indicators are tested (flash).

   b. If the synchronization beam is not aligned, the Status Blocked indicator is red and both Alignment indicators will be off.

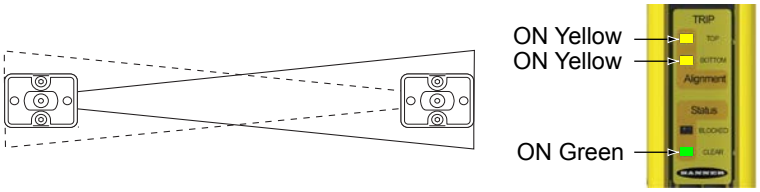


   c. If the green Status and amber Alignment indicators are on, go to step "d". If not, rotate each sensor (one at a time) left and right until the green Status Clear indicator comes on. As the sensor rotates out of alignment, the Status Blocked indicator will turn solid red.

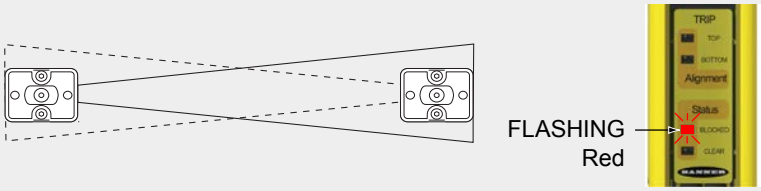


   d. To optimize alignment, note the position where the red Status Blocked indicator comes on when the sensor is rotated both left and right. Center the sensor between the two positions, and tighten the end cap mounting screws, making sure the positioning does not drift as the screws are tightened.

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



Note: If at any time the red Status Blocked indicator begins to flash, the System has entered a Lockout condition. See Troubleshooting on p. 39 for more information.



4.3.4 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, under Mechanical Installation Considerations on p. 11.

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

In addition to the standard optical alignment procedure, verify:

1. 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.
3. 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.

Note: A LAT-1-LS Laser Alignment Tool is very helpful by providing a visible red dot along the optical axis. See Figure 14 on p. 28 and Banner Safety Applications Note SA104 (p/n 57477) for further information.

Figure 14. Optical alignment using the LAT-1-LS

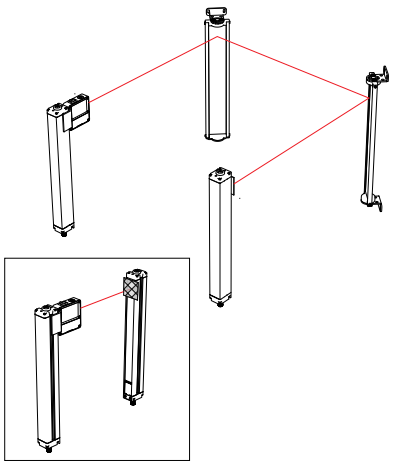
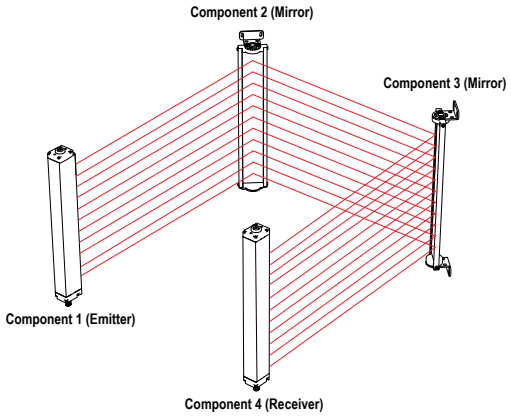


Figure 15. Corner Mirror Alignment

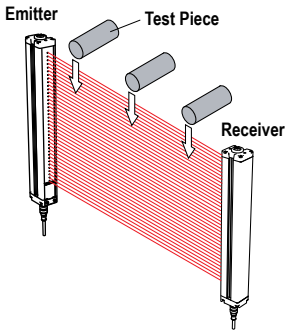


4.3.5 Trip Test

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 (1.18 in) diameter specified test piece supplied with the receiver .
2. Verify that the System is in Run mode, the Status Clear indicator is ON steady Green and the Top and Bottom Status indicators are ON steady Yellow. A manual reset may be required for Latching models when the Top and Bottom LED are flashing Yellow.
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.

Figure 16. Trip Test



4. During each pass (see Status Indicators on p. 37 for more details):
   - 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.

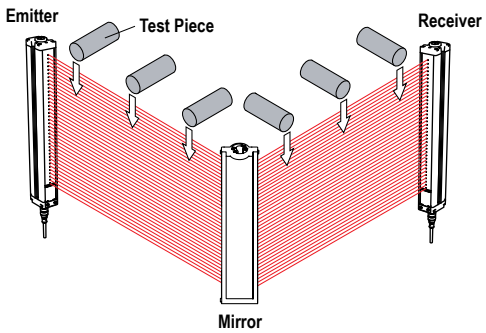
     If the Yellow Alignment indicators begin to flash at any time while the test piece is interrupting the defined area, the installation has failed the trip test. Check for correct sensor orientation and reflective surfaces. Do not continue until the situation is corrected. In Latch Output Operation, the Status Blocked indicator will remain ON until a manual reset is performed (both Yellow Alignment indicators will be flashing).

WARNING: If the 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 sensing field. **Failure to follow these instructions could result in serious injury or death.**

5. If mirrors are used in the application: Test the defined area on each leg of the sensing path (for example, between emitter to mirror, between mirror and receiver).

Figure 17. Trip Test with Corner Mirror



6. If the EZ-SCREEN Type 2 System passes all checks during the trip test, go on to Electrical Connections to the Guarded Machine on p. 29.

4.4 Electrical Connections to the Guarded Machine

Verify that power has been removed from the EZ-SCREEN Type 2 and the guarded machine. Make the permanent electrical connections as described in OSSD Output Connections on p. 30 and FSD Interfacing Connections on p. 30 as required by each individual application.

Lockout/tagout procedures may be required (refer to OSHA 1910.147, ANSI Z244-1, ISO 14118, 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 external device monitoring (EDM) 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 p. 25.

The final connections to be made or verified are:

- OSSD outputs
- FSD interfacing
- MPCE/EDM

WARNING:
- **Risk of electric shock**
- Use extreme caution to avoid electrical shock. Serious injury or death could result.
- Always disconnect power from the safety system (for example, device, module, interfacing, etc.), guarded machine, and/or the machine being controlled before making any connections or replacing any component. Lockout/tagout procedures might be required. Refer to OSHA 29CFR1910.147, ANSI Z244-1, or the applicable standard for controlling hazardous energy.
- Make no more connections to the device or system than are described in this manual. Electrical installation and wiring must be made by a Qualified Person [4] and must comply with the applicable electrical standards and wiring codes, such as the NEC (National Electrical Code), NFPA 79, or IEC 60204-1, and all applicable local standards and codes.

4.4.1 OSSD Output Connections

Refer to the output specifications in the Receiver Specifications and these warnings before making OSSD output connections and interfacing the EZ-SCREEN Type 2 to the machine.

WARNING:
- **Interfacing both output signal switching devices (OSSD)**
- Failure to follow these instructions could result in serious injury or death.
- Unless the same degree of safety is maintained, never wire an intermediate device(s) (PLC, PES, PC) between the safety module outputs and the master stop control element it switches such that a failure causes a loss of the safety stop command or the failure allows the safety function to be suspended, overridden, or defeated.
- Connect both OSSD outputs 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.

WARNING:
- **OSSD Interfacing**
- Failure to properly interface the OSSD Outputs to the guarded machine could result in serious injury or death.
- To ensure proper operation, the Banner device output parameters and machine input parameters must be considered when interfacing the Banner device OSSD outputs to machine inputs. Design machine control circuitry so that all of the following are true:

  The maximum load resistance value is not exceeded.
  The maximum specified OSSD OFF-state voltage does not result in an ON condition.

4.4.2 FSD Interfacing Connections

FSDs (Final Switching Devices) take many forms. The most common are forced-guided devices, mechanically linked relays, or interface modules. 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.

[4] 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.

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 contacts from forced-guided, mechanically linked relays, which are monitored through External Device 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 normally open contacts; or dual-channel, which is a separate connection of two normally open 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 arrests the hazards and prevents the next cycle from occurring. See Wiring Diagrams on p. 33.

The interfacing of the protective stop circuits must be accomplished so that the safety function cannot be suspended, overridden, or defeated, unless accomplished in a manner of 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 Wiring Diagrams on p. 33.

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 a loss of the switching ability of one of the FSD outputs. Such failures may lead to a 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 increases, 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 a 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 cannot 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

4.4.3 Machine Primary Control Elements and EDM Input

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 (Ts, used to calculate the safety distance, see Calculating the Safety Distance (Minimum Distance) on p. 11) 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 p. 34 and Generic Wiring — Interface Module (2-Channel EDM, Manual Reset) on p. 35, or consult the machine manufacturer for additional information.

4.4.4 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 on p. 39 for clearing lockouts.)

Connect the receiver's reset/test wire (pin 8) to the supply voltage (see Generic Wiring to FSDs (manual reset) on p. 34 and Generic Wiring — Interface Module (2-Channel EDM, Manual Reset) on p. 35) 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 p. 15).

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 could 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 p. 34 and Generic Wiring — Interface Module (2-Channel EDM, Manual Reset) on p. 35). 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 p. 34 and Generic Wiring — Interface Module (2-Channel EDM, Manual Reset) on p. 35 for Power Monitoring hookup.
- No Monitoring. Use this configuration initially, in order to perform the initial checkout; see Initial Checkout Procedure on p. 25. 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.

4.4.5 Preparing for System Operation

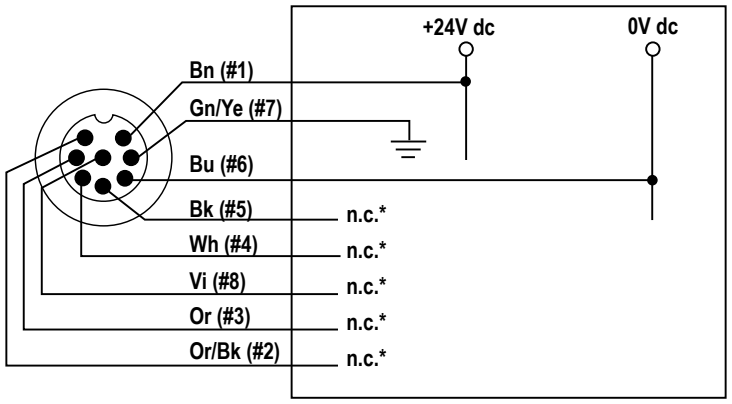
After the initial trip test has been accomplished, and the OSSD safety outputs and EDM connections have been made to the machine to be controlled, the EZ-SCREEN Type 2 is ready for testing in combination with the guarded machine.

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.

4.5 Wiring Diagrams

4.5.1 Generic Emitter Wiring Diagram

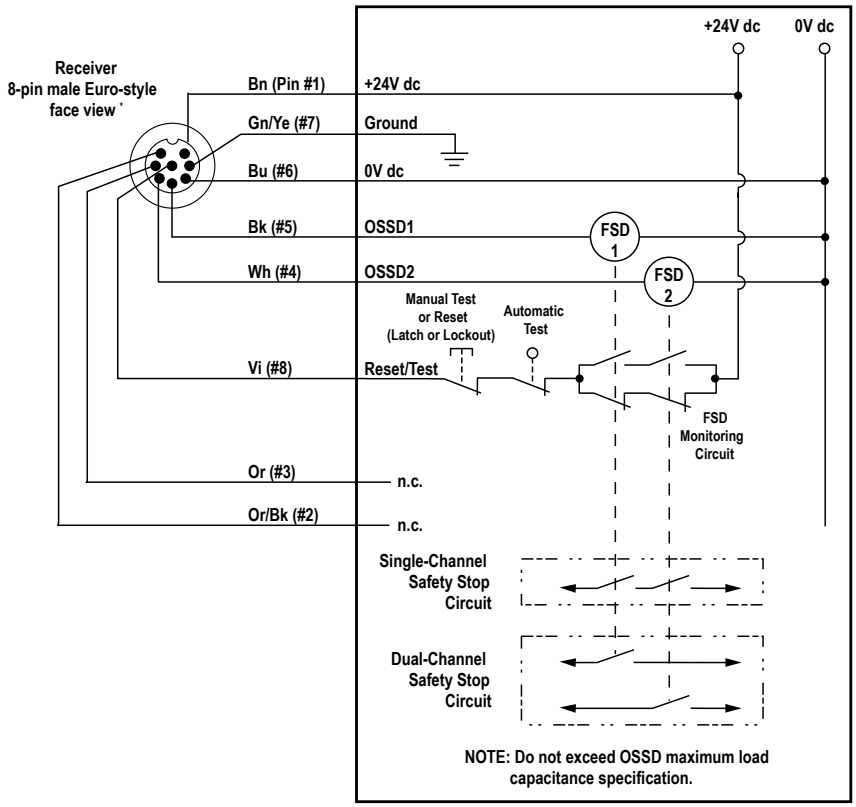
Figure 18. Emitter—Generic Wiring Diagram



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.

4.5.2 Generic Wiring to FSDs (manual reset)

Figure 19. Generic Wiring to FSDs (manual reset)

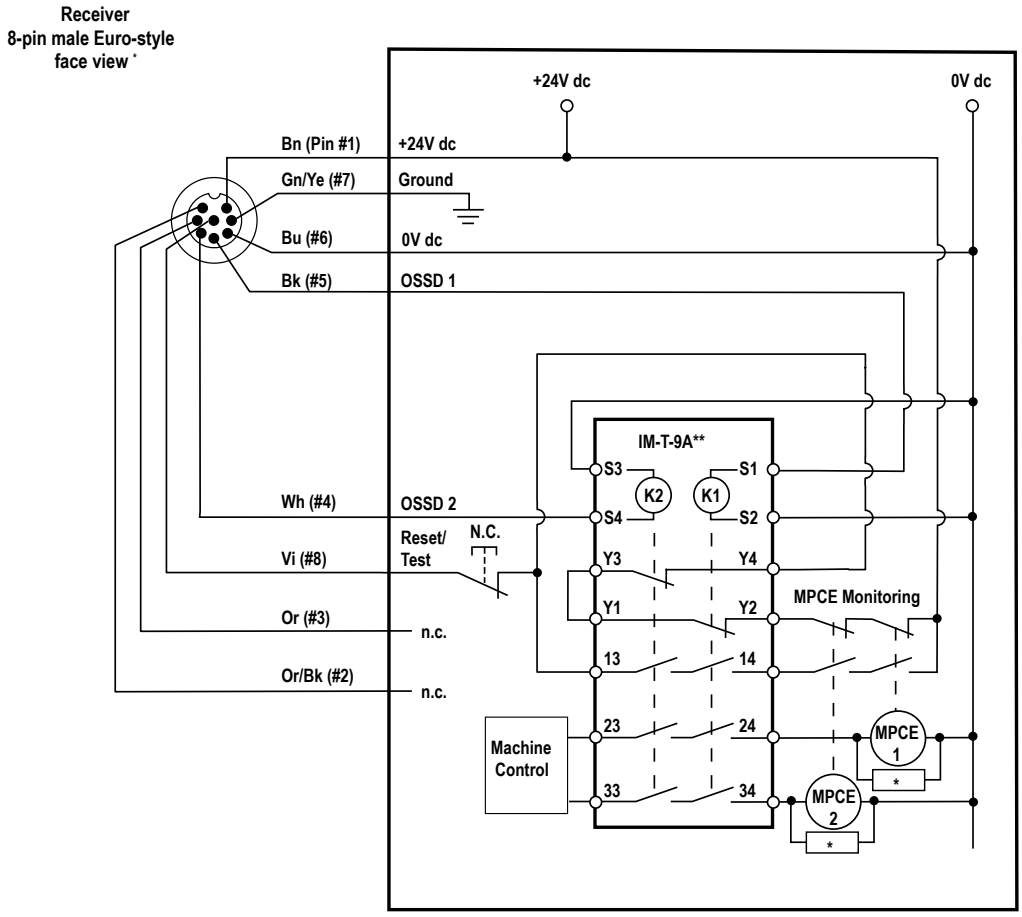


*See Single-Ended (Machine Interface) Cordsets on p. 49 for available cordsets.

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.

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

Figure 20. Generic Wiring — Interface Module (2-Channel EDM, Manual Reset)



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.
- Installation of transient (arc) suppressors across the coils of MPCE1 and MPC2 is recommended.
- See Cordsets on p. 49 for available cordset information

Other interfacing modules and solutions are available, see Accessories on p. 49.

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 creates an unsafe condition. **Failure to follow these instructions could result in serious injury or death.**

5 System Operation

5.1 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
- 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

5.2 Reset Procedures

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 p. 15). 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 provides some level of personal control, since the key may be removed from the switch. This hinders 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.

5.2.1 Receiver Resets

The EZ-SCREEN Type 2 receiver has a Reset input, pin 8 (violet wire), that provides for a manual reset input signal.

Receiver manual resets are required in the following situations:

- Trip Output operation – only after a Lockout (see Troubleshooting and Lockout Conditions on p. 39 for causes).
- Latch Output operation – at power-up, after each Latch condition occurs, or after a Lockout.

Reset Routine

To reset the receiver, open the reset switch for 1/4 second, then close it. An alternative method of resetting the receiver to clear a fault is to power the receiver down, then power it back up.

5.2.2 Resetting the Emitter

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.

5.3 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. Additional LED condition combinations indicate errors or faults; refer to Troubleshooting on p. 39.

5.3.1 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).

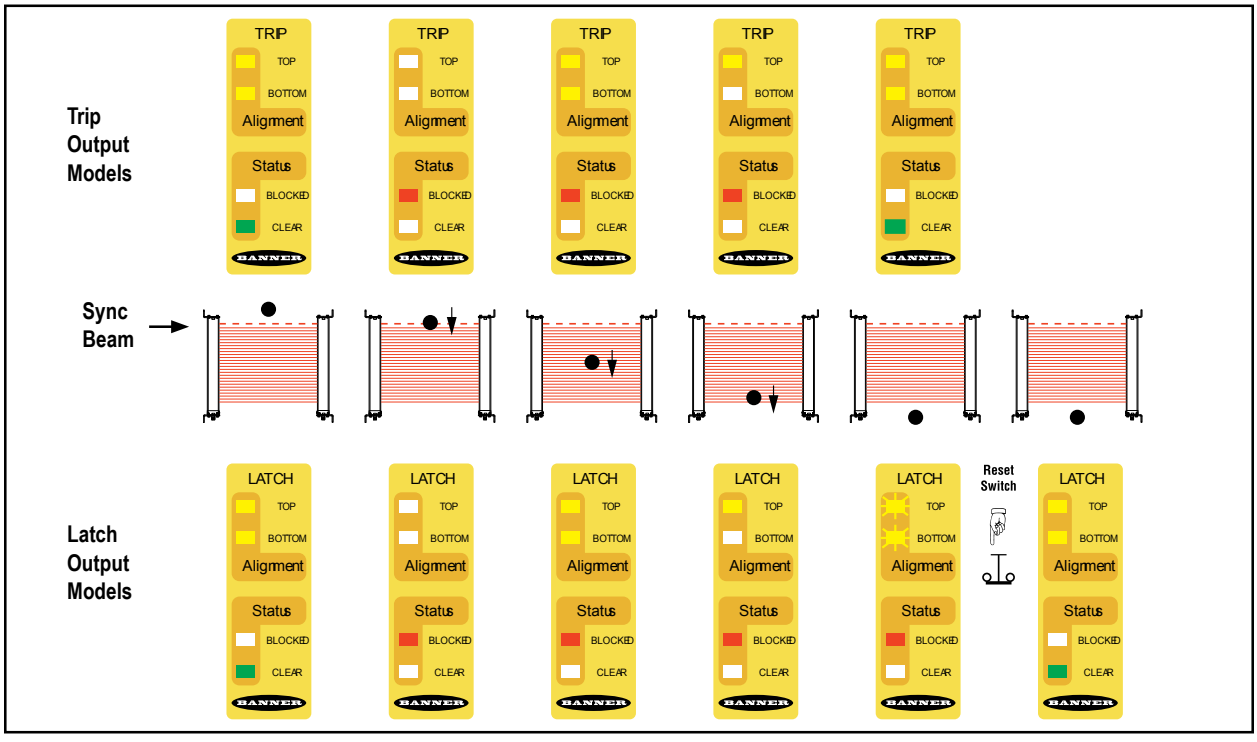
Indicator	Color	On	Flashing	Off
Top Alignment	Yellow	Top (sync) beam is aligned and clear	(Both together) System is aligned; waiting for manual reset (Latch models)	Top (sync) beam is blocked or misaligned
Bottom Alignment	Yellow	Bottom beam is aligned and clear		Bottom beam is blocked or misaligned;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

Status Indicators

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

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 21. Status Indicator behavior during the trip test



5.3.2 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

5.4 Normal Operation

5.4.1 System Power-Up

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 p. 39). 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 p. 39). 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.

5.4.2 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 Models With Response Times on p. 12). 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 Models With Response Times on p. 12). 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 p. 39 for resolution of error/fault conditions.

5.4.3 Manual Reset Procedure

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

6 Troubleshooting

6.1 Troubleshooting and Lockout Conditions

Evaluate status indicators per Status Indicators on p. 36.

A Lockout condition causes all 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 the *Troubleshooting* section.

6.2 Recovery Procedures

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

6.2.1 Receiver (System Reset)

Open the Reset switch for 0.25 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.

6.2.2 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, ISO 14118, or the appropriate standard for controlling hazardous energy). **Servicing the EZ-SCREEN Type 2 while the hazardous machinery is operational could result in serious injury or death.**

Table 2: Emitter Troubleshooting

Emitter		
Display	**LED Status**	**Possible Cause and Appropriate Action**
Power/Fault	Green flashing	Emitter Failure • Check the power supply for low or erratic voltage, or excessive electrical noise. • Verify the sensor has a good earth ground. If the condition continues, contact Factory.
Power/Fault	Green OFF	Power Supply Failure - Check the power supply.

Table 3: Receiver Troubleshooting

Receiver		
Display	**LED Status**	**Possible Cause and Appropriate Action**
Alignment Top Alignment Bottom Status Blocked Status Clear	Yellow flashing Yellow flashing Red flashing Green OFF	Output Fault • Check output connections. • Check for a short between OSSD1 and OSSD2 or to a secondary source of power. • When connecting to a capacitive load greater than 0.1 µF, contact Factory. • Open Reset/Test for at least 0.25 seconds and close. If the condition continues, contact Factory.
Alignment Top Alignment Bottom Status Blocked Status Clear	Yellow flashing Yellow OFF Red flashing Green OFF	Optical Fault • Open Reset/Test for at least 0.25 seconds and close. • Check for optical interference or noise. If the condition continues, contact Factory.
Alignment Top Alignment Bottom Status Blocked Status Clear	Yellow OFF Yellow OFF Red flashing Green OFF	Internal Fault • Open Reset/Test for at least 0.25 seconds and close. • Check the power supply for low or erratic voltage, or excessive electrical noise. • Verify the sensor has a good earth ground. If the condition continues, contact Factory.
Alignment Top Alignment Bottom Status Blocked Status Clear	Yellow OFF Yellow OFF Red ON Green ON	Reset/Test Input Fault • Reset/Test input open at power-up. • Switch the device OFF, verify the Reset/Test input is connected to +24 V dc (e.g., the reset button or switch is closed) and reapply power.
Alignment Top Alignment Bottom Status Blocked Status Clear	Yellow OFF Yellow OFF Red ON Green flashing	Test Mode - Reset/Test input is open.
Alignment Top Alignment Bottom Status Blocked Status Clear	Yellow OFF Yellow OFF Red OFF Green OFF	Power Supply Failure - Check power supply.

6.3 Electrical and Optical Noise

If random nuisance Trips or lockouts 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

6.3.1 Check for Sources of Electrical Noise

It is 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 high-voltage wiring can inject noise into the EZ-SCREEN Type 2 System. It is good wiring practice (and may be required by code) to isolate EZ-SCREEN Type 2 wires from high-voltage wires.

1. Use the Banner model BT-1 Beam Tracker Alignment Aid to detect electrical transient spikes and surges.
2. Cover the lens of the BT-1 with electrical tape to block optical light from entering the receiver lens.
3. 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.
4. Install proper transient suppression across the load to reduce the noise.

6.3.2 Check for Sources of Optical Noise

1. Turn off the emitter, completely block the emitter, or open the Test input.
2. Use a Banner BT-1 Beam Tracker (see Accessories on p. 49) to check for light at the receiver.
3. 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 emitted light from other sources (other safety light screens, grids or points, or standard photoelectric sensors).

7 Product Support and Maintenance

7.1 Cleaning

EZ-SCREEN Type 2 components are constructed of aluminum with a yellow painted finish and are rated IP65. Lens covers are acrylic. Components 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.

7.2 Manufacturing Date

Every EZ-SCREEN Type 2 produced is marked with a code that defines the week and year of manufacture and manufacturing location. The code format (U.S. Standard format) is: **YYWWL**

- YY = Year of manufacture, 2 digits
- WW = Week of manufacture, 2 digits
- L = Banner-specific code, 1 digit

Example: 1809H = 2018, Week 9.

7.3 Warranty Service

Contact Banner Engineering for troubleshooting of this device. **Do not attempt any repairs to this Banner device; it contains no field-replaceable parts or components.** If the device, device part, or device component is determined to be defective by a Banner Applications Engineer, they will advise you of Banner's RMA (Return Merchandise Authorization) procedure.



Important: If instructed to return the device, pack it with care. Damage that occurs in return shipping is not covered by warranty.

7.4 Disposal

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

7.5 Banner Engineering Corp 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 or installation of the Banner product.

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For patent information, see www.bannerengineering.com/patents.

7.6 Contact Us

Banner Engineering Corp. headquarters is located at:

9714 Tenth Avenue North
Minneapolis, MN 55441, USA
Phone: + 1 888 373 6767

For worldwide locations and local representatives, visit www.bannerengineering.com.

8 Checkout Procedures

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

Banner Engineering highly recommends performing the System checkouts as described. However, a qualified person (or team) should evaluate these generic recommendations considering their specific application and determine the appropriate frequency of checkouts. This will generally be determined by a risk assessment, such as the one contained in ANSI B11.0. The result of the risk assessment will drive the frequency and content of the periodic checkout procedures and must be followed.

8.1 Schedule of Checkouts

Checkout cards and this manual can be downloaded at http://www.bannerengineering.com.

Checkout Procedure	When to Perform	Where to Find the Procedure	Who Must Perform the Procedure
Trip Test	At Installation Any time the System, the guarded machine, or any part of the application is altered.	Trip Test on p. 28	Qualified Person
Commissioning Checkout	At Installation 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 p. 44	Qualified Person
Shift/Daily Checkout	At each shift change Machine setup change Whenever the System is powered up During continuous machine run periods, this checkout should be performed at intervals not to exceed 24 hours.	**Daily Checkout Card** (Banner p/n 122450) A copy of the checkout results should be recorded and kept in the appropriate place (for example, near or on the machine, in the machine's technical file).	Designated Person or Qualified Person
Semi-Annual Checkout	Every six months following System installation, or whenever changes are made to the System (either a new configuration of the EZ-SCREEN Type 2 or changes to the machine).	**Semi-Annual Checkout Card** (Banner p/n 122451) A copy of the checkout results should be recorded and kept in the appropriate place (for example, near or on the machine, in the machine's technical file).	Qualified Person

8.2 Commissioning Checkout

WARNING:
- **Do not use the system until the checkouts are verified**
- Attempts to use the guarded/controlled machine before these checks are verified could result in serious injury or death.
- If all these checks cannot be verified, do not attempt to use the safety system that includes the Banner Engineering Corp. device and the guarded/controlled machine until the defect or problem has been corrected.

Perform this checkout procedure as part of the 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 p. 7 for a list of misapplications.
2. Verify that the EZ-SCREEN Type 2 is configured for the intended application.
3. Verify that the safety distance (minimum 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 p. 11.
4. 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 (fixed) guarding, or supplemental safeguarding, and

- It is not possible for a person to stand between the defined area and the dangerous parts of the machine, or
- Supplemental safeguarding and hard (fixed) 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.

5. If used, 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.
6. Examine the electrical wiring connections between the EZ-SCREEN Type 2 OSSD outputs and the guarded machine's control elements to verify that the wiring meets the requirements stated in Electrical Connections to the Guarded Machine on p. 29.
7. Inspect the area near the defined area (including work pieces and the guarded machine) for reflective surfaces (see Adjacent Reflective Surfaces on p. 16). Remove the reflective surfaces if possible by relocating them, painting, masking or roughening them. Remaining problem reflections will become apparent during the Trip Test.
8. Verify that power to the guarded machine is Off. Remove all obstructions from the defined area. Apply power to the EZ-SCREEN Type 2 System. Latch Output models: (Manual Power-Up), both Alignment indicators will be flashing amber. Perform a manual reset (open the reset switch for 1/4 second, then close it).
9. 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 amber area clear) Status Clear Off
10. A Blocked condition indicates that one or more of the beams is misaligned or interrupted. See the Optical Alignment procedure in the Initial Checkout Procedure on p. 25 section to correct this situation.
11. After the green and amber Status indicators are On, **perform the trip test** (in the Initial Checkout Procedure on p. 25 section) 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.**



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



WARNING:
- **Clear the guarded area before applying power or resetting the system**
- Failure to clear the guarded area before applying power could result in serious injury or death.
- Verify that the guarded area is clear of personnel and any unwanted materials before applying power to the guarded machine or before resetting the system.

12. Apply power to the guarded machine and verify that the machine does not start up.
13. 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.
14. 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 must come to a stop with no apparent delay.
15. 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.
16. Remove electrical power to the EZ-SCREEN Type 2. Both OSSD outputs should immediately turn Off, and the machine must not be capable of starting until power is re-applied to the EZ-SCREEN Type 2.
17. 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.

Do not continue operation until the entire checkout procedure is complete and all problems are corrected.

9 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.

9.1 Specifications

9.1.1 General Specifications

Short Circuit Protection
All inputs and outputs are protected from short circuits to +24 V DC or DC common

Electrical Safety Class
III (per IEC 61140: 1997)

Safety Rating
Type 2 per IEC 61496-1, -2
Category 2 PL c per EN ISO13849-1

	8 Beams	96 Beams
$MTTF_d$ (EN ISO 13849-1)	284.14 yr.	47.65 yr.
Mission Time, Tm	20 years	

Operating Range
0.2 to 15 m (8 in. to 50 ft) — Range decreases with use of mirrors and/or lens shields:
- Lens shields — approx 10% less range per shield
- Glass-surface mirrors — approx 8% less range per mirror

See the specific mirror datasheet for more information.

Resolution
30 mm

Effective Aperture Angle (EAA)
Meets Type 2 requirements per IEC 61496-2; ±5° at 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 Models With Response Times on p. 12)

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

Environmental Rating
IEC IP65

Operating Conditions
0 °C to +55 °C (+32 °F to +131 °F)
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 in) single amplitude (0.70 mm peak-to-peak) and shock of 10 g for 16 milliseconds (6,000 cycles).

Certifications

9.1.2 Emitter Specifications

Supply Voltage at the Device
24 V DC ±20% (use a PELV-rated power supply according to EN IEC 60950). The external voltage supply must be capable of buffering brief mains interruptions of 20 ms, as specified in IEC/EN 60204-1.

Supply Current
50 mA maximum

Wavelength of Emitter Elements
Infrared LEDs, 850 nm at peak emission

9.1.3 Receiver Specifications

Supply Voltage at the Device
24 V DC ±15% (use a PELV-rated power supply according to EN IEC 60950).The external voltage supply must be capable of buffering brief mains interruptions of 20 ms, as specified in IEC/EN 60204-1.

Supply Current (no load)
90 mA maximum, exclusive of OSSD1 and OSSD2 loads (up to an additional 0.5 A each)

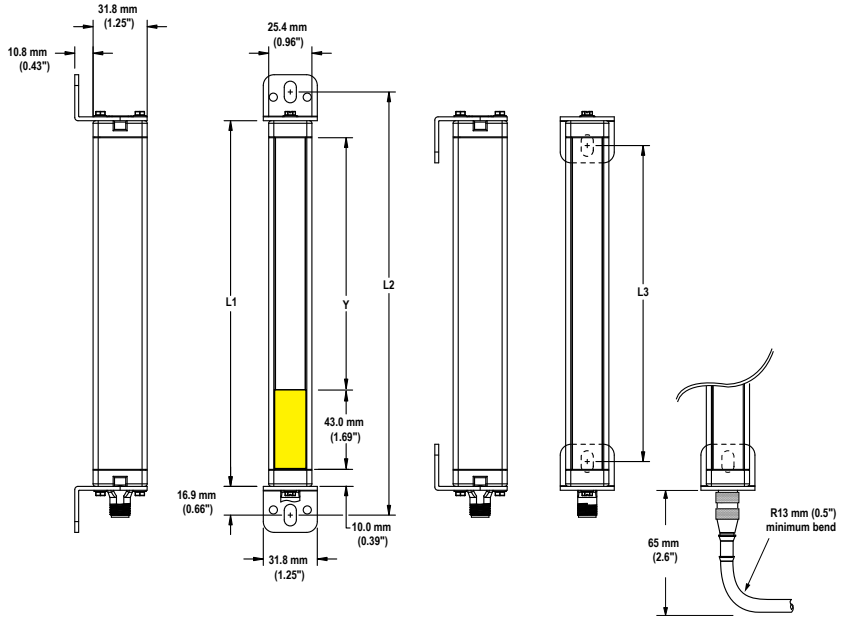
EDM Input
Power monitoring accomplished via Reset/Remote Test input

Reset Input/Remote Test Input
Connect to +24 V DC via a normally closed (N.C.) reset switch
Auto Reset (Trip Output) Models: Test/Reset
Manual Reset (Latch Output) Models: Test/Restart/Reset

Output Signal Switching Devices (OSSDs)
Two redundant solid-state 24 V DC, 0.5 A maximum sourcing OSSD (Output Signal Switching Device) safety outputs. (Use optional interface modules for AC or larger DC loads.) Not capable of the Banner "Safety Handshake".
ON-State voltage: ≥ Vin-1.5 V DC
OFF-State voltage: 0 V dc typical, 0.5 V dc maximum (no load)
Maximum load capacitance: 100 nF
Maximum cable resistance to load: 5 ohms per wire
Open ground leakage current: 0.65 mA maximum
OSSD test pulse width: 200 to 250 microseconds typical
OSSD test pulse period: 260 ms typical

Status Indicators
See Status Indicators on p. 36 and Emitter Reset on p. 39
Emitter: Green LED, Power ON
Receiver: Two yellow alignment indicators (top and bottom), two status indicators (blocked and clear)

9.1.4 Emitter and Receiver Dimensions



Emitter or Receiver Model	Housing Length L1	Distance Between Bracket Holes L2 L3		Defined Area [5] Y
LS2..-150	215 mm (8.5 in)	249 mm (9.8 in)	186 mm (7.3 in)	150 mm (5.9 in)
LS2..-300	365 mm (14.4 in)	349 mm (13.7 in)	336 mm (13.2 in)	300 mm (11.8 in)
LS2..-450	515 mm (20.3 in)	549 mm (21.6 in)	486 mm (19.1 in)	450 mm (17.7 in)
LS2..-600	665 mm (26.2 in)	699 mm (27.5 in)	636 mm (25.0 in)	600 mm (23.6 in)
LS2..-750	815 mm (32.1 in)	849 mm (33.4 in)	786 mm (30.9 in)	750 mm (29.5 in)
LS2..-900	964 mm (38.0 in)	998 mm (39.3 in)	935 mm (36.8 in)	900 mm (35.4 in)
LS2..-1050	1114 mm (43.9 in)	1148 mm (45.2 in)	1085 mm (42.7 in)	1050 mm (41.3 in)
LS2..-1200	1264 mm (49.8 in)	1298 mm (51.1 in)	1235 mm (48.6 in)	1200 mm (47.2 in)
LS2..-1350	1414 mm (55.7 in)	1448 mm (57.0 in)	1385 mm (54.6 in)	1350 mm (53.1 in)
LS2..-1500	1563 mm (61.5 in)	1597 mm (62.9 in)	1534 mm (60.4 in)	1500 mm (59.1 in)
LS2..-1650	1713 mm (67.4 in)	1747 mm (68.8 in)	1684 mm (66.3 in)	1650 mm (65.0 in)
LS2..-1800	1863 mm (73.3 in)	1897 mm (74.7 in)	1834 mm (72.2 in)	1800 mm (70.9 in)

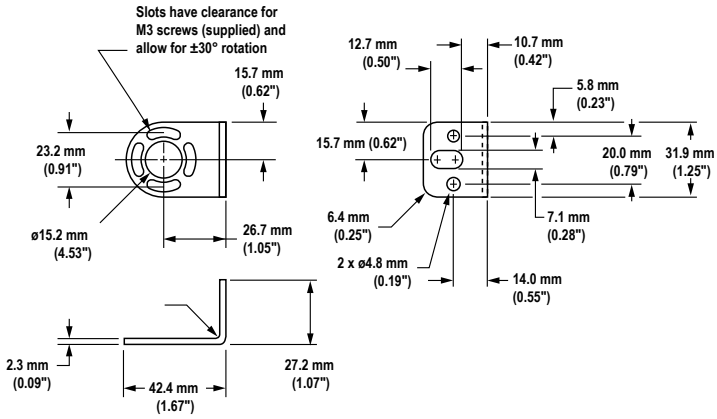
9.1.5 Bracket Dimensions

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.

[5] Normal measurement

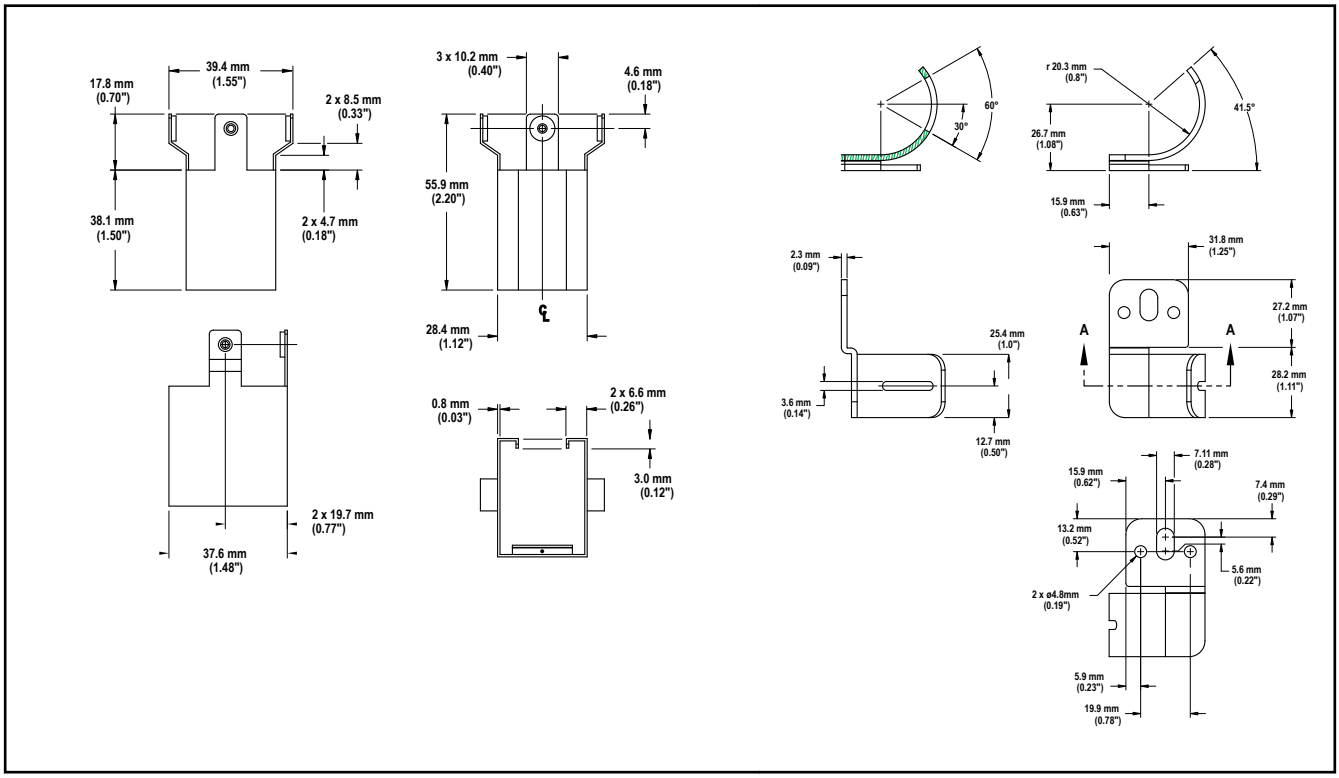
Standard End Cap Brackets

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



9.2 Accessories

9.2.1 Accessories

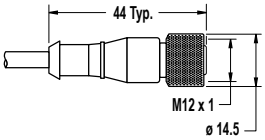
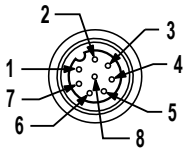
Additional interfacing solutions and accessories continue to be added; refer to http://www.bannerengineering.com for a current list.

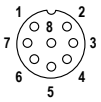
9.2.2 Cordsets

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.

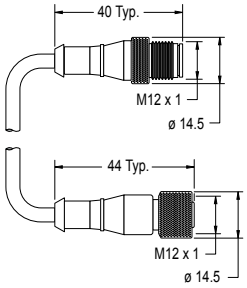
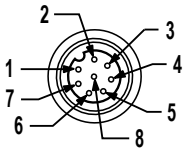
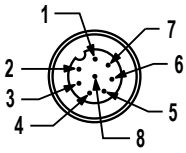
8-Pin Threaded M12 Cordsets—Single Ended				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
QDE-815D	4.57 m (15 ft)	Straight		 1 = Brown 2 = Or/Bk 3 = Orange 4 = White 5 = Black 6 = Blue 7 = Gn/Ye 8 = Violet
QDE-825D	7.62 m (25 ft)			
QDE-850D	15.24 m (50 ft)			
QDE-875D	22.86 m (75 ft)			
QDE-8100D	30.48 m (100 ft)			

QDE-8..D Pinout/Color Code			European M12 Specification [6]			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	

[6] 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.

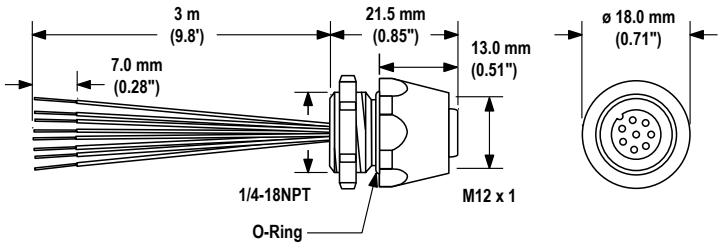
Double-Ended Cables

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 p. 50).

8-Pin Threaded M12 Cordsets—Double Ended					
Model (8-pin/8-pin) [7]	**Length**	**Style**	**Dimensions**	**Pinout**	
DEE2R-81D	0.3 m (1 ft)	Female Straight/ Male Straight		Female  Male 	
DEE2R-82D	0.91 m (3 ft)				
DEE2R-88D	2.44 m (8 ft)				
DEE2R-815D	4.57 m (15 ft)				
DEE2R-825D	7.62 m (25 ft)				
DEE2R-850D	15.24 m (50 ft)				
DEE2R-875D	22.86 m (75 ft)				
DEE2R-8100D	30.48 m (100 ft)			1 = White 2 = Brown 3 = Green 4 = Yellow	5 = Gray 6 = Pink 7 = Blue 8 = Red

Bulkhead Connector

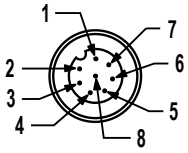
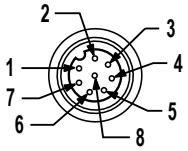
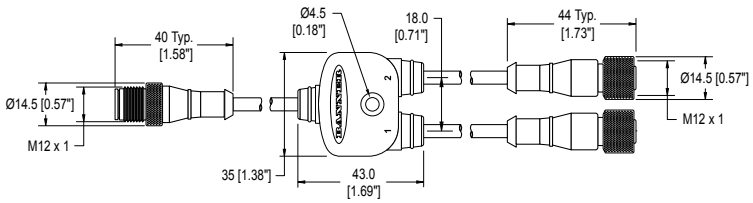
Connector for panel connection of EZ-SCREEN Type 2 component cables.

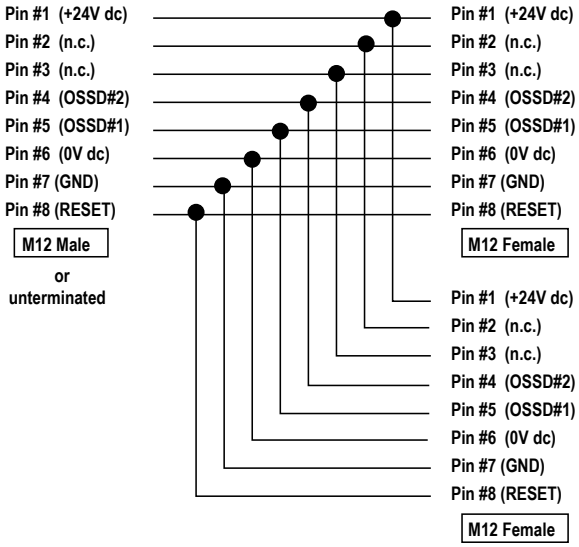
Model	Connection	Dimensions
PMEF-810D	8-pin Euro-style female connector 3 m (10 ft) wires, cut to length (Banner color code); 22 AWG/0.33 mm²	

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” connection. 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 ft long. The model QDE-8..D single-ended cables may be used to extend the QD trunk for cut-to-length applications.

[7] Standard cordsets are yellow PVC with black overmold. For black PVC and overmold, add the suffix "**B**" to the model number (example, **DEE2R-81DB**)

8-Pin Threaded M12 Splitter Cordsets—Flat Junction			
Model	**Trunk (Male)**	**Branches (Female)**	**Pinout**
CSB-M1280M1280	No trunk	No branches	Male  Female  1 = Brown 2 = Or/Bk 3 = Orange 4 = White 5 = Black 6 = Blue 7 = Gn/Ye 8 = Violet
CSB-M1281M1281	0.3 m (1 ft)	2 x 0.3 m (1 ft)	
CSB-M1288M1281	2.44 m (8 ft)		
CSB-M12815M1281	4.57 m (15 ft)		
CSB-M12825M1281	7.62 m (25 ft)		
CSB-UNT825M1281	7.62 m (25 ft) Unterminated		
			



9.2.3 Interface Modules

Interface modules provide forced-guided, mechanically-linked relay (safety) outputs for the EZ-SCREEN Type 2 System The interface module is required to be monitored by the EDM function (see Generic Wiring — Interface Module (2-Channel EDM, Manual Reset) on p. 35).

Model	Description	Datasheet
IM-T-9A	Interface module, 3 normally open (N.O.) redundant-output 6 amp contacts, removable screw terminals	62822
IM-T-11A	Interface module, 2 normally open (N.O.) redundant-output 6 amp contacts, plus 1 normally closed (N.C.) auxiliary contact, removable screw terminals	
SR-IM-9A	Interface module, 3 normally open (N.O.) redundant-output 6 amp contacts, spring clamp terminals	208873
SR-IM-11A	Interface module, 2 normally open (N.O.) redundant-output 6 amp contacts, plus 1 normally closed (N.C.) auxiliary contact, spring clamp terminals	

9.2.4 Contactors

Contactors provide forced-guided, mechanically-linked relay (safety) outputs for the EZ-SCREEN Type 2 System. The contactor is required to be monitored via an EDM function (See Generic Wiring to FSDs (manual reset) on p. 34).

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

9.2.5 Safety Controllers

Safety Controllers provide a fully configurable, software-based safety logic solution for monitoring safety and non-safety devices. For additional models and XS26 expansion modules, see instruction manual p/n 174868 (XS/SC26-2).

Non-Expandable Models	Expandable Models	Description
SC26-2	**XS26-2**	26 convertible I/O and 2 Redundant Solid State Safety Outputs
SC26-2d	**XS26-2d**	26 convertible I/O and 2 Redundant Solid State Safety Outputs with Display
SC26-2e	**XS26-2e**	26 convertible I/O and 2 Redundant Solid State Safety Outputs with Ethernet
SC26-2de	**XS26-2de**	26 convertible I/O and 2 Redundant Solid State Safety Outputs with Display and Ethernet
SC10-2roe		10 Inputs, 2 redundant relay safety outputs (3 contacts each) (ISD compatible)

9.2.6 Lens Shield

Constructed of 1.5 mm (0.06 in) clear polycarbonate; attach to sensor using supplied adhesive-backed Neoprene foam strips.

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

Lens Shield Model	Sensor Defined Area Height	Lens Shield Length	
LSS-150	150 mm (5.9 in)	210 mm (8.3 in)	
LSS-300	300 mm (11.8 in)	360 mm (14.2 in)	
LSS-450	450 mm (17.7 in)	510 mm (20.1 in)	
LSS-600	600 mm (23.6 in)	660 mm (26.0 in)	
LSS-750	750 mm (29.5 in)	810 mm (31.9 in)	
LSS-900	900 mm (35.4 in)	959 mm (37.8 in)	
LSS-1050	1050 mm (41.3 in)	1109 mm (43.7 in)	
LSS-1200	1200 mm (47.2 in)	1259 mm (49.6 in)	
LSS-1350	1350 mm (53.1 in)	1409 mm (55.5 in)	
LSS-1500	1500 mm (59.1 in)	1558 mm (61.3 in)	
LSS-1650	1650 mm (65.0 in)	1708 mm (67.2 in)	
LSS-1800	1800 mm (70.9 in)	1858 mm (73.1 in)	

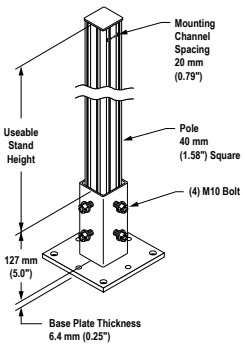
9.2.7 EZ-LIGHT® for EZ-SCREEN®

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

Models		Construction	Connector/LED Function/Inputs
	**M18RGX8PQ8** [8]	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	

9.2.8 MSA Series Stands

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

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

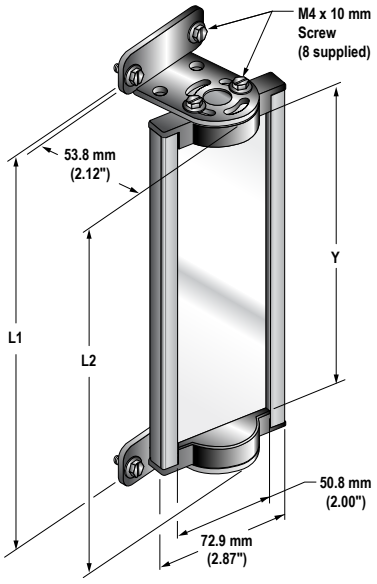
9.2.9 MSM Series Corner Mirrors

- Compact for light-duty applications
- Rear-surface glass mirrors are rated at 85% efficiency. The total sensing range decreases by approximately 8% per mirror. See mirror data sheet p/n 43685 or http://www.bannerengineering.com for further information.
- Mounting brackets may be inverted from the positions shown (flanges pointing "inward" instead of "outward," as shown). When this is done, dimension L1 decreases by 57 mm.

[8] 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)**.

- MSAMB adapter bracket kit included with each MSA stand.

Mirror Model	Part Number	Reflective Area Length (Y)	Mounting Length (L1)	Mirror Height Overall (L2)
MSM4A	43162	165 mm (6.5")	221 mm (8.7")	191 mm (7.5")
MSM8A	43163	267 mm (10.5")	323 mm (12.7")	292 mm (11.5")
MSM12A	43164	356 mm (14")	411 mm (16.2")	381 mm (15")
MSM16A	43165	457 mm (18")	513 mm (20.2")	483 mm (19")
MSM20A	43166	559 mm (22")	615 mm (24.2")	584 mm (23")
MSM24A	43167	660 mm (26")	716 mm (28.2")	686 mm (27")
MSM28A	43168	762 mm (30")	818 mm (32.2")	787 mm (31")
MSM32A	43169	864 mm (34")	919 mm (36.2")	889 mm (35")
MSM36A	43170	965 mm (38")	1021 mm (40.2")	991 mm (39")
MSM40A	43171	1067 mm (42")	1123 mm (44.2")	1092 mm (43")
MSM44A	43172	1168 mm (46")	1224 mm (48.2")	1194 mm (47")
MSM48A	43173	1270 mm (50")	1326 mm (52.2")	1295 mm (51")

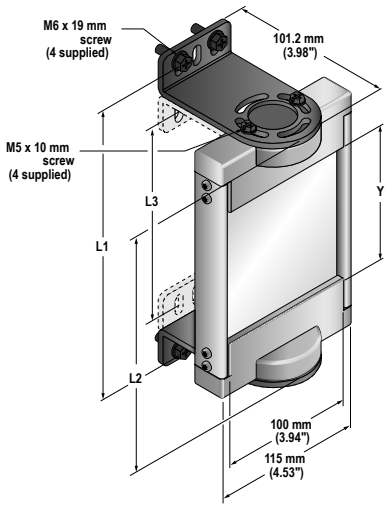


MSM Model	EZ-SCREEN Models			
	SLS Defined Area	LP Defined Area	LS Defined Area	Type 2 Defined Area
MSM4A				
MSM8A	150			150
MSM12A	300	270	280	300
MSM16A		410	350	
MSM20A	450		490	450
MSM24A	600	550	560	600
MSM28A		690	630/700	
MSM32A	750		770	750
MSM36A	900	830	840/910	900
MSM40A		970	980	
MSM44A	1050	1110	1050/1120	1050
MSM48A	1200		1190	1200

9.2.10 SSM Series Corner Mirrors

- Robust for heavy-duty applications
- Extra wide for use with long-range optical safety systems
- Rear-surface glass mirrors are rated at 85% efficiency. The total sensing range decreases by approximately 8% per mirror. See mirror datasheet p/n 61934 or www.bannerengineering.com for further information.
- To order the stainless steel reflective surface models, add the suffix **-S** (for example, **SSM-375-S**); range reduction for these models is approximately 30% per mirror. See datasheet p/n 67200.
- Robust construction, two mounting brackets and hardware included.
- In addition to the included SMA-MBK-1 brackets, an EZA-MBK-2 adapter bracket kit is required for use with MSA Series stands; refer to the mounting bracket accessories list.
- Brackets may be inverted from the positions shown, decreasing dimension L1 by 58 mm (2.3 in).

Mirror Model	Reflective Area Height (Y)	Mounting Height (L1) [9]	Overall Height (L2)
SSM-100-S	100 mm (3.9 in)	211 mm (8.3 in)	178 mm (7.0 in)
SSM-150-S	150 mm (5.9 in)	261 mm (10.3 in)	228 mm (9.0 in)
SSM-200-S	200 mm (7.9 in)	311 mm (12.2 in)	278 mm (10.9 in)
SSM-250-S	250 mm (9.8 in)	361 mm (14.2 in)	328 mm (12.9 in)
SSM-375-S	375 mm (14.8 in)	486 mm (19.1 in)	453 mm (17.8 in)
SSM-475-S	475 mm (18.7 in)	586 mm (23.1 in)	553 mm (21.8 in)
SSM-550-S	550 mm (21.7 in)	661 mm (26.0 in)	628 mm (24.7 in)
SSM-675-S	675 mm (26.6 in)	786 mm (31.0 in)	753 mm (29.6 in)
SSM-825-S	825 mm (32.5 in)	936 mm (36.9 in)	903 mm (35.6 in)
SSM-875-S	875 mm (34.4 in)	986 mm (38.8 in)	953 mm (37.5 in)
SSM-975-S	975 mm (38.4 in)	1086 mm (42.8 in)	1053 mm (41.5 in)
SSM-1100-S	1100 mm (43.3 in)	1211 mm (47.7 in)	1178 mm (46.4 in)
SSM-1175-S	1175 mm (46.3 in)	1286 mm (50.6 in)	1253 mm (49.3 in)
SSM-1275-S	1275 mm (46.3 in)	1386 mm (54.6 in)	1353 mm (53.3 in)
SSM-1400-S	1400 mm (55.1 in)	1511 mm (59.5 in)	1478 mm (58.2 in)
SSM-1475-S	1475 mm (58.1 in)	1586 mm (62.5 in)	1553 mm (61.1 in)
SSM-1550-S	1550 mm (61.0 in)	1661 mm (65.4 in)	1628 mm (64.1 in)
SSM-1675-S	1675 mm (65.9 in)	1786 mm (70.3 in)	1753 mm (69.0 in)
SSM-1750-S	1750 mm (68.9 in)	1861 mm (73.3 in)	1828 mm (72.0 in)
SSM-1900-S	1900 mm (74.8 in)	2011 mm (79.2 in)	1978 mm (77.9 in)



SSM Models	EZ-SCREEN Models				
	SLS	LP	LS	Type 2	SGS
SSM-100					
SSM-150					
SSM-200	150			150	
SSM-250					
SSM-375	300	270	280	300	
SSM-475		410	350/420		
SSM-550	450		490	450	2-500
SSM-675	600	550	560/630	600	
SSM-825	750	690	700/770	750	
SSM-875		830	840		3-400
SSM-975	900		910	900	4-300
SSM-1100	1050	970	980/1050	1050	
SSM-1175		1110	1120		

[9] The mounting brackets may be inverted from the positions shown at left (flanges pointing “inward” instead of “outward,” as shown). When this is done, dimension L1 decreases by 58 mm (2.3 in).

SSM Models	EZ-SCREEN Models				
	SLS	LP	LS	Type 2	SGS
SSM-1275	1200		1190	1200	4-400
SSM-1400	1350	1250	1260/1330	1350	
SSM-1475		1390	1400		
SSM-1550	1500		1470	1500	
SSM-1675		1530	1540/1610		
SSM-1750	1650	1670	1680	1650	
SSM-1900	1800	1810	1750/1820	1800	

9.2.11 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.

USMB-5

- Retrofit mounting bracket for STI MPT21.
- 2.3 mm (0.09 in) thickness, black zinc-plated, chromate dip finish.
- Mounting hardware included: 1 kit required per emitter or receiver.



USMB-6

- Universal mounting bracket kit.
- 2.3 mm (0.09 in) 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

- 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.



9.2.12 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 EZ-SCREEN Type 2 models	
LSA-LAT-1	Clip-on retroreflective LAT target	
BRT-THG-2-100	2 inch retroreflective tape, 100 ft	
BT-1	Beam Tracker	

9.2.13 Replacement Parts

Model Number	Description	
MGA-KSO-1	Keyed reset switch	
MGA-K-1	Replacement key	
STP-14	30 mm (1.2 in) test piece	
USMB-1	Standard end bracket kit with hardware (includes 2 end brackets and hardware to mount to MSA Series stands.	
USCMB-1	Center bracket kit (includes bracket(s) and hardware to mount to MSA Series stands	1 bracket, for 600–900 mm (23.6–35.4 in) long sensors
USCMB-2		2 brackets, for 1050–1500 mm (41.3–59.1 in) long sensors
USCMB-3		3 brackets, for 1650–1800 mm (65.0–70.9 in) long sensors

9.2.14 Documentation

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

10 Standards and Regulations

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

10.1 Applicable U.S. Standards

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

10.2 OSHA Regulations

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

10.3 International/European Standards

EN ISO 12100 Safety of Machinery – General Principles for Design — Risk Assessment and Risk Reduction

ISO 13857 Safety of Machinery – Safety Distances to Prevent Hazard Zones Being Reached

ISO 13850 (EN 418) Emergency Stop Devices, Functional Aspects – Principles for Design

ISO 13851 Two-Hand Control Devices – Principles for Design and Selection

IEC 62061 Functional Safety of Safety-Related Electrical, Electronic and Programmable Control Systems

EN ISO 13849-1 Safety-Related Parts of Control Systems

EN 13855 (EN 999) The Positioning of Protective Equipment in Respect to Approach Speeds of Parts of the Human Body

ISO 14119 (EN 1088) Interlocking Devices Associated with Guards – Principles for Design and Selection

EN 60204-1 Electrical Equipment of Machines Part 1: General Requirements

IEC 61496 Electro-sensitive Protection Equipment

IEC 60529 Degrees of Protection Provided by Enclosures

IEC 60947-1 Low Voltage Switchgear – General Rules

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

IEC 61508 Functional Safety of Electrical/Electronic/ Programmable Electronic Safety-Related Systems

IEC 62046 Safety of Machinery – Applications of Protective Equipment to Detect the Presence of Persons

ISO 3691-4 Industrial Trucks—Safety Requirements and Verification, Part 4 Driverless Industrial trucks and their Systems

11 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 Banner device. For more definitions, visit www.bannerengineering.com.

A

ANSI (American National Standards Institute)

Acronym for the American National Standards Institute, an association of industry representatives that develops technical standards (including safety standards). These standards comprise a consensus from a variety of industries on good practice and design. ANSI standards relevant to application of safety products include the ANSI B11 Series, and ANSI/RIA R15.06. See Standards and Regulations on p. 58.

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 Auto Start/Restart mode.

C

CE

Abbreviation for "Conformité Européenne" (French translation of "European Conformity"). The CE mark on a product or machine establishes its compliance with all relevant European Union (EU) Directives and the associated safety standards.

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

The time it takes to bridge a jittery input signal or bouncing of the input contacts to prevent nuisance tripping of the Controller. Adjustable from 6 ms to 100 ms. The default value is 6 ms (50 ms for mute sensors). 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.

D

Defined Area

The "screen of light" generated by a safety light curtain system, defined by the height and the safety distance (minimum distance) of the system.

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.

E

Emitter

The light-emitting component of a safety light curtain system, consisting of a row of synchronized modulated LEDs. The emitter, together with the receiver (placed opposite), creates a "screen of light" called the defined area.

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.

External Device Monitoring (EDM)

A means by which a safety device (such as a safety light curtain) actively monitors the state (or status) of external devices that may be controlled by the safety device. A lockout of the safety device will result if an unsafe state is detected in the external device. External device(s) may include, but are not limited to: MPCEs, captive contact relays/contactors, and safety modules.

F

Failure to Danger

A failure which delays or prevents a machine safety system from arresting dangerous machine motion, thereby increasing risk to personnel.

Final Switching Device (FSD)

The component of the machine’s safety-related control system that interrupts the circuit to the machine primary control element (MPCE) when the output signal switching device (OSSD) goes to the OFF-state.

FMEA (Failure Mode and Effects Analysis)

A testing procedure by which potential failure modes in a system are analyzed to determine their results or effects on the system. Component failure modes that produce either no effect or a Lockout condition are permitted; failures which cause an unsafe condition (a failure to danger) are not. Banner safety products are extensively FMEA tested.

H

Hard (Fixed) Guard

Screens, bars, or other mechanical barriers affixed to the frame of the machine intended to prevent entry by personnel into the hazardous area(s) of a machine, while allowing the point of operation to be viewed. The maximum size of the openings is determined by the applicable standard, such as Table O-10 of OSHA 29CFR1910.217, also called a "fixed barrier guard."

Harm

Physical injury or damage to the health of people, which may result through direct interaction with the machine or through indirect means, as a result of damage to property or to the environment.

Hazard Point

The closest reachable point of the hazardous area.

Hazardous Area

An area that poses an immediate or impending physical hazard.

I

IEC

International Electrotechnical Commission

Internal Lockout

A Lockout condition that is due to an internal safety system problem. Generally, indicated by the red Status indicator LED (only) flashing. Requires the attention of a Qualified Person.

K

Key Reset (Manual Reset)

A key-operated switch used to reset a safety light curtain system to Run mode following a Lockout condition, or to enable machine operation following a Manual Start/Restart (Latch) condition. Also refers to the act of using the switch.

L

Manual Start/Restart (Latch) Condition

The safety outputs of a safety light curtain system turn off when an object completely blocks a beam. In a Manual Start/Restart condition, the safety outputs stay off when the object is removed from the defined area. To re-energize the outputs, perform a proper manual reset.

Lockout Condition

A safety light curtain condition that is automatically attained in response to certain failure signals (an internal lockout). When a Lockout condition occurs, the safety light curtain's safety outputs turn OFF; the failure must be corrected and a manual reset is required to return the system to Run mode.

M

Machine Primary Control Element (MPCE)

An electrically powered element, external to the safety system, which directly controls the machine's normal operating motion in such a way that the element is last (in time) to operate when machine motion is either initiated or arrested.

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.

Minimum Object Sensitivity (MOS)

The minimum-diameter object that a safety light curtain system can reliably detect. Objects of this diameter or greater will be detected anywhere in the defined area. A smaller object can pass undetected through the light if it passes exactly midway between two adjacent light beams. Also known as MODS (Minimum Object Detection Size). See also **Specified Test Piece**.

Muting

The automatic suspension of the safeguarding function of a safety device during a non-hazardous portion of the machine cycle.

O

OFF State

The state in which the output circuit is interrupted and does not permit the flow of current.

ON State

The state in which the output circuit is complete and permits the flow of current.

Open-Closed Debounce Time

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

OSHA (Occupational Safety and Health Administration)

A U.S. Federal agency, Division of the U.S. Department of Labor, that is responsible for the regulation of workplace safety.

P

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."

Point of Operation

The location of a machine where material or a workpiece is positioned and a machine function is performed upon it.

PSDI (Presence-Sensing Device Initiation)

An application in which a presence-sensing device is used to actually start the cycle of a machine. In a typical situation, an operator manually positions a part in the machine for the operation. When the operator moves out of the danger area, the presence sensing device starts the machine (no start switch is used). The machine cycle runs to completion, and the operator can then insert a new part and start another cycle. The presence sensing device continually guards the machine. Single-break mode is used when the part is automatically ejected after the machine operation. Double-break mode is used when the part is both inserted (to begin the operation) and removed (after the operation) by the operator. PSDI is commonly confused with "Trip Initiate." PSDI is defined in OSHA CFR1910.217. Banner safety light curtain systems may not be used as PSDI devices on mechanical power presses, per OSHA regulation 29 CFR 1910.217.

Q

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.

R

Receiver

The light-receiving component of a safety light curtain system, consisting of a row of synchronized phototransistors. The receiver, together with the emitter (placed opposite), creates a "screen of light" called the defined area.

Reduced Resolution

A feature that allows a safety light curtain system to be configured to produce an intentionally disabled light beam(s) within the light curtain, which increases the minimum object sensitivity. The disabled beam(s) appears to move up and down (float) to allow the feeding of an object through the defined area at any point without tripping the safety outputs (for example, OSSDs) and causing a Auto Start/Restart (Trip) or Manual Start/Restart (Latch) condition. Sometimes called Floating Blanking.

Reset

The use of a manually operated switch to restore the safety outputs to the On state from a lockout or a Manual Start/Restart (Latch) condition.

Resolution

See **Minimum Object Sensitivity**.

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.

S

Safety-Rated Device

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

Self-Checking (Circuitry)

A circuit with the capability to electronically verify that all of its own critical circuit components, along with their redundant backups, are operating properly. Banner safety light curtain systems and safety modules are self-checking.

Safety Distance

The minimum distance required to allow the machine’s hazardous motion to stop completely, before a hand (or other object) can reach the nearest hazard point. Measured from the midpoint of the defined area to the nearest hazard point. Factors that influence minimum separation distance include the machine stop time, the light curtain system response time, and the light curtain minimum object detection size.

Simultaneous (also Simultaneity)

The setting in which both channels must be off at the same time AND, when they turn back on, they must turn on within 3 seconds of each other. If both conditions are not satisfied, the input will be in a fault condition.

Single-Channel

Having only one signal line for a safety input or safety output.

Specified Test Piece

An opaque object of sufficient size used to block a light beam to test the operation of a safety light curtain system. When inserted into the defined area and placed in front of a beam, the test piece causes the outputs to de-energize.

Start Up Test

For certain safety devices, like safety light curtains 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 curtain and the light curtain is clear at power-up, it would be necessary to cycle the light curtain one time (from ON to OFF and back to ON), even if the Controller has been configured for auto power-up.

Supplemental Guarding

Additional safeguarding device(s) or hard guarding, used to prevent a person from reaching over, under, through or around the primary safeguard or otherwise accessing the guarded hazard.

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

A configurable reset of one or more safety outputs to turn ON after Controller power-up, when set for manual power-up, or lockout (fault detection) situations.

T

Test Piece

An opaque object of sufficient size used to block a light beam to test the operation of a safety light curtain system.

Auto Start/Restart (Trip) Condition

The safety outputs of a safety light curtain system turn off when an object completely blocks a beam. In an Auto Start/Restart condition, the safety outputs re-energize when the object is removed from the defined area.

Auto Start/Restart (Trip) Initiate

The resetting of a safeguard causing the initiation of machine motion or operation. Auto Start/Restart Initiate is not allowed as a means to initiate a machine cycle per NFPA 79 and ISO 60204-1, and is commonly confused with PSDI.

U

UL (Underwriters Laboratory)

A third-party organization that tests products for compliance with appropriate standards, electrical codes, and safety codes. Compliance is indicated by the UL listing mark on the product.

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