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EZ-SCREEN® LP

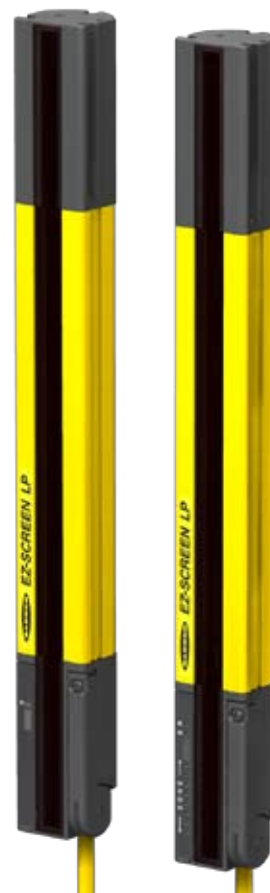
Low-Profile Safety Light Screen

Instruction Manual

Original Instructions

Features

- A two-piece optoelectronic safeguarding device
- Creates a screen of synchronized, modulated infrared sensing beams that extend from end to end of the housing (no “dead” zone)
- Low-profile, compact package for smaller production machines, robust for large power presses
- Choose standard or cascadeable models
- 14 mm or 25 mm resolution; defined areas from 270 to 1810 mm (10.6" to 71.2")
- 100 mm to 7 m (4" to 23') sensing range
- Easily configured reduced resolution and fixed blanking. Remote Teach of fixed blanking option on cascade models.
- Zone and Status indicators plus digital display to indicate number of beams blocked, detailed diagnostics
- Highly immune to EMI, RFI, ambient light, weld flash, and strobe light
- Selectable 1-ch, 2-ch, or no external device monitoring
- Selectable auxiliary output option to monitor the state of the OSSDs or monitor receiver and emitter lockouts
- Selectable emitter test option simulates a “blocked” condition
- Vibration-tolerant, factory burned-in emitter and receiver circuitry for toughness and dependability
- FMEA tested to ensure control reliability
- Up to four pairs of SLPC.. model emitters and receivers can be cascaded
- Safety PLC input compatible (per OSSD specifications)



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Important ... read this page before proceeding!

In the United States, the functions that EZ-SCREEN LP is intended to perform are regulated by the Occupational Safety and Health Administration (OSHA). Outside of the United States, these functions are regulated by other agencies, organizations, and governments. Whether or not any particular EZ-SCREEN LP installation meets all applicable requirements depends upon factors that are beyond the control of Banner Engineering Corp. These factors include the details of how the EZ-SCREEN LP is applied, installed, wired, operated, and maintained. **It is the responsibility of the purchaser and user to apply this EZ-SCREEN LP System in full compliance with all relevant applicable regulations and standards.**

EZ-SCREEN LP can guard against accidents only when it is properly installed and integrated into the machine, properly operated, and properly maintained. Banner Engineering Corp. has attempted to provide complete application, installation, operation, and maintenance instructions. In addition, please direct any questions regarding application or use of EZ-SCREEN LP to the factory applications department at the telephone number or addresses shown on the back cover.

In addition to OSHA regulations, several other organizations provide information about the use of safeguarding devices. Refer to the American National Standards Institute (ANSI), the Robotics Industries Association (RIA), the Association for Manufacturing Technology (AMT), and others (see below). Banner Engineering Corp. makes no claim regarding a specific recommendation of any organization, the accuracy or effectiveness of any information provided, or the appropriateness of the provided information for a specific application.

The user has the responsibility to ensure that all local, state, and national laws, rules, codes, and regulations relating to the use of this safeguarding system in any particular application are satisfied. Extreme care is urged to ensure that all legal requirements have been met and that all installation and maintenance instructions contained in this manual are followed.

Safety Standards Applicable to Use of EZ-SCREEN LP

See inside back cover for information pertaining to applicable U.S., European and International standards, and where to acquire copies.

Certificate of Adequacy

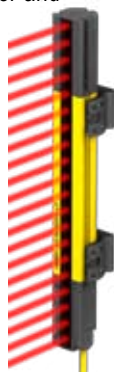
The EZ-SCREEN LP Instruction Manual (p/n 140044) satisfies the requirements of Machinery Directive 2006/42/EC, Safety of Machinery, Section 1.7.4 — Instructions.

1. Overview

1.1 Introduction

Banner EZ-SCREEN LP emitters and receivers provide a redundant, microprocessor-controlled, opposed-mode optoelectronic “curtain of light,” or “safety light screen.” EZ-SCREEN LP typically is used for point-of-operation safeguarding, and is suited to safeguard a variety of machinery.

Emitters have a row of synchronized modulated infrared (invisible) light-emitting diodes (LEDs) in a compact metal housing. Receivers have a corresponding row of synchronized photodetectors. The light screen created by the emitter and receiver is called the “defined area”; its width and height are determined by the length of the sensor pair and the distance between them. The low-profile housing provides maximum sensing within minimum space; its defined area (sensing area) is equivalent to the height of the housing. The maximum sensing range is 7 m (23'), which decreases if corner mirrors are used. The sensing area extends from end to end of the housing; there is no “dead zone.” Specialty brackets allow easy mounting of cascaded sensors, without any loss of resolution between sensor pairs.



In typical operation, if any part of an operator’s body (or any opaque object) of more than a pre-determined cross section is detected, the solid-state output signal switching device (OSSD) safety outputs will turn OFF. These safety outputs are connected to the guarded machine’s final switching devices (FSDs) that control the primary control elements (MPCEs), which immediately stop the motion of the guarded machine.

EZ-SCREEN LP is extensively FMEA (Failure Mode and Effects Analysis) tested to establish an extremely high degree of confidence that when properly installed, no system component will (even if it should fail) cause a failure to danger.

The OSSD safety outputs are capable of performing a “handshake” communication with the muteable safety stop interface (MSSI) or universal safety stop interface (USSI) found on other Banner Engineering safety products.

Banner EZ-SCREEN LP is a two-piece (“two-box”) system – comprising an emitter and a receiver, but no external controller. The external device monitoring (EDM) function ensures the fault detection capability required by U.S. Control Reliability and ISO13849-1 Categories 3 and 4 without a third box, a controller or a “smart” (i.e., self-checking) safety module required of systems without EDM.

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

Functions such as Trip/Latch select, Display Invert, Cascading, Fixed Blanking (including Remote Teach), Reduced Resolution (Floating Blanking), Scan Code select, and External Device Monitoring are described in Section 1.4. An auxiliary (aux.) output may be used to signal the state of the OSSDs to a process controller; see Section 1.4.3. All models require a supply voltage of +24V dc \pm 15%. See Section 2.4 for interfacing solutions.

Both emitter and receiver feature 7-segment Diagnostic Displays and individual LEDs to provide continuous indication of operating status, configuration and error conditions. See Section 1.4.7 for more information.

This manual contains numerous WARNING and CAUTION statements. Warnings refer to situations that could lead to significant or serious personal injury or death. Cautions refer to situations that could lead to slight personal injury or potential damage to equipment.

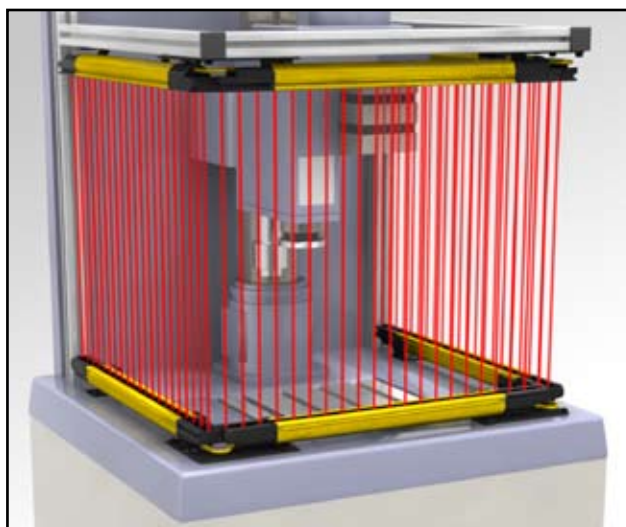


Figure 1-1. Banner EZ-SCREEN LP: a typical application

1.2 Applications and Limitations

The Banner EZ-SCREEN LP is intended for point-of-operation machine guarding applications 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.

Before installing the EZ-SCREEN LP, read this manual in its entirety, paying particular attention to this section and all of Section 3. The EZ-SCREEN LP's 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 LP cannot provide the protection for which it was designed.**

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

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

EZ-SCREEN LP may NOT be used with the following machinery or unsuitable applications:

- Any machine that cannot be stopped immediately after a stop signal is issued, such as single-stroke (or "full-revolution") clutched machinery.
- Any machine with inadequate or inconsistent machine response time and stopping performance.
- Any machine that ejects materials or component parts through the defined area.
- In any environment that is likely to adversely affect photoelectric sensing efficiency. For example, corrosive chemicals or fluids or unusually severe levels of smoke or dust, if not controlled, may degrade sensing efficiency.
- As a tripping device to initiate or reinitiate machine motion (PSDI applications), unless the machine and its control system fully comply with the relevant standard or regulation (see OSHA 29CFR1910.217, ANSI/NFPA 79, ANSI B11, ANSI/RIA R15.06, ISO 12100, IEC 60204-1, IEC 61496, or other appropriate standard).

If an EZ-SCREEN LP is installed for use as a perimeter guard (i.e., where a pass-through hazard may exist), **the dangerous machine motion can be initiated by normal means only after the safeguarded area is clear of individuals and the EZ-SCREEN LP has been manually reset. See Section 3.1.2.**

WARNING . . . Read this Section Carefully Before Installing the System

The user is responsible for satisfying all local, state, and national laws, rules, codes, or regulations relating to the installation and use of this control system in any particular application. Take extreme care to meet all legal requirements and follow all installation and maintenance instructions contained in this manual.

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

Carefully read this manual in its entirety, paying particular attention to Section 1.2 and all of Section 3, before installing the System. **Failure to follow these instructions could result in serious bodily injury or death.**

WARNING . . . Install EZ-SCREEN LP Only on Appropriate Applications

Banner EZ-SCREEN LP 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 EZ-SCREEN LP be used on full-revolution clutched machinery or in unsuitable applications as those listed at left. **If there is any doubt about whether or not your machinery is compatible with EZ-SCREEN LP, contact Banner's Application Engineers at the factory.**

1.3 Control Reliability: Redundancy and Self-Checking

Redundancy requires that EZ-SCREEN LP 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 LP is designed with redundant microprocessors.

Redundancy must be maintained whenever the EZ-SCREEN LP is in operation. Because a redundant system is no longer redundant after a component has failed, EZ-SCREEN LP 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 LP into a Lockout condition.

Recovery from this type of Lockout condition requires:

- replacement of the failed component (to restore redundancy) and
- the appropriate reset procedure (see Section 1.4.8).

The Diagnostic Display is used to diagnose causes of a Lockout condition (see Section 5.1).

1.4 Operating Features

The Banner EZ-SCREEN LP models described by this manual feature several standard selectable functions:

- Reduced Resolution (Floating Blanking),
- Trip or Latch Output,
- External Device Monitoring (EDM),
- Auxiliary Output — OSSD Follow or Fault,
- Scan Code setting,
- Fixed Blanking (including Remote Teach),
- Emitter Test and Fault functions,
- Inverted Display, and
- Cascading (available on SLPC.. models).

These functions are configured via DIP switches (behind the access door on the front of each sensor) and the sensor wiring configuration; see Sections 3 and 4.2 for more information.

The sensing resolution is determined by the emitter and receiver model. See Section 2 for a list of model numbers.

1.4.1 Selectable Trip/Latch Output

The setting for Trip or Latch Output determines whether the System will enter RUN mode automatically after power-up, or if it will require a manual reset first (see Sections 1.4.8 and 4.2). If the System is set for Trip Output, other measures must be taken to prevent a pass-through hazard; see Section 3.1.2 and the warning below for more information.

If Trip Output is selected, the OSSD outputs will turn ON after power is applied and the receiver passes its internal self-test/ synchronization and recognizes that all beams are clear. They will also automatically reset after all beams are cleared. If Latch Output is selected, the EZ-SCREEN LP requires a manual reset for the OSSD outputs to turn ON, whenever power is applied (and all beams are clear), or following a blocked beam (see Section 4.5).



WARNING . . . Use of Trip/Latch Output

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

1.4.2 Emitter Hookup Options

An EZ-SCREEN LP emitter can be connected either to its own power supply or to the receiver cable, color-for-color (see Figures 3-19 and 3-20). The color-for-color hookup allows the emitter and receiver positions to be interchanged without rewiring. If the color-for-color hookup is used, however, the emitter Test function is not available.

1.4.3 External Device Monitoring (EDM)

This feature allows the EZ-SCREEN LP to monitor the status of external devices, such as MPCEs. The choices are 1- or 2-channel monitoring, or no monitoring. EDM is used when the EZ-SCREEN LP's OSSD outputs directly control the MPCEs or other external devices; see Sections 3.5.3 and 4.2 for more information.

Auxiliary (Aux.) Output; OSSD Follow/Fault

An aux. output function is available when the receiver is configured for 1-channel EDM. This current sourcing (PNP) solid-state output (250 mA max.) is used for control functions that are not safety-related; a typical use is to signal the state of the OSSDs to a programmable logic controller (PLC). The aux. output either follows the state of the OSSDs or provides a fault signal (lockout = ON). DIP switch configuration and pin 2 (orange/black) connection configure this feature; see Section 3.5.5 and Figure 3-26. See Section 4.2 for information on the emitter Fault function.

1.4.4 Remote Test Input

EZ-SCREEN LP emitters provide a Test function, selectable by DIP switch. An external switch, typically a normally open contact, held closed, is connected between the emitter and 24V dc (see Section 3.5.4). Opening the switch “turns off” the emitter, simulating an interruption of one or more light beams. This function may be useful for EZ-SCREEN LP setup and to verify machine control circuit operation.

NOTE: The emitter Test function can not be used in a color-for-color (“swapable”) hookup (see Figure 3-22).

1.4.5 Scan Code Configuration

The emitter and receiver may be configured to one of two Scan Code positions (1 or 2); a receiver will recognize beams only from an emitter with the same setting. This helps minimize the effects of crosstalk between multiple emitter/receiver pairs, and allows multiple pairs to operate in close proximity in certain situations. See Sections 3.1.5 and 3.1.8 for proper mounting configurations. The Scan Code is set via DIP switch on each sensor; see Section 4.2 for more information. Both the emitter and its corresponding receiver must have the same setting.

1.4.6 Reduced Resolution (Floating Blanking)

Reduced Resolution increases the minimum diameter of an object that the light screen can reliably detect anywhere within its defined area. Reduced Resolution is generally used to allow one or more objects (usually workpiece materials) to move anywhere through the defined area, without tripping the OSSD safety outputs.

Enabling two-beam Reduced Resolution reduces the overall minimum object sensitivity, which allows multiple objects to move through the defined area (see Section 3.4.2). The effect is that any two consecutive beams (except for the sync beam) can be blocked, without causing the OSSDs to turn OFF. This is also called "Multiple-Point Floating Blanking."

Resolution directly affects the minimum allowable distance between the defined area of a light screen and the nearest

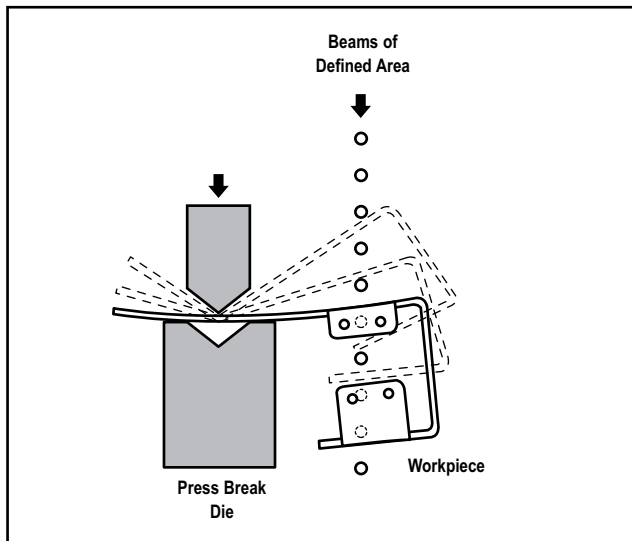


Figure 1-2. Reduced Resolution

hazard point (separation distance, see Section 3.1.1). The receiver's Green status indicator flashes when Reduced Resolution is enabled. The ignored object size and resultant Reduced Resolution are listed in Section 3.4.2.

1.4.7 Status Indicators

Status indicators on both the emitter and receiver are clearly 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, TEST mode, or Lockout condition.

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

• Receiver:

Bi-color red/green Zone indicators – show status of a group of beams:

- aligned and clear (green ON), or
- blocked and/or misaligned (red ON), or
- fixed blanked area (flashing green).

Yellow Reset indicator – shows System status:

- RUN mode (ON) or
- waiting for a reset (flashing).

Bi-color red/green Status indicator – shows System status:

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

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

See Sections 4.4 and 5.1 for more information about specific indicator and Diagnostic Display code meanings.

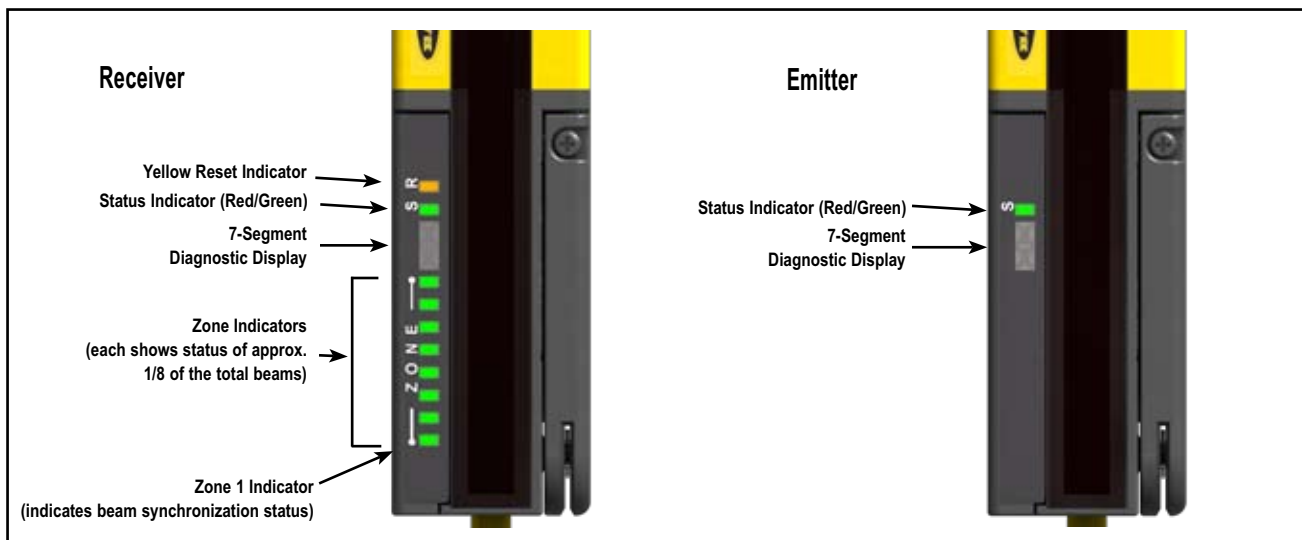


Figure 1-3. EZ-SCREEN LP emitter and receiver status indicators

1.4.8 Manual Resets and Lockout Conditions

Reset Routine

The EZ-SCREEN LP requires a manual reset to clear a Power-Up Lockout or Latch condition, and after correcting the cause of a Lockout condition. This function is designed to provide a “monitored manual reset” (i.e., open-closed-open action), such that a shorted or tied-down button cannot cause a reset. When a key-operated switch is used, this is typically called a key reset. (Reset switch is sold separately; see Section 2.4 for options.)

To perform a manual reset, close the normally open switch for at least 1/4 second, but no longer than 2 seconds, and then re-open the switch. See Sections 3.1.3 and 4.3 for further information.

A Lockout condition will cause the EZ-SCREEN LP OSSD outputs to turn OFF. A Lockout condition is indicated by a flashing Red emitter or receiver Status indicator and an error number displayed on the Diagnostic Display. Lockout conditions require a manual reset routine to return the system to RUN mode after the failure has been corrected. A description of possible lockouts, their causes, and troubleshooting hints are listed in Section 5.

Trip Output/Auto Reset

While the use of a reset switch is recommended, it is not required for receivers configured for Trip Output (automatic reset). Cycling the supply power (OFF for > 2 seconds, then ON) will also clear lockouts if their cause has been corrected. If a reset switch is not used, leave pin 8 (violet wire) not connected (open) and secure it against shorting to a source of power or ground.

1.4.9 Fixed Blanking

The fixed blanking feature allows for a stationary object(s) positioned in the defined area, such as tooling, to be ignored. A flashing Green Zone indicator denotes the location of a blanked area. If the object is either moved or removed, the System goes into Lockout mode, ensuring that an unexpected hole in the sensing field is not created.

Fixed blanking is easily configured, simply by positioning the object(s), flipping two DIP switches and resetting the System, as described in Section 3.4.3.

For cascade models (either when used alone, or as the last receiver in a cascade), fixed blanking may be configured remotely; see Section 7.10 for details. This feature is useful when the light screen is in a difficult-to-access location, or when the fixed blanked area changes frequently.

1.4.10 Inverted Display

A DIP switch can be used to invert the seven-segment display. This makes the display “right reading” when an emitter and receiver are mounted with the QD connector ends up (upside down). See Section 4.4 for more information.

1.4.11 Cascadeable Models

Emitter and receiver models SLPC.. (see Section 7) are capable of interconnecting up to four emitter/receiver pairs – regardless of the resolution, the total number of beams, or the size of the defined area. EZ-SCREEN SLPC.. (cascadeable) models can also be used individually as stand-alone systems. They also can be cascaded with EZ-SCREEN SLSC.. models.

Double-ended RD-style 24 AWG cordsets (listed in Section 2.3) are required for connecting sensors in a cascade; see Section 7.4 for maximum cable lengths. (RD-to-QD cordsets are available to connect between SLPC.. and SLSC.. models.)

Maximum system response time for a cascade is dependent on the number of beams in each light screen, and the light screen's position in the cascade. It can be calculated in two ways:

- Individually for each light screen in the cascade (safety distance is calculated for each light screen in the cascade), or
- Based on the worst-case maximum for the entire cascade (all light screens in the cascade have the same separation distance).

See Section 7.5 for more information.

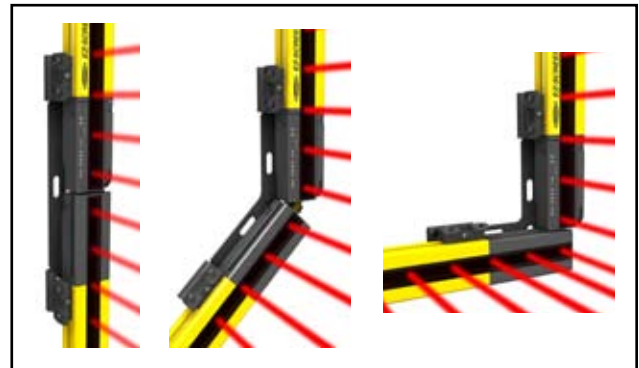


Figure 1-4. Fixed-angle brackets allow easy cascading while maintaining 25 mm resolution

2. Components and Specifications

An EZ-SCREEN LP “System” refers to a compatible emitter and receiver (equal length and resolution; available separately or in pairs), and cordset(s) for each. It also refers to the emitters and receivers in a cascade, and their cabling. Mounting hardware is included with each emitter and receiver; special-purpose accessory brackets are also available, both for standalone pairs and for cascades. Interfacing solutions include IM-T-.. modules, redundant positively guided contactors, and muting modules; see Section 2.4. See Sections 7.2 and 7.3 for cascadeable models.

Models are listed in the tables either with a 300 mm (1') pigtail with 8-pin Euro-style QD termination or with the integral RD connection (no cordset included). The 13 mm (0.5") minimum bend radius for all cordset models accommodates low-clearance installations; cords can exit to left, right, or back of sensor, when mounting. The pigtail QD option is useful for connection to splitter cables or other QD cordsets.

Standard models (listed in the following tables) feature a yellow painted aluminum housing. Clear anodized (silver colored) housing finish is also available; contact the factory for more information. Both housing colors have black endcaps.

Electro-static dissipative (ESD-safe) models with nickel-plated housing and endcaps are also available. Their static-dissipative polymer coating protects nearby components from damaging ESD voltages. Contact the factory for more information.

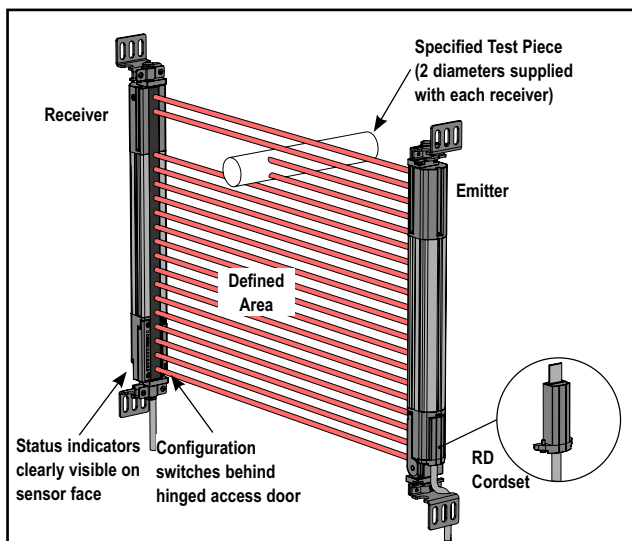


Figure 2-1. Banner EZ-SCREEN LP system: emitter, receiver, and two interconnecting cables

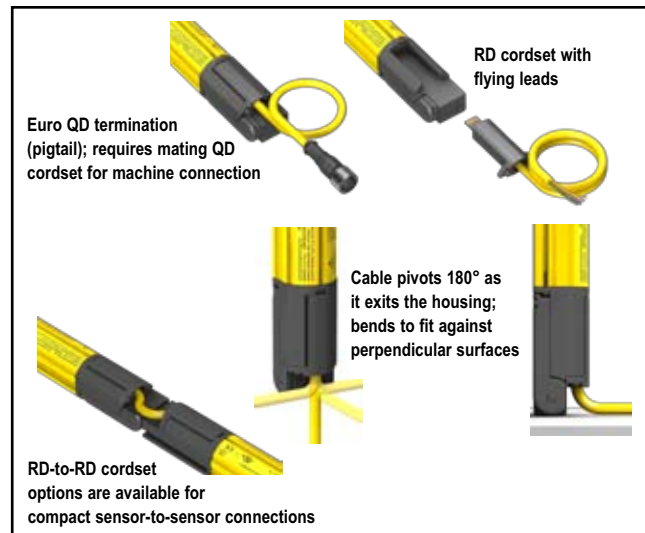


Figure 2-2. EZ-SCREEN LP removable-disconnect (RD) cordsets

To Order:

1. Choose model, resolution (14 or 25 mm) and defined area.
2. Choose an Emitter (E), a Receiver (R), or a Pair (P).
3. Yellow housing is standard. To choose an optional housing finish, add A or N prior to the connection designation:
 - A for clear anodized aluminum finish with black endcaps (example, **SLPE25-270A**).
 - N for ESD-safe models with a nickel-plated housing and endcaps (example, **SLPE25-270N**).
4. Choose the connection: 300 mm M12/Euro-Style Pigtail QD or integral Removable Disconnect (RD).
5. Choose one cordset for each sensor or two cordsets for a pair. See Section 2.3.
 - **M12/Euro Pigtail QD models** for (example, **SLPE...270P8**) require mating 8-pin M12/Euro QD cordsets, such as:
 - QDE cordset with flying leads
 - DEE2R double-ended cordset
 - CSB series splitter cordset
 - **Integral RD models** for (example, **SLPE...270**) require mating cordsets such as:
 - RDL cordset with flying leads
 - DELPE double-ended cordset with M12/Euro QD (requires additional mating 8-pin M12/Euro QD cordset)
 - DELP cordset in cascade applications for connection of 2nd, 3rd, and 4th sensors
6. Choose an optional interfacing solution, such as an **IM-T-9A** or **-11A** interfacing model. See Section 2.4.

2.1 Standard Emitter and Receiver Models (Non-Cascadeable) – 14 mm Resolution

For cascadeable emitter and receiver models, see Sections 7.2 and 7.3. Only standard yellow housing models are listed. Pigtail QD models (e.g., **SLPE14-270P8**) have yellow PVC cable and black PVC QD overmold. **For other models, see below.***

See the Banner Safety catalog or call the factory for kit model numbering scheme.

Order one machine interface cordset for each emitter or receiver; see Section 2.3.**

Defined Area	Models*			Connection**	Response Time	# Beams
	Emitter	Receiver	Pair †			
270 mm	SLPE14-270P8	SLPR14-270P8	SLPP14-270P88	300 mm pigtail, 8-pin M12/Euro QD	10.5 ms	27
	SLPE14-270	SLPR14-270	SLPP14-270	Integral Removable Disconnect (RD)		
410 mm	SLPE14-410P8	SLPR14-410P8	SLPP14-410P88	300 mm pigtail, 8-pin M12/Euro QD	13.5 ms	41
	SLPE14-410	SLPR14-410	SLPP14-410	Integral Removable Disconnect (RD)		
550 mm	SLPE14-550P8	SLPR14-550P8	SLPP14-550P88	300 mm pigtail, 8-pin M12/Euro QD	16.5 ms	55
	SLPE14-550	SLPR14-550	SLPP14-550	Integral Removable Disconnect (RD)		
690 mm	SLPE14-690P8	SLPR14-690P8	SLPP14-690P88	300 mm pigtail, 8-pin M12/Euro QD	19.5 ms	69
	SLPE14-690	SLPR14-690	SLPP14-690	Integral Removable Disconnect (RD)		
830 mm	SLPE14-830P8	SLPR14-830P8	SLPP14-830P88	300 mm pigtail, 8-pin M12/Euro QD	22.5 ms	83
	SLPE14-830	SLPR14-830	SLPP14-830	Integral Removable Disconnect (RD)		
970 mm	SLPE14-970P8	SLPR14-970P8	SLPP14-970P88	300 mm pigtail, 8-pin M12/Euro QD	25.5 ms	97
	SLPE14-970	SLPR14-970	SLPP14-970	Integral Removable Disconnect (RD)		
1110 mm	SLPE14-1110P8	SLPR14-1110P8	SLPP14-1110P88	300 mm pigtail, 8-pin M12/Euro QD	28.5 ms	111
	SLPE14-1110	SLPR14-1110	SLPP14-1110	Integral Removable Disconnect (RD)		
1250 mm	SLPE14-1250P8	SLPR14-1250P8	SLPP14-1250P88	300 mm pigtail, 8-pin M12/Euro QD	31.5 ms	125
	SLPE14-1250	SLPR14-1250	SLPP14-1250	Integral Removable Disconnect (RD)		
1390 mm	SLPE14-1390P8	SLPR14-1390P8	SLPP14-1390P88	300 mm pigtail, 8-pin M12/Euro QD	34.5 ms	139
	SLPE14-1390	SLPR14-1390	SLPP14-1390	Integral Removable Disconnect (RD)		
1530 mm	SLPE14-1530P8	SLPR14-1530P8	SLPP14-1530P88	300 mm pigtail, 8-pin M12/Euro QD	37.5 ms	153
	SLPE14-1530	SLPR14-1530	SLPP14-1530	Integral Removable Disconnect (RD)		
1670 mm	SLPE14-1670P8	SLPR14-1670P8	SLPP14-1670P88	300 mm pigtail, 8-pin M12/Euro QD	40.5 ms	167
	SLPE14-1670	SLPR14-1670	SLPP14-1670	Integral Removable Disconnect (RD)		
1810 mm	SLPE14-1810P8	SLPR14-1810P8	SLPP14-1810P88	300 mm pigtail, 8-pin M12/Euro QD	43.5 ms	181
	SLPE14-1810	SLPR14-1810	SLPP14-1810	Integral Removable Disconnect (RD)		

* For other models:

Anodized aluminum housing: Prior to the connection designation (if any) in the model number, add "A" for a clear (brushed) anodized aluminum finish and black endcaps (e.g., **SLPE14-270A**). Pigtail QD models (e.g., **SLPE14-270AP8**) have black PVC cable and QD overmold.

ESD-safe models: Prior to the connection designation (if any) in the model number, add "N" for a nickel-plated housing and endcaps (e.g., **SLPE14-270N**). Pigtail QD models (e.g., **SLPE14-270NP8**) have black PVC cable and QD overmold.

** Pigtail QD models require mating cordsets with an 8-pin M12/Euro-style connector (such as **QDE-8..D**, **DEE2R-8..D**, or **CSB-M128..M1281**; see Section 2.3). Integral RD models require mating cordsets with a removable disconnect connector (such as **RDLPE-8..D**, **DELPE-8..D**, or **DELPE-11..D**; see Section 2.3).

† A pair includes an emitter and receiver.

2.2 Standard Emitter and Receiver Models (Non-Cascadeable) – 25 mm Resolution

For cascadeable emitter and receiver models, see Sections 7.2 and 7.3. Only standard yellow housing models are listed. Pigtail QD models (e.g., **SLPE25-270P8**) have yellow PVC cable and black PVC QD overmold. **For other models, see below.***

See the Banner Safety catalog or call the factory for kit model numbering scheme.

Order one machine interface cordset for each emitter or receiver; see Section 2.3.**

Defined Area	Models*			Connection**	Response Time	# Beams
	Emitter	Receiver	Pair †			
270 mm	SLPE25-270P8	SLPR25-270P8	SLPP25-270P88	300 mm pigtail, 8-pin M12/Euro QD	8 ms	14
	SLPE25-270	SLPR25-270	SLPP25-270	Integral Removable Disconnect (RD)		
410 mm	SLPE25-410P8	SLPR25-410P8	SLPP25-410P88	300 mm pigtail, 8-pin M12/Euro QD	9.5 ms	21
	SLPE25-410	SLPR25-410	SLPP25-410	Integral Removable Disconnect (RD)		
550 mm	SLPE25-550P8	SLPR25-550P8	SLPP25-550P88	300 mm pigtail, 8-pin M12/Euro QD	11 ms	28
	SLPE25-550	SLPR25-550	SLPP25-550	Integral Removable Disconnect (RD)		
690 mm	SLPE25-690P8	SLPR25-690P8	SLPP25-690P88	300 mm pigtail, 8-pin M12/Euro QD	12.5 ms	35
	SLPE25-690	SLPR25-690	SLPP25-690	Integral Removable Disconnect (RD)		
830 mm	SLPE25-830P8	SLPR25-830P8	SLPP25-830P88	300 mm pigtail, 8-pin M12/Euro QD	14 ms	42
	SLPE25-830	SLPR25-830	SLPP25-830	Integral Removable Disconnect (RD)		
970 mm	SLPE25-970P8	SLPR25-970P8	SLPP25-970P88	300 mm pigtail, 8-pin M12/Euro QD	15.5 ms	49
	SLPE25-970	SLPR25-970	SLPP25-970	Integral Removable Disconnect (RD)		
1110 mm	SLPE25-1110P8	SLPR25-1110P8	SLPP25-1110P88	300 mm pigtail, 8-pin M12/Euro QD	17 ms	56
	SLPE25-1110	SLPR25-1110	SLPP25-1110	Integral Removable Disconnect (RD)		
1250 mm	SLPE25-1250P8	SLPR25-1250P8	SLPP25-1250P88	300 mm pigtail, 8-pin M12/Euro QD	18.5 ms	63
	SLPE25-1250	SLPR25-1250	SLPP25-1250	Integral Removable Disconnect (RD)		
1390 mm	SLPE25-1390P8	SLPR25-1390P8	SLPP25-1390P88	300 mm pigtail, 8-pin M12/Euro QD	20 ms	70
	SLPE25-1390	SLPR25-1390	SLPP25-1390	Integral Removable Disconnect (RD)		
1530 mm	SLPE25-1530P8	SLPR25-1530P8	SLPP25-1530P88	300 mm pigtail, 8-pin M12/Euro QD	21 ms	77
	SLPE25-1530	SLPR25-1530	SLPP25-1530	Integral Removable Disconnect (RD)		
1670 mm	SLPE25-1670P8	SLPR25-1670P8	SLPP25-1670P88	300 mm pigtail, 8-pin M12/Euro QD	22.5 ms	84
	SLPE25-1670	SLPR25-1670	SLPP25-1670	Integral Removable Disconnect (RD)		
1810 mm	SLPE25-1810P8	SLPR25-1810P8	SLPP25-1810P88	300 mm pigtail, 8-pin M12/Euro QD	24 ms	91
	SLPE25-1810	SLPR25-1810	SLPP25-1810	Integral Removable Disconnect (RD)		

* For other models:

Anodized aluminum housing: Prior to the connection designation (if any) in the model number, add "A" for a clear (brushed) anodized aluminum finish and black endcaps (e.g., **SLPE25-270A**). Pigtail QD models (e.g., **SLPE25-270AP8**) have black PVC cable and QD overmold.

ESD-safe models: Prior to the connection designation (if any) in the model number, add "N" for a nickel-plated housing and endcaps (e.g., **SLPE25-270N**). Pigtail QD models (e.g., **SLPE25-270NP8**) have black PVC cable and QD overmold.

Pigtail QD models require mating cordsets with an 8-pin M12/Euro-style connector (such as **QDE-8..D, **DEE2R-8..D**, or **CSB-M128..M1281**; see Section 2.3).

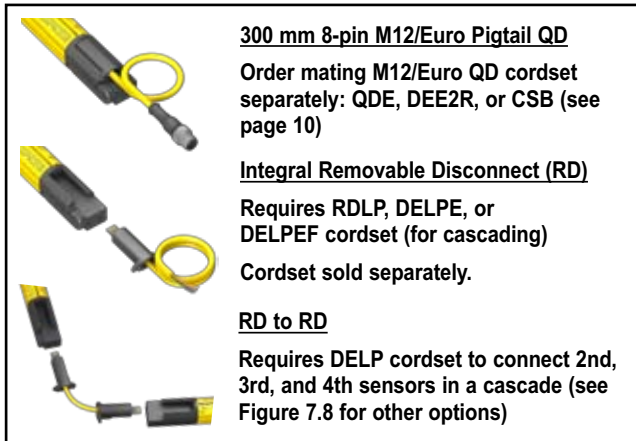
Integral RD models require mating cordsets with a removable disconnect connector (such as **RDLP-8..D**, **DELPE-8..D**, or **DELPE-11..D**; see Section 2.3).

† A pair includes an emitter and receiver.

2.3 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. Only cordsets with yellow PVC cable and black overmolds are listed; for cordsets with black PVC cables and overmolds, add suffix “B” to the model number (e.g., **RDLP-815DB**).

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

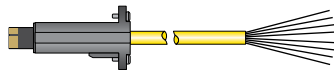


300 mm 8-pin M12/Euro Pigtail QD
Order mating M12/Euro QD cordset separately: QDE, DEE2R, or CSB (see page 10)

Integral Removable Disconnect (RD)
Requires RDLP, DELPE, or DELPEF cordset (for cascading)
Cordset sold separately.

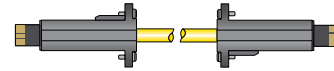
RD to RD
Requires DELP cordset to connect 2nd, 3rd, and 4th sensors in a cascade (see Figure 7.8 for other options)

Figure 2-3. EZ-SCREEN LP connection options

RD to Flying Leads Cordsets			
Removable disconnect (RD) connector on one end; unterminated (cut to length) on other.			
			
Model Number	Length	Wire	Banner Cordset Color Code
For Emitters and Receivers			Color Function
RDLP-815D	4.6 m (15.1')	8-conductor cable, 22 AWG/ 0.33 mm ²	Bn +24V dc
RDLP-825D	8 m (26.2')		Or/Bk EDM 2 (Aux)
RDLP-850D	15.3 m (50.2')		Or EDM 1
RDLP-875D	23 m (75.5')		Wh OSSD 2
RDLP-8100D	30.5 m (100.1')		Bk OSSD 1
			Bu 0V dc
			Gn/Ye Gnd/Chassis
			Vi Reset
RD to Flying Leads Cordsets (E-Stop/Interlock Connections)			
Used to connect devices to receiver cascade input RD connection. Removable disconnect (RD) connector on one end; unterminated (cut to length) on other. See Figures 7-8, 7-9, and 7-10.			
For Cascade Receivers Only			Color E-Stop Function
RDLP6G-415D	4.6 m (15.1')	4-conductor cable, 22 AWG/ 0.33 mm ²	Bn Ch 1a
RDLP6G-425D	8 m (26.2')		Wh Ch 2a
RDLP6G-450D	15.3 m (50.2')		Bk Ch 1b
			Bu Ch 2b

RD to RD Cordsets

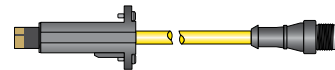
Used to interconnect multiple SLPC.. emitters or receivers in a cascade. See Section 7.4 for maximum cordset lengths.



Model	Length	Wire	Termination
DELP-110E	0.05 m (0.2')	11-conductor cable, 24 AWG/ 0.20 mm ²	RD-style removable disconnect fitting at each end, for cascade connections between SLPC.. sensors
DELP-111E	0.3 m (1')		
DELP-113E	1 m (3.3')		
DELP-118E	2.5 m (8.2')		
DELP-1115E	4.6 m (15.1')		
DELP-1125E	8 m (26.2')		
DELP-1150E	15.3 m (50.2')		
DELP-1175E	23 m (75.5')		
DELP-11100E	30.5 m (100.1')		

RD to M12/Euro QD Cordsets

Used to interconnect SLPC.. and SLSC.. (standard EZ-SCREEN) emitters or receivers in a cascade, or for use with a mating M12/ Euro QD cordset, such as QDE.., DEE2R-..., or CSB-..., listed on page 10). See Section 7.4 for maximum cascade cordset lengths.



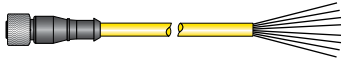
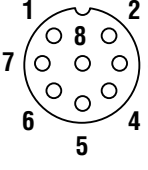
Model	Length	Wire	Termination
DELPE-81D	0.3 m (1')	8-conductor cable, 22 AWG/ 0.33 mm ²	RD-style removable disconnect fitting at one end, male M12/Euro QD fitting at the other
DELPE-83D	1 m (3.3')		
DELPE-88D	2.5 m (8.2')		
DELPE-815D	4.6 m (15.1')		
DELPE-825D	8 m (26.2')		
DELPE-850D	15.3 m (50.2')		
DELPE-875D	23 m (75.5')		
DELPE-8100D	30.5 m (100.1')		

RD to Female M12/Euro QD and Mating Cordsets

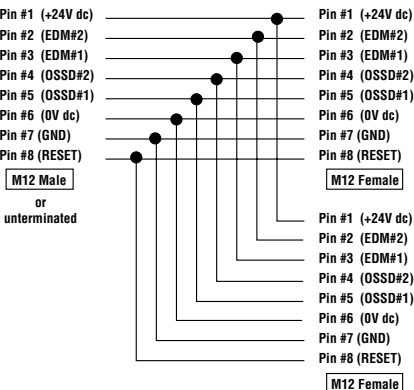
Used to connect E-stop or other devices to sensor input RD connection. See Figure 7-8.

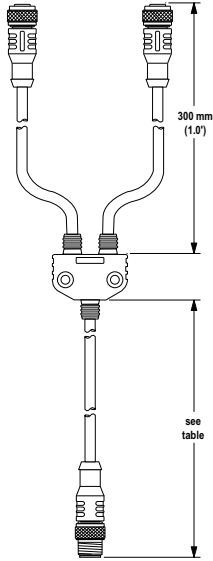


Model	Length	Wire	Termination
DELPEF-81D	0.3 m (1')	8-conductor cable, 22 AWG/ 0.33 mm ²	RD-style fitting at one end, female M12/Euro QD fitting at the other to connect to QDE2R4-8..D cordset below
DELPEF-83D	1 m (3.3')		
DELPEF-88D	2.5 m (8.2')		
DELPEF-815D	4.6 m (15.1')		
QDE2R4-815D	4.6 m (15')	8-pin connector, 4-conductor cable, 22 AWG/ 0.33 mm ²	Male M12/Euro QD fitting at one end, flying leads at the other to enable 4-wire hookup to device
QDE2R4-825D	7.6 m (25')		
QDE2R4-850D	15.2 m (50')		

Euro/M12 QD to Flying Leads Cordsets										
M12/Euro QD connector on one end; unterminated (cut to length) on other to interface with guarded machine. PVC-jacketed overmold and cables.										
Model	Length	Wire	Termination	Banner Cordset Pinout/Color Code			European M12 Specification*		Connector (female face view)	
For 8-Pin Emitters and Receivers**				Pin	Color	Function	Pin	Color	Function	
QDE-815D	4.5 m (15')	22 AWG/ 0.33 mm ²	8-pin Euro-style female connector on one end; cut to length	1	Bn	+24V dc	1	Wh	+24V dc	
QDE-825D	7.6 m (24.9')			2	Or/Bk	EDM #2 (Aux)	2	Bn	EDM #2 (Aux)	
QDE-830D	9.1 m (30')			3	Or	EDM #1	3	Gn	EDM #1	
QDE-850D	15.2 m (49.8')			4	Wh	OSSD #2	4	Ye	OSSD #2	
QDE-875D	22.8 m (74.7')			5	Bk	OSSD #1	5	Gy	OSSD #1	
QDE-8100D	30.4 m (99.7')			6	Bu	0V dc	6	Pk	0V dc	
				7	Gn/Ye	Gnd/Chassis	7	Bu	Gnd/Chassis	
		8	Vi	Reset	8	Rd	Reset			

** The European M12 Specification pin assignment and color codes are listed as a customer courtesy. The user must verify suitability of these cables for each application.

Splitter Cordsets			
Used for easy interconnection between an EZ-SCREEN LP receiver and its emitter, providing a single "homerun" cable (see Figure 3-22). Model DEE2R-.. double-ended cordsets may be used to extend the QD trunk or either branch. (Branch #1 and branch #2 cable sections are 300 mm/1' long.) Model QDE-8..D single-ended cordsets may be used to extend the QD trunk for cut-to-length applications.			
Model	Trunk Length	Wire	Pinout
CSB-M1281M1281	0.3 m (1')	22 AWG/ 0.33 mm ²	
CSB-M1288M1281	2.5 m (8')		
CSB-M12815M1281	4.6 m (15')		
CSB-M12825M1281	7.6 m (25')		
CSB-UNT825M1281	8 m (25') (unterminated)		



300 mm (1.0')

see table

Male M12/Euro to Female M12/Euro QD Cordsets			
Used for extending either the branch or trunk of a model CSB splitter cordset. M12/Euro-style connectors, female to male (rotateable). Overmold and cables are PVC-jacketed.			
Model	Length	Wire	Termination
DEE2R-81D	0.3 m (1')	8-conductor cable, 22 AWG/ 0.33 mm ²	M12/Euro QD fitting at each end, one male, one female
DEE2R-83D	0.9 m (3')		
DEE2R-88D	2.5 m (8')		
DEE2R-815D	4.6 m (15')		
DEE2R-825D	7.6 m (25')		
DEE2R-830D	9.1 m (30')		
DEE2R-850D	15.2 m (50')		
DEE2R-875D	22.9 m (75')		
DEE2R-8100D	30.5 m (100')		

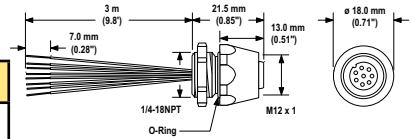
DEE8-..D Adaptor M12/Euro QD Cordsets			
Used to connect 8-pin female QD to a 4-pin or 5-pin cordset or QD connection to a safety BUS gateway/node, a "smart" self-monitored safety module, safety controller, or safety PLC. Overmold and cables are PVC-jacketed.			
Model	Length	Wire	Pinout
DEE8-41D	0.3 m (1')	4-conductor cable, 22 AWG/ 0.33 mm ²	8-Pin Female to 5-Pin Male 1 ↔ 1 2 3
DEE8-48D	2.5 m (8')		
DEE8-415D	4.6 m (15')		
DEE8-425D	7.6 m (25')		
DEE8-51D	0.3 m (1')	5-conductor cable, 22 AWG/ 0.33 mm ²	4 ↔ 2 5 ↔ 4 6 ↔ 3 7 ↔ 5* 8
DEE8-58D	2.5 m (8')		
DEE8-515D	4.6 m (15')		
DEE8-515D	4.6 m (15')		
DEE8-525D	7.6 m (25')		

*DEE8-4..D cordsets do not have the pin 5 GND/chassis connection. GND/chassis connection should be made via the mounting hardware.

Bulkhead Connector

Connector for panel connection of EZ-SCREEN LP emitter and receiver cables.

Model	Connection
PMEF-810D	8-pin Euro-style female connector 3 m (10') wires, cut to length (Banner color code); 22 AWG/0.33 mm ² .

**2.4 Accessories**

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

Interface Modules

Provide forced-guided, mechanically-linked relay (safety) outputs for the EZ-SCREEN LP. See Banner data sheet p/n 62822 and Figure 3-26 for more information.

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

Contactors

The N.C. contacts are to be used in an external device monitoring (EDM) circuit. If used, two contactors per EZ-SCREEN LP system are required. (See Figure 3-21.) See data sheet p/n 111880 for additional options and more information.

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

AC Boxes

AC power supply for use with EZ-SCREEN LP emitters and/or receivers. Models **EZAC-R..** can be interfaced with up to three receivers or two cascaded emitter/receiver pairs; models **EZAC-E..** can power up to four emitters.

Box supplies +24V dc power @ 0.7 amps (16.8 W max. power); accepts input voltages from 100-250V ac (50-60 Hz); IP65 metal housing. Models available with external device monitoring (EDM); key reset switch on **EZAC-R..** models (Emitter/Receiver models). See data sheet p/n 120321 for more information.



Emitter/Receiver Boxes					
Model	Outputs	EDM	Emitter/Receiver Connection	AC Power Connection	Output and EDM Connections
EZAC-R9-QE8	3 N.O.	Selectable 1- or 2-Channel or no EDM	8-Pin M12 Euro-style QD	Hard-wired	Hard-wired
EZAC-R11-QE8	2 N.O., 1 N.C.				
EZAC-R15A-QE8-QS83	1 N.O. + 1 SPDT (Form C)	1-Channel		3-pin Mini-style QD	8-pin Mini-style QD
EZAC-R8N-QE8-QS53	1 N.O., 1 N.C.	Power Monitoring		3-pin Mini-style QD	5-pin Mini-style QD
EZAC-R10N-QE8-QS53	2 N.O.				
Emitter-Only Boxes					
Model	For Emitter Models	Emitter Connection	AC Power Connection		
EZAC-E-QE8	SLPE...Q8	8-Pin M12 Euro-style QD	Hard-wired		
EZAC-E-QE8-QS3	SLPE...Q8	8-Pin M12 Euro-style QD	3-Pin Mini-style QD		

Muting Modules

Provide muting capability for the EZ-SCREEN LP. See Banner manuals p/n 63517 or 116390 for further information and additional cabling options.

MMD-TA-11B	DIN-mount Muting module	2 NO safety outputs (6 amps), 2 or 4 muting inputs, SSI, override input; IP20; terminal connections
MMD-TA-12B		2 OSSD (0.5 amps), 2 or 4 muting inputs, SSI, override input; IP20; terminal connections
MM-TA-12B	Muting module	2 OSSD (0.5 amps), 2 or 4 muting inputs, USSI, override input; IP65; QD connections, see below
DESE4-508D DESE4-515D DESE4-525D	2.5 m (8') cable 5 m (15') cable 8 m (25') cable	Cordset to interface EZ-SCREEN LP Receiver with MM-TA-12B Muting Module – 22 Ga, 8-pin Euro-style (M12) female connector to 7-pin Mini-style male connector; double-ended. NOTE: DELPE-8..D cordsets required on RD-interconnect sensor models, or DEE2R-8..D cordsets on pigtail interconnect models.



SC22-3(E) Safety Controller

Provide monitoring of multiple safety devices via 22 configurable inputs to control three pairs of OSSD safety outputs. Other options available (e.g., EtherNet communications); see Banner manual p/n 133487.

SC22-3-S	Screw-type terminals	10 Auxiliary outputs, includes external memory XM card
SC22-3-C	Clamp-type terminals	
SC22-3E-S	Screw-type terminals	10 Auxiliary outputs, includes external memory XM card, plus EtherNet/IP and Modbus TCP, 32 virtual outputs
SC22-3E-C	Clamp-type terminals	



Remote Blanking Key Switch Box

Used to configure fixed blanking remotely on cascadeable model receivers (when used as a standalone sensor pair, or the last receiver in a cascade). Use with **DELPEF-8..D** cordset to interface with receiver cascade end and **DEE2R-8..D** cordset to provide required extension, as needed.

EZA-RBK-1	Remote Blanking Key Switch	Allows the frequent configuration of a fixed blanked area, without using the receiver DIP switches
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External Keyed Reset Switches

EZA-RR-1	External normally open reset switch with 8-pin M12/Euro-style QD; can be interconnected using cordset models QDE-8..D , DEE2R-8..D , or CSB-..M1281 .
MGA-KSO-1	Panel-mount keyed normally open reset switch
MGA-K-1	Replacement key for switch MGA-KSO-1

Alignment Aids



LAT-1



Model	Description
LAT-1-LP	Self-contained visible-beam laser tool for aligning any EZ-SCREEN LP emitter/receiver pair. Includes retroreflective target materia, mounting clip.
LPA-LAT-2	Replacement adaptor clip and screw for EZ-SCREEN LP models
LPA-LAT-1	Clip-on retroreflective LAT target
BRT-THG-2-100	2" retroreflective tape, 100'
BT-1	Beam Tracker







Snap-On Lens Shields

Impact-resistant copolyester lens shields snap easily over entire length of sensor housing, protect against metal cutting fluids, other chemicals. Not sealed at top and bottom. Decreases sensing range by approx. 15%, when protecting both emitter and receiver.

Sensor Model	Lens Shield Model	Sensor Model	Lens Shield Model
SLP.-270..	LPSS-270	SLP.-1110..	LPSS-1110
SLP.-410..	LPSS-410	SLP.-1250..	LPSS-1250
SLP.-550..	LPSS-550	SLP.-1390..	LPSS-1390
SLP.-690..	LPSS-690	SLP.-1530..	LPSS-1530
SLP.-830..	LPSS-830	SLP.-1670..	LPSS-1670
SLP.-970..	LPSS-970	SLP.-1810..	LPSS-1810










EZ-LIGHT™ for EZ-SCREEN

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

Models	Construction	Connector	LED Function	Inputs
 M18RGX8PQ8	Nickel-plated brass housing, thermoplastic dome, M18x1 thread barrel mount Fully encapsulated, IP67	8-pin Euro-style integral QD	Red/Green indication follows OSSD output of the EZ-SCREEN LP receiver ON Red: Power ON Beam Blocked or Lockout ON Green: Power ON Beam Clear	PNP (Sourcing)
 T18RGX8PQ8	Thermoplastic polyester housing, thermoplastic dome, 18 mm barrel mount Fully encapsulated, IP67			
 T30RGX8PQ8	Thermoplastic polyester housing, thermoplastic dome, 30 mm barrel mount Fully encapsulated, IP67			
 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			

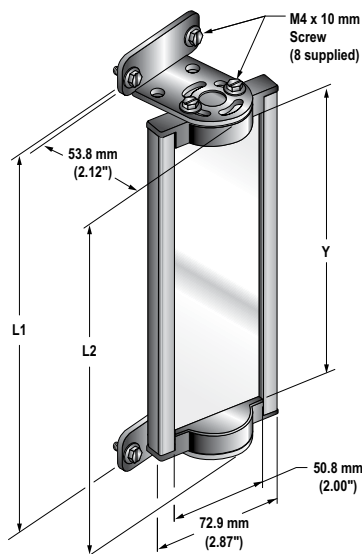
Accessory Mounting Brackets

See Section 2.5 for standard brackets (included with sensors).

	<p>LPA-MBK-13</p> <ul style="list-style-type: none"> • Adaptor for side-mount bracket LPA-MBK-12 • Reorients sensor rotation by 90° (+10°/ -30°) • 14 ga (1.9 mm) steel, black zinc plated • Includes 1 bracket and hardware 		<p>LPA-MBK-120</p> <ul style="list-style-type: none"> • Fixed angled "L" bracket for two cascaded emitters or receivers; uses clamps from side-mount bracket LPA-MBK-12. Order one per cascaded joint; set includes two brackets. • Fixed 120° orientation; maintains 25 mm resolution between sensor pairs • +10°/ -30° sensor rotation • 14 ga (1.9 mm) steel, black zinc plated • Cascade brackets join two sensors. Each model number is one set of 2 (mirror image) brackets and hardware.
	<p>LPA-MBK-20</p> <ul style="list-style-type: none"> • Universal adapter bracket for mounting to engineered/slotted aluminum framing (e.g., 80/20™, Bosch) • Retrofit for Banner MS/US/MG; clearance for M4 and M6 hardware • Use with LPA-MBK-11, -12, or -13 • 12 ga (2.66 mm) steel, black zinc plated • Includes 1 bracket and hardware 		<p>LPA-MBK-135</p> <ul style="list-style-type: none"> • Fixed angled "L" bracket for two cascaded emitters or receivers; uses clamps from side-mount bracket LPA-MBK-12. Order one per cascaded joint; set includes two brackets. • Fixed 135° orientation; maintains 25 mm resolution between sensor pairs • +10°/ -30° sensor rotation • 14 ga (1.9 mm) steel, black zinc plated • Cascade brackets join two sensors. Each model number is one set of 2 (mirror image) brackets and hardware.
	<p>LPA-MBK-22</p> <ul style="list-style-type: none"> • End-cap bracket for mounting sensor inside Unistrut® metal framing; uses end-cap plates from bracket LPA-MBK-11 • Fits Unistrut P1000 size, with M6 or 1/4" channel nuts • 14 ga (1.90 mm) steel, black zinc plated; die-cast zinc clamps • Includes 2 brackets and hardware 		<p>LPA-MBK-180</p> <ul style="list-style-type: none"> • Fixed inline (straight) bracket for two cascaded emitters or receivers; uses clamps from side-mount bracket LPA-MBK-12. Order one per cascaded joint; set includes two brackets. • Fixed 180° orientation; maintains 25 mm resolution between sensor pairs • +10°/ -30° sensor rotation • 14 ga (1.9 mm) steel, black zinc plated • Cascade brackets join two sensors. Each model number is one set of 2 (mirror image) brackets and hardware.
	<p>LPA-MBK-21</p> <ul style="list-style-type: none"> • Pivoting "L" bracket system for two cascaded emitters or receivers; uses clamps from side-mount bracket LPA-MBK-12. Order one per cascaded joint; set includes two brackets. • Adjustable 90° to 180° orientation; resolution is 25 mm at < 135°, 28 mm at 120°, and 32 mm at 90° configuration. (Resolution between sensors at the pivot point can be as large as 32 mm.) • +10°/ -30° sensor rotation • 14 ga (1.9 mm) steel, black zinc plated • Cascade brackets join two sensors. Each model number is one set of 2 (mirror image) brackets and hardware. 		<p>LPA-MBK-Pxxx</p> <ul style="list-style-type: none"> • L-shaped bracket for one emitter or receiver protects sensor from weld flash, impact. • Sized to match sensor length; replace "xxx" in model number with sensor size (e.g., LPA-MBK-P270 for use with sensor SLP..-270..); bracket studs mate with side-mount brackets LPA-MBK-12, included with sensor. Corner notch accommodates cable routing. • +10°/ -30° sensor rotation • 12 ga (2.66 mm) steel, black zinc plated or painted • One bracket and hardware.
	<p>LPA-MBK-90</p> <ul style="list-style-type: none"> • Fixed angled "L" bracket for two cascaded emitters or receivers; uses clamps from side-mount bracket LPA-MBK-12. Order one per cascaded joint; set includes two brackets. • Fixed 90° orientation; maintains 25 mm resolution between sensor pairs • +10°/ -30° sensor rotation • 14 ga (1.9 mm) steel, black zinc plated • Cascade brackets join two sensors. Each model number is one set of 2 (mirror image) brackets and hardware. 		

MSM Series Corner Mirrors

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

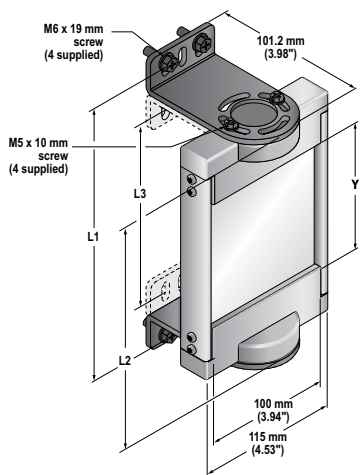


Defined Area Length	Mirror Model	Reflective Area Y	Mounting L1	Height L2
270 mm (10.6")	MSM12A	356 mm (14")	411 mm (16.2")	381 mm (15")
410 mm (16.1")	MSM20A	559 mm (22")	615 mm (24.2")	584 mm (23")
550 mm (21.7")	MSM24A	660 mm (26")	716 mm (28.2")	686 mm (27")
690 mm (27.2")	MSM28A	762 mm (30")	818 mm (32.2")	787 mm (31")
830 mm (32.7")	MSM36A	965 mm (38")	1021 mm (40.2")	991 mm (39")
970 mm (38.2")	MSM40A	1067 mm (42")	1123 mm (44.2")	1092 mm (43")
1110 mm (43.7")	MSM44A	1168 mm (46")	1224 mm (48.2")	1194 mm (47")

SSM Series Corner Mirrors

Rear-surface glass mirrors rated at 85% efficiency. *The total sensing range decreases by approximately 8% per mirror.* See mirror data sheet P/N 61934 or the Banner Safety catalog for further information.

- Robust construction, two mounting brackets and hardware included.
- EZA-MBK-2 adapter bracket is required for use with MSA Series stand, see page 14.



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

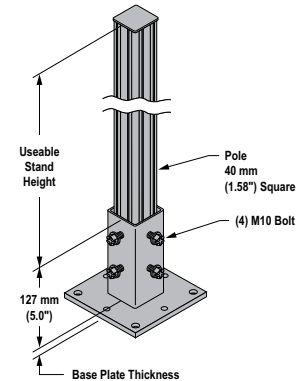
Defined Area Length	Mirror Model*	Reflective Area Y	Mounting L1	Height L2
270 mm (10.6")	SSM-375	375 mm (14.8")	486 mm (19.1")	453 mm (17.8")
410 mm (16.1")	SSM-550	550 mm (21.7")	661 mm (26.0")	628 mm (24.7")
550 mm (21.7")	SSM-675	675 mm (26.6")	786 mm (31.0")	753 mm (29.6")
690 mm (27.2")	SSM-825	825 mm (32.5")	936 mm (36.9")	903 mm (35.6")
830 mm (32.7")	SSM-975	975 mm (38.4")	1086 mm (42.8")	1053 mm (41.5")
970 mm (38.2")	SSM-1100	1100 mm (43.3")	1211 mm (47.7")	1178 mm (46.4")
1110 mm (43.7")	SSM-1175	1175 mm (46.3")	1286 mm (50.6")	1253 mm (49.3")
1250 mm (49.2")	SSM-1400	1400 mm (55.1")	1511 mm (59.5")	1478 mm (58.2")
1390 mm (54.7")	SSM-1475	1475 mm (58.1")	1586 mm (62.4")	1553 mm (61.1")
1530 mm (60.2")	SSM-1675	1675 mm (65.9")	1786 mm (70.3")	1753 mm (69.0")
1670 mm (65.7")	SSM-1750	1750 mm (68.9")	1861 mm (73.3")	1828 mm (72.0")
1810 mm (71.3")	SSM-1900	1900 mm (74.8")	2011 mm (79.2")	1978 mm (77.9")

*Stainless steel reflective surface models also available by adding model number suffix "-S" (e.g., **SSM-375-S**); range reduction for these models is approximately 30% per mirror. See data sheet p/n 67200.

MSA Series Stands (Base Included)*

Stand Model	Pole Height	Useable Stand Height	Overall Stand Height
MSA-S24-1	610 mm (24")	483 mm (19")	616 mm (24.25")
MSA-S42-1	1067 mm (42")	940 mm (37")	1073 mm (42.25")
MSA-S66-1	1676 mm (66")	1550 mm (61")	1682 mm (66.25")
MSA-S84-1	2134 mm (84")	2007 mm (79")	2140 mm (84.25")
MSA-S105-1	2667 mm (105")	2667 mm (100")	2673 mm (105.25")

*Available without a base by adding the suffix "NB" to model number, e.g., **MSA-S42-1NB**.



2.5 Replacement Parts

Model	Description
STP-13	14 mm test piece (14 mm resolution systems)
STP-17	34 mm test piece (14 mm resolution systems with 2-beam reduced resolution)
STP-16	25 mm test piece (25 mm resolution systems)
STP-18	65 mm test piece (25 mm resolution systems with 2-beam reduced resolution)
LPA-TP-1	Terminator plug, for SLPC... emitter or receiver (included with sensor)
DELPE-81D	Replacement for M12-terminated pigtail QD, as shipped with standard pigtail QD models; 8-conductor cable, 22 AWG/ 0.33 mm ² ; 0.3 m (1') long; see Section 2.3 for other lengths
LPA-MBK-11	End-cap bracket kit (includes 2 end brackets and hardware; see Figure 2-1); 360° sensor rotation; 14 ga (1.9 mm) steel, black zinc plated; die-cast zinc end-cap plate. Includes 2 brackets and hardware.
LPA-MBK-12	Side-mount bracket kit (includes 1 bracket and hardware; see Figure 2-1); +10°/ -30° sensor rotation; 14 ga (1.9 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.



LPA-MBK-11
End-cap bracket



LPA-MBK-12
Side-mount bracket



2.6 Literature

The following documentation is supplied with each EZ-SCREEN LP receiver. Additional copies are available at no charge; contact the factory or visit www.bannerengineering.com.

Description	Part #
EZ-SCREEN LP System Instruction Manual	140044
Checkout Procedure Card (Daily) – Stand-Alone Systems	140045
Checkout Procedure Card (Daily) – Cascaded Systems	140046
Checkout Procedure Card (Semi-Annual)	140047
EZ-SCREEN LP Bracket Supplement	147360

2.7 Specifications

2.7.1 General Specifications

Short Circuit Protection	All inputs and outputs are protected from short circuits to +24V dc or dc common.
Electrical Safety Class (IEC 61140: 1997)	III
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
Operating Range	0.1 m to 7 m (4" to 23") Range decreases with use of mirrors and/or lens shields: Lens shields – approximately 10% less range per shield. Glass-surface mirrors – approximately 8% less range per mirror. See the specific mirror data sheet or the Banner Safety Catalog for further information.
Resolution	14 mm or 25 mm, depending on model (Reduced Resolution OFF)
Effective Aperture Angle (EAA)	Meets Type 4 requirements per IEC 61496-2, Section 5.2.9 ± 2.5° @ 3 m
Enclosure	Size: See Figure 2-6 Materials: Extruded aluminum housing with yellow polyester powder finish standard (optional clear anodized or static-dissipative nickel-plated finish) and well-sealed, rugged die-cast zinc end caps, acrylic lens cover, copolyester access cover. Nickel-plated models also have static-dissipative acrylic lens cover and nickel-plated end caps. Rating: IEC IP65
Operating Conditions	Temperature: 0° to +55° C (+32° to 131°F) Max. Relative Humidity: 95% maximum relative humidity (non-condensing)
Shock and Vibration	EZ-SCREEN LP components have passed vibration and shock tests according to IEC 61496-1. This includes vibration (10 cycles) of 10-55 Hz at 0.35 mm (0.014") single amplitude (0.70 mm peak-to-peak) and shock of 10 g for 16 milliseconds (6,000 cycles).
Mounting Hardware	Emitter and receiver each are supplied with a pair of swivel end-mounting brackets and two swivel side-mount brackets. Models longer than 690 mm also include additional side-mount bracket(s) for center support. Mounting brackets are 14-gauge/1.9 mm cold-rolled steel, black zinc finish.
Cables and Connections	See Section 2.3 for recommended cables. If other cables are used with the EZ-SCREEN LP, the user must verify suitability of these cables for each application.
Certifications	 

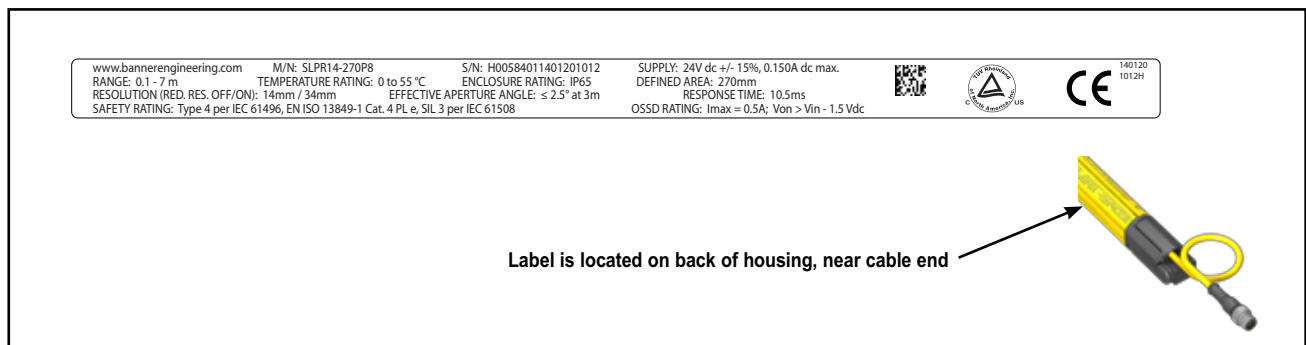


Figure 2-4. Emitter or receiver product identification label

2.7.2 Emitter Specifications

Supply Voltage at the Device	24V dc \pm 15% (use a SELV-rated 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	\pm 10% maximum
Supply Current	60 mA max., exclusive of Fault Out load
Fault Output Switching Capacity	Current-sourcing (PNP) solid-state output, 24V dc at 250 ma max. (see Section 3.5.1)
Remote Test Input	Test mode is activated either by applying a low signal (less than 3V dc) to emitter Test/Reset terminal for a minimum of 50 milliseconds, or by opening a switch connected between Test/Reset and +24V dc for a minimum of 50 milliseconds. Beam scanning stops to simulate a blocked condition. A high signal at Test/Reset deactivates Test mode. (See Section 3.5.6 for more information.) High Signal: 10 to 30V dc Low Signal: 0 to 3V dc Input Current: 35 mA inrush, 10 mA max.
Controls and Adjustments (see Section 4.2)	Scan Code Selection: 2-position switch (code 1 or 2). Factory default position is <u>code 1</u> . Test/Reset: 2-position switch. Factory default position is <u>Reset</u> . Invert Display: 2-position switch. Factory default position is <u>OFF</u> (standard display). Fault: 2-position switch. Factory default position is <u>OFF</u> .
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 See Figure 1-3 for indicator locations and Section 4.4 for indicator conditions.
Wavelength of Emitter Elements	Infrared LEDs, 850 nm at peak emission

2.7.3 Receiver Specifications

Supply Voltage at the Device	24V dc \pm 15% (use a SELV-rated 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	\pm 10% maximum										
Supply Current (no load)	150 mA max., exclusive of OSSD1 and OSSD2 loads (up to an additional 0.5 A each) and Aux Out load (up to 0.25 A)										
Response Time	Dependent on number of sensing beams; see models tables in Sections 2.1, 2.2, 7.2, and 7.3 for number of beams and response time for each model.										
CSSI Response Time (SLPC.. cascade models only)	Response time for a cascade receiver due to opening contacts at the cascade interface (CSSI): 40 ms max (contacts must open for 60 ms minimum). See Section 7.5.										
Recovery Time	Blocked to Clear (OSSDs turn ON; varies with total number of sensing beams and whether Sync beam is blocked): <table border="1" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>Beam 1 (Sync Beam)</th> <th>All Other Beams</th> </tr> </thead> <tbody> <tr> <td>14 mm Models</td> <td>109 ms to 800 ms</td> <td>33 ms to 220 ms</td> </tr> <tr> <td>25 mm Models</td> <td>81 ms to 495 ms</td> <td>25 ms to 152 ms</td> </tr> </tbody> </table>			Beam 1 (Sync Beam)	All Other Beams	14 mm Models	109 ms to 800 ms	33 ms to 220 ms	25 mm Models	81 ms to 495 ms	25 ms to 152 ms
	Beam 1 (Sync Beam)	All Other Beams									
14 mm Models	109 ms to 800 ms	33 ms to 220 ms									
25 mm Models	81 ms to 495 ms	25 ms to 152 ms									
EDM Input	+24V dc signals from external device contacts can be monitored (one-channel, two-channel or no monitoring) via EDM1 and EDM2 terminals in the receiver (see Section 3.5.3). High Signal: 10 to 30V dc at 30 mA typical Low Signal: 0 to 3V dc										
Reset Input	Reset input must be high for 0.25 to 2 seconds and then low to reset the receiver (see Section 4.3). High Signal: 10 to 30V dc at 30 mA typical Low Signal: 0 to 3V dc Closed Switch Time: 0.25 to 2 seconds										

2.7.3 Receiver Specifications, continued

<p>Output Signal Switching Devices (OSSDs)</p>	<p>Two redundant solid-state 24V dc, 0.5 A max. sourcing OSSD (Output Signal Switching Device) safety outputs. (Use optional interface modules for ac or larger dc loads.) Capable of the Banner "Safety Handshake" (see Section 1.1). ON-State voltage: $\geq V_{in}-1.5V$ dc OFF-State voltage: 1.2V dc max. (0-1.2V dc) Max. load capacitance: 1.0 μF Max. load inductance: 10 H Leakage Current: 0.50 mA maximum Cable Resistance: 10 Ω maximum OSSD test pulse width: 100 to 300 microseconds OSSD test pulse period: 10 ms to 22 ms (varies with number of beams) Switching Current: 0-0.5 A</p>
<p>Auxiliary Output Switching Capacity (OSSD/Fault)</p>	<p>Current-sourcing (PNP) solid-state output, 24V dc at 250 mA max. (see Section 3.5.5)</p>
<p>Controls and Adjustments (see Section 4.2)</p>	<p>Scan Code selection: 2-position switch (code 1 or 2). Factory default position is <u>code 1</u>. Trip/Latch Output selection: Redundant switches. Factory default position is <u>T (trip)</u>. EDM/MPCE monitor selection: 2-position switch selects between 1- or 2-channel monitoring. Factory default position is <u>2-channel monitoring</u>. Reduced Resolution: Redundant switches. Factory default position is <u>OFF</u>. Aux./Fault: 2-position switch. Factory default position is <u>Aux</u>. Invert Display: 2-position switch. Factory default position is <u>OFF</u>.</p>
<p>Ambient Light Immunity</p>	<p>> 10,000 lux at 5° angle of incidence</p>
<p>Strobe Light Immunity</p>	<p>Totally immune to one Federal Signal Corp. "Fireball" model FB2PST strobe</p>
<p>Status Indicators</p>	<p>Yellow Reset indicator – indicates whether system is ready for operation or requires a reset Bi-color (Red/Green) Status indicator – indicates general system and output status Bi-color (Red/Green) Zone Status indicators – indicate condition (clear or blocked beam) of a defined group of beams 7-Segment Diagnostic indicator (1 digit) – indicates proper operation, scan code, error code, or total number of blocked beams See Figure 1-3 for indicator locations and Section 4.4 for indicator conditions.</p>

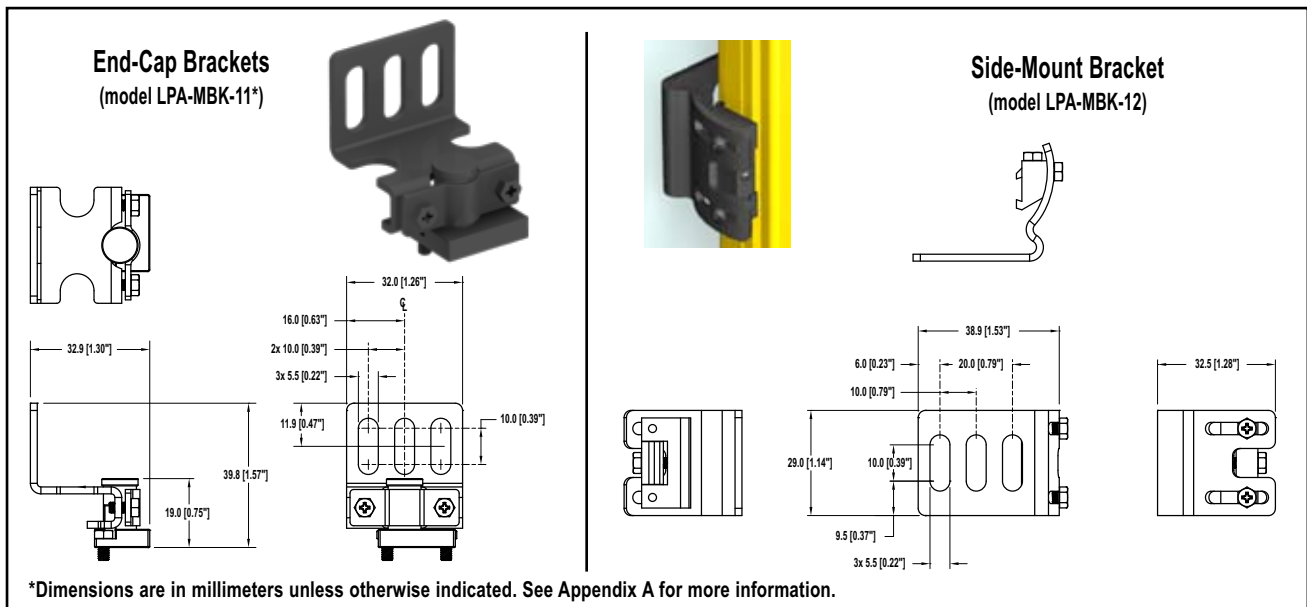


Figure 2-5. Included mounting bracket dimensions (for emitter or receiver)

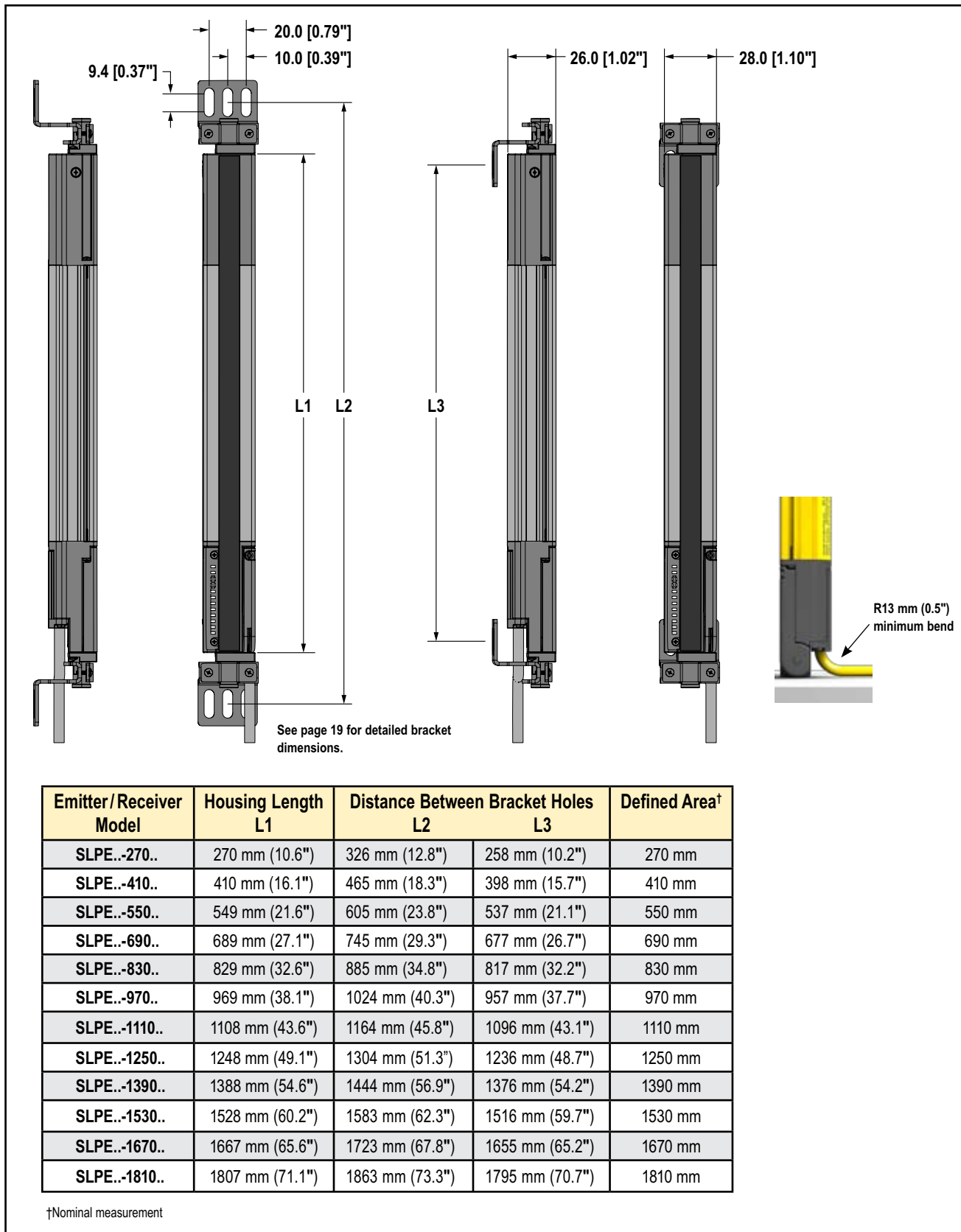


Figure 2-6. Emitter and receiver mounting dimensions and location of defined area

3. Installation and Alignment

Before installing the EZ-SCREEN LP, read Section 1.2 and Section 3 of this manual in their entirety. The System's ability to perform its safety guarding 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 System cannot provide the protection for which it was designed. Installation must be performed by a Qualified Person, as defined in Section 4.1. See Warning below.

⚠ WARNING . . . Read this Section Carefully Before Installing the System

The user is responsible for satisfying all local, state, and national codes and regulations relating to the installation and use of this control system in any particular application. Take extreme care to meet all legal requirements and follow all technical installation and maintenance instructions contained in this manual.

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

Read Section 1.2 and all of Section 3 of this manual carefully before installing the System. Failure to follow these instructions could result in serious bodily injury or death.

3.1 Mechanical Installation Considerations

The two factors that most influence the layout of the EZ-SCREEN LP's mechanical installation are safety (minimum) distance and hard guarding. Other considerations include emitter and receiver orientation, adjacent reflective surfaces, use of corner mirrors, and installation of multiple EZ-SCREEN LP emitter/receiver pairs.

⚠ WARNING . . . Position Components Carefully

The emitter and receiver must be positioned such that the hazard can not be accessed by reaching over, under, around or through the sensing field. Additional guarding may be required; see Separation Distance, Section 3.1.1, and Pass-Through Hazards, Section 3.1.2, and Supplemental Safeguarding, Section 3.1.4.

3.1.1 Safety Distance (Minimum Distance)

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

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

⚠ WARNING . . . Minimum Safety Distance

EZ-SCREEN LP emitters and receivers must be mounted at a distance from the nearest hazard such that an individual cannot reach the hazard before cessation of hazardous motion or situation. **Failure to establish and maintain the minimum distance could result in serious bodily injury or death.**

Reduced Resolution

Reduced Resolution increases Dpf (or C). **Increase the depth penetration factor to calculate proper minimum distance whenever Reduced Resolution is used.** Always turn Reduced Resolution OFF when the larger minimum object detection size is not required.

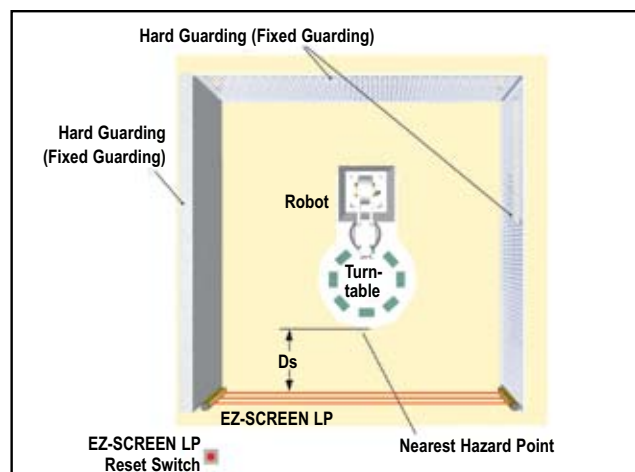


Figure 3-1. Safety (minimum) distance and hard guarding

WARNING . . . Determine Correct Stop Time

Stop time (Ts) must include the response time of all devices or controls that react to stop the machine. If all devices are not included, the calculated safety/minimum distance (**Ds** 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.**

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

$$D_s = K \times (T_s + T_r) + D_{pf}$$

where:

- Ds** – the safety distance, in mm (inches);
- K** – 1600 mm per second (or 63" per second), the OSHA1910.217, ANSI B11, ANSI/RIA R15.06 hand-speed constant (see Note 1);
- Ts** – the overall stop time of the machine (in seconds) from the initial "stop" signal to the final ceasing of all motion, including stop times of all relevant control elements (e.g., interface modules) and measured at maximum machine velocity (see Note 2 and Warning on page 21).
- Tr** – the maximum response time, in seconds, of the EZ-SCREEN LP emitter/receiver pair (depending on model); and
- Dpf** – the added distance due to depth penetration factor as prescribed in OSHA1910.217, ANSI B11, ANSI/RIA R15.06 for U.S. applications (see Warning):

Reduced Resolution	Depth Penetration Factor (Dpf)	
	14 mm Systems	25 mm Systems
OFF	24 mm (0.94")	61 mm (2.4")
ON	92 mm (3.6")	915 mm (36")

NOTES:

1. The OSHA-recommended hand speed constant **K** has been determined by various studies, and although these studies indicate speeds of 63"/second to more than 100"/second, 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. **Ts** is usually measured by a stop-time measuring device. **If the machine manufacturer's specified stop time is used, add at least 20% to allow for possible clutch/ brake system deterioration.** This measurement must take into account the slower of the two MPCE channels, and the response time of all devices or controls that react to stop the machine. See Notice Regarding MPCEs. **If all devices are not included, the calculated safety distance (Ds) will be too short and serious injury could result.**

Example: U.S. Applications, Model SLSP14-550

- K** = 63" per second (the hand speed constant set by OSHA)
 - Ts** = 0.32 (0.250 second specified by machine manufacturer; plus 20% safety factor; plus 20 ms interface module response)
 - Tr** = 0.0165 second (the specified SLSP14-550 response time)
 - Dpf** = 3.6" (14 mm resolution, Reduced Resolution ON)
- Substitute the numbers into the formula as follows:

$$D_s = K \times (T_s + T_r) + D_{pf}$$

$$D_s = 63 \times (0.32 + 0.0165) + 3.6 = 24.8"$$

Mount this EZ-SCREEN LP emitter and receiver so that no part of the defined area will be closer than 24.8" to the closest reachable hazard point on the guarded machine.

Notice Regarding MPCEs

Each of the machine primary control elements (MPCE1 and MPCE2) must be capable of immediately stopping the dangerous machine motion, regardless of the state of the other. The two machine control channels need not be identical, but the machine's stop time performance (**Ts**, used to calculate separation distance) must be based on the slower of the two channels (see Section 3.5.3).

The minimum distance formula for European applications:

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

where:

- S** – the minimum distance, in mm, from danger zone to light screen center line; minimum allowable distance is 100 mm (175 mm for non-industrial applications), regardless of calculated value.
- K** – hand-speed constant (see Note 1);
2000 mm/s (for minimum safety distances ≤ 500 mm)
1600 mm/s (for minimum safety distances > 500 mm)
- T** – the overall machine stopping response time (in seconds), from the physical initiation of the safety device and the machine coming to a stop (or the hazard removed). This can be broken down into two parts: **Ts** or **Tr**, where **T = Ts + Tr**
- Ts** – the overall stop time of the machine (in seconds) from the initial "stop" signal to the machine coming to a stop (or the risk being removed), including stop times of all relevant control elements (e.g., interface modules) and measured at maximum machine velocity (see Note 2 and Warning on page 21).
- Tr** – the maximum response time, in seconds, of the EZ-SCREEN LP emitter/receiver pair, depending on model; and
- C** – the additional distance, in mm, based on intrusion of hand or object towards danger zone prior to actuation of a safety device. Calculate using the formula: **C = 8 x (d - 14)** where **d** is the resolution of the device (for **d < 40 mm**) or use 850 mm for **C**.

NOTES:

1. 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.
2. **Ts** is usually measured by a stop-time measuring device. **If the machine manufacturer's specified stop time is used, add at least 20% to allow for possible clutch/ brake system deterioration.** This measurement must take into account the slower of the two MPCE channels, and the response time of all devices or controls that react to stop the machine. See Notice Regarding MPCEs. **If all devices are not included, the calculated minimum distance (S) will be too short and serious injury could result.**

Example: European Applications, Model SLSP14-550

- K** = 1600 mm per second
 - T** = 0.32 (0.250 second specified by machine manufacturer; plus 20% safety factor; plus 20 ms interface module response), plus 0.0165 second (the specified SLSP14-550 response time)
 - C** = 8 x (34-14) = 160 mm (14 mm resolution, Reduced Resolution ON)
- Substitute the numbers into the formula as follows:

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

$$S = (1600 \times 0.3365) + 160 = 698.4 \text{ mm}$$

Mount this EZ-SCREEN LP emitter and receiver so that no part of the defined area will be closer than 698.4 mm to the closest reachable hazard point on the guarded machine.

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

Reducing or Eliminating Pass-Through Hazards

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

One solution is to ensure that personnel are continually sensed while within the hazardous area. This can be accomplished by using supplemental safeguarding, such as described by the ANSI B11 series of safety requirements or other appropriate standards (see Section 3.1.4).

An alternate method is to ensure that once the safeguarding device is tripped it will latch, and will require a deliberate manual action to reset. This method of safeguarding relies upon the location of the reset switch as well as safe work practices and procedures to prevent an unexpected start or restart of the guarded machine (see Section 3.1.3).

WARNING . . . Use of EZ-SCREEN LP for Perimeter Guarding

If an EZ-SCREEN LP System is installed in an application that results in a pass-through hazard (e.g., perimeter guarding), either the EZ-SCREEN LP 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. The switch must be positioned as described in Section 3.1.3.

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

3.1.3 Reset Switch Location

The reset switch must be mounted at a location that complies with the warning 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 (e.g., 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.

Resetting a safeguard must not initiate hazardous motion.

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

WARNING . . . Reset Switch Location

All reset switches must be:

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

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 series or other appropriate standards. **Failure to do so could result in serious injury or death.**

3.1.4 Supplemental Safeguarding

As described in Section 3.1.1, the EZ-SCREEN LP components must be properly positioned such that an individual can not reach through the defined area and access the hazard point before the machine has stopped.

Additionally, the hazard can not be accessible by reaching around, under, or over the defined area. To accomplish this, supplemental guarding (mechanical barriers, such as screens or bars), as described by ANSI B11 safety requirements or other appropriate standards, must be installed. Access will then be possible only through the defined area of the EZ-SCREEN LP or through other safeguarding that prevents access to the hazard (see Figure 3-3).

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

⚠ WARNING . . . The Hazard Must Be Accessible Only through the Defined Area

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

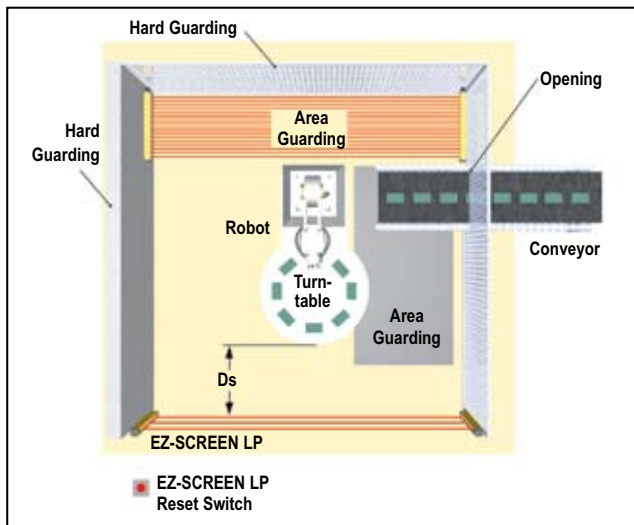


Figure 3-3. An example of supplemental safeguarding

Figure 3-3 shows an example of supplemental safeguarding inside a robotic work cell. The EZ-SCREEN LP, in conjunction with the hard guarding, is the primary safeguard. Supplemental safeguarding (such as a horizontal-mounted safety light screen as an area guard) is required in areas that can not be viewed from the reset switch (i.e., behind the robot and the conveyor). Additional supplemental safeguarding may be required to prevent clearance or trapping hazards (e.g., the safety mat as an area guard between the robot, the turntable, and the conveyor).

⚠ WARNING . . . Proper Orientation of EZ-SCREEN LP Emitters and Receivers

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

3.1.5 Emitter and Receiver Orientation

The emitter and receiver must be mounted parallel to each other and aligned in a common plane, with both cable ends pointing in the same direction. **Never mount the emitter with its cable end oriented opposite the cable end of the receiver.** If this occurs, voids in the light screen may allow objects or personnel to pass through the defined area undetected (see Figure 3-4).

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

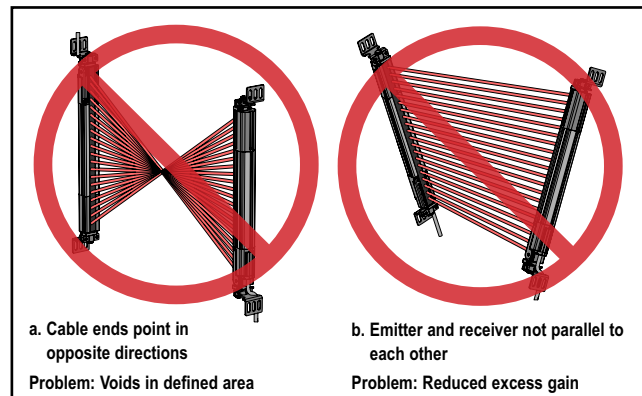


Figure 3-4. Examples of incorrect emitter / receiver orientation

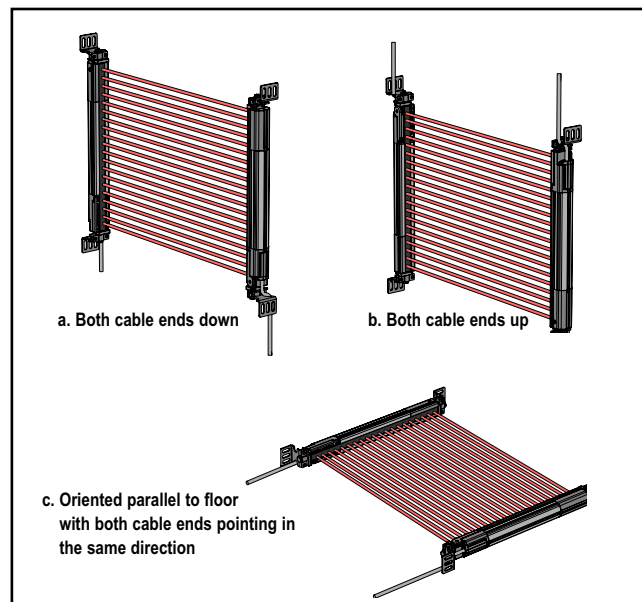


Figure 3-5. Examples of correct emitter / receiver orientation

3.1.6 Adjacent Reflective Surfaces

A reflective surface 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 (see Figure 3-6).

This reflective surface may result from shiny surfaces or glossy paint on the machine, the workpiece, the work surface, the floor or the walls. Discover beams deflected by reflective surfaces by performing the trip test portion of the final alignment procedure and the periodic checkout procedures (Section 3.4.4).

To eliminate problem reflections:

- **If possible, relocate the sensors** to move the beams away from the reflective surface(s), being careful to maintain adequate safety (minimum) distance (see Figure 3-6).
- **Otherwise, 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) in the safety (minimum) distance formula (see Figure 3-7 and Section 3.1.1); 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** to verify that the changes eliminated the problem. If the workpiece is especially reflective and comes close to the defined area, perform the trip test with the workpiece in place.

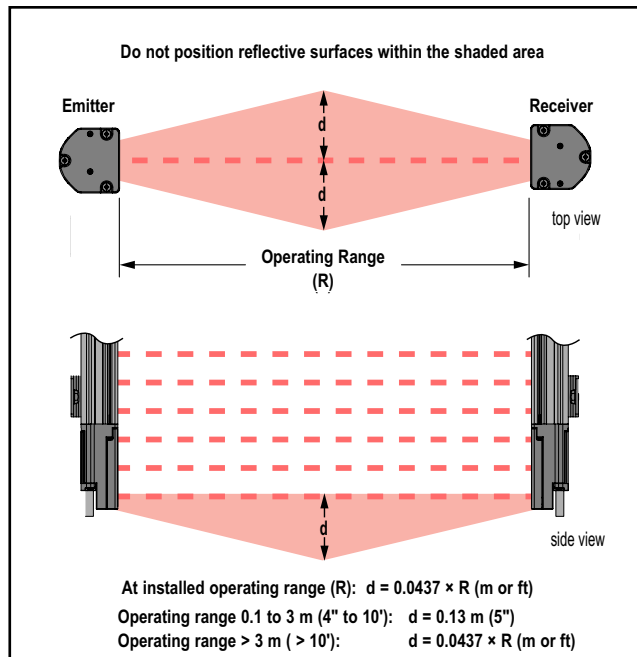


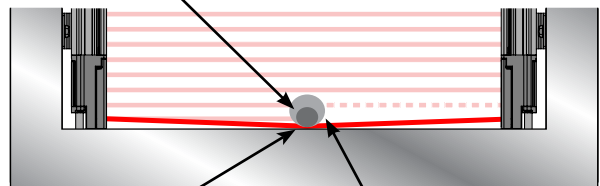
Figure 3-6. Adjacent reflective surfaces

⚠ 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 LP System. Perform the trip test, as described in Section 3.4.4, 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 bodily injury or death.

At the midpoint of the defined area, a test piece (represented by the darker circle) with the specified system resolution does not cause a blocked condition, due to an optical short circuit. Zone indicator LEDs are ON Green and the OSSDs are ON.



Optical Short Circuit

Increasing the size of the test piece to block additional beams will cause a blocked condition. The size of the test piece required to do this will determine 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")	0 mm
STP-2	19 mm	41 mm (1.6")	40 mm (1.6")
STP-16	25 mm	61 mm (2.5")	88 mm (3.5")
STP-14	30 mm	78 mm (3")	128 mm (5")
STP-4	32 mm	85 mm (3.3")	144 mm (5.7")
STP-17	34 mm	92 mm (3.6")	160 mm (6.3")
STP-1	38 mm	106 mm (4.2")	192 mm (7.6")
STP-3	45 mm	129 mm (5")	850 mm (33.5")
STP-8	51 mm	150 mm (5.9")	850 mm (33.5")
STP-5	58 mm	173 mm (6.8")	850 mm (33.5")
STP-15	60 mm	180 mm (7")	850 mm (33.5")
STP-12	62 mm	187 mm (7.4")	850 mm (33.5")

See Section 3.1.1 for Safety (Separation) Distance calculation information

Figure 3-7. Increasing resolution value to mitigate an optical short circuit

3.1.7 Use of Corner Mirrors

EZ-SCREEN LP may be used with one or more corner mirrors (see Section 2.4). The use of glass-surface corner mirrors reduces the maximum specified emitter/receiver separation by approximately 8 percent per mirror, as shown below:

SSM and MSM Series Glass-Surface Mirrors – Maximum Emitter and Receiver Separation				
Sensor Models	Number of Corner Mirrors			
	1	2	3	4
14 mm or 25 mm Resolution Models 7 m (23') Range	6.5 m (21.2')	6.0 m (19.5')	5.5 m (18.0')	5.1 m (16.6')

See the specific mirror data sheet or the Banner Safety Catalog for further information.

⚠ WARNING . . . Avoid Retroreflective Installation

Do not install emitters and receivers in “retroreflective” mode, with less than a 45° angle of incidence, as shown in Figure 3-8. Sensing could be unreliable in this configuration; serious bodily injury or death could result.

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

If mirrors are used, the difference between the angle of incidence from the emitter to the mirror and from the mirror to the receiver must be between 45° and 120° (see Figure 3-8). If placed at a sharper angle, as shown in the example, an object in the light screen may deflect beam(s) to the receiver, preventing the object from being detected (i.e., “false proxing”). Angles greater than 120° result in difficult alignment and possible optical short circuits.

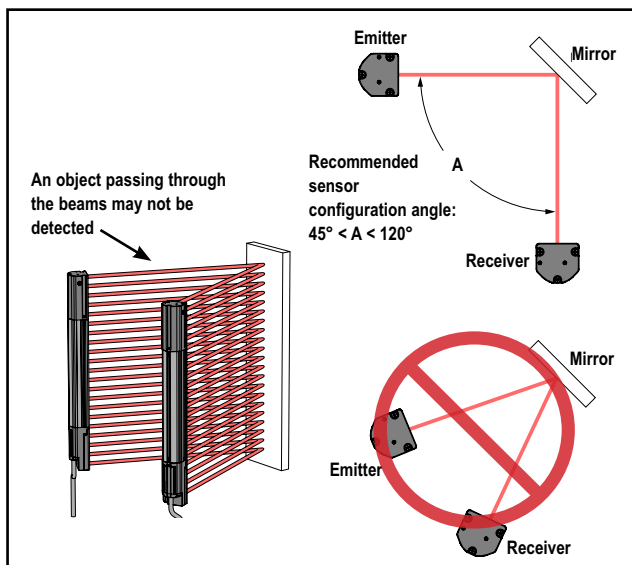


Figure 3-8. Never use EZ-SCREEN LP in a retroreflective mode.

3.1.8 Installation of Multiple Systems

Whenever two or more EZ-SCREEN LP emitter and receiver pairs are adjacent to one another, optical crosstalk may potentially take place between systems. To minimize optical crosstalk, alternate the positions of emitters and receivers, (see Figure 3-9a), or alternate scan codes.

When three or more sensor pairs are installed in the same plane (as shown for two pairs in Figure 3-9), 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 “see” an emitter set to another code (see Section 4.2).

⚠ WARNING . . . Scan Code

In situations where multiple systems are mounted closely together, or where a secondary emitter is in view (within ±5°), within range of an adjacent receiver; the adjacent systems must be configured for different Scan Codes (i.e., 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 will be discovered by performing the trip test (see Section 3.4.3).

⚠ WARNING . . . Multiple Pairs of Sensors

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

Connection of multiple OSSD safety outputs to a single device can result in serious bodily injury or death, and is prohibited.

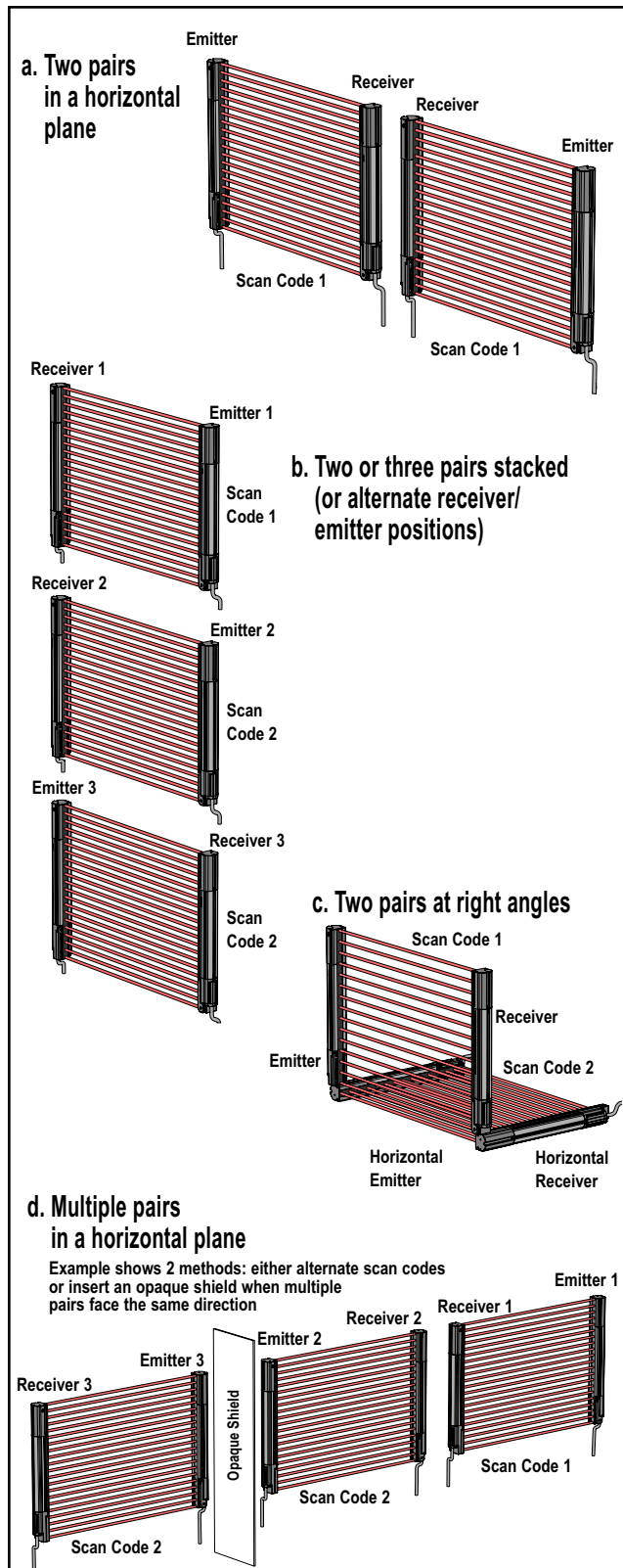


Figure 3-9. Installation of multiple pairs; alternate emitters and receivers to avoid optical crosstalk.

3.2 Mechanical Mounting Procedure

Once the mechanical layout considerations of Section 3.1 are addressed, mount the sensors and route the cables.

3.2.1 Sensor Mounting

Emitter/receiver pairs may be spaced from 0.1 m to 7 m (4" to 23') apart. This distance is reduced if corner mirrors are used (see Section 3.1.7).

Each sensor is shipped with two end-cap brackets and at least two side-mount brackets. The supplied end-cap brackets allow 360° rotation. Side-mount brackets allow 30° rotation in one direction, and 10° in the other (see Figure 3-10). Side-mount brackets may be mounted on either or both sides of the housing. If additional rotation is required, see the accessory brackets in Section 2.4.

Center-mounted side brackets must be used with longer sensors, if they are subject to shock or vibration. In such situations, the sensors are designed to be mounted with up to 690 mm unsupported distance (between brackets). Sensors 830 mm and longer are supplied with one or more additional side brackets for center-mounting (see Figure 3-10).

Mounting the End-Cap Brackets

1. From a common point of reference (ensuring the minimum safety distance calculated in Section 3.1.1), measure to locate the emitter and receiver in the same plane, with their midpoints directly opposite each other. **Important: The connector ends of both sensors must point in the same direction** (see Figure 3-5 and warning, Section 3.1.4). Loosely mount the brackets to the desired surface, using the supplied M5 bolts and nuts, or user-supplied hardware. Brackets may face "in" or "out," as desired (see Figure 2-6).
2. Attach the end-cap bracket plate to each end of the sensor, using the supplied M3x6 screws.
3. Position the emitter and receiver in their brackets, as shown in Figure 3-11. Loosely attach the front bracket plate to the bracket, at each end.
4. Verify that the sensor windows directly face each other. Measure from a reference plane (e.g., 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 Section 2.5) or check the diagonal distances between the sensors, to achieve mechanical alignment; see Figure 3-11. Final alignment procedures are explained in Section 3.4.
5. Tighten all fasteners.

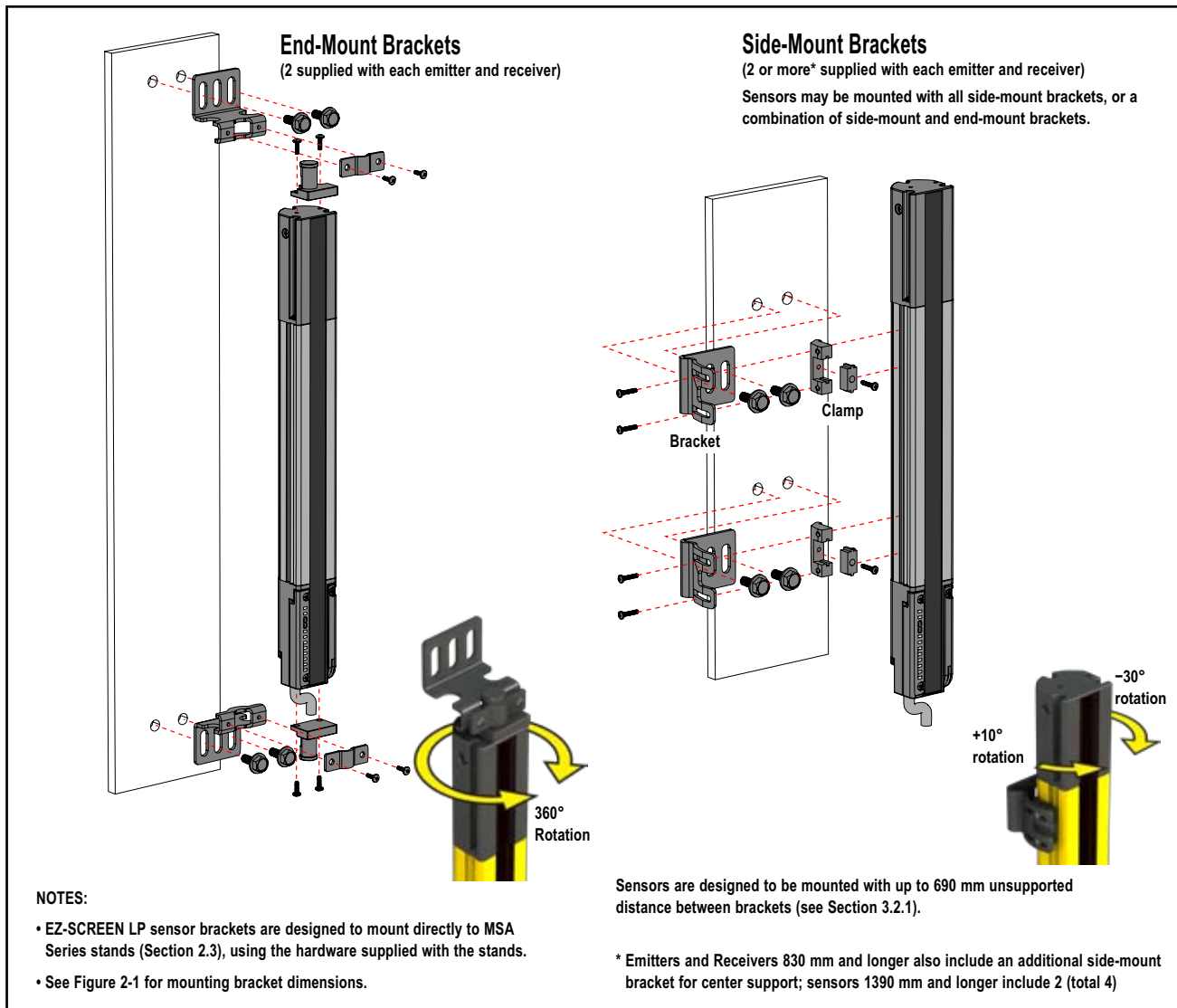


Figure 3-10. Emitter and receiver mounting hardware (see Appendix A for more information)

Mounting the Side-Mount Brackets

1. From a common point of reference (ensuring the minimum safety distance calculated in Section 3.1.1), measure to locate the emitter and receiver in the same plane, with their midpoints directly opposite each other. **Important: The connector ends of both sensors must point in the same direction** (see Figure 3-5 and warning, Section 3.1.4). Mount the emitter and receiver mounting brackets to the desired surface, using the supplied M5 bolts and nuts or user-supplied hardware; see Figure 3-10.
2. Attach the 2-piece clamp to the sensor housing side channels (either side of the housing) at the appropriate locations, using the supplied M3x6 screws.
3. Attach the clamp to the bracket, using the supplied M5 screws.
4. Position the emitter and receiver windows directly facing each other. Measure from a reference plane (e.g., 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 Section 2.5) or check the diagonal distances between the sensors, to achieve mechanical alignment; see Figure 3-11. Final alignment procedures are explained in Section 3.4.
5. Tighten all fasteners.

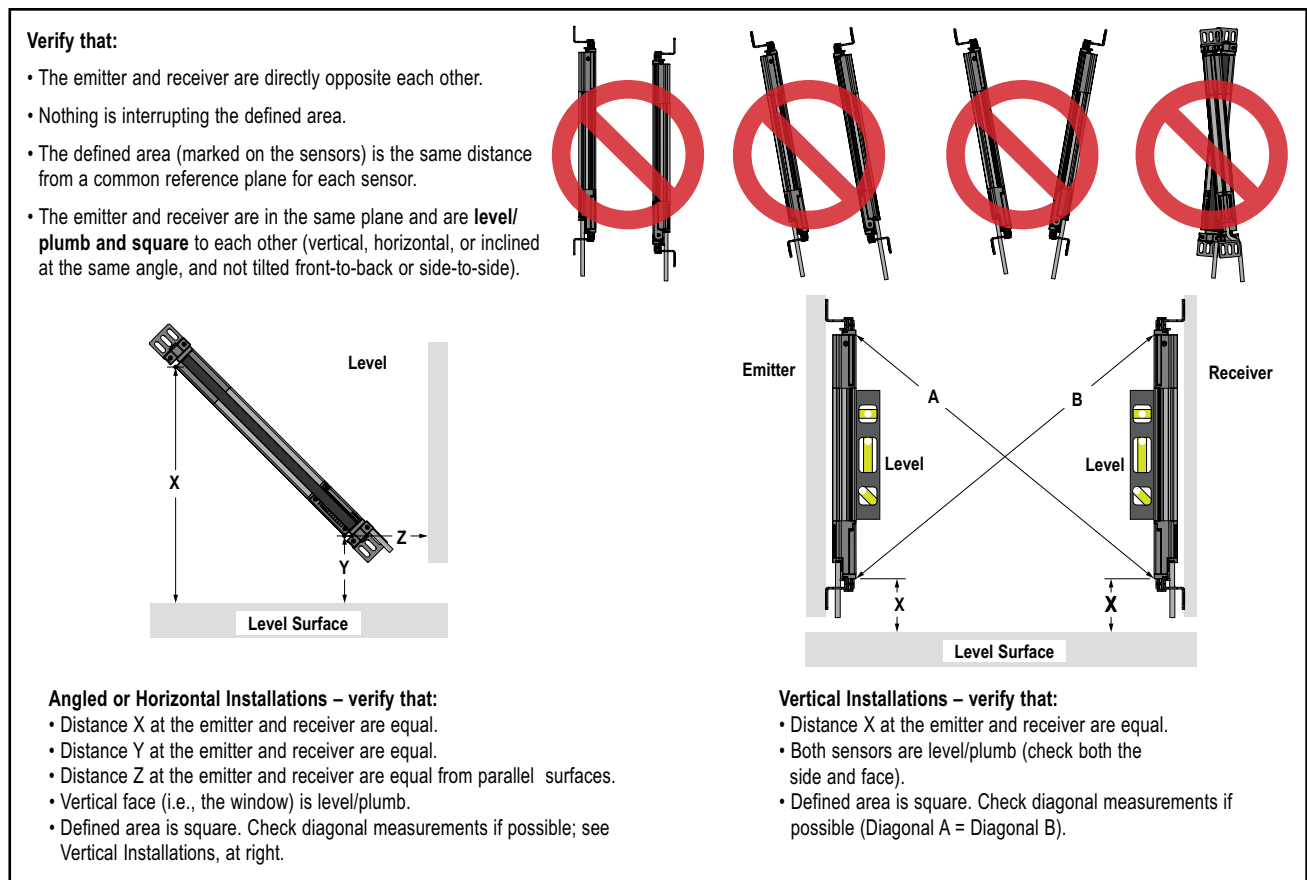


Figure 3-11. Sensor mounting, mechanical alignment

3.2.2 Mounting the Reset Switch

Mount the reset switch in a location that complies with the warning in Section 3.1.3. See Figures 3-23 through 3-26 for electrical connection.

3.2.3 Routing Cables

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 Section 2.3 for selection of Banner-supplied cables.

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

EZ-SCREEN LP is designed and manufactured to be highly resistant to electrical noise and to operate reliably in industrial settings. However, extreme electrical noise may cause a random Trip or Latch condition; in extreme cases, a Lockout is possible.

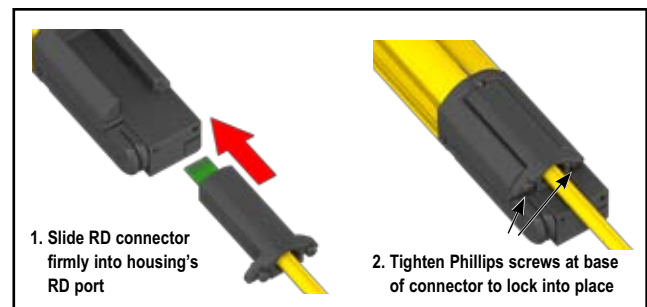


Figure 3-12. RD cordset installation

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 LP system. It is good wiring practice (and may be required by code) to isolate emitter and receiver cables from high-voltage wires, avoid routing cables close to “noisy” wiring, and provide a good connection to earth ground.

Sensor cabling and any interconnect wiring should have an insulation temperature rating of at least 90°C (194°F).

3.3 Initial Electrical Connections

Lockout/tagout procedures may be required (refer to OSHA 29CFR1910.147, ANSI Z244-1, or the appropriate standard for controlling hazardous energy). Following relevant electrical standards and wiring codes, such as the NEC, NFPA79 or IEC60204-1, always connect earth ground (green/yellow wire, see Figures 3-23 through 3-26). **Do not operate the EZ-SCREEN LP System without an earth ground connection. See the warning at right.**

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 via RD or pigtail QD connections.

Emitter Cordset

EZ-SCREEN LP emitters use an 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 (see Figure 3-22), 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

Do not connect any wires to the machine control circuits (i.e., OSSD outputs) at this time. For the initial power-up and checkout, NO EDM must be configured. Locate the orange and orange/black wires (pins 2 and 3) and temporarily connect the ends of the wires to each other (but not to the machine at this time). Take precautions to prevent the wires from shorting to ground or to other sources of energy (e.g., terminate with the included wire-nut). Final EDM wiring must be completed later.

If used, connect the external reset switch to the reset wire (violet) on the receiver cable and to 24V dc (see Figures 3-24 and 3-26). See warning in Section 3.1.3 about the physical location of the reset switch. The reset switch must be a normally open switch that is held closed for approximately 1/4 second, but no longer than 2 seconds, and then re-opened to accomplish the reset. The switch must be capable of switching 10 to 30V dc at 30 mA.

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 LP System than are described in Sections 3.3 through 3.5.5 of this manual.

Connection of other wiring or equipment to the EZ-SCREEN LP System could result in serious bodily injury or death.

Maximum Machine Interface Cordset Length*

EZ-SCREEN LP Receivers in Cascade	Total Load Current (OSSD 1 + OSSD 2 + Aux Out)					
	0.1A	0.25A	0.5A	0.75A	1.0A	1.25A
1	78.9 m (259')	62.5 m (205')	46.6 m (153')	37.2 m (122')	30.8 m (101')	26.5 m (87')
2	43.3 m (142')	37.8 m (124')	31.4 m (103')	26.8 m (88')	23.5 m (77')	20.7 m (68')
3	29.6 m (97')	27.1 m (89')	23.5 m (77')	20.7 m (68')	18.6 m (61')	17.1 m (56')
4	22.6 m (74')	21.0 m (69')	18.9 m (62')	17.1 m (56')	15.5 m (51')	14.3 m (47')

*RDLP-8..D or QDE-8..D model cordsets, see Section 2.3; may require multiple cables. See Section 7.4 for cascade installations.
NOTE: Emitter and receiver power (current) requirements are accounted for. The above values represent additional current draw that must be accounted for.

Figure 3-13. Maximum machine interface cable length versus total load current (OSSDs + Aux)

NOTE: Maximum cordset lengths are intended to ensure that adequate power is available to the EZ-SCREEN LP when the supply is operating at +24V dc – 15%.

3.4 Light Screen Initial Checkout

The initial checkout procedure must be performed by a Qualified Person (see Section 4.1). It must be performed only after configuring the System and after connecting the emitter and receiver per Section 3.3.

Configuring the System for Initial Checkout

Verify that the emitter and receiver both are set to the factory defaults for initial checkout and optical alignment. (Receiver factory defaults are for trip output, 2-channel EDM, reduced resolution OFF, aux output, inverted display OFF, and scan code 1. Emitter factory defaults are for reset, fault output OFF, inverted display OFF, and Scan Code 1. See Figure 4-1.)

Initial checkout is performed on two occasions:

- To ensure proper installation when the System is first installed, and
- To ensure proper System function whenever any maintenance or modification is performed on the System or on the machinery being guarded by the System. (See Section 6.1 for a schedule of required checkouts.)

For the initial checkout, the EZ-SCREEN LP System must be checked without power being available to the guarded machine.

Final interface connections to the guarded machine cannot take place until the light screen system has been checked out. This may require lockout/tagout procedures (refer to OSHA1910.147, ANSI Z244-1, or the appropriate standard for controlling hazardous energy). These connections will be made after the initial checkout procedure has been successfully completed.

Verify that:

- Power has been removed from (or is not available to) the guarded machine, its controls or actuators; and
- The machine control circuit or the interface module is not connected to the OSSD outputs at this time (permanent connections will be made later); and
- EDM is configured for no monitoring, per Section 3.5.3.

3.4.1 Initial Power-Up and Optical Alignment

1. **Inspect nearby areas 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 Section 3.1.6.

Eliminate the reflective surfaces as possible by relocating them, painting, masking or roughening them. Remaining problem reflections will become apparent during step 5.

2. **Verify that power is removed from the EZ-SCREEN LP System and from the guarded machine** and that the OSSD safety outputs are not connected. Remove all obstructions from the light screen.

Leaving power to the guarded machine OFF, make power and earth ground connections on both the emitter and receiver cables (see Figures 3-23 to 3-26) and then power up the EZ-SCREEN LP System (only).

Verify that input power is present to both emitter and receiver. At least one indicator on both emitter and receiver should be ON and the start-up sequence should cycle.

3. Observe both the emitter and the receiver Status indicators and the receiver Zone indicators to determine light screen alignment status:

- **An Emitter Lockout condition** – the emitter Status indicator single-flashing Red; the receiver Status indicator ON Red, 7-segment display reads “CH1”. Proceed to Section 5 for diagnostic information.
- **A Receiver Lockout condition** – the emitter Status indicator ON Green; the receiver Status indicator single-flashing Red, Zone and Reset indicators OFF. Proceed to Section 5 for diagnostic information.
- **Normal operating mode** (emitter) – the Status indicator ON Green.
- **A Latch condition** (receiver), all optical beams clear – the receiver Status indicator ON Red and the Reset indicator double-flashing Yellow; Zone indicators ON Green. When the receiver is configured for Latch Output, the outputs are ON only when all beams are clear and after a manual reset (see Section 1.4.8). If a reset routine can cause a Clear (Run) condition, optimize the alignment as described in step 4. If a Clear (Run) condition can not be achieved, see “Blocked condition” below.
- **A Clear (Run) condition** (receiver) – the Status indicator ON Green (or flashing Green if reduced resolution is enabled), and the Reset indicator ON Yellow. All Zone indicators ON Green.
- **A Blocked condition** (receiver) – the Status indicator ON Red, the yellow Reset indicator ON, and one or more Zone indicator(s) ON Red, identifying the location of the blocked beams, and the number of blocked beams will be displayed. Proceed to step #4.

NOTE: If beam 1 is blocked, Zone indicator 1 will be Red and all others OFF. (Beam 1 provides the synchronization signal.)

NOTE: If the emitter Test input is open, the receiver's 7-segment Display will indicate the total number of beams in the system (minus one) and all Zone indicators will be Red (except for 14-beam systems, where Zone 1 indicator will be Green).

4. 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 sensor mounting per Section 3.2.

Verify Optimal Alignment (Rotate with power ON)

a. Ensure the emitter and receiver are pointed squarely at each other. A straight edge (e.g., a level) can determine the direction the sensor is facing (see Figure 3-14). The sensor face must be perpendicular to the optical axis.

NOTE: At power-up, the EZ-SCREEN LP tests all indicators (they flash), then displays the Scan Code.

b. If Channel #1 beam is not aligned, the receiver Status and Zone 1 indicators are Red, the Reset indicator is Yellow, and the 7-segment display sequentially indicates "CH1". Zone indicators 2-8 will be OFF.

c. If the Green Status and Yellow Reset indicators are ON, go to step "d". If not, rotate each sensor (one at a time) left and right until the Status indicator comes ON Green. (As the sensor rotates out of alignment, the Status indicator will turn ON Red.) As more beams are made, the Zone indicators will turn from Red to Green and the number of blocked beams displayed will decrease.

NOTE: If the emitter Test input is open, the 7-segment Display will indicate the total number of beams in the system (minus one) and all Zone indicators will be Red (except for 14-beam systems, where Zone 1 indicator will be Green).

d. 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 (see Figure 3-14). 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-LP Laser Alignment Tool** can be used to assist or confirm alignment by providing a visible red dot along the sensor's optical axis (see Figure 3-16).

e. If, at any time, a Status indicator begins to flash Red, that sensor has entered a Lockout condition. See Section 5.1.1 for further information.

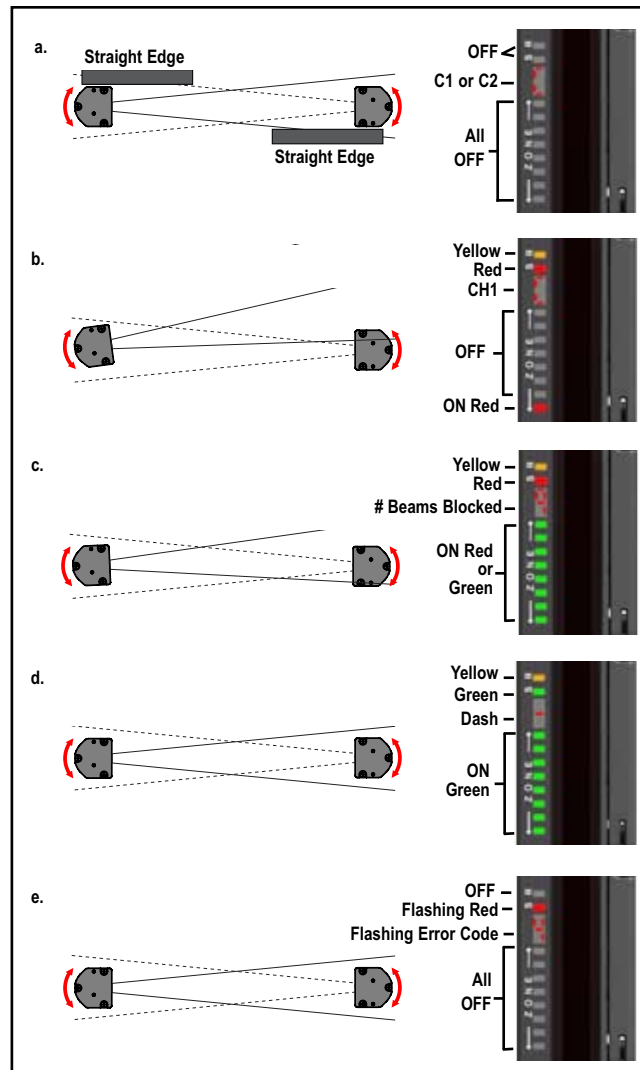


Figure 3-14. Optimum optical alignment

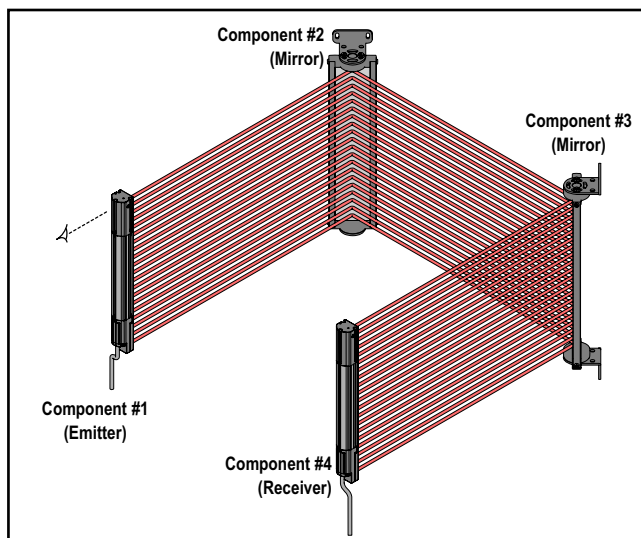


Figure 3-15. Corner mirror alignment

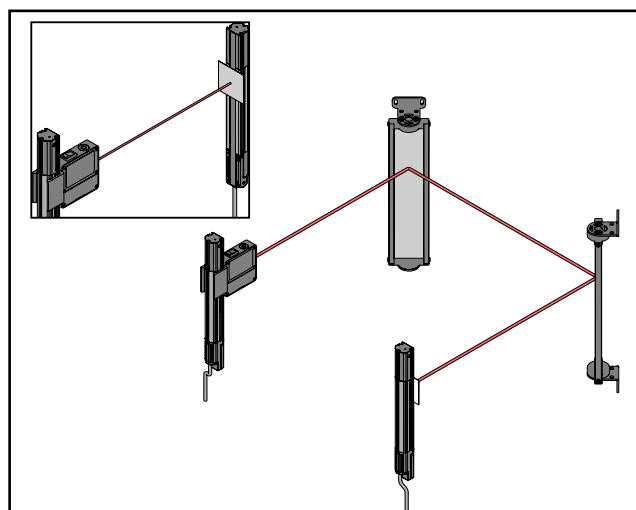


Figure 3-16. Optical alignment using the LAT-1

Optical Alignment Procedure with Mirrors

EZ-SCREEN LP sensors may be used with one or more corner mirrors for guarding more than one side of an area. The models **MSM...** and **SSM...** rear-surface glass mirrors are rated at 85% efficiency. Thus, **excess gain and sensing range are reduced when using mirrors; see Section 3.1.7.**

In addition to the standard optical alignment procedure for these applications (see Figures 3-15 and 3-16), also verify:

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

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

NOTE: A LAT-1-LP Laser Alignment Tool is very helpful by providing a visible red dot along the optical axis. See Figure 3-16 and Banner Safety Applications Note SA104 (P/N 57477) for further information.

3.4.2 Reduced Resolution (Floating Blanking)

Reduced resolution allows objects of a certain maximum size to interrupt the defined area without causing a Trip condition (i.e., the OSSDs turn OFF). **Use Reduced Resolution only when necessary.** In reduced resolution applications, the safety (minimum) distance always increases due to the larger depth penetration factor (Dpf). In either case, see Section 3.1.1 to determine separation distance.

With 2-beam reduced resolution enabled, **any two consecutive beams** (except for the sync beam), can be blocked without causing a stop condition. Thus, multiple “holes” are created in which 14 mm systems will detect a 34 mm object and ignore a 16 mm object. Similarly, 25 mm sensors will detect a 65 mm object and ignore a 36 mm object. See Figure 4-1 for DIP-switch configuration. During operation, the Status indicator flashes Green when reduced resolution is enabled.

Model	Reduced Resolution Setting	Maximum Size of Undetected Objects	Resulting Resolution
14 mm Resolution	OFF	(Not applicable)	14 mm (0.55")
	ON (2-beam)	16 mm (0.63")	34 mm (1.34")
25 mm Resolution	OFF	(Not applicable)	25 mm (0.98")
	ON (2-beam)	36 mm (1.42")	65 mm (2.56")

⚠ WARNING . . . Use of Reduced Resolution and Fixed Blanking

Use Reduced Resolution and 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 Section 3.1.1).

3.4.3 Fixed Blanking

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 LP sensor pair may be “blanked out,” with a minimum of one beam between two blanked areas. Any beam other than the sync beam may be blanked. **All beams of a fixed blanked area must remain blocked during operation** in order for the OSSDs to stay ON.

See Section 7.10 for instructions on remote fixed blanking configuration and programming (cascadeable models only).

Fixed Blanking Configuration

- From either normal operation or a power OFF condition, set the *first* and *second* DIP switches (T/L and Red Res) both to the left (Trip operation and Reduced Resolution enabled positions). See Figure 3-17.
- Set the *third* and *fourth* DIP switches (the second T/L and Red Res) both to the right (Latch operation and Reduced Resolution OFF positions).
- The receiver should now either be in a lockout condition or power is still OFF.
- If power is OFF:** Apply power
Lockout condition: Perform a valid reset sequence (close the reset switch for 1/4 to 2 seconds, then reopen it).
- Fixed Blanking configuration indicated by:**
 - Display sequentially displays "PFA" (program fixed blanking active) and the number of blocked beams ("0" if all beams are clear).
 - Zone indicators active
 - Reset indicator OFF
 - Status indicator ON Red
- Position object(s) to be blanked (or remove objects that will no longer be blanked).
- When any beams are blocked, the 7-segment display sequentially displays "PFA" and the number of blocked beams. The zone indicators remain active and denote the location of blocked beams.
- To teach the blanked beams, re-configure DIP switches for normal operation (see Table 4-1 and Figure 4-1). Verify that only the objects to be blanked are interrupting the defined area. A lockout will occur if an object is moved or removed after teaching.
- Receiver indicates:
 - Display: sequentially displays "PFC" (PFC = Program Fixed Blanking Complete)
 - Zone indicators flash approximate location of fixed blanked area programmed
 - Reset indicator single-flashing Yellow
 - Status indicator single-flashing Red
- Perform a valid reset sequence (see Step 4) or cycle power.
- To disable fixed blanking, follow this same procedure, but remove all objects not to be blanked at Step 6.

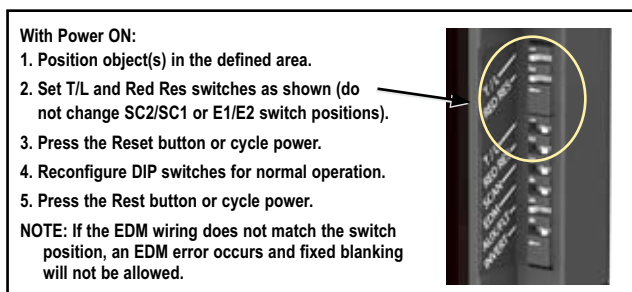


Figure 3-17. DIP switch configuration to teach fixed blanking

3.4.4 Trip Test

After optimizing the optical alignment and configuring fixed blanking and reduced resolution (if applicable), perform the trip test to verify the detection capability of the EZ-SCREEN LP. This test will also verify correct sensor orientation (Section 3.1.5), identify optical short circuits (Section 3.1.6), and verify the expected resolution for applications using reduced resolution (Section 3.4.2). After the installation passes the trip test, the safety outputs may be connected and the commissioning checkout may be performed (initial installations only).

Appropriate Test Pieces for Trip Test		
Reduced Resolution	14 mm Resolution Models	25 mm Resolution Models
OFF	14 mm (0.55") dia. Model STP-13	25 mm (0.98") dia. Model STP-16
ON (2-beam)	34 mm (1.34") dia. Model STP-17	65 mm (2.56") dia. Model STP-18

Cascaded systems: To test a cascaded system, test each light screen individually, while monitoring the status indicator on the first (master) receiver in the cascade.

- Select the proper test piece (see table), supplied with the receiver.
- Verify that the EZ-SCREEN LP is in Run mode with the Green Status indicator ON (or flashing if reduced resolution is enabled), all Zone indicators are Green, and the Yellow Status indicator ON. A manual reset may be required in Latch mode (see Sections 4.2 and 4.3).
- 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 3-18).
- During each pass, while the test piece is interrupting the defined area, at least one Zone indicator **must be Red. The Red Zone indicator must change with the position of the test piece within the defined area.**
 - Trip Output Operation:** The Status indicator must turn Red and remain Red for as long as the test piece remains in the defined area. If not, the installation has failed the trip test.
 - Latch Output Operation:** The Status indicator must turn Red and remain Red. The Yellow Reset indicator must remain ON steady. If the Reset indicator begins to flash at any time while the test piece is interrupting the defined area, the installation has failed the trip test.

If all Zone 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, reflective surfaces and unguarded areas created due to the use of Blanking. Do not continue until the situation is corrected.

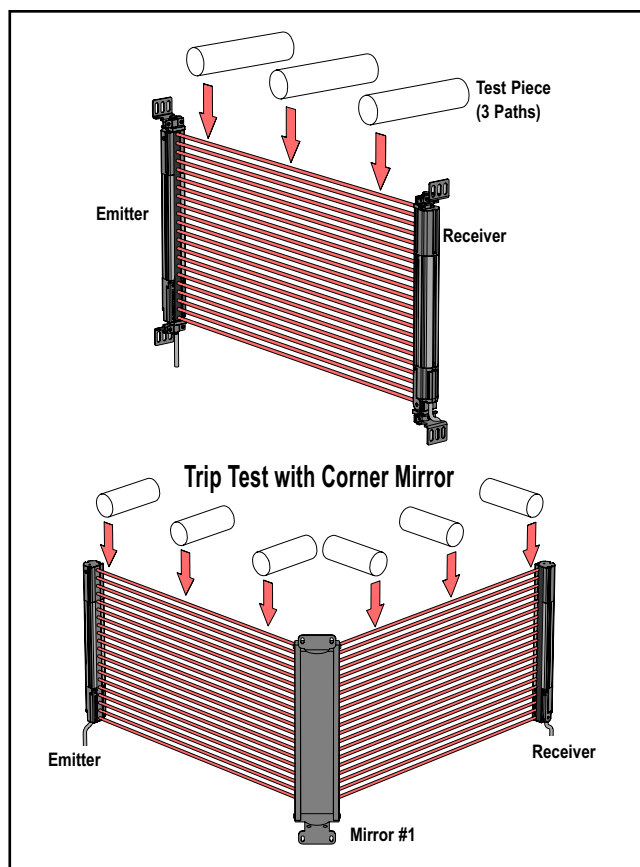


Figure 3-18. EZ-SCREEN LP trip test

⚠ WARNING . . . If Trip Test Indicates a Problem

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

If this occurs, the EZ-SCREEN LP 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.

When the test piece is removed from the defined area, in trip output operation, the Status indicator must turn ON Green (or flash Green, if reduced resolution is enabled). In latch output operation, the Status indicator will remain Red until a manual reset is performed (the Yellow Reset indicator will be flashing).

If mirrors are used in the application: Test the defined area on each leg of the sensing path (e.g. emitter to mirror, between mirror and receiver, see Figure 3-18).

If the EZ-SCREEN LP System passes all three checks during the trip test, go on to Section 3.5.

3.5 Electrical Interface to the Guarded Machine

Permanent Hookup

Verify that power has been removed from the EZ-SCREEN LP and the guarded machine. Make the electrical connections as described in Sections 3.5.1 to 3.5.5 as required by each individual application.

Lockout/tagout procedures may be required (refer to OSHA CFR 1910.147, ANSI Z244-1, or the appropriate standard for controlling hazardous energy). Follow relevant electrical standards and wiring codes, such as the NEC, NFPA79 or IEC 60204-1. See the warning in Section 3.3.

Supply power and the external reset switch should already be connected. The EZ-SCREEN LP must also have been aligned and passed the initial checkout, as described in Section 3.4.

The final connections to be made are:

- OSSD outputs
- FSD interfacing
- MPCE/EDM connections
- Remote Test

⚠ WARNING . . . Interfacing of Both OSSDs

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

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

⚠ WARNING . . . OSSD Interfacing

To ensure proper operation, the EZ-SCREEN LP OSSD output parameters and machine input parameters must be considered when interfacing the EZ-SCREEN LP solid-state 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 could result in serious bodily injury or death.

⚠ WARNING . . . Shock Hazard

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

3.5.1 OSSD Output Connections

Both the output signal switching device (OSSD) outputs must be connected to the machine control so that the machine's safety-related control system interrupts the circuit or power to the machine primary control element(s) (MPCE), resulting in a non-hazardous condition.

Final switching devices (FSDs) typically accomplish this when the OSSDs go to an OFF state. See Figure 3-24.

Refer to the output specifications in Section 2.7 and the warnings on page 35 before making OSSD output connections and interfacing the EZ-SCREEN LP to the machine.

3.5.2 FSD Interfacing Connections

Final switching devices (FSDs) can take many forms, although the most common are forced-guided, mechanically linked relays or an interface module. The mechanical linkage between the contacts allows the device to be monitored by the external device monitoring circuit for certain failures.

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

Safety Stop (Protective Stop) Circuits

A 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 safety stop circuit typically comprises a minimum of two normally open (N.O.) contacts from forced-guided, mechanically linked relays, which are monitored (via 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, safety stop circuits are either single-channel, which is a series connection of at least two N.O. contacts; or dual-channel, which is a separate connection of two N.O. contacts. In either method, the safety function relies on the use of redundant contacts to control a single hazard (if one contact fails ON, the second contact will arrest the hazard and prevent the next cycle from occurring). See Figure 3-24.

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

The normally open safety outputs from an interface module provide a series connection of redundant contacts that form safety stop circuits for use in either single-channel or dual-channel control. (See Figure 3-26.)

Dual-Channel Control

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

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

Single-Channel Control

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

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

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

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

3.5.3 Machine Primary Control Elements and EDM Inputs

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 IEC61496-1). 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 (i.e., diverse redundant), but the stop time performance of the machine (Ts, used to calculate the safety distance, see Section 3.1.1) must take into account the slower of the two channels. Refer to Figure 3-26 or consult the machine manufacturer for additional information.

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

For the EZ-SCREEN LP external device monitoring to function properly, each device must include a normally closed (N.C.), 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 (e.g., contacts that welded closed or stuck ON).

It is strongly recommended that a normally closed, forced-guided monitoring contact of each FSD and MPCE be connected to EDM inputs (see Figures 3-24 and 3-26). 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 (ISO13849-1).

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

- 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 (e.g., monitor the FSDs),
and
- Employ 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.

⚠ WARNING . . . EDM Monitoring

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

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.

External Device Monitoring

EZ-SCREEN LP provides three possible EDM configurations: 1-channel monitoring, 2-channel monitoring, and no monitoring. Their functions are described below. The most common form of EDM is 1-channel monitoring; its primary advantages are simplicity of wiring and the ability to use the Auxiliary output. The installation must prevent short circuits across the N.C. monitoring contacts and to secondary sources of power. Two-channel monitoring has the ability to detect additional failures, such as short circuits, and should be used when those failures can not be designed out or reasonably be excluded. Two-channel monitoring is also the default setting and has the advantage of additional diagnostic capability that can identify which specific element that has slowed or failed.

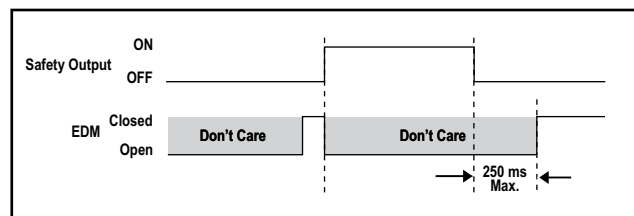


Figure 3-19. One-channel EDM status, with respect to safety output

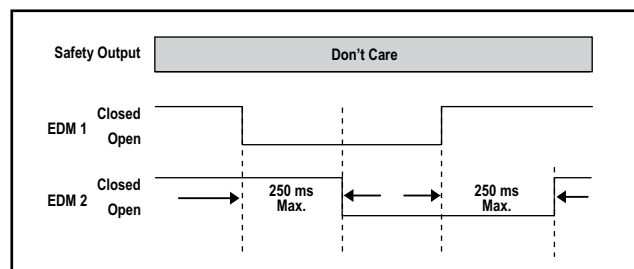


Figure 3-20. Two-channel EDM, timing between channels

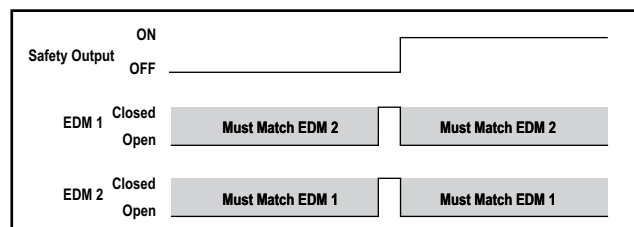


Figure 3-21. Two-channel EDM status, with respect to safety output

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 Figures 3-24 and 3-26). Pins 2 and 3 of the receiver connector provide connection for the external device monitoring input. External device monitoring (EDM) must be wired in one of three configurations described below and this wiring configuration must agree with the receiver's EDM DIP switch settings (see Section 4.2).

One-Channel Monitoring: This is a series connection of closed monitor contacts that are forced-guided (mechanically linked) from each device controlled by the EZ-SCREEN LP. The monitor contacts must be closed before the EZ-SCREEN LP can be reset and the OSSDs can turn ON. After a reset is executed and 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. See Figure 3-19.

Refer to Figure 3-26 for 1-channel EDM hookup. Connect the monitor contacts between +24V dc and EDM1 (pin 3). Leave EDM2 (pin 2) open (no connection), unless using the Auxiliary Output feature (Section 3.5.5). Set the configuration DIP switch to the 1-channel EDM position, per Section 4.2.

Two-Channel Monitoring: This is an independent connection of closed monitor contacts that are forced-guided (mechanically linked) from each device controlled by the EZ-SCREEN LP. The monitor contacts must be closed before the EZ-SCREEN LP can be reset and the OSSDs can turn ON. Regardless of the state of the OSSDs, the monitor contacts may change state (either both open, or both closed). If the monitor contacts remain in opposite states for more than 250 milliseconds, a lockout will occur.

Refer to Figures 3-24 or 3-26 for 2-channel EDM hookup. Connect the monitor contacts as shown between +24V dc and EDM1 (pin 3) and between +24V dc and EDM2 (pin 2). Set the configuration DIP switch to the 2-channel EDM position, per Section 4.2.

No Monitoring: Use this configuration initially, in order to perform the initial checkout; see Section 3.6. *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.*

Refer to Figure 3-25 for "no monitoring" hookup. To configure the EZ-SCREEN LP for no monitoring, connect or jumper EDM1 (pin 3) to EDM2 (pin 2) using the supplied wire-nut. Set the configuration DIP switch to the 2-channel EDM position, per Section 4.2.

An alternate method to configure no monitoring is to set the configuration DIP switch to the 1-channel EDM position, per Section 4.2, and connect EDM1 (pin 3) to +24V dc. This method allows the use of the auxiliary output (see Section 3.5.5) in applications that do not require the EDM function.

3.5.4 Remote Test Input

An emitter connection is provided (Test) for the connection of an external remote test switch (typically a normally open contact held closed). Opening this switch "turns OFF" the emitter, simulating an interruption of the light beams; all OSSD outputs will turn OFF. This input is used in conjunction with the emitter Test/Reset DIP switch. See Sections 2.7.2, 4.2, and Figure 3-23.

3.5.5 Auxiliary (OSSD Follow/Fault) Output

EZ-SCREEN LP receivers have an auxiliary status output that provides a PNP current-sourcing output (250 mA max.) that mirrors the state of the OSSDs or indicates a lockout (ON = Fault). The output is on pin 2 (orange/black wire) when the EDM configuration DIP switch is set to the 1-channel monitoring position, per Section 4.2. See the 1-channel EDM circuit on Figure 3-26 for hookup information.

To use the auxiliary output in an application configured for no monitoring, set the configuration DIP switch to the 1-channel monitoring position, per Section 4.2, and connect EDM1 (pin 3) to +24V dc (see Section 3.5.3).

The emitter also has a Fault output that can be enabled to indicate the emitter lockout status (see Section 4.2 Fault).

3.6 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 LP is ready for testing in combination with the guarded machine.

The operation of the EZ-SCREEN LP with the guarded machine must be verified before the combined EZ-SCREEN LP and machine may be put into service. To do this, **a Qualified Person must perform the Commissioning Checkout Procedure described in Section 6.2.**

3.7 Sensor "Swapability" and Emitter Hookup

Figure 3-22 illustrates a hookup option that provides sensor interchangeability (or "swapability") – the ability to install either sensor at either QD connection. This allows the emitter and receiver positions to be easily swapped, similar to a popular feature of Banner MACHINE-GUARD™, MINI-SCREEN® and MICRO-SCREEN® safety light screens, providing 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.

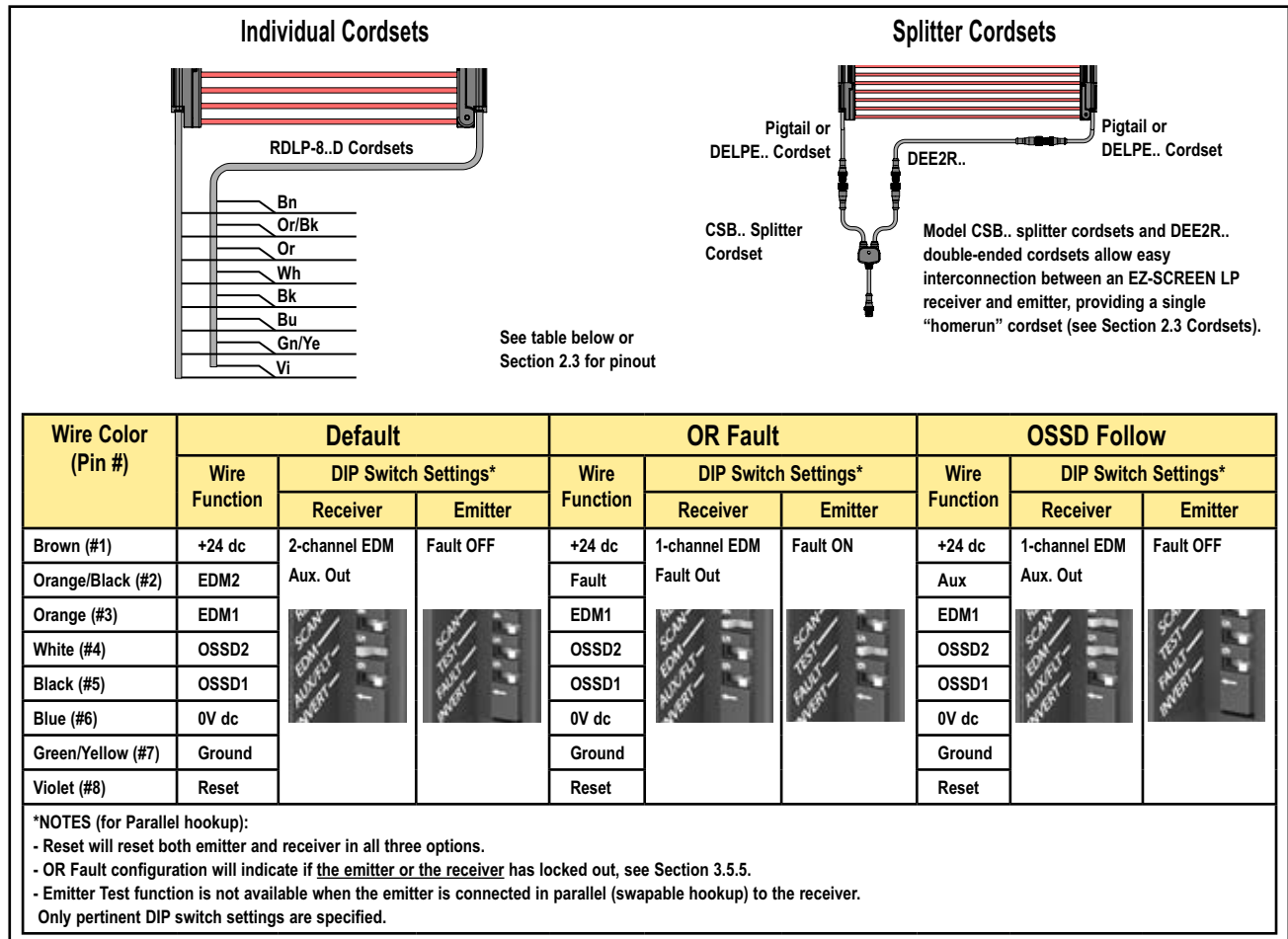


Figure 3-22. Parallel emitter/receiver hookup for easy sensor interchange ("swapability")

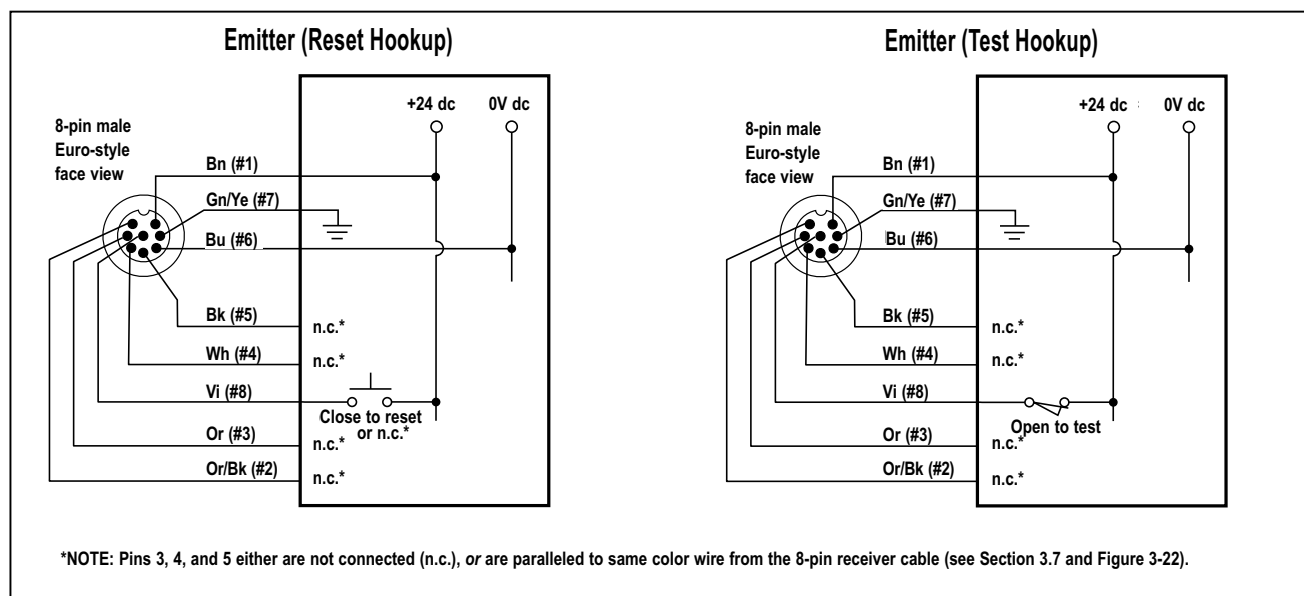


Figure 3-23. Emitter; generic hookup

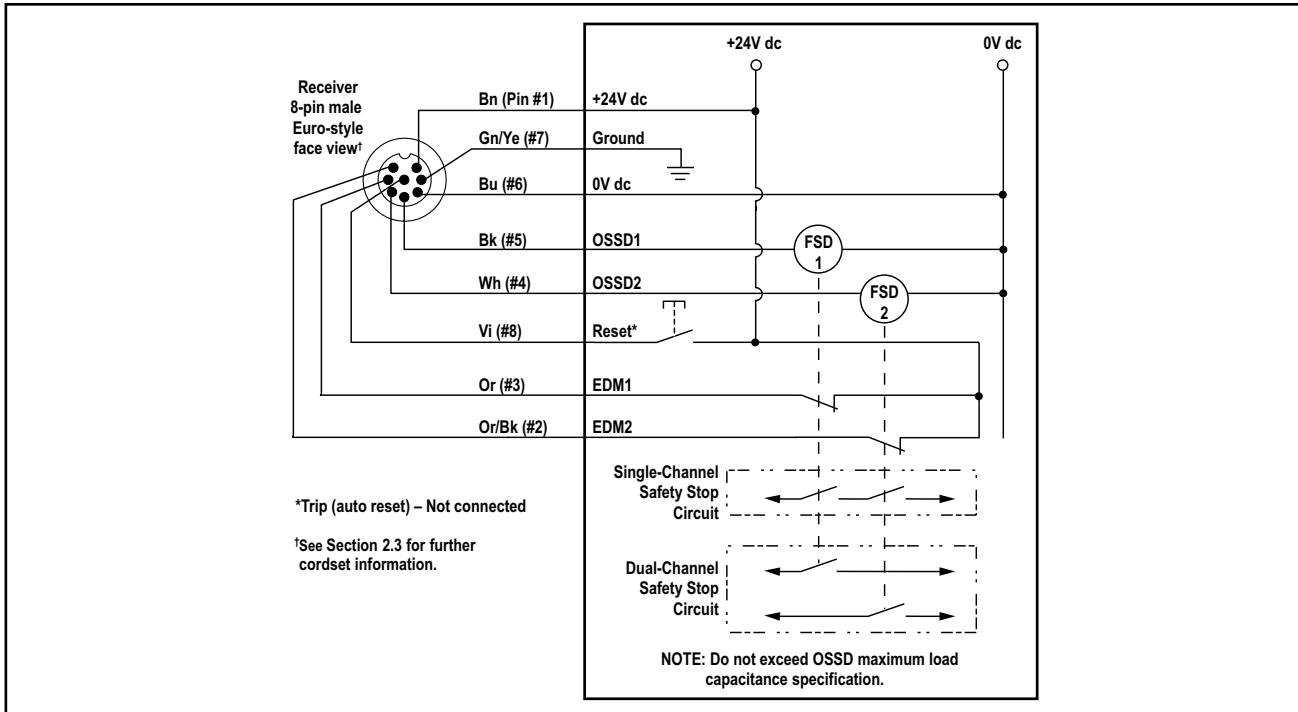


Figure 3-24. Generic hookup – FSDs (2-channel EDM, manual reset)

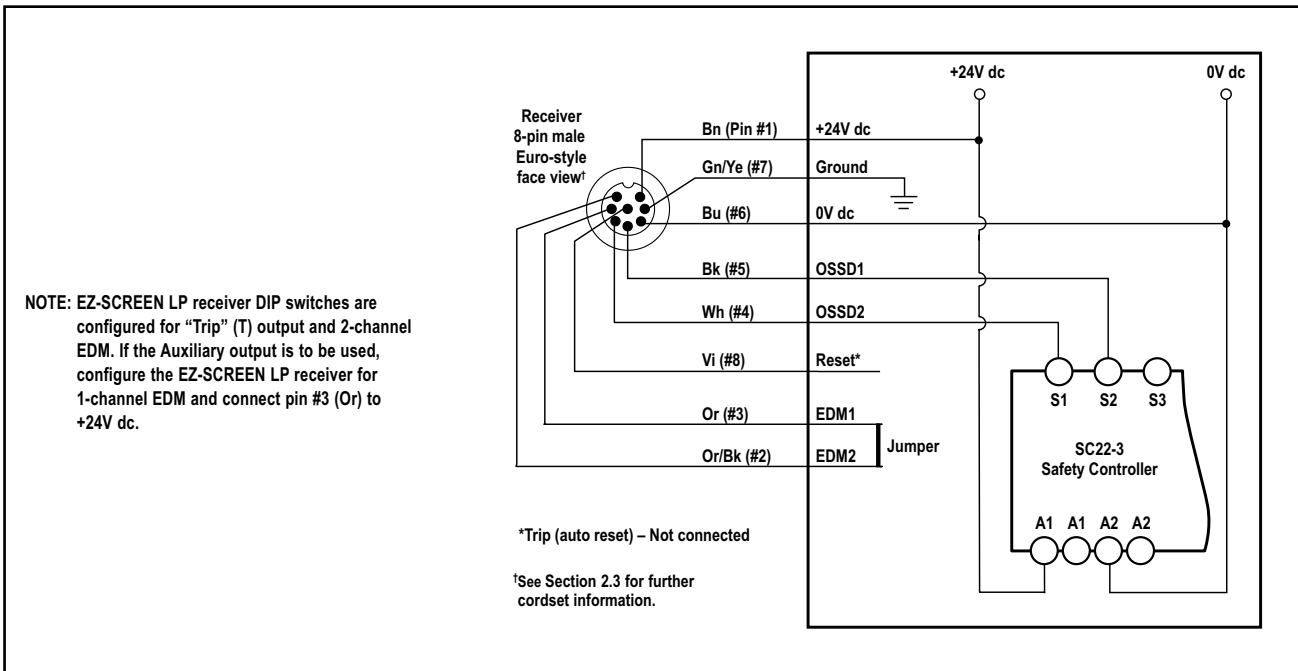


Figure 3-25. Generic hookup – self-checking Safety module, Safety Controller, Safety PLC (no monitoring, automatic reset)

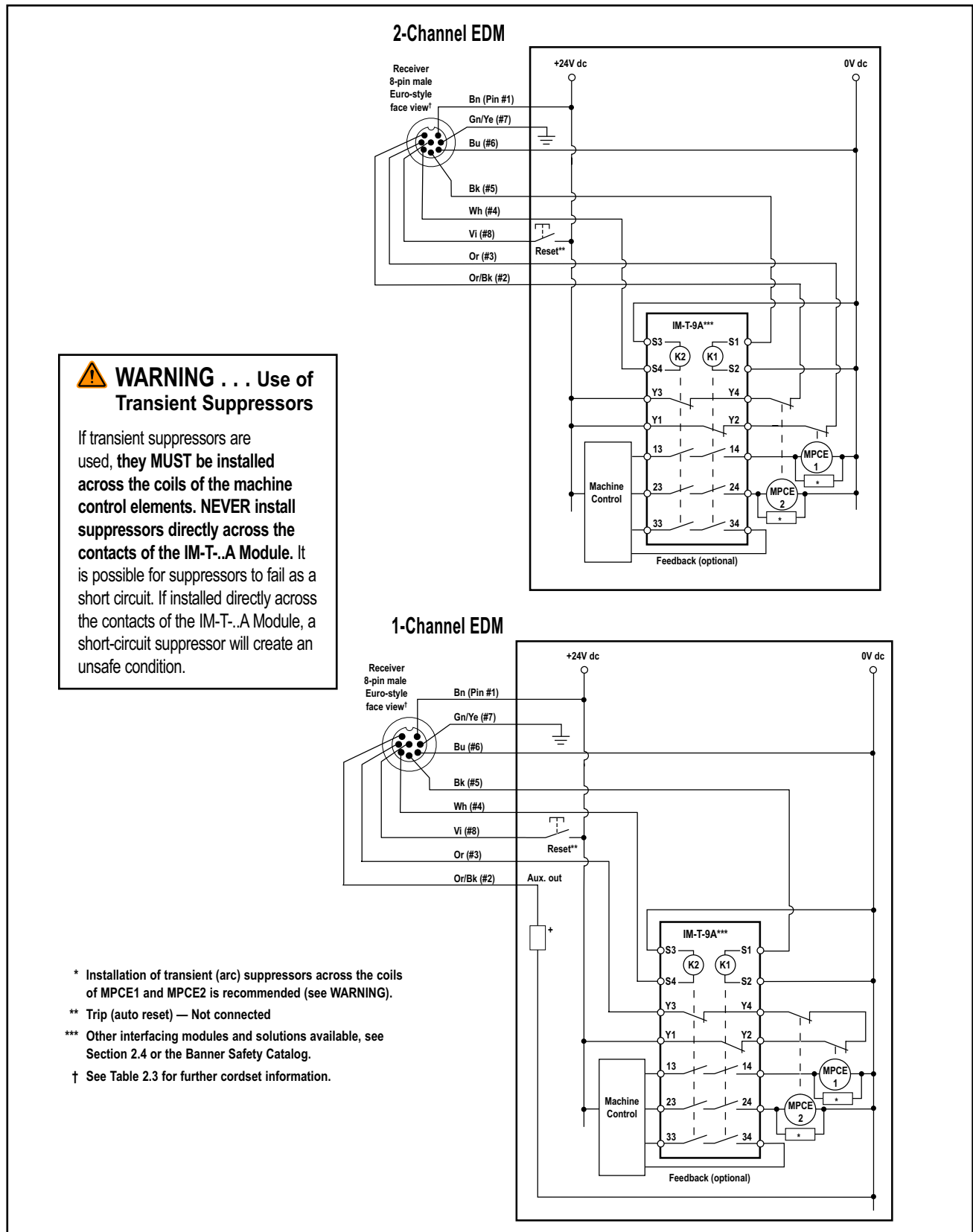


Figure 3-26. Generic hookup – Interface Module (1-Channel or 2-Channel EDM, manual reset)

4. System Operation

4.1 Security Protocol

Certain procedures for installing, maintaining and operating the EZ-SCREEN LP 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 LP System. The Designated Person is empowered to:

- Perform manual resets and hold possession of the reset key (see Section 4.3), and
- Perform the daily checkout procedure (see Section 6).

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 LP 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 LP,
- Perform all checkout procedures (see Section 6),
- Make changes to the internal configuration settings, and
- Reset the System following a Lockout condition.

4.2 System Configuration Settings

If not previously configured, System settings are made on the configuration panels located on each sensor, behind the access door. The access door is opened by loosening the factory-installed screw. See Figure 4-1.

The receiver has redundant Trip/Latch and Reduced Resolution DIP switches, which must be set identically (see Section 4.2). Failure to do so will cause a Lockout condition when power is applied. **If the corresponding pairs of DIP switches are not set identically, the EZ-SCREEN LP will not operate.**

Power to the EZ-SCREEN LP receiver should be OFF when changing DIP switch settings (other than Scan Code) or a Lockout will occur.

After configuration settings are verified/set, fully close the access door and tighten the screw to maintain the sensor IP rating.

Table 4-1. DIP Switch Settings

Underlined entries indicate factory defaults. “Left” and “right” refer to positions as shown in Figure 4-1.

Label	Left Position (←)	Right Position (→)
T/L	<u>Trip Output</u>	Latch Output
RED RES	2-Beam Reduced Resolution enabled	<u>Reduced Resolution OFF</u>
SCAN	Scan Code 2	<u>Scan Code 1</u>
EDM	1-Channel EDM (E1)	<u>2-Channel EDM (E2)</u>
AUX/FLT	<u>Aux (OSSD follow)</u>	Fault (lockout)
INVERT	Inverted display	<u>OFF (Standard display)</u>
TEST (Emitter)	Test function	<u>Reset function</u>
FAULT (Emitter)	ON	<u>OFF</u>

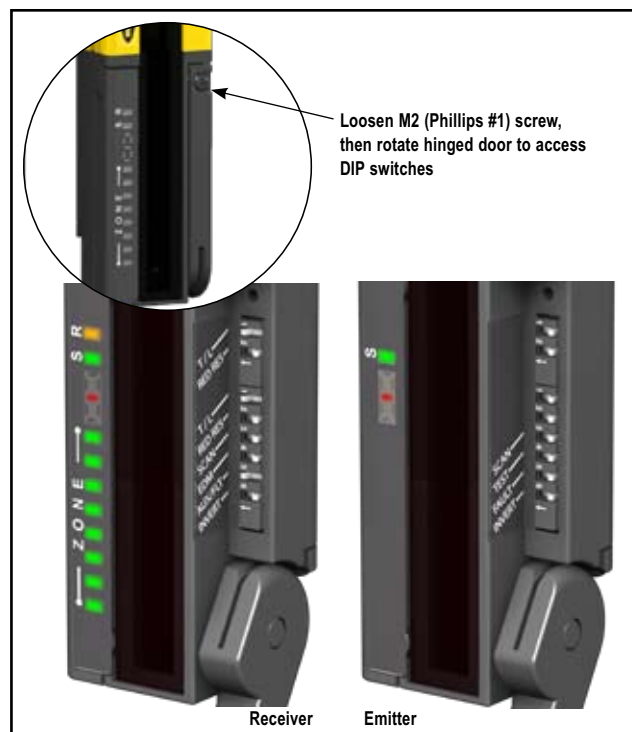


Figure 4-1. Accessing the configuration switches

Scan code is used to allow operation of multiple pairs of emitters and receivers in close proximity (see Sections 3.1.8 and 1.4.4). Scan code may be set to 1 or 2, via DIP switch (see Table 4-1). The scan code setting for each emitter must agree with its corresponding receiver. Scan code settings may be changed while in Run mode without causing a Lockout.

Trip or latch output operation is selected on two DIP switches in the receiver configuration port; see Figure 4-1. Both switches must be set to the same setting. If they have different settings, an error code will be displayed.

If the switches are set for trip output (T), the EZ-SCREEN LP will auto-reset after a blocked condition. If the switches are set for latch output (L), it will require a manual reset.

External Device Monitoring (EDM): EDM mode is selected via a 2-position DIP switch on the receiver; see Figure 4-1. For 1-channel monitoring, set the EDM DIP switch to the 1-channel EDM position. For 2-channel monitoring or no monitoring, set the switch to the 2-channel EDM position (see Section 3.5.3).

Auxiliary Output: Determines whether the aux. output follows the state of the OSSDs (ON = Green Status LED) or if the sensor is in a lockout (ON = Fault). When 2-channel monitoring (EDM) is selected, these aux. output options are not available and this DIP switch setting has no effect (see Section 1.4.3).

Reduced Resolution: Enables or disables two-beam reduced resolution (see Section 3.4.2), and is selected on two DIP switches that must be set to the same setting.

NOTE: Enabling reduced resolution will affect the minimum safety distance (see Section 3.1.1).

Inverted Display: Inverts the 7-segment display for right-reading when sensors are mounted with the indicator end facing up. DIP switch position OFF results in standard orientation.

Test/Reset: This emitter-only function is used to configure the violet wire (pin 8) for either a Reset function (similar to the receiver), or for a Test function which, when activated, simulates a blocked condition for receiver testing purposes. See emitter hookups, Figure 3-23.

NOTE: The emitter Test function can not be used in a color-for-color ("swapable") hookup.

Fault (Emitter): This emitter-only function is used to determine whether the emitter Fault signal is active (+24V) when the emitter locks out. Options are ON or OFF. If the color-for-color ("swapable") hookup is used and the receiver is configured for 2-channel EDM or OSSD follow, set this switch to OFF; if the system is configured for OR fault function, set this switch to ON (see Figure 3-22).

4.3 Reset Procedures

Resetting the System

System resets are typically performed using an external reset switch. This switch must be located as discussed in Section 3.1.3.

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

Emitter and Receiver Resets

The EZ-SCREEN LP receiver and emitter each have a Reset input, pin 8 (Violet wire), that provides for a manual reset input signal.

The receiver requires a manual reset to clear a Latch condition and resume operation following a stop command. Internal Lockout conditions also require a manual reset to return either the emitter or the receiver to Run mode after the failure has been corrected. Emitter resets are needed only in the unlikely event that a Lockout occurs.

Receiver manual resets are required in the following situations:

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

Reset Routine

To reset the emitter and/or receiver, close the reset switch for 1/4 to 2 seconds, then open it. (If reset switch model MGA-KS0-1, listed in Section 2, is used, turn the key 1/4 turn clockwise to close; turn counterclockwise, back to its original position, to open.) An alternate method to reset either component is to power the sensor down, then power it up.

NOTE: Closing the reset switch too long will cause the sensor to ignore the reset request; the switch must be closed from 1/4 second to 2 seconds, but no longer.

4.4 Status Indicators

A variety of status indicators are clearly visible on each emitter and receiver face (see Figure 1-3 and Section 3.4.1, steps #3 and #4, and Section 7.7 for cascadeable models).

Emitter: A single bi-color Red/Green Status indicator shows whether power is applied, and whether the emitter is in Run mode, Test mode, or Lockout status. A 7-segment 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.

Receiver: Bi-color Red/Green Zone indicators show whether a section of the defined area is aligned and clear, or is blocked and/or misaligned. A Yellow Reset indicator shows when the System is in Run mode or is waiting for a reset. All models have 8 Zone indicators, each of which indicates Blocked/Clear conditions for approximately 1/8 of the total light screen.

A bi-color Red/Green Status indicator shows when the OSSD outputs are ON (Green) or OFF (Red), or the System is in

Lockout status (flashing Red). A 7-segment Diagnostic Display indicates the receiver's trip (-) or latch (L) configuration setting and displays a specific error code when the receiver is in Lockout. The 7-segment display also momentarily indicates the scan code setting at power-up or when changed.

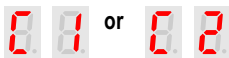




Operating Status	Status Indicator	7-Segment Diagnostic Display
Power-up	Red single-flash	Scan code flash 3x – sequentially
Run Mode	Green	
Test Mode	Flashing Green	
Lockout	Flashing Red	Displays error code (see Section 5.1)

Figure 4-3. Emitter status indicator operation

Operating Mode	Reset Indicator	Status Indicator	Zone Indicators*	7-Segment Diagnostic Display	OSSD Outputs
Power-up	OFF	Single-Flash Red	All Single-Flash Red	Scan code flash 3x – sequentially 	OFF
Alignment Mode – Beam 1 Blocked	OFF	Red	Zone 1 Red* Others OFF		OFF
Alignment Mode – Beam 1 Clear	OFF	Red	Red or Green	Total number of blocked beams	OFF
Run Mode – Clear	ON	ON Green or Flashing Green†	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 Section 5.1)	OFF

* NOTE: If beam 1 is blocked, Zone indicators 2-8 will be OFF, because beam 1 provides the synchronization signal for all the beams.
† Flashing if Reduced Resolution is enabled.

Figure 4-4. Receiver status indicator operation (trip output configured)

Operating Mode	Reset Indicator	Status Indicator	Zone Indicators*	7-Segment Diagnostic Display	OSSD Outputs
Power-up	OFF	Single-Flash Red	All Single-Flash Red	Scan code flash 3x – sequentially 	OFF
Alignment Mode – Beam 1 Blocked	OFF	Red	Zone 1 Red* Others OFF		OFF
Alignment Mode – Beam 1 Clear	OFF	Red	Red or Green	Total number of blocked beams	OFF
Alignment Mode – All Beams Clear	Double-Flash	Red	All ON Green	OFF	OFF
Run Mode – Clear	ON	ON Green or Flashing Green†	All ON Green		ON
Latched – Blocked Beam 1 Blocked	ON	Red	Red or Green*		OFF
Latched – Blocked Beam 1 Clear	ON	Red	Red or Green*	Total number of blocked beams	OFF
Latched – Clear	Flashing	Red	All ON Green		OFF
Lockout	OFF	Flashing Red	OFF	Displays error code (see Section 5.1)	OFF

* NOTE: If beam 1 is blocked, Zone indicators 2-8 will be OFF, because beam 1 provides the synchronization signal for all the beams.
† Flashing if Reduced Resolution is enabled.

Figure 4-5. Receiver status indicator operation (latch output configured)

Status Indicators for Cascaded Applications

When multiple light screens are cascaded, some unique indications may occur, as indicated in Figure 4-7 and table 4-2.

When a receiver's CSSI input is in a Stop condition (because of a blocked light screen further upstream in the cascade, or because of a Stop signal from an E-stop button, for example), the display on the downstream receivers, including the master receiver, will be bracketed by a pair of vertical "goalposts." See Section 5.1.1 for an illustration.

Table 4-2. EZ-SCREEN LP Cascade Diagnostics

Condition	OSSDs	Display	Reset Indicator	Status Indicator
Receiver #1 (Master — Configured for Latch Operation)				
Clear	ON		ON	Green
CSSI Stop (Receiver #2, 3, or 4 is blocked)	OFF		ON	Red
Latch	OFF		Flashing	Red
Receiver #2, 3, or 4 (Configured for Trip Operation)				
Clear	ON		ON	Green
Blocked	OFF	# Beams blocked	ON	Red
CSSI Stop (Receiver upstream is blocked)	OFF		ON	Red
Cleared	ON		ON	Green

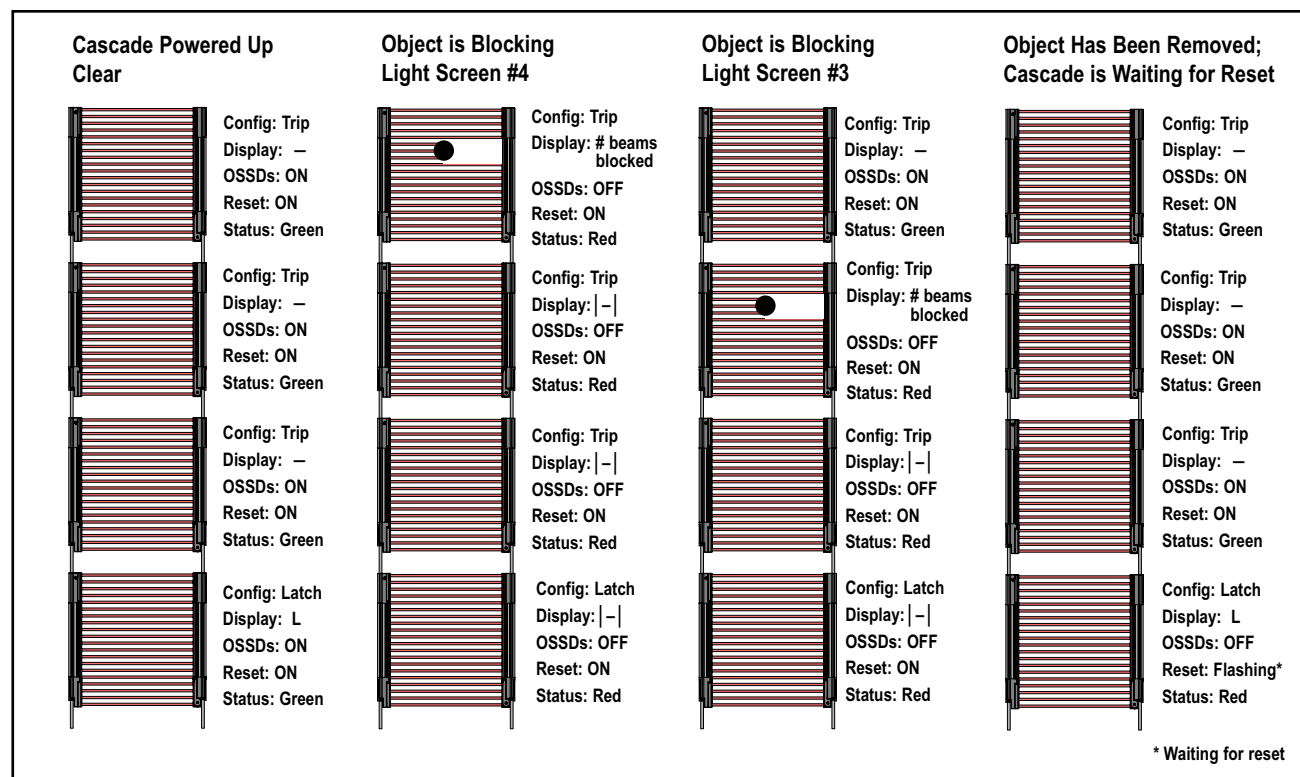


Figure 4-7. Cascade indicator status conditions

4.5 Normal Operation

System Power-Up

The EZ-SCREEN LP will power up in one of two ways, depending on the trip/latch output configuration. If it is set for trip output, it will power up and reset automatically; if it is set for latch output, it will require a manual reset procedure after power-up and sensor alignment.

Trip Output Power-Up: When power is applied, each sensor conducts self-tests to detect critical internal faults, determine configuration settings, and prepare the EZ-SCREEN LP for operation. (If either sensor detects a critical fault, scanning ceases, the receiver outputs remain OFF and diagnostic information is displayed on the sensor's 7-segment display.) If no faults are detected, the EZ-SCREEN LP 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.

Latch Output Power-Up: When power is applied, each sensor conducts self-tests to detect critical internal faults, determine configuration settings, and prepare for operation. (If either sensor detects a critical fault, scanning ceases, the receiver outputs remain OFF and diagnostic information is displayed on the sensor's 7-segment display.) If no faults are detected, the EZ-SCREEN LP 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 begins scanning to determine the blocked or clear status of each beam. When all beams are aligned, the Yellow Reset indicator double-flashes to indicate the EZ-SCREEN LP is waiting for a manual reset. After a valid manual reset, the EZ-SCREEN LP enters Run mode and continues scanning.

During Run Mode

Trip Output Configuration: If any beams become blocked while the EZ-SCREEN LP is running with trip output selected, the receiver outputs turn OFF within the stated EZ-SCREEN LP response time (see Specifications). If all the beams then become clear, the receiver outputs come back ON. No resets of any kind are needed. All required machine control resets are provided by the machine control circuit.

Latch Output Configuration: If any beams become blocked while the EZ-SCREEN LP is running with latch output selected, the receiver outputs turn OFF within the stated EZ-SCREEN LP response time (see Specifications). If all the beams then become clear, the receiver Zone indicators will all be Green and the Reset indicator single-flashes, indicating the EZ-SCREEN LP is waiting for a manual latch reset. In latch output operation, the outputs come back ON only when all beams are clear and after a manual reset. The EZ-SCREEN LP will wait for a manual reset; when a valid reset signal is received and all beams remain clear, the receiver outputs turn ON.

Internal Faults (Lockouts): If either sensor detects a critical fault, scanning ceases, the receiver outputs turn OFF and diagnostic information is displayed on the sensor's 7-segment display. See Section 5 for resolution of error/fault conditions.

4.6 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 (see Section 6.3 and the Daily Checkout Card for the procedure).

Semi-annually, the EZ-SCREEN LP and its interface to the guarded machine should be thoroughly checked out; this checkout must be performed by a Qualified Person (see Section 6.4). 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 LP or changes to the machine), the Commissioning Checkout should be performed (see Section 6.2).

WARNING . . . Verify Proper Operation

It is the user's responsibility to verify proper operation, on a regular basis, as instructed in Section 6. **Failure to correct such problems can result in serious bodily injury or death.**

5. Troubleshooting and Maintenance

5.1 Troubleshooting Lockout Conditions

Evaluate status indicators per Section 4.4. See Section 5.2 for Test mode indication.

A Lockout condition causes all of the EZ-SCREEN LP's 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 Sections 5.1.1 and 5.1.2 or the Diagnostic Error Code label supplied in the documentation pack).

The System provides easy methods for determining operating problems. A Lockout condition is indicated by the following:

Emitter	
Status indicator	Flashing Red
Diagnostic Display	Error code (flashing)
Receiver	
Reset indicator	OFF
Status indicator	Flashing Red
Zone Indicators	OFF
Diagnostic Display	Error code (flashing)

Recovery Procedures

To recover from a Lockout condition, all errors must be corrected and a single sensor reset sequence must be performed as described below.

Emitter and Receiver Reset

Close the remote reset switch for 1/4 to 2 seconds and then open the switch (per Section 4.3), or power the sensor down, wait a second or two, then power it up.

NOTE: If the receiver is set for latch output, a manual reset using a remote switch, as described in Section 4.3, is required to resume full operation.

WARNING . . . Lockouts and Power Failures

Power failures and Lockout conditions are indication of a problem and must be investigated immediately by a Qualified Person.







Attempts to continue to operate machinery by bypassing the EZ-SCREEN LP or other safeguards is dangerous and could result in serious bodily injury or death.

WARNING . . . Shut Down Machinery Before Servicing









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

5.1.1 Receiver Error Codes

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



Diagnostic Display	Error Description	Cause of Error and Appropriate Action
	<p>Output Error Error is caused by:</p> <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, or • by an overload (greater than 0.5A). 	<ul style="list-style-type: none"> • Disconnect the OSSD loads and reset 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.
	<p>Reset Input Error This error occurs when the Reset switch is closed (or the wiring is shorted to +24V) during power-up.</p>	<ul style="list-style-type: none"> • Verify that the reset switch is in the open position. • Reset the receiver per Section 4.3. • If the error remains, disconnect the reset wire at pin 8; cycle power. • If the error clears, the problem is in the reset switch or in the wiring. • If the error continues when the reset wire is disconnected, replace the receiver.
	<p>EDM Input Error Can occur for the following reasons:</p> <ul style="list-style-type: none"> • EDM wiring configuration does not match the EDM switch configuration. • No connection to EDM connections. • <i>Both</i> EDM inputs fail to respond within 250 ms of each other. • Excessive noise on EDM inputs. • Loose QD connection(s). 	<ul style="list-style-type: none"> • Verify that the EDM configuration switches are set correctly and that the wiring is correct for the EDM type configured (see Section 3.5.3). • Reset the receiver. • If the error continues, remove power to the guarded machine, disconnect the OSSD loads, disconnect the EDM input signals, configure EDM for No Monitoring (Section 3.5.3) and conduct the Initial Checkout procedure in Section 3.4. • 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 Section 3.5.3. • If the error continues, check for noise on the EDM inputs (see Section 5.3). If error continues, replace the receiver
	<p>Receiver Error This error can occur due to either excessive electrical noise or an internal failure.</p>	<ul style="list-style-type: none"> • Perform a reset per Section 4.3. • If the error clears, perform a Daily Checkout procedure (per Section 6.3; Daily Checkout Card) and if OK, 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 Section 3.4). • If the error clears, check the external connections and configuration settings. • If the error continues, replace the receiver.
	<p>DIP Switch Error This error can be caused by incorrect DIP switch settings or by changes to the DIP switch settings when the system is ON.</p>	<ul style="list-style-type: none"> • Verify that the DIP switch settings are valid (per Section 4.2). Make any corrections necessary and perform a receiver reset. • If the error occurred due to a change of the DIP switch settings while the System was in Run mode, verify the switch settings and perform a receiver reset to resume operation with the new switch settings and modified System configuration. • If the error continues, replace the receiver.
	<p>EDM 1 Error This error can occur due to EDM 1 input signal failing 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 Section 3.5.3. • 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 Section 3.5.3) and conduct the Initial Checkout procedure in Section 3.4. • 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 Section 3.5.3. • If the error continues, check for noise on the EDM inputs (see Section 5.3).

5.1.1 Receiver Error Codes (continued)

Diagnostic Display	Error Description	Cause of Error and Appropriate Action
	EDM 2 Error EDM 2 configuration not valid (wiring or switch).	<ul style="list-style-type: none"> Verify that the EDM wiring is correct and that the external devices meet the requirements described in Section 3.5.3. 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 Section 3.5.3) and conduct the initial checkout procedure (Section 3.4). 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 Section 3.5.3. If the error continues, check for noise on the EDM inputs (see Section 5.3).
	Fixed Blanking Error 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.	<ul style="list-style-type: none"> Reposition the object and perform a key reset (or cycle power). Re-program (teach) the fixed blanked object(s), see Sections 3.4.3 and 7.10.
	Programming Timeout Error This error occurs when the Fixed Blanking programming mode (teach) exceeds the ten-minute limit.	<ul style="list-style-type: none"> Re-program (teach) the fixed blanked object(s), see Sections 3.4.3 and 7.10.
	Cascade Configuration Error This error occurs when the configuration sequence is incorrectly followed, receiver(s) 2, 3 or 4 are configured, or receiver 1 is moved to a different position in the cascade. If this code appears for a non-cascaded application, check EDM wiring.	<ul style="list-style-type: none"> The CSSI input channel(s) are shorted together or to another source of power or ground. Configure ONLY the first receiver in the cascade (connected to the machine interface). All other receivers must be set for 2-channel EDM and trip output (T), see Section 7.7. Re-configure the first receiver to adapt System to changes or replacement of other receivers, see Section 7.7. See Section 7.10 for Remote Fixed Blanking procedures. <p>NOTE: In a cascaded System, all receivers are connected together, and all emitters are connected together.</p>
	Excessive Noise Error – Reset Interface This error can occur due to excessive levels of electrical noise.	<ul style="list-style-type: none"> Perform a reset per Section 4.3. If the error clears, perform the daily checkout procedure (per Section 6.3; Daily Checkout Card) and if OK, resume operation. If the System fails the Daily Checkout procedure, replace the receiver.
	Excessive Noise Error – EDM Interface This error can occur due to excessive levels of electrical noise.	<ul style="list-style-type: none"> 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 (Section 3.4). If the error clears, check for sources of electrical noise (see Section 5.3). If the error continues, replace the receiver.
	Excessive Noise Error – Cascade Input This error can occur due to excessive levels of electrical noise.	
Flashing 	Cascade Input Simultaneity Operation of channels A and B mismatch > 3 seconds.	<ul style="list-style-type: none"> Check operation of Channel A and Channel B of cascade input. Cycle power or cycle the input. See Sections 7.8 and 7.9.
"Axx"/"bxx", where "xx" are alpha-numeric characters	Advanced Diagnostics for the purpose of factory troubleshooting and repair; not intended for field troubleshooting.	If advanced diagnostic codes are inadvertently displayed, toggle the Invert Display DIP switch (to the opposite state and back, within 1 second) to return to the standard error code display.

5.1.2 Emitter Error Codes

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

Diagnostic Display*	Error Description	Cause of Error and Appropriate Action
	Emitter Error This error can occur either due to excessive electrical noise or due to an internal failure.	<ul style="list-style-type: none"> Reset the emitter by either performing a reset or cycling power to the emitter (see Section 4.3). If the error clears, perform the daily checkout procedure (Section 6.3) and if OK, resume operation. If the System fails the daily checkout procedure, replace the emitter. If the error continues, check the ground connection (see Section 2.3). If the sensor has a good earth ground connection, check for electrical noise (see Section 5.3). If the error continues, replace the emitter.
	Excessive Noise Error This error can occur due to excessive electrical noise.	<ul style="list-style-type: none"> Reset the emitter by either performing a reset or cycling power to the emitter (see Section 4.3). If the error clears, perform the daily checkout procedure (Section 6.3) and if OK, resume operation. If the System fails the daily checkout procedure, replace the emitter. If the error continues, check the ground connection (see Section 2.3). If the sensor has a good earth ground connection, check for electrical noise (see Section 5.3). If the error continues, replace the emitter.
"Axx"/"cxx", where "xx" are alpha-numeric characters	Advanced Diagnostics for the purpose of factory troubleshooting and repair; not intended for field troubleshooting.	If advanced diagnostic codes are inadvertently displayed, toggle the Invert Display DIP switch (to the opposite state and back, within 1 second) to return to the standard error code display.

5.2 Test Mode

If System will not align or go to a Green/Clear condition, the emitter's Test input may be open. If so, the receiver Reset indicator will be Yellow, all Zone indicators Red, and the Status LED Red; the 7-segment display will show a numerical value equal to the total number of beams, minus one. (Multiple-digit codes are displayed sequentially.) For example, if an array has 55 beams total, the display would indicate 54. The emitter's Status indicator will flash Green. See Section 4.4 and Figure 5-1. (Exception: on a 14-beam system only, the Zone 1 indicator will be Green, and all others Red.)

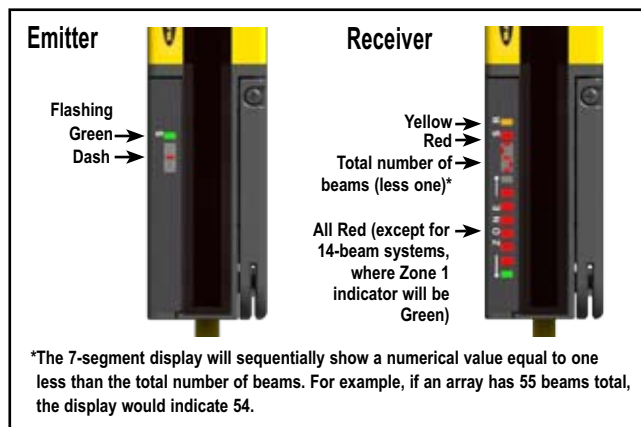


Figure 5-1. TEST mode status indicators

Opening a switch or relay contacts connected to the emitter Test connections, or supplying a voltage of less than 3V dc to Test only, simulates a Blocked condition, for testing purposes.

To verify proper operation, measure the voltage between emitter Test (pin 8, violet) and dc COM (pin 6, blue) and refer to the following table:

Supply Voltage	Other Conditions	Appropriate Action
10 to 30V dc	Emitter should be in Run mode with beam scanning occurring.	If not, check the +24V dc (pin 1, brown) to verify proper supply voltage
Outside the rated supply voltage specifications	—	Correct the supply voltage and recheck emitter operation.
10 to 30V dc	Test1 is 10 to 30V dc, but emitter is not in Run mode with beam scanning.	Replace the emitter.
Less than 3V dc	Emitter should be in Test mode with no scanning occurring.	If not in Test mode, replace the emitter.

5.3 Electrical and Optical Noise

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

If random nuisance Trips occur, check the following:

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

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

The Banner model **BT-1** beam tracker (see Section 2.4) is a good tool for detecting electrical noise (transient spikes and surges). Cover the lens of the beam tracker with electrical tape to block optical light from the receiver lens. Press the “RCV” button, and position the beam tracker on the wires going to the EZ-SCREEN LP or any other nearby wires. Noise caused by the switching of inductive loads will cause the beam tracker’s indicator to light; address the noise problem by installing proper transient suppression across the load.

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

5.4 Servicing and Maintenance

Cleaning

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

Warranty Service

EZ-SCREEN LP components are designed for reliability. Do not open the emitter or receiver housings, other than the configuration access door. (Following configuration, close the access door and tighten the screw to maintain IP65 status.)

Sensors contain no field-replaceable components. If repair is necessary, do not attempt to repair an emitter or receiver yourself; return the unit to the factory, as described below.

1. Contact a Banner Factory Application Engineer at the address or numbers listed below or on the back page:

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

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

- They will attempt to troubleshoot the System from your description of the problem. If they conclude that a component is defective, they will issue a return merchandise authorization (RMA) number for your paperwork, and give you the proper shipping address.
2. Pack the component(s) carefully. Damage which occurs during return shipping is not covered by warranty.

6. Checkout Procedures

Study each procedure in its entirety, to understand each step thoroughly before beginning. Refer all questions to a Banner applications engineer at the address or numbers listed on the cover of this manual. Checkouts must be performed as detailed in Section 6.1 below and results should be recorded and kept in the appropriate place (e.g., near the machine, and/or in a technical file).

6.1 Schedule of Checkouts

Trip Test: The procedure for the EZ-SCREEN LP trip test is described in Section 3.4.4. This procedure must be performed at installation, and at any time the EZ-SCREEN LP, the guarded machine, or any part of the application is installed or altered. The procedure must be performed by a Qualified Person.

Commissioning Checkout: The procedure described in Section 6.2 must be performed at installation or whenever changes are made to the System (either a new configuration of the EZ-SCREEN LP or changes to the machine). The procedure must be performed by a Qualified Person.

Shift/Daily Checkout: The procedure for “daily” checkout of the EZ-SCREEN LP is described on the supplied Daily Checkout card (Banner p/n 140045 for SLP.. stand-alone models, P/N 140046 for SLPC.. cascadeable models). Daily Checkout is to be performed at each shift change or machine setup change, whenever the System is powered up — at least daily. The procedure is listed on the Daily Checkout card and may be performed by a Designated Person or a Qualified Person.

Semi-Annual Checkout: The procedure for initial checkout of the EZ-SCREEN LP System is to be performed every six months, following installation. The procedure is listed on the Semi-Annual Checkout card (Banner P/N 140047) and must be performed by a Qualified Person.

6.2 Commissioning Checkout

Perform this checkout procedure as part of the EZ-SCREEN LP installation (after it has been interfaced to the guarded machine as described in Section 3.5), or whenever changes are made to the System (either a new configuration of the EZ-SCREEN LP or changes to the machine). A Qualified Person (as defined in Section 4.1) 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 LP. See Section 1.2 for a list of misapplications.
2. Verify that the EZ-SCREEN LP is configured for the intended application (see Section 4.2).
3. Verify that the minimum safety distance from the closest danger point of the guarded machine to the defined area is not less than the calculated distance, per Section 3.1.1 of this manual.
4. Verify that:
 - Access to any dangerous parts of the guarded machine is not possible from any direction not protected by the EZ-SCREEN LP, hard 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 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 LP (see Sections 3.1.2 and 3.1.4).
5. 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 (see Section 3.1.3).
6. Examine the electrical wiring connections between the EZ-SCREEN LP's FSD outputs and the guarded machine's control elements to verify that the wiring meets the requirements stated in Section 3.5.
7. Inspect the area near the defined area (including work pieces and the guarded machine) for reflective surfaces (see Section 3.1.6). Remove the reflective surfaces if possible by relocating them, painting, masking or roughening them. Remaining problem reflections will become apparent during the trip test in step 11.
8. Apply power to the EZ-SCREEN LP. Verify that power to the guarded machine is OFF. Remove all obstructions from the defined area. If the EZ-SCREEN LP is configured for latch output, the Yellow Status indicator will double-flash; perform a manual reset (close the reset switch for 1/4 to 2 seconds, then open it).

9. Observe the Status indicators and the Diagnostic Display:

- **Lockout:** Status flashing Red
All others OFF
- **Blocked:** Status ON Red
One or more Zone indicators ON Red
Reset ON Yellow
- **Clear:** Status ON Green*
All Zone indicators ON Green**
Reset ON Yellow
- **Latch:** Status ON Red
(defined area clear) All Zone indicators ON Green
Reset flashing Yellow

* The Status indicator will be flashing Green if reduced resolution is enabled.

** The Zone indicators will be flashing Green if fixed blanking is enabled.

10. A Blocked condition indicates that one or more of the beams is misaligned or interrupted. To correct this situation see the Alignment procedure in Section 3.4. If the System is in a Latch condition, perform a manual reset.

11. Once the Green and Yellow Status indicators are ON, **perform the trip test** (described in Section 3.4.4) 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 LP System passes the trip test. Do not expose any individual to any hazard during the following checks.**

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

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

12. Apply power to the guarded machine and verify that the machine does not start up. Interrupt (block) the defined area with the appropriate supplied test piece (see table in Section 3.4.4) and verify that it is not possible for the guarded machine to be put into motion while any beam is blocked.

13. Initiate machine motion of the guarded machine and, while it is moving, use the supplied test piece to block the defined area. **Do not attempt to insert the test piece into the dangerous parts of the machine.** Upon blocking any beam, the dangerous parts of the machine should come to a stop with no apparent delay.

Remove the test piece from the beam; **verify that the machine does not automatically restart**, and that the initiation devices must be engaged to restart the machine.

14. Remove electrical power to the EZ-SCREEN LP. Both OSSD outputs should immediately turn OFF, and the machine should not be capable of starting until power is re-applied to the EZ-SCREEN LP.

15. Test the machine stopping response time, using an instrument designed for that purpose, to verify that it is the same or less than the overall system response time specified by the machine manufacturer. (Banner's applications engineers can recommend a suitable instrument.)

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

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

If any of these checks cannot be verified, do not attempt to use the EZ-SCREEN LP/guarded machine until the defect or problem has been corrected (see Section 5).

Attempts to use the guarded machine under such conditions could result in serious bodily injury or death.

6.3 Shift/Daily Checkout

Perform the procedure contained on the Daily Checkout card at every shift change, power-up and machine set-up change. During continuous machine run periods, this checkout should be performed at intervals not to exceed 24 hours.

A Designated Person or Qualified Person (as defined in the Glossary) must perform the procedure. A copy of checkout results should be recorded and kept in the appropriate place (e.g., near or on the machine, in the machine's technical file).

Refer to the procedure detailed on the Daily Checkout card (Banner p/n 140045 for SLP.. stand-alone models, P/N 140046 for SLPC.. cascadeable models) in the lit packet included with the receiver. If the Daily Checkout card is missing, contact Banner Engineering or download at www.bannerengineering.com.

6.4 Semi-Annual (Six-Month) Checkout

Perform the procedure contained on the Semi-Annual Checkout card every six months following System installation, or whenever changes are made to the System (either a new configuration of the EZ-SCREEN LP or changes to the machine).

A Qualified Person (as defined in the Glossary) must perform the procedure. A copy of checkout results should be recorded and kept in the appropriate place (e.g., near or on the machine, in the machine's technical file).

Refer to the procedure contained on the Semi-Annual Checkout card (Banner part number 140047) in the lit packet included with the receiver. If the Semi-Annual Checkout card is missing, contact Banner Engineering or download at www.bannerengineering.com.

7. Cascadeable EZ-SCREEN LP

7.1 Overview of Cascading

EZ-SCREEN LP emitters and receivers are also 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 7-1. The cascaded sensor pairs can be any length, any number of beams, or have different resolutions (i.e., 14 mm and 25 mm), as long as each emitter matches its own receiver.

NOTE: EZ-SCREEN **SLP.** (stand-alone) or 8-pin **SLSC.** models can be used as the end sensor pair. EZ-SCREEN Grid/Point and PICO-GUARD components can not 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 Section 2.3. 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.

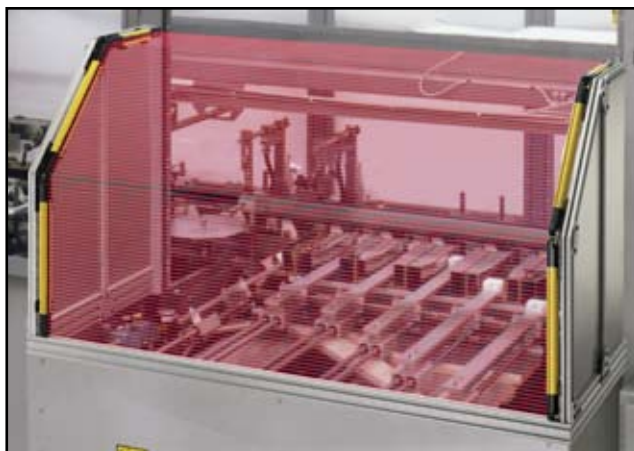


Figure 7-1. Multiple cascaded light screens used to guard an irregular opening in a machine

7.1.1 System Components and Specifications

A multiple-light screen cascaded EZ-SCREEN LP 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 IP65 rating.) Additional cordsets may be used to enable QD connections; see Section 2.3.

The terminator plug (model LPA-TP-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 box or an **RDLP6G-4..D** cordset interfaced with an E-stop or other hard contacts is in place (see Sections 7.8 – 7.10).

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

Available single-ended, double-ended, and splitter cordsets are listed in Section 2.3. Cordset lengths are limited – for both the machine interface/power cables and the sensor interconnect cables; see Section 7.4 for more information.

7.1.2 Receiver Display

In Run mode, the 7-segment display will show the following. See Section 5.1.1 if any indication is flashing.

Clear condition	
Latch output operation	L
Trip output operation	-
Blocked condition	Number of blocked beams (sequential)
CSSI Input OFF or open (e.g., “upstream” receiver is blocked or in lockout)	Solid (not flashing) H

7.2 Cascadeable Emitter and Receiver Models – 14 mm Resolution

Only standard yellow housing models are listed. Pigtail QD models (e.g., **SLPCE14-270P8**) have yellow PVC cable and black PVC QD overmold. **For other models, see below.***

See the Banner Safety catalog or call the factory for kit model numbering scheme.

Order one machine interface cordset for each “master” emitter or receiver; see Section 2.3.** **For interconnections between cascaded emitters and receivers, use DELP. series double-ended cordsets.**

Defined Area	Models*			Connection**	Response Time	# Beams
	Emitter	Receiver	Pair †			
410 mm	SLPCE14-410P8	SLPCR14-410P8	SLPCP14-410P88	300 mm pigtail, 8-pin M12/Euro QD	13.5 ms	41
	SLPCE14-410	SLPCR14-410	SLPCP14-410	Integral Removable Disconnect (RD)		
550 mm	SLPCE14-550P8	SLPCR14-550P8	SLPCP14-550P88	300 mm pigtail, 8-pin M12/Euro QD	16.5 ms	55
	SLPCE14-550	SLPCR14-550	SLPCP14-550	Integral Removable Disconnect (RD)		
690 mm	SLPCE14-690P8	SLPCR14-690P8	SLPCP14-690P88	300 mm pigtail, 8-pin M12/Euro QD	19.5 ms	69
	SLPCE14-690	SLPCR14-690	SLPCP14-690	Integral Removable Disconnect (RD)		
830 mm	SLPCE14-830P8	SLPCR14-830P8	SLPCP14-830P88	300 mm pigtail, 8-pin M12/Euro QD	22.5 ms	83
	SLPCE14-830	SLPCR14-830	SLPCP14-830	Integral Removable Disconnect (RD)		
970 mm	SLPCE14-970P8	SLPCR14-970P8	SLPCP14-970P88	300 mm pigtail, 8-pin M12/Euro QD	25.5 ms	97
	SLPCE14-970	SLPCR14-970	SLPCP14-970	Integral Removable Disconnect (RD)		
1110 mm	SLPCE14-1110P8	SLPCR14-1110P8	SLPCP14-1110P88	300 mm pigtail, 8-pin M12/Euro QD	28.5 ms	111
	SLPCE14-1110	SLPCR14-1110	SLPCP14-1110	Integral Removable Disconnect (RD)		
1250 mm	SLPCE14-1250P8	SLPCR14-1250P8	SLPCP14-1250P88	300 mm pigtail, 8-pin M12/Euro QD	31.5 ms	125
	SLPCE14-1250	SLPCR14-1250	SLPCP14-1250	Integral Removable Disconnect (RD)		
1390 mm	SLPCE14-1390P8	SLPCR14-1390P8	SLPCP14-1390P88	300 mm pigtail, 8-pin M12/Euro QD	34.5 ms	139
	SLPCE14-1390	SLPCR14-1390	SLPCP14-1390	Integral Removable Disconnect (RD)		
1530 mm	SLPCE14-1530P8	SLPCR14-1530P8	SLPCP14-1530P88	300 mm pigtail, 8-pin M12/Euro QD	37.5 ms	153
	SLPCE14-1530	SLPCR14-1530	SLPCP14-1530	Integral Removable Disconnect (RD)		
1670 mm	SLPCE14-1670P8	SLPCR14-1670P8	SLPCP14-1670P88	300 mm pigtail, 8-pin M12/Euro QD	40.5 ms	167
	SLPCE14-1670	SLPCR14-1670	SLPCP14-1670	Integral Removable Disconnect (RD)		
1810 mm	SLPCE14-1810P8	SLPCR14-1810P8	SLPCP14-1810P88	300 mm pigtail, 8-pin M12/Euro QD	43.5 ms	181
	SLPCE14-1810	SLPCR14-1810	SLPCP14-1810	Integral Removable Disconnect (RD)		

* For other models:

Anodized aluminum housing: Prior to the connection designation (if any) in the model number, add “A” for a clear (brushed) anodized aluminum finish and black endcaps (e.g., **SLPCE14-270A**). Pigtail QD models (e.g., **SLPCE14-270AP8**) have black PVC cable and QD overmold.

ESD-safe models: Prior to the connection designation (if any) in the model number, add “N” for a nickel-plated housing and endcaps (e.g., **SLPCE14-270N**). Pigtail QD models (e.g., **SLPCE14-270NP8**) have black PVC cable and QD overmold.

** Pigtail QD models require mating cordsets with an 8-pin M12/Euro-style connector (such as **QDE-8..D**, **DEE2R-8..D**, or **CSB-M128..M1281**; see Section 2.3). Integral RD models require mating cordsets with a removable disconnect connector (such as **RDLP-8..D**, **DELPE-8..D**, or **DELPE-11..D**; see Section 2.3).

† A pair includes an emitter and receiver.

7.3 Cascadeable Emitter and Receiver Models – 25 mm Resolution

Only standard yellow housing models are listed. Pigtail QD models (e.g., **SLPCE14-270P8**) have yellow PVC cable and black PVC QD overmold. **For other models, see below.***

See the Banner Safety catalog or call the factory for kit model numbering scheme.

Order one machine interface cordset for each “master” emitter or receiver; see Section 2.3.** **For interconnections between cascaded emitters and receivers, use DELP. series double-ended cordsets.**

Defined Area	Models*			Connection**	Response Time	# Beams
	Emitter	Receiver	Pair †			
410 mm	SLPCE25-410P8	SLPCR25-410P8	SLPCP25-410P88	300 mm pigtail, 8-pin M12/Euro QD	9.5 ms	21
	SLPCE25-410	SLPCR25-410	SLPCP25-410	Integral Removable Disconnect (RD)		
550 mm	SLPCE25-550P8	SLPCR25-550P8	SLPCP25-550P88	300 mm pigtail, 8-pin M12/Euro QD	11 ms	28
	SLPCE25-550	SLPCR25-550	SLPCP25-550	Integral Removable Disconnect (RD)		
690 mm	SLPCE25-690P8	SLPCR25-690P8	SLPCP25-690P88	300 mm pigtail, 8-pin M12/Euro QD	12.5 ms	35
	SLPCE25-690	SLPCR25-690	SLPCP25-690	Integral Removable Disconnect (RD)		
830 mm	SLPCE25-830P8	SLPCR25-830P8	SLPCP25-830P88	300 mm pigtail, 8-pin M12/Euro QD	14 ms	42
	SLPCE25-830	SLPCR25-830	SLPCP25-830	Integral Removable Disconnect (RD)		
970 mm	SLPCE25-970P8	SLPCR25-970P8	SLPCP25-970P88	300 mm pigtail, 8-pin M12/Euro QD	15.5 ms	49
	SLPCE25-970	SLPCR25-970	SLPCP25-970	Integral Removable Disconnect (RD)		
1110 mm	SLPCE25-1110P8	SLPCR25-1110P8	SLPCP25-1110P88	300 mm pigtail, 8-pin M12/Euro QD	17 ms	56
	SLPCE25-1110	SLPCR25-1110	SLPCP25-1110	Integral Removable Disconnect (RD)		
1250 mm	SLPCE25-1250P8	SLPCR25-1250P8	SLPCP25-1250P88	300 mm pigtail, 8-pin M12/Euro QD	18.5 ms	63
	SLPCE25-1250	SLPCR25-1250	SLPCP25-1250	Integral Removable Disconnect (RD)		
1390 mm	SLPCE25-1390P8	SLPCR25-1390P8	SLPCP25-1390P88	300 mm pigtail, 8-pin M12/Euro QD	20 ms	70
	SLPCE25-1390	SLPCR25-1390	SLPCP25-1390	Integral Removable Disconnect (RD)		
1530 mm	SLPCE25-1530P8	SLPCR25-1530P8	SLPCP25-1530P88	300 mm pigtail, 8-pin M12/Euro QD	21 ms	77
	SLPCE25-1530	SLPCR25-1530	SLPCP25-1530	Integral Removable Disconnect (RD)		
1670 mm	SLPCE25-1670P8	SLPCR25-1670P8	SLPCP25-1670P88	300 mm pigtail, 8-pin M12/Euro QD	22.5 ms	84
	SLPCE25-1670	SLPCR25-1670	SLPCP25-1670	Integral Removable Disconnect (RD)		
1810 mm	SLPCE25-1810P8	SLPCR25-1810P8	SLPCP25-1810P88	300 mm pigtail, 8-pin M12/Euro QD	24 ms	91
	SLPCE25-1810	SLPCR25-1810	SLPCP25-1810	Integral Removable Disconnect (RD)		

* For other models:

Anodized aluminum housing: Prior to the connection designation (if any) in the model number, add “A” for a clear (brushed) anodized aluminum finish and black endcaps (e.g., **SLPCE25-270AP8**). Pigtail QD models (e.g., **SLPCE25-270AP8**) have black PVC cable and QD overmold.

ESD-safe models: Prior to the connection designation (if any) in the model number, add “N” for a nickel-plated housing and endcaps (e.g., **SLPCE25-270NP8**). Pigtail QD models (e.g., **SLPCE25-270NP8**) have black PVC cable and QD overmold.

** Pigtail QD models require mating cordsets with an 8-pin M12/Euro-style connector (such as **QDE-8..D**, **DEE2R-8..D**, or **CSB-M128..M1281**; see Section 2.3). Integral RD models require mating cordsets with a removable disconnect connector (such as **RDLP-8..D**, **DELPE-8..D**, or **DELPE-11..D**; see Section 2.3).

† A pair includes an emitter and receiver.

7.4 Determining Interconnect Cordset Lengths

The following Cordset length charts are possible combinations for each side of example cascaded systems. Model **DELP-..E** cordsets (24 awg wire) used for calculations. Other lengths and combinations are possible; please call factory for assistance.

As the machine interface Cordset lengthens, the voltage drop

increases, which results in shorter possible interconnect Cordsets to maintain supply voltage requirements at the cascaded sensor. See Section 2 for Cordsets. Due to the large number of possible combinations, the table in Figure 7-4 includes only applications in which L2 = L4. A common installation example is one that protects two areas of a machine (e.g., the front and back of a power press) and uses four EZ-SCREEN LP pairs to create two "L"-shaped sensing fields.

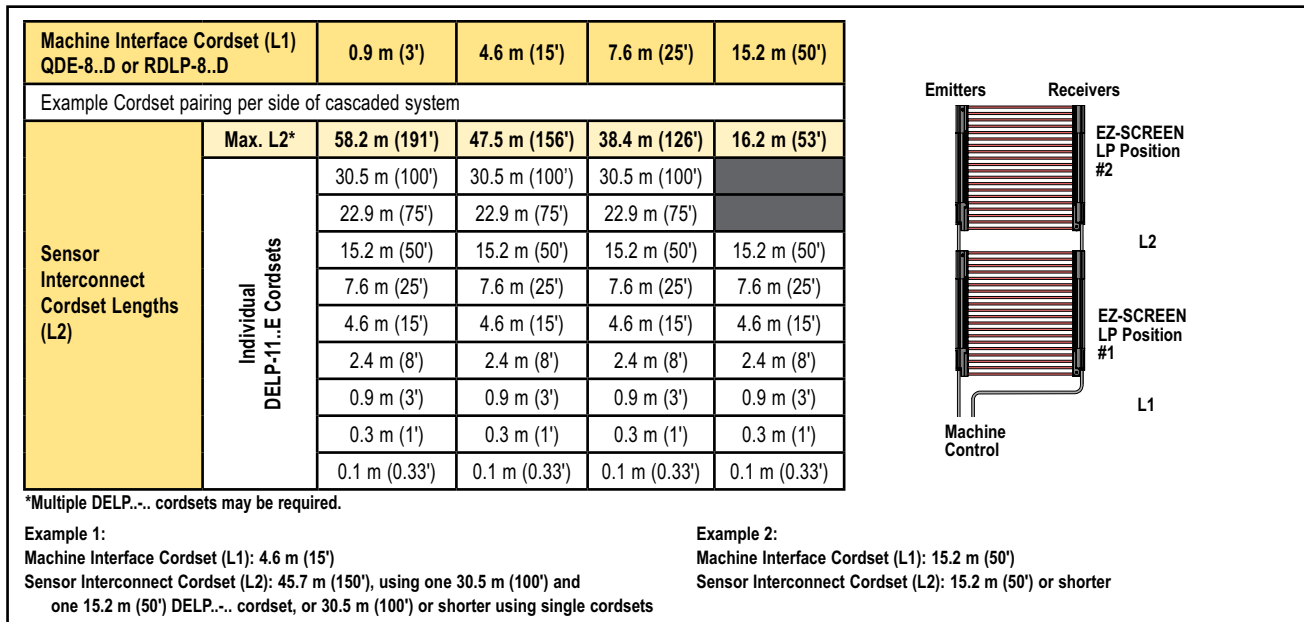


Figure 7-2. Cordset length options for two cascaded light screens

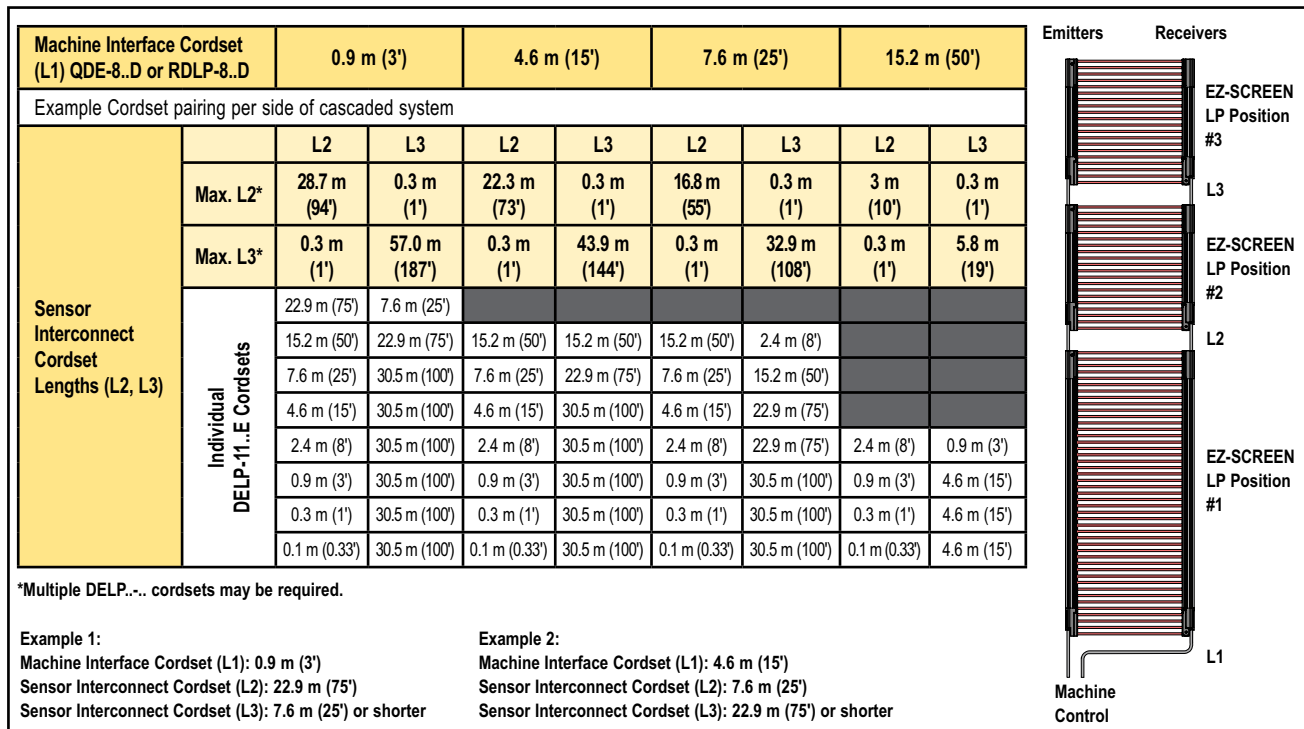


Figure 7-3. Cordset length options for three cascaded light screens

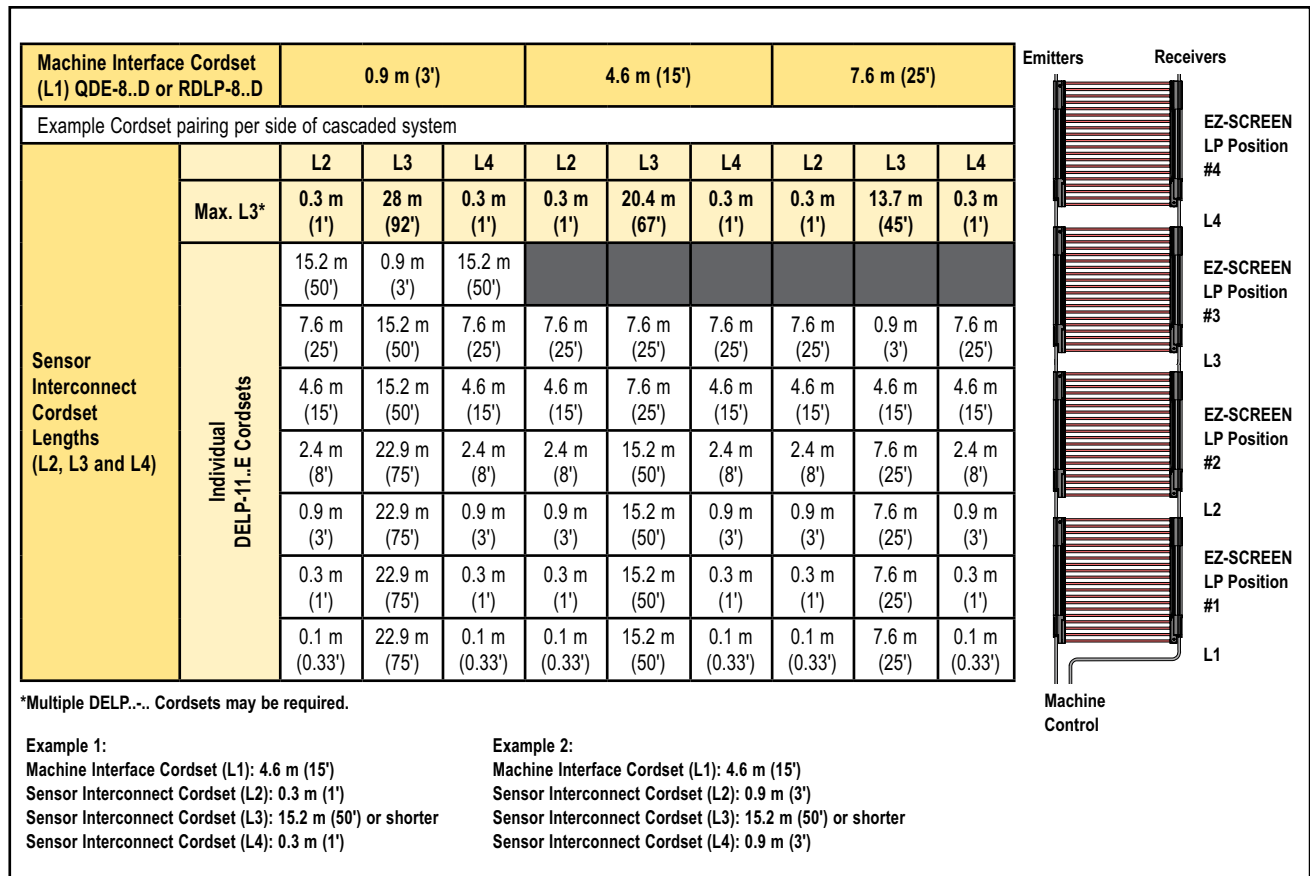


Figure 7-4. Cordset length options for four cascaded light screens

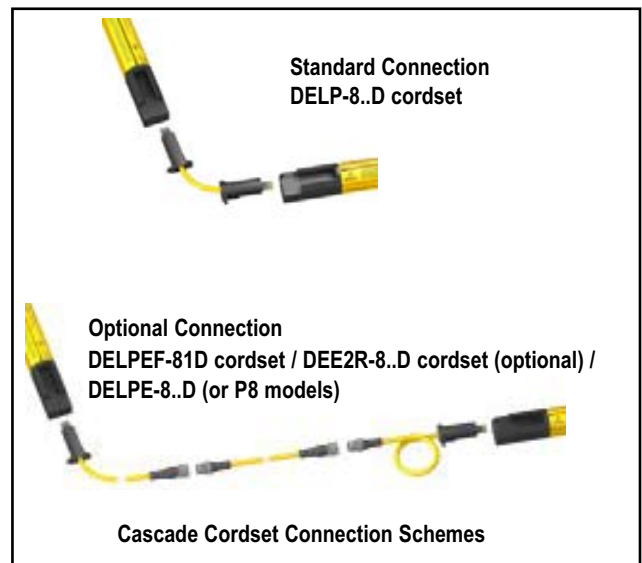
7.5 Response Time for Cascaded Light Screens

Response time is an important factor in determining a light screen's separation (safety) distance. For cascaded (or "daisy-chained") EZ-SCREEN LP 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:

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

⚠ WARNING . . . Proper Installation

The user must comply with all instructions within Section 3 for proper installation. See Sections 7.2 and 3.1.1 for complete information.



Individual Response Time and Safety (Minimum) Distance

When calculating individual safety (minimum) distance for each emitter/receiver pair, the pair's position in the cascade impacts its response time, which then impacts its safety distance (see safety distance formulas in Section 3.1.1). The "individual" method results in the closest possible safety distance for each light screen in the cascade, while ensuring that each sensor pair is located at an adequate distance from the hazard.

Response time depends on how far "downstream" the light screen is from the machine control. Each light screen position in the cascade, starting from the first light screen in the cascade, increases the light screen's response time by 2 ms.

Figure 7-5 depicts a four-pair cascade. The 25 mm resolution, 550 mm EZ-SCREEN LP emitter/receiver pairs each begin with a response time of 11 ms. The pair in position #1 (connected directly to the machine control), maintains its 11 ms response time. Response time for the second pair in the cascade circuit increases by 2 ms, to 13 ms; for the third pair by 4 ms, to 15 ms, and for the fourth pair by 6 ms, to 17 ms. To calculate response time (Tr) for *individual placement of each emitter/receiver pair* in the cascaded system use the formulas:

$$\text{Position \#1: } Tr_{(\text{cascade1})} = Tr^*$$

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

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

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

*See Sections 7.2 and 7.3 for listed response times.

Overall Response Time and Safety (Minimum) Distance

The cascaded system's Overall Response Time (Tr) is equal to the response time of the individual sensor pair with the most beams (i.e., the slowest individual response time), plus an adder resulting from the number of systems in the cascade. Tr can be found by the following formula:

$$Tr = Tr_{(\text{max})} + [(N-1) \times 2 \text{ ms}]$$

where:

$Tr_{(\text{max})}$ is the response time of the slowest individual pair in the cascade (i.e., the pair with the most beams; see Section 7.2).

N is the number of sensor pairs in the cascade.

Use this Tr value in the formula in Section 3.1.1 to determine Overall Safety Distance (Ds). This will ensure that all sensor pairs will be located at an adequate distance from the hazard, no matter how the system is installed.

When contacts (e.g., an E-stop button) are connected to a cascaded receiver (per Section 7.8), CSSI response time is 40 ms plus the 2 ms adder for each additional light screen, similar to the defined area Tr .

$$Tr_{(\text{CSSI})} = 40 \text{ ms} + [(N-1) \times 2 \text{ ms}]$$

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

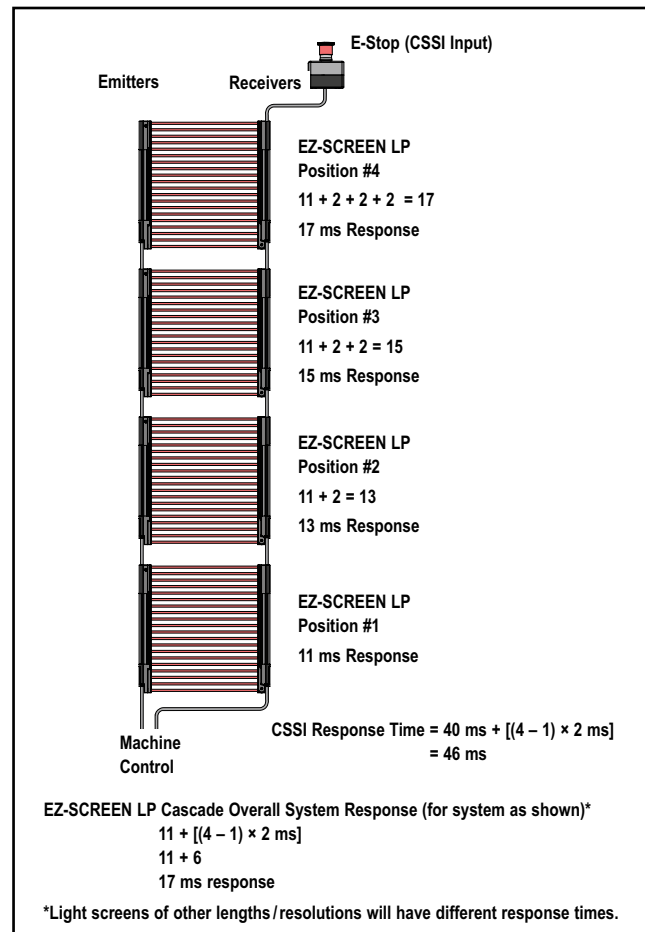


Figure 7-5. Calculating the individual response times of four cascaded safety light screens, each 550 mm long, with 25 mm resolution

Cascade Configuration vs. Response Time

When light screens of different lengths or different resolutions (and therefore different response times) are used in one circuit, their positions in the cascade may become a consideration.

For example, consider the light screen circuits depicted in Figure 7-6. Each example contains three safety light screens, one 1810 mm long (with a response time of 43.5 ms), and two 410 mm long (13.5 ms response each). Depending on their placement in the cascade, the individual response time for the same three light screens can vary.

Simplified Method for Determining 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 greatest number of beams (worst case Tr), and use that number as the overall response time. The 6 ms adder increases safety distance a total of 10 mm (0.4") when using 1600 mm/s for the hand speed constant K (see Section 3.1.1).

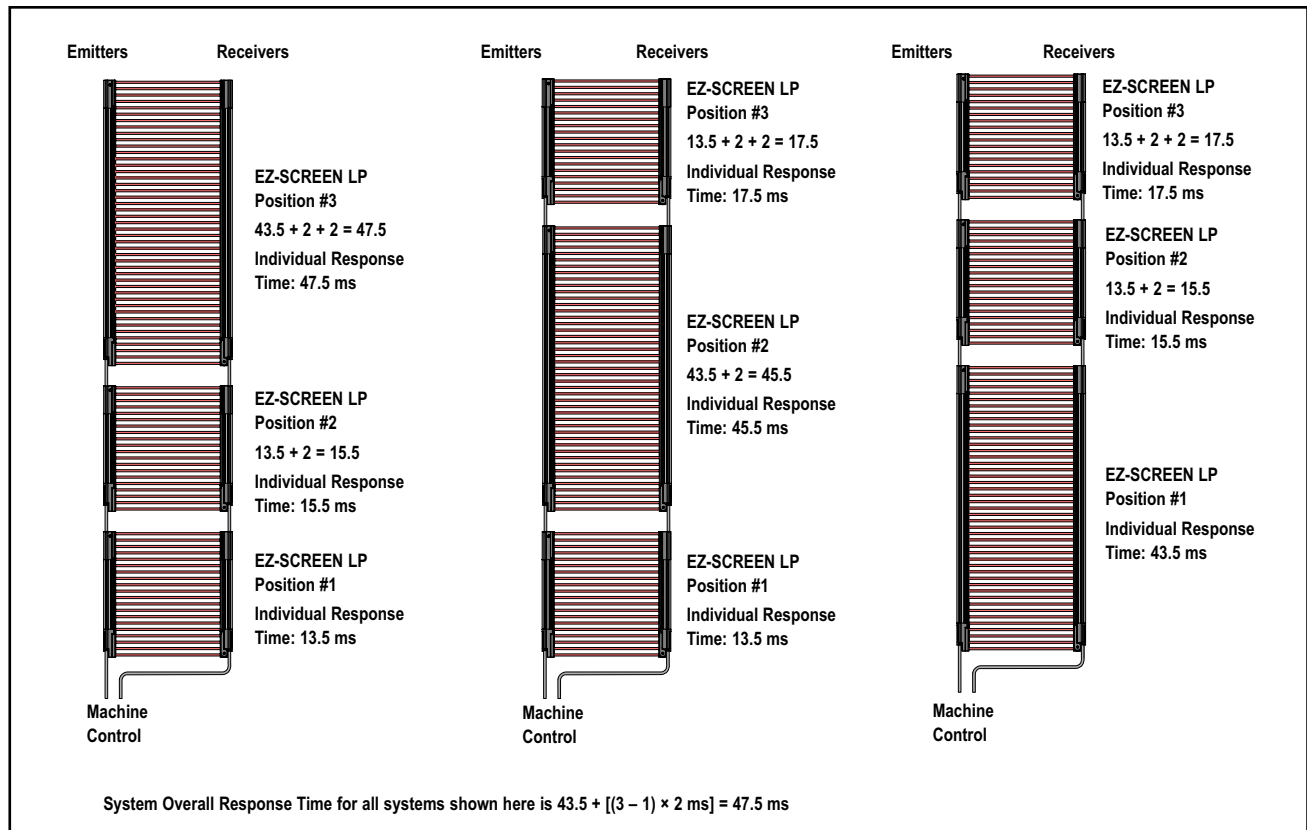


Figure 7-6. Calculating response times for a three-light screen cascade – both Individual and Overall methods

7.6 Cascaded Sensor Configuration Settings

Setting cascaded sensors for scan code, trip or latch output, external device monitoring (EDM), reduced resolution, fixed blanking and inverted display is identical to the procedure for non-cascadeable emitters and receivers (see Section 4).

Scan codes for each emitter and receiver pair must match. However, for cascaded installations, scan codes must alternate on adjacent systems as described in Section 3.1.8 and Figure 3-10. **See warning.**

While the scan code, reduced resolution, fixed blanking, and inverted display settings are independent for each cascaded sensor pair, the trip/latch mode and EDM settings must be determined by the first receiver in the cascade (closest to the machine interface), which controls the OSSD outputs. **All other receivers in the cascade must be set for trip mode and 2-channel EDM (factory default settings).**

The settings on the first receiver then determine trip or latch mode and 1- or 2-channel EDM/aux. output, and this is the only receiver that requires a reset following a latch condition.

WARNING . . . Scan Code

In situations where multiple systems are mounted closely together, or where a secondary emitter is in view (within $\pm 5^\circ$), within range of an adjacent receiver; the adjacent systems must be configured for different Scan Codes (i.e., 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 will be discovered by performing the trip test (see Section 3.4.4).

7.6.1 Fixed Blanking

One or more areas within any cascaded EZ-SCREEN LP sensor pair can be blanked out, just as with other EZ-SCREEN LP light screens. **Blanking for each sensor pair within a cascade, if required, must be programmed separately.** See Section 3.4.3 for more information and programming procedure.

For cascadeable models only: a standalone receiver or the last receiver in a cascade may be configured remotely for fixed blanking, using an **EZA-RBK-1** remote key switch box or other options as described in Section 7.10.

7.7 Configuration for Cascaded Operation

Each cascaded system must be configured, before it can be run in a production environment.

Before configuration, install all emitters and receivers per Sections 3 and 7. **The last SLPCR-.. receiver must be terminated either with a terminator plug, or with an EZA-RBK-1 remote key switch box, or by connecting two closed mechanical contacts** (see Sections 7.8 and 7.9).

Perform the following procedure **on the first receiver only in the cascade** (closest to the machine interface). *Other than scan code, set all other receivers in the cascade to the factory default positions.*

- From either normal operation or a power OFF condition, set the *first* and *fourth* DIP switches (T/L and Red Res) both to the left (Trip operation and Reduced Resolution enabled positions). See Figure 7-7.
- Set the *second* and *third* DIP switches (Red Res and T/L) both to the right (Reduced Resolution OFF and Latch operation positions).
- The receiver should be in a lockout condition or power OFF.
- If power is OFF:** Apply power
Lockout condition: Perform a valid reset sequence (close the reset switch for 0.25 to 2 seconds, then reopen).
- Coming out of lockout or during startup, the DIP switch configuration will be recognized as Cascaded Teach Mode, indicated by the following:
 - First receiver display sequentially shows
No E-stop connected: "4C," "3C," or "2C"
E-stop w/closed contacts: "4CE," "3CE," or "2CE"
E-stop w/open contacts: "4CO," "3CO" or "2CO"
 - Last cascaded receiver display sequentially shows
Terminator connected: "1C"
E-stop w/closed contacts: "1CE"
E-stop w/open contacts: "1CO"
 - Other receivers sequentially display "1C"
 - All receiver Zone indicators OFF
 - All receiver Yellow Reset indicators OFF
 - All receiver Status indicators solid red
- To enable and exit Cascade Teach Mode, reconfigure DIP switches for normal operation.
- Perform a valid reset sequence (see Step 4), or cycle power.

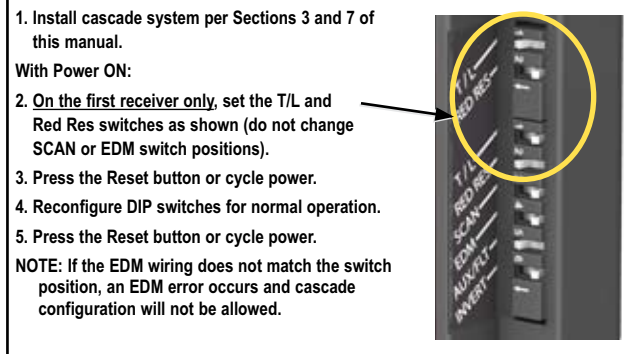


Figure 7-7. DIP switch configuration to enable cascade installation

7.8 Emergency Stop Buttons and Devices

Cascadeable EZ-SCREEN LP 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 Ohms.

NOTE: The simultaneity between the two E-stop contacts, on opening and closing, is 3 seconds. If simultaneity is not met on either opening or closing, the last receiver's display will flash "|-|". If simultaneity is not met on opening, the closed contact can be opened later (after more than 3 seconds), then both contacts must be closed again.

⚠ WARNING . . . Emergency Stop Functions

If Cascade Input is used for an Emergency Stop function, do not mute or bypass the safety outputs (OSSDs) of the EZ-SCREEN LP. ANSI/NFPA79 and IEC 60204-1 require that the Emergency Stop function remain active at all times. **Muting or bypassing the safety outputs will render the Emergency Stop function ineffective.**

E-Stop Switch Requirements (Positive-Opening)

As shown in Figure 7-8, 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.

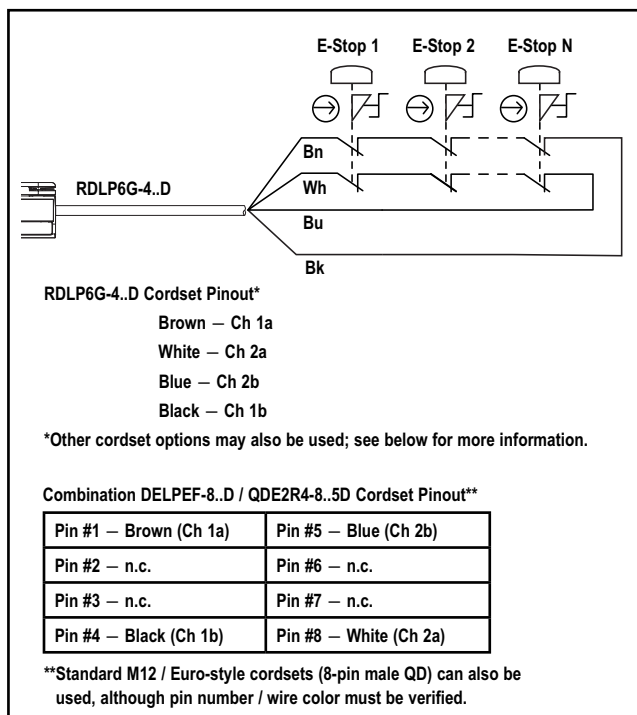


Figure 7-8. Hookup of E-stop buttons to the last receiver in the cascade

⚠ WARNING . . . Multiple E-Stop Switches

- Whenever two or more E-stop switches are connected to the same EZ-SCREEN LP 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 LP receiver input.

Never connect the contacts of multiple E-stop switches in parallel to the EZ-SCREEN LP inputs; this defeats the switch contact monitoring ability of the EZ-SCREEN LP light curtain, and creates an unsafe condition which could result in serious bodily injury or death.

- Also, when two or more E-stop switches are used, each switch must be individually actuated (engaged), then re-armed and the EZ-SCREEN LP light curtain reset (if using latch mode). 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 returning the E-stop switch to its closed-contact position (when arming the E-stop switch). When automatic reset is used, an alternate means must be established to require a reset routine, after the E-stop switch is armed. **Allowing the machine to restart as soon as the E-stop switch is armed creates an unsafe condition which could result in serious injury or death.**

7.9 Positive-Opening Safety Interlock Switches

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, it is the responsibility of the user to safely install, operate, and maintain each safety system and comply with all relevant laws and regulations. Of the following applications, Figure 7-9 meets or exceeds the requirements for OSHA/ANSI control reliability and Safety Category 4, per ISO 13849-1.

⚠ WARNING . . . Unguarded Moving Parts

It must not be possible for personnel to reach any hazard point through an opened guard (or any opening) before hazardous machine motion has completely stopped.

Please reference OSHA CFR1910.217, ANSI B11 standards, or other appropriate standards for information on determining safety distances and safe opening sizes for your application (see Inside back cover).

Interlock Guarding Requirements

The following general requirements and considerations apply to the installation of interlocked gates and guards for the purpose of safeguarding. In addition, the user must 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 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 (ANSI/RIA R15.06). 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 Cascade must be designed and installed so that they cannot be easily defeated. They must be mounted securely, so that their physical position can not 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.

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 (see Figure 7-9).

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 (see the Banner Safety Catalog for examples). In addition, the switches must be mounted in a “positive mode” to move/disengage the actuator from its home position and open the normally closed contact when the guard opens.

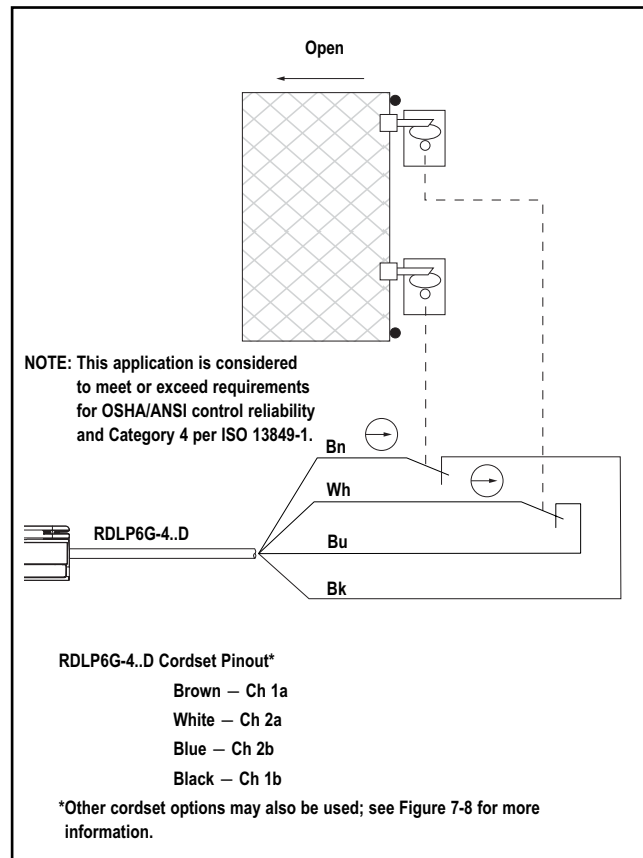


Figure 7-9. Monitoring two positive-opening safety switches

Monitoring Series-Connected Positive-Opening Safety Switches

When monitoring two individually mounted safety switches (as shown in Figure 7-9), a faulty switch will be detected if it fails to switch as the guard opens. In this case, the EZ-SCREEN LP will de-energize its OSSD output and disable its reset function until the input requirements are met (i.e., the faulty switch is replaced). However, when a series of interlocking safety switches is monitored by the EZ-SCREEN LP, the failure of one switch in the System may be masked or not detected at all (refer to Figure 7-10).

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. The following two scenarios assume two positive-opening safety switches on each guard:

1. **Masking of a failure.** If a guard is opened but a switch fails to open, the redundant safety switch will open and cause the EZ-SCREEN LP to de-energize its outputs. If the faulty guard is then closed, both cascade input channels also close, but because one channel did not open, the EZ-SCREEN LP will not reset.

However, if the faulty switch is not replaced and a second “good” guard is cycled (opening and then closing both of the cascade input channels), the EZ-SCREEN LP considers the failure to be corrected. With the input requirements apparently satisfied, the EZ-SCREEN LP allows a reset. *This system is*

no longer redundant and, if the second switch fails, may result in an unsafe condition (i.e., the accumulation of faults results in the loss of the safety function).

2. **Non-detection of a failure.** If a good guard is opened, the EZ-SCREEN LP de-energizes its outputs (a normal response). But if a faulty guard is then opened and closed before the good guard is re-closed, the failure on the faulty guard is not detected. *This system also is no longer redundant and may result in a loss of safety if the second safety switch fails to switch when needed.*

The circuits in either scenario do not inherently comply with the safety standard requirements of detecting single faults and preventing the next cycle. In multiple-guard systems using series-connected positive-opening safety switches, it is important to periodically check the functional integrity of each interlocked guard individually. **Operators, maintenance personnel, and others associated with the operation of the machine must be trained to recognize such failures and be instructed to correct them immediately.**

Open and close each guard separately while verifying that the EZ-SCREEN LP outputs operate correctly throughout the check procedure. Follow each gate closure with a manual reset, if needed. If a contact set fails, the EZ-SCREEN LP will not enable its reset function. If the EZ-SCREEN LP does not reset, a switch may have failed; that switch must be immediately replaced.

This check must be performed and all faults must be cleared, at a minimum, during periodic checkouts. **If the application can not exclude these types of failures and such a failure could result in serious injury or death, then the safety switches must not be connected in series.**

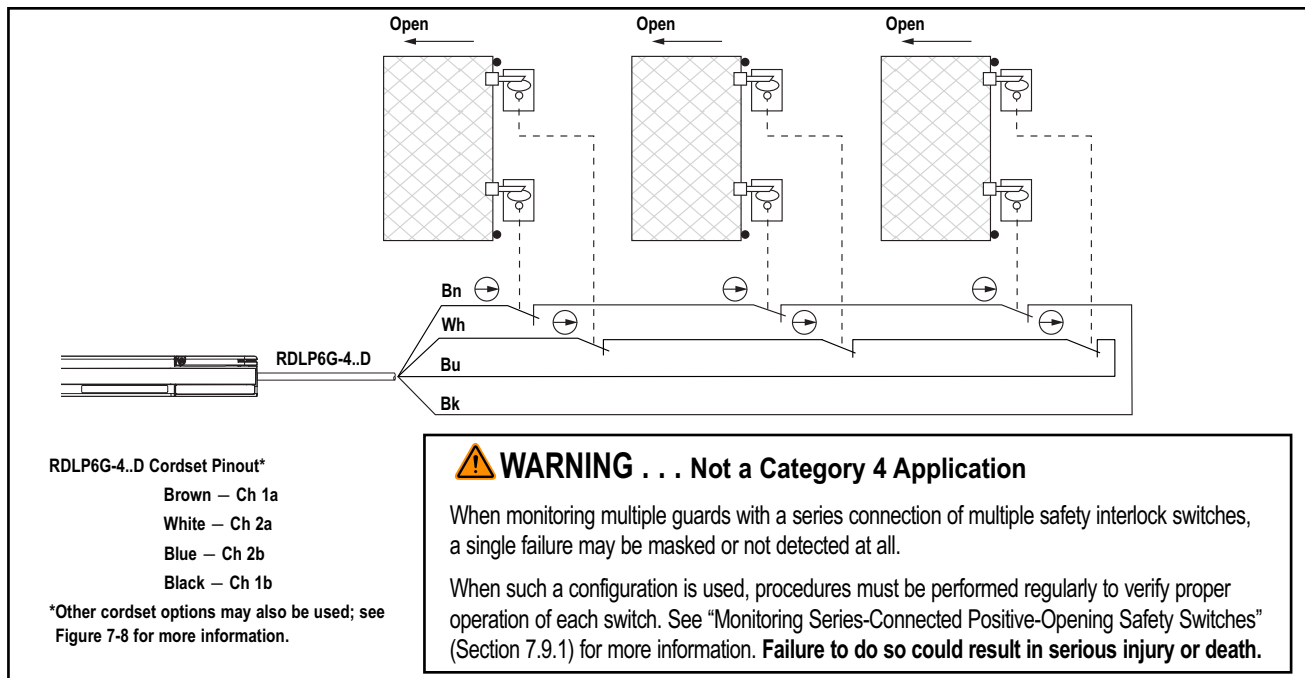


Figure 7-10. Monitoring positive-opening safety switches on multiple gates

7.10 Remote Fixed Blanking

As described in Sections 1.4.9 and 3.4.3, 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 LP sensor pair may be “blanked out,” with a minimum of one beam between two blanked areas. The first sensing beam (synchronization beam) at the display end of sensor must remain clear (can not 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.

On initial installations of cascadeable emitter/receiver pairs, when they are used as a standalone system, the cascade configuration procedure is not necessary.

⚠ WARNING . . . Use of Reduced Resolution and Fixed Blanking

Use Reduced Resolution and 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 Section 3.1.1).

The Remote Fixed Blanking feature can be used on an EZ-SCREEN LP cascade receiver as a stand-alone system or as the end (slave) unit in a cascaded system. The remote programming is only effective on that receiver. If fixed blanking is required on other receivers in the cascade string, see Section 3.4.3 for DIP switch configuration information.

Programming Key Switch Location

The EZA-RBK-1 or an SPDT (Form C) switch is required to perform the remote programming procedure, as shown in Figure 7-12. In addition, a normally open (N.O.) reset switch, such as the EZA-RR-1, is generally recommended and is required for systems configured for Latch output. A key-actuated switch provides some supervisory control since the key can be removed from the switch (see Section 3.1.3).

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, and
- Protected against unauthorized or inadvertent operation.

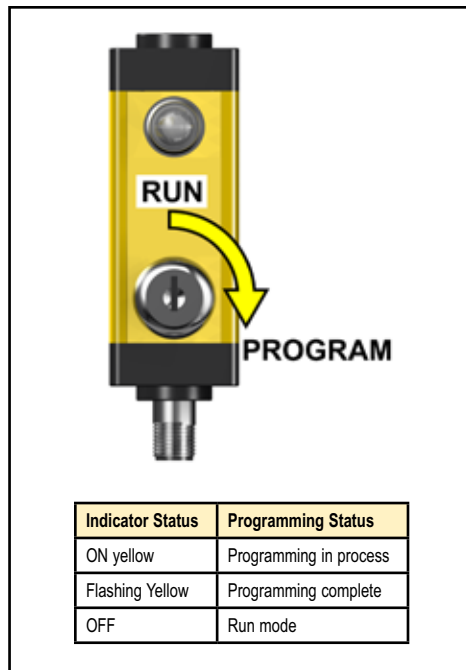


Figure 7-11. EZA-RBK-1 switch positions and programming status indications

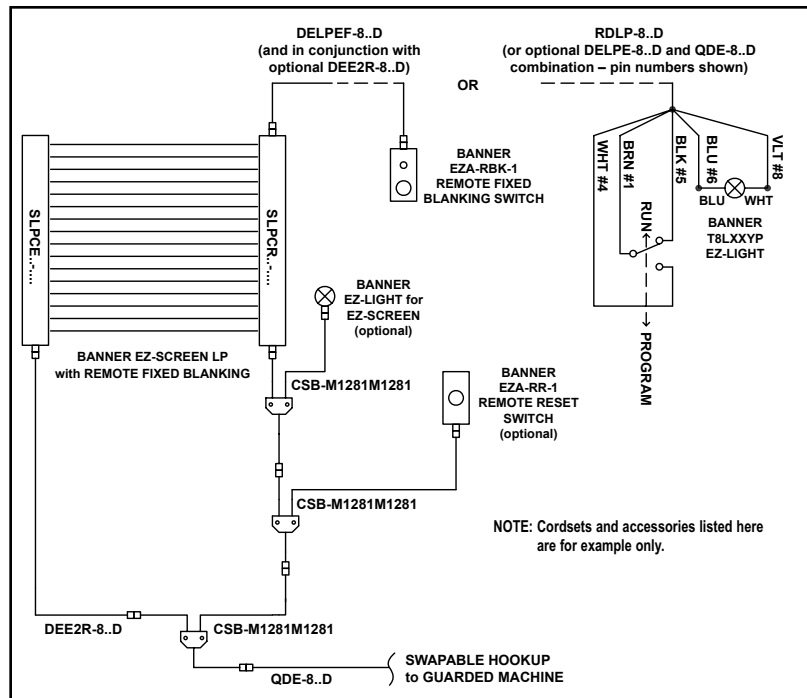


Figure 7-12. Connections for use of remote fixed blanking programming

Remote Fixed Blanking Programming Procedures

Prior to performing these procedures, install the EZ-SCREEN LP per Section 3 of this document, including all other DIP switch configuration settings (T/L, RR, and Scan Code). Align the E/R 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 position (Run position, see Figure 7-11) at power-up and normal operation.

Important:

1. The first sensing beam (synchronization beam) at the display end of the sensor must remain clear.
2. The number and location of blocked beams is indicated by the receiver's 7-segment display and the zone indicators. If the configuration is reliable, this number should not change.
3. A reset switch (e.g., a normally open switch) must be used to complete some programming procedures below.

Initial programming – no fixed blanking previously programmed, perform the following:

The following procedures must be completed within 10 minutes or a lockout will occur (Error Code 12 will be displayed).

Action		Indication	Comments
1	Locate the obstruction in the defined area and secure it.	EZA-RBK-1: OFF Receiver: number and location of blocked beams is indicated by the 7-segment display and the zone indicators.	If the configuration is reliable, this number should not change.
2	Turn the programming key switch to the Program position (clockwise) momentarily (> ¼ second) and then return to the Run position.	EZA-RBK-1: ON (key in Program position), then slowly flashes for approximately 5 seconds (key returns to Run position). Receiver: display indicates "P" "F" "C"	This "teaches" and saves the new fixed blanking configuration.
3	Trip Output: the OSSDs turn ON. Latch Output: After the EZA-RBK-1 indicator turns OFF, a valid reset sequence is required to turn ON the OSSDs.	EZA-RBK-1: OFF Receiver: display indicates normal operation. (See Section 3.4.3, step 9.)	

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: ON Receiver: sequences between "P" "F" "A" and the number of blocked beams.	EZA-RBK-1 indicator steady ON indicates program mode.
2	Locate or relocate the obstruction (e.g. tooling, fixturing, etc.) in the defined area and secure. If clearing the fixed blanked area, remove all obstructions.	EZA-RBK-1: ON Receiver: display sequences between "P" "F" "A" 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: 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. Latch Output: After the EZA-RBK-1 indicator turns OFF, a valid reset sequence is required to turn ON the OSSDs.	EZA-RBK-1: OFF Receiver: display indicates normal operation if fixed blanking is removed. Otherwise, see Section 3.4.3, step 9.	

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

- Obstruction is relocated or cleared with EZ-SCREEN LP power OFF.
- Clearing an Error Code 10 “Fixed Blanking Error” (begin at step #5, with the programming key switch in the Run position)
- 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 LP.		
2	Locate or relocate the obstruction (e.g., tooling, fixturing, etc.) in the defined area and secure it, or if clearing the fixed blanked area, remove all obstructions.		
3	Reapply power to the EZ-SCREEN LP system.	EZA-RBK-1: rapid flashing Receiver: Power-up Test Sequence.	All LEDs turn ON momentarily during the Power-up Display Test Sequence.
4	An Error code 10 is generated when one or more of the currently fixed blanked beams become clear.	EZA-RBK-1: OFF Receiver: display flashes “1”, “0”, status LED flashes red.	
5	Place the programming key switch in the Program position (clockwise) until step 8.	EZA-RBK-1: OFF Receiver: display flashes “1”, “0”, status LED flashes red.	
6	Perform a valid reset (close the reset switch for ¼ to 2 seconds, then open it).	EZA-RBK-1: rapid flashing, then steady ON Receiver: display sequences between “P” “F” “A” and the number of blocked beams.	<ul style="list-style-type: none"> • EZA-RBK-1 indicator flashes rapidly to indicate the reset is in process. • The timer resets to 10 minutes. • Cascade systems: the first receiver locks out in an Error Code 13.
7	If necessary, locate or relocate the obstruction (e.g., tooling, fixturing, etc.) in the defined area and secure. If clearing the fixed blanked area, remove all obstructions.	EZA-RBK-1: steady ON Receiver: display sequences between “P” “F” “A” and the number of blocked beams.	If an Error Code 12 occurs (programming time out), repeat step #6 above (do not return the programming key switch to the RUN position).
8	Return the programming key switch to the Run position (counter-clockwise).	EZA-RBK-1: slowly flashes for approximately 5 seconds Receiver: display indicates “P” “F” “C”	This saves the new fixed blanking configuration.
9A	Standalone (one sensor pair) Trip Output: the OSSDs turn ON. Latch Output: After the EZA-RBK-1 indicator turns OFF, a valid reset sequence is required.	EZA-RBK-1: OFF Receiver: display indicates normal operation.	
9B	Cascade system (multiple connected emitter-receiver pairs), after the EZA-RBK-1 indicator turns OFF: Trip Output: Perform a single valid reset, and the OSSDs will turn ON. Latch Output: Two valid reset sequences are required to turn ON the OSSDs. Pause between the reset actuations to allow the Error code 13 to clear.	EZA-RBK-1: OFF 1st Receiver: Error Code 13. Cascaded Receiver(s): display indicates normal operation.	<ul style="list-style-type: none"> • A reset is required to clear the Error Code 13 on the first receiver (i.e., the receiver connected to the machine control). • EZA-RBK-1 indicator ON when the reset is actuated (closed) in normal Run mode, flashes rapidly when reset is in process. • Latch Output: the second reset is required to clear the latch.

Appendix A. Bracket Assembly Instructions

The screwdriver provided with the EZ-SCREEN LP is intended for access to the DIP switches and for preassembly of the mounting brackets. Final assembly (tightening) of the mounting bracket should be accomplished with a #1 Phillips screwdriver or 3/16" / 5 mm "thin-walled" nut driver to achieve the listed torque specifications. Sensors may be mounted with side-mount brackets, end-mount brackets, or a combination of both.

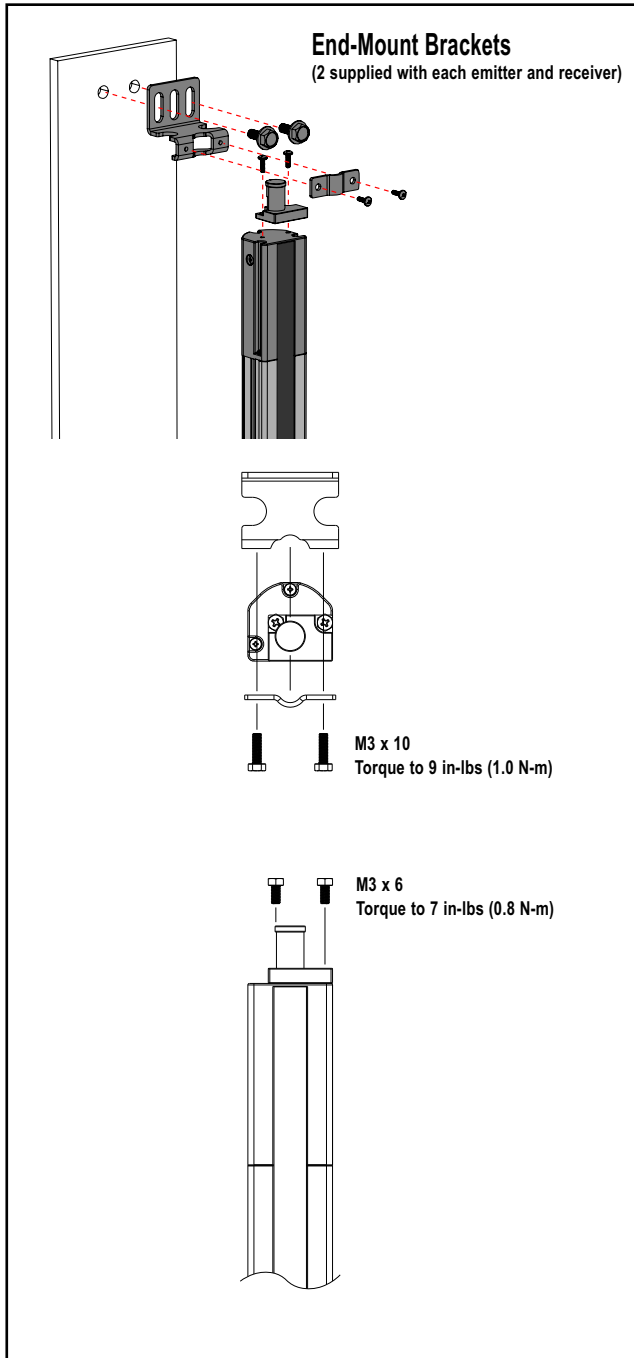


Figure A-1. End-mount hardware attachment

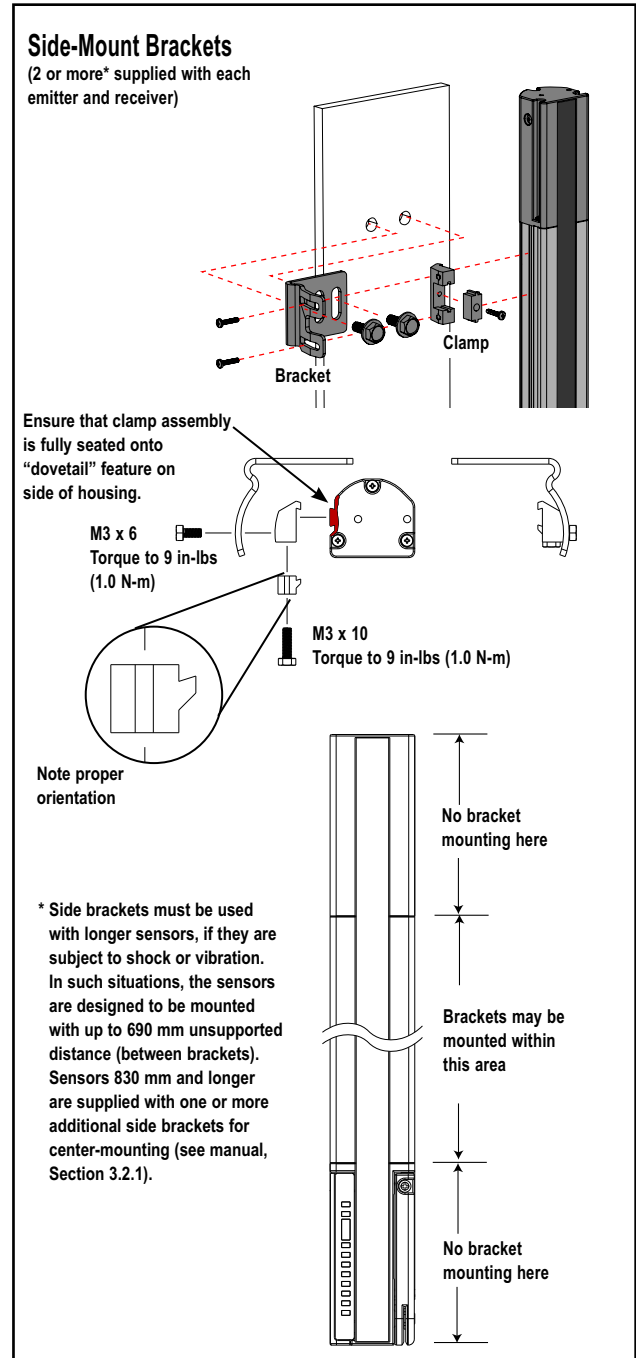


Figure A-2. Side-mount hardware attachment

Glossary of Terms

The following terms are used often in this manual. Where possible, this manual uses definitions from the U.S. and international product performance standards that govern the design of the Safety Controller. For more definitions, visit www.BannerEngineering.com/training/glossary.php.

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 "Safety Standards" on inside back cover.

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.

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 *fixed blanking*, *Floating Blanking*, and *Reduced Resolution*.

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.

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

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

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.

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.

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.

Defined Area: The "screen of light" generated by a safety light screen system, defined by the height and the safety (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: An individual identified and designated in writing, by the employer, as being appropriately trained and qualified to perform a specified checkout procedure. (See *Qualified Person*.)

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.

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

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

Fixed Blanking: A programming feature that allows a safety light screen system to ignore objects (such as brackets or fixtures) which will always be present at a specific location within the defined area. The presence of these objects will not cause the system's safety outputs (e.g., Final Switching Devices) to trip or latch. If any fixed objects are moved within or removed from the defined area, a Lockout condition results.

Floating Blanking: See *Reduced Resolution*.

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.

Guarded Machine: The machine whose point of operation is guarded by the safety system.

Hard 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 openings is determined by the applicable standard, such as Table O-10 of OSHA 29CFR1910.217, also called a "fixed barrier guard."

Hazardous Area: An area that poses an immediate or impending physical hazard.

Hazard Point: The closest reachable point of the hazardous area.

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*.

Key Reset (Manual Reset): A key-operated switch used to reset a safety light screen system to RUN mode following a Lockout condition, or to enable machine operation following a Latch condition. Also refers to the act of using the switch.

Latch Condition: The response of the safety light screen Safety Outputs (e.g., 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 *Trip Condition*.)

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.

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

Machine Response Time: The time between the activation of a machine stopping device and the instant when the dangerous parts of the machine reach a safe state (are brought to rest).

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 *Specified Test Piece*.

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

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

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

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.

OSSD: Output Signal Switching Device. The safety outputs that are used to initiate a stop signal.

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.

Pass-Through Hazard: A situation that may exist when personnel pass through a safeguard (at which point the hazard stops or is removed), and then continue into the guarded area. At this point the safeguard may not be able to prevent an unexpected start or restart of the machine with personnel within the guarded area.

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

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

Qualified Person: An individual who, 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 subject matter and work. (See *Designated Person*.)

Receiver: The light-receiving component of a safety light screen, consisting of a row of synchronized phototransistors. The receiver, together with the emitter (placed opposite), creates a “screen of light” called the *defined area*.

Reduced Resolution: A feature that allows a safety light screen to be configured to produce one or more intentionally disabled light beam(s) within the light screen, which increases the minimum object sensitivity. The disabled beam(s) appears to move up and down (“float”) in order to allow the feeding of an object through the defined area at any point without tripping the safety outputs (e.g., OSSDs) and causing a Trip or Latch condition. Sometimes called “*Floating Blanking*.”

Reset: The use of a manually operated switch to restore the safety outputs to the ON state from a lockout or a Latch condition.

Resolution: See *Minimum Object Sensitivity*.

Safety Distance: The minimum distance required to allow the machine’s hazardous motion to stop completely, before a hand (or other object) can reach the nearest hazard point. Measured from the midpoint of the defined area to the nearest hazard point. Factors that influence minimum safety distance include the machine stop time, the light screen system response time, and the light screen minimum object detection size. Also known as “Minimum Distance” (EN and ISO) and “Separation Distance”.

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 screens and safety modules are self-checking.

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*.

Start/restart (interlock): When applied to the function of a safety or safeguarding device, this term refers to the ability of the device to prevent or allow the machine operating cycle to begin or resume by normal actuating means after the cause of a stop has been removed. This function is also called “reset”.

NOTE: *The reset (clearing of the Start/Restart interlock) of the device must not cause hazardous motion or a hazardous situation, but only enable the normal start command.*

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.

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

Trip Condition: The response of the safety outputs (e.g., OSSDs) of a safety light screen 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*.

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.

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

SOURCES

OSHA Documents

Superintendent of Documents
Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954
Tel: (202) 512-1800
<http://www.osha.gov>

ANSI Accredited Standards

American National Standards Institute (ANSI)
11 West 42nd Street
New York, NY 10036
Tel: (212) 642-4900
<http://www.ansi.org>

B11 Documents

Safety Director
The Association for Manufacturing
Technology (AMT)
7901 Westpark Drive
McLean, VA 22102
Tel: (703) 893-2900
<http://www.mfgtech.org>

RIA Documents

Robotics Industries Association (RIA)
900 Victors Way, P.O. Box 3724
Ann Arbor, MI 48106
Tel: (734) 994-6088
<http://www.robotics.org>

NFPA Documents

National Fire Protection Association
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101
Tel: (800) 344-3555
<http://www.nfpa.org>

Alternate sources for these, plus ISO, IEC, EN, DIN, and BS Standards:

Global Engineering Documents

15 Inverness Way East
Englewood, CO 80112-5704
Tel: (800) 854-7179
<http://www.global.ihc.com>

National Standards Systems Network (NSSN)

25 West 43rd Street
New York, NY 10036
Tel: (212) 642-4980
<http://www.nssn.com>

Document Center, Inc.

111 Industrial Road, Suite 9
Belmont, CA 94002
Tel: (650) 591-7600
<http://www.document-center.com>

U.S. Application Standards

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 B11.TR3 Risk Assessment

ANSI/RIA R15.06 Safety Requirements for
Industrial Robots and Robot Systems

NFPA 79 Electrical Standard for Industrial
Machinery

OSHA Regulations

OSHA Documents listed are part of: Code
of Federal Regulations Title 29, Parts 1900
to 1910

OSHA 29 CFR 1910.212 General Require-
ments 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

International/European Standards

ISO 12100-1 & -2 (EN 292-1 & -2) Safety
of Machinery – Basic Concepts, General
Principles for Design

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

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

ISO 13849-1 (EN 954-1) 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 14121 (EN 1050) Principles of Risk
Assessment

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

EC Declaration of Conformity

Banner Engineering Corp.
9714 Tenth Avenue North
Minneapolis, MN 55441-5019 USA

We herewith declare that EZ-SCREEN LP low-profile light screen for industrial control is in conformity with the provisions of the Machinery Directive (Directive 98/37/EEC and 2006/42/EC), and all essential Health and Safety Requirements have been met.



12/02/2009

R. Eagle / Engineering Manager
Banner Engineering Corp.
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Date



12/02/2009

Peter Mertens / Managing Director
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1831 Diegem, Belgium

Date

Download the complete EC Declaration of Conformity as a PDF file at www.bannerengineering.com/EZSCREEN



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WARRANTY: Banner Engineering Corp. warrants its products to be free from defects for one year. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture found to be defective at the time it is returned to the factory during the warranty period. This warranty does not cover damage or liability for the improper application of Banner products. This warranty is in lieu of any other warranty either expressed or implied.

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