

EZ-SCREEN® LS Safety Light Screen

Instruction Manual

Original Instructions
179480 Rev. C
11 November 2015



Contents

1 About This Document	5
1.1 Important . . . Read This Before Proceeding!	5
1.1.1 Use of Warnings and Cautions	5
1.2 EC Declaration of Conformity (DoC)	5
1.3 Banner Engineering Corp Limited Warranty	5
1.4 Contact Us	6
2 Product Overview	7
2.1 Appropriate Applications and Limitations	8
2.1.1 Appropriate Applications	8
2.1.2 Examples: Inappropriate Applications	8
2.1.3 Control Reliability: Redundancy and Self-Checking	9
2.2 Operating Features	9
2.2.1 Trip Output	9
2.2.2 External Device Monitoring (EDM)	9
2.2.3 Fault Output	9
2.2.4 Scan Code Configuration	10
2.2.5 Wiring Options	10
2.2.6 Cascading	10
2.2.7 EZ-LIGHT® Indication	10
2.2.8 Interfacing an E-Stop Button or Interlocking Switch	11
2.2.9 Remote Fixed Blanking	11
2.2.10 Status Indicators	11
3 Mechanical Installation	13
3.1 Mechanical Installation Considerations	13
3.1.1 Calculating the Safety Distance (Minimum Distance)	13
3.1.2 Reducing or Eliminating Pass-Through Hazards	15
3.1.3 Supplemental Safeguarding	16
3.1.4 Reset Switch Location	16
3.1.5 Adjacent Reflective Surfaces	17
3.1.6 Use of Corner Mirrors	18
3.1.7 Emitter and Receiver Orientation	19
3.1.8 Installation of Multiple Systems	20
3.2 Mounting System Components	21
3.2.1 Mounting Hardware	21
3.2.2 Mounting the End-Mount Brackets	22
3.2.3 Mounting the Center- and Side-Mount Brackets	23
3.2.4 Optional EZLSA-MBK-16 Side-Mount Bracket	23
3.2.5 Sensor Mounting and Mechanical Alignment	24
3.2.6 Mounting Dimensions	25
4 Electrical Installation and Testing	27
4.1 Routing Cordsets	27
4.2 Initial Electrical Connections	28
4.3 Initial Checkout Procedure	28
4.3.1 Configuring the System for Initial Checkout	28
4.3.2 Initial Power-Up	29
4.3.3 Optical Alignment	29
4.3.4 Optical Alignment Procedure with Mirrors	30
4.3.5 Remote Fixed Blanking	31
4.3.6 Trip Test	34
4.4 Electrical Connections to the Guarded Machine	35
4.4.1 OSSD Output Connections	35
4.4.2 FSD Interfacing Connections	36
4.4.3 Machine Primary Control Elements and EDM Input	37
4.4.4 External Device Monitoring	37
4.4.5 Fault Output	38
4.4.6 Scan Code Select	38
4.4.7 Preparing for System Operation	38
4.4.8 Sensor Interchangeability	38
4.5 Reference Wiring Diagrams	39
4.5.1 Generic Wiring Diagram—5-pin and 8-pin Emitter	39
4.5.2 Generic Wiring Diagram—5-pin Receiver and UM-FA-...A Safety Module	40
4.5.3 Generic Wiring Diagram—5-pin Receiver and Safety Module/Controller or Safety PLC/PES	41
4.5.4 Generic Wiring Diagram—8-pin Receiver and Redundant FSDs	42
4.5.5 Generic Wiring Diagram—8-pin Receiver and IM-T-9A Interface Module	43

5 Cascadeable EZ-SCREEN LS	44
5.1 Overview of Cascading	44
5.1.1 System Components and Specifications	45
5.1.2 Receiver Display	45
5.2 Determining Interconnect Cordset Lengths	45
5.3 Response Time for Cascaded Light Screens	47
5.3.1 Determining System Response Time	47
5.3.2 Individual Response Time and Safety (Minimum) Distance	48
5.3.3 CSSI Response Time	48
5.4 Emergency Stop Buttons in Cascaded Systems	48
5.4.1 E-Stop Switch Requirements (Positive-Opening)	49
5.5 Interlock Switches in Cascaded Systems	50
5.5.1 Interlock Guarding Requirements	50
5.5.2 Positive-Opening Interlocking Safety Switches	51
5.6 Remote TEACH Fixed Blanking (Wiring)	52
6 System Operation	54
6.1 Security Protocol	54
6.2 Status Indicators	54
6.2.1 Emitter	54
6.2.2 Receiver	54
6.3 Normal Operation	56
6.3.1 System Power-Up	56
6.3.2 Run Mode	56
6.4 Periodic Checkout Requirements	56
7 Troubleshooting and Maintenance	58
7.1 Lockout Conditions	58
7.2 Recovery Procedures	58
7.2.1 Receiver Error Codes	58
7.2.2 Emitter Error Codes	60
7.3 Electrical and Optical Noise	61
7.3.1 Sources of Electrical Noise	61
7.3.2 Sources of Optical Noise	61
7.4 Cleaning	61
7.5 Warranty Service	61
7.6 Manufacturing Date	61
7.7 Disposal	62
8 Checkout Procedures	63
8.1 Schedule of Checkouts	63
8.2 Commissioning Checkout	63
9 Specifications	65
9.1 General Specifications	65
9.2 Receiver Specifications	66
9.3 Emitter Specifications	66
9.4 Dimensions	67
10 Components	69
10.1 Models	69
10.1.1 Ordering Guide	70
10.1.2 Models Tables	72
10.2 Accessories	77
10.2.1 Cordsets	77
10.2.2 Universal (Input) Safety Modules	83
10.2.3 Safety Controllers	84
10.2.4 Muting Module	84
10.2.5 Interface Modules	84
10.2.6 Contactors	84
10.2.7 Optional Mounting Brackets	85
10.2.8 Remote Blanking Key Switch Box	87
10.2.9 Alignment Aids	87
10.2.10 Snap-On Lens Shields	87
10.2.11 Tubular Enclosures	87
10.2.12 EZ-LIGHTS® for EZ-SCREEN® LS	88
10.2.13 MSM Series Corner Mirrors	90
10.2.14 SSM Series Corner Mirrors	90
10.2.15 MSA Series Stands	91
10.3 Replacement Parts	91
11 Standards and Regulations	93
11.1 Applicable U.S. Standards	93
11.2 Applicable OSHA Regulations	93
11.3 International/European Standards	93

12 Glossary	94
-------------------	----

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.* Please direct any questions regarding the application or use of the device to Banner Engineering.

For more information regarding U.S. and international institutions that provide safeguarding application and safeguarding device performance standards, see [Standards and Regulations](#) on page 93.



WARNING: User Responsibility

The user is responsible to:

- 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.

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

1.1.1 Use of Warnings and Cautions

This manual contains numerous WARNING and CAUTION statements:

- Warnings refer to potentially hazardous situations which, if not avoided, may lead to serious injury or death.
- Cautions refer to potentially hazardous situations which, if not avoided, which may lead to minor or moderate injury or potential damage to equipment. Cautions are also used to alert against unsafe practices.

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 LS to meet the various safeguarding application requirements. These individuals are responsible to read and abide by these statements.

1.2 EC Declaration of Conformity (DoC)

Banner Engineering Corp. herewith declares that the EZ-SCREEN LS Safety Light Screen is in conformity with the provisions of the Machinery Directive 2006/42/EC and all essential health and safety requirements have been met.

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

1.3 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.

THIS LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED (INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), AND WHETHER ARISING UNDER COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE.

This Warranty is exclusive and limited to repair or, at the discretion of Banner Engineering Corp., replacement. IN NO EVENT SHALL BANNER ENGINEERING CORP. BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR ANY EXTRA COSTS, EXPENSES, LOSSES, LOSS OF PROFITS, OR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES RESULTING FROM ANY PRODUCT DEFECT OR FROM THE USE OR INABILITY TO USE THE PRODUCT, WHETHER ARISING IN CONTRACT OR WARRANTY, STATUTE, TORT, STRICT LIABILITY, NEGLIGENCE, OR OTHERWISE.

Banner Engineering Corp. reserves the right to change, modify or improve the design of the product without assuming any obligations or liabilities relating to any product previously manufactured by Banner Engineering Corp.

1.4 Contact Us

Corporate Headquarters

Address:
Banner Engineering Corporate
9714 Tenth Avenue North
Minneapolis, Minnesota 55441, USA

Europe

Address:
Banner Engineering EMEA
Park Lane Culliganlaan 2F
Diegem B-1831, Belgium

Turkey

Address:
Banner Engineering Turkey
Barbaros Mah. Uphill Court Towers A Blok D:49
34746 Batı Ataşehir Istanbul Türkiye

India

Address:
Banner Engineering India Pune Head Quarters
Office No. 1001, 10th Floor Sai Capital, Opp. ICC Senapati Bapat Road
Pune 411016, India

Mexico

Address:
Banner Engineering de Mexico Monterrey Head Office
Edificio VAO Av. David Alfaro Siqueiros No.103 Col. Valle Oriente C.P.66269
San Pedro Garza Garcia, Nuevo Leon, Mexico

Brazil

Address:
Banner do Brasil
Rua Barão de Teffé nº 1000, sala 54
Campos Eliseos, Jundiaí - SP, CEP.: 13208-761, Brasil

China

Address:
Banner Engineering Shanghai Rep Office
Xinlian Scientific Research Building Level 12, Building 2
1535 Hongmei Road, Shanghai 200233, China

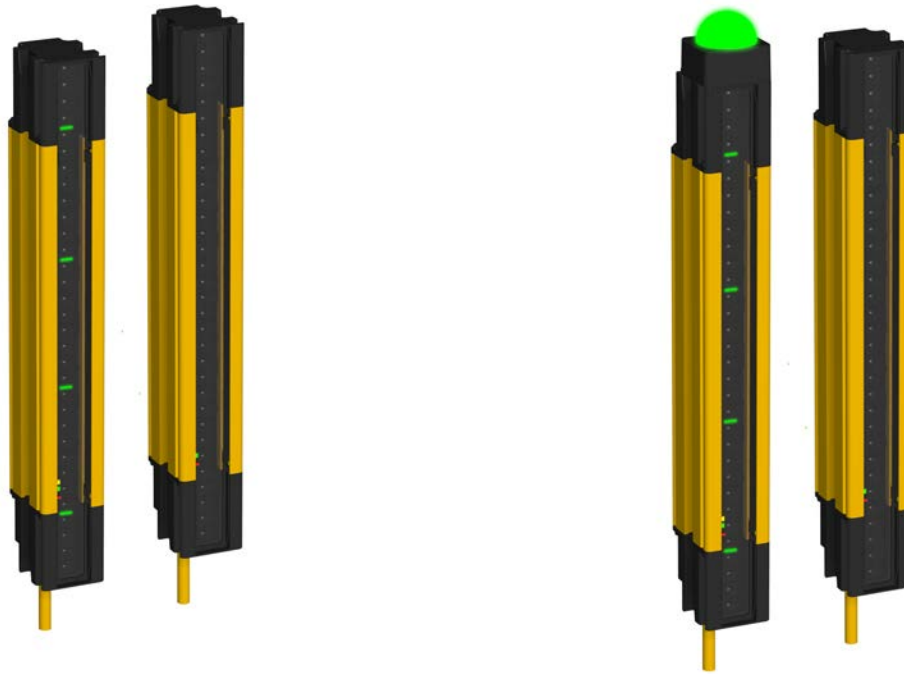
Japan

Address:
Banner Engineering Japan
Cent-Urban Building 305 3-23-15 Nishi-Nakajima Yodogawa-Ku
Osaka 532-0011, Japan

Taiwan

Address:
Banner Engineering Taiwan
8F-2, No. 308 Section 1, Neihu Road
Taipei 114, Taiwan

2 Product Overview



EZ-SCREEN LS Safety Light Screen shown without and with the optional EZLSA-K30LGR EZ-LIGHT

Banner EZ-SCREEN LS is a two-piece (emitter and receiver), redundant, microprocessor-controlled, opposed-mode optoelectronic "light curtain" or "safety light screen". Standard and cascable models are available in either 14 mm, 23 mm, or 40 mm resolution. Up to four pairs of SLLC.. model emitters and receivers can be cascaded together.

Emitters have a row of synchronized modulated infrared (invisible) light-emitting diodes (LEDs) in a robust, compact metal housing. Receivers have a corresponding row of synchronized photodetectors. The sensing field 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 sensing range spans from 100 mm to 12 m (4 in to 39 ft) for all resolutions, which decreases if corner mirrors or lens shields are used.

The length of the sensor pair (housing) is dependent on the model; from 280 mm to 1820 mm (11 in to 71.6 in). The end to end sensing design of the EZ-SCREEN LS, also known as "no blind zone" and "no dead zone," allows mounting with minimal or no "gaps" in detection.

The EZ-SCREEN LS standard and cascade models have trip output (auto power-up and automatic reset). 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. When the defined area becomes clear, the OSSD outputs are allowed to turn ON.

EZ-SCREEN LS sensors are extensively FMEA (Failure Mode and Effects Analysis) tested to establish an extremely high degree of confidence that when properly installed, no system component (even if it should ever fail) can cause a failure to danger. Because of the due scan technology, EZ-SCREEN LS sensors are also highly immune to EMI, RFI, ambient light, weld flash, and strobe light.

Eight-conductor EZ-SCREEN LS systems (receivers with 8-pin pigtail QD or flying leads) do not require an external controller when using the external device monitoring (EDM) function. This function ensures the fault detection capability required by U.S. Control Reliability and ISO 13849-1 Categories 3 or 4 and PL d or e for controlling final switching devices (FSDs) or Machine Primary Control Elements (MPCEs).

When configured with a five-conductor hookup, the EZ-SCREEN LS requires a self-checking safety module, safety controller, or safety PLC/PES that conforms to the level of performance required by the risk assessment. Examples include the UM-FA-9A/-11A safety module, SC22-3/-3E or XS/SC26-2 safety controller for applications requiring Control Reliability and/or ISO 13849-1 Categories 3 or 4 and PL d or e.

Electrical connections (power, ground, inputs and outputs) are made via M12 quick-disconnect cordsets or unique RD (removable disconnect) cordsets, depending on model. A "System" as referred to in this manual, is defined as an emitter and its receiver, plus their cabling, or to a cascade of emitters and their receivers and their cabling.

Available features include selectable scan code via hookup, an auxiliary fault output, a recessed exit window, and robust metal housing and end-caps for industry leading durability.

Additional features on cascade models include automatic configuration of up to four sensor pairs (any length or resolution), optional EZ-LIGHT indication (integral or remotely located) the ability to interface an E-Stop button or Interlocking switches (hard contacts), and remote fixed blanking. All models require a supply voltage of +24 V dc $\pm 15\%$.

Both emitter and receiver feature 7-segment Diagnostic Displays and individual LEDs to provide continuous indication of operating status, configuration and error conditions. An adhesive Diagnostics label is provided that includes a summary of the operational and error codes. Active Alignment (Segment) Indicators provide beam block information and easier installation. See [Status Indicators](#) on page 54 for more information.

2.1 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 has the responsibility to ensure that all local, state, and national laws, rules, codes, or regulations relating to the installation and use of this control system in any particular application are satisfied. 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 Persons¹, in accordance with this manual and applicable safety regulations.

The Banner EZ-SCREEN LS is intended for machine guarding and other safeguarding applications. 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 LS 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 LS cannot provide the protection for which it was designed.



CAUTION: Install System Only on Appropriate Applications

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

2.1.1 Appropriate Applications

EZ-SCREEN LS is typically used for, but is not limited to, the following applications:

- Automated production equipment
- Robotic work cells
- Molding and power presses
- Assembly and packaging machines
- Lean manufacturing systems

2.1.2 Examples: Inappropriate Applications

Do not use EZ-SCREEN LS in the following applications:

- 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

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.

- 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 LS is installed for use as a perimeter guard (where a pass-through hazard may exist, see [Reducing or Eliminating Pass-Through Hazards](#) on page 15), the dangerous machine motion can be initiated by normal means only after the safeguarded area is clear of individuals and the safety related part of the control system that is providing the latching function has been manually reset.

2.1.3 Control Reliability: Redundancy and Self-Checking

Redundancy requires that EZ-SCREEN LS circuit components be backed up to the extent that, if the failure of a single component will prevent effective machine stopping action when needed, that component must have a redundant counterpart which will perform the same function. The EZ-SCREEN LS is designed with redundant microprocessors.

Redundancy must be maintained whenever the EZ-SCREEN LS is in operation. Because a redundant system is no longer redundant after a component has failed, EZ-SCREEN LS is designed to monitor itself continuously. A component failure detected by or within the self-checking system causes a stop signal to be sent to the guarded machine and puts the EZ-SCREEN LS into a Lockout condition.

A recovery from this type of Lockout condition requires:

- Replacement of the failed component (to restore redundancy)
- The appropriate reset procedure

The Diagnostic Display is used to diagnose causes of a Lockout condition. See [Lockout Conditions](#) on page 58.

2.2 Operating Features

The Banner EZ-SCREEN LS models described in this manual feature several functions (depending on model).

2.2.1 Trip Output

The System is configured for Trip Output which allows the System to enter Run mode automatically. Other measures must be taken to prevent a pass-through hazard; see [Reducing or Eliminating Pass-Through Hazards](#) on page 15 and the warning below for more information.

The OSSD outputs turn ON after power is applied, and the receiver passes its internal self-test/synchronization and recognizes that all beams are clear. The Trip Output also automatically resets after all beams are cleared.



WARNING: Use of Trip Output

Application of power to the Banner device, the clearing of the defined area, or the reset of an error condition must not initiate dangerous machine motion. Machine control circuitry must be designed so that one or more initiation devices must be engaged to start the machine (a conscious act), in addition to the Banner device entering Run mode. Failure to follow these instructions may result in a serious bodily injury or death.

2.2.2 External Device Monitoring (EDM)

The External Device Monitoring (EDM) feature allows the EZ-SCREEN LS to monitor the status of external devices, such as MPCEs. The choices are 1-channel monitoring or no monitoring. EDM is used when the EZ-SCREEN LS OSSD outputs directly control the MPCEs or other external devices.

This feature is only available with the 8-conductor models.

2.2.3 Fault Output

The current sourcing (PNP) solid-state output (100 mA maximum) is used for control functions that are not safety related; a typical use is to signal a lockout (fault) to a programmable logic controller (PLC). Available on both the receiver and emitter, the output provides a fault signal (lockout = On). Interrupting (blocking) the sensing field is not considered a lockout, so the Fault Output does not change state.

This feature is available only with 8-conductor models.

2.2.4 Scan Code Configuration

Use the scan code to allow operation of multiple pairs of emitters and receivers in close proximity without the effects of cross-talk. The emitter and receiver may be configured to use one of two scan codes (1 or 2); a receiver recognizes light only from an emitter with the same scan code. Set the scan code using the wiring on each sensor (see [Scan Code Select](#) on page 38). Both the emitter and its corresponding receiver must have the same setting. Cascaded emitters and receivers automatically alternate scan codes based on the scan code of the first (master) pair.

This feature is only available with the 8-conductor models.

2.2.5 Wiring Options

Depending on the model, the Machine Interface connection has several options, including:

- A 300 mm (1 ft) pigtail cable with an 8-pin M12/Euro-style male quick disconnect (QD)
- A 300 mm (1 ft) pigtail cable with a 5-pin M12/Euro-style male quick disconnect (QD)
- The Removable Disconnect (RD) that can mate with either a double-ended RD cordset as an interconnect between cascaded sensors or an 8-wire flying lead RD cordset.

Each connection option is intended for maximum flexibility to solve unique application requirements such as directly connecting the EZ-SCREEN LS to remotely located safety I/O blocks. For interfacing modules or remotely located safety I/O blocks where pin 5 of a 5-pin M12 QD is not earth ground, a 4-pin cordset where pin 5 is not physically present or is not electrically connected can be used (such as MQDEC-406SS double-ended cordset). In such situations, earth ground must be provided via the mounting brackets.

Additionally, an EZ-SCREEN LS emitter can be connected either to its own power supply or to the receiver cable, color-for-color. The color-for-color wiring allows the emitter and receiver positions to be interchanged (swapped) without rewiring.

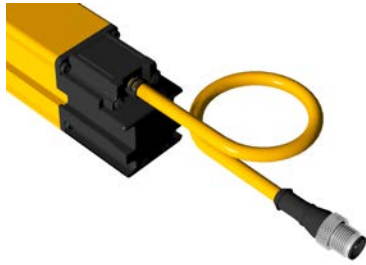


Figure 1. 300 mm Pigtail with M12/Euro-style QD

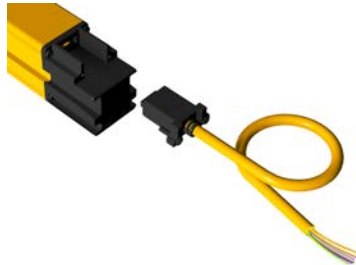


Figure 2. RD Connection with 8-wire Flying Lead Cordset



Figure 3. RD Connection with Double-ended RD Cordset

2.2.6 Cascading

Up to four sensor pairs (any length or resolution) can be combined into one system. The cascade system automatically configures at power up when the terminator plug is installed (pre-installed from factory) or when a standard sensor pair or an interfacing cordset is used at the end of the series. Double-ended DELS-11xE cordsets are required for connecting sensors in a cascade.

2.2.7 EZ-LIGHT® Indication

EZ-SCREEN LS cascading models have the ability to connect and remotely locate an EZ-LIGHT or other indicator using a DELSEF-4xD cordset. Solid-state current sourcing (PNP) outputs (24 V dc at 100 mA) allow for the connection of remote indicators or other devices for non-safety status information that includes OSSDs ON or OSSDs OFF/Lockout (flashing).

Additionally, EZ-LIGHT model EZLSA-K30LGR (patent pending) is designed to mount directly to the end of a cascade receiver via the cascade RD connector. The EZLSA-K30LGR provides a replaceable integral solution with a bright 360° red/green indication.

For the EZ-SCREEN LS standard/stand-alone 8-pin pigtail QD models, a CSB-M128..M1281 splitter cable and optional DEE2R-8..D double-ended cables can be used with specific models of EZ-LIGHTs at the machine interface connection. The EZ-LIGHT can be remotely mounted on the machine frame or another convenient mounting surface and provides clear, 360° indication of the EZ-SCREEN LS receiver's OSSD output status.

See [EZ-LIGHTS® for EZ-SCREEN® LS](#) on page 88 for both stand-alone and cascade solutions.



Figure 4. EZ-SCREEN LS with M18 EZ-LIGHT

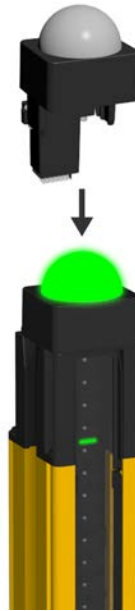


Figure 5. EZ-SCREEN LS with EZLSA-K30LGR EZ-LIGHT



Figure 6. EZ-SCREEN LS with TL50 EZ-LIGHT

2.2.8 Interfacing an E-Stop Button or Interlocking Switch

EZ-SCREEN LS cascading models can connect electrical (hard) contacts from external devices, such as emergency stop buttons and interlocking switches, by using an RDLS-8..D cordset. The cascade input may be used to monitor emergency stop buttons, interlocked gates, or guards and meets or exceeds the requirements for OSHA/ANSI control reliability and up to Category 4 PLe, per ISO 13849-1.

2.2.9 Remote Fixed Blanking

On cascade models, fixed blanking is available to, in effect, "disable" beams that would otherwise be continually blocked by a stationary object. One or multiple areas within an EZ-SCREEN LS sensor pair may be "blanked out," with a minimum of one beam between two blanked areas. The first sensing beam (CH1 synchronization beam) at the display end of sensor must remain clear (cannot be blanked); any other beam may be blanked. All beams of a fixed blanked area must remain blocked during operation in order for the OSSDs to remain ON.

The Remote Fixed Blanking feature can be used on an EZ-SCREEN LS cascade receiver as a stand-alone system or in a cascaded system. A DELSEF-81D cordset used with a EZA-RBK-1 Remote Blanking Key Switch or a RDLS-8..D cordset with a user-supplied switch and indicator provides a convenient means to program the blanked area. The remote programming is effective on all receivers in the cascaded systems (for example, multiple areas can be blanked on different sensor pairs).

2.2.10 Status Indicators

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

Emitter

Bi-color red/green Status indicator—shows whether power is applied, and whether the emitter is in RUN mode (green) or Lockout condition (flashing red) .

1-Digit Diagnostic Display—indicates configuration or specific error conditions.

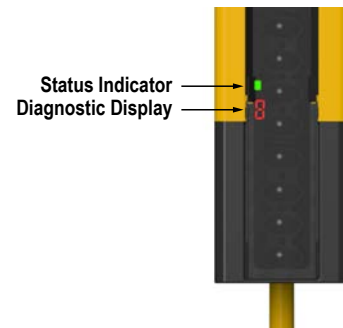


Figure 7. Status Indicators—Emitter

Receiver

Bi-color red/green Status indicator—shows system status:

- outputs are ON or OFF (green ON or red OFF), or
- the System is in Lockout condition (flashing red)

Amber RUN mode indicator—shows system status:

- RUN mode (ON), or
- Lockout (OFF)

1-Digit Diagnostic Display—indicates configuration or specific error conditions, or the total number of blocked beams.

Bi-color red/green Alignment indicators—show status of a group of beams (+/- 35 mm of indicator) along the length of the exit window:

- aligned and clear (green ON), or
- blocked and/or misaligned (red ON),
- fixed blanked area (flashing green),
- lockout (all OFF), or
- Beam 1 (sync) is blocked (Alignment Indicator 1 is red and all others are OFF).

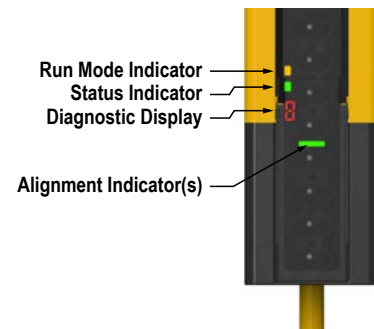


Figure 8. Status Indicators—Receiver

3 Mechanical Installation

The EZ-SCREEN LS 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 has the responsibility to ensure that all local, state, and national laws, rules, codes, or regulations relating to the installation and use of this control system in any particular application are satisfied. 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 Persons², in accordance with this manual and applicable safety regulations.

3.1 Mechanical Installation Considerations

The two primary factors that influence the layout of the EZ-SCREEN LS system mechanical installation are the Safety Distance (Minimum Distance) (see [Calculating the Safety Distance \(Minimum Distance\)](#) on page 13) and the supplemental safeguarding/eliminating pass-through hazards (see [Reducing or Eliminating Pass-Through Hazards](#) on page 15). Other considerations include:

- [Emitter and Receiver Orientation](#) on page 19
- [Adjacent Reflective Surfaces](#) on page 17
- [Use of Corner Mirrors](#) on page 18
- [Installation of Multiple Systems](#) on page 20



WARNING: Position Components Carefully

The emitter and receiver must be positioned 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 LS 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: Safety Distance (Minimum Distance)

The Banner emitters and receivers must be mounted at a distance from the nearest hazard such that an individual cannot reach the hazard before cessation of hazardous motion or situation. This distance can be calculated using the formulas in this section, as described by ANSI B11.19 and ISO 13855, and must be greater than 100 mm (4 in) regardless of calculated value. Failure to establish and maintain the minimum distance may result in serious bodily injury or death.

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.

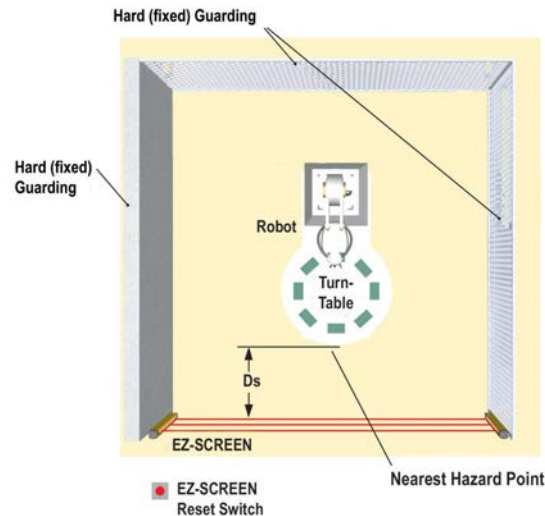


Figure 9. Safety distance (minimum distance) and hard (fixed) guarding

Formula and Examples

U.S. Applications	European Applications
The Safety (Separation) Distance formula for U.S. applications:	The Minimum Distance formula for European applications:
$D_s = K \times (T_s + T_r) + D_{pf}$	$S = (K \times T) + C$
<p>D_s the Safety Distance, in inches</p> <p>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)</p> <p>T_s 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)</p> <p>T_r the maximum response time, in seconds, of the EZ-SCREEN LS emitter/receiver pair (depending on model)</p> <p>D_{pf} the added distance due to the depth penetration factor as prescribed in OSHA 29CFR1910.217, and ANSI B11.19 for U.S. applications. See Depth Penetration Factor (Dpf) table below.</p>	<p>S the Minimum Distance, in mm, from danger zone to light screen center line</p> <p>K hand-speed constant (see Note 2 below); 2000 mm/s (for Minimum Distances ≤ 500 mm) 1600 mm/s (for Minimum Distances > 500 mm)</p> <p>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: T_s and T_r where $T = T_s + T_r$</p> <p>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:</p>
	$C = 8 \times (d - 14)$
	where d is the resolution of the light curtain (for $d \leq 40$ mm).

Table 1: Depth Penetration Factor (Dpf)

14 mm System	23 mm System	40 mm System
24 mm (0.94 in)	54 mm (2.14 in)	112 mm (4.4 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. T_s 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.

US Application example: Model SLLP23-560P88	European Application example: Model SLLP23-560P88
$K = 63$ in per second	$K = 1600$ mm per second
$T_s = 0.32$ (0.250 seconds is specified by the machine manufacturer; plus 20% safety factor; plus 20 ms interface module IM-T-9A response)	$T = 0.3316$ (0.250 seconds is specified by the machine manufacturer; plus 20% safety factor; plus 20 ms interface module IM-T-9A response), plus 0.0116 seconds (the specified SLLP23-560P88 response time)
$T_r = 0.0116$ second (the specified SLLP23-560P88 response time)	
$D_{pf} = 2.14$ in (for 23 mm resolution)	$C = 8 \times (23 - 14) = 72$ mm (for 23 mm resolution)
$D_s = 63 \times (0.32 + 0.0116) + 2.14 = 23$ in	$S = (1600 \times 0.3316) + 72 = 603$ mm
Mount the EZ-SCREEN LS emitter and receiver so that no part of the defined area is closer than 23 inches to the closest reachable hazard point on the guarded machine.	Mount the EZ-SCREEN LS emitter and receiver so that no part of the defined area will be closer than 602 mm to the closest reachable hazard point on the guarded machine.



WARNING: Determine Correct Stop Time

Stop time (T_s) 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 (D_s or S) will be too short. This can lead to serious bodily injury or death. Be sure to include the stop time of all relevant devices and controls in your calculations.

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

3.1.2 Reducing or Eliminating Pass-Through Hazards

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

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



WARNING: Use of the Banner device for Perimeter Guarding

If a Banner device is installed in an application that results in a pass-through hazard (for example, perimeter guarding), either the Banner device System or the Machine Primary Control Elements (MPCEs) of the guarded machine must cause a Latched response following an interruption of the defined area.

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

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

3.1.3 Supplemental Safeguarding

As described in [Calculating the Safety Distance \(Minimum Distance\)](#) on page 13, the EZ-SCREEN LS must be properly positioned 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 LS System or through other safeguarding that prevents access to the hazard (see [Figure 10](#) on page 16).

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.

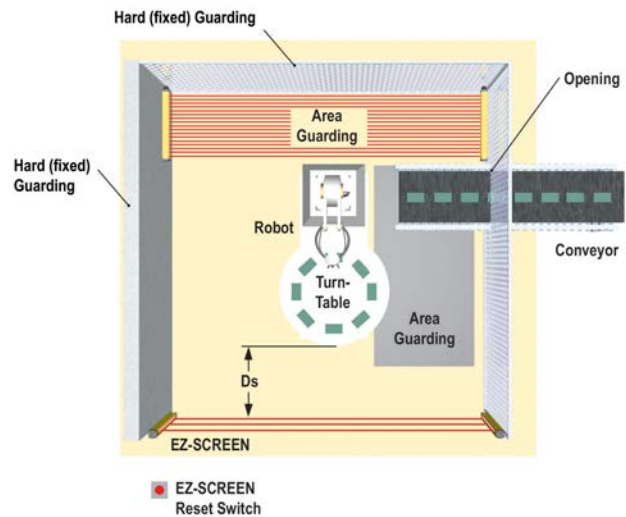


Figure 10. An example of supplemental safeguarding

[Figure 10](#) on page 16 shows an example of supplemental safeguarding inside a robotic work cell. The EZ-SCREEN LS, 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 Defined Area

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

3.1.4 Reset Switch Location

The EZ-SCREEN LS with a trip output (auto power-up and automatic reset) will turn the OSSD outputs ON when the defined area is unobstructed (clear). Per application requirements, a latch response requiring a manual reset to a power-up condition or after an interruption has cleared the defined area might be required. The latch function can be provided by interfacing the EZ-SCREEN LS OSSD outputs to the machine's safety-related control system, a safety controller (such as SC22-3 or XS/SC26-2), or safety module (such as the UM-FA-9A/11A).

The system or device providing the latch/reset function must conform to the level of performance required by the risk assessment. In applications requiring Control Reliability and/or ISO 13849-1 Categories 3 or 4 and PL d or e, it is recommended that a monitored manual reset (for example, open-closed-open action), such that a shorted or tied-down button cannot cause a reset be used.

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: Reset Switch Location**

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

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

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

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.

3.1.5 Adjacent Reflective Surfaces

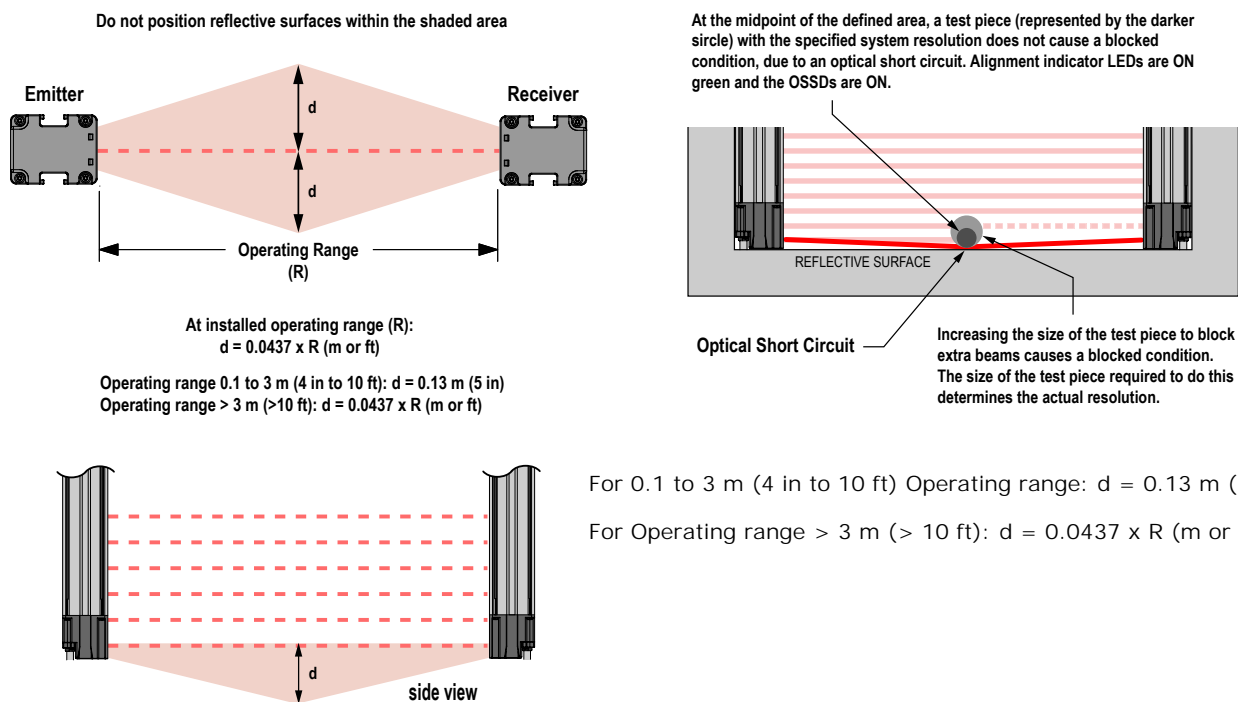
**WARNING: Avoid Installation Near Reflective Surfaces**

Avoid locating the defined area near a reflective surface; it could reflect sensing beam(s) around an object or person within the defined area, and prevent its detection by the EZ-SCREEN LS. Perform the trip test, as described in the manual, to detect such reflection(s) and the resultant optical short circuit. Failure to prevent reflection problems will result in incomplete guarding and could result in serious injury or death.

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](#) on page 34) to verify that these changes have eliminated the problem reflection(s). If the workpiece is especially reflective and comes close to the defined area, perform the trip test with the workpiece in place



For 0.1 to 3 m (4 in to 10 ft) Operating range: $d = 0.13$ m (5 in)

For Operating range > 3 m (> 10 ft): $d = 0.0437 \times R$ (m or ft)

Figure 11. Adjacent Reflective Surfaces

At the midpoint of the defined area, a test piece (represented by the darker circle in [Figure 11](#) on page 18) with the specified system resolution does not cause a blocked condition due to an optical short circuit. Green Alignment indicator lights are On and the OSSDs are On. Increasing the size of the test piece to block additional beams causes a blocked condition. The size of the test piece required to do this determines the actual resolution. Use the table below to calculate Dpf or Factor "C" when a shiny surface causes an optical short circuit.

Test Piece Model	Resolution	Depth Penetration Factor for U.S. Applications	Factor "C" for European Applications
STP-13	14 mm	24 mm (1 in)	0 mm
STP-2	19 mm	41 mm (1.6 in)	40 mm (1.6 in)
STP-16	25 mm	61 mm (2.5 in)	88 mm (3.5 in)
STP-14	30 mm	78 mm (3 in)	128 mm (5 in)
STP-4	32 mm	85 mm (3.3 in)	144 mm (5.7 in)
STP-17	34 mm	92 mm (3.6 in)	160 mm (6.3 in)
STP-1	38 mm	106 mm (4.2 in)	192 mm (7.6 in)
STP-3	45 mm	129 mm (5 in)	850 mm (33.5 in)
STP-8	51 mm	150 mm (5.9 in)	850 mm (33.5 in)
STP-5	58 mm	173 mm (6.8 in)	850 mm (33.5 in)
STP-15	60 mm	180 mm (7 in)	850 mm (33.5 in)
STP-12	62 mm	187 mm (7.4 in)	850 mm (33.5 in)

3.1.6 Use of Corner Mirrors

EZ-SCREEN LS 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:

Table 2: SSM and MSM Series Glass-Surface Mirrors³ —Maximum Emitter and Receiver Separation

Number of Corner Mirrors	Max. Emitter / Receiver Separation
1	11.0 m (36 ft)
2	10.1 m (33 ft)
3	9.3 m (30.5 ft)
4	8.6 m (28 ft)

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 12](#) on page 19). 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 known as false proxing. Angles greater than 120° result in difficult alignment and possible optical short circuits.



WARNING: Avoid Retroreflective Installation

Do not install emitters and receivers in "retroreflective" mode, with less than a 45° angle of incidence, as shown. Sensing may be unreliable in this configuration and result in a serious bodily injury or death.

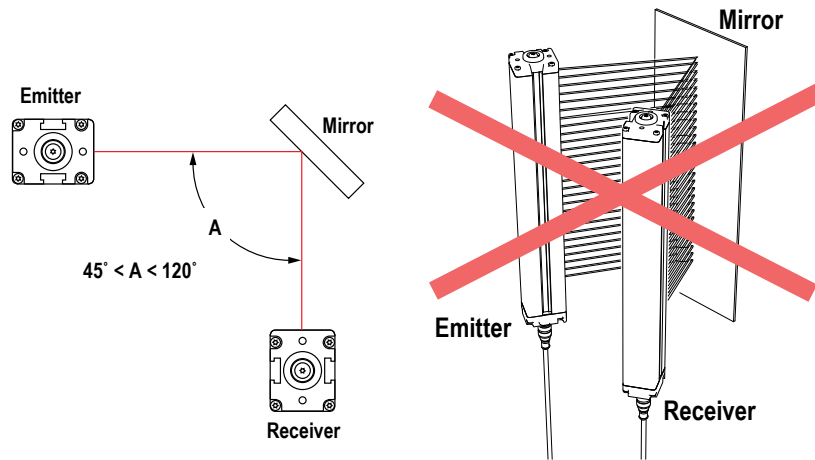


Figure 12. Using EZ-SCREEN LS sensors in a retroreflective mode

3.1.7 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: Proper Orientation of System Emitters and Receivers

EZ-SCREEN LS emitters and receivers must be installed with their corresponding cabled ends pointing in the same direction (for example, both cabled ends facing up). Failure to orient them properly will impair the performance of the EZ-SCREEN LS System and will result in incomplete guarding, and could result in serious bodily injury or death.

³ See the specific mirror data sheet or [Banner Engineering website](#) for further information.

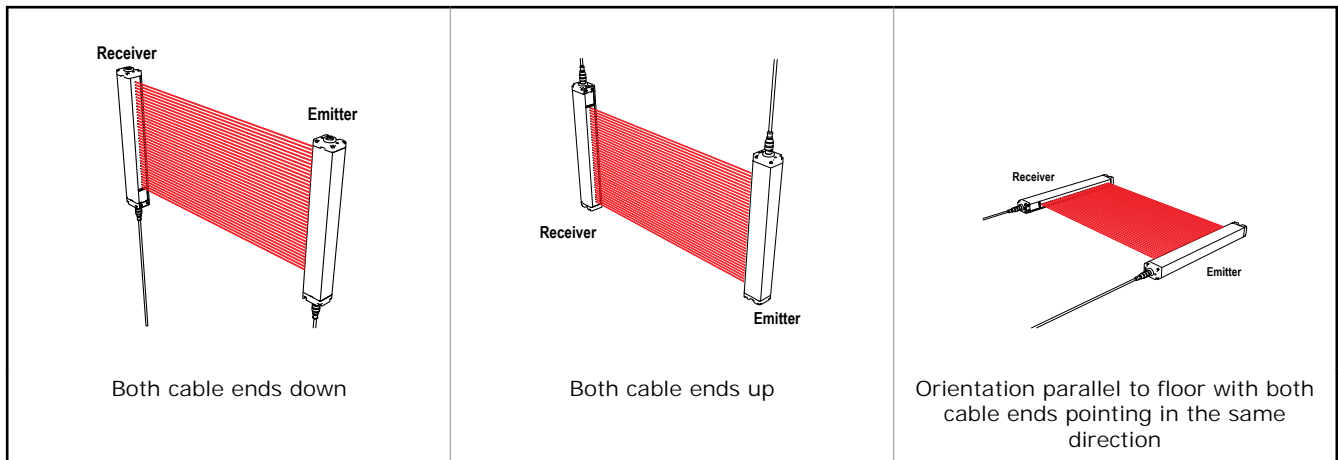


Figure 13. Examples of Correct Emitter/Receiver Orientation

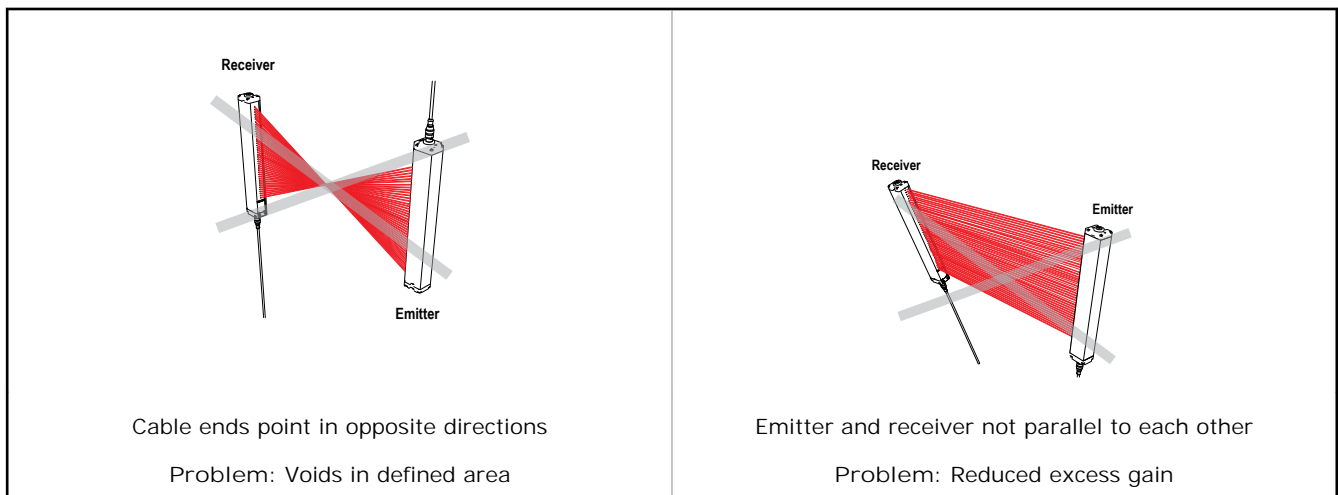


Figure 14. Examples of Incorrect Emitter/Receiver Orientation

3.1.8 Installation of Multiple Systems

Whenever two or more EZ-SCREEN LS 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 15](#) on page 21).

When three or more systems are installed in the same plane (as shown in [Figure 15](#) on page 21), 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.

To further aid in avoiding crosstalk, the sensors feature two selectable scan codes. A receiver set to one scan code will not respond to an emitter set to another code.

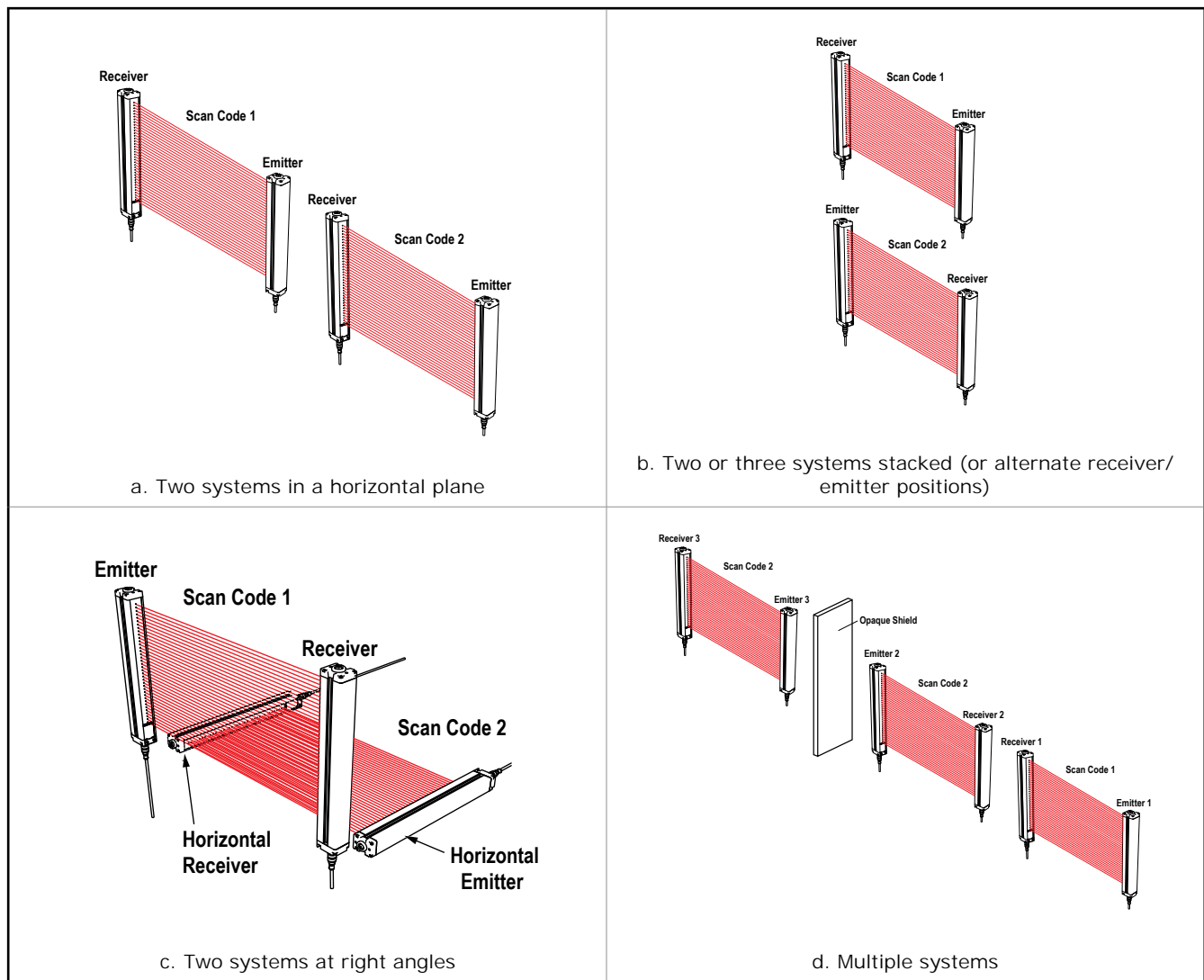


Figure 15. Installation of Multiple Systems

**WARNING: Multiple Pairs of Sensors**

Do not connect multiple pairs of sensors to one Interface Module (for example, IM-T-9A/-11A) or otherwise parallel OSSD outputs. Connection of multiple OSSD safety outputs to a single device may result in serious bodily injury or death, and is prohibited.

**WARNING: Scan Code**

In situations where multiple systems are mounted closely together, or where a secondary emitter is in view (within $\pm 5^\circ$) and within range of an adjacent receiver, the adjacent systems must be configured for different Scan Codes (one system set for Scan Code 1 and the other for Scan Code 2). If not, a receiver may synchronize to the signal from the wrong emitter, reducing the safety function of the light screen. This situation is discovered by performing the trip test.

3.2 Mounting System Components

3.2.1 Mounting Hardware

After the mechanical layout consideration of *Mechanical Installation Considerations* are addressed, mount the sensors and route the cables.

Emitter/receiver pairs can be spaced from 0.1 m (4 in) to 12 m (39 ft) apart. This distance is reduced if corner mirrors are used.

Each sensor ships with two EZLSA-MBK-11 end-mount brackets. Emitters and receivers 980 mm and longer also include one EZLSA-MBK-12 center-mount bracket. The supplied end-mount brackets allow $\pm 23^\circ$ rotation, can be mounted with flange out or flange in, and in 90° increments. EZLSA-MBK-12 center-mount brackets allow 30° rotation in one direction and 15° in the other (see [Mounting the end-mount Brackets](#) and [Mounting Side-Mount Brackets](#)). Center- and side-mount brackets allow "no blind zone" mounting with minimal or no "gaps" in detection. If additional rotation is required, see the available accessory brackets.

The supplied EZLSA-MBK-12 or optional EZLSA-MBK-16 side-mount bracket must be used with longer sensors if they are subject to shock or vibration. In such situations, the sensors are designed to be mounted with up to 910 mm unsupported distance (between brackets). Sensors 980 mm and longer are supplied with one additional center-mount bracket.

3.2.2 Mounting the End-Mount Brackets

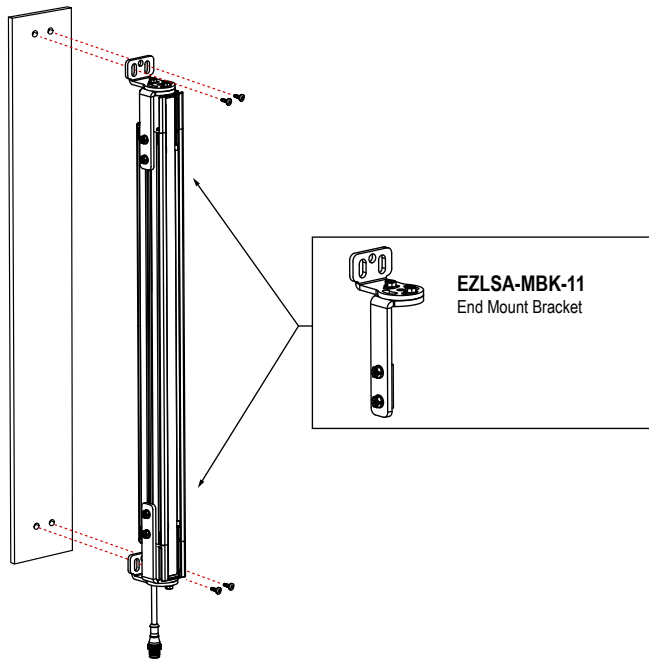
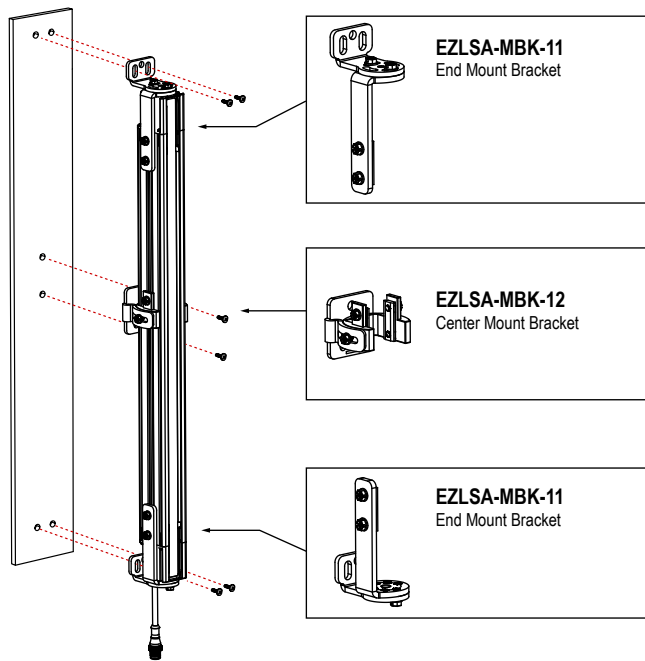


Figure 16. End-Mount Brackets

- See [Sensor Mounting and Mechanical Alignment](#) on page 24 for additional mounting recommendations.
- The machine interface connector ends of both sensors must point in the same direction.
- Two EZLSA-MBK-11 brackets are supplied with each emitter and receiver. Additional EZLSA-MBK-12 center-mount bracket(s) may be required (see [Mounting the Center- and Side-Mount Brackets](#) on page 23).
- Loosely mount the brackets to the desired surface using the supplied bolts and nuts, or user-supplied hardware. (Use the M5 hardware to mount the brackets to the light curtain; use the M6 hardware to mount the brackets to the machine.)
- Brackets are designed to mount directly to MSA Series stands using the hardware supplied with the stands.
- Brackets may face in (shown on bottom) or out (shown on top), as desired.
- See [Optional Mounting Brackets](#) on page 85 for mounting bracket dimensions.

1. From a common point of reference (ensuring the calculated minimum safety distance), measure to position the emitter and receiver in the same plane, with their midpoints directly opposite each other, and locate and drill mounting holes if necessary.
2. Slide the end-mount bracket onto the side mounting channels and tighten the channel screws.
3. Position the emitter and receiver, and attach the flange to the mounting holes.
4. Verify that the sensor windows directly face each other by rotating the sensor(s), then tighten the bracket screws.
5. 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. Use a carpenter's level, a plumb bob, or the optional LAT-1 Laser Alignment Tool (see [Alignment Aids](#) on page 87) or check the diagonal distances between the sensors, to achieve mechanical alignment. See [Sensor Mounting and Mechanical Alignment](#) on page 24.
6. Temporarily tighten all fasteners that allow for adjustment. Final alignment procedures are explained in [Initial Checkout Procedure](#) on page 28.

3.2.3 Mounting the Center- and Side-Mount Brackets



- See [Sensor Mounting and Mechanical Alignment](#) on page 24 for additional mounting recommendations.
- The machine interface connector ends of both sensors must point in the same direction.
- Emitters and Receivers 980 mm and longer include an EZLSA-MBK-12 center-mount bracket for center support.
- The sensors are designed to be mounted with up to 910 mm of unsupported distance between brackets when they are subject to shock or vibration.
- Loosely mount the brackets to the desired surface using the supplied M5 bolts and nuts, or user-supplied hardware.
- A simple "L" mounting bracket can be created by disassembling the EZLSA-MBK-11 and only using the mounting flange.
- See [Optional Mounting Brackets](#) on page 85 for mounting bracket dimensions.

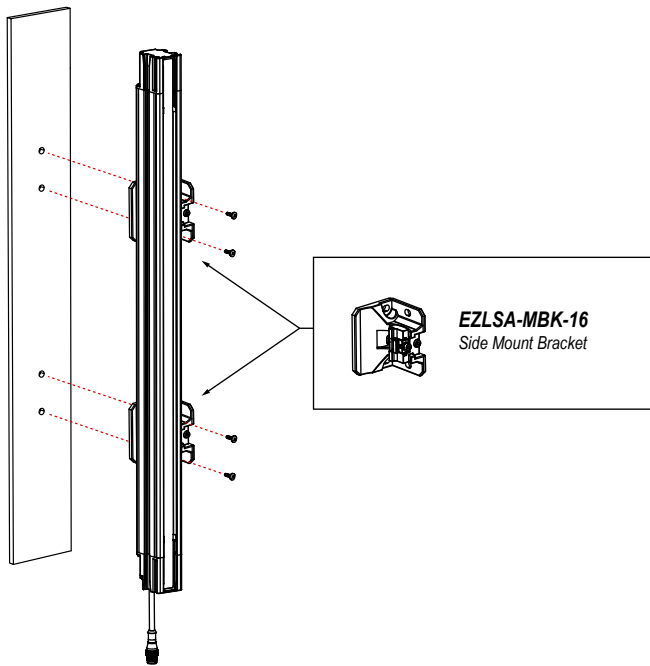
Figure 17. Mounting the center- and side-mount brackets

1. From a common point of reference (ensuring the calculated minimum safety distance), measure to locate the emitter and receiver in the same plane, with their midpoints directly opposite each other, and locate and drill mounting holes if necessary.
2. Attach the mounting flange of the EZLSA-MBK-12 to the mounting holes (back-mount only).
3. Remove the channel nuts from the EZLSA-MBK-12 clamp and slide them into the side mounting channel. A small piece of adhesive tape can be used to temporarily location the nuts within the channel.
4. Position the emitter and receiver and re-assemble the clamp to the channel nuts. Tighten when the sensor is properly located.
5. Rotate sensor(s) so that the windows directly face each other. Tighten the screw.
6. 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. Use a carpenter's level, a plumb bob, or the optional LAT-1 Laser Alignment Tool (see [Alignment Aids](#) on page 87) or check the diagonal distances between the sensors, to achieve mechanical alignment.
7. Temporarily tighten all fasteners that allow for adjustment. Final alignment procedures are explained in [Initial Checkout Procedure](#) on page 28.

3.2.4 Optional EZLSA-MBK-16 Side-Mount Bracket

The EZLSA-MBK-16 provides a mounting option that is adjustable (lateral and +15/-20° rotational) from the face of the sensor and allows "no blind zone" mounting with minimal or no "gaps" in detection. The bracket can be mounted to a surface on the back or the side of the sensor (not typically to be used in conjunction with EZLSA-MBK-11 end-mount bracket).

Figure 18. Optional Side-Mount Bracket



- See [Mounting the Center- and Side-Mount Brackets](#) on page 23 for the general mounting procedure.
- See [Sensor Mounting and Mechanical Alignment](#) on page 24 for additional mounting recommendations.
- The machine interface connector ends of both sensors must point in the same direction.
- The sensors are designed to be mounted with up to 910 mm of unsupported distance between brackets when they are subject to shock or vibration.
- See [Optional Mounting Brackets](#) on page 85 for mounting bracket dimensions and the installation guide.

3.2.5 Sensor Mounting and Mechanical Alignment

Verify that:

- The emitter and receiver are directly opposite each other
- Nothing is interrupting the defined area
- 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, and not tilted front-to-back or side-to-side)

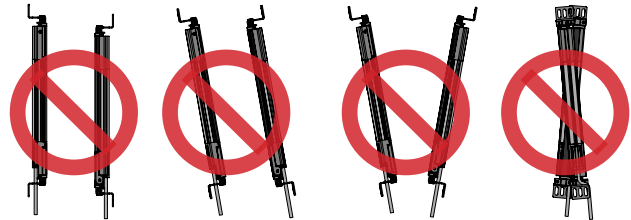
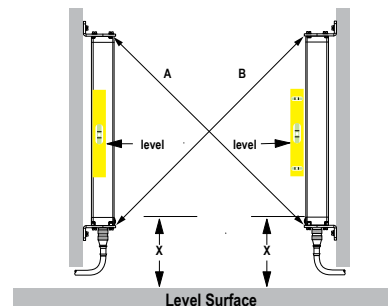
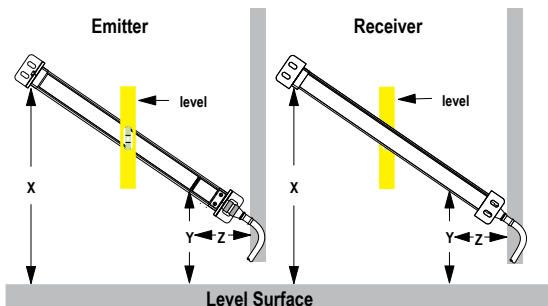


Figure 19. Incorrect Sensor Alignment



Angled or Horizontal Installations – verify that:

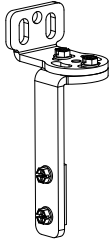
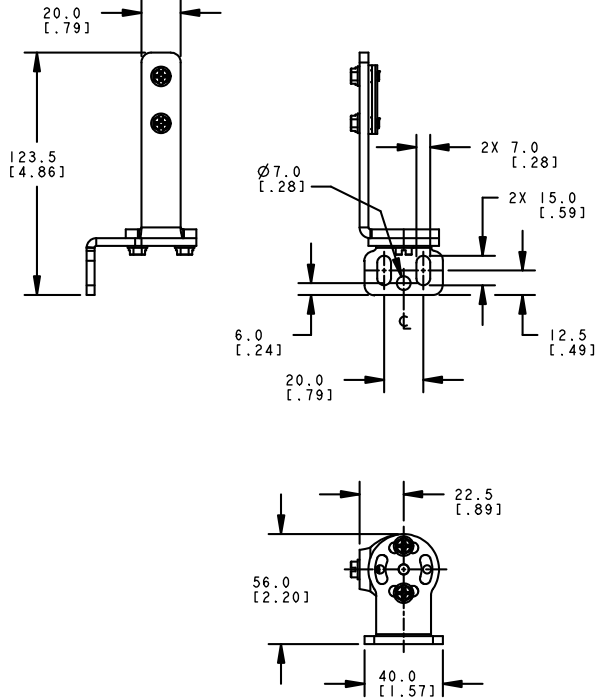
- Distance X at the emitter and receiver are equal
- Distance Y at the emitter and receiver are equal
- Distance Z at the emitter and receiver are equal from parallel surfaces
- Vertical face (the window) is level/plumb
- Defined area is square. Check diagonal measurements if possible; see Vertical Installations,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

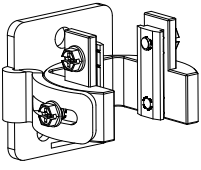
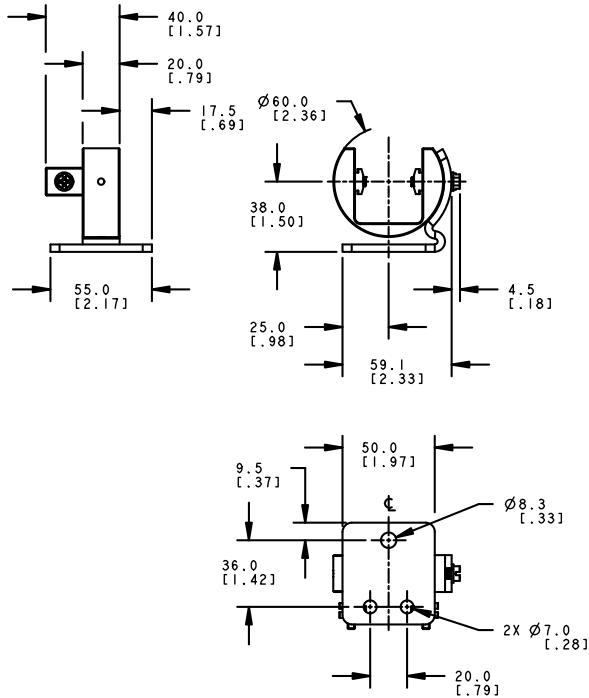
Vertical Installations – verify that:

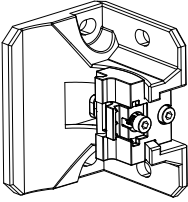
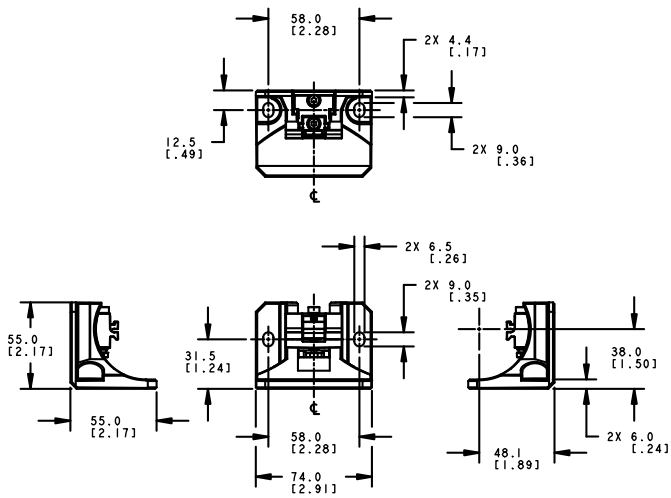
- Distance X at the emitter and receiver are equal
- Both sensors are level/plumb (check both the side and face)
- Defined area is square. Check diagonal measurements if possible (Diagonal A = Diagonal B).

3.2.6 Mounting Dimensions

All measurements are listed in millimeters (inches), unless noted otherwise. See [Dimensions](#) on page 67 for EZ-SCREEN LS dimensions with and without brackets installed. See [Side Bracket Mounting](#) for additional information about mounting the EZLSA-MBK-16 brackets.

End-Mount Brackets	Dimensions
 <p data-bbox="259 1003 503 1029">Figure 20. EZLSA-MBK-11</p>	 <p>Technical drawings of the EZLSA-MBK-11 bracket showing side, front, and top views with dimensions in millimeters (mm) and inches (in).</p> <ul style="list-style-type: none"> Side View: <ul style="list-style-type: none"> Top flange width: 20.0 mm [0.79 in] Mounting hole spacing: 123.5 mm [4.86 in] Front View: <ul style="list-style-type: none"> Top flange width: 20.0 mm [0.79 in] Mounting hole spacing: 123.5 mm [4.86 in] Top flange thickness: 6.0 mm [0.24 in] Top flange hole diameter: Ø 7.0 mm [0.28 in] Top flange hole spacing: 2X 7.0 mm [0.28 in] Top flange hole diameter: 2X 15.0 mm [0.59 in] Top flange hole spacing: 12.5 mm [0.49 in] Top View: <ul style="list-style-type: none"> Top flange width: 22.5 mm [0.89 in] Top flange thickness: 56.0 mm [2.20 in] Top flange hole diameter: 40.0 mm [1.57 in]

Center-Mount Brackets	Dimensions
 <p data-bbox="259 514 506 535">Figure 21. EZLSA-MBK-12</p>	 <p>Technical drawings of the EZLSA-MBK-12 center-mount bracket showing side and front views with dimensions in mm and inches.</p> <p>Side View Dimensions:</p> <ul style="list-style-type: none"> Top flange width: 40.0 [1.57] Top flange thickness: 20.0 [.79] Mounting hole offset from top: 17.5 [.69] Base width: 55.0 [2.17] <p>Front View Dimensions:</p> <ul style="list-style-type: none"> Outer diameter: $\phi 60.0$ [2.36] Mounting hole diameter: $\phi 8.3$ [.33] Distance from top to mounting hole center: 38.0 [1.50] Distance from bottom to mounting hole center: 25.0 [.98] Distance from bottom to base: 59.1 [2.33] Base thickness: 4.5 [.18] Distance between mounting holes: 50.0 [1.97] Distance from top to mounting hole center: 9.5 [.37] Distance from bottom to mounting hole center: 36.0 [1.42] Mounting hole diameter: $2 \times \phi 7.0$ [.28] Distance from center to mounting hole: 20.0 [.79]

Side-Mount Brackets	Dimensions
 <p data-bbox="259 1407 506 1428">Figure 22. EZLSA-MBK-16</p>	 <p>Technical drawings of the EZLSA-MBK-16 side-mount bracket showing top, side, and front views with dimensions in mm and inches.</p> <p>Top View Dimensions:</p> <ul style="list-style-type: none"> Top flange width: 58.0 [2.28] Distance between mounting holes: 2X 4.4 [.17] Distance from center to mounting hole: 2X 9.0 [.36] Distance from center to mounting hole: 12.5 [.49] <p>Side View Dimensions:</p> <ul style="list-style-type: none"> Top flange width: 55.0 [2.17] Base width: 55.0 [2.17] Distance from top to mounting hole center: 31.5 [1.24] Distance from bottom to mounting hole center: 58.0 [2.28] Distance from bottom to base: 74.0 [2.91] <p>Front View Dimensions:</p> <ul style="list-style-type: none"> Distance between mounting holes: 2X 6.5 [.26] Distance from center to mounting hole: 2X 9.0 [.35] Distance from top to mounting hole center: 38.0 [1.50] Distance from bottom to mounting hole center: 48.1 [1.89] Base thickness: 2X 6.0 [.24]

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 has the responsibility to ensure that all local, state, and national laws, rules, codes, or regulations relating to the installation and use of this control system in any particular application are satisfied. 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 Persons⁴, in accordance with this manual and applicable safety regulations.

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

1. Routing cordsets and making initial electrical connections (see [Routing Cordsets](#) on page 27 and [Initial Electrical Connections](#) on page 28).
2. Apply power to each emitter/receiver pair (see [Initial Electrical Connections](#) on page 28).
3. Perform an Initial Checkout Procedure (see [Initial Checkout Procedure](#) on page 28).
4. Make all electrical interface connections to the guarded machine (see [Electrical Connections to the Guarded Machine](#) on page 35).
5. Perform a commissioning checkout procedure (see [Commissioning Checkout](#) on page 63).

4.1 Routing Cordsets

Attach the required cordsets to the sensors, and route the sensor cables to the junction box, electrical panel, or other enclosure in which the interface module, the redundant mechanically linked interposing relays, FSDs, or other safety-related parts of the control system are located. This must be done per local wiring code for low-voltage dc control cables and may require installation of electrical conduit. See [Cordsets](#) on page 77 for selection of Banner supplied cables.

EZ-SCREEN LS 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 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 LS System. It is good wiring practice, and sometimes 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 cabling and any interconnect wiring should have an insulation temperature rating of at least 90 °C (194 °F).

Installation/Replacement of RD Cordsets— To remove the Removable Disconnect (RD) cordset, unscrew the two Phillips screws and carefully pull the connector straight back. To install an RD Cordset:

1. Slide the RD connector firmly into housing's RD port. (Ensure rectangular gasket is installed.)
2. Tighten the Phillips screws at base of connector to lock into place. Do not over tighten.



NOTE: The machine interface cable must connect to the sensor end adjacent to the indicators for the system to operate properly.

Table 3: Maximum machine interface cable length versus total load current (OSSDs)

EZ-SCREEN LS Receivers in Cascade	Maximum Machine Interface Cordset Length				
	Total Load Current (OSSD 1 + OSSD 2)				
	0.1 A	0.25 A	0.5 A	0.75 A	1.0 A
1	95.7 m (314 ft)	78 m (256 ft)	54.9 m (180 ft)	42.1 m (138 ft)	34.1 m (112 ft)
2 ⁵	45.7 m (150 ft)	38.1 m (125 ft)	28.9 m (98 ft)	24.7 m (81 ft)	20.7 m (68 ft)
3 ⁶	25.3 m (83 ft)	22.3 m (73 ft)	18.6 m (61 ft)	15.8 m (52 ft)	13.7 m (45 ft)
4 ⁷	20.1 m (66 ft)	18.3 m (60 ft)	15.5 m (51 ft)	13.7 m (45 ft)	12.2 m (40 ft)

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.

⁵ Assumes a 50 ft L2 cascade cable.

⁶ Assumes 26.2 ft L2 and L3 cascade cables.



NOTE: Emitter and receiver power (current) requirements are accounted for. The above values represent additional current draw that must be accounted for because of the load current.



NOTE: Maximum cordset lengths are intended to ensure that adequate power is available to the EZ-SCREEN LS when the supply is operating at +20 V dc. Values in the previous table are worse case. Contact banner Engineering if there are any questions.



NOTE: The length of Emitter machine interface cordsets can be two times longer than those listed for the receiver in the table above if a CSB Splitter cordset is not used. If a CSB Splitter cordset is used, connect one branch of the CSB splitter to the receiver and other branch to the emitter via DEE2R double-ended cordset up to the same length listed in the table above.

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 LS System than are described in this manual. Connection of other wiring or equipment to the EZ-SCREEN LS System could result in serious bodily 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 LS 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 RD or pigtail QD connections.

Emitter Cordset

EZ-SCREEN LS emitters have either a 5-pin or 8-pin cordset, but not all conductors are used. The other wires are in place to allow a parallel connection (color-for-color) to the receiver cable, providing sensor interchangeability (or “swapability”); either sensor may be installed at either cordset connection. In addition to providing similar cabling, this wiring scheme is advantageous during installation, wiring, and troubleshooting.

Receiver Cordset—5-pin

Do not connect any wires to the machine control circuits (OSSD outputs) at this time.

Receiver Cordset—8-pin

Do not connect any wires to the machine control circuits (OSSD outputs) at this time. For the initial power-up and checkout, External Device Monitoring (EDM) must be configured/wired (see [External Device Monitoring](#) on page 37), the Scan Code must be selected (see [Scan Code Select](#) on page 38), and the Fault Output can be connected (see [Fault Output](#) on page 9). Take precautions to prevent unused wires from shorting to ground or to other sources of energy (for example, terminate with a wire-nut). Final OSSD wiring must be completed later.

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 emitter and receiver.

The procedure is performed on two occasions:

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

4.3.1 Configuring the System for Initial Checkout

For the initial checkout, the EZ-SCREEN LS 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.

⁷ Assumes L2 and L4 are 1 ft and L3 is 50 ft.

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)
- EDM is configured and wired per application requirements (1-channel or no monitoring, see [External Device Monitoring](#) on page 37)

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 page 17).
2. Eliminate the reflective surfaces as much as 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 LS System and from the guarded machine and that the OSSD safety outputs are not connected.
4. Remove all obstructions from the light screen.
5. With the power to the guarded machine Off, make external device monitoring (EDM), power, and earth ground connections on both the emitter and receiver cables (see [Reference Wiring Diagrams](#) on page 39). The +24 V dc (brown wire) and 0 V dc (blue wire) should be connected to a SELV-rated supply and GND (green/yellow wire) to earth ground. If the installation does not allow direct connection to earth ground via the cordset, the earth ground must be provided via the mounting brackets.
6. Power up the EZ-SCREEN LS 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 Status indicators and the receiver Alignment indicators to determine the light screen alignment status:
 - An Emitter Lockout Condition—the emitter Status indicator is single-flashing red; the receiver Status indicator is solid red, and the receiver's 7-segment display reads CH1.
 - A Receiver Lockout Condition—the receiver Status indicator is single-flashing red, with Alignment and Run mode indicators Off, and the receiver 7-segment display shows an Error Code.
 - Normal Operating Mode (emitter)—the Status indicator is solid green.
 - Clear (Run) Condition (receiver)—the Status indicator is solid green, and the Run mode indicator is solid amber. All Alignment indicators are solid green.
 - A Blocked Condition (receiver)—The Status indicator is solid red, Run mode indicator is solid amber, one or more Alignment indicator(s) are solid red, identifying the location of the blocked beams, and the number of blocked beams is displayed.



NOTE: If beam 1 is blocked, the Alignment indicator 1 will be red and all others Off. Beam 1 provides the synchronization signal.

9. Proceed to [Optical Alignment](#) on page 29.

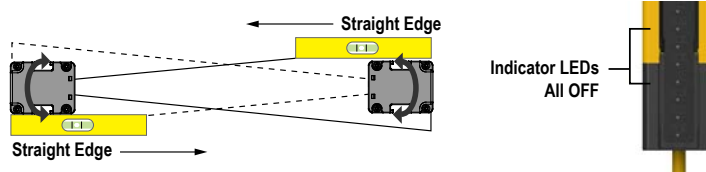
4.3.3 Optical Alignment



CAUTION: Ensure that no individuals are exposed to any hazard if the OSSD outputs turn ON when the emitter and receiver become aligned.

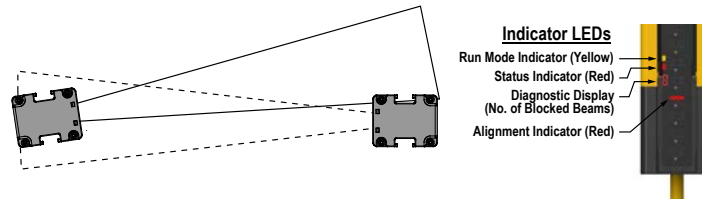
Verify the optimal alignment, adjusting the sensor rotation with the power on:

1. 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.

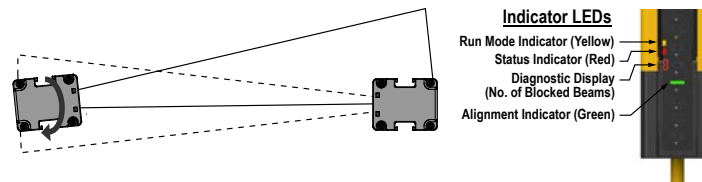


NOTE: At power-up, all indicators are tested (flash), then the Scan Code is displayed.

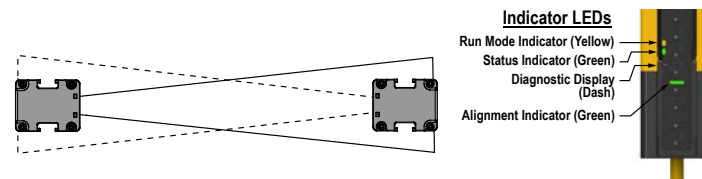
- Turn on the power to the emitter and receiver. If the Channel #1 beam is not aligned, the Status and Alignment indicator 1 will be red, the Run mode indicator will be off, and the 7-segment display sequentially indicates CH1. All the Alignment indicators (2-n) will be off.



- If the green Status and amber Run mode indicators are on, go to the next step. If not, rotate each sensor (one at a time) left and right until the green Status indicator is on. (As the sensor rotates out of alignment, the red Status indicator turns on). As more beams are aligned, the Alignment indicators turn from red to green and the number of blocked beam indicators decreases.



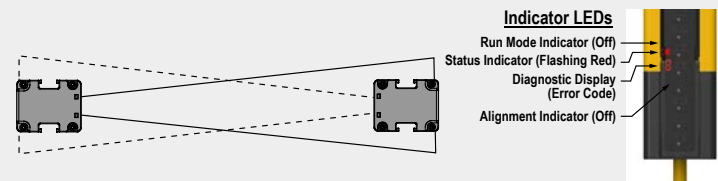
- To optimize alignment and maximize excess gain, slightly loosen the sensor mounting screws and rotate one sensor left and right, noting the positions in each arc where the Status indicators turn red (blocked condition); repeat with the other sensor. Center each sensor between those two positions and tighten the mounting screws, making sure to maintain the positioning as the screws are tightened.



For situations where alignment is difficult, a LAT-1-SS Laser Alignment Tool can be used 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 indicator begins to flash steadily, the System has entered a Lockout condition. See [Lockout Conditions](#) on page 58 for further information.



4.3.4 Optical Alignment Procedure with Mirrors

EZ-SCREEN LS sensors may be used with one or more corner mirrors for guarding more than one side of an area. The MSM-... and SSM-... rear-surface glass mirrors are rated at 85% efficiency. Thus, excess gain and sensing range are reduced when using mirrors; see [Use of Corner Mirrors](#) on page 18.

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:

- 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-SS Laser Alignment Tool is very helpful by providing a visible red dot along the optical axis. See [Figure 23](#) on page 31 and Banner Safety Applications Note SA104 (p/n 57477) for further information.

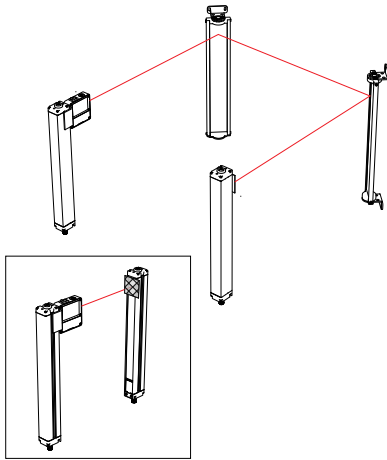


Figure 23. Optical alignment using the LAT-1-SS

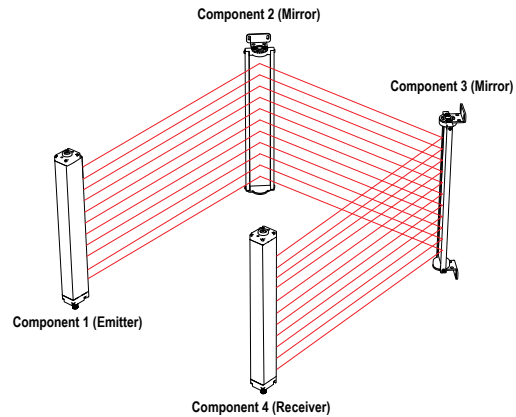


Figure 24. Corner Mirror Alignment

4.3.5 Remote Fixed Blanking

On cascade models, fixed blanking is available to, in effect, "disable" beams that would otherwise be continually blocked by a stationary object. One or multiple areas within an EZ-SCREEN LS sensor pair may be "blanked out," with a minimum of one beam between two blanked areas. The first sensing beam (CH1 synchronization beam) at the display end of sensor must remain clear (cannot be blanked); any other beam may be blanked. All beams of a fixed blanked area must remain blocked during operation in order for the OSSDs to remain ON.

The Remote Fixed Blanking feature can be used on an EZ-SCREEN LS cascade receiver as a stand-alone system or in a cascaded system. A DELSEF-81D cordset used with a EZA-RBK-1 Remote Blanking Key Switch or a RDLS-8...D cordset with a user-supplied switch and indicator provides a convenient means to program the blanked area. The remote programming is effective on all receivers in the cascaded systems (for example, multiple areas can be blanked on different sensor pairs).

Programming Key Switch Location

The EZA-RBK-1 or an SPDT (Form C) switch is required to perform the remote programming procedure, as shown. A key-actuated switch provides some supervisory control since the key can be removed from the switch. The Programming Key Switch must be:

- Located outside the guarded area
- Located to allow the switch operator full unobstructed view of the entire defined area
- Protected against unauthorized or inadvertent operation



WARNING: Use of Fixed Blanking.

Use Fixed Blanking only when necessary. Any holes created in the defined area either must be completely filled by the blanked object or the safety (minimum) distance must be increased to account for the larger resolution (see [Calculating the Safety Distance \(Minimum Distance\)](#) on page 13).



Figure 25. EZA-RBK-1 switch positions and programming status indications.

Indicator Status	Programming Status
Amber/yellow on	Programming in process
Amber/yellow flashing	Programming complete
Off	Run mode

Remote Fixed Blanking Programming Procedures

Prior to performing these procedures, install the EZ-SCREEN LS per [Mechanical Installation](#) on page 13 of this document. Align the emitter/receiver pair and perform all required checkout procedures to ensure proper operation. Ensure that the EZA-RBK-1 programming key switch is rotated to the counter-clockwise Run position at power-up and normal operation.



Important:

1. The first sensing beam (CH1 synchronization beam) at the display end of the sensor must remain clear during normal operation.
2. The number and location of blocked beams is indicated by the receiver's 7-segment display and the alignment indicators. If the configuration is reliable, this number should not change.

Initial programming—no fixed blanking previously programmed, perform the following: The following procedures must be completed within 10 minutes or a lockout occurs (Error Code 12 displays).

Action	Indication	Comments
1 Locate the obstruction in the defined area and secure it.	EZA-RBK-1 LED: OFF Receiver: number and location of blocked beams is indicated by the 7-segment display and the alignment indicators.	The number of blocked beams should not change if all beams to be blanked are reliably obstructed. If the number changes, some beams may be partially or intermittently blocked, which may cause a lockout condition during operation.
2 Turn the programming key switch to the Program position (clockwise) momentarily (> 0.25 second) and then return to the Run position.	EZA-RBK-1 LED: ON (key in Program position), then slowly flashes for approximately 5 seconds after the key returns to the Run position. Receiver: displays "P" and the number of blocked beams. Then displays "P" "F" "C" after the key returns to the Run position.	This teaches and saves the new fixed blanking configuration.
3 Trip Output: the OSSDs turn ON.	EZA-RBK-1 LED: OFF Receiver: display indicates normal operation with flashing alignment indicator(s) corresponding to the location of the blocked beams.	System is ready for the Trip Test, see Trip Test on page 34.

Further programming with the power on—To change (relocate) or clear (remove) previous fixed blanking, perform the following steps: The following procedures must be completed within 10 minutes or a lockout will occur (Error Code 12 will be displayed).

Action		Indication	Comments
1	Place the programming key switch in the Program position (clockwise) until step 3.	EZA-RBK-1 LED: ON Receiver: sequences between "P" and the number of blocked beams.	EZA-RBK-1 indicator steady ON indicates program mode.
2	Locate or relocate the obstruction (for example, tooling, fixturing, etc.) in the defined area and secure. If clearing the fixed blanked area, remove all obstructions.	EZA-RBK-1 LED: ON Receiver: sequences between "P" and the number of blocked beams.	If an Error code 12 occurs (programming time out), go to step 6 below (do not return the programming key switch to the Run position at this time).
3	Return the programming key switch to the Run position (counter-clockwise).	EZA-RBK-1 LED: slowly flashes, approximately 5 seconds Receiver: display indicates "P" "F" "C"	This saves the new fixed blanking configuration.
4	Trip Output: The OSSDs turn ON.	EZA-RBK-1 LED: OFF Receiver: display indicates normal operation if fixed blanking is removed. Otherwise displays normal operation with flashing alignment indicator(s) corresponding to the location of the blanked beams.	System is ready for the Trip Test, see Trip Test on page 34.

To change (relocate) or clear (remove) previous fixed blanking, when:

- Obstruction is relocated or cleared with EZ-SCREEN LS power OFF.
- Clearing an Error Code 10 "Fixed Blanking Error"
- Clearing an Error Code 12 "Timeout Expired" (begin at step 6, with the programming key switch in the Program position)

Action		Indication	Comments
1	Remove power from EZ-SCREEN LS.		
2	Locate or relocate the obstruction (for example, tooling, fixturing, etc.) in the defined area and secure it, or if clearing the fixed blanked area, remove all obstructions.		
3	Temporarily block the first sensing beam (CH1 synchronization beam) at the display end of the sensor.		
4	Ensure that the programming key switch is in the Run position and reapply power to the EZ-SCREEN LS system.	EZA-RBK-1 LED: rapid flashing, and then OFF Receiver: Power-up Test Sequence, scan code ("C" and "1" or "2"), and then "C" "H" "1" (repeats)	All LEDs turn on momentarily during the Power-up Display Test Sequence.
5	Place the programming key switch in the Program position (clockwise).	EZA-RBK-1 LED: ON Receiver: displays sequences "C" "H" "1" (repeats) and then "P" "0" (repeats)	The timer resets to 10 minutes.
6	Clear the first sensing beam (CH1 synchronization beam) at the display end of the sensor.	EZA-RBK-1: ON Receiver: display sequences between "P" and the number of blocked beams	Adjustments to position of the fixed blanked object can be made within the 10 minute programming time limit.
7	Return the programming key switch to the Run position (counterclockwise).	EZA-RBK-1 LED: slowly flashes for approximately 5 seconds Receiver: display indicates "P" "F" "C"	This saves the new fixed blanking configuration.
8	Trip Output: the OSSDs turn ON.	EZA-RBK-1 LED: OFF Receiver: display indicates normal operation if fixed blanking is removed. Otherwise, displays normal operation with flashing alignment indicator(s) corresponding to the location of the blanked beams.	System is ready for the Trip Test, see Trip Test on page 34.

4.3.6 Trip Test

After optimizing the optical alignment and configuring fixed blanking (if applicable), perform the trip test to verify the detection capability of the EZ-SCREEN LS System. This test also verifies correct sensor orientation and identifies optical short circuits. After the installation has passed the trip test, the safety outputs may be connected and the commissioning checkout may be performed (initial installations only).

1. Select the proper test piece (see [Table 4](#) on page 34), supplied with the receiver.

Table 4: Appropriate Test Pieces for Trip Test

14 mm Resolution Models	23 mm Resolution Models	40 mm Resolution Models
14 mm (0.55 in) dia.	23 mm (0.91 in) dia.	40 mm (1.57 in) dia.
STP-13	STP-19	STP-20

2. Verify that the System is in Run mode, the Green Status indicator is On, all Alignment indicators are green, and the amber Status indicator is On.
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.

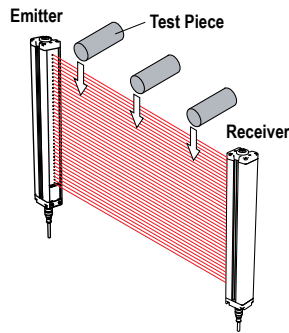


Figure 26. Trip Test

4. During each pass, while the test piece is interrupting the defined area, at least one Alignment indicator must be Red. The Red Alignment indicator must change with the position of the test piece within the defined area.

If all Alignment indicators turn green or fail to follow the position of the test piece while it is within the defined area, the installation has failed the trip test. Check for correct sensor orientation and reflective surfaces.

When the test piece is removed from the defined area, in trip output operation, the green Status indicator must turn on .



WARNING: If Trip Test Indicates a Problem

If the EZ-SCREEN LS System does not respond properly to the trip test, do not attempt to use the System. If this occurs, the System cannot be relied on to stop dangerous machine motion when a person or object enters the defined area. Serious bodily injury or death could result.

5. If mirrors are used in the application: Test the defined area on each leg of the sensing path (for example, emitter to mirror, between mirror and receiver, see [Figure 27](#) on page 35).

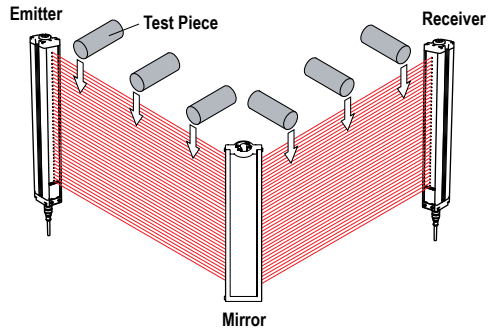


Figure 27. Trip Test with Corner Mirror

6. If the EZ-SCREEN LS System passes all checks during the trip test, go on to [Electrical Connections to the Guarded Machine](#) on page 35.

4.4 Electrical Connections to the Guarded Machine

Verify that power has been removed from the EZ-SCREEN LS and the guarded machine. Make the permanent electrical connections as described in [OSSD Output Connections](#) on page 35 and [FSD Interfacing Connections](#) on page 36 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 LS must also have been aligned and passed the Initial Checkout, as described in [Initial Checkout Procedure](#) on page 28.

The final connections to be made or verified are:

- OSSD outputs
- FSD interfacing
- MPCE/EDM
- Fault Output
- Scan Code Select



CAUTION: Shock Hazard

Always disconnect power from the Banner device and the guarded machine before making any connections or replacing any component. Use extreme caution to avoid electrical shock at all times.

4.4.1 OSSD Output Connections

Refer to the output specifications in the Receiver Specifications (see [Specifications](#) on page 65) and the warning below before making OSSD output connections and interfacing the EZ-SCREEN LS to the machine.



WARNING: Interfacing of Both OSSDs

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

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

**WARNING: OSSD Interfacing**

To ensure proper operation, the Banner device output parameters and machine input parameters must be considered when interfacing the Banner device OSSD outputs to machine inputs. Machine control circuitry must be designed so that the maximum load resistance value is not exceeded and that the maximum specified OSSD Off-state voltage does not result in an On condition.

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

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 LS. FSDs can also be used to control an additional number of hazards by creating multiple safety stop circuits.

Protective Stop (Safety Stop) Circuits

A protective stop (safety stop) allows for an orderly cessation of motion for safeguarding purposes, which results in a stop of motion and removal of power from the MPCEs (assuming this does not create additional hazards). A protective stop circuit typically comprises a minimum of two normally open 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.

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 LS.

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.

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

A machine primary control element (MPCE) is an electrically powered element that directly controls the normal operation of a machine in such a way that it is the last element (in time) to function when machine operation is to be initiated or arrested (per IEC 61496-1). Examples include motor contactors, clutch/brakes, valves, and solenoids.

Depending on the level of risk of harm, it may be required to provide redundant MPCEs or other control devices that are capable of immediately stopping the dangerous machine motion, irrespective of the state of the other. These two machine control channels need not be identical (diverse redundant), but the stop time performance of the machine (T_s , used to calculate the safety distance, see [Calculating the Safety Distance \(Minimum Distance\)](#) on page 13) must take into account the slower of the two channels. Consult the machine manufacturer for additional information.

To ensure that an accumulation of failures does not compromise the redundant control scheme (cause a failure to danger), a method to verify the normal functioning of MPCEs or other control devices is required. EZ-SCREEN LS provides a convenient method for this verification: external device monitoring (EDM).

For the EZ-SCREEN LS external device monitoring to function properly, each device must include a normally closed, forced-guided (mechanically linked) contact that can accurately reflect the status of the device. This ensures that the normally open contacts, used for controlling hazardous motion, have a positive relationship with the normally closed monitoring contacts and can detect a failure to danger (for example, contacts that are welded closed or stuck On).

It is strongly recommended that a normally closed, forced-guided monitoring contact of each FSD and MPCE be connected in series with the EDM input (see [Generic Wiring Diagram—8-pin Receiver and IM-T-9A Interface Module](#) on page 43). If this is done, proper operation will be verified. Monitoring FSD and MPCE contacts is one method of maintaining control reliability (OSHA/ANSI) and Category 3 and 4 (ISO 13849-1).

If monitoring contacts are not available or do not meet the design requirement of being forced-guided (mechanically linked), it is recommended you:

- Replace the devices so that they are capable of being monitored; or
- Incorporate the EDM function into the circuit as close to the MPCE as possible (for example, monitor the FSDs); and
- Employ the use of well-tried, tested, and robust components, and generally accepted safety principles, including fault exclusion, into the design and installation to either eliminate, or reduce to an acceptable (minimal) level of risk, the possibility of undetected faults or failures that can result in the loss of the safety function.

The principle of fault exclusion allows the designer to design out the possibility of various failures and justify it through the risk assessment process to meet the required level of safety performance, such as the requirements of Category 2, 3, or 4. See ISO 13849-1/-2 for further information.



WARNING: 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.

4.4.4 External Device Monitoring

EZ-SCREEN LS provides two possible EDM configurations: 1-channel monitoring and no monitoring. Their functions are described below. The most common form of EDM is 1-channel monitoring; its primary advantages is the simplicity of wiring. The installation must prevent short circuits across the N.C. monitoring contacts and to secondary sources of power.

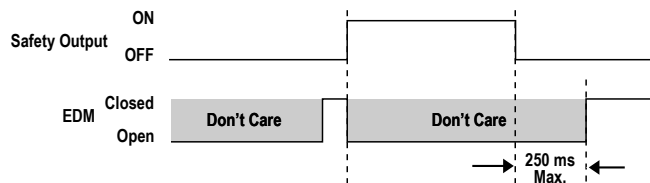


Figure 28. One-channel EDM status, with respect to safety output

External Device Monitoring Hookup

If not connected previously, it is again strongly recommended that one normally closed, forced-guided monitoring contact of each FSD and MPCE be wired as shown in the monitoring circuit (see [Generic Wiring Diagram—8-pin Receiver and IM-T-9A Interface Module](#) on page 43). Pin 3 of the receiver connector provides connection for the external device monitoring input.

External device monitoring (EDM) must be wired in one of two configurations described below.

One-Channel Monitoring: This is a series connection of normally closed monitor contacts that are force-guided (mechanically linked) from each device controlled by the EZ-SCREEN LS. The monitor contacts must be closed before the EZ-SCREEN LS OSSDs can turn On. After the safety outputs (OSSDs) turn On, the status of the monitor contacts are no longer monitored and may change state. However, the monitor contacts must be closed within 250 milliseconds of the OSSD outputs going from On to Off.

Refer to [Generic Wiring Diagram—8-pin Receiver and IM-T-9A Interface Module](#) on page 43 for wiring. Connect the monitor contacts between +24 V dc and EDM (pin 3).

No Monitoring: Use this configuration to perform the initial checkout; see [Initial Checkout Procedure](#) on page 28. *If the application does not require the EDM function, it is the user's responsibility to ensure that this configuration does not create a hazardous situation.*

To configure the EZ-SCREEN LS for no monitoring, connect EDM (Pin 3) to +24 V dc.



WARNING: Retrofit of 2-channel EDM Installations.

In existing installations using 2-channel external device monitoring (default setting of EZ-SCREEN and EZ-SCREEN LP systems), the parallel wiring of the N.C. monitoring contacts must be rewired for the series connection used for 1-channel EDM. If the required wiring changes are not made, the device connected to pin 2 (Orn/Blk) will not be monitored and could result in undetected faults and create an unsafe condition, which could result in serious bodily injury or death.

If there are any questions concerning retrofit installations, contact Banner Engineering.

4.4.5 Fault Output

The current sourcing (PNP) solid-state output (100 mA maximum) is used for control functions that are not safety related; a typical use is to signal a lockout (fault) to a programmable logic controller (PLC). Available on both the receiver and emitter, the output provides a fault signal (lockout = On). Interrupting (blocking) the sensing field is not considered a lockout, so the Fault Output does not change state.

This feature is available only with 8-conductor models.

4.4.6 Scan Code Select

The 8-pin emitter and receiver may be configured to one of two Scan Codes (1 or 2). A receiver recognizes light only from an emitter with the same scan code.

- Select Scan Code 1 by connecting pin 8 (violet wire) to 0 V dc or leaving it open (not connected). Prevent unused wires from shorting to ground or to other sources of energy (for example, terminate with wire-nut).
- Select Scan Code 2 by connecting pin 8 (violet wire) to +24 V dc.

Both the emitter and its corresponding receiver must have the same setting. Standard 5-pin emitter or receiver models are always configured for Scan Code 1.

4.4.7 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 LS is ready for testing in combination with the guarded machine.

The operation of the EZ-SCREEN LS with the guarded machine must be verified before the combined System and machine may be put into service. To do this, a Qualified Person must perform the Commissioning Checkout Procedure described in [Commissioning Checkout](#) on page 63.

4.4.8 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 (can be used with only emitters and receivers with similar connectors, such as a pair with 8-pin quick disconnects or a pair with 5-pin quick disconnects.).

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

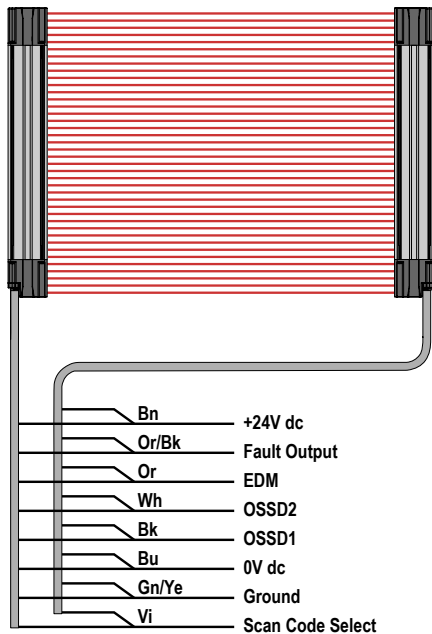


Figure 29. Individual cordsets

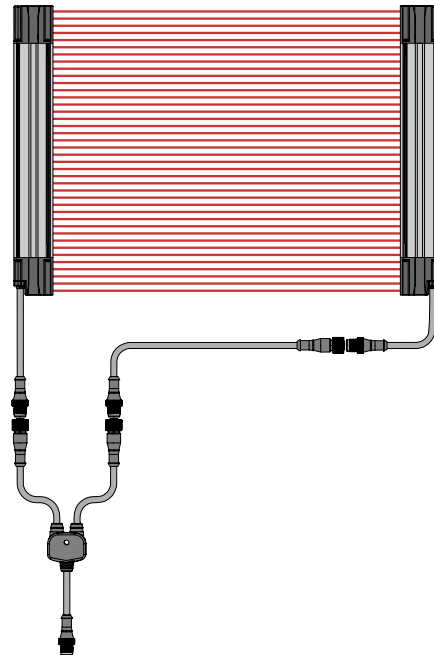


Figure 30. Splitter cordsets

4.5 Reference Wiring Diagrams

Other interfacing modules and solutions are available, see [Accessories](#) on page 77 and Banner Engineering website.



NOTE: For interfacing modules or remotely located safety I/O blocks where pin 5 of a 5-pin M12 QD is not earth ground, a 4-pin cordset where pin 5 is not physically present or is not electrically connected can be used (such as MQDEC-406SS double-ended cordset). In such situations, earth ground must be provided via the mounting brackets.

4.5.1 Generic Wiring Diagram—5-pin and 8-pin Emitter

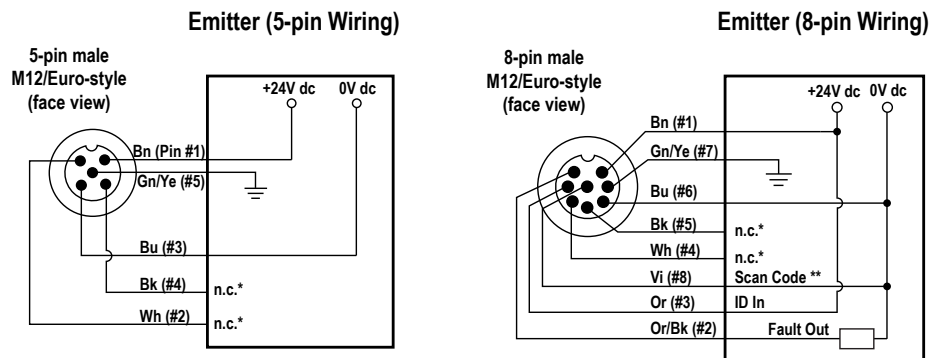


Figure 31. Generic Wiring Diagram—Emitter

* All pins shown as no connection (n.c.) are either not connected or are paralleled to same color wire from the receiver cable.

** Scan Code 1: not connected or connected to 0 V dc (as shown). Scan Code 2: connect to 24 V dc.

4.5.2 Generic Wiring Diagram—5-pin Receiver and UM-FA-..A Safety Module

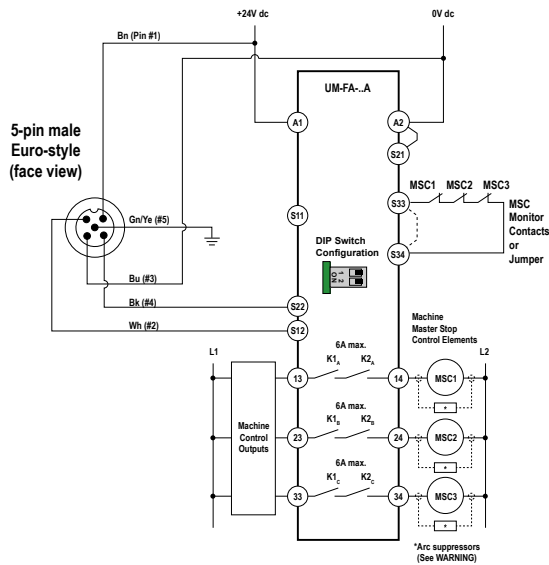


Figure 32. Generic Wiring Diagram - UM-FA-..A with Auto Reset

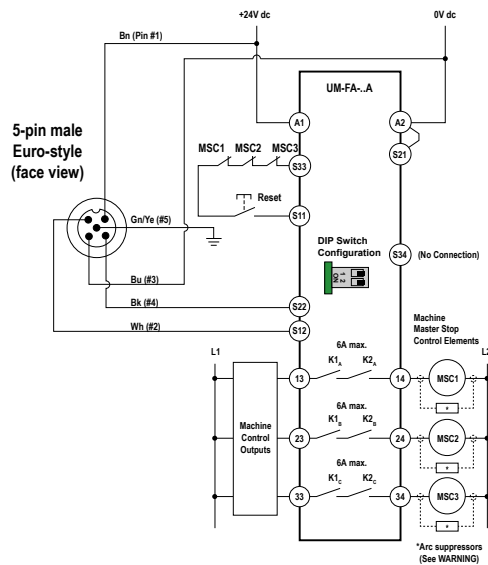


Figure 33. Generic Wiring Diagram - UM-FA-..A with Manual Reset



NOTE: See UM-FA-..A module datasheet (p/n 141249) for complete installation instructions.



WARNING: Wiring of Arc Suppressors

If arc suppressors are used, they MUST be installed as shown across the actuator coil of the stop control elements (MSCs or MPCEs). NEVER install suppressors directly across the output contacts of the Safety Device or Module. It is possible for suppressors to fail as a short circuit. If installed directly across the output contacts, a short-circuited suppressor creates an unsafe condition which may result in serious injury or death.

4.5.3 Generic Wiring Diagram—5-pin Receiver and Safety Module/Controller or Safety PLC/PES

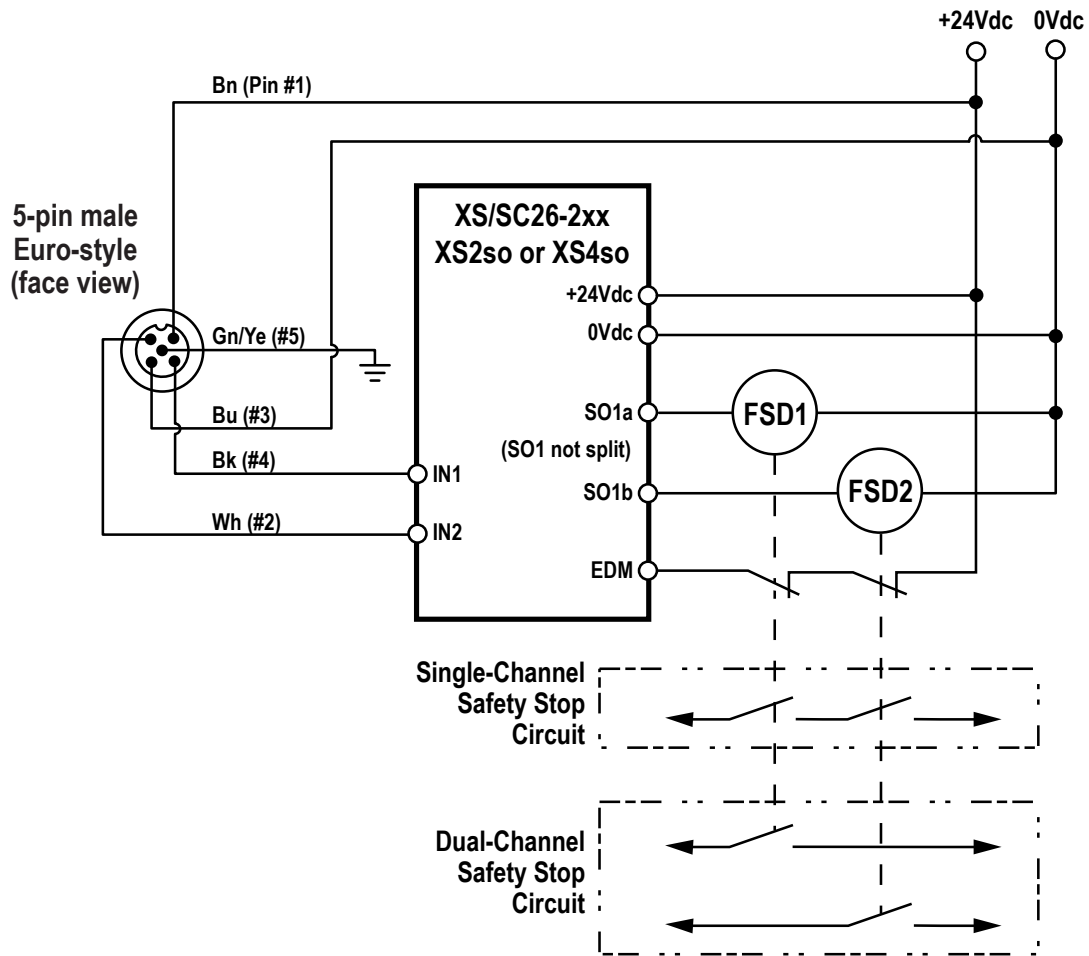


Figure 34. Generic Wiring Diagram—XS/SC26-2 Safety Controller



NOTE: See the XS/SC26-2.. instruction manual (p/n [174868](#)) for complete installation instructions.

4.5.4 Generic Wiring Diagram—8-pin Receiver and Redundant FSDs

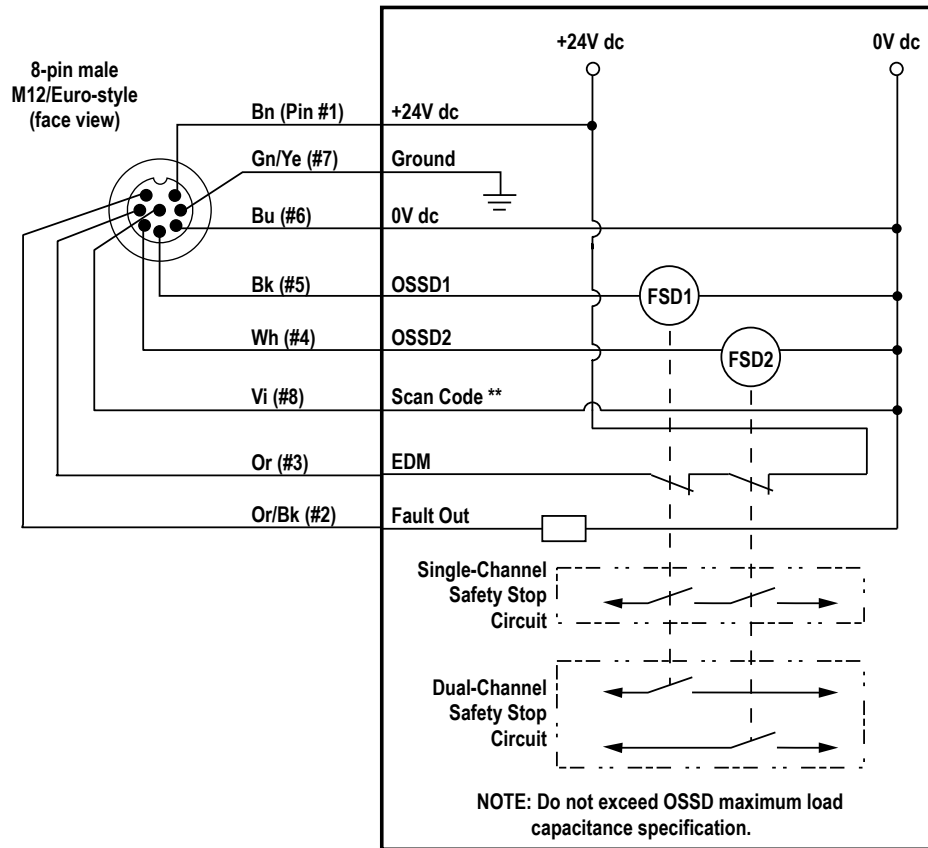


Figure 35. Generic Wiring Diagram—8-pin Receiver and Redundant FSDs

** Scan Code 1: not connected or connected to 0 V dc (as shown). Scan Code 2: connect to 24 V dc.

4.5.5 Generic Wiring Diagram—8-pin Receiver and IM-T-9A Interface Module

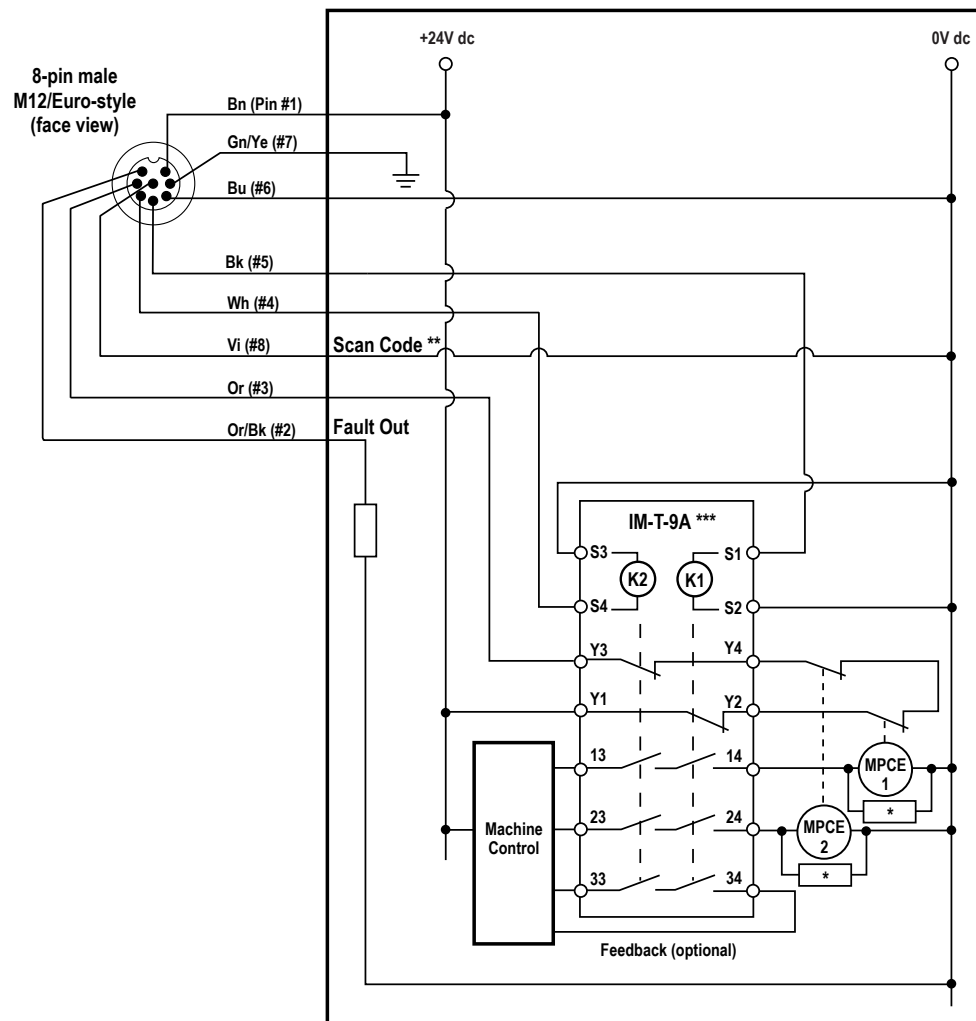


Figure 36. Generic Wiring Diagram—IM-T-9A Interface Module (1-Channel EDM)

* Installation of transient (arc) suppressors across the coils of MPCE1 and MPCE2 is recommended (see WARNING).

** Scan Code 1: not connected or connected to 0 V dc (as shown). Scan Code 2: connect to 24 V dc.

*** Other interfacing modules and solutions available. See the Banner Engineering catalog or website for more information.



NOTE: See the IM-T-...A module datasheet (p/n [62822](#)) for complete installation instructions.



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.

5 Cascadeable EZ-SCREEN LS

5.1 Overview of Cascading

EZ-SCREEN LS emitters and receivers are available in cascadeable models. These models can be used as stand-alone light screens, or can be cascaded up to four pairs in one system; see [Figure 37](#) on page 44. The cascaded sensor pairs can be any length, any number of beams, or have different resolutions (14 mm, 23 mm, and 40 mm), as long as each emitter matches its receiver.



NOTE: EZ-SCREEN SLL.. (stand-alone) or SLLC.. (cascadeable) models can be used as the end sensor pair. Other EZ-SCREEN components cannot be interfaced with the cascade input.

The control reliability, installation and alignment, electrical interface to the guarded machine, initial checkout, periodic checkout, troubleshooting and maintenance features of cascadeable models are functionally identical to those of the standard models.

Electrical connections are made via removable disconnect (RD) cordsets; see [Cordsets](#) on page 77. All receivers in a cascade activate the same set of OSSD outputs: the OSSDs of the master receiver.



NOTE: In a cascaded system, all receivers are connected together, and all emitters are connected together. Cascaded sensors are configured automatically.



WARNING: Scan Code

In situations where multiple systems are mounted closely together, or where a secondary emitter is in view (within $\pm 5^\circ$) and within range of an adjacent receiver, the adjacent systems must be configured for different Scan Codes (one system set for Scan Code 1 and the other for Scan Code 2). If not, a receiver may synchronize to the signal from the wrong emitter, reducing the safety function of the light screen. This situation is discovered by performing the trip test.

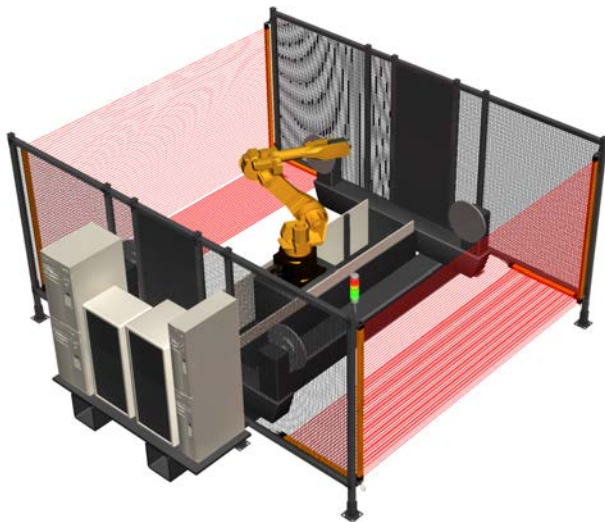


Figure 37. Light screens guarding a robotic cell



Figure 38. Cascaded light screens guarding a u-shaped cell

5.1.1 System Components and Specifications

A multiple-light screen cascaded EZ-SCREEN LS system includes compatible emitter/receiver pairs (up to four), a terminator plug (shipped installed on each cascade receiver) for the last receiver in the cascade, two RD cables or pigtail cables to interface with the machine and provide power to the system, and pairs of double-ended (sensor interface) cables to interconnect the emitters and the receivers in the cascade. (A “dummy” plug is installed at the cascade end of each emitter. It is not required for operation, but maintains the emitter’s IP67 rating.) Additional cordsets may be used to enable quick disconnect (QD) connections; see [Cordsets](#) on page 77.

The terminator plug (model EZLSA-RTP-1) must be used on the receiver in a stand-alone system, and on the last receiver in a multiple-pair cascade, unless an EZA-RBK-1 key switch for remote teach fixed blanking, an RDLS-8..D cordset interfaced with an E-stop or other hard contacts is in place (see [Emergency Stop Buttons in Cascaded Systems](#) on page 48, [Interlock Switches in Cascaded Systems](#) on page 50), or an EZLSA-K30LGR EZ-LIGHT or DELSEF-xxE cordset with a remotely located EZ-LIGHT or indicator.



NOTE: The machine interface cable must connect to the sensor end adjacent to the status indicators.

Available single-ended, double-ended, and splitter cordsets are listed in [Cordsets](#) on page 77. Cordset lengths are limited – for both the machine interface/power cables and the sensor interconnect cables; see [Determining Interconnect Cordset Lengths](#) on page 45 for more information.

5.1.2 Receiver Display

In Run mode, the 7-segment display shows the following. See [Receiver Error Codes](#) on page 58 if any indication is flashing.

Condition	Display
Clear	
Trip output operation	
Blocked	Number of blocked beams (sequential)
CSSI Input Off or open, for example, “upstream” receiver is blocked or in lockout	Solid (not flashing)

5.2 Determining Interconnect Cordset Lengths

The following cordset length charts are possible combinations for each side of example cascaded systems. Model DELS-11...E cordsets are used for calculations. Other lengths and combinations are possible; call Banner Engineering for assistance.



Figure 39. Cascade Cordset Connection

As the machine interface cordset lengthens, the voltage available at the first (master) sensor pair decreases, which results in shorter possible interconnect cordsets to maintain supply voltage requirements at last cascaded sensor.

Table 5: Maximum machine interface cable length versus total load current (OSSDs)

Maximum Machine Interface Cordset Length					
EZ-SCREEN LS Receivers in Cascade	Total Load Current (OSSD 1 + OSSD 2)				
	0.1 A	0.25 A	0.5 A	0.75 A	1.0 A
1	95.7 m (314 ft)	78 m (256 ft)	54.9 m (180 ft)	42.1 m (138 ft)	34.1 m (112 ft)
2 ⁸	45.7 m (150 ft)	38.1 m (125 ft)	28.9 m (98 ft)	24.7 m (81 ft)	20.7 m (68 ft)
3 ⁹	25.3 m (83 ft)	22.3 m (73 ft)	18.6 m (61 ft)	15.8 m (52 ft)	13.7 m (45 ft)
4 ¹⁰	20.1 m (66 ft)	18.3 m (60 ft)	15.5 m (51 ft)	13.7 m (45 ft)	12.2 m (40 ft)



NOTE: Emitter and receiver power (current) requirements are accounted for. The above values represent additional current draw that must be accounted for because of the load current.



NOTE: Maximum cordset lengths are intended to ensure that adequate power is available to the EZ-SCREEN LS when the supply is operating at +20 V dc. Values in the previous table are worse case. Contact banner Engineering if there are any questions.



NOTE: The length of Emitter machine interface cordsets can be two times longer than those listed for the receiver in the table above if a CSB Splitter cordset is not used. If a CSB Splitter cordset is used, connect one branch of the CSB splitter to the receiver and other branch to the emitter via DEE2R double-ended cordset up to the same length listed in the table above.

Of the standard DELS-11..E interconnect cordsets, all cascade installations (2, 3, or 4 pairs) can use up to a 15.3 m (50.2 ft) DELS-1150E cordset to connect the sensor pairs (L2, L3, and L4), except for the following situations (refer to the following table).

Because of the large number of possible combinations, the table for four cascaded light screens cordset options includes only applications in which L2 = L4. A common installation is one that protects two areas of a machine, for example, the front and back of a power press, and uses four EZ-SCREEN LS pairs to create two L-shaped sensing fields.

Table 6: Maximum DELS-11..E Cascade Interconnection Cordset Lengths

	Machine Interface Cordset Length L1	Total Load Current (OSSD1 + OSSD2)									
		0.1 A		0.25 A		0.5 A		0.75 A		1.0 A	
		L2	L3	L2	L3	L2	L3	L2	L3	L2	L3
3 pairs	15.3 m (50.2 ft)	15.3 m (50.2 ft)	15.3 m (50.2 ft)	15.3 m (50.2 ft)	8 m (26.2 ft)	15.3 m (50.2 ft)	8 m (26.2 ft)	8 m (26.2 ft)	8 m (26.2 ft)	N/A	N/A
		15.3 m (50.2 ft)	15.3 m (50.2 ft)	8 m (26.2 ft)	15.3 m (50.2 ft)	8 m (26.2 ft)	15.3 m (50.2 ft)	8 m (26.2 ft)	15.3 m (50.2 ft)	N/A	N/A
		L2/L4	L3	L2/L4	L3	L2/L4	L3	L2/L4	L3	L2/L4	L3
4 pairs	15.3 m (50.2 ft)	0.3 m (1 ft)	8 m (26.2 ft)	0.3 m (1 ft)	8 m (26.2 ft)	0.3 m (1 ft)	8 m (26.2 ft)	N/A	N/A	N/A	N/A

⁸ Assumes a 50 ft L2 cascade cable.

⁹ Assumes 26.2 ft L2 and L3 cascade cables.

¹⁰ Assumes L2 and L4 are 1 ft and L3 is 50 ft.

Cordset example for two cascaded light screens

Machine Interface Cordset (L1): 15.3 m (50.2 ft) QDE-850D cordset

Sensor Interconnect Cordset (L2): 15.3 m (50.2 ft) DELS-1150E cordset or shorter

Cordset example for three cascaded light screens at 0.5 A OSSD load current

Machine Interface Cordset (L1): 15.3 m (50.2 ft) QDE-850D cordset

Sensor Interconnect Cordset (L2): 15.3 m (50.2 ft) DELS-1150E cordset or shorter

Sensor Interconnect Cordset (L3): 8 m (26.2 ft) DELS-1125E cordset or shorter

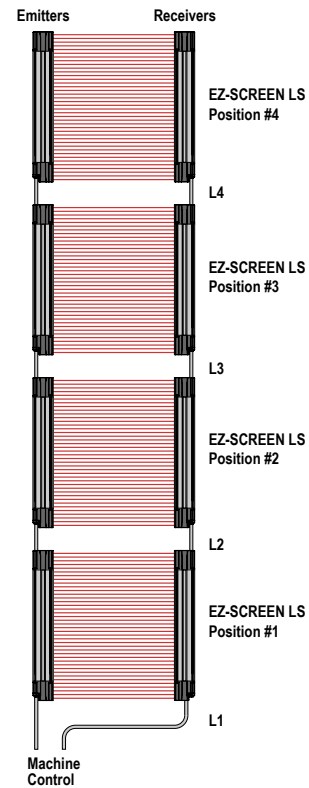
Cordset example for four cascaded light screens at 0.5 A OSSD load current

Machine Interface Cordset (L1): 15.3 m (50.2 ft) QDE-850D cordset

Sensor Interconnect Cordset (L2): 0.3 m (1 ft) DELS-111E cordset

Sensor Interconnect Cordset (L3): 8 m (26.2 ft) DELS-1125E cordset or shorter

Sensor Interconnect Cordset (L4): 0.3 m (1 ft) DELS-111E cordset



5.3 Response Time for Cascaded Light Screens

Response time is an important factor in determining a light screen's safety distance (minimum distance). For cascaded EZ-SCREEN LS systems, that response time is dependent on the number of light screens, the number of beams in the light screens, and their positions in the cascade. It can be calculated easily, in two ways:

- Based on the worst-case time for the entire cascade (where all light screens in the cascade have the same safety distance)
- Individually for each light screen in the cascade (safety distance is calculated for each light screen in the cascade)



WARNING: Improper Installation

Failure to follow the installation guidelines and procedures may result in the ineffective or non-operation of the Banner device that could create an unsafe condition resulting in serious injury or death.

5.3.1 Determining System Response Time

If the safety distance does not need to be optimized (at a minimum), simply add 6 ms to the response time of the receiver with the longest response time $Tr_{(max)}$ (greatest number of beams), and use that number as the overall cascade system response time.

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

where

$$Tr = Tr_{(max)} + 6 \text{ ms}$$

The 6 ms adder increases safety distance (Ds) a total of 10 mm (0.4 in) when using 1600 mm/s for the hand speed constant K (see [Calculating the Safety Distance \(Minimum Distance\)](#) on page 13).

5.3.2 Individual Response Time and Safety (Minimum) Distance

When calculating individual safety distance for each emitter/receiver pair, the pair's position in the cascade affects its response time, which then affects its safety distance (see safety distance formulas in [Calculating the Safety Distance \(Minimum Distance\)](#) on page 13). The individual method results in an optimized safety distance for each light screen in the cascade, while ensuring that each sensor pair is located at an adequate distance from the hazard.

The response time depends on how far the light screen is from the machine control. Each light screen position in the cascade, starting from the first light screen in the cascade that is connected to the machine control, increases the light screen's response time by 2 ms. To calculate response time (Tr) for individual placement of each emitter/receiver pair in the cascaded system, use the following formulas:

Position #1: $Tr_{(cascade1)} = Tr$

Position #2: $Tr_{(cascade2)} = Tr + 2 \text{ ms}$

Position #3: $Tr_{(cascade3)} = Tr + 4 \text{ ms}$

Position #4: $Tr_{(cascade4)} = Tr + 6 \text{ ms}$

5.3.3 CSSI Response Time

When contacts (such as an E-stop button) are connected to the CSSI cascaded receiver input, the CSSI response time is 40 ms plus 2 ms for each additional light screen (slave pairs).

This is an example of a four sensor pair, cascade system with the individual response times calculated for each of the sensor pairs. Light screens of other lengths/resolutions will have different response times.

The 23 mm resolution, 560 mm EZ-SCREEN LS emitter/receiver pairs each begin with a response time of 11.6 ms. The pair in position #1 (connected directly to the machine control), maintains its 11.6 ms response time. Response time for the second pair in the cascade circuit increases by 2 ms, to 13.6 ms; for the third pair by 4 ms, to 15.6 ms, and for the fourth pair by 6 ms, to 17.6 ms.

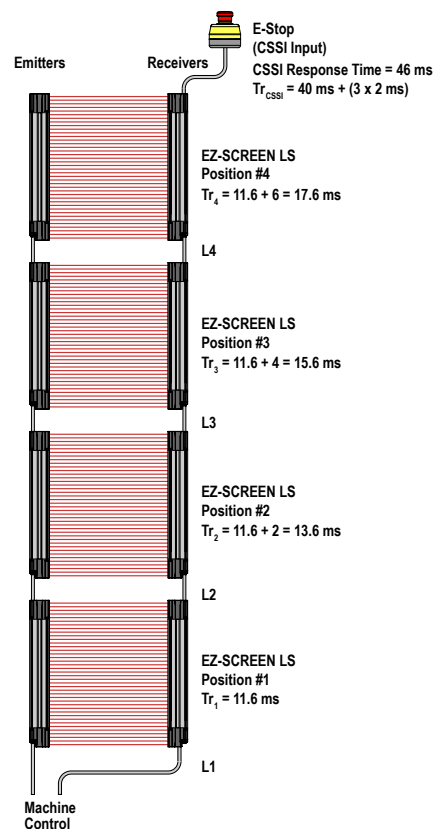



Figure 40. Individual Response Time Calculation Example

5.4 Emergency Stop Buttons in Cascaded Systems

Cascadeable EZ-SCREEN LS receivers may be connected to one or more E-stop buttons. The button(s) must connect to the end of the last receiver in the cascade, in place of the terminator plug. The connected E-stop button(s) will activate/deactivate the OSSD outputs in all receivers in the cascade.

The number of E-stop buttons allowed in a series connection is limited by the total resistance per channel. The total resistance is the sum of all contact resistance values in the channel, plus the total wire resistance in the channel. The maximum total resistance per channel is 100 Ω .

The CSSI input is a two-channel (4-wire) input such that the redundant channels must be in the same state (either open or closed). The CSSI input can be connected to hard/relay contacts per requirements. The simultaneity between the two

contacts, on opening and closing, is 3 seconds. If simultaneity is not met, the last receiver's display will flash . If simultaneity is not met, to clear the fault condition, close both inputs (rear E-stop button), wait 3 seconds, and open both channels within 3 seconds, then both contacts can be closed again.



WARNING: Emergency Stop Functions

Do not mute or bypass any Emergency Stop device. ANSI B11.19, ANSI NFPA79 and IEC/EN 60204-1 require that the Emergency Stop function remain active at all times.

5.4.1 E-Stop Switch Requirements (Positive-Opening)

As shown in [Figure 41](#) on page 50, the E-stop switch must provide two contact pairs, which are closed when the switch is in the armed position. Once activated, the E-stop switch must open its contacts and return to the closed-contact position only after deliberate action (such as twisting, pulling, or unlocking). The switch should be a positive-opening type, as described by IEC947-5-1. A mechanical force applied to such a button (or switch) is transmitted directly to the contacts, forcing them open. This ensures that the switch contacts will open whenever the switch is activated. ANSI/NFPA 79 specifies the following additional requirements:

- Emergency Stop push buttons shall be located at each operator control station and at other operating stations where emergency shutdown shall be required
- Stop and Emergency Stop push buttons shall be continuously operable from all control and operating stations where located
- Actuators of Emergency Stop devices shall be colored Red. The background immediately around the device actuator shall be colored Yellow. The actuator of a push-button-operated device shall be of the palm or mushroom-head type
- The Emergency Stop actuator shall be a self-latching type



NOTE: Some applications may have additional requirements. The user must comply with all relevant regulations.



WARNING: Multiple Emergency Stop Switches

When two or more E-stop switches are connected to the same EZ-SCREEN LS receiver, the contacts of the E-stop switches must be connected together in series. This series combination is then wired to the respective EZ-SCREEN LS receiver input.

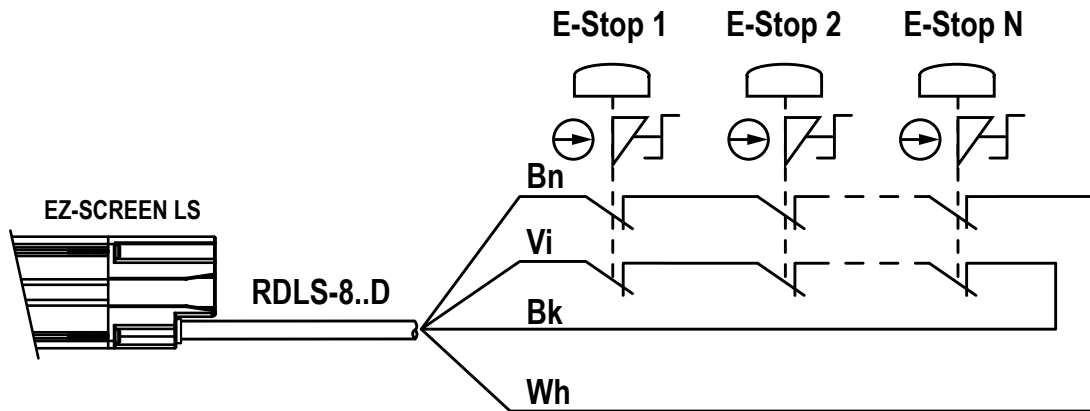
Do not connect the contacts of multiple E-stop switches in parallel to the EZ-SCREEN LS inputs; this defeats the switch contact monitoring ability of the EZ-SCREEN LS light curtain, and creates an unsafe condition which could result in serious bodily injury or death.

In addition, when two or more E-stop switches are used, each switch must be individually actuated (engaged), then re-armed and reset the machine's safety-related control system. This allows the monitoring circuits to check each switch and its wiring to detect faults. Failure to test each switch individually in this manner could result in undetected faults and create an unsafe condition which could result in serious bodily injury or death.



WARNING: Reset Routine Required

U.S. and international standards require that a reset routine be performed after clearing the cause of a stop condition (for example, arming an E-stop button, closing an interlocked guard, etc.). Allowing the machine to restart without actuating the normal start command/device can create an unsafe condition which may result in serious injury or death.



RDLS-8..D Pinout	
Brown	Ch1a
Orn/Blk	n.c.
Orange	n.c.
White	Ch1b
Black	Ch2b
Blue	n.c.
Gn/Ye	n.c.
Violet	Ch2a


Take precautions to prevent unused wires from shorting to ground or to other sources of energy (for example, terminate with wire-nut).

Figure 41. Connecting of E-stop buttons to the last receiver in the cascade

5.5 Interlock Switches in Cascaded Systems

The Cascade input may be used to monitor interlock safety gates or guards. Requirements vary widely for the level of control reliability or safety category (per ISO 13849-1) in the application of interlocked guards. While Banner Engineering recommends the highest level of safety in any application, the user is responsible to safely install, operate, and maintain each safety system, and comply with all relevant laws and regulations. Of the following applications, [Figure 42](#) on page 52 meets or exceeds the requirements for OSHA/ANSI control reliability and Safety Category 4, per ISO 13849-1.

The CSSI input is a two-channel (4-wire) input such that the redundant channels must be in the same state (either open or closed). The CSSI input can be connected to hard/relay contacts per requirements. The simultaneity between the two

contacts, on opening and closing, is 3 seconds. If simultaneity is not met, the last receiver's display will flash . If simultaneity is not met, to clear the fault condition, close both inputs (rearm E-stop button), wait 3 seconds, and open both channels within 3 seconds, then both contacts can be closed again.



WARNING: Safety Distances and Safe Openings

It must not be possible for personnel to reach any hazard through an opened guard or by reaching over, under, around, or through any opening in the guard before the hazardous situation has ceased. See ANSI B11.19 or ISO 14119, ISO 14120 and ISO 13857 for information on determining safety distances and safe opening sizes for your guarding device.

5.5.1 Interlock Guarding Requirements

The following general requirements and considerations apply to the installation of interlocked gates and guards for the purpose of safeguarding. Refer to the relevant regulations to be sure to comply with all necessary requirements.

Hazards guarded by the interlocked guard must be prevented from operating until the guard is closed. A Stop command must be issued to the guarded machine if the guard opens while the hazard is present. Closing the guard must not, by itself, initiate hazardous motion; a separate procedure must be required to initiate the motion. The safety switches must not be used as a mechanical or end-of-travel stop.

The guard must be located at an adequate distance from the danger zone (so the hazard has time to stop before the guard is opened sufficiently to provide access to the hazard), and it must open either laterally or away from the hazard, not into the safeguarded area. Depending on the application, an interlocked gate or door should not be able to close by itself and activate the interlocking circuitry. In addition, the installation must prevent personnel from reaching over, under, around, or through the guard to the hazard. Any openings in the guard must not allow access to the hazard (see ANSI B11.19 or the appropriate standard). The guard must be strong enough and designed to protect personnel and contain hazards within the guarded area, which may be ejected, dropped, or emitted by the machine.

The safety switches and actuators used with the cascaded system must be designed and installed so that they cannot be easily defeated. They must be mounted securely, so that their physical position cannot shift, using reliable fasteners that require a tool to remove. Mounting slots in the housings are for initial adjustment only; final mounting holes must be used for permanent location.

5.5.2 Positive-Opening Interlocking Safety Switches

Two individually mounted safety interlock switches are recommended for each guard to meet Category 4, per ISO 13849-1, and must satisfy several requirements. Each switch must provide at minimum, one normally closed (N.C.) electrically isolated contact to interface with the Cascade input ([Figure 42](#) on page 52).

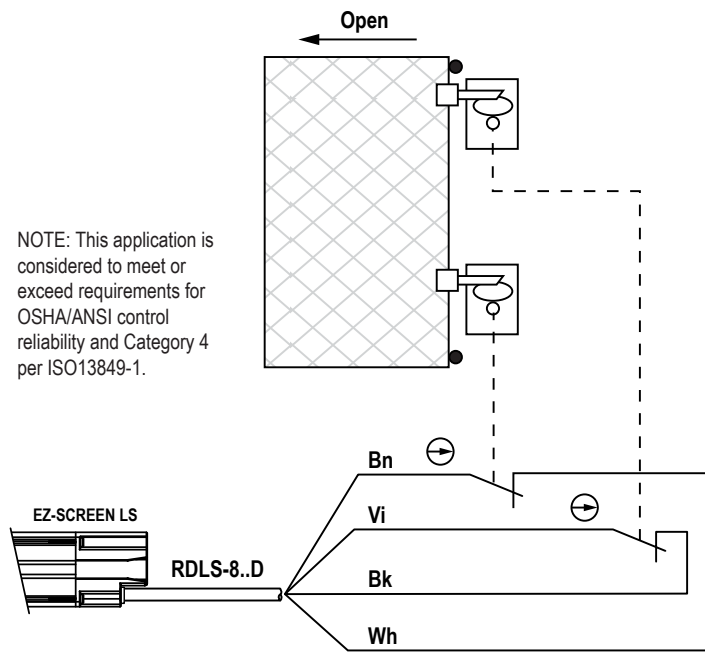
The contacts must be of positive-opening design, with one or more normally closed contacts rated for safety. Positive-opening operation causes the switch to be forced open, without the use of springs, when the switch actuator is disengaged or moved from its home position. In addition, the switches must be mounted in a positive state to move/disengage the actuator from its home position and open the normally closed contact when the guard opens.

Series-connected, positive-opening interlock switch circuits do not meet ISO 13849-1 Category 4 and may not meet Control Reliability requirements because of the potential of an inappropriate reset or a potential loss of the safety stop signal. A multiple connection of this type should not be used in applications where loss of the safety stop signal or an inappropriate reset could lead to serious injury or death.



WARNING: Series Connection of Safety Switches

Monitoring multiple guards with a series connection of safety interlock switches may result in a failure being masked or not detected at all. When such a configuration is used, periodic checks must be performed regularly to verify proper operation. All failures must be immediately corrected (for example, immediately replacing a failed switch), or the loss of the safety stop signal or an inappropriate reset may lead to serious injury or death.



RDLS-8..D Pinout	
Brown	Ch1a
Orn/Blk	n.c.
Orange	n.c.
White	Ch1b
Black	Ch2b
Blue	n.c.
Gn/Ye	n.c.
Violet	Ch2a

Take precautions to prevent unused wires from shorting to ground or to other sources of energy (for example, terminate with wire-nut).

Figure 42. Monitoring two positive-opening safety switches

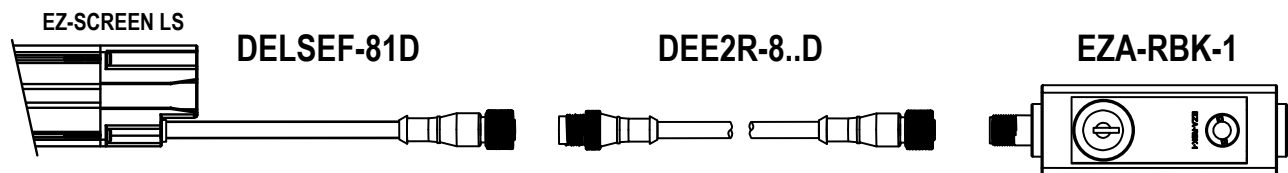
5.6 Remote TEACH Fixed Blanking (Wiring)

See [Programming Key Switch Location](#) on page 31 for complete instructions.

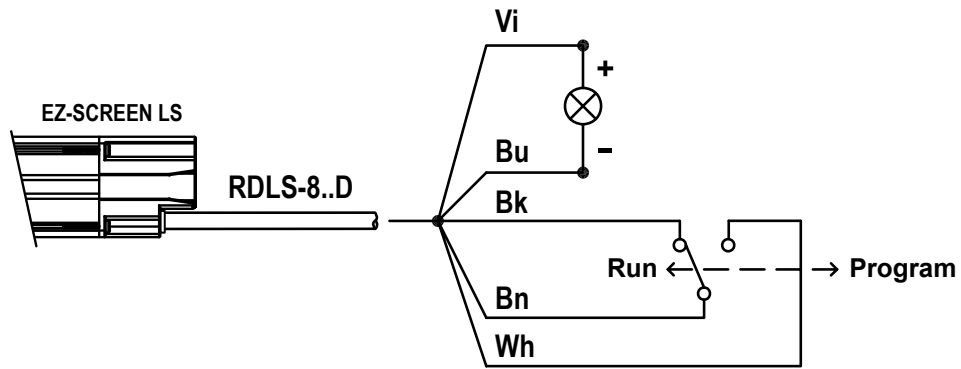
A key-actuated switch provides some supervisory control since the key can be removed from the switch. The Programming Key Switch must be located:

- Located outside the guarded area,
- Located to allow the switch operator full unobstructed view of the entire defined area, and
- Protected against unauthorized or inadvertent operation.

DELSEF-81D Wiring. RD-to-M12 QD double-ended 300 mm (1') cordset in combination with EZA-RBK-1 Remote Blanking Key Switch, and DEE2R-8..D Doubled-ended cordsets to extend the position.



RDLS-8..D Wiring. RD-to-flying lead cordset can be used to directly wire to a SPDT (form C) switch and a separate indication device. Take precautions to prevent unused wires from shorting to ground or to other sources of energy (for example, terminate with wire-nut).



6 System Operation

6.1 Security Protocol

Certain procedures for installing, maintaining, and operating the EZ-SCREEN LS 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 LS. 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 LS 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:

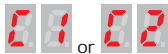

- Install the EZ-SCREEN LS System
- Perform all checkout procedures
- Make changes to the internal configuration settings
- Reset the System following a Lockout condition

6.2 Status Indicators

6.2.1 Emitter

A single bi-color Red/Green Status indicator shows whether power is applied, and whether the emitter is in a Run mode or a Lockout. A Diagnostic Display indicates a specific error code when the emitter is in Lockout; the display also momentarily indicates the scan code setting at power-up or when changed.

Table 7: Emitter Status Indicator Operation


Operating Status	Status Indicator	7-Segment Diagnostic Display
Power-up	Red Single Flash	Scan code flashes 3 times - sequentially 
Run Mode	Green	
Lockout	Flashing Red	Displays error code (see Lockout Conditions on page 58)

6.2.2 Receiver

A single bi-color red/green Status indicator shows when the OSSD outputs are On (green) or Off (red), blanking is enabled (flashing green), or the System is in Lockout status (flashing red). An amber status indicator shows when the system is in Run mode. The Diagnostic Display indicates the receiver's trip (–) configuration and displays a specific error code when the receiver is in Lockout. The Diagnostic Display also momentarily indicates the scan code setting at power-up or when changed.

Along the length of the exit window are located bi-color red/green Alignment indicators that show whether a section of the defined area (± 35 mm of indicator) is aligned and clear, blocked and/or misaligned, or has been fixed blanked.

Receiver Status Indicator Operation - Trip Output

Operating Mode	Run Mode Indicator	Status Indicator	Alignment Indicators ¹¹	7-Segment Diagnostic Display	OSSD Outputs
Power-up	Off	Single-Flash Red	All Single-Flash Red	Scan code flashes 3 times - sequentially 	Off

¹¹ If beam 1 is blocked, Alignment indicators will be Off, because beam 1 provides the synchronization signal for all the beams.

Operating Mode	Run Mode Indicator	Status Indicator	Alignment Indicators ¹¹	7-Segment Diagnostic Display	OSSD Outputs
Alignment Mode - Beam 1 Blocked	Off	Red	Alignment 1 Red, Others Off		Off
Alignment Mode - Beam 1 Clear	On	Red	Red or Green	Total number of blocked beams	Off
Run Mode - Clear	On	Solid Green or Flashing Green (Blanking)	All On Green		On
Run Mode - Blocked	On	Red	Red or Green	Total number of blocked beams	Off
Lockout	Off	Flashing Red	All Off	Displays error code (see Lockout Conditions on page 58)	Off



NOTE: If both the emitter and its corresponding receiver do not have the same scan code setting, the receiver indicates that Beam 1 is blocked (the Diagnostic display indicating "C" "H" "1" as shown above). This can occur if the Scan Code input is not wired the same for both sensors or if the EDM circuit has not been re-wired for one-channel monitoring in retrofit installations of two-channel EDM applications, see warning in [External Device Monitoring Hookup](#) on page 37.

Status Indicators for Cascaded Applications

When multiple light screens are cascaded, some unique indications may occur, as indicated in [Table 8](#) on page 55, [Table 9](#) on page 55 and [Figure 43](#) on page 56.

Table 8: Receiver #1

Condition	OSSDs	Display	Run Mode Indicator	Status Indicator
Clear	On		On	Green
CSSI Stop (Receiver #2, 3, or 4 is open)	Off		On	Red

Table 9: Receiver #2, 3, or 4 (Configured for Trip Operation)

Condition	OSSDs	Display	Run Mode Indicator	Status Indicator
Clear	On		On	Green
Blocked	Off	# of beams blocked	On	Red
CSSI Stop (Receiver upstream is blocked)	Off		On	Red
Cleared	On		On	Green

¹¹ If beam 1 is blocked, Alignment indicators will be Off, because beam 1 provides the synchronization signal for all the beams.

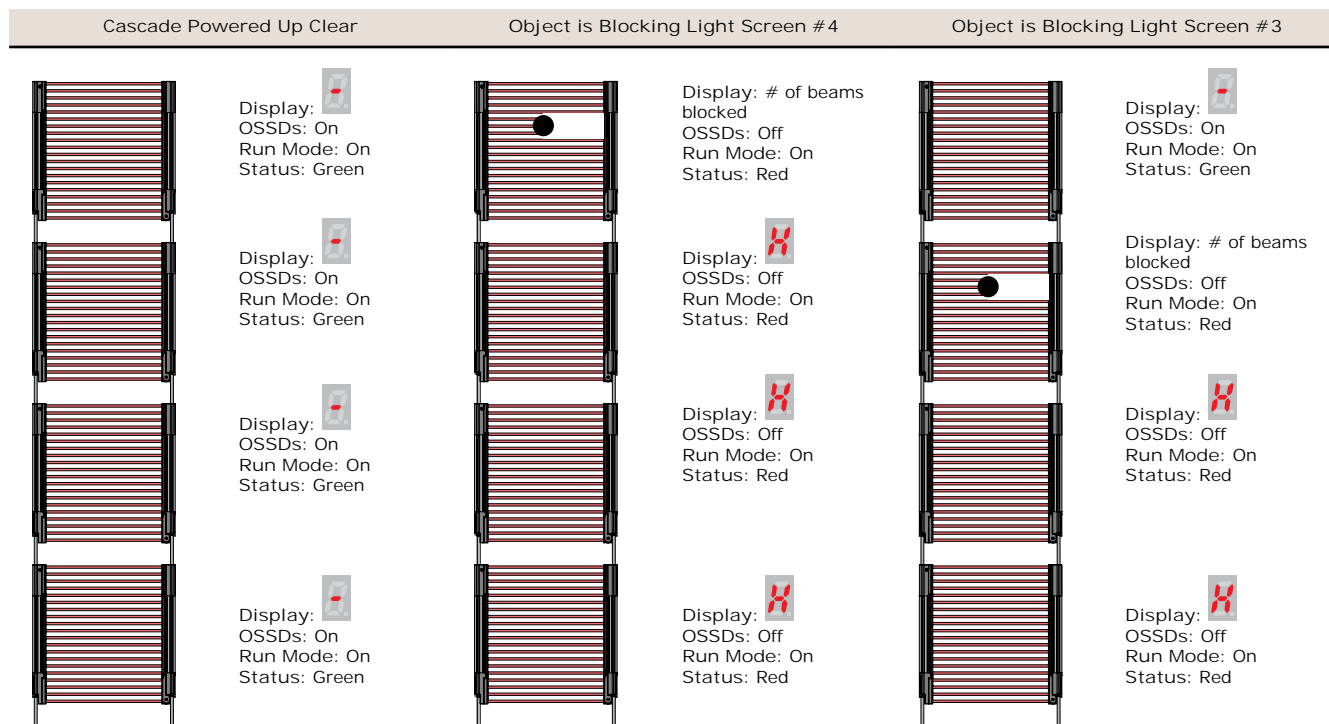


Figure 43. Cascade Indicator Status Conditions

6.3 Normal Operation

6.3.1 System Power-Up

When power is applied, each sensor conducts self-tests to detect critical internal faults, determine configuration settings, and prepare the EZ-SCREEN LS for operation. If either sensor detects a critical fault, scanning ceases, the receiver outputs remain Off and diagnostic information displays on the sensor's Diagnostic Display. If no faults are detected, the EZ-SCREEN LS automatically enters Alignment mode, and the receiver looks for an optical sync pattern from the emitter. If the receiver is aligned and receives 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.

6.3.2 Run Mode

If any beams become blocked while the EZ-SCREEN LS is running, the receiver outputs turn Off within the stated EZ-SCREEN LS response time (see [Specifications](#) on page 65). If all the beams then become clear, the receiver outputs come back On. No resets are needed. All required machine control resets are provided by the machine control circuit.

Internal Faults (Lockouts): If either sensor detects a critical fault, scanning ceases, the receiver outputs turn Off and diagnostic information displays on the sensor's Diagnostic Display. See [Lockout Conditions](#) on page 58 for resolution of error/fault conditions.

6.4 Periodic Checkout Requirements

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

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

Semi-annually, the System and its interface to the guarded machine should be thoroughly checked out; this checkout must be performed by a Qualified Person (see [Checkout Procedures](#) on page 63). A copy of these test results should be posted on or near the machine.

Whenever changes are made to the System (either a new configuration of the EZ-SCREEN LS System or changes to the machine), the Commissioning Checkout should be performed (see [Commissioning Checkout](#) on page 63).

**NOTE: Verify Proper Operation**

The EZ-SCREEN LS can operate as it is designed only if it and the guarded machine are operating properly, both separately and together. It is the user's responsibility to verify this, on a regular basis, as instructed in [Checkout Procedures](#) on page 63. Failure to correct such problems can result in an increased risk of harm.

Before the System is put back into service, verify that the EZ-SCREEN LS System and the guarded machine perform exactly as outlined in the checkout procedures and any problem(s) are found and corrected.

7 Troubleshooting and Maintenance

7.1 Lockout Conditions

A Lockout condition causes all of the EZ-SCREEN LS OSSD outputs to turn or remain Off, sending a stop signal to the guarded machine. Each sensor provides diagnostic error codes to assist in the identification of the cause(s) of lockouts (see *Receiver Error Codes* and *Emitter Error Codes*).

The following tables indicate a sensor lockout condition:

Table 10: Receiver Lockout Conditions

Run mode indicator	Off
Status indicator	Flashing Red
Alignment indicators	Off
Diagnostic display	Error code (flashing)

Table 11: Emitter Lockout Conditions

Status indicator	Flashing Red
Diagnostic Display	Error code (flashing)

7.2 Recovery Procedures

To recover from a Lockout condition, correct all errors, power the sensor down, wait a few seconds, and then power the sensor back up.



WARNING: Lockouts and Power Failures


Power failures and Lockout conditions are indication of a problem and must be investigated immediately by a Qualified Person¹². Attempts to continue to operate machinery by bypassing the Banner device or other safeguards is dangerous and may result in serious bodily injury or death.



WARNING: Shut Down Machinery Before Servicing








The machinery to which the Banner device 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 Banner device while the hazardous machinery is operational may result in serious bodily injury or death.

7.2.1 Receiver Error Codes



Diagnostic Display ¹³	Error Description	Cause of Error and Appropriate Action
	Output Error Error is caused by: <ul style="list-style-type: none"> one or both outputs being shorted to a power supply (high or low) by shorting OSSD 1 to OSSD 2 by an overload (greater than 0.5 A) 	<ul style="list-style-type: none"> Disconnect the OSSD loads and cycle power to the receiver. If the error clears, the problem is in the OSSD load(s) or in the load wiring. If the error continues with no load connected, replace the receiver.

¹² 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.



¹³ Multiple-digit codes are sequential, followed by a pause.

Diagnostic Display ¹³	Error Description	Cause of Error and Appropriate Action
	<p>Receiver Error</p> <p>This error can occur due to either excessive electrical noise or an internal failure.</p> <p>This error can also occur when the remote fixed blanking RUN/PROGRAM switch is in the PROGRAM position during power-up.</p>	<ul style="list-style-type: none"> • Cycle power, Recovery Procedures on page 58. • If the error clears, perform a Daily Checkout procedure (per EZ-SCREEN Checkout Procedures: Shift and Daily Checkout Procedure; Daily Checkout Card) and if the System checks out, resume operation. If the System fails the Daily Checkout procedure, replace the receiver. • If the error continues, check the ground connection (pin 7). • If the sensor has a good earth ground connection to pin 7, perform the Initial Checkout procedure (per Initial Checkout Procedure on page 28). • If the error clears, check the external connections and configuration settings. • If remote fixed blanking is used, ensure RUN/PROGRAM is in the RUN position and cycle power. • If the error continues, replace the receiver.
	<p>Receiver Error</p> <p>This error can be caused by intermittent connections between cascaded receivers or excessive electrical noise.</p>	<ul style="list-style-type: none"> • Verify the cordset connections between the cascaded receivers. • If the error continues, replace the cordset(s). • If the error still continues, replace the receiver with the error code.
	<p>EDM Error</p> <p>This error can occur when the EDM input is open at power up or if the signal fails to respond within 250 ms of the OSSDs changing state (On to Off).</p>	<ul style="list-style-type: none"> • Verify that the EDM wiring is correct and that the external devices meet the requirements described in Machine Primary Control Elements and EDM Input on page 37 • If the error continues, remove power to the guarded machine, disconnect the OSSD loads, disconnect the EDM input signals, configure EDM for No Monitoring (per Machine Primary Control Elements and EDM Input on page 37) and conduct the Initial Checkout procedure • If the error clears, the problem is in the External Device contacts or wiring, or is a response-time problem of the external devices. Verify that the EDM wiring is correct and that the external devices meet the requirements described in Machine Primary Control Elements and EDM Input on page 37 • If the error continues, check for noise on the EDM inputs (see Electrical and Optical Noise on page 61)
	<p>Fixed Blanking Error</p> <p>This error occurs when beam(s) that have been blanked (programmed to ignore a fixed object) become clear when the object is removed or moved.</p>	<ul style="list-style-type: none"> • Reposition the object and cycle power. • Re-program (teach) the fixed blanked object(s), see Remote Fixed Blanking Programming Procedures on page 32.
	<p>Programming Timeout Error</p> <p>This error occurs when the Fixed Blanking programming mode (teach) exceeds the ten-minute limit.</p>	<ul style="list-style-type: none"> • Re-program (teach) the fixed blanked object(s), see Remote Fixed Blanking Programming Procedures on page 32.
	<p>Cascade Error</p> <p>This error occurs when a cascade receiver is not terminated properly or if the EDM wiring to a cascade receiver is not terminated properly.</p>	<ul style="list-style-type: none"> • Verify that the last receiver in the cascade is terminated properly (see Cascadeable EZ-SCREEN LS on page 44). • Verify that the EDM wiring is correct. • Verify the cordset connections between cascaded receivers. • If the error continues, replace the receiver. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p> NOTE: In a cascaded System, all receivers are connected together, and all emitters are connected together.</p> </div>

¹³ Multiple-digit codes are sequential, followed by a pause.

Diagnostic Display ¹³	Error Description	Cause of Error and Appropriate Action
	<p>Excessive Noise Error – Cascade Input</p> <p>This error can occur due to excessive levels of electrical noise.</p>	<ul style="list-style-type: none"> • Cycle power (see Recovery Procedures on page 58). • If the error clears, perform the daily checkout procedure (per EZ-SCREEN Checkout Procedures: Shift and Daily Checkout Procedure; Daily Checkout Card) and if the System checks out, resume operation. If the System fails the Daily Checkout procedure, replace the receiver. • If the error continues, check the ground connection (pin 7). • If the sensor has a good earth ground connection to pin 7, perform the Initial Checkout procedure (Trip Test on page 34). • If the error clears, check for sources of electrical noise (see Electrical and Optical Noise on page 61). • If the error continues, replace the receiver.
	<p>Cascade Input Simultaneity</p> <p>Flashing H: Operation of channels A and B mismatch > 3 seconds.</p> <p>Steady H: Cascade Input (CSSI) Stop Command. A Receiver upstream in a cascade system is blocked or the dual-channel input is open (for example, Interlocked Guard is open).</p>	<ul style="list-style-type: none"> • Check operation of Channel A and Channel B of cascade input. • Cycle power or cycle the input. See Emergency Stop Buttons in Cascaded Systems on page 48 and Interlock Switches in Cascaded Systems on page 50.

7.2.2 Emitter Error Codes

Diagnostic Display ¹⁴	Error Description	Cause of Error and Appropriate Action
	<p>Emitter Error</p> <p>This error can occur if the ID Input (pin 3, Orange) is not connected to +24 V dc.</p> <p>Excessive electrical noise or an internal failure can also cause this error.</p>	<ul style="list-style-type: none"> • Verify that the ID Input (ID_in) wiring is connected to +24 V dc. See Generic Wiring Diagram—5-pin and 8-pin Emitter on page 39 • Cycle the power to the emitter per Recovery Procedures on page 58 • If the error clears, perform the daily checkout procedure (per EZ-SCREEN Checkout Procedures: Shift and Daily Checkout Procedure; Daily Checkout Card). If the System checks out, resume operation. If the System fails, replace the emitter • If the error continues, check the ground connection (see Cordsets on page 77) • If the sensor has a good earth ground connection, check for electrical noise (see Electrical and Optical Noise on page 61) • If the error persists, replace the emitter
	<p>Emitter LED Problem</p> <p>This is not an error.</p>	<p>This indication can occur due to a potential problem with an LED and is provided as an early warning indicator</p>

¹³ Multiple-digit codes are sequential, followed by a pause.

¹⁴ Multiple-digit codes are sequential, followed by a pause.

7.3 Electrical and Optical Noise

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

If random nuisance Trips occur, check the following:

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

7.3.1 Sources of Electrical Noise

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

All EZ-SCREEN LS 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 LS System. It is good wiring practice (and may be required by code) to isolate EZ-SCREEN LS wires from high-voltage wires.

The Banner model BT-1 Beam Tracker (see [Alignment Aids](#) on page 87) is a good tool for detecting electrical noise. It can be used to detect electrical transient spikes and surges. Cover the lens of the BT-1 with electrical tape to block optical light from entering the receiver lens. Press the RCV button on the BT-1 and position the Beam Tracker on the wires going to the EZ-SCREEN LS or any other nearby wires. The noise caused by switching of the inductive loads should be addressed by installing proper transient suppression across the load.

7.3.2 Sources of Optical Noise

Checking for sources of optical noise: Turn off the emitter or completely block the emitter, then use a Banner BT-1 Beam Tracker (see [Alignment Aids](#) on page 87) to check for light at the receiver. Press the RCV button on the BT-1 and move it across the full length of the receiver's sensing window. If the BT-1's indicator lights, check for emitted light from other sources (other safety light screens, grids or points, or standard photoelectric sensors).

7.4 Cleaning

EZ-SCREEN LS emitters and receivers are constructed of aluminum with a yellow painted finish and are rated IP67. Lens covers are acrylic. Emitters and receivers are best cleaned using mild detergent or window cleaner and a soft cloth. Avoid cleaners containing alcohol, as they may damage the acrylic lens covers.

7.5 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.

7.6 Manufacturing Date

Every EZ-SCREEN LS 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: 1509H = 2015, week 9.

7.7 Disposal

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

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).

8.1 Schedule of Checkouts

Checkout cards and this manual can be downloaded at [Banner Engineering website](#).

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 page 34	Qualified Person
Commissioning Checkout	At Installation Whenever changes are made to the System (for example, either a new configuration of the EZ-SCREEN LS or changes to the guarded machine).	Commissioning Checkout on page 63	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 179481 and 179482) 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 LS or changes to the machine).	Semi-Annual Checkout Card (Banner p/n 179483) 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 Machine Until System Is Working Properly

If all of these checks cannot be verified, do not attempt to use the safety system that includes the Banner device and the guarded machine until the defect or problem has been corrected. Attempts to use the guarded machine under such conditions may result in serious bodily injury or death.

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 LS 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 LS System. See [Examples: Inappropriate Applications](#) on page 8 for a list of misapplications.
2. Verify that the EZ-SCREEN LS 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 page 13.
4. Verify that:
 - Access to any dangerous parts of the guarded machine is not possible from any direction not protected by the EZ-SCREEN LS 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 LS.
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 LS 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 page 35.
 7. Inspect the area near the defined area (including work pieces and the guarded machine) for reflective surfaces (see [Adjacent Reflective Surfaces](#) on page 17). 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 LS System.
 9. Observe the Status indicators and Diagnostic Display:
 - Lockout: Status flashing red; all others Off
 - Blocked: Status—Solid red; one or more Alignment indicators— Solid red; Run Mode— Solid amber
 - Clear: Status—Solid green; Alignment indicators— Solid green (flashing green indicates blanking is enabled); Run Mode— Solid amber
 10. A Blocked condition indicates that one or more of the beams is misaligned or interrupted. See the Alignment procedure in to correct this situation.
 11. After the green and amber Status indicators are On, perform the trip test ([Trip Test](#) on page 34) 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 LS passes the trip test.



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



WARNING: Before Applying Power to the Machine

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

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 LS. 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 LS.
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. A Banner Applications Engineer can recommend a suitable instrument.

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

9 Specifications

9.1 General Specifications

Supply Current (mA)

	Emitter		Receiver*		
				Cascade**	Standard
Length	Max***	Typical	Max***	Typical	Typical
280	30	25	112	97	69
350	30	25	115	100	72
420	30	25	117	102	74
490	30	25	119	104	76
560	30	25	122	106	78
630	30	25	124	108	80
700	31	25	127	110	82
770	31	26	129	112	84
840	31	26	132	114	86
910	31	26	134	117	89
980	31	26	137	119	91
1050	31	26	139	121	93
1120	31	26	141	123	95
1190	31	26	144	125	97
1260	32	26	146	127	99
1330	32	26	149	129	101
1400	32	26	151	131	103
1470	32	27	154	134	106
1540	32	27	156	136	108
1610	32	27	159	138	110
1680	32	27	161	140	112
1750	32	27	163	142	114
1820	32	27	166	144	116

*Supply current exclusive of OSSD1 and OSSD2 loads (up to additional 0.5 A each) and Fault Output load (up to 0.070 A).

**Adding an indicator (EZ-LIGHT) to the CSSI will increase the receiver current draw. Consult the indicator specifications for the value of the additional current.

***Maximum current occurs at a supply voltage of 20 V dc.

Operating Conditions

–20 °C to +55 °C (–4 °F to +131°F)

95% maximum relative humidity (non-condensing)

Environmental Rating

IEC IP65/IEC IP67

Supply Voltage at the Device

24 V dc ±15% (use a SELV-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.

Residual Ripple

±10% maximum

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)

Operating Range

0.1m to 12 m (4 in. to 39 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

14 mm, 23 mm, or 40 mm, depending on model

Effective Aperture Angle (EAA)

Meets Type 4 requirements per IEC 61496-2, Section 5.2.9

Enclosure

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

Mounting Hardware

Emitter and receiver each are supplied with a pair of end-mounting brackets. Models longer than 910 mm also include an additional center-mount bracket for support. Mounting brackets are 8-gauge cold-rolled steel, black zinc finish.

Cables and Connections

See [Cordsets](#) on page 77

Safety Rating

Type 4 per IEC 61496-1, -2

Category 4 PL e per EN ISO13849-1

SIL3 per IEC 61508; SIL CL3 per IEC 62061

PFHd:

Non-Cascade 1.30×10^{-10}

1-Pair Cascade 3.92×10^{-10}

2-Pair Cascade 7.83×10^{-10}

3-Pair Cascade 1.18×10^{-9}

4-Pair Cascade 1.57×10^{-9}

Proof Test Interval: 20 years

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



9.2 Receiver Specifications

Response Time

Dependent on the number of sensing beams; for the response time, see [Models Tables](#) on page 72

EDM Input (Available with 8-Conductor Models)

+24 V dc signals from external device contacts can be monitored (one-channel or no monitoring) via the EDM terminal in the receiver.

High Signal: 10 to 30 V dc at 30 mA typical

Low Signal: 0 to 3 V dc

Recovery Time

Blocked to Clear (OSSDs turn On): Dependent on the number of beams and whether the first beam (CH 1 synchronization beam) has been blocked. For specific values, see [Models Tables](#) on page 72.

CSSI Status Output Switching Capacity

Current-sourcing (PNP) solid-state output, 24 V dc at 100 mA maximum

Scan Code Input (Available with 8-Conductor Models)

High Signal: 10 to 30 V dc at 30 mA typical

Low Signal: 0 to 3 V dc

Scan Code Selection: 8-pin/8-wire connection only (5-pin systems are Scan Code 1)

- Select Scan Code 1 by connecting pin 8 (violet wire) to 0 V dc or leaving it open (not connected)
- Select Scan Code 2 by connecting pin 8 (violet wire) to +24 V dc

Output Signal Switching Devices (OSSDs)

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

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

OFF-State voltage: 0 V dc typical, 1 V dc maximum (no load)

OFF-State, maximum allowed external voltage: 1.5 V dc¹⁵

Maximum load capacitance: 1.0 μF

Maximum cable resistance to load: 5 ohms per wire

Maximum leakage current: 50 μA (with open 0 V)

OSSD test pulse width: 200 μs typical

OSSD test pulse period: 200 ms typical

Switching current: 0 A minimum; 0.5 A maximum (per OSSD)

Fault Output Switching Capacity (Available with 8-Conductor Models)

Current-sourcing (PNP) solid-state output, 24 V dc at 70 mA maximum

Status Indicators

Amber Run Mode Indicator: indicates the System is ready for operation

Bi-color (red/green) Status indicator: indicates general system and output status

Bi-color (red/green) Alignment Status indicators: indicate condition (clear or blocked beam) of a defined group of beams ($\pm 35 \text{ mm}$ of indicator)

7-Segment Diagnostic indicator (1 digit): indicates proper operation, scan code, error code, or total number of blocked beams

Ambient Light Immunity

10,000 lux at 5° angle of incidence

Strobe Light Immunity

Totally immune to one Federal Signal Corp. "Fireball" model FB2PST strobe

9.3 Emitter Specifications

Emitter Elements Wavelength

Infrared LEDs, 850 nm at peak emission

Fault Output Switching Capacity

Current-sourcing (PNP) solid-state output, 24 V dc at 70 mA maximum

Position ID Input (Available with 8-Conductor Models)

Input connected to +24 V dc to identify emitter's position as a stand-alone or the first (master) in a cascade system.

Status Indicators

One bi-color (Red/Green) Status Indicator: indicates operating mode, lockout or power Off condition

7-Segment Diagnostic indicator (1 digit): indicates proper operation, scan code, or error code

Scan Code Input (Available with 8-Conductor Models)

High Signal: 10 to 30 V dc at 30 mA typical

Low Signal: 0 to 3 V dc

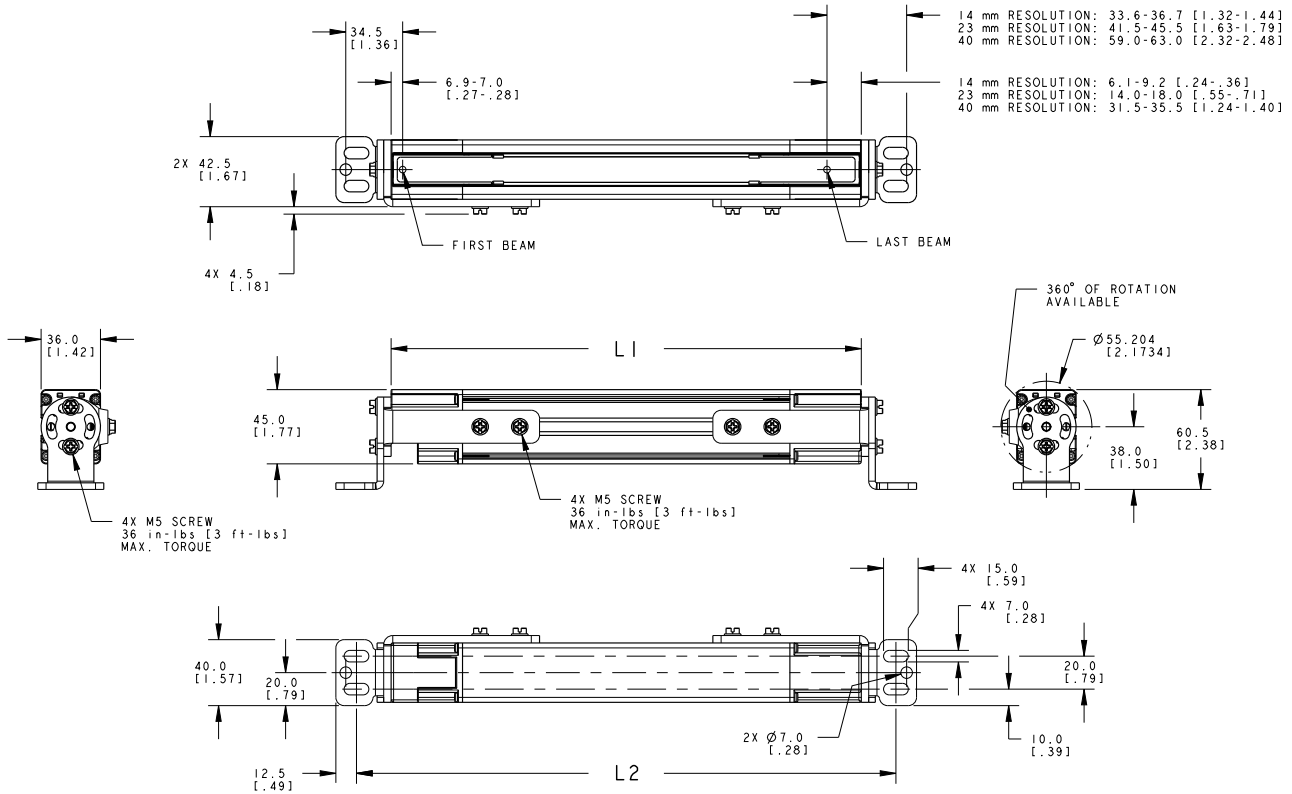
Scan Code Selection: 8-pin/8-wire connection only (5-pin systems are Scan Code 1)

- Select Scan Code 1 by connecting pin 8 (violet wire) to 0 V dc or leaving it open (not connected)
- Select Scan Code 2 by connecting pin 8 (violet wire) to +24 V dc

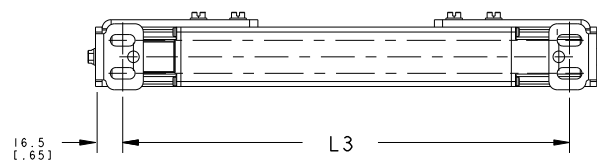
¹⁵ The maximum voltage allowed on the OSSDs in the OFF-state without a lockout occurring. This voltage may occur, for example, from the input structure of a safety relay module connected to the EZ-SCREEN LS OSSDs.

9.4 Dimensions

End Brackets Mounted Outward

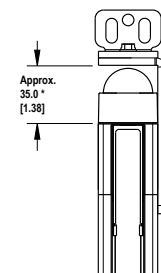


End Brackets Mounted Inward



End Bracket with EZ-LIGHT

*Add 35 mm to L2 value to determine overall mounting length



Emitter/Receiver Model	Housing Length (L1)	Hole to Hole Length with Brackets Out (L2) (mm)	Hole to Hole Length with Brackets In (L3) (mm)	Defined Area ¹⁶ (mm)
SLL...-280...	285 mm (11.2 in)	327.1	269.1	280
SLL...-350...	355 mm (14.0 in)	397.1	339.1	350
SLL...-420...	425 mm (16.7 in)	466.6	408.6	420
SLL...-490...	495 mm (19.5 in)	536.6	478.6	490
SLL...-560...	564 mm (22.2 in)	606.1	548.1	560
SLL...-630...	634 mm (25.0 in)	676.1	618.1	630

¹⁶ Nominal measurement

EZ-SCREEN® LS Safety Light Screen

Emitter/Receiver Model	Housing Length (L1)	Hole to Hole Length with Brackets Out (L2) (mm)	Hole to Hole Length with Brackets In (L3) (mm)	Defined Area ¹⁶ (mm)
SLL...-700...	704 mm (27.7 in)	746.1	688.1	700
SLL...-770...	774 mm (30.5 in)	816.1	758.1	770
SLL...-840...	844 mm (33.2 in)	885.6	827.6	840
SLL...-910...	914 mm (36.0 in)	955.6	897.6	910
SLL...-980...	983 mm (38.7 in)	1025.1	967.1	980
SLL...-1050...	1053 mm (41.5 in)	1095.1	1037.1	1050
SLL...-1120...	1123 mm (44.2 in)	1165.1	1107.1	1120
SLL...-1190...	1193 mm (47.0 in)	1235.1	1177.1	1190
SLL...-1260...	1263 mm (49.7 in)	1304.6	1246.6	1260
SLL...-1330...	1333 mm (52.5 in)	1374.6	1316.6	1330
SLL...-1400...	1402 mm (55.2 in)	1444.1	1386.1	1400
SLL...-1470...	1472 mm (58.0 in)	1514.1	1456.1	1470
SLL...-1540...	1542 mm (60.7 in)	1584.1	1526.1	1540
SLL...-1610...	1612 mm (63.5 in)	1654.1	1596.1	1610
SLL...-1680...	1682 mm (66.2 in)	1723.6	1665.6	1680
SLL...-1750...	1752 mm (69.0 in)	1793.6	1735.6	1750
SLL...-1820...	1821 mm (71.7 in)	1863.1	1805.1	1820

¹⁶ Nominal measurement

10 Components

10.1 Models

An EZ-SCREEN LS “System” refers to a compatible emitter and receiver of equal length and resolution (available in pairs or separately), including cascaded sensors, and their cordsets. Mounting hardware is included with each emitter and receiver. Special-purpose mounting brackets both for standalone pairs and for cascades are also available. Depending on the connection option, interfacing solutions include IM-T... modules, redundant positively guided contactors, safety modules/controllers, and muting modules.

The 13 mm (0.5 in) minimum bend radius for all cordset models accommodates low-clearance installations; cords can exit to the left, right, or back of the sensor, when mounting. The pigtail QD option is useful for connection to splitter cables or other QD cordsets.

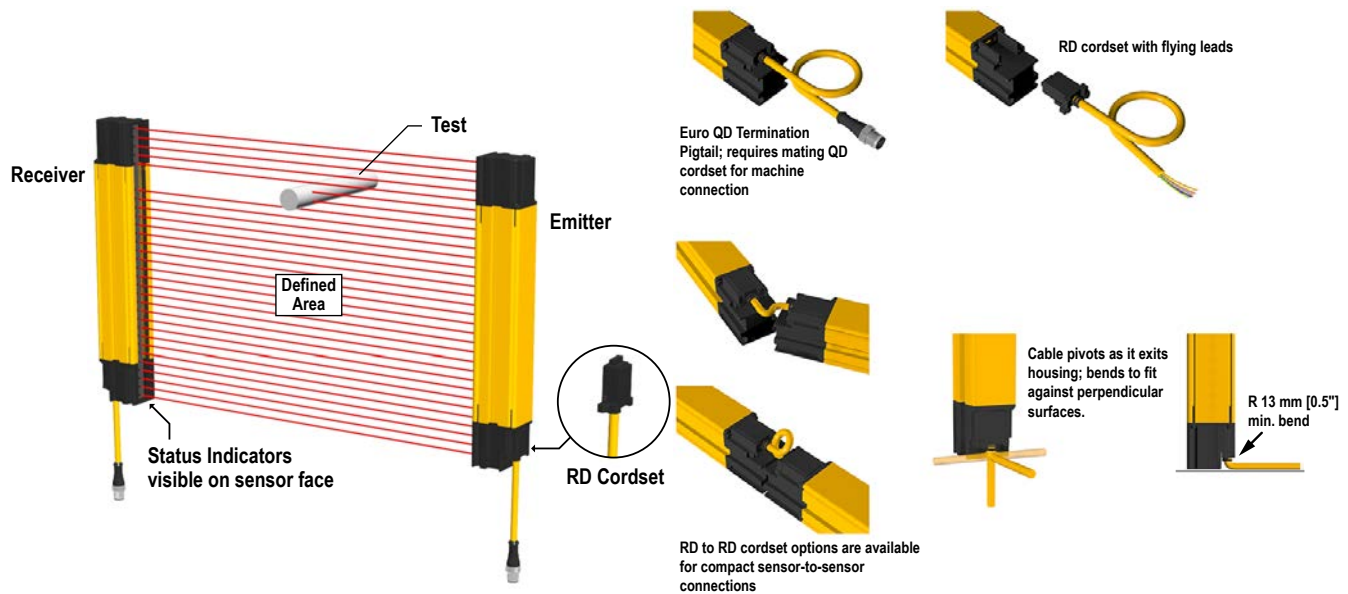


Figure 44. EZ-SCREEN LS System: Emitter, Receiver, Interconnecting Cordsets

Figure 45. EZ-SCREEN LS cordset options

EZ-SCREEN LS Pair model numbers include the following items:

Qty	Description
1	EZ-SCREEN LS Receiver
1	EZ-SCREEN LS Emitter
2	EZLSA-MBK-11 End-Cap Bracket Kit (four brackets)
2	EZLSA-MBK-12 Center-Mount Bracket Kit (two brackets included for models with defined areas ≥ 980 mm)
1	Test Rod (STP-13 for 14 mm models; STP-19 for 23 mm models; or STP-20 for 40 mm models)
1	Literature packet with CD-ROM and Diagnostic Label

Table 12: EZ-SCREEN LS Model Key

Product Family	Cascadable	System Type	Resolution	-	Defined Area	Termination
Options: SLL	Options: Blank = No C = Yes	Options: E = Emitter only R = Receiver only P = Pair (Emitter and Receiver)	Options: 14 = 14 mm 23 = 23 mm 40 = 40 mm	-	Options: 280 = 280 mm * 350 = 350 mm 420 = 420 mm 490 = 490 mm 560 = 560 mm 630 = 630 mm 700 = 700 mm 770 = 770 mm 840 = 840 mm 910 = 910 mm 980 = 980 mm 1050 = 1050 mm 1120 = 1120 mm 1190 = 1190 mm 1260 = 1260 mm 1330 = 1330 mm 1400 = 1400 mm 1470 = 1470 mm 1540 = 1540 mm 1610 = 1610 mm 1680 = 1680 mm 1750 = 1750 mm 1820 = 1820 mm	Options: Blank = no pigtail, RD connection (for middle/end units in cascade, or with RDLS-8..D cordset) P5 = 300 mm pigtail, 5-Pin M12 QD (individual Emitter or Receiver models) P55 = 300 mm pigtail, 5-Pin M12 QD (paired models) P8 = 300 mm pigtail, 8-Pin M12 QD (individual Emitter or Receiver models) P88 = 300 mm pigtail, 8-Pin M12 QD (paired models)
Example: SLLCP23-1470P88						
* 280 mm defined area not available on cascade systems						

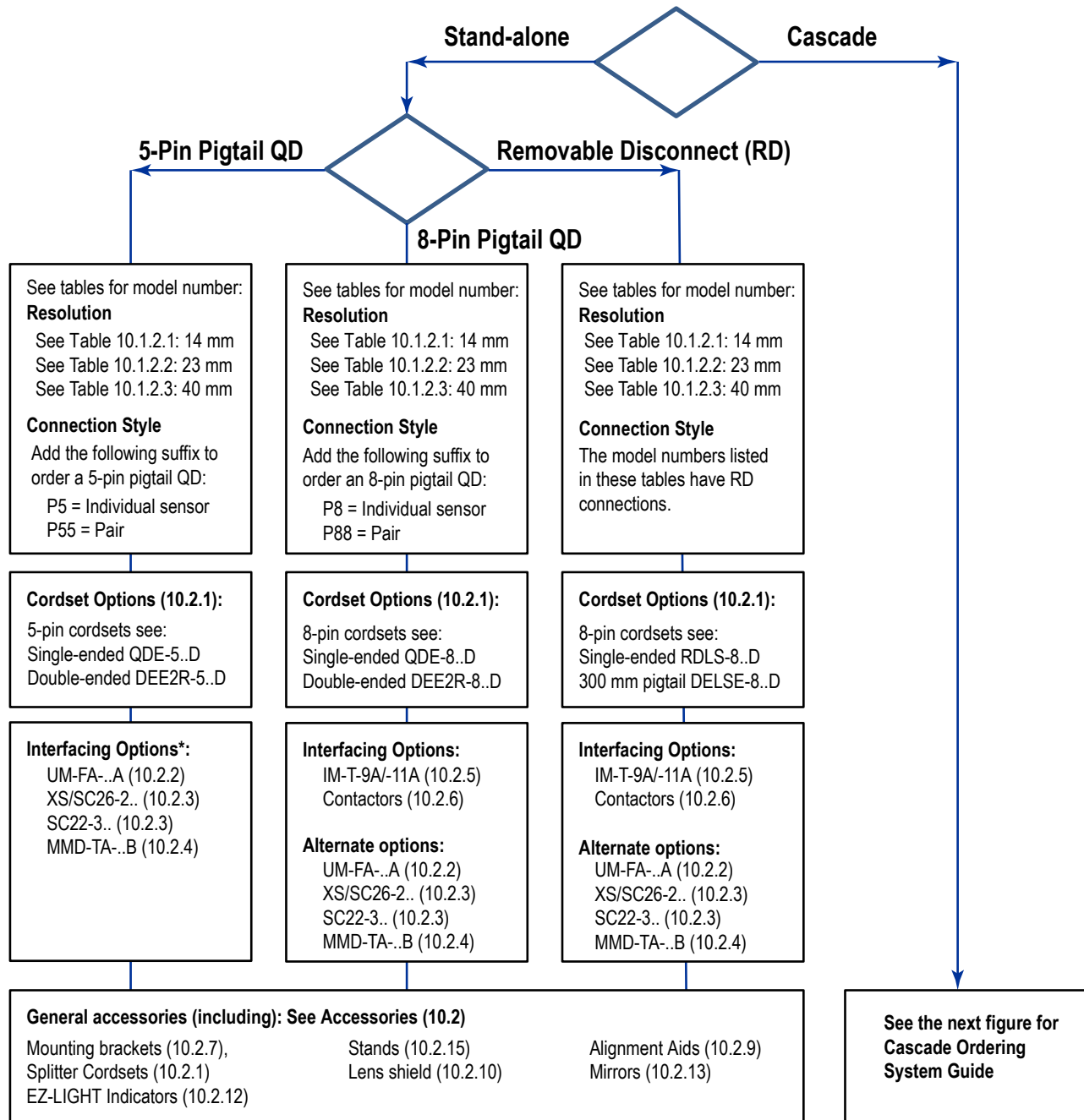
To determine the components required for an EZ-SCREEN LS system using the Model Key:

1. Determine if the application calls for a stand-alone (a single, non-cascade emitter and receiver pair) or if a cascade pair is to be used as a stand-alone and/or with multiple pairs to be ordered are part of a cascaded system.
2. Choose an Emitter (E), a Receiver (R), or a Pair (P).
3. Choose resolution (14, 23, or 40 mm) and defined area.
4. Determine the Machine Interface connection style: 300 mm pigtail QD (5-pin or 8-pin) or a Removable Disconnect (RD).
5. Model number(s) can be verified in the models tables.
6. See [Cordsets](#) on page 77 for mating cordsets:
 - Models with RD connection use either RDLS-8..D, DELS-11..E, DELSE-81D, or DELSE-51D
 - Models with P8 (P88) suffix use QDE-8..D, DEE2R-8..D, or CSB-M128..M1281
 - Models with P5 (P55) suffix use QDE-5..D, DEE2R-5..D, or CSB-M125..M1251 (MQDEC-406SS is used in applications where pin 5 is open and ground is via mounting brackets)
7. See [Accessories](#) on page 77 for interfacing solutions and accessories.

10.1.1 Ordering Guide

To order an EZ-SCREEN LS system, see [Figure 46](#) on page 71:

1. Determine if the application calls for a stand-alone (single, non-cascade emitter and receiver pair) or if a cascade pair is to be used as a stand-alone and/or with multiple pairs to be ordered are part of a cascaded system.
2. Determine the connection style, which is typically dictated by the type of interfacing with the machine's safety-related control system (300 mm pigtail QD (5-pin or 8-pin) or a Removable Disconnect).
3. Choose the model number(s) from the applicable model number table. Model numbers listed in the tables are RD connection style model numbers. Add a P5 (or P55) or a P8 (or P88) at the end of the listed model number for a sensor with a 300 mm (1 ft) pigtail M12/Euro-style QD.

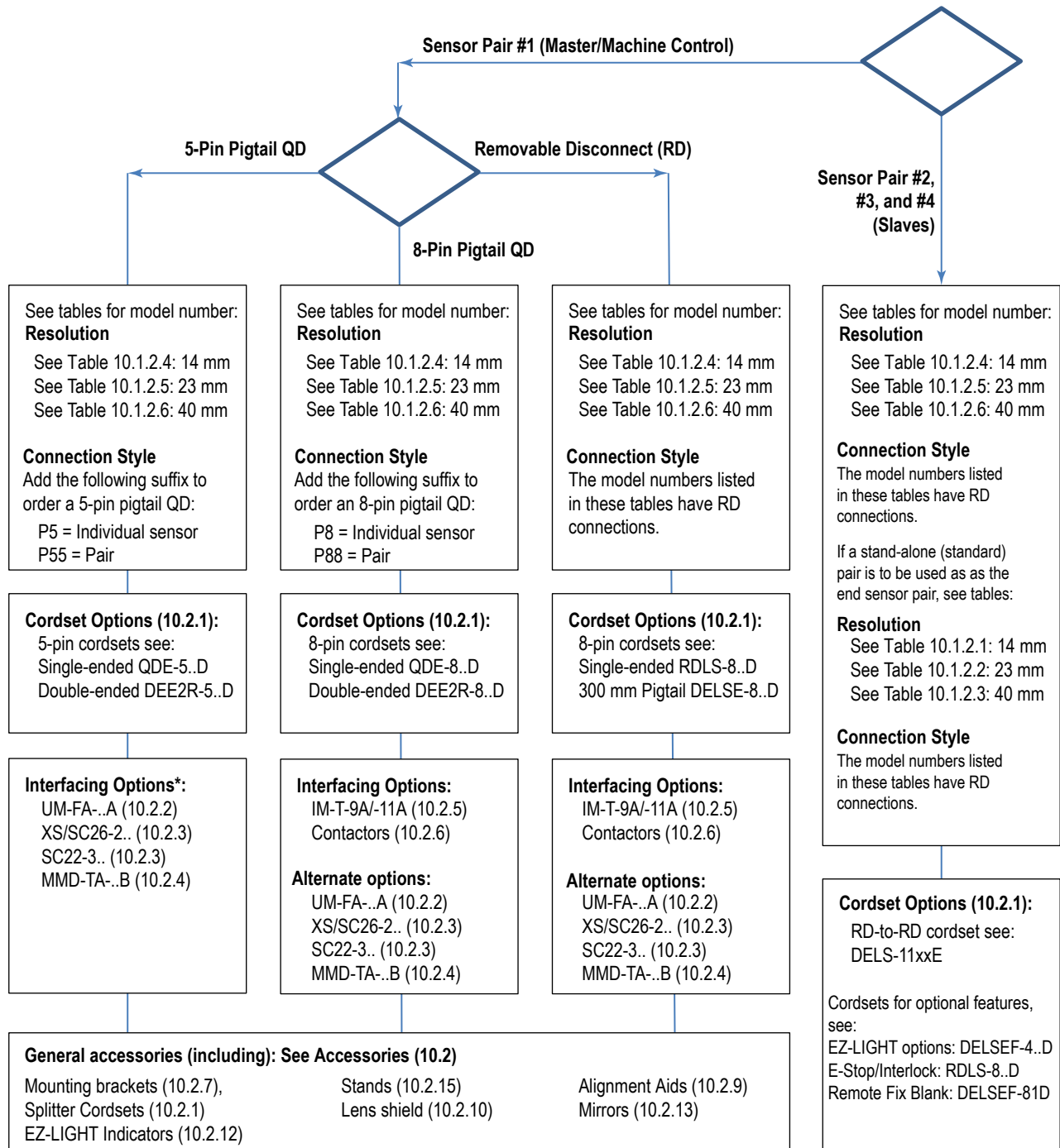


* 5-pin models must be interfaced with a self-checking safety module, safety controller, or safety PLC/PES that conforms to the level of performance required by the risk assessment (such as Control Reliability and/or ISO13849-1 Categories 3 or 4 and PL d or e).

Figure 46. Ordering guide for stand-alone systems

To order a cascade system, see [Figure 47](#) on page 72:

1. Determine the configuration of the first sensor pair (a stand-alone or the "Master" is connected to the machine control).
2. Determine the model from the applicable model number table. Model numbers listed in the tables are RD connection style model numbers. Add a P5 (or P55) or a P8 (or P88) at the end of the listed model number for a sensor with a 300 mm (1 ft) pigtail M12/Euro-style QD.
3. Determine the remaining sensor pairs (slaves), which will be an RD connection style that uses a DELS-11xxE interconnection cordset.



* 5-pin models must be interfaced with a self-checking safety module, safety controller, or safety PLC/PES that conforms to the level of performance required by the risk assessment (such as Control Reliability and/or ISO13849-1 Categories 3 or 4 and PL d or e).

Figure 47. Ordering guide for cascading systems

10.1.2 Models Tables

As listed in the following tables, the models include an RD connection (for middle/end units in cascade, or with RDLS-8..D cordset). Add one of these suffixes to the end of the model number(s) listed in the tables below:

- P5: 300 mm (1 ft) pigtail PVC cable with a 5-pin M12/Euro-style male quick disconnect (QD) (individual Emitter or Receiver models)
- P55: 300 mm (1 ft) pigtail PVC cable with a 5-pin M12/Euro-style male quick disconnect (QD) (only Paired models)

- P8: 300 mm (1 ft) pigtail PVC cable with a 8-pin M12/Euro-style male quick disconnect (QD) (individual Emitter or Receiver models)
- P88: 300 mm (1 ft) pigtail PVC cable with a 8-pin M12/Euro-style male quick disconnect (QD) (only Paired models)

Table 13: 10.1.2.1: EZ-SCREEN LS 14 mm Resolution Models (Standard/Stand-alone with RD connection)

Emitter	Receiver	Pair	Defined Area	Response Time, Tr (ms)	Recovery Time, Typ, OSSDs OFF to ON (ms)	
					Non-sync beam blocked	All beams blocked
SLLE14-280	SLLR14-280	SLLP14-280	280 mm	11.6	47	160
SLLE14-350	SLLR14-350	SLLP14-350	350 mm	13.3	55	186
SLLE14-420	SLLR14-420	SLLP14-420	420 mm	15.0	63	211
SLLE14-490	SLLR14-490	SLLP14-490	490 mm	16.7	69	237
SLLE14-560	SLLR14-560	SLLP14-560	560 mm	18.4	78	263
SLLE14-630	SLLR14-630	SLLP14-630	630 mm	20.1	86	288
SLLE14-700	SLLR14-700	SLLP14-700	700 mm	21.8	93	314
SLLE14-770	SLLR14-770	SLLP14-770	770 mm	23.5	101	339
SLLE14-840	SLLR14-840	SLLP14-840	840 mm	25.2	108	265
SLLE14-910	SLLR14-910	SLLP14-910	910 mm	26.9	116	391
SLLE14-980	SLLR14-980	SLLP14-980	980 mm	28.6	122	416
SLLE14-1050	SLLR14-1050	SLLP14-1050	1050 mm	30.3	130	442
SLLE14-1120	SLLR14-1120	SLLP14-1120	1120 mm	32.0	137	467
SLLE14-1190	SLLR14-1190	SLLP14-1190	1190 mm	33.7	145	493
SLLE14-1260	SLLR14-1260	SLLP14-1260	1260 mm	35.4	153	518
SLLE14-1330	SLLR14-1330	SLLP14-1330	1330 mm	37.1	160	544
SLLE14-1400	SLLR14-1400	SLLP14-1400	1400 mm	38.7	168	570
SLLE14-1470	SLLR14-1470	SLLP14-1470	1470 mm	40.4	175	595
SLLE14-1540	SLLR14-1540	SLLP14-1540	1540 mm	42.1	183	621
SLLE14-1610	SLLR14-1610	SLLP14-1610	1610 mm	43.8	191	646
SLLE14-1680	SLLR14-1680	SLLP14-1680	1680 mm	45.5	198	672
SLLE14-1750	SLLR14-1750	SLLP14-1750	1750 mm	47.2	206	697
SLLE14-1820	SLLR14-1820	SLLP14-1820	1820 mm	48.9	215	723

Table 14: 10.1.2.2: EZ-SCREEN LS 23 mm Resolution Models (Standard/Stand-alone with RD Connection)

Emitter	Receiver	Pair	Defined Area	Response Time, Tr (ms)	Recovery Time, Typ, OSSDs OFF to ON (ms)	
					Non-sync beam blocked	All beams blocked
SLLE23-280	SLLR23-280	SLLP23-280	280 mm	8.2	32	110
SLLE23-350	SLLR23-350	SLLP23-350	350 mm	9.1	36	124
SLLE23-420	SLLR23-420	SLLP23-420	420 mm	9.9	40	135
SLLE23-490	SLLR23-490	SLLP23-490	490 mm	10.8	44	148
SLLE23-560	SLLR23-560	SLLP23-560	560 mm	11.6	47	160
SLLE23-630	SLLR23-630	SLLP23-630	630 mm	12.5	51	175
SLLE23-700	SLLR23-700	SLLP23-700	700 mm	13.3	55	186
SLLE23-770	SLLR23-770	SLLP23-770	770 mm	14.2	59	199
SLLE23-840	SLLR23-840	SLLP23-840	840 mm	15.0	63	211

Emitter	Receiver	Pair	Defined Area	Response Time, Tr (ms)	Recovery Time, Typ, OSSDs OFF to ON (ms)	
					Non-sync beam blocked	All beams blocked
SLLE23-910	SLLR23-910	SLLP23-910	910 mm	15.9	67	225
SLLE23-980	SLLR23-980	SLLP23-980	980 mm	16.7	69	237
SLLE23-1050	SLLR23-1050	SLLP23-1050	1050 mm	17.5	74	249
SLLE23-1120	SLLR23-1120	SLLP23-1120	1120 mm	18.4	78	269
SLLE23-1190	SLLR23-1190	SLLP23-1190	1190 mm	19.2	82	274
SLLE23-1260	SLLR23-1260	SLLP23-1260	1260 mm	20.1	86	288
SLLE23-1330	SLLR23-1330	SLLP23-1330	1330 mm	20.9	89	300
SLLE23-1400	SLLR23-1400	SLLP23-1400	1400 mm	21.8	93	314
SLLE23-1470	SLLR23-1470	SLLP23-1470	1470 mm	22.6	97	325
SLLE23-1540	SLLR23-1540	SLLP23-1540	1540 mm	23.5	101	339
SLLE23-1610	SLLR23-1610	SLLP23-1610	1610 mm	24.3	104	350
SLLE23-1680	SLLR23-1680	SLLP23-1680	1680 mm	25.2	108	365
SLLE23-1750	SLLR23-1750	SLLP23-1750	1750 mm	26.0	112	376
SLLE23-1820	SLLR23-1820	SLLP23-1820	1820 mm	26.9	116	391

Table 15: 10.1.2.3: EZ-SCREEN LS 40 mm Resolution Models (Standard/Stand-alone with RD Connection)

Emitter	Receiver	Pair	Defined Area	Response Time, Tr (ms)	Recovery Time, Typ, OSSDs OFF to ON (ms)	
					Non-sync beam blocked	All beams blocked
SLLE40-280	SLLR40-280	SLLP40-280	280 mm	8.2	32	110
SLLE40-350	SLLR40-350	SLLP40-350	350 mm	8.2	32	110
SLLE40-420	SLLR40-420	SLLP40-420	420 mm	8.2	32	110
SLLE40-490	SLLR40-490	SLLP40-490	490 mm	8.2	32	110
SLLE40-560	SLLR40-560	SLLP40-560	560 mm	8.2	32	110
SLLE40-630	SLLR40-630	SLLP40-630	630 mm	8.6	34	117
SLLE40-700	SLLR40-700	SLLP40-700	700 mm	9.1	36	124
SLLE40-770	SLLR40-770	SLLP40-770	770 mm	9.5	38	129
SLLE40-840	SLLR40-840	SLLP40-840	840 mm	9.9	40	135
SLLE40-910	SLLR40-910	SLLP40-910	910 mm	10.3	42	142
SLLE40-980	SLLR40-980	SLLP40-980	980 mm	10.8	44	148
SLLE40-1050	SLLR40-1050	SLLP40-1050	1050 mm	11.2	45	155
SLLE40-1120	SLLR40-1120	SLLP40-1120	1120 mm	11.6	47	160
SLLE40-1190	SLLR40-1190	SLLP40-1190	1190 mm	12.0	49	168
SLLE40-1260	SLLR40-1260	SLLP40-1260	1260 mm	12.5	51	175
SLLE40-1330	SLLR40-1330	SLLP40-1330	1330 mm	12.9	53	179
SLLE40-1400	SLLR40-1400	SLLP40-1400	1400 mm	13.3	55	186
SLLE40-1470	SLLR40-1470	SLLP40-1470	1470 mm	13.7	57	193
SLLE40-1540	SLLR40-1540	SLLP40-1540	1540 mm	14.2	59	199
SLLE40-1610	SLLR40-1610	SLLP40-1610	1610 mm	14.6	61	206
SLLE40-1680	SLLR40-1680	SLLP40-1680	1680 mm	15.0	63	211

Emitter	Receiver	Pair	Defined Area	Response Time, Tr (ms)	Recovery Time, Typ, OSSDs OFF to ON (ms)	
					Non-sync beam blocked	All beams blocked
SLLC40-1750	SLLR40-1750	SLLP40-1750	1750 mm	15.4	65	216
SLLC40-1820	SLLR40-1820	SLLP40-1820	1820 mm	15.9	57	225

Table 16: 10.1.2.4: EZ-SCREEN LS 14 mm Resolution Models (Cascade with RD Connection)

Emitter	Receiver	Pair	Defined Area	Response Time, Tr (ms)	Recovery Time, Typ, OSSDs OFF to ON (ms)	
					Non-sync beam blocked	All beams blocked
SLLC14-350	SLLR14-350	SLLP14-350	350 mm	13.3	55	186
SLLC14-420	SLLR14-420	SLLP14-420	420 mm	15.0	63	211
SLLC14-490	SLLR14-490	SLLP14-490	490 mm	16.7	69	237
SLLC14-560	SLLR14-560	SLLP14-560	560 mm	18.4	78	263
SLLC14-630	SLLR14-630	SLLP14-630	630 mm	20.1	86	288
SLLC14-700	SLLR14-700	SLLP14-700	700 mm	21.8	93	314
SLLC14-770	SLLR14-770	SLLP14-770	770 mm	23.5	101	339
SLLC14-840	SLLR14-840	SLLP14-840	840 mm	25.2	108	365
SLLC14-910	SLLR14-910	SLLP14-910	910 mm	26.9	116	391
SLLC14-980	SLLR14-980	SLLP14-980	980 mm	28.6	122	416
SLLC14-1050	SLLR14-1050	SLLP14-1050	1050 mm	30.3	130	442
SLLC14-1120	SLLR14-1120	SLLP14-1120	1120 mm	32.0	137	467
SLLC14-1190	SLLR14-1190	SLLP14-1190	1190 mm	33.7	145	493
SLLC14-1260	SLLR14-1260	SLLP14-1260	1260 mm	35.4	153	518
SLLC14-1330	SLLR14-1330	SLLP14-1330	1330 mm	37.1	160	544
SLLC14-1400	SLLR14-1400	SLLP14-1400	1400 mm	38.7	168	570
SLLC14-1470	SLLR14-1470	SLLP14-1470	1470 mm	40.4	175	595
SLLC14-1540	SLLR14-1540	SLLP14-1540	1540 mm	42.1	183	621
SLLC14-1610	SLLR14-1610	SLLP14-1610	1610 mm	43.8	191	646
SLLC14-1680	SLLR14-1680	SLLP14-1680	1680 mm	45.5	198	672
SLLC14-1750	SLLR14-1750	SLLP14-1750	1750 mm	47.2	206	697
SLLC14-1820	SLLR14-1820	SLLP14-1820	1820 mm	48.9	215	723

Table 17: 10.1.2.5: EZ-SCREEN LS 23 mm Resolution Models (Cascade with RD Connection)

Emitter	Receiver	Pair	Defined Area	Response Time, Tr (ms)	Recovery Time, Typ, OSSDs OFF to ON (ms)	
					Non-sync beam blocked	All beams blocked
SLLC23-350	SLLR23-350	SLLP23-350	350 mm	9.1	36	124
SLLC23-420	SLLR23-420	SLLP23-420	420 mm	9.9	40	135
SLLC23-490	SLLR23-490	SLLP23-490	490 mm	10.8	44	148
SLLC23-560	SLLR23-560	SLLP23-560	560 mm	11.6	47	160
SLLC23-630	SLLR23-630	SLLP23-630	630 mm	12.5	51	175
SLLC23-700	SLLR23-700	SLLP23-700	700 mm	13.3	55	186

Emitter	Receiver	Pair	Defined Area	Response Time, Tr (ms)	Recovery Time, Typ, OSSDs OFF to ON (ms)	
					Non-sync beam blocked	All beams blocked
SLLCE23-770	SLLCR23-770	SLLCP23-770	770 mm	14.2	59	199
SLLCE23-840	SLLCR23-840	SLLCP23-840	840 mm	15.0	63	211
SLLCE23-910	SLLCR23-910	SLLCP23-910	910 mm	15.9	67	225
SLLCE23-980	SLLCR23-980	SLLCP23-980	980 mm	16.7	69	237
SLLCE23-1050	SLLCR23-1050	SLLCP23-1050	1050 mm	17.5	74	249
SLLCE23-1120	SLLCR23-1120	SLLCP23-1120	1120 mm	18.4	78	269
SLLCE23-1190	SLLCR23-1190	SLLCP23-1190	1190 mm	19.2	82	274
SLLCE23-1260	SLLCR23-1260	SLLCP23-1260	1260 mm	20.1	86	288
SLLCE23-1330	SLLCR23-1330	SLLCP23-1330	1330 mm	20.9	89	300
SLLCE23-1400	SLLCR23-1400	SLLCP23-1400	1400 mm	21.8	93	314
SLLCE23-1470	SLLCR23-1470	SLLCP23-1470	1470 mm	22.6	97	325
SLLCE23-1540	SLLCR23-1540	SLLCP23-1540	1540 mm	23.5	101	339
SLLCE23-1610	SLLCR23-1610	SLLCP23-1610	1610 mm	24.3	104	350
SLLCE23-1680	SLLCR23-1680	SLLCP23-1680	1680 mm	25.2	108	365
SLLCE23-1750	SLLCR23-1750	SLLCP23-1750	1750 mm	26.0	112	376
SLLCE23-1820	SLLCR23-1820	SLLCP23-1820	1820 mm	26.9	116	391

Table 18: 10.1.2.6: EZ-SCREEN LS 40 mm Resolution Models (Cascade with RD Connection)

Emitter	Receiver	Pair	Defined Area	Response Time, Tr (ms)	Recovery Time, Typ, OSSDs OFF to ON (ms)	
					Non-sync beam blocked	All beams blocked
SLLCE40-350	SLLCR40-350	SLLCP40-350	350 mm	8.2	32	110
SLLCE40-420	SLLCR40-420	SLLCP40-420	420 mm	8.2	32	110
SLLCE40-490	SLLCR40-490	SLLCP40-490	490 mm	8.2	32	110
SLLCE40-560	SLLCR40-560	SLLCP40-560	560 mm	8.2	32	110
SLLCE40-630	SLLCR40-630	SLLCP40-630	630 mm	8.6	34	117
SLLCE40-700	SLLCR40-700	SLLCP40-700	700 mm	9.1	36	124
SLLCE40-770	SLLCR40-770	SLLCP40-770	770 mm	9.5	38	129
SLLCE40-840	SLLCR40-840	SLLCP40-840	840 mm	9.9	40	135
SLLCE40-910	SLLCR40-910	SLLCP40-910	910 mm	10.3	42	142
SLLCE40-980	SLLCR40-980	SLLCP40-980	980 mm	10.8	44	148
SLLCE40-1050	SLLCR40-1050	SLLCP40-1050	1050 mm	11.2	45	155
SLLCE40-1120	SLLCR40-1120	SLLCP40-1120	1120 mm	11.6	47	160
SLLCE40-1190	SLLCR40-1190	SLLCP40-1190	1190 mm	12.0	49	168
SLLCE40-1260	SLLCR40-1260	SLLCP40-1260	1260 mm	12.5	51	175
SLLCE40-1330	SLLCR40-1330	SLLCP40-1330	1330 mm	12.9	53	179
SLLCE40-1400	SLLCR40-1400	SLLCP40-1400	1400 mm	13.3	55	186
SLLCE40-1470	SLLCR40-1470	SLLCP40-1470	1470 mm	13.7	57	193
SLLCE40-1540	SLLCR40-1540	SLLCP40-1540	1540 mm	14.2	59	199
SLLCE40-1610	SLLCR40-1610	SLLCP40-1610	1610 mm	14.6	61	206

Emitter	Receiver	Pair	Defined Area	Response Time, Tr (ms)	Recovery Time, Typ, OSSDs OFF to ON (ms)	
					Non-sync beam blocked	All beams blocked
SLLCE40-1680	SLLCR40-1680	SLLCP40-1680	1680 mm	15.0	63	211
SLLCE40-1750	SLLCR40-1750	SLLCP40-1750	1750 mm	15.4	65	216
SLLCE40-1820	SLLCR40-1820	SLLCP40-1820	1820 mm	15.9	67	225

10.2 Accessories

10.2.1 Cordsets

Machine interface cordsets provide power to the first emitter/receiver pair. Sensor interconnect cables provide power to subsequent emitters and receivers in the cascade. Cordsets typically have yellow PVC cables and black overmolds.

A removable disconnect (RD) is required to connect directly to the sensor housing. QD connectors are used for cable-to-cable interconnections and connections to other devices.

Single-ended (to connect to the machine interface):

RDLS-8..D RD-to-flying leads is used with sensors without a 300 mm pigtail M12 QD

QDE-8..D QD-to-flying leads is used with sensors with a 8-pin 300 mm pigtail M12 QD (model ends in P8)

QDE-5..D QD-to-flying leads is used with sensors with a 5-pin 300 mm pigtail M12 QD (model ends in P5)

Double-ended

DELS-11..E RD-to-RD is used for sensor interconnect in a cascading system

DEE2R-8..D M12 QD-to-M12 QD (female-male) is used for extending the length of cordsets and directly connects to other devices with a 8-pin M12 QD

DEE2R-5..D M12 QD-to-M12 QD (female-male) is used for extending the length of cordsets and directly connects to other devices with a 5-pin M12 QD

MQDEC-4..SS M12 QD-to-M12 QD (female-male) is used for connecting to devices that do not have earth ground on pin 5 of a 5-pin QD (In such situations, earth ground must be provided via the mounting brackets)

DELSE-81D RD-to M12 QD (male) is used to create or replace an 8-pin 300 mm pigtail M12 QD

DELSE-51D RD-to M12 QD (male) is used to create or replace a 5-pin 300 mm pigtail M12 QD

DELSEF-81D RD-to M12 QD (female) is used for remote teach fixed blanking programming

DELSEF-4..D RD-to M12 QD (female) is used for connecting two-color EZ-LIGHT or other indicators

Splitter cordsets

CSB-M128..M1281 allow easy interconnection between an 8-pin receiver and 8-pin emitter, and provides a single trunk cable for the optional interchangeable ("swapable") hookup

CSB-M125..M1251 allow easy interconnection between a 5-pin receiver and 5-pin emitter, and provides a single trunk cable for the optional interchangeable ("swapable") hookup



NOTE: See [Routing Cordsets](#) on page 27 and [Determining Interconnect Cordset Lengths](#) on page 45 for maximum cordset lengths.

EZ-SCREEN LS Connection Examples

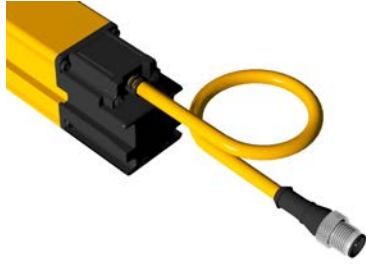


Figure 48. 300 mm Pigtail with M12/Euro-style QD

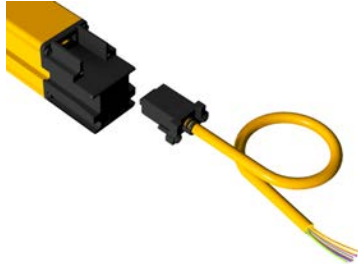


Figure 49. RD Connection with 8-Wire Flying Lead Cordset



Figure 50. RD Connection with Double-Ended RD Cordset

Single-Ended (Machine Interface) Cables

Typically one cordset for each emitter and receiver.

Table 19: RDLS-8..D 8-wire single-ended cordsets

Use RD-to-flying lead cordsets with sensors without a 300 mm cable M12/Euro-style QD.

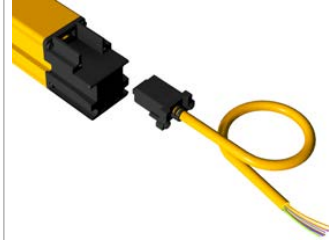
Model	Length	Pinout/Color Code			Product Image																											
RDLS-815D	4.6 m (15.1 ft)	<table><tr><th>Color</th><th>Emitter Function</th><th>Receiver Function</th></tr><tr><td>Brown</td><td>+24 V dc</td><td>+24 V dc</td></tr><tr><td>Or/Bk</td><td>Fault</td><td>Fault</td></tr><tr><td>Orange</td><td>ID in</td><td>EDM</td></tr><tr><td>White</td><td>no connection</td><td>OSSD2</td></tr><tr><td>Black</td><td>no connection</td><td>OSSD1</td></tr><tr><td>Blue</td><td>0 V dc</td><td>0 V dc</td></tr><tr><td>Gn/Ye</td><td>Gnd/Chassis</td><td>Gnd/Chassis</td></tr><tr><td>Violet</td><td>Scan Code</td><td>Scan Code</td></tr></table>			Color	Emitter Function	Receiver Function	Brown	+24 V dc	+24 V dc	Or/Bk	Fault	Fault	Orange	ID in	EDM	White	no connection	OSSD2	Black	no connection	OSSD1	Blue	0 V dc	0 V dc	Gn/Ye	Gnd/Chassis	Gnd/Chassis	Violet	Scan Code	Scan Code	
Color	Emitter Function				Receiver Function																											
Brown	+24 V dc				+24 V dc																											
Or/Bk	Fault				Fault																											
Orange	ID in				EDM																											
White	no connection				OSSD2																											
Black	no connection				OSSD1																											
Blue	0 V dc				0 V dc																											
Gn/Ye	Gnd/Chassis	Gnd/Chassis																														
Violet	Scan Code	Scan Code																														
RDLS-825D	8 m (26.2 ft)																															
RDLS-850D	15.3 m (50.2 ft)																															

Table 20: QDE-5..D 5-pin M12/Euro-style QD to flying lead cordsets

Used with sensors with a 300 mm cable and a 5-pin M12/Euro-style quick disconnect (model ends in P5). M12/Euro-style QD connector on one end; unterminated (cut to length) on the other to interface with guarded machine. PVC jacketed overmold and cables.

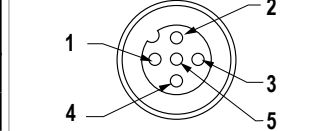
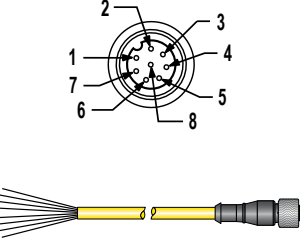
Model	Length	Banner Cordset Pinout/Color Code				M12 Connector (female face view)																					
QDE-515D	4.5 m (15 ft)	<table><tr><th>Pin</th><th>Color</th><th>Emitter Function</th><th>Receiver Function</th></tr><tr><td>1</td><td>Brown</td><td>+24 V dc</td><td>+24 V dc</td></tr><tr><td>2</td><td>White</td><td>no connection</td><td>OSSD2</td></tr><tr><td>3</td><td>Blue</td><td>0 V dc</td><td>0 V dc</td></tr><tr><td>4</td><td>Black</td><td>no connection</td><td>OSSD1</td></tr><tr><td>5</td><td>Gn/Ye</td><td>Gnd/Chassis</td><td>Gnd/Chassis</td></tr></table>	Pin	Color	Emitter Function	Receiver Function	1	Brown	+24 V dc	+24 V dc	2	White	no connection	OSSD2	3	Blue	0 V dc	0 V dc	4	Black	no connection	OSSD1	5	Gn/Ye	Gnd/Chassis	Gnd/Chassis	
Pin	Color		Emitter Function	Receiver Function																							
1	Brown		+24 V dc	+24 V dc																							
2	White		no connection	OSSD2																							
3	Blue		0 V dc	0 V dc																							
4	Black		no connection	OSSD1																							
5	Gn/Ye	Gnd/Chassis	Gnd/Chassis																								
QDE-525D	7.6 m (25 ft)																										
QDE-550D	15.2 m (50 ft)																										
QDE-575D	22.8 m (75 ft)																										
QDE-5100D	30.4 m (100 ft)																										

Table 21: QDE-8..D 8-pin M12/Euro-style QD to flying lead cordsets

Used with sensors with a 300 mm cable and an 8-pin M12/Euro-style quick disconnect (model ends in P8). M12/Euro-style QD connector on one end; unterminated (cut to length) on the other to interface with guarded machine. PVC jacketed overmold and cables.

Model	Length	Banner Cordset Pinout/Color Code				M12 Connector (female face view)																																	
QDE-815D	4.5 m (15 ft)	<table><tr><th>Pin</th><th>Color</th><th>Emitter Function</th><th>Receiver Function</th></tr><tr><td>1</td><td>Brown</td><td>+24 V dc</td><td>+24 V dc</td></tr><tr><td>2</td><td>Or/Bk</td><td>Fault</td><td>Fault</td></tr><tr><td>3</td><td>Orange</td><td>ID in</td><td>EDM</td></tr><tr><td>4</td><td>White</td><td>no connection</td><td>OSSD2</td></tr><tr><td>5</td><td>Black</td><td>no connection</td><td>OSSD1</td></tr><tr><td>6</td><td>Blue</td><td>0 V dc</td><td>0 V dc</td></tr><tr><td>7</td><td>Gn/Ye</td><td>Gnd/Chassis</td><td>Gnd/Chassis</td></tr><tr><td>8</td><td>Violet</td><td>Scan Code</td><td>Scan Code</td></tr></table>	Pin	Color	Emitter Function	Receiver Function	1	Brown	+24 V dc	+24 V dc	2	Or/Bk	Fault	Fault	3	Orange	ID in	EDM	4	White	no connection	OSSD2	5	Black	no connection	OSSD1	6	Blue	0 V dc	0 V dc	7	Gn/Ye	Gnd/Chassis	Gnd/Chassis	8	Violet	Scan Code	Scan Code	
Pin	Color		Emitter Function	Receiver Function																																			
1	Brown		+24 V dc	+24 V dc																																			
2	Or/Bk		Fault	Fault																																			
3	Orange		ID in	EDM																																			
4	White		no connection	OSSD2																																			
5	Black		no connection	OSSD1																																			
6	Blue		0 V dc	0 V dc																																			
7	Gn/Ye		Gnd/Chassis	Gnd/Chassis																																			
8	Violet	Scan Code	Scan Code																																				
QDE-825D	7.6 m (25 ft)																																						
QDE-850D	15.2 m (50 ft)																																						
QDE-875D	22.8 m (75 ft)																																						
QDE-8100D	30.4 m (100 ft)																																						

Double-Ended (Sensor Interconnect) Cordsets

Double ended cordsets are generally used to interconnect multiple emitters or receivers within a cascade system. They are also useful for extending either the branch or trunk cables of a model CSB splitter cordset used in sensor "swapability" installations.

Table 22: DELS-11..E RD-to-RD cordset

Used for sensor interconnect in a cascading system.

Model	Length	Product Image
DELS-110E	0.07 m (0.2 ft)	
DELS-111E	0.3 m (1 ft)	
DELS-113E	1 m (3.3 ft)	
DELS-118E	2.5 m (8.2 ft)	
DELS-1115E	4.6 m (15.1 ft)	
DELS-1125E	8 m (26.2 ft)	
DELS-1150E	15.3 m (50.2 ft)	

Table 23: DEE2R-8..D 8-pin M12/Euro-style QD to M12/Euro-style QD (female-male) cordsets

Used for extending the length of cordsets and directly connects to other devices with an 8-pin M12/Euro-style quick disconnect. Other lengths are available.

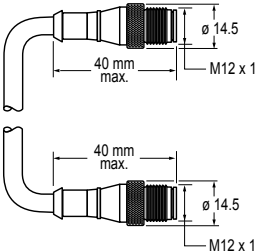
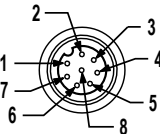
Model	Length	Banner Cordset Pinout/Color Code				M12 Connector (female face view)																																		
DEE2R-81D	0.3 m (1 ft)	<table><tr><th>Pin</th><th>Color</th><th>Emitter Function</th><th>Receiver Function</th></tr><tr><td>1</td><td>Brown</td><td>+ 24 V dc</td><td>+ 24 V dc</td></tr><tr><td>2</td><td>Or/Bk</td><td>Fault</td><td>Fault</td></tr><tr><td>3</td><td>Orange</td><td>ID in</td><td>EDM</td></tr><tr><td>4</td><td>White</td><td>no connection</td><td>OSSD2</td></tr><tr><td>5</td><td>Black</td><td>no connection</td><td>OSSD1</td></tr><tr><td>6</td><td>Blue</td><td>0 V dc</td><td>0 V dc</td></tr><tr><td>7</td><td>Gn/Ye</td><td>Gnd/Chassis</td><td>Gnd/Chassis</td></tr><tr><td>8</td><td>Violet</td><td>Scan Code</td><td>Scan Code</td></tr></table>	Pin	Color	Emitter Function	Receiver Function	1	Brown	+ 24 V dc	+ 24 V dc	2	Or/Bk	Fault	Fault	3	Orange	ID in	EDM	4	White	no connection	OSSD2	5	Black	no connection	OSSD1	6	Blue	0 V dc	0 V dc	7	Gn/Ye	Gnd/Chassis	Gnd/Chassis	8	Violet	Scan Code	Scan Code		
Pin	Color		Emitter Function	Receiver Function																																				
1	Brown		+ 24 V dc	+ 24 V dc																																				
2	Or/Bk		Fault	Fault																																				
3	Orange		ID in	EDM																																				
4	White		no connection	OSSD2																																				
5	Black		no connection	OSSD1																																				
6	Blue		0 V dc	0 V dc																																				
7	Gn/Ye		Gnd/Chassis	Gnd/Chassis																																				
8	Violet		Scan Code	Scan Code																																				
DEE2R-83D	0.9 m (3 ft)																																							
DEE2R-88D	2.5 m (8 ft)																																							
DEE2R-812D	3.6 m (12 ft)																																							
DEE2R-815D	4.6 m (15 ft)																																							
DEE2R-825D	7.6 m (25 ft)																																							
DEE2R-830D	9.1 m (30 ft)																																							
DEE2R-850D	15.2 m (50 ft)																																							
DEE2R-875D	22.9 m (75 ft)																																							
DEE2R-8100D	30.5 m (100 ft)																																							
																																								

Table 24: DEE2R-5..D 5-pin M12/Euro-style QD to M12/Euro-style QD (female-male) cordsets

Used for extending the length of cordsets and directly connects to other devices with a 5-pin M12/Euro-style quick disconnect. Other lengths are available.

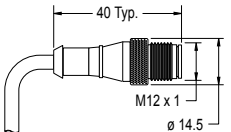
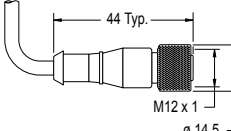
Model	Length	Banner Cordset Pinout/Color Code				M12 Connector (female face view)																									
DEE2R-51D	0.3 m (1 ft)	<table><thead><tr><th>Pin</th><th>Color</th><th>Emitter Function</th><th>Receiver Function</th></tr></thead><tbody><tr><td>1</td><td>Brown</td><td>+24 V dc</td><td>+24 V dc</td></tr><tr><td>2</td><td>White</td><td>no connection</td><td>OSSD2</td></tr><tr><td>3</td><td>Blue</td><td>0 V dc</td><td>0 V dc</td></tr><tr><td>4</td><td>Black</td><td>no connection</td><td>OSSD1</td></tr><tr><td>5</td><td>Gn/Ye</td><td>Gnd/Chassis</td><td>Gnd/Chassis</td></tr></tbody></table>				Pin	Color	Emitter Function	Receiver Function	1	Brown	+24 V dc	+24 V dc	2	White	no connection	OSSD2	3	Blue	0 V dc	0 V dc	4	Black	no connection	OSSD1	5	Gn/Ye	Gnd/Chassis	Gnd/Chassis		
Pin	Color					Emitter Function	Receiver Function																								
1	Brown					+24 V dc	+24 V dc																								
2	White					no connection	OSSD2																								
3	Blue					0 V dc	0 V dc																								
4	Black					no connection	OSSD1																								
5	Gn/Ye					Gnd/Chassis	Gnd/Chassis																								
DEE2R-53D	0.9 m (3 ft)																														
DEE2R-58D	2.5 m (8 ft)																														
DEE2R-515D	4.6 m (15 ft)																														
DEE2R-525D	7.6 m (25 ft)																														
DEE2R-550D	15.2 m (50 ft)																														
DEE2R-575D	22.9 m (75 ft)																														
DEE2R-5100D	30.5 m (100 ft)																														

Table 25: MQDEC-4xxSS 4-pin M12/Euro-style QD to M12/Euro-style QD (female-male) cordsets

Used for connecting to devices that do not have earth ground on pin 5 of a 5-pin QD (In such situations, earth ground must be provided via the mounting brackets). This cordsets has black PVC cables and black overmolds.

Model	Length	Banner Cordset Pinout/Color Code				M12 Connector (female face view)																				
MQDEC-401SS	0.3 m (1 ft)	<table><thead><tr><th>Pin</th><th>Color</th><th>Emitter Function</th><th>Receiver Function</th></tr></thead><tbody><tr><td>1</td><td>Brown</td><td>+24 V dc</td><td>+24 V dc</td></tr><tr><td>2</td><td>White</td><td>no connection</td><td>OSSD2</td></tr><tr><td>3</td><td>Blue</td><td>0 V dc</td><td>0 V dc</td></tr><tr><td>4</td><td>Black</td><td>no connection</td><td>OSSD1</td></tr></tbody></table>				Pin	Color	Emitter Function	Receiver Function	1	Brown	+24 V dc	+24 V dc	2	White	no connection	OSSD2	3	Blue	0 V dc	0 V dc	4	Black	no connection	OSSD1	
Pin	Color					Emitter Function	Receiver Function																			
1	Brown					+24 V dc	+24 V dc																			
2	White					no connection	OSSD2																			
3	Blue					0 V dc	0 V dc																			
4	Black					no connection	OSSD1																			
MQDEC-403SS	0.9 m (3 ft)																									
MQDEC-406SS	1.8 m (6 ft)																									
MQDEC-412SS	3.6 m (12 ft)																									
MQDEC-420SS	6.1 m (20 ft)																									
MQDEC-430SS	9.2 m (30 ft)																									
MQDEC-450SS	15.2 m (50 ft)																									

Table 26: DELSE-..1D RD to M12/Euro-style QD (male) cordsets

Used to create or replace a 300 mm pigtail M12/Euro-style quick disconnect (model number ends in P8 or P5).

Model	Length	Banner Cordset Pinout/Color Code			
DELSE-81D	0.3 m (1 ft)	Pin	Color	Emitter Function	Receiver Function
		1	Brown	+24 V dc	+24 V dc
		2	Or/Bk	Fault	Fault
		3	Orange	ID in	EDM
		4	White	no connection	OSSD2
		5	Black	no connection	OSSD1
		6	Blue	0 V dc	0 V dc
		7	Gn/Ye	Gnd/Chassis	Gnd/Chassis
		8	Violet	Scan Code	Scan Code
DELSE-51D	0.3 m (1 ft)	Pin	Color	Emitter Function	Receiver Function
		1	Brown	+24 V dc	+24 V dc
		2	White	no connection	OSSD2
		3	Blue	0 V dc	0 V dc
		4	Black	no connection	OSSD1
		5	Gn/Ye	Gnd/Chassis	Gnd/Chassis

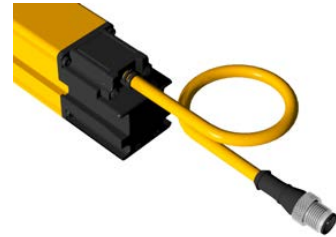


Table 27: DELSEF-81D RD to M12/Euro-style QD (female) cordset

Used for remote teach fixed blanking programming (see [Remote Blanking Key Switch Box](#) on page 87 for list of EZA-RBK-1 Remote Blanking Key Switch).

Model	Length	Banner Cordset Pinout/Color Code		
DELSEF-81D	0.3 m (1 ft)	Pin	Color	Function
		1	Brown	RUN/PROG Common
		2	Or/Bk	no connection
		3	Orange	no connection
		4	White	PROGRAM (N.O.)
		5	Black	RUN (N.C.)
		6	Blue	0 V dc
		7	Gn/Ye	no connection
		8	Violet	Indicator (+V)

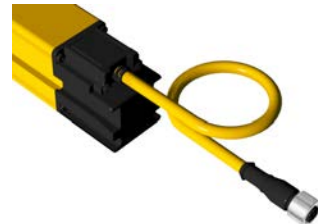



Table 28: DELSEF-4..D 4-pin RD to M12/Euro-style QD (female) cordsets

Used for connecting one or two-color EZ-LIGHTS or other indicators (see [EZ-LIGHTS® for EZ-SCREEN® LS](#) on page 88 for list of EZ-LIGHTS).

Model	Length	Banner Cordset Pinout/Color Code																
DELSEF-40D	0.07 m (0.2 ft)	<table><tr><th>Pin</th><th>Color</th><th>Function</th></tr><tr><td>1</td><td>Brown</td><td>OSSD OFF/FAULT (red)</td></tr><tr><td>2</td><td>White</td><td>no connection</td></tr><tr><td>3</td><td>Blue</td><td>0 V dc</td></tr><tr><td>4</td><td>Black</td><td>OSSD ON (green)</td></tr></table>	Pin	Color	Function	1	Brown	OSSD OFF/FAULT (red)	2	White	no connection	3	Blue	0 V dc	4	Black	OSSD ON (green)	
Pin	Color		Function															
1	Brown		OSSD OFF/FAULT (red)															
2	White		no connection															
3	Blue		0 V dc															
4	Black	OSSD ON (green)																
DELSEF-41D	0.3 m (1 ft)																	
DELSEF-43D	1 m (3.3 ft)																	
DELSEF-48D	2.5 m (8.2 ft)																	
DELSEF-415D	4.6 m (15.1 ft)																	

Splitter Cordsets

Model CSB splitter cordsets allow easy interconnection between an EZ-SCREEN 8-pin receiver and its 8-pin emitter, providing a single trunk cable for the optional "swapable" hookup. The model DEE2R... double-ended cables 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 (11.8 in) long. The model QDE-8...D single-ended cables may be used to extend the QD trunk for cut-to-length applications.

Table 29: 8-Pin Splitter Cordsets

Allows easy interconnection between an 8-pin receiver and 8-pin emitter, and provides a single trunk cable for the optional interchangeable ("swapable") hookup

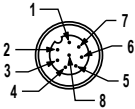
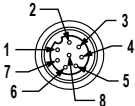
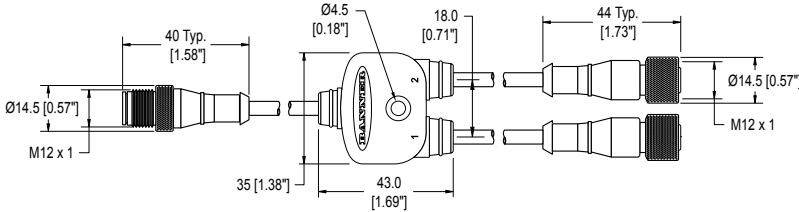
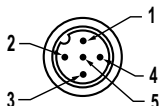
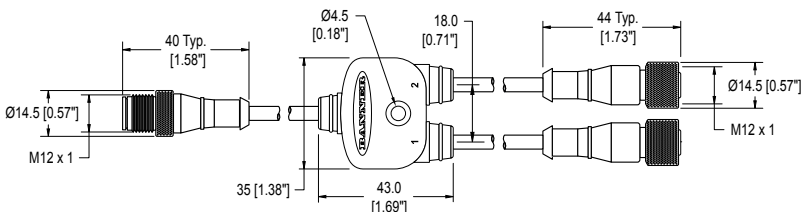
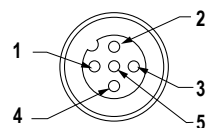
8-Pin Threaded M12/Euro-Style Splitter Cordsets—Flat Junction			
Model	Trunk (Male)	Branches (Female)	Pinout
CSB-M1280M1280	No trunk	No branches	<div>Male</div> <div></div> <div>Female</div> <div></div> <div>1 = Brown 2 = Or/Bk 3 = Orange 4 = White 5 = Black 6 = Blue 7 = Gn/Ye 8 = Violet</div>
CSB-M1281M1281	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 ¹⁷	7.62 m (25 ft) Unterminated		
<div></div>			

Table 30: 5-Pin Splitter Cordsets

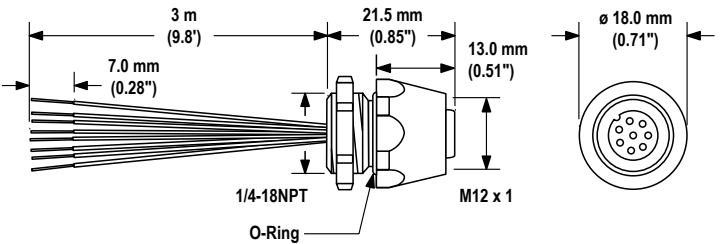
Allows easy interconnection between an 5-pin receiver and 5-pin emitter, and provides a single trunk cable for the optional interchangeable ("swapable") hookup.

¹⁷ Standard cordsets are yellow PVC with black overmold. For black PVC and overmold, add suffix B to model number (example, CSB-M1280M1280B).

5-Pin Threaded M12/Euro-Style Splitter Cordsets—Flat Junction			
Model	Trunk (Male)	Branches (Female)	Pinout
CSB-M1251M1251	0.3 m (1 ft)	2 x 0.3 m (1 ft)	<div>Male</div> 
CSB-M1258M1251	2.44 m (8 ft)		
CSB-M12515M1251	4.57 m (15 ft)		
CSB-M12525M1251	7.62 m (25 ft)		
CSB-UNT525M1251 ¹⁸	7.62 m (25 ft) Unterminated		
			<div>Female</div>  <div>1 = Brown 2 = White 3 = Blue 4 = Black 5 = Grn/Ye</div>

Bulkhead Connector

Connector for panel connection of EZ-SCREEN LS emitter and receiver 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 mm ²	

10.2.2 Universal (Input) Safety Modules

UM-FA-xA Safety Modules provide forced-guided, mechanically-linked relay (safety) outputs for the EZ-SCREEN LS system with a 5-pin interconnect (P5) or 8-pin interconnect (P8) when a manual reset (latch) is required by the application. See datasheet p/n [141249](#) for more information.

Model	Description
UM-FA-9A	3 normally open (N.O.) redundant-output 6 amp contacts
UM-FA-11A	2 normally open (N.O.) redundant-output 6 amp contacts, plus 1 normally closed (N.C.) auxiliary contact

¹⁸ Standard cordsets are yellow PVC with black overmold. For black PVC and overmold, add suffix B to model number (example, CSB-M1280M1280B).

10.2.3 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 manuals p/n [174868](#) (XS/SC26-2) and [133487](#) (SC22-3).

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

Model	Description
SC22-3-S	22 safety inputs, 10 Auxiliary Outputs, 3 Redundant Solid State safety Outputs with display
SC22-3-SU1	22 safety inputs, 10 Auxiliary Outputs, 3 Redundant Solid State safety Outputs with display (includes programming tool and USB cable)
SC22-3E-S	22 safety inputs, 10 Auxiliary Outputs, 3 Redundant Solid State safety Outputs with display and Ethernet
SC22-3E-SU1	22 safety inputs, 10 Auxiliary Outputs, 3 Redundant Solid State safety Outputs with display and Ethernet (includes programming tool and USB cable)

10.2.4 Muting Module

Provides the muting capability for the EZ-SCREEN LS. See Banner manual [116390](#) for more information and additional cabling options.

Model	Description	
MMD-TA-11B	DIN-mount Muting module	2 N.O. safety outputs (6 amps), 2 or 4 muting inputs, SSI, override input; IP20; terminal connections
MMD-TA-12B		2 OSSD outputs, 2 or 4 muting inputs, SSI, override input; IP20; terminal connections

10.2.5 Interface Modules

IM-T-...A interface modules provide forced-guided, mechanically-linked relay (safety) outputs for the EZ-SCREEN LS System with an 8-pin interconnect (with EDM function). The IM-T-...A interface module is required to be monitored by the EDM function and should not be used with EZ-SCREEN LS with a 5-pin interconnection (P5). See Banner datasheet p/n [62822](#) for more information.

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

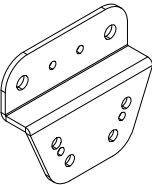
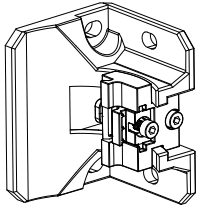
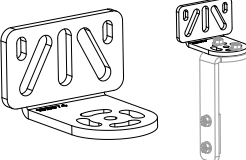
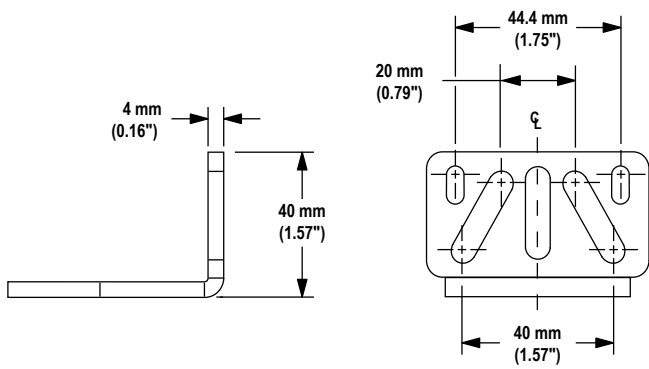
10.2.6 Contactors

If used, two contactors per EZ-SCREEN LS System that are monitored by the EDM circuit are required and should not be used with the EZ-SCREEN LS with a 5-pin interconnection (P5) model. See Banner datasheet p/n [111881](#) for more information.

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)

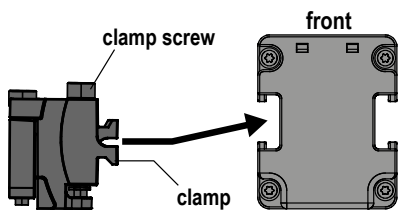
10.2.7 Optional Mounting Brackets

See [Replacement Parts](#) on page 91 for standard brackets. Contact Banner Engineering Corp. for more information.

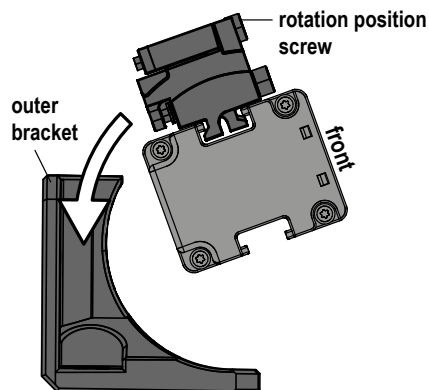
<p>EZA-MBK-2</p> <ul style="list-style-type: none"> Adapter bracket for mounting SSM series mirror to MSA series stands  <p>Hole center spacing: A = 63.9, B = 19.9, A to B = 22.0</p> <p>Hole size: A = \varnothing 8.3, B = \varnothing 4.8</p>	<p>EZLSA-MBK-16</p> <ul style="list-style-type: none"> Side-mounting bracket provides a mounting option that is full adjustable (lateral and +15/-20° rotational) from the face of the sensor and allows "no blind zone" mounting with minimal or no "gaps" in detection. The bracket can be mounted to a surface on the back or the side of the sensor. Includes one bracket and hardware. Order two or three EZLSA-MBK-16 brackets per sensor. 
<p>EZLSA-MBK-20</p> <ul style="list-style-type: none"> Adapter brackets for mounting to engineered/slotted aluminum framing such as 80/20™ and Unistrut™. Angled slots allow mounting to 20 mm to 40 mm dual channel and center slot. Allows mounting to single channel framing Used to replace the flange bracket of the EZLSA-MBK-11 (included with emitter and receiver) Order one EZLSA-MBK-20 bracket per sensor, two per pair. 	<p>EZLSA-MBK-20 Dimensions</p>  <p>Side view dimensions: 4 mm (0.16"), 40 mm (1.57")</p> <p>Top view dimensions: 44.4 mm (1.75"), 20 mm (0.79"), 40 mm (1.57")</p>

This installation guide describes how to mount the EZLSA-MBK-16 side-mount brackets. See [Optional EZLSA-MBK-16 Side-Mount Bracket](#) on page 23 for more information.

- 1 Adjust clamp screw to loosen or tighten clamp.

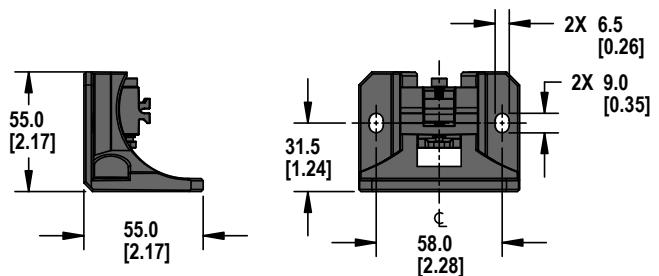
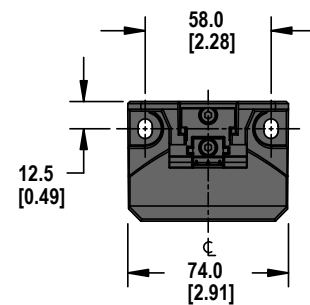
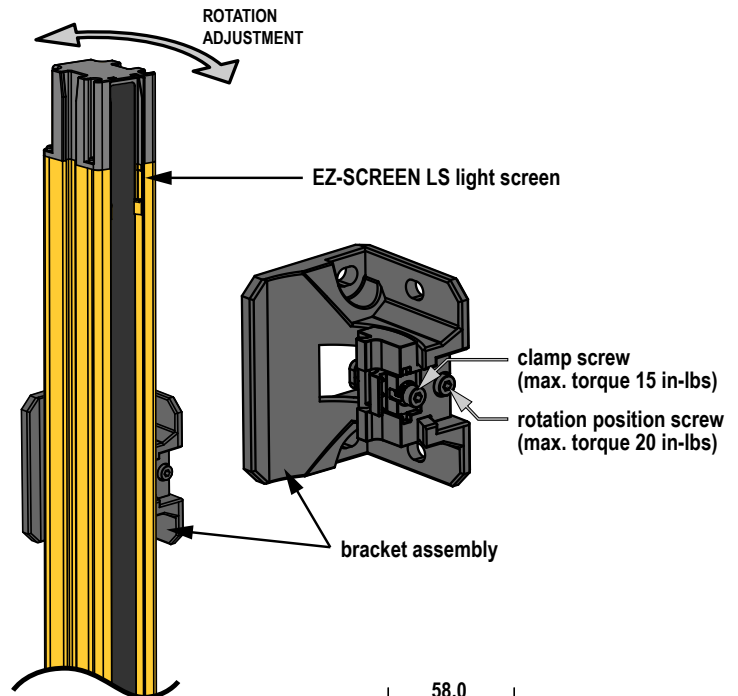
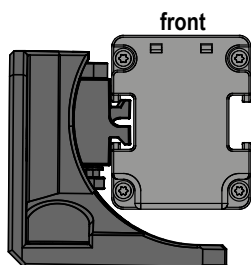


- 2 Slide inner bracket assembly into outer bracket groove.



(Depending on your configuration, it may be helpful to mount the outer bracket to the mount surface first before Step 2 process)

- 3 With the light screen aligned, tighten rotation position screw to complete installation.




10.2.8 Remote Blanking Key Switch Box

Use the remote blanking key switch box to configure fixed blanking remotely on cascadeable model receivers. The DELSEF-81D cordset interfaces with the receiver cascade end and the DEE2R-8..D cordset provides the required extension as needed.

Model	Description
EZA-RBK-1	Remote Blanking Key Switch. Allows the configuration of a fixed blanked area.




10.2.9 Alignment Aids

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

10.2.10 Snap-On Lens Shields

Impact-resistant copolyester lens shields snap easily over entire length of sensor housing, protecting against direct contact with fluids and solid debris. The lens shields are not sealed at top and bottom, and decrease sensing range by approximately 20% when they are protecting both the emitter and receiver. Order one per sensor.

Sensor Model	Lens Shield Model	Sensor Model	Lens Shield Model	
SLL..-280..	EZLS-280	SLL..-1050..	EZLS-1050	
SLL..-350..	EZLS-350	SLL..-1120..	EZLS-1120	
SLL..-420..	EZLS-420	SLL..-1190..	EZLS-1190	
SLL..-490..	EZLS-490	SLL..-1260..	EZLS-1260	
SLL..-560..	EZLS-560	SLL..-1330..	EZLS-1330	
SLL..-630..	EZLS-630	SLL..-1400..	EZLS-1400	
SLL..-700..	EZLS-700	SLL..-1470..	EZLS-1470	
SLL..-770..	EZLS-770	SLL..-1540..	EZLS-1540	
SLL..-840..	EZLS-840	SLL..-1610..	EZLS-1610	
SLL..-910..	EZLS-910	SLL..-1680..	EZLS-1680	
SLL..-980..	EZLS-980	SLL..-1750..	EZLS-1750	
		SLL..-1820..	EZLS-1820	

10.2.11 Tubular Enclosures


The tubular enclosures include stainless mounting brackets and hardware and are:

- Ideal for high-pressure wash-down environments
- Made of clear FDA-grade polycarbonate tubing with acetal end caps

EZ-SCREEN® LS Safety Light Screen

- Rated NEMA 4X; IP67

Using enclosures affects the sensing range of the emitter/receiver used: when in pairs, range can be reduced by 50%. The EZA-MBK-2 adapter bracket is required for use with the MSA Series stand, see [MSA Series Stands](#) on page 91.

Sensor Model	Tubular Enclosure Model	Sensor Model	Tubular Enclosure Model	
SLL..-280..	EZLSA-TE-280	SLL..-1050..	EZLSA-TE-1050	
SLL..-350..	EZLSA-TE-350	SLL..-1120..	EZLSA-TE-1120	
SLL..-420..	EZLSA-TE-420	SLL..-1190..	EZLSA-TE-1190	
SLL..-490..	EZLSA-TE-490	SLL..-1260..	EZLSA-TE-1260	
SLL..-560..	EZLSA-TE-560	SLL..-1330..	EZLSA-TE-1330	
SLL..-630..	EZLSA-TE-630	SLL..-1400..	EZLSA-TE-1400	
SLL..-700..	EZLSA-TE-700	SLL..-1470..	EZLSA-TE-1470	
SLL..-770..	EZLSA-TE-770	SLL..-1540..	EZLSA-TE-1540	
SLL..-840..	EZLSA-TE-840	SLL..-1610..	EZLSA-TE-1610	
SLL..-910..	EZLSA-TE-910	SLL..-1680..	EZLSA-TE-1680	
SLL..-980..	EZLSA-TE-980	SLL..-1750..	EZLSA-TE-1750	
		SLL..-1820..	EZLSA-TE-1820	

10.2.12 EZ-LIGHTS® for EZ-SCREEN® LS

Provides clear, 360° indication of the of the EZ-SCREEN receiver's output status and receiver lockouts. EZ-LIGHT or other means of indication must draw less than 100 mA at 24 V dc.



Figure 51. EZ-SCREEN LS with M18 EZ-LIGHT



Figure 52. EZ-SCREEN LS with EZLSA-K30LGR EZ-LIGHT



Figure 53. EZ-SCREEN LS with TL50 EZ-LIGHT

Table 31: Stand-Alone Receivers (SLLR..-....P8)

With stand-alone receivers (SLLR..-....P8), use with a CSB-M128..M1281 splitter cable and optional DEE2R-8..D double-ended cables. Use only EZ-LIGHT models with the suffix "8PQ8" when connecting to the machine interface connection. See datasheet p/n [121901](#) for more information.













Models		Construction	Connector/LED Function/Inputs
	M18RGX8PQ8 ¹⁹	Nickel-plated brass housing, M18 × 1 thread; thermoplastic lens Fully encapsulated IP67	8-pin M12/Euro-style Integral QD Red/green indication follows OSSD output of the EZ-SCREEN receiver Red ON: Power ON, Beam Blocked, or Lockout Green ON: Power ON or Beam Clear
	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	

Table 32: Cascade Receivers (SLLCR...-....)

With cascade receivers (SLLCR...-....), use a DELSEF-4..D RD-to-M12/Euro-style QD (4-pin) and optional DEE2R-5..D double-ended cables for remotely locating the EZ-LIGHT, or a EZLSA-K30LGR can be mounted directly to the CSSI connector.

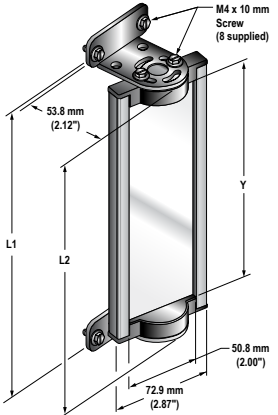
Model	Construction	Connection	LED Function
	<ul style="list-style-type: none"> Base: ABS and Polycarbonate Domes: Polycarbonate IP67 Indicates System Status Adds 35 mm (1.38 in) to the housing length Patent Pending 	Integral RDLS connector connects directly to SLLCR... receiver	Green ON: OSSDs On
	<ul style="list-style-type: none"> Bases and Domes: Polycarbonate 22.5 mm base mount IP67, IP69K Indicates System Status 	4-pin M12/Euro-style QD DELSEF-4..D	Red ON: OSSDs Off Red Flashing: Receiver lockout (OSSDs off)
	<ul style="list-style-type: none"> Bases and Domes: Polycarbonate 30 mm base mount IP67, IP69K Indicates System Status 	4-pin M12/Euro-style QD DELSEF-4..D	

¹⁹ 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).

Model	Construction	Connection	LED Function
 K50FLGRXPQ	<ul style="list-style-type: none"> Bases and Domes: Polycarbonate IP67, IP69K Indicates System Status 	4-pin M12/Euro-style QD DELSEF-4..D	
 K80LGRXPQ	<ul style="list-style-type: none"> Bases: ABS and Polycarbonate Dome: Polycarbonate IP67 Indicates System Status 		
 TL50GRQ	<ul style="list-style-type: none"> Bases and Covers: ABS Light Segment: Polycarbonate 30 mm base mount IP67 Indicates System Status 		

10.2.13 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 **Banner Engineering website** 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.
- MSAMB adapter bracket kit included with each MSA stand.

Mirror Model	Defined Area Length	Reflective Area Y	Mounting L1	Mounting L2	
MSM8A	150 mm (5.9 in)	267 mm (10.5 in)	323 mm (12.7 in)	292 mm (11.5 in)	 <p>Diagram illustrating the dimensions and mounting details of the MSM Series Corner Mirror. The mirror is shown with its mounting brackets and screws. Dimensions include L1 (total mounting length), L2 (mounting length to the mirror), Y (reflective area height), and specific mounting dimensions: 53.8 mm (2.12") for the top bracket, 72.9 mm (2.87") for the bottom bracket, and 50.8 mm (2.00") for the mirror width. The mounting is secured with M4 x 10 mm screws (8 supplied).</p>
MSM12A	300 mm (11.8 in)	356 mm (14 in)	411 mm (16.2 in)	381 mm (15 in)	
MSM20A	450 mm (17.7 in)	559 mm (22 in)	615 mm (24.2 in)	584 mm (23 in)	
MSM24A	600 mm (23.6 in)	660 mm (26 in)	716 mm (28.2 in)	686 mm (27 in)	
MSM32A	750 mm (29.5 in)	864 mm (34 in)	919 mm (36.2 in)	889 mm (35 in)	
MSM36A	900 mm (35.4 in)	965 mm (38 in)	1021 mm (40.2 in)	991 mm (39 in)	
MSM44A	1050 mm (41.3 in)	1168 mm (46 in)	1224 mm (48.2 in)	1194 mm (47 in)	
MSM48A	1200 mm (47.2 in)	1270 mm (50 in)	1326 mm (52.2 in)	1295 mm (51 in)	

10.2.14 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 **Banner Engineering website** for further information.
- Stainless steel reflective surface models are also available. See datasheet p/n 67200.
- Robust construction, two mounting brackets and hardware included.
- EZA-MBK-2 adapter bracket is required for use with MSA Series stand, see [Optional Mounting Brackets](#) on page 85.
- Brackets may be inverted from the positions shown, decreasing dimension L1 by 58 mm (2.3 in).

Mirror Model ²⁰	Defined Area Length	Reflective Area Y	Mounting 1	Mounting L2	
SSM-200	150 mm (5.9 in)	200 mm (7.9 in)	278 mm (10.9 in)	311 mm (12.2 in)	
SSM-375	300 mm (11.8 in)	375 mm (14.8 in)	486 mm (19.1 in)	453 mm (17.8 in)	
SSM-550	450 mm (17.7 in)	550 mm (21.7 in)	661 mm (26.0 in)	628 mm (24.7 in)	
SSM-675	600 mm (23.6 in)	675 mm (26.6 in)	786 mm (31.0 in)	753 mm (29.6 in)	
SSM-825	750 mm (29.5 in)	825 mm (32.5 in)	936 mm (36.9 in)	903 mm (35.6 in)	
SSM-975	900 mm (35.4 in)	975 mm (38.4 in)	1086 mm (42.8 in)	1053 mm (41.5 in)	
SSM-1100	1050 mm (41.3 in)	1100 mm (43.3 in)	1211 mm (47.7 in)	1178 mm (46.4 in)	
SSM-1275	1200 mm (47.2 in)	1275 mm (50.2 in)	1386 mm (54.6 in)	1353 mm (53.3 in)	
SSM-1400	1350 mm (53.1 in)	1400 mm (55.1 in)	1511 mm (59.5 in)	1478 mm (58.2 in)	
SSM-1550	1500 mm (59.0 in)	1550 mm (61.0 in)	1661 mm (65.4 in)	1628 mm (64.1 in)	
SSM-1750	1650 mm (65.0 in)	1750 mm (68.9 in)	1861 mm (73.3 in)	1828 mm (72.0 in)	
SSM-1900	1800 mm (70.9 in)	1900 mm (74.8 in)	2011 mm (79.2 in)	1978 mm (77.9 in)	

10.2.15 MSA Series Stands

- Provides mounting T-slots with 20 mm dimension between slots
- 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)	
MSA-S105-1	2667 mm (105 in)	2667 mm (100 in)	2673 mm (105.25 in)	

10.3 Replacement Parts

Model	Description
STP-13	14 mm test piece (14 mm resolution systems)
STP-19	23 mm test piece (23 mm resolution systems)
STP-20	40 mm test piece (40 mm resolution systems)
EZLSA-RTP-1	Terminator plug, for SLLCR... receivers (included with receivers)
EZLSA-DP-1	Dust plug, for SLLCE... emitters (included with emitters)
DELSE-51D	Replacement for 300 mm pigtail, as shipped with standard 5-pin pigtail QD models; 5-conductor cable, 0.3 m (1 ft) long
DELSE-81D	Replacement for 300 mm pigtail, as shipped with standard 8-pin pigtail QD models; 8-conductor cable, 0.3 m (1 ft) long
EZLSA-MBK-11	End-cap bracket kit (includes 2 end brackets and hardware); 360° sensor rotation possible ($\pm 23^\circ$ increments); 8 ga (4.0 mm) steel, black zinc plated; Includes 2 brackets and hardware

²⁰ Stainless steel reflective surface models are available by adding model number suffix "-S" (for example, SSM-375-S); range reduction for these models is approximately 30% per mirror. See datasheet p/n 67200.

EZ-SCREEN® LS Safety Light Screen

Model	Description
EZLSA-MBK-12	Center-mount bracket kit (includes 1 bracket and hardware); +15°/ –30° sensor rotation; 8 ga (4.0 mm) steel, black zinc plated; die-cast zinc clamp. Includes 1 bracket and hardware
SMA-MBK-1	SSM mirror bracket kit. Includes 2 replacement brackets for one mirror

11 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.

11.1 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
 ANSI NFPA 79 Electrical Standard for Industrial Machinery
 ANSI/PMMA B155.1 Package Machinery and Packaging-Related Converting Machinery — Safety Requirements

11.2 Applicable 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

11.3 International/European Standards

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

ISO 13857 Safety Distances . . . Upper and Lower Limbs

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

ISO 13851 (EN 574) Two-Hand Control Devices – Functional Aspects – Principles for Design

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

ISO 13849-1 Safety-Related Parts of Control Systems

ISO 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

IEC 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

12 Glossary

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 page 93.

Auto Power-Up
A safety light screen system feature that enables the system to be powered up into Run mode (or recover from a power interruption) without requiring a manual reset.

B

Blanking
A programmable feature of a safety light screen system which allows the light screen to ignore certain objects located within the defined area. See *Floating Blanking* and *Reduced Resolution*.

Brake
A mechanism for stopping, slowing, or preventing motion.

Blocked Condition
A condition that occurs when an opaque object of sufficient size blocks/interrupts one or more light screen beams. When a blocked condition occurs, OSSD1 and OSSD2 outputs simultaneously turn off within the system response time.

C

Cascade
Series connection (or "daisy-chaining") of multiple emitters and receivers.

Control Reliability
A method of ensuring the performance integrity of a control system or device. Control circuits are designed and constructed so that a single failure or fault within the system does not prevent the normal stopping action from being applied to the machine when required, or does not create unintended machine action, but does prevent initiation of successive machine action until the failure is corrected.

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.

Clutch
A mechanism that, when engaged, transmits torque to impart motion from a driving member to a driven member.

CSA
Abbreviation for Canadian Standards Association, a testing agency similar to Underwriters Laboratories, Inc. (UL) in the United States. A CSA-certified product has been type-tested and approved by the Canadian Standards Association as meeting electrical and safety codes.

D

Defined Area
The "screen of light" generated by a safety light screen system, defined by the height and the safety distance (minimum distance) of the emitter and receiver. When the defined area is interrupted by an opaque object of a specified cross section, a Trip or Latch condition results.

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.

E	
Emitter The light-emitting component of a safety light screen 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.	External Device Monitoring (EDM) A means by which a safety device (such as a safety light screen) 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.	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.
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.	
G	
Guarded Machine The machine whose point of operation is guarded by the safety system.	
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."	Hazard Point The closest reachable point of the hazardous area.
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.	Hazardous Area An area that poses an immediate or impending physical hazard.
I	
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 screen system to RUN mode following a Lockout condition. Also refers to the act of using the switch.	

L	
Latch Condition The response of the safety light screen safety outputs (for example, OSSDs) when an object equal to or greater than the diameter of the specified test piece enters the defined area. In a Latch condition, safety outputs simultaneously de-energize and open their contacts. The contacts are held (latched) open until the object is removed from the defined area and a manual reset is performed. A latching output is used most often in perimeter guarding applications. (See <i>Trip Condition</i> .)	Lockout Condition A safety light screen condition that is automatically attained in response to certain failure signals (an internal lockout). When a Lockout condition occurs, the safety light screen'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.	Minimum Object Sensitivity (MOS) The minimum-diameter object that a safety light screen 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 <i>Specified Test Piece</i> .
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.	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.	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.
On State The state in which the output circuit is complete and permits the flow of current.	OSSD Output Signal Switching Device. The safety outputs that are used to initiate a stop signal.
P	
Part-Revolution Clutch A type of clutch that may be engaged or disengaged during the machine cycle. Part-revolution clutched machines use a clutch/brake mechanism, which can arrest machine motion at any point in the stroke or cycle.	Point of Operation The location of a machine where material or a workpiece is positioned and a machine function is performed upon it.
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.	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 screen 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 screen 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.

Reset

The use of a manually operated switch to restore the safety outputs to the On state from a lockout condition.

Resolution

See *Minimum Object Sensitivity*

S

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 screen systems and safety modules are self-checking.

Separation Distance (Safety Light Screen)

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 screen system response time, and the light screen minimum object detection size.

Specified Test Piece

An opaque object of sufficient size used to block a light beam to test the operation of a safety light screen system. When inserted into any part of the defined area, it will place a system into a Trip or Latch condition. Banner supplies specified test pieces with each system. See also *Minimum Object Sensitivity*.

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.

T

Test Piece

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

Trip Condition

The response of the safety outputs (for example, OSSDs) of a safety light screen system when an object equal to or greater than the diameter of the specified test piece enters the defined area. In a Trip condition, the OSSDs simultaneously de-energize. A Trip condition clears (resets) automatically when the object is removed from the defined area. (See *Latch Condition*.)

Trip Initiate

The resetting of a safeguard causing the initiation of machine motion or operation. Trip 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.