WINTRISS®

User Manual

Shadow® 10

Safety Light Curtain
1148800
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WINTRISS®

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Requirements You Must Meet When Installing and Using Shadow Safety Light Curtains

⚠ DANGER

DO NOT USE SHADOW LIGHT CURTAINS ON FULL-REVOLUTION POWER PRESSES

- DO NOT use Shadow safety light curtains on full-revolution clutched machinery, which cannot be stopped in mid-stroke.
- Use Shadow safety light curtains only on machinery that can be stopped at any point in the stroke or cycle.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

AVOID IMPROPER INSTALLATION, USE, OR MAINTENANCE

- Follow all procedures in this manual. Perform only the tests and repairs listed in this manual. Use only factory-supplied replacement parts.
- Wire, install and maintain Shadow safety light curtain in accordance with OSHA lockout/tagout regulation 1910.147.
- Ensure that Shadow safety light curtain is installed, tested, and repaired by a qualified person. Only a qualified person should possess keys, special tools, or other means needed to gain access to the control and modify the configuration of the Shadow light curtain.
- Ensure that all metal stamping presses on which Shadows are used meet the requirements and inspection procedures of OSHA regulation 1910.217 and ANSI standard B11.1-2009, which govern the use of presence-sensing devices on metal stamping presses. Ensure that all other machinery, or other devices on which Shadows are used, meet the general machine guarding requirements in OSHA standard 1910.212 and any other regulations and standards that apply.
- Ensure that guarding is installed to prevent access to the machine over, under or around the light curtains.
- Test the operation of your Shadow safety light curtain, using the test procedure shown on the Shadow safety light curtain control enclosure and also included in this manual.
- Perform the checkout and test procedures after any maintenance is done on the Shadow safety light curtain.
- Ensure that supervisors, die-setters, maintenance persons, machine operators, foremen, or any others responsible for the proper operation of the machinery have read and understood all instructions for use of the Shadow light curtain.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

MAKE SURE THAT MACHINERY IS CONFIGURED AND WORKING PROPERLY

- Ensure that the machinery and devices on which Shadow safety light curtains are used meet the general machine guarding requirements of OSHA standard 1910.212 and any other regulations and standards that apply.
- Inspect all stopping mechanisms of the machinery regularly to be sure they work properly.
- DO NOT operate a machine equipped with Shadow safety light curtains if the machine or any of its stopping mechanisms is not in proper working order.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

PREVENT STOPPING MECHANISM FAILURE

- Install and maintain stopping mechanisms of machinery or other devices according to the applicable regulations or standards.
- Regularly inspect all stopping mechanisms of the machinery to ensure proper functioning.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

UNPROTECTED EQUIPMENT MAY CONTINUE TO OPERATE AFTER GUARDED PRESS STOPS

- Equipment that operates with the machinery connected to Shadow safety light curtain may continue to operate after the machinery has received a stop signal.
- Ensure that all operators and other affected personnel know which equipment is connected to Shadow safety light curtain and which is not.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

PREVENT PROJECTILES FROM EXITING HAZARDOUS AREA

Shadow 10 cannot protect a person from a projectile exiting the hazardous area. Install protective cover(s) or fence(s).

Failure to comply with these instructions will result in death or serious injury.

⚠ WARNING

GUARD AGAINST ELECTRIC SHOCK HAZARD

Turn off and disconnect power from the Shadow safety light curtain and from the machinery it is connected to, including the machine control and motor, before making any wiring connections.

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

Thank you for purchasing a Wintriss Product. We appreciate your business and want to do whatever we can to ensure your satisfaction. Wintriss products are built to stay on the job day after day, and are backed by an ironclad guarantee, international standards approvals, and unbeatable support.

Whenever you need assistance or service, we back all our products with excellent spare parts inventories, training programs, and prompt repair service. We would like to share with you a list of service options– probably the largest number of service options offered in the industry.

- **Technical Assistance**

  We offer a toll-free number for technical assistance. Call 1-800-586-TECH (8324) should you have any questions about your equipment. Our technical staff is ready to assist you Monday through Friday, 8 a.m. to 5 p.m. Eastern Time. In many cases our experienced technical staff can resolve your inquiry right over the phone.

- **Return Authorization**

  Please call our 800 number for a return authorization (RMA) number to return a product for repair. Returned goods must arrive freight prepaid. In order to process your return quickly, we ask that you provide us with the following pertinent information when you call: purchase order number, shipping address, contact name and telephone number, and product type. The assigned RMA number should appear on all packages returned to Wintriss Controls Group to ensure prompt service.

  At the time of requesting an RMA, you will be quoted a flat-rate repair price for the product you are returning. We ask that you email a PO to orders@wintriss.com for that amount or enclose the PO with the returned item. This will enable us to ship the item back to you as soon as the repair has been completed. If the item cannot be repaired or there are additional charges, you will be contacted for approval.

  Please be sure to carefully pack all returned items and ship to our Acton, MA location.

- **Expedited Repair Program**

  Rush service providing 48-hour turnaround is available for most products upon request. An Expedite Fee will be applied to our standard repair rate.

- **Board Exchange Program**

  If your needs are urgent, you can take advantage of our Board Exchange (EX) program. Call our 800 number between 8 a.m. and 3:30 p.m. Eastern Time and we will send a replacement to you overnight. A fee does apply to this service. Contact Wintriss Technical Support at 800-586-8324 for details.

- **Service Center**

  Our Service Center for product service is located at our headquarters in Acton MA. If your equipment requires repair, please contact us at 800-586-8324 to obtain a return authorization number.

  Nationwide field service is also available. Contact the Wintriss Technical Support group at 800-586-8324.

- **Product Training**

  We also offer both product training and maintenance/troubleshooting courses at our Acton, MA and Chicago-area facilities. On-site training is available from the factory or through your local Wintriss representative.

- **Restocking Charge**

  Returned goods are subject to a 20% restocking charge if returned for credit.

Whatever the product, we are committed to satisfying you with innovative engineering, quality construction, reliable performance, and ongoing, helpful support. Call us whenever you need assistance.

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How to Use This Manual

This manual shows you how to install, operate, and troubleshoot Shadow 10 light curtains and includes pertinent information about OSHA and ANSI requirements.

Chapter 1, *Introduction*, provides an overview of Shadow 10.

Chapter 2, *Safety Considerations*, explains safety considerations in applying and using Shadow 10 light curtains.

Chapter 3, *Product Description*, gives details on Shadow 10 light curtains and their features.

Chapter 4, *Installation*, gives instructions for determining safety distance and installing Shadow 10 light curtains.

Chapter 5, *Parameterization*, describes factory settings and how to set parameters on Shadow 10 light curtains.

Chapter 6, *Commissioning,* gives instruction for optical alignment during commissioning.

Chapter 7, Inspection *and Maintenance*, provides inspection and maintenance instructions, including pre-commissioning tests, maintenance and periodic inspection.

Chapter 8, *Troubleshooting*, gives troubleshooting instructions.

Chapter 9, *Decommissioning*, gives guidance on decommissioning Shadow 10 light curtains.

Chapter 10, *Technical Specifications*, contains the technical specifications for Shadow 10 light curtains.

Appendix A – *Verification Checklist* provides a verification checklist.

Appendix B – *Parameters Quick Reference* gives parameters quick reference information

Appendix C – *Compliance* provides compliance information.

Appendix D – *Extracts from OSHA Regulations and ANSI Standards* provides extracts from OSHA regulation 1910.217 and ANSI standards B11.1-2009 and B11.19-2010.

Appendix E – *Glossary*, explains terms used in this manual.

Wiring diagrams at the end of the manual provide detailed wiring schematics to help you install your Shadow 10 light curtains.

Important Highlighted Information

Important danger, warning, caution and notice information is highlighted throughout the manual as follows:

This manual uses the following symbols to emphasize sections or paragraphs of particular importance to those using or setting up the device. Strict adherence to the instructions next to these symbols should be observed at all times.

⚠ DANGER

A DANGER symbol indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury.

⚠ WARNING

A WARNING symbol indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.

CAUTION

A CAUTION symbol indicates a potentially hazardous situation, which, if not avoided, may result in property damage.

NOTICE

A NOTICE symbol indicates important information that you should remember, including tips to aid you in performance of your job.

WARRANTY

Wintriss Controls warrants that Wintriss electronic controls are free from defects in material and workmanship under normal use and service for a period of one year (two years for Shadow light curtains) from date of shipment. All software products (SFC), electro-mechanical assemblies, and sensors are warranted to be free from defects in material and workmanship under normal use and service for a period of 90 days from date of shipment. Wintriss's obligations under this warranty are limited to repairing or replacing, at its discretion and at its factory or facility, any products which shall, within the applicable period after shipment, be returned to Wintriss Controls freight prepaid and which are, after examination, disclosed to the satisfaction of Wintriss to be defective. This warranty shall not apply to any equipment which has been subjected to improper installation, misuse, misapplication, negligence, accident, or unauthorized modification. The provisions of this warranty do not extend the original warranty of any product which has either been repaired or replaced by Wintriss Controls. No other warranty is expressed or implied. Wintriss accepts no liability for damages, including any anticipated or lost profits, incidental damages, consequential damages, costs, time charges, or other losses incurred in connection with the purchase, installation, repair or operation of our products, or any part thereof.

Please note:

It is solely the user's responsibility to properly install and maintain Wintriss controls and equipment. Wintriss Controls manufactures its products to meet stringent specifications and cannot assume responsibility for consequences arising from their misuse.

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Shadow 10 Safety Light Curtain
USER MANUAL
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Wintriss Controls Group, LLC

Chapter 1 – Introduction

⚠ DANGER

DO NOT USE SHADOW LIGHT CURTAINS ON FULL-REVOLUTION POWER PRESSES

- DO NOT use Shadow safety light curtains on full-revolution clutched machinery, which cannot be stopped in mid-stroke.
- Use Shadow safety light curtains only on machinery that can be stopped at any point in the stroke or cycle.

Failure to comply with these instructions will result in death or serious injury.

⚠ WARNING

OBSERVE SAFETY REGULATIONS AND STANDARDS WHEN INSTALLING EQUIPMENT

- Install and use Shadow safety light curtains according to applicable safety regulations and standards.
- Install Shadow safety light curtains on presses according to the requirements and inspection procedures of OSHA regulation 1910.217 and ANSI standard B11.1-2009.
- Install Shadow safety light curtains on other machinery according to OSHA regulation 1910.212 for general machine guarding and any other regulations that apply.

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

NOTICE

USE EXTRACTS FROM SAFETY STANDARDS FOR REFERENCE ONLY

For your convenience, Wintriss has provided extracts from OSHA regulation 1910.217 and from ANSI standards B11.1-2009 and B11.19-2010 in Appendix D. These extracts are provided for the user's convenience only and may not reflect the current revisions of these documents. For the most up-to-date information, refer to the latest versions of the original OSHA and ANSI documents.

Please make sure you read this instruction manual carefully before using the Wintriss Shadow 10 Safety Light Curtain in order to understand the product features and functions. Please consult with Wintriss Tech Support if you have any questions or comments.

This document contains information on mounting, installation, configuration, commissioning, operation and maintenance of the Shadow 10 safety light curtains in accordance with their intended applications. However, specialized technical knowledge not provided in this manual is also required for the planning and implementation of safety light curtains on power driven machinery.

As the required knowledge may not be completely included in this manual, we suggest the customer contact the specialized organizations and local authorities such as the body responsible for prescribing and/or enforcing machinery safety regulations in the location where the equipment is to be used.

This document is part of the Shadow 10 safety light curtain. Keep a printed copy accessible for reference throughout the Shadow 10 system's whole life cycle to all the personnel responsible for its installation, configuration, commissioning, operation, maintenance and safety control.

If a Shadow 10 system is purchased by a buyer (e.g. OEM, integrator) to be resold or delivered to a third party, the buyer must provide such third party with a copy of this manual and all the pertaining documentation included in the original product.

Abbreviations

AOPD	Active Optoelectronic Protective Device
DC	Detection Capability
EAA	Effective Aperture Angle
EDM	External Device Monitoring
EMC	Electromagnetic Compatibility
ESPE	Electro Sensitive Protective Equipment
FCN	Multi-function Button
IR	Infrared
LC	Light Curtain
OSSD	Output Signal Switching Device
PELV	Protective Extra-Low Voltage
PSDI	Presence Sensing Device Initiation
RCVR	Receiver
RST	Reset
PROG/RUN	Program/Run Mode Key-Switch
RX	Receiver (Detector)
SELV	Safety Extra-Low Voltage
TX	Transmitter (Emitter)

Chapter 2 – Safety Considerations

⚠ WARNING

UNPROTECTED EQUIPMENT MAY CONTINUE TO OPERATE AFTER GUARDED PRESS STOPS

Ensure that all operators know which device(s) are protected by your Shadow safety light curtains and which are not. Though a protected press will stop when the Shadow light curtain is interrupted, associated feeds and conveyors not protected by Shadow will continue to operate after the press stops.

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

The information provided in this chapter is very important for the safety of the personnel operating the equipment protected with a Shadow 10 safety light curtain. Please read this chapter and carefully observe the following safety instructions.

Before using the Shadow 10 safety light curtain, a risk evaluation must be performed according to applicable standards (e.g., EN ISO 12100-1, ISO 13849-1, IEC 61508, EN 62061, ANSI B11, IEC 69496, ISO 13855, OSHA 1910), and applicable regulations and codes. The result of the risk assessment determines the required safety level of the light curtain.

When selecting a Shadow 10 safety light curtain, it must be ensured that its safety-related capability meets or exceeds the required safety level ascertained in the risk assessment.

Proper Application and Use

The Shadow 10 safety light curtains are active optoelectronic protection devices (AOPD) designed to protect people or objects from going into hazardous areas in which they can come in contact with moving parts of machinery or automated systems which present a risk of physical injury or property damage.

The Shadow 10 safety light curtains are designed as Type 4 electro-sensitive protection equipment (ESPE) in accordance with IEC 61496-1 and IEC 61496-2 standards and therefore are suitable for hazardous point protection, hazardous area protection and access protection. See – Compliance, page 101, for certification details.

The Shadow 10 safety light curtain must only be used after it has been selected in accordance with all the applicable national and international standards, rules and regulations regarding labor protection and occupational safety, and after it has been installed, configured and commissioned by qualified personnel and conforming with the procedures described in this manual.

Application Requirements

It must be possible to control the machine stop circuit electrically and the stop time must be known.

- The hazardous moving parts of the machine must always be able to be stopped immediately at any stage of its operation cycle and must achieve a safe position or complete standstill within the specified stop time of the machine.
- Access to hazardous areas must be allowed only through the protective field of the safety light curtain. Additional safeguarding or guards may be necessary to prevent access over, under or around the safety light curtain or from other areas of a particular machine not protected by the safety light curtain.

Application Restrictions

- The protective field of the Shadow 10 safety light curtains is based on infrared technology and cannot detect transparent and/or translucent objects.
- As an AOPD (active optoelectronic protective device), safety light curtains cannot provide protection against objects or materials which may be expelled from the hazardous area.
- The Shadow 10 cannot be used in PSDI mode unless appropriate external safety devices are used and the machine and its control system comply with all the applicable standards and regulations, including requirements for an anti-tiedown mechanism.
- The Shadow 10 safety light curtain cannot be used on mechanical presses with single stroke or full-revolution clutch (see *Application Requirements*, above).

Qualified Personnel

The requisite qualifications for the personnel responsible for the installation, configuration and commissioning include a suitable technical education and the appropriate knowledge of the machine on which the safety light curtain is going to be installed. They must also have been instructed by the responsible person in the operation of the machine and its current safety guidelines.

The qualified personnel also must be acquainted with the applicable regulations for occupational safety, safety at work and safety technology in order to assess the safety of the machine.

A thorough understanding of all safety notes and procedures described in this instruction manual is also part of this competence.

Responsibilities and Liability

Whether a particular installation of a Shadow 10 safety light curtain does in fact meet all applicable requirements depends upon how Shadow 10 heads are applied, installed, commissioned, operated and maintained. These are factors beyond the control of Wintriss Controls Group and therefore, Wintriss Controls Group declines any responsibility in case of faulty installation and/or manipulation of Shadow 10 safety light curtains.

Wintriss Controls Group does not assume responsibility for unauthorized repairs to the Shadow 10 heads or control box under any circumstances.

Every effort has been made to provide complete application, installation, operation and maintenance instructions in this manual. Effective use of this information to provide full compliance with the applicable regulations is the responsibility of the equipment purchaser and/or user.

Shadow 10 and Control Reliability

⚠ WARNING

OBSERVE PROPER INSTALLATION PROCEDURES

- Install Shadow safety light curtains in compliance with applicable OSHA and ANSI safety regulations (extracts are provided in Appendix D).
- Refer to the latest revision of all applicable documents.
- Ensure that your installation meets the control reliability requirements of the applicable regulations.
- Ensure that both optional Shadow control box safety relays are used in any Shadow installation and that they are connected directly to the press control's stop circuit, to a PLC, or to another type of machine control. Wiring is explained in Chapter 2.
- Read carefully and understand the installation instructions before attempting to install and wire Shadows to any control.
- Ensure that installation is performed by qualified personnel.

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

⚠ WARNING

UNPROTECTED EQUIPMENT MAY CONTINUE TO OPERATE AFTER GUARDED PRESS STOPS

Ensure that all operators know which device(s) are protected by your Shadow safety light curtains and which are not. Though a protected press will stop when the Shadow light curtain is interrupted, associated feeds and conveyors not protected by Shadow will continue to operate after the press stops.

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

NOTICE

OSHA and ANSI have issued regulations for the use of presence-sensing devices such as Shadows. Both organizations require control reliability. See *Appendix D* for more information.

Shadow 10 is "control reliable" as defined by OSHA and ANSI. A control-reliable device must be "constructed so that a failure within the system does not prevent the normal stopping action from being applied to the press when required but does prevent the initiation of a successive stroke until the failure is corrected" (OSHA 1910.217 (c) (3) (iii) (c)).

All critical components in Shadow 10 are duplicated so that if one component fails, its duplicate will still allow the guarded machinery to be stopped. When a component failure occurs, Shadow 10 immediately detects it and sends a stop signal to the machinery. The light curtain will not allow equipment to resume operation until repairs are made to the failed component.

The Shadow 10 receiver has two solid-state PNP safety outputs that source 24 Vdc when the sensing field is unobstructed. When an obstruction enters the field, Shadow's circuitry instantly de-energizes the outputs. Safety outputs must be wired to either the optional Shadow 10 control or to a WPC.

The Shadow 10 control has cross-checked "captive contact" safety relays, one N/O (Normally Open), the other either N/O or N/C (Normally Closed). When an obstruction enters the field, Shadow's control circuitry instantly de-energizes the relays, which results in opening the contacts and breaking the stop circuit of the press.

The WPC clutch/brake control also has two "captive-contact" N/O safety relays. When an obstruction enters the sensing field while the machine is energized, WPC instantly de-energizes its relays, stopping the press.

Shadow 10's response time from loss of light to relay contacts open (or de-energized) is listed in Table 10-5, page 95. Even if one of Shadow's control relay contacts fails closed (i.e., the contact welds shut), the second relay will still de-energize and a stop signal will be sent to the machinery. Shadow 10 will also detect the failed relay and will not allow further press operation until the relay is replaced.

Chapter 3 – Product Description

The Shadow 10 series of safety light curtains offer 0.866 in (22 mm) detection capability (DC) and seven protective field heights covering from 300 mm up to 1500 mm, as shown in Table 3-1, below.

A Shadow 10 light curtain system can consist of one to four pairs of transmitter and receiver heads and may include an optional Shadow 10 control box.

- Four pairs of heads may be connected directly to WPC APEX.
- One or two pairs of Shadow 10 heads can be connected directly to a Shadow 10 Control Box or WPC APEX clutch/brake control. To connect more than two pairs of heads to WPC II or WPC 2000, use the optional control box.

Please refer to *Chapter 10 – Technical Specifications*, page 93, for detailed specifications.

Table 3-1. Shadow 10 Protective Field Heights and Part Numbers

Protective Field Heights	Part Number
11.8 in. (300 mm)	9688402
17.7 in. (450 mm)	9688403
23.5 in. (600 mm)	9688404
29.5 in. (750 mm)	9688405
35.4 in. (900 mm)	9688406
47.2 in. (1200 mm)	9688408
59.0 in. (1500 mm)	9688410

Shadow 10 offers the following special features:

- Scan Code (A & B)
- Start and Restart Interlock
- EDM (external device monitoring)
- Fully Monitored Blanking
- Blanking Tolerance, Positive (up to 3 beams)
- Blanking Tolerance, Negative (1 beam)
- Floating Blanking (up to 3 beams)
- Floating Mode

All the special functions can be individually parameterized as required by the application. A complete description of each function is provided in *Special Functions,* page 30.

Operating Principle

The Shadow 10 safety light curtain consists of a transmitter head containing a linear array that emits beams of infrared (IR) light and a receiver head with a complementary array of IR photo-sensors. The IR light beams generated by the transmitter head and received by the receiver head determine a protective field whose coverage is defined by the number of beams and their relative spacing.

The nominal detection capability (DC) of the safety light curtain is defined as the minimum diameter of an opaque object that will be reliably detected. It depends only on the beam lenses geometry and the distance between their optical centers. However, the effective detection capability of a light curtain may increase due to the use of blanking functions (see *Blanking*, page 31 for further information).

Any opaque object of size equal to or greater than the effective detection capability of the light curtain, positioned anywhere within its protective field will be detected causing the light curtain's safety outputs to be deactivated (OFF state).

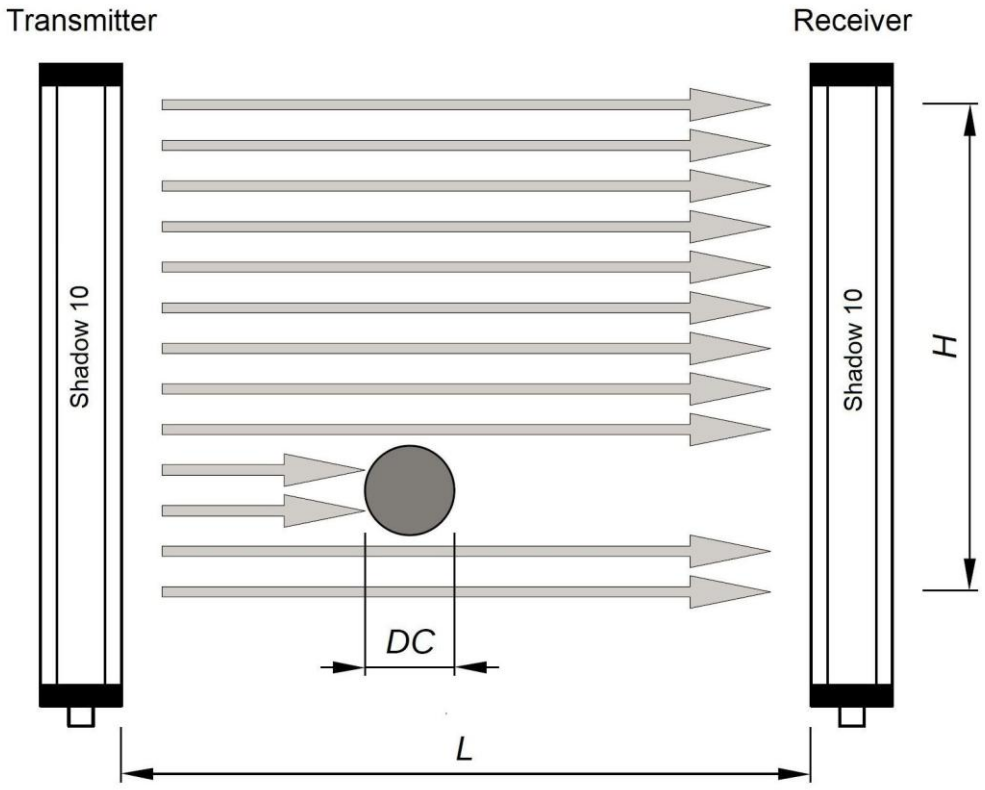


Figure 3-1. Protective Field and Detection Capability

Figure 3-1 shows a conceptual drawing of a safety light curtain system, where DC represents its detection capability, H is the protective field height, and L is the protective field width (or range).

The transmitter and receiver heads are housed inside sturdy extruded aluminum housings. The external connections are easily made through industry standard M12 connectors located at the end of the Shadow 10 heads.

Sync Beam

The Shadow 10 system requires no electrical connection between the transmitter and the receiver heads as the synchronization between them is carried out optically through a dedicated IR beam of the light curtain.

This special beam is named “sync beam” and it is the farthest one from the end that has the status indicators (see next section). For proper operation, this beam must not be obstructed, otherwise, the system will go into OFF state until it is cleared to resume normal operation.

Status Indicators on Shadow 10 Heads

Status indicators on the transmitter and receiver heads provide the operator with information about the current operating status of the Shadow 10 safety light curtain.

The status indicators are located on the front panel of each head and use clearly visible light emitting diodes (LED). The function of each indicator is clearly identified by using different colors and blinking patterns.

NOTICE

TAKE NOTE OF THIS LABEL ON TRANSMITTER HEADS

The transmitter head Is labeled “EMITTER” near the status indicators. See Figure 3-2

The terms “transmitter” and “emitter” are used interchangeably in this manual.

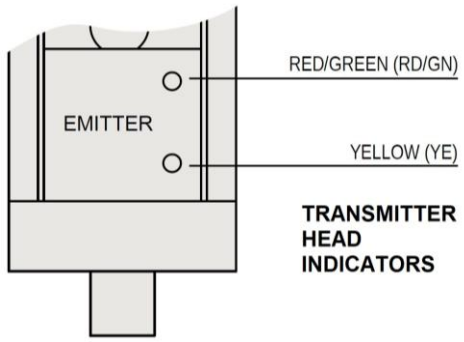


Figure 3-2. Transmitter Head Indicators

NOTICE

The Shadow 10 heads are designed to offer an optimal visibility of the status indicators when the transmitter and receiver heads are mounted to the left-hand side and to the right-hand side of the operator, respectively.

Receiver Head Indicators

The indicator panel of the receiver heads consists of three visible status indicators and a seven-segment display, as shown on the following illustration.

NOTICE

TAKE NOTE OF THIS LABEL ON RECEIVER HEADS

The receiver head ls labeled “DETECTOR” above the seven-segment display, near the status indicators. See Figure 3-3. The terms “receiver” and “detector” are used interchangeably in this manual.

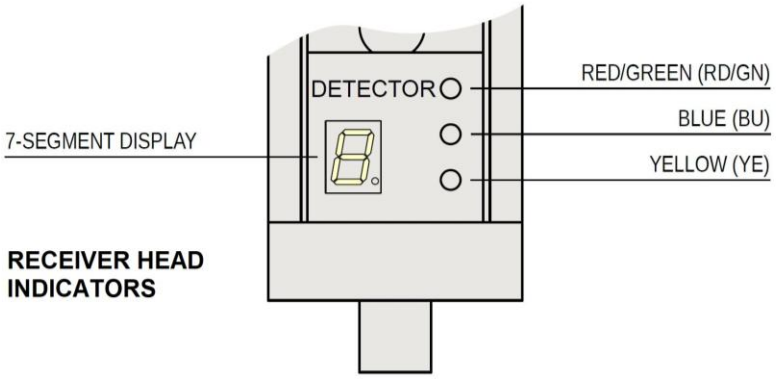


Figure 3-3. Receiver Head Indicators

The topmost indicator (RD/GN) is a bi-color LED that provides visual feedback of the status of the safety outputs. This indicator will light in green (GN) only when both OSSD (output signal switching device) output channels are activated (ON state). Otherwise, it will stay lit in red (RD). Since this indicator is always lit (in either color), it also serves as a power-on indicator.

The yellow LED (YE) will illuminate constantly when in lock-out condition, or it will flash if any of the interlock functions (start interlock or restart interlock) is engaged, thus indicating a reset signal request. Once the reset signal has been asserted and the system has resumed its normal operation, it will turn off.

The blue (BU) LED is constantly lit when a blanking function (of any type) is active.

The seven-segment display is used to show supplementary status information, when required. During normal operation, it is turned off. The most common status codes are shown on Table 3-2. Additional codes can be displayed in lock-out or system error conditions (please refer to *Troubleshooting*, page 89, for further information on fault diagnosis).

Table 3-2. Display Codes

Display	Meaning
-	Operation with scan code A (shown for 1 s after the start-up lamp test)
-	Operation with scan code B (shown for 1 s after the start-up lamp test)
=	Sync beam obstructed, misaligned or wrong scan code
b	Blanking not satisfied.
P	Parameterization mode
o	Override mode
t	Teach-in mode
C	Clearing mode
dc22	Effective detection capability, mm (see below)

Immediately after switching on the power supply, a special symbol is shown on the display to indicate the scan code in use (see table above).

After this symbol, the display shows the effective detection capability of the system (in mm) for the current parameterization settings. The digits are shown in sequence, preceded by the letters DC. For the Shadow 10 effective detection capability of 22 mm (0.866 in) the display shows dc22. This value can vary when blanking is enabled. For additional information on how parameterization may affect effective detection capability please see *Blanking Tolerance*, page 36 and *Floating Blanking (Reduced Resolution)*, page 38.

Pressing and holding the FCN button at this time will cause all the LEDs on the display panel to be lit in sequence so that a defective LED can be easily spotted.

Transmitter Heads Indicators

The operating status of the transmitter heads is shown through the two visible LED indicators located at the bottom of the heads, as shown in *Figure 3-2. Transmitter Head Indicators*, page 25.

The indicator at the top (RD/GN) is a bi-color LED that constantly lights in green (GN) when the This transmitter head is working normally, and it changes to red (RD) when the transmitter head is set on test mode or during lock-out conditions). Since this indicator is always lit (in either color), it also serves as a power-on indicator.

The yellow indicator (YE) will illuminate constantly when an error or lock-out condition is detected in the transmitter head. Under normal operating conditions, this indicator is turned off.

Immediately after switching on the power supply, both indicators will illuminate briefly (the first in red) and then the first LED will turn green while the yellow turns off. Before going to constant illumination, the green LED will blink once or twice to indicate which scan code is in use (one blink

means code A, two blinks means code B). This illumination pattern will also help to spot a faulty LED.

Beam Status Indicators

A distinctive feature of the Shadow 10 safety light curtains is that each infrared beam has its own status indicator on the receiver heads. The indicator consist of a red LED at the left side of each lens.

During normal operation, each status indicator will illuminate when its respective infrared beam is blocked, providing the machine operator with a clear indication of the location of the obstruction within the protective field.

When using the fixed blanking functions the status indicators will also blink to indicate current blanking conditions. Further details on the operation of blanking mode indicators are provided in *Blanking*, page 31.

⚠ DANGER

Beam status indicators are not safety-related and are only provided for convenience during alignment and blanking operations. Always check the protective field with a 22 mm (0.866 in.) test rod to make sure the light curtain is properly configured. See *Daily Functional Test*, page 86.

Optional Control Box

An optional Shadow 10 control box is available, Figure 3-4.

It is a compact, programmable safety controller pre-configured by Wintriss for optimal integration with Shadow 10 systems. Each light curtain head is connected to an individual input on the controller, allowing for parallel operation. This design improves system responsiveness and simplifies troubleshooting.

Use the optional control box unless you are connecting Shadow 10 to a Wintriss clutch/brake control. The optional Shadow 10 control can accommodate all sizes of transmitter and receiver heads. No special settings are required. The optional Shadow 10 control contains a power supply and relay circuitry.

For added security, the optional Shadow 10 control comes standard with a mode key-switch. The Program/Run mode key-switch is used alone to reset the light curtain after machinery has been stopped due to a fault. The Program/Run mode key-switch is also used in programming Shadow 10 functions.

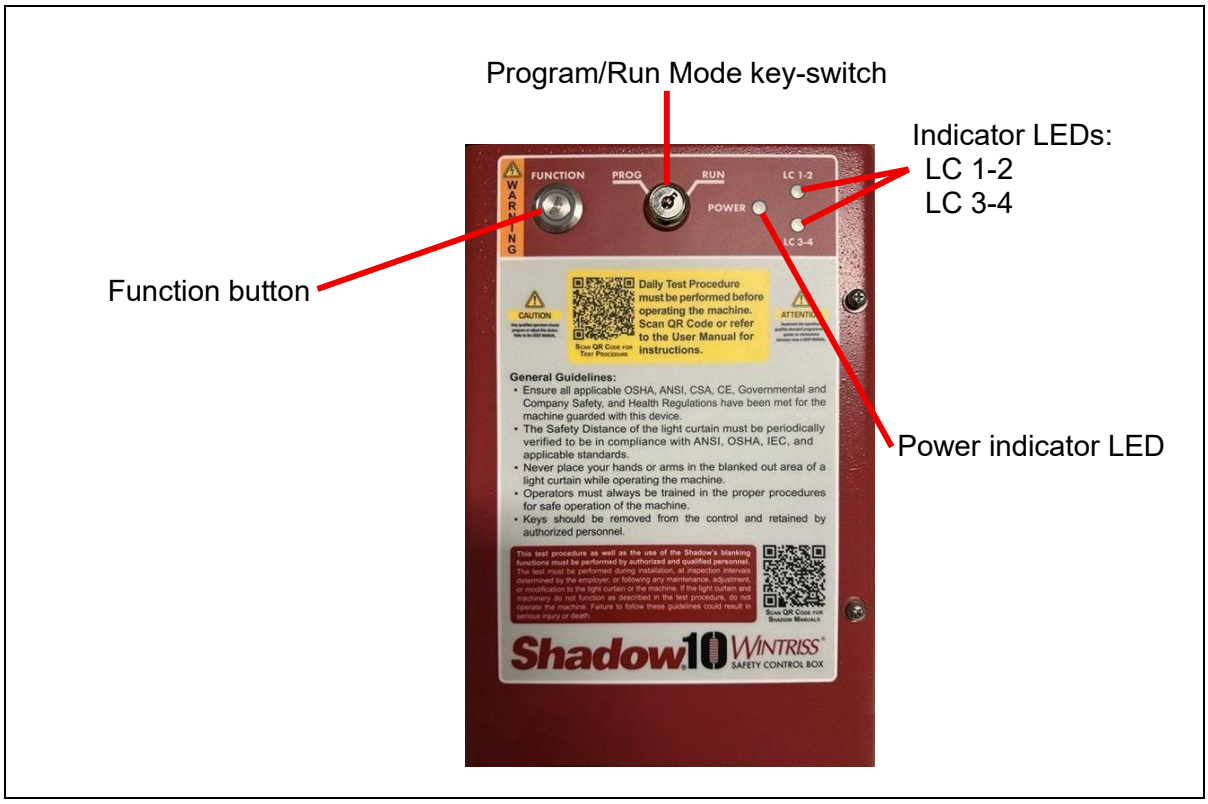


Figure 3-4. Optional Shadow 10 Control Box

Status indicator LEDS on the optional Shadow 10 control box, Figure 3-4:

Power LED

The green Power LED on the optional Shadow 10 control box illuminates when power is applied to the unit.

Safety relay LEDs

The two green LEDs labelled “LC 1-2” and “LC 3-4” illuminate to indicate that the safety relays are energized (closed). When the safety relays are deenergized (open), these two LEDs turn off.

Switches on the optional Shadow 10 control box, Figure 3-4:

Function button

Press this button as part of programming processes to initiate blanking setup and other programmable parameters..

Mode key-switch (Program/Run)

This key-switch changes between Program and Run modes.

Output Options

The Shadow 10 optional controller box is available in two output configurations:

- 9688603 - 24VDC OSSD Output: Standard configuration, fully compatible with Wintriss WPC 1000/2000 controllers and most modern safety circuits.
- 9688604 - 120VAC OSSD Output: Available via an alternate version of the controller for compatibility with older or legacy equipment requiring higher voltage output signals.

Special Functions

This section describes the special functions available in the Shadow 10 series of safety light curtains.

All the special functions can be individually parameterized, as needed by your application. Please refer to *Chapter 5 – Parameterization*, page 73, for a detailed description of the parameterization procedure.

Start and Restart Interlocks

The start interlock function is intended to hold the OSSD outputs into the OFF state after a power up, even if the protective field is clear. This feature's main application is to prevent the unexpected start-up of the protected machine after a power outage or power cycle.

⚠ DANGER

It is mandatory to use the start interlock function whenever it is possible to stand, walk or slip behind the safety light curtain.

The restart interlock function is intended to hold the OSSD outputs into the OFF state after an interruption of the protective field, preventing the automatic restarting of the machine when the protective field is cleared.

Once any of the interlock functions has been engaged, the situation is signaled by blinking of the yellow LED on the receiver head (see *Receiver Head Indicators*, page 25) and the OSSD outputs will not be switched back to the ON state until actuation of the RST/EDM input through a supervisory key-switch, which is a normally closed momentary key-switch provided by the user. A momentary key-switch is recommended, but you could also use a normally closed momentary push button switch.

In order to reset an engaged interlock (any type), the protective field must be clear, otherwise the reset action/s will be ignored.

⚠ DANGER

The supervisory key-switch described above (or any other means to release the interlock) must be installed in a location that provides a clear view of the hazardous zone and must not be able to be operated from within the hazardous zone.

Figure 3-5 shows a simplified timing diagram for the start and restart interlock functions. The duration of the reset pulse (t_R) shall be at least 0.5 second and no more than 5 seconds. Shorter pulses will be ignored and pulses longer than the maximum value will cause the receiver head to enter into lockout state.

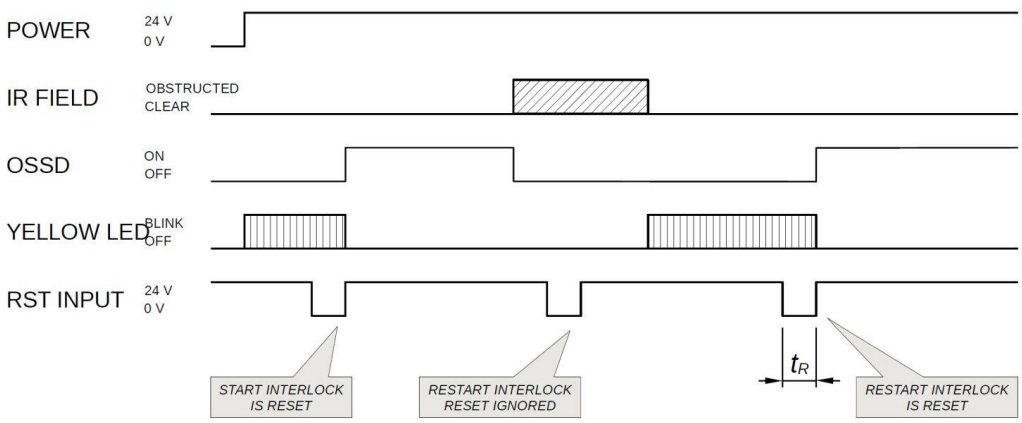


Figure 3-5. Interlock Function Timing Diagram

Both interlock functions are disabled by default when the system is delivered. If an interlock function is required, it should be enabled through the parameterization procedure (see *Parameter* Code 2: Interlock function, page 79).

The electrical connections for the interlock reset input are described in section *Receiver Head Wiring Diagrams*, page 59.

Blanking

⚠ DANGER

OBSERVE CORRECT SAFETY DISTANCE WHEN USING BLANKING WINDOWS

- Ensure that the correct safety distance exists between the light curtain and the hazardous area. See *Safety Distance*, page 42,for detailed information on object sensitivity, depth penetration factor, and OSHA and ANSI safety distance formulas.
- Add to the calculated safety distance as needed when using blanking windows. Refer to pages 36-38.
- When more than one beam is programmed as a fixed blanking window, and the blanked area is not completely obstructed, the depth penetration factor is at least 36 in. (0.91 m).
- You do not have to change the safety distance if the blanked area is entirely blocked by a fixture from the transmitter to the receiver so that operator intrusion into this area is impossible.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

PREVENT UNAUTHORIZED PERSONNEL FROM PROGRAMMING FIXED BLANKING WINDOWS

A method of supervisory control, such as use of a key switch, must be employed to limit access to Shadow 10's programmable fixed blanking feature so that only a qualified person is able to program a fixed blanking window.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

ENSURE THAT FIXED AND FLOATING BLANKING FUNCTIONS ARE USED CORRECTLY

When the fixed blanking function is used, observe the following. Failure to do so may cause a person to go undetected, resulting in serious injury.

- A responsible person must verify that a test rod is detected for all detection zones except the blanked area.
- When the fixed blanking function is used, install a protective structure to cover the whole blanked area in order to prevent access to the hazardous area through the blanked area.

Perform an inspection for all pairs of Shadow 10 heads, according to the checkout procedure in the Commissioning chapter.

Failure to comply with these instructions will result in death or serious injury.

The blanking function allows an object of a size greater than the detection capability of the safety light curtain to be inside the protective field without switching off the safety outputs of the ESPE (electro-sensitive protection equipment).

The intended uses of this function are those applications where a machinery part is required to be present in the protective field without impairing the manufacturing process or the functionality of the machine.

⚠ DANGER

The operation principle of the blanking function implies the deactivation of a specific zone of the detection area, effectively creating a “hole” in the protective field. Therefore, a thorough risk analysis must be carried out to determine whether the use of the blanking function is actually needed and is in compliance with OSHA and ANSI standards, as well as any other applicable requirements.

In order to cope with the constraints of particular applications, the Shadow 10 system offers two different blanking modes:

A) fixed monitored blanking

B) floating blanking.

Each blanking mode can be independently configured through the parameterization procedure (see *Chapter 5 – Parameterization*, page 73, for further details).

Special Considerations

The following operating and safety considerations must be taken into account when using the blanking function:

- For all blanking modes, the sync beam must be excluded from the blanking pattern (see *Sync Beam*, page 25, for details on the sync beam).
- Blanking modes can be combined as needed.

⚠ DANGER

When using the blanking function, the objects in the blanked areas must extend across the dangerous zone of the protective field or must be appropriately extended by mechanical barriers so that nothing can enter from the sides. Otherwise, the safety distance must be re-calculated according to the effective device resolution resulting from the activation of the blanking function.

⚠ DANGER

After changes in the blanking configuration the protective function has to be verified by following the procedure indicated in *Daily Functional Test*, page 86. Careful risk analysis might be required when the blanked objects contain highly reflective surfaces (see ***Reflective Surfaces***, page 48)

Fixed Fully Monitored Blanking

⚠ WARNING

DO NOT CREATE A FIXED BLANKING WINDOW GREATER THAN ONE BEAM UNLESS THE ENTIRE AREA BETWEEN TRANSMITTER AND RECEIVER IS OBSTRUCTED

Do not blank more than one beam unless the entire area between transmitter and receiver is blocked by a permanent fixture or is guarded.

Failure to comply with these instructions will result in death or serious injury.

The fixed blanking allows an object of a fixed size to be located at a specific position in the protective field without deactivating the safety outputs of the light curtain.

The actual size and position of the object are continuously monitored and, as soon as these parameters differ from the programmed values (if the object is moved or removed) the safety outputs of the light curtain will be immediately deactivated (OFF state).

This blanking mode is intended to allow a fixed part of the machinery (e.g. part feeder, support arm, conveyor, etc.) to be present within the protective field without impairing the operation of the machine.

When the blanking conditions are satisfied, the status indicators of the blanked beams will be immediately turned off to confirm to the operator that the blanked object is properly positioned and, if the object remains stable for more than 60 s, the indicators will begin to blink slowly to indicate the blanked area. On the contrary, when the blanked object is not present or it is improperly positioned, the indicators of the blanked beams will blink fast in order to turn the operator's attention to the location of the misplaced object. Also, the 7-segment display on the receiver head will show the letter ‘ b ‘ (which stands for “blanking”).

The desired blanking pattern is easily defined through a simple teach-in procedure, as explained in *Teach-in Procedure for Fixed Fully* Monitored Blanking, page 34.

Beam Percentage Setting for Blanking

Sometimes there may be misalignment at the bottom part of the light curtains and the operator may want to blank (teach) the misalignment part to allow the press to run. Disabling the fully monitored blanking feature by default would prevent this situation.

You set this with Parameter Code 4. For details on setting this parameter, see *Parameter Code 4: Percent Beam Blanked Settings*, page 80, and *Setting Parameters for a Light Curtain*, page 76.

Table 3-3 shows the number of beams for each percentage for the different sizes of light curtains.

Table 3-3. Teaching Max Beams Percentages Based on Light Curtain Model

	LC height (mm)						
	300	450	600	750	900	1200	1500
Percentage	Count of max teaching beams						
25%	5	7	10	12	15	20	25
50%	10	15	20	25	30	40	50
100%*	20	30	40	50	60	80	100

*In the case of 100%, the maximum count will be one beam less.

Teach-in Procedure for Fixed Fully Monitored Blanking

The programming of fixed blanking is easily carried out by placing the object to be blanked at the desired position within the protective field and then following a simple teach-in procedure.

⚠ DANGER

BLANKING CHANGES DETECTION CAPABILITY

A teach-in procedure changes the size and/or position of the blanked areas and their tolerance beams, hence changes the effective detection capability of the light curtain. The teach-in procedure shall be carried out by qualified personnel only. It is the responsibility of the supervisor to give access to the keys for the mode key-switch only to authorized personnel.

Failure to comply with these instructions will result in death or serious injury.

Make sure that the objects to be blanked are firmly secured at the desired position before starting the teach-in procedure. Then, complete the teach-in process by operating the mode key-switch (PROG/RUN) and the FCN button according to the following sequence:

Pre-Programming

For the light curtain you want to program, if you are using the optional Shadow 10 control box, move the corresponding jumper (JP 3 - 6) from Disable to Enable. See *Preparing for Parameterization with Optional Shadow 10 Control Box*, page 74.

If you are using a Teach Tool, connect it as shown in *Preparing for Parameterization Using a Teach Tool*, page 75.

Setting Blanking Configuration

1. Make sure the object to be blanked is at the desired position within the protective field and that it is firmly secured. Beam status indicators, Figure 3-6, will show and confirm the position of the object.

Figure 3-6. Beam Status Indicators

2. Turn the key-switch to PROG and press the Function button 3 times.
   Flashing “t” will be shown on the display until the button is pressed 3 times.
   Solid “t” will be shown on the display after the button is pressed 3 times, indicating the system is ready to be programmed.

NOTICE
“t” is T for Teach mode. After 1 minute of inactivity the flashing “t” times out and the display shows a 3.

3. Turn the key-switch back to RUN. The display will be OFF when the object is located in its proper position. Solid “b” will be shown on the display if the object is not in position. At the same time, the beam status indicators will be flashing quickly when the object is in the expected position.

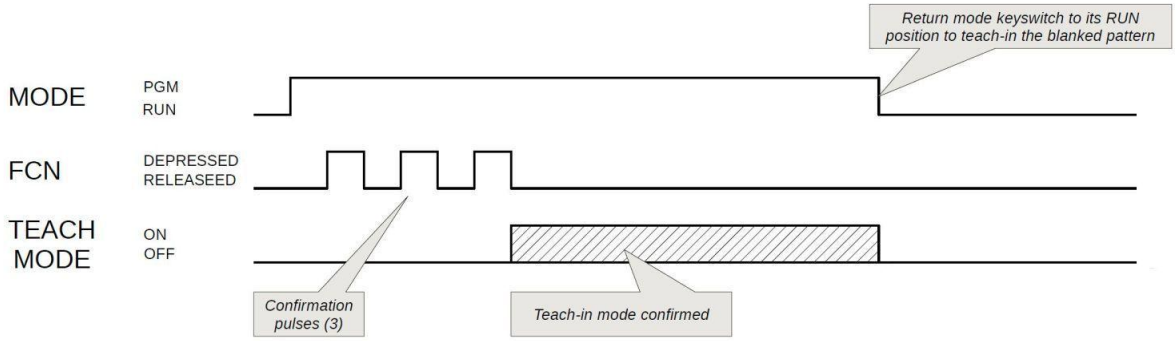


Figure 3-7. Teach-in Sequence

If the teach-in procedure is completed successfully, and depending on whether the restart interlock function is disabled or not, the OSSD outputs are switched on automatically.

If the teach-in sequence is not started properly (either because the push-button pulses do not meet the timing requirements or because they were not applied within the time-out period), the teach-in initiation will be ignored. The same applies if the teaching process is not completed within one minute after entering teach-in mode. In both cases, the ' ' on the display is turned off and the Shadow 10 resumes its normal operation.

To delete a fixed blanking pattern, simply repeat the teach-in procedure for the fixed blanking you want to remove, making sure that the protective field is completely free of obstructions before returning the mode key-switch to its RUN position.

Alternatively, you can also delete all blanking zones simultaneously from the teach-in mode by pressing the FCN button for more than 3 seconds until the yellow LED starts blinking and then, pressing and holding the FCN button, exit teach-in mode by moving the key-switch to its RUN position. If the FCN button is released before you leave the teach-in mode, the yellow LED goes out and the delete operation is cancelled.

⚠ DANGER

The mode key-switch (PROG/RUN) must be installed in a location that provides a clear view of the hazardous zone and must be ensured that it cannot be operated from within the hazardous zone.

NOTICE

Even though the teach-in cancels itself after the time-out period, make sure to return the mode key-switch to its RUN position and remove the key after completing the teach-in procedure. Otherwise, if the key-switch is left on its PGM position for more than one minute, the Shadow 10 will enter into lock-out state.

Teach-in Considerations

The following considerations must be taken into account during the teaching-in of fixed blanking patterns:

- For all use cases, the teach-in of a new fixed blanking pattern overwrites any previously taught-in blanking pattern of its same type.
- Blanking tolerances (see *Blanking Tolerance*, page 36) do not apply for the teach-in procedures. The size of the obstruction patterns detected during the teach-in are assumed as nominal.
- The teaching-in or clearing of any fixed blanking does not affect the current configuration of the floating blanking function. For further information on floating blanking please refer to *Floating Blanking (Reduced Resolution)*, page 38.

Blanking Tolerance

In some applications, the blanked object cannot be precisely positioned due to vibration, poor handling or physical limitations (e.g. flexing and twisting in large objects), causing size discrepancies in the sensed pattern.

For these cases, the Shadow 10 can assign a blanking tolerance at each end of a fixed blanking pattern.

NOTICE

The factory setting (default) for blanking tolerance is + 1 beam. You can disable or change this setting in parameterization. See the appropriate section: *Parameter Code 6: Fixed* Blanking Tolerance, Positive, page 81, *Parameter Code 7: Fixed Blanking Tolerance, Negative*, page 81, and *Parameter Code 8: Floating Blanking*, page 81.

The use of blanking tolerance inevitably implies an increase in detection capability at the edges of the blanked object. However, the detection capability at the other areas of the protected field remains unchanged.

The blanking tolerance can be selected between two possible types: plus and/or minus. When plus tolerance is selected, the blanked object is only allowed to block one (or more) extra beam(s) ,

whereas the minus tolerance only allows the object to block one beam fewer. The bilateral tolerance allows both discrepancies to occur at the same time.

NOTICE

For blanked objects located at the ends of the head, positive tolerances that fall outside the protective field will be ignored and will not restrict the values for positive tolerances inside the protective field.

The illustration below (Figure 3-8) shows an example of beam allowances for a blanked object with +1, −1 and ±1 beam tolerances:

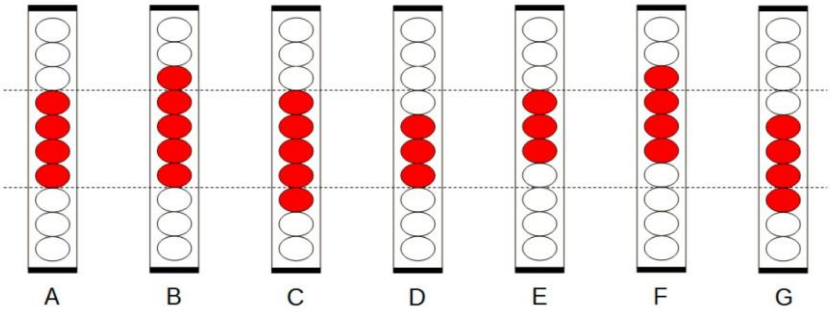


Figure 3-8. Beam Tolerance Examples

In the examples shown above, the A represents the nominal obstruction pattern of a blanked object blocking four beams. Examples B and C show the allowed obstruction pattern for the same object when subject to a beam tolerance of +1 beam, and examples D and E show the allowed obstruction pattern when the same object is subject to a tolerance of −1 beam.

If a tolerance of ±1 beam is applied to the same object, then all the obstruction patterns in the examples (A, B, C, D, E, F and G) are allowed. Examples F and G depict a particular case in which the object uses both tolerances (plus and minus) at the same time (object is shifted one beam)

⚠ DANGER

INCREASE SAFETY DISTANCE WHEN BLANKING IS IN USE

When using tolerance with the fixed monitored blanking, the effective detection capability is increased at the edges of the blanked areas, and hence the safety distance must also be increased. The safety distance must be re-calculated according to the effective detection capability for the tolerance type used (as shown on Table 3-4) and the safety light curtain must be repositioned accordingly.

Failure to set up and maintain the minimum safety distance may result in serious injury or death.

Table 3-4. Effective Detection Capability with Blanking Tolerance

Nominal detection capability is 0.866 in. (22 mm)	
Tolerance, [beams]	Effective detection capability for fixed blanking with tolerance
−1	1.2 in. (30 mm)
+1	1.2 in. (30 mm)
+2	1.8 in.(45 mm)
+3	2.4 in.(60 mm)
±1	1.8 in. (45 mm)
−1/+2	2.4 in. (60 mm)
−1/+3	3.0 in.(75 mm)

The value of positive and negative tolerances can be chosen independently through the parameterization procedure, as described in sections *Parameter Code 6: Fixed* Blanking Tolerance, Positive, page 81, and *Parameter Code 7: Fixed Blanking Tolerance, Negative*, page 81.

During the setup, the user can choose any tolerance value that best suits its application needs. However, when the free areas between two adjacent blanking areas are not large enough to fit the requested tolerance, the actual positive tolerance in those areas will be automatically reduced to ensure the minimum separation of the blanked areas without affecting the tolerances on other parts of the protective field.

Floating Blanking (Reduced Resolution)

⚠ DANGER

OBSERVE CORRECT SAFETY DISTANCE WHEN USING FLOATING WINDOW

- Ensure that the correct safety distance exists between the light curtain and the hazardous area. See *Safety Distance*, page 42, for information on object sensitivity, depth penetration factor, and OSHA and ANSI safety distance formulas.
- Add to the calculated safety distance as needed when using blanking windows. Refer to pages 36-38.
- Place the ability to set floating blanking windows under supervisory control to avoid unauthorized usage.

Failure to comply with these instructions will result in death or serious injury.

The floating blanking mode allows a single (or multiple) object(s) of a defined maximum size to enter and move within the protective field without switching off the safety outputs of the light curtain. For example, a hose may enter and exit the protective field.

This feature can be useful in those applications where it is necessary that a small object(s) can enter, leave, and move freely within the protective field during the operation cycle of the machine (e.g. hanging hoses, moving machinery parts, etc.).

When using the floating blanking function, the effective detection capability of the AOPD is increased according to the number of floating beams, as shown in Table 3-5. However, the effective detection capability is not affected by the number of floating objects.

⚠ DANGER

INCREASE SAFETY DISTANCE WHEN FLOATING BLANKING IS IN USE

The floating blanking mode effectively increases the detection capability of the AOPD, and hence the safety distance must also be increased. The safety distance must be re-calculated according to the actual detection capability resulting from the activation of this function and the safety light curtain must be repositioned accordingly.

Failure to set up and maintain the minimum safety distance may result in serious injury or death.

Floating objects can touch the edges of a fixed blanked object as long as this overlap does not cause the effective detection capability to exceed the value indicated in Table 3-4 and Table 3-5; otherwise, the OSSDs will be immediately deactivated.

If an object is required to float freely along the entire protective field without deactivating the OSSD, its size shall be equal or smaller than the maximum object size shown in Table 3-5. Object sizes larger than indicated could also be moved freely without deactivating the OSSDs, but this is not guaranteed.

Table 3-5. Effective Detection Capability and Maximum Object Size for Floating Blanking

Nominal Detection Capability = 0.866 in. (22 mm)		Effective Detection Capability in. (mm)	Maximum Object Size in. (mm)
Number of floating beams	1	1.5 (38)	0.6 (14)
	2	2.0 (52)	1.2 (30)
	3	2.7 (68)	1.8 (45)

The configuration of the floating blanking mode, i.e. the maximum object size and the number of blanked objects allowed (single or multiple) is independent of the configuration of the fixed blanking and it can be carried out through the parameterization procedure, as explained in *Parameter Code 8: Floating Blanking*, page 81, and *Parameter Code 9: Floating* Mode, page 82.

Chapter 4 – Installation

⚠ DANGER

OBSERVE PROPER INSTALLATION, OPERATION, AND MAINTENANCE PROCEDURES

- Follow all procedures in this manual to ensure proper operation of the light curtain.
- Ensure that the light curtain is installed so it is impossible for anyone to reach over, under, or around it and into the hazardous area of the machine without being detected. Use a light curtain of the correct height in combination with physical guards. See Figure 4-4, page48.
- Ensure that the operator cannot position himself or herself between the light curtain and the hazardous area. Use another pair of light curtains or a mechanical barrier at knee to waist height to prevent the operator or a passerby from being “trapped” between the light curtain and the hazard.
- Install and maintain your machine guarding system according to OSHA standard 1910.212 and any other regulations and standards that apply.
- Wire and install Shadow 10 safety light curtains in accordance with the requirements of OSHA lockout/tagout regulation 1910.147.
- Ensure that Shadow 10 safety light curtains are installed, tested and repaired by a qualified person. Only a qualified person should possess keys, special tools, or other means needed to gain access to the control and modify the configuration of the Shadow light curtain.
- Perform only the tests and repairs listed in this manual.
- Test the operation of your Shadow safety light curtain, using the test procedure shown on the Shadow safety light curtain control box and also included in this manual (see page 94).
- Perform the checkout and test procedures after any maintenance is done on the Shadow safety light curtain.
- Ensure that supervisors, die-setters, maintenance persons, machine operators, foremen, or any other individuals responsible for the proper operation of the machinery have read and understood all instructions in this manual pertaining to the use of Shadow 10 safety light curtains.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

MAKE SURE TO PERFORM SAFETY SYSTEM TESTS

- Perform the checkout and test procedures (see page 94) when you have completed installation of your light curtain and before operating the equipment it is connected to.
- Operate your machinery only after your safety system meets all the requirements of the checkout sequence.
- Perform the test procedure whenever repair, maintenance or modification is performed on your light curtain or the machinery it is connected to.

Failure to comply with these instructions will result in death or serious injury.

⚠ WARNING

GUARD AGAINST ELECTRIC SHOCK HAZARD

- Turn off and disconnect power from the Shadow 10 safety light curtain and from the machinery it is connected to, including the machine control and motor, before making any wiring connections.
- Remove all fuses and “tag out” per OSHA 1910.147 Control of Hazardous Energy (Lockout/Tagout).
- Ensure that installation is performed by qualified personnel.

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

This chapter provides important information on the installation of the Shadow 10 safety light curtain. The installation procedures include the determination of the safety distance, the mechanical mounting and the electrical connections.

NOTICE

Refer to the current versions of relevant OSHA Regulations and ANSI Standards. Appendix D, page 103, contains extracts for reference only from OSHA Regulation 1910.217 and ANSI Standards for Presence-sensing Devices.

Safety Distance

⚠ DANGER

OBSERVE THE CORRECT SAFETY DISTANCE

- Calculate the safety distance carefully, following the instructions below, and mount your light curtain heads at least the calculated distance from the hazardous area.
- Mount your light curtain heads at least 4 in. (100 mm) from the hazardous area regardless of the calculated safety distance.
- Be sure your value for Ts (overall stopping time) includes the response times of all devices that react to stop the press. If your measurement of stop time does not include response time of the press control, light curtain, and any other devices that react to stop the press, the safety distance will be too short.
- Enabling floating blanking increases the depth penetration factor (Dpf) and, therefore, will increase your safety distance. Enabling fixed blanking may also increase Dpf and safety distance.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

OBSERVE CORRECT SAFETY DISTANCE WHEN USING FIXED OR FLOATING BLANKING

- Read pages 36-39 before calculating the safety distance. This section explains how to modify the safety distance when you use programmable fixed blanking or floating blanking windows.
- Modify the calculated safety distance as required.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

ADJUST SAFETY DISTANCE TO COMPENSATE FOR LONGER RESPONSE TIME

Determine which model Shadow 10 safety light curtains you have, and use the correct response time for your model light curtain, as shown in Table 10-5, page 95, in your safety distance calculations. If you are using the optional Shadow 10 control, add 10 ms to these response times for N/O safety relay connections, 20 ms for N/C relay connections.

Safety depends on your installing your light curtain at the correct safety distance from the hazardous area.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

USE BRAKE MONITOR TO CHECK STOPPING TIME

Use a brake monitor where a Shadow 10 light curtain is installed to protect operators whose hands are routinely exposed to a hazardous area, as required by OSHA 1910.217 (c) (3) (5). A brake monitor continually checks that the machine's stopping time does not exceed a predetermined limit.

Failure to comply with these instructions will result in death or serious injury.

NOTICE

Wintriss recommends that you use the American National Standards Institute (ANSI) formula for calculating safety distance because it contains more factors, allowing you to calculate the safety distance more precisely. The ANSI formula is covered in the extracts in Appendix D.

Safety light curtains can only fulfil their protective function if they are installed to the correct safety distance (S) from the hazardous point. This safety distance ensures that a person cannot reach the hazard point until the motion of the hazardous parts of the machinery have been completely stopped.

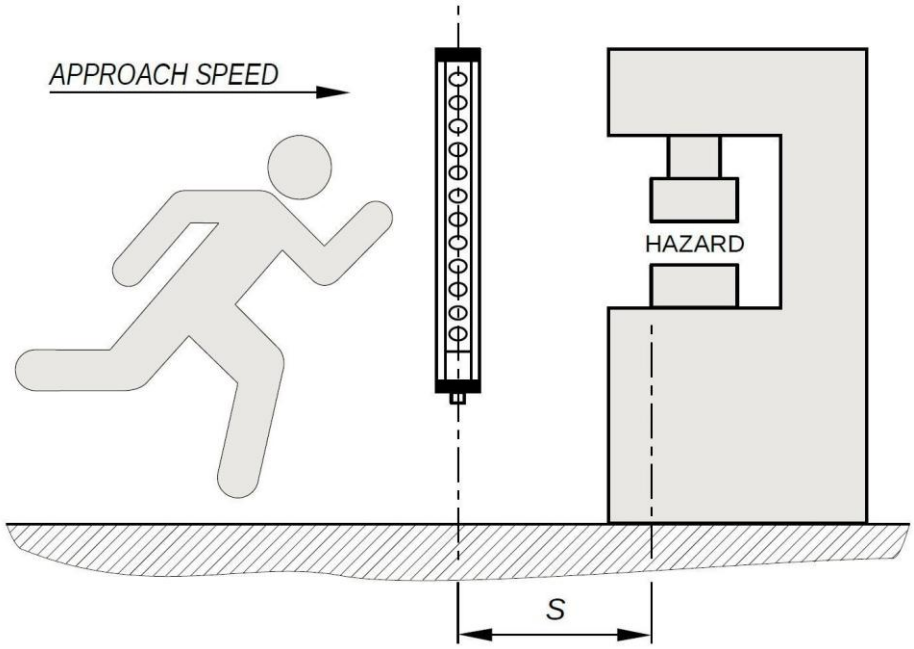


Figure 4-1. Safety Distance

In general terms, the safety distance for safety light curtains depends on the following factors:

- Approach speed to the detection zone of the object requiring detection (e.g. body or parts of the body)
- Overall stopping response time of the system, from the initial event leading to the activation of the safety light curtain to the full stop of the machine. This time includes the machine's stopping time, the AOPD's response time and the response times of all relevant control elements (e.g. safety relays).
- Effective detection capability of the safety light curtain.
- Other parameters specified by the applicable standards depending on the particular application.

The minimal required safety distance as well as the specific procedures for its determination vary according to the type of protection and the standards and regulations of the country in which the system is installed.

⚠ DANGER

SAFETY DISTANCE MUST COMPLY WITH REGULATIONS

Make sure that the safety distance between the Shadow 10 safety light curtain and the hazardous point complies with all the applicable regulations. Failure to set up and maintain the minimum safety distance may result in serious injury or death.

Failure to comply with these instructions will result in death or serious injury.

The following sections give calculation guidelines for determining the safety distance according to common standards.

When using special functions such as fixed blanking with tolerance or floating blanking, the effective detection capability of the AOPD is increased, hence the safety distance must also be increased. Always use the effective detection capability when calculating the safety distance!

Safety Distance According to ISO 13855 for Hazard Point Safeguarding

For hazard point safeguarding (i.e. the protective field is perpendicular to the approach direction), the safety distance can be determined using the following formula:

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

where:

S: Safety distance, in mm. The minimum allowable distance is 100 mm (or 157 mm for non industrial applications), regardless of calculated value.

K: Approach speed to the detection zone in mm/s. It is assumed as being 2000 mm/s. If the resulting value for S is greater than 500 mm, then the calculation is repeated with a reduced speed value of 5.2 ft/s (1600 mm/s), provided that the result cannot be lower than 500 mm.

Ts: Overall stopping response time of the machine, in s.

C: Extra distance margin, in mm, dependent of the effective detection capability of the AOPD. For devices with an effective detection capability d ≤ 40 mm, $C = 8 \cdot (d - 14)$, where d is the effective detection capability of the device.

Example:

Consider a system with a total stopping time Ts = 0.1 s and an effective detection capability d = 22 mm.

$$C=8\times(d-14)=8\times(22-14)=64mm$$

Therefore, using K = 2000 mm/s

$$S=(K\times Ts)+C=(2000\times 0.1)+64=264mm$$

Safety Distance According to ISO 13855 for Danger Area Safeguarding

For safeguarding of danger areas (i.e. the approach direction is coplanar with the protective field), the minimum safety distance can be determined using the following formula:

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

where:

S: Safety distance, in mm, from the hazard zone's front edge to the furthest beam of the protective field. The effective detection capability at the end of the column must be added to the calculated safety distance to compensate for the actual position of the switch point

K: Approach speed to the detection zone in mm/s. The standard establishes a value of 5.2 ft/s (1600 mm/s).

Ts: Overall stopping response time of the system, in s.

C: Additional distance margin, in mm. This parameter depends on the installation height H and it is defined as C = 1200 – (0.4 · H). It cannot be less than 33.1 in. (850 mm) (arm length), regardless of the calculated value.

H: Installation height of the protective field above the reference plane (e.g. floor), in mm. The maximum allowed height is 39.4 in. (1000 mm). The minimum height must satisfy the following relationship: H [mm] ≥ 15·(d − 50 [mm], where d is the effective detection capability of the AOPD. However, special precautions must be taken when the installation height exceeds 300 mm, because of the risk of crawling or slipping beneath the protective field.

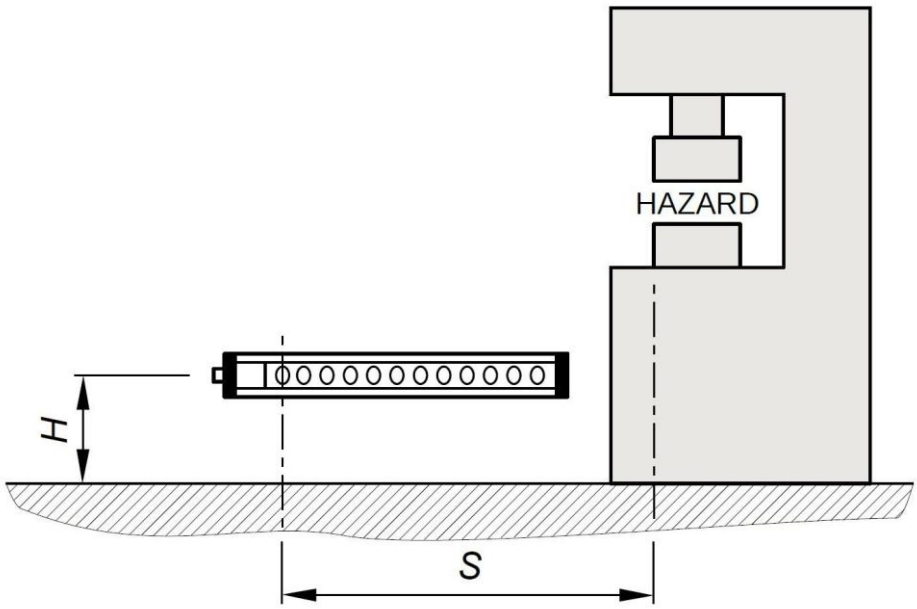


Figure 4-2. Danger Area Safeguarding

Example:

Calculate the minimum safety distance and the maximum mounting clearance from the danger area for a safety light curtain with an effective detection capability d = 82 mm and an overall system stopping time Ts = 0.1 s

Minimum installation height:

$$H=15\times(d-50)=15\times(82-50)=480mm$$

then,

$$C=1200-(0.4\times H)=1200-(0.4\times 480)=1008mm$$

and the safety distance:

$$S'=(K\times Ts)+C=(1600\times 0.1)+1008=1168mm$$

Finally, adding the effective detection capability to compensate the switch point, the minimum safety distance is:

$$S=S'+d=1168+82=1250mm$$

Safety Distance According to ANSI B11.19 for Hazard Point Safeguarding

For hazard point safeguarding (i.e. the protective field is perpendicular to the approach direction), the safety distance can be calculated using the following formula:

$$S = K \times (T_s + T_c + T_r + T_{bm}) + D_{pf}$$

where:

S: Minimum distance from the hazardous point to the detection point.

K: Approach speed to the detection zone. The ANSI B11.19 standard does not specify a value for K, but it is common to use the value recommended by the OSHA of 5.2 ft/s (1600 mm/s).

T_s: Stopping time of the machine.

T_c: Response time of the control system.

T_r: Response time of the safeguarding device and its interface.

T_{bm}: Additional time for the brake monitor, as a percentage of ($T_s + T_c$). When not using brake monitors, it is recommended to use a minimum value of 20 % of ($T_s + T_c$).

D_{pf}: Depth penetration factor. For AOPDs with an effective detection capability d < 64 mm, D_{pf} can be estimated as $D_{pf} = 3.4 \cdot (d-7)$ [mm].

Increasing Safety Distance for Perimeter Guarding

⚠ DANGER

DO NOT INSTALL CONTROL INSIDE THE GUARDED AREA FOR PERIMETER GUARDING

The Shadow 10 control must be placed outside the guarded area for perimeter guarding applications. The guarded machine must only be restarted using a switch located outside and with a full view of the area of hazardous motion. Use of Start/Restart Interlock operating mode is suitable for this type of application. See *Start and Restart Interlocks*, page 30 and *Setting Parameters for a Light Curtain*, page 76.

Failure to comply with these instructions will result in death or serious injury.

For perimeter safeguarding, there is another consideration: personnel might be walking while simultaneously reaching into a safeguarded area. Although there is no commonly accepted “walking speed constant” like the “hand constant,” you might use ergonomic tables or possibly even 100 inches per second, which is a conservative European “speed constant.” For perimeter guarding, the formula would be:

$$Ds = (100) \times (Ts + Tc + Tr + Tbm) + Dpf$$

Providing Pass-Through Protection Within the Safety Distance

⚠ DANGER

PREVENT OPERATOR FROM BEING ABLE TO STAND BETWEEN LIGHT CURTAIN AND HAZARDOUS AREA

Ensure that the operator cannot position himself or herself between the light curtain and the hazardous area. Use another pair of light curtains or a mechanical barrier at knee to waist height to prevent the operator or a passerby from being trapped between the light curtain and the hazard.

Failure to comply with these instructions will result in death or serious injury.

"Pass-through protection" must be provided for areas within the calculated safety distance in which operators may have to move. For safety distances of 6 in. or more, there is a danger that the operator could become trapped between the light curtain and the pinch point.

A recommendation would be to install a second pair of light curtains at waist height mounted horizontally between the vertical light curtain and the hazard (see Figure 4-3, below). The length of the horizontal light curtain should be the minimum needed to detect the thinnest operator standing between the vertical light curtain and pinch point. For example, a 11.8-in. light curtain located in the center of a 15-in. safety distance at waist height should be adequate.

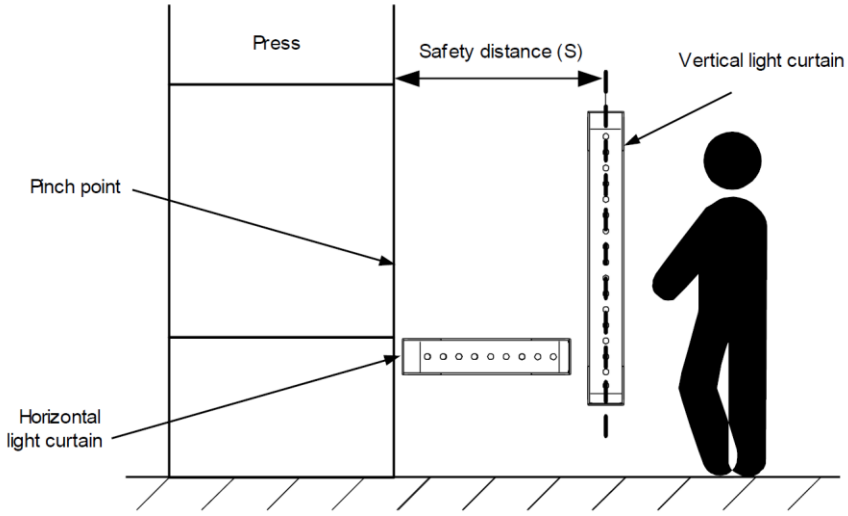


Figure 4-3. Pass-through Protection

With Shadow 10, multiple pairs of heads can be wired to the same WPC press control, making this configuration easily implemented.

All areas between the light curtains and pinch point that are not guarded by Shadow 10 must be protected by supplemental guarding (see Figure 4-4, below).

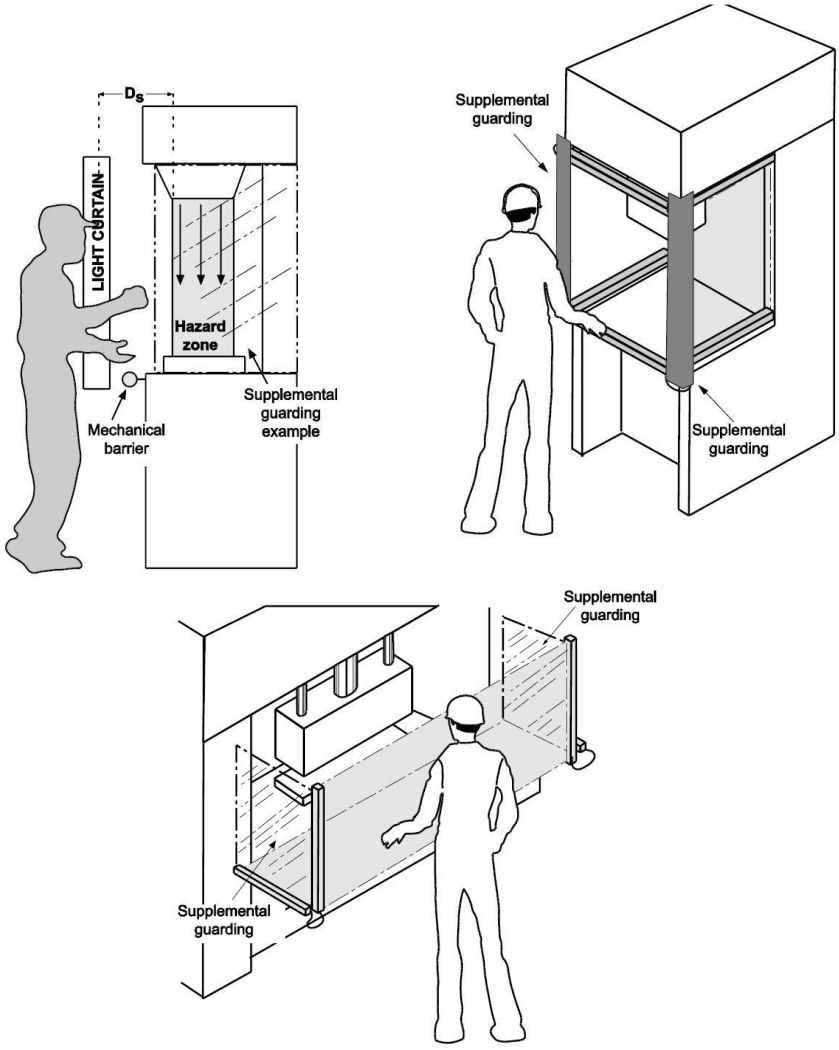


Figure 4-4. Supplemental Guarding

Optical Considerations

Reflective Surfaces

Reflective surfaces close to the safety light curtain (whether above, below or to the sides) can indirectly deflect the transmitter's light beams into the receiver head, adversely affecting the detection of objects within the protective field, even if the object blocks the main beams.

To avoid that problem, it is of utmost importance that all reflective surfaces and objects (metallic or glossy painted walls, floors or ceilings, containers, workpieces, etc.) must therefore be kept at a minimum distance from the protective field of the safety light curtain.

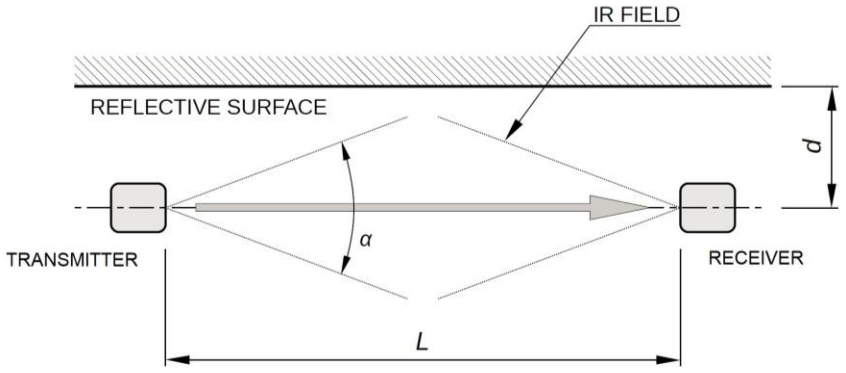


Figure 4-5. Minimum Distance to Reflective Surfaces

⚠ DANGER

An improper installation may result in a protective field which can be obstructed without detection, leading to serious injury.

NOTICE

DIFFERING LABELS ON THE TRANSMITTER AND RECEIVER HEADS

The transmitter head Is labeled “EMITTER” near the status indicators. See Figure 3-2

The receiver head Is labeled “DETECTOR” above the seven-segment display, near the status indicators. See Figure 3-3 and Figure 3-2. In this manual, the terms “transmitter” and “emitter” are used interchangeably and so are “receiver” and “detector.”

The minimum distance to reflective surfaces (d) depends on the protective field width (L) and on the maximum aperture angle (α) of the AOPD. The following chart gives the minimum distance 'd' from reflective surfaces for Type 4 safety light curtains, according to IEC 61496 2:

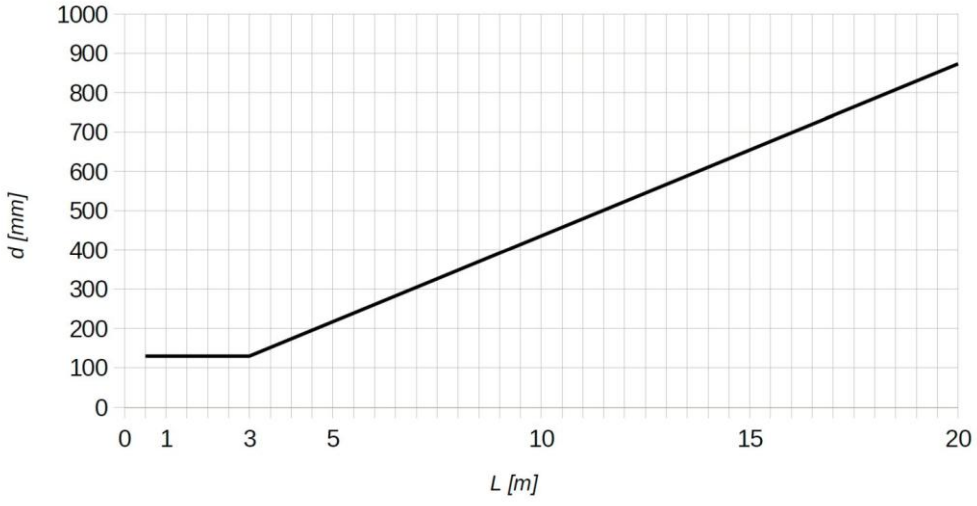


Figure 4-6. Minimum Distance to Reflective Surfaces vs. Protective Field Width

For protective field widths of less than 9.8 ft (3 m), the minimum distance 'd' shall be 5.1 in. (130 mm), while for values of L larger than 9.8 ft (3 m), the minimum distance 'd' can be calculated as follows:

$$d = \frac{L}{2} \times \tan(\alpha) = \frac{L}{2} \times \tan(5°) \approx L \times 0.044`$$

Mutual Interference Between Multiple Systems

⚠ DANGER

PREVENT INTERFERENCE BETWEEN SETS OF SHADOW 10 HEADS

When using more than one set of Shadow 10 in adjacent areas, the emitter of one Shadow 10 may interfere with the receiver of the other, causing the safety functions to stop working properly.

Install and configure them so that mutual interference does not occur.

Failure to comply with these instructions will result in death or serious injury.

NOTICE

DIFFERING LABELS ON THE TRANSMITTER AND RECEIVER HEADS

The transmitter head Is labeled “EMITTER” near the status indicators. See Figure 3-2, page 25.

The receiver head Is labeled “DETECTOR” above the seven-segment display, near the status indicators. See Figure 3-3, page 26. In this manual, the terms “transmitter” and “emitter” are used interchangeably and so are “receiver” and “detector.”

When multiple safety light curtains need to be installed in adjacent areas, the systems must be arranged in a way such that the transmitter of one system cannot interfere with the receiver of another.

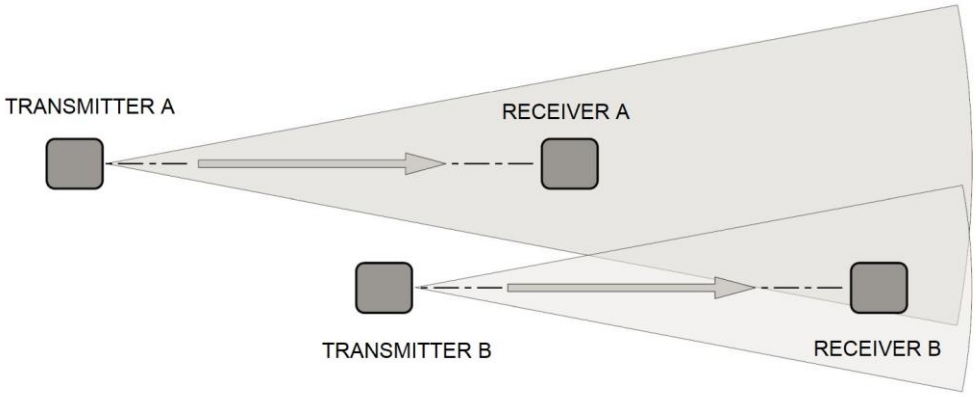


Figure 4-7. Mutual Interference Between Adjacent Systems

The following approaches can be used to prevent the mutual interference:

- Alternate direction of transmitters
- Use an opaque screen between systems
- Configure systems with different scan codes (see *Scan Coding*, page 52)

The following pictures gives some examples of alternative arrangements that can be used to reduce mutual interference:

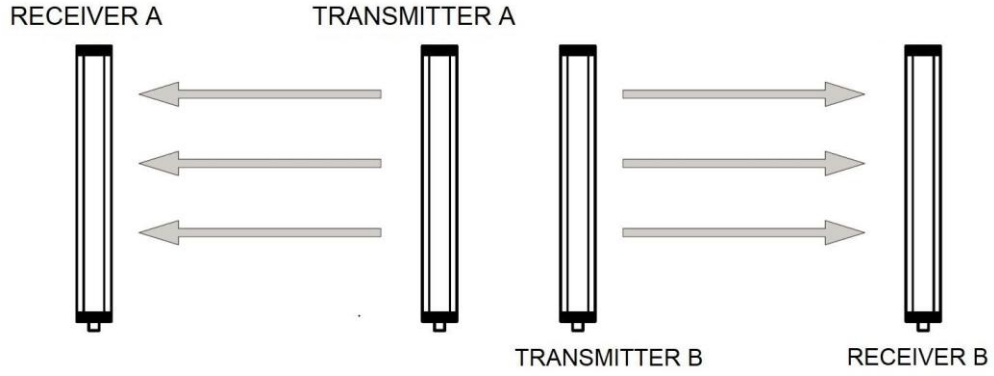


Figure 4-8. Back-to-Back Transmitters to Prevent Mutual Interference

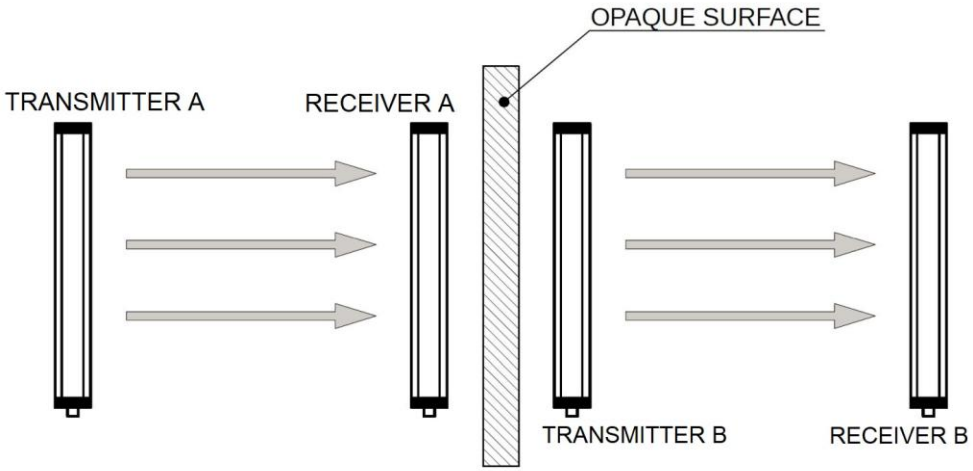


Figure 4-9. Use of an Opaque Screen to Prevent Mutual Interference

The arrangement shown in Figure 4-10 shall never be used because it could lead to optical interference:

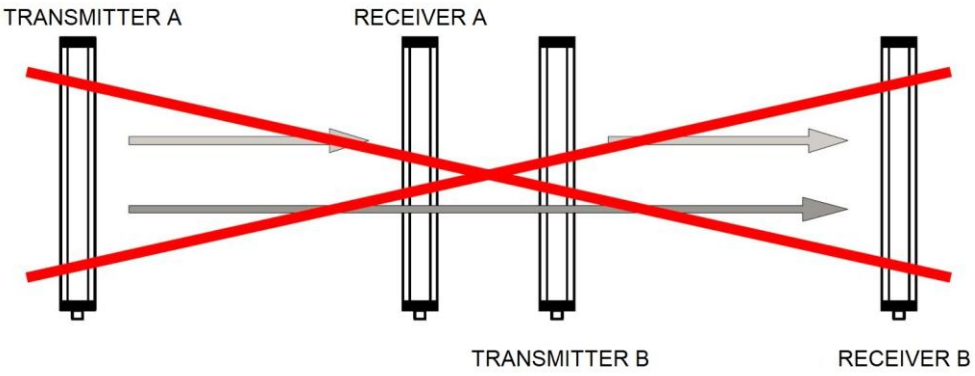


Figure 4-10. Wrong Arrangement for Neighboring Light Curtains

Scan Coding

The Shadow 10 heads provide two selectable light modulation patterns that allow two transmitter-receiver pairs to operate in close proximity to each other without mutual interference.

These patterns are called scan codes and are designed so that a receiver head will recognize only the light emission from a transmitter head using the same scan code.

For further details on scan code configuration, refer to *Chapter 5 – Parameterization*, page 73.

Use of Deflection Mirrors

In some uses, multiple sides of a hazard point or a danger area can be safeguarded with a single safety light curtain by using deflection mirrors. A typical application example is shown in Figure 4-11:

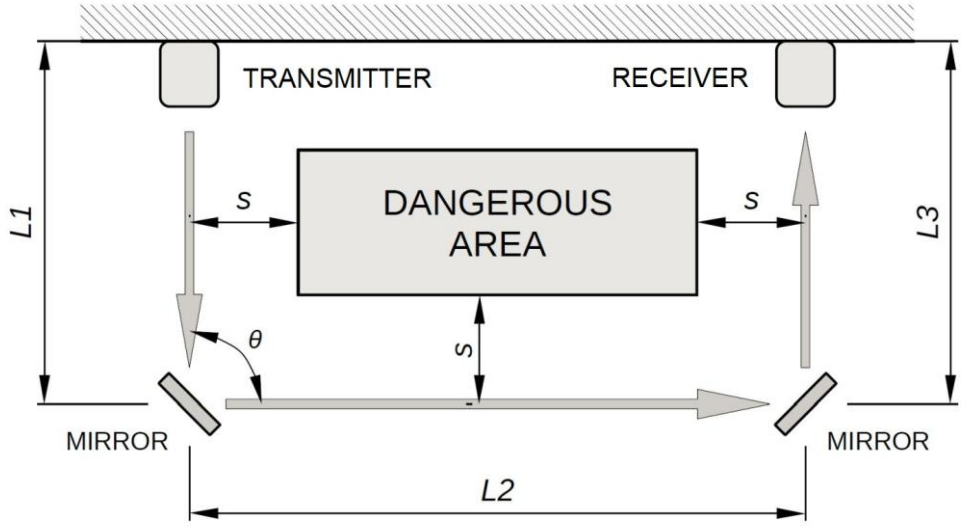


Figure 4-11. Use of Corner Mirrors

The overall operating range is given by the sum of the lengths of all sides that make up the protective field (L1, L2, L3). The minimum safety distance(s) must be maintained for each side of the protective field. Note that the use of deflection mirrors reduces the overall operating range of the light curtain by

approximately 20% per mirror. The use of more than two mirrors will make the alignment more difficult.

⚠ DANGER

REDUCTION IN MIRRORS' REFLECTIVE PROPERTIES

The reflective properties of mirrors are adversely affected by dust accumulation or moisture condensation on their surfaces.

Use of deflection mirrors in such circumstances may result in serious injury or death.

When using deflection mirrors, the total reflection angle θ (the sum of the incident angle and the reflection angle) must be between 45° and 120°. Angles smaller than 45° could result in unwanted reflections from an object in the protective field towards the receiver, hindering its detection. Angles greater than 120° are also not recommended due to alignment difficulties and the risk of optical bypassing.

⚠ DANGER

THE MINIMUM SAFETY DISTANCE MUST BE MAINTAINED FOR EACH SIDE OF THE PROTECTIVE FIELD.

The use of blanking functions with deflection mirrors is not recommended. The activation of these functions with deflection mirrors will suspend the safety function of the light curtain on all sides of the protective field. If the use of these functions is strictly necessary at one side of the protective field, all other sides must be protected with mechanical barriers to prevent access and to close any gaps in the protective field.

Failure to follow these procedures may result in serious injury or death.

Deflection mirrors are available as standard accessories.

Mechanical Mounting

⚠ DANGER

AVOID IMPROPER INSTALLATION

Ensure that the light curtain is installed so it is impossible for anyone to reach over, under, or around it and into the hazardous area of the machine without being detected. Use the correct height light curtain, combined with ancillary physical guards.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

PREVENT OPERATOR FROM BEING ABLE TO STAND BETWEEN LIGHT CURTAIN AND HAZARDOUS AREA

Ensure that the operator cannot position himself or herself between the light curtain and the hazardous area. Use another pair of light curtains or a mechanical barrier at knee to waist height to prevent the operator or a passerby from being "trapped" between the light curtain and the hazard.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

LOCATE PROGRAM/RUN/START KEY SWITCH OUTSIDE THE HAZARDOUS ZONE

Install the WPC or optional Shadow 10 control box containing the Program/Run/Start key switch in a location that provides a clear view of the entire hazardous zone and where it cannot be activated from within the hazardous zone.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

AVOID INSTALLING IN AREAS SUBJECT TO INTENSE INTERFERING LIGHT

Do not install Shadow 10 in areas exposed to strong, interfering light sources, such as direct sunlight.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

AVOID INSTALLING IN AREAS SUBJECT TO STRONG ELECTROMAGNETIC FIELDS

Do not install Shadow 10 in environments where a strong electromagnetic field may be produced.

Failure to comply with these instructions will result in death or serious injury.

NOTICE

DIFFERING LABELS ON THE TRANSMITTER AND RECEIVER HEADS

The transmitter head Is labeled “EMITTER” near the status indicators. See Figure 3-2, page 25

The receiver head Is labeled “DETECTOR” above the seven-segment display, near the status indicators. See Figure 3-3, page 26. In this manual, the terms “transmitter” and “emitter” are used interchangeably and so are “receiver” and “detector.”

The Shadow 10 transmitter and receiver heads can be mounted directly on the machine frame or on rugged mounting adapters to the machine frame.

General Considerations

The following considerations must be taken into account when mounting the Shadow 10 safety light curtain:

- The transmitter and receiver heads must be mounted parallel to each other at the same height and aligned in the same plane. The small, specified angle of beam spread of ± 2.5° requires increased precision in aligning the two heads with each other before the heads are tightly secured into place.
- The transmitter and receiver heads can be mounted at either side of the machine. However, the beam status indicators are easier to see when the receiver head is mounted at the right-hand side. Always make sure that the status indicator lights are clearly visible to the operator.

⚠ DANGER

LIGHT CURTAINS AND/OR ADDITIONAL GUARDS OR SAFEGUARDING REQUIRED TO PREVENT ACCESS TO HAZARDOUS AREAS

Access to hazardous areas must be allowed only through the protective field of the safety light curtain. Additional safeguarding or guards may be necessary to prevent access over, under or around the safety light curtain or from other areas of a particular machine not protected by the safety light curtain.

Failure to comply with these instructions will result in death or serious injury.

Mounting with Vibration Damping Shock Mounts

Shadow 10 light curtain split collar mounting brackets allow for easy installation and alignment of the light curtains.

Use the hex nylon nuts and washers provided with the kit (Set of 4 brackets, PN 4358402) to install the vibration damping shock mounts onto the Shadow 10 bracket as indicated in the figures below.

4. Install the vibration damping shock mounts to the bracket.
5. Install the light curtain into the bracket holder.

6. Perform the regular alignment procedure as described in the light curtains user manual before the final adjust of the light curtain into the bracket.

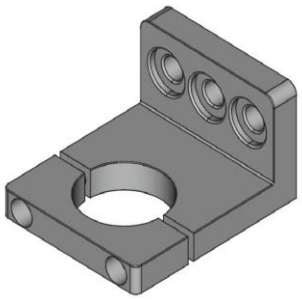


Figure 4-12. Aluminum Mounting Bracket

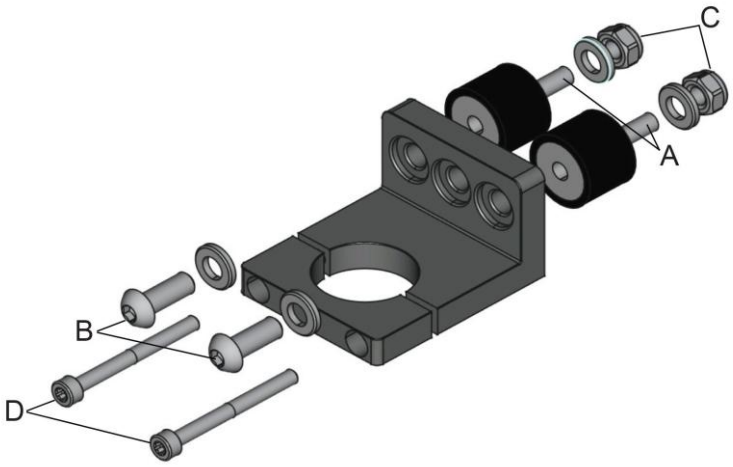
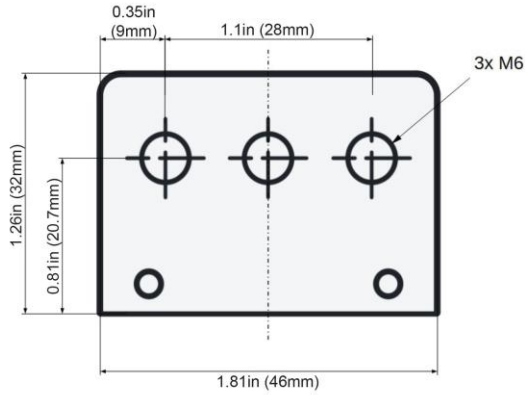


Figure 4-13. Assembling the Mounting Bracket with Vibration Damping Shock Mounts

Table 4-1. Assembly Fastening Details

Assy. Location	**Vibration Damping Shock Mount Stud Thread**	**Size**
A	Stud Threading	M6x1.0 Metric
	Tap	M6x1.0 Metric
	Drill	#9 (or 5mm)
	Fasteners	**Tools Required**
B	Black Cap Screw	#4 Allen wrench (metric)
C	Hex Nylon Nut	10 mm wrench or socket
D	Adjustment Screw	#3 Allen wrench (metric)



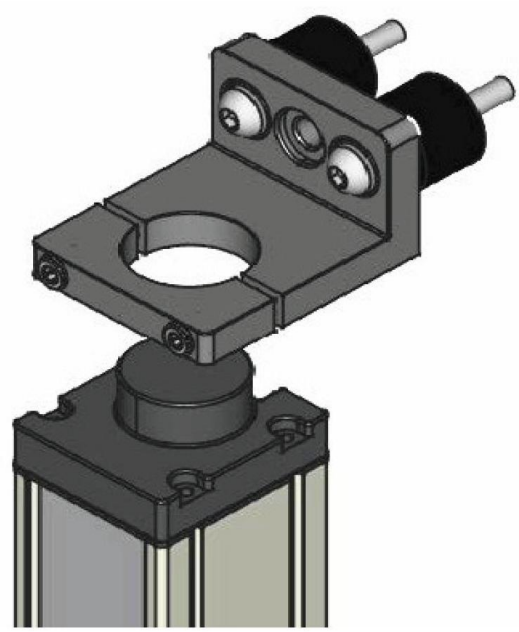


Figure 4-14. Mounting Bracket Hole Dimensions *Figure 4-15. Mounting Bracket Assembled*

Please contact Wintriss Controls Group for ordering information on mounting accessories.

Electrical Installation

Connectors and Cables

All the external connections on the Shadow 10 system are made through industry standard M12 circular connectors (IEC 61076-2-101) located at the bottom end of the head's housing.

In order to prevent accidental misconnection, the main connectors on the transmitter and receiver heads have different number of contacts.

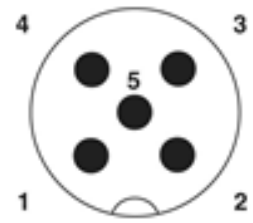
In most situations, the functional ground (notated FE) connection can be left unconnected. However, in cases of extreme electromagnetic interference, the use of shielded connection cables is recommended, and the cable shield and the FE should be connected together on a large metal surface.

Pre-assembled connection cables and extensions can be ordered in different lengths.

Transmitter Head Main Connector

On transmitter heads (all models), the M12 main connector is of male type and has five (5) positions. Table 4-2 shows the connector diagram with the signal names and descriptions.

Table 4-2. Transmitter Head M12 Connector Assignments

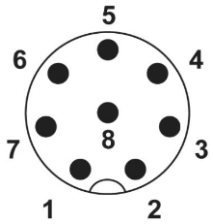
Contact numbering		Signal	
Diagram*	Position	Name	Description
	1	L+	Power input (24 V DC)
	2	CS	Code selection input
	3	L−	Power and signal common (0 V DC)
	4	TEST	Test input
	5	FE	Functional grounding (Functional earthing)

*Connector diagram shown as seen from the bottom end of the head.

Receiver Head Main Connector

The main receiver heads have a male type, eight (8) position M12 main connector. The connector diagram with contact numbering, signal names and descriptions is shown in Table 4-3.

Table 4-3. Receiver Head M12 Connector Assignments

Contact numbering		Signal	
Diagram*	Position	Name	Description
	1	FCN	Function button
	2	L+	Power input (24 V DC)
	3	AUX	Auxiliary I/O
	4	RST/EDM	Reset/External device monitoring input
	5	OSSD1	Safety output channel 1
	6	OSSD2	Safety output channel 2
	7	L−	Power and signal ground (0 V DC)
	8	FE	Functional grounding (Functional earthing)

*Connector diagram shown as seen from the bottom end of the head.

Power Supply

In order to comply with the IEC 61496-1 standard, the external DC power supply must satisfy all of the following conditions:

- Must be within the rated power voltage (24 V DC ± 20 %)
- Must comply with EMC directives for industrial environments
- Must have double or reinforced insulation between the primary and secondary circuits according to PELV/SELV standards.
- Must exhibit an output holding time equal or greater than 20 ms
- Must satisfy output characteristics requirements for class 2 circuit or limited voltage current circuit.
- Must comply with laws and regulations regarding EMC and electrical equipment safety of the country or region where the Shadow 10 is used.

A suitable power supply head compliant with the above requirements can be ordered as an optional accessory.

Transmitter Head Wiring Diagram

The schematic diagram on Figure 4-16 shows the typical connections of the transmitter head for the Shadow 10 safety light curtains:

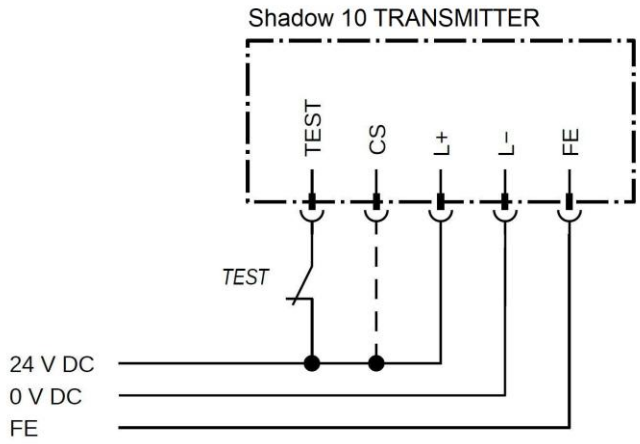


Figure 4-16. Transmitter Head Wiring Diagram

The TEST input is connected to 24 V DC through the normally closed contact of a push-button, relay, etc. The transmitter head will enter into test mode whenever the TEST input circuit is open.

NOTICE

If the transmitter test function is not used, the TEST input should be connected to the power line (24 V DC). Otherwise, the safety light curtain will remain in OFF state.

The CS (code selection) input is used to select the scan code of the transmitter head at power-up. For the default scan code (CODE A) this signal can be left open or connected to 0 V DC. Otherwise, for

the alternate scan code (CODE B), it must be connected to 24 V DC. Refer to *Transmitter Head Configuration*, page 73, for further information on CS input operation.

Any change in the state of the CS input after the power-up will bring the transmitter head into lockout state.

For detailed information on the transmitter head connector, pin assignments and wire colors, see Table 4-2, page 57.

Receiver Head Wiring Diagrams

The following sections show the typical wiring of each different function on the receiver heads. Since receiver heads have different connectors you should check the pin numbers and wire colors for each model on the tables in *Receiver Head Main Connector*, page 57.

OSSD Outputs

Safety outputs OSSD1 and OSSD2 must be connected separately as shown on Figure 4-17, otherwise, safety will not be assured.

⚠ DANGER

Under no circumstances should safety outputs OSSD1 and OSSD2 be wired together. Also, both outputs should be used at all times, separately connected to independent stop circuits in the target machine's control system to maintain the Type 4 specification.

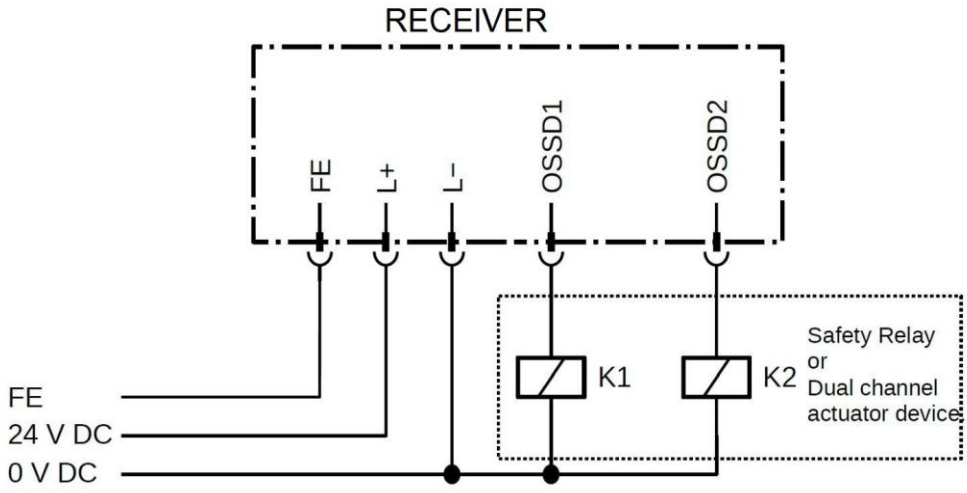


Figure 4-17. OSSD Wiring Diagram

Monitoring pulses are periodically applied to the safety outputs during ON state in order to detect short-circuit conditions, either to 24 V DC, 0 V DC or between outputs.

If safety relays are used, check that they are able to operate properly in presence of the monitoring pulses. Suitable safety relays can be ordered from Wintriss Controls Group as an optional accessory.

Shadow 10 Optional Control Box Installation

Mounting the Optional Shadow 10 Control Box

⚠ DANGER

LOCATE PROGRAM/RUN/START KEY-SWITCH OUTSIDE THE HAZARDOUS ZONE

Install the WPC or optional Shadow 10 control box containing the Program/Run Mode key-switch in a location that provides a clear view of the entire hazardous zone and where it cannot be activated from within the hazardous zone.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

DO NOT MOUNT CONTROL WHERE IT CAN AFFECT LIGHT CURTAIN OPERATION

Install the light curtain control in a location where access to it will not affect the operation of the light curtain.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

DO NOT INSTALL CONTROL INSIDE THE GUARDED AREA FOR PERIMETER GUARDING

Install the light curtain control outside the guarded area for perimeter guarding applications.

Failure to comply with these instructions will result in death or serious injury.

NOTICE

Mount the Control Box within view of the Detector/Receiver so you can see the seven-segment display and status LED indicators. You must be able to see the display and status LEDs during programming Parameters and Fixed Monitored blanking.

Choose an appropriate location when mounting the optional Shadow 10 control box. Mount the control box vertically (refer to Figure 3-4, page 29) in a location where personnel can easily turn the Program/Run Mode key-switch and see the warning indicators without interfering with the operation of the light curtains. The control must never be installed inside the protected area in perimeter guarding applications. The enclosure can be mounted to the press, on a free-standing pedestal, on a pendant, or at the entrance of a location used for area guarding.

Refer to Figure 4-18, below, for mounting dimensions. After you select a mounting location, drill four holes for mounting where shown in Figure 4-19, page 62, and tap them, if necessary. Shock mount studs are 1/4-20. Mount the enclosure using the shock mounts provided. Use a No. 7 drill and 1/4-20 tap.

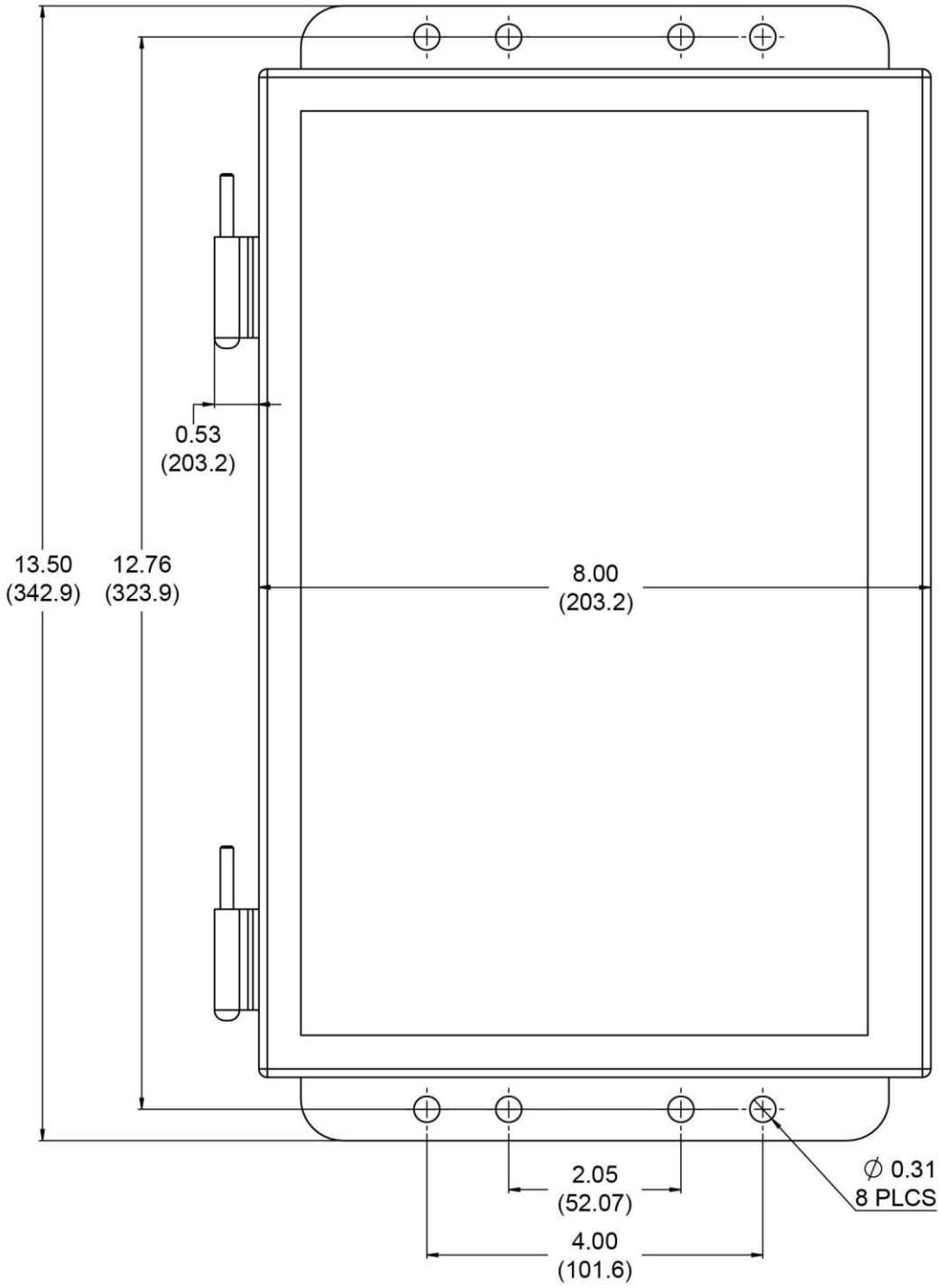


Figure 4-18. Shadow 10 Control Box Dimensions (door removed)

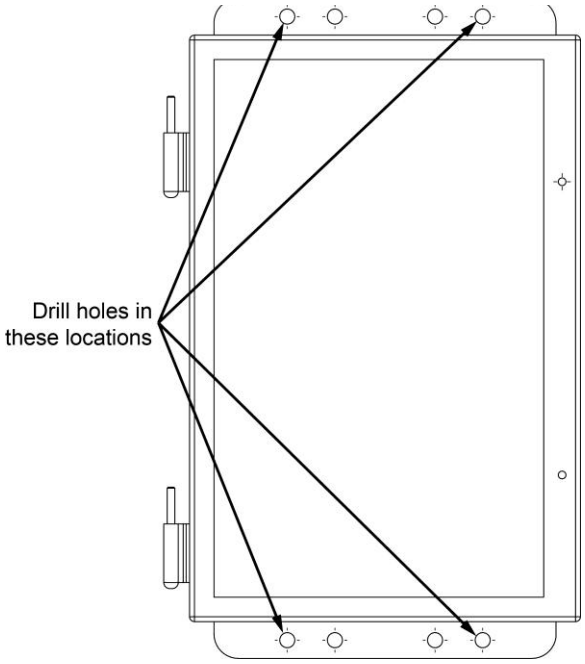


Figure 4-19. Locations for Mounting Holes

Wiring Heads to Shadow 10 Optional Control Box

⚠ DANGER

DO NOT USE SHADOW LIGHT CURTAINS ON FULL-REVOLUTION POWER PRESSES

- DO NOT use Shadow 10 safety light curtains on full-revolution clutched machinery, which cannot be stopped in mid-stroke.
- Use Shadow 10 safety light curtains only on machinery that can be stopped at any point in the stroke or cycle.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

PREVENT PRESS FROM BEING ABLE TO MOVE AFTER INTRUSION

- Ensure that Shadow 10 is wired to the immediate stop circuitry of the press.
- Ensure that any stop initiated by the light curtain is an immediate stop, one that occurs immediately after the stop signal is sent to the machinery. (If the light curtain is wired by mistake to the top-stop circuitry, the press continues its stroke until it reaches the top of the stroke, even after an intrusion or obstruction is detected.)

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

AVOID WIRING STOP CIRCUITS THAT ARE NON-OPERATIVE IN SOME MODES

Wire the light curtain to your press control circuit so the stop signal from the light curtain stops the machine immediately in all modes of operation, including Inch.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

AVOID WIRING OTHER DEVICES TO SHADOW 10 POWER

Wire only the Shadow 10 light curtain heads to the Shadow 10 control box. Do not wire any other device to the control box or its power supply.

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

⚠ DANGER

GUARD AGAINST ELECTRIC SHOCK HAZARD

- Ensure that the power source is off before you make any wiring connections.
- Turn off and disconnect power from the Shadow 10 safety light curtain and from the machinery it is connected to, including the machine control and motor, before making any wiring connections.
- Ensure that all procedures are performed by qualified personnel.

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

To wire a pair of heads, transmitter and receiver, to the optional Shadow 10 control, perform the following steps. Refer to the following for wiring connections:

- Control box terminal board, Figure 4-20, page 64
- M12 connectors to the heads: Table 4-2, page 57, and Table 4-3, page 57
- Receiver and transmitter head connections on the control box terminal board, the following tables on pages 66-67

  First pair of heads: Table 4-4 and Table 4-5

  Second pair of heads: Table 4-6 and Table 4-7

  Third pair of heads: Table 4-8 and Table 4-9

  Fourth pair of heads: Table 4-10 and Table 4-11

- Figures 1, 2, 3, and 4 at the end of the manual

For each pair of heads, follow the instructions below.

1. Select the cable with appropriate M 12 connector for each head: 8 position for receiver, 5 position for transmitter.
2. Plug the connector into each head and twist the locknut until the connection is tight.

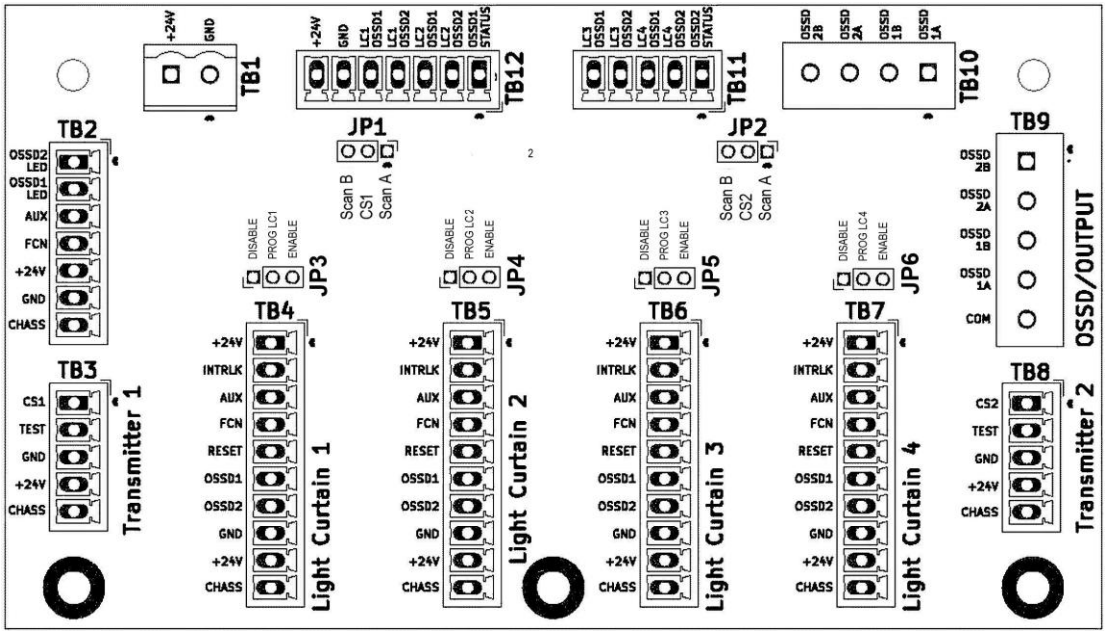


Figure 4-20. Shadow 10 Control Box Terminal Board

NOTICE

When joining cables with quick-disconnect fittings, be sure to make the connections between the two cables as tight as you can make them by hand. Do not use tools such as wrenches or pliers to tighten quick-disconnects.

3. Run the cables from the transmitter and receiver to appropriate knockouts in the control box.
4. Locate terminal blocks on the Shadow 10 control box terminal board (see Figure 4-20).
5. Measure the wires to fit and cut the wires as necessary. Allow 4 1/2 in. at the end of the cable jacket for connections at the control box.

NOTICE

Install the wiring with user-provided gland nut and threaded coupling or seal tight connectors.

6. If using gland nut and threaded coupling, thread the receiver cable through the hole in the top of the plastic gland nut (see Figure 4-21), then through the hole in the tapered end of the threaded coupling. Slide both components well down the cable so they are out of the way.

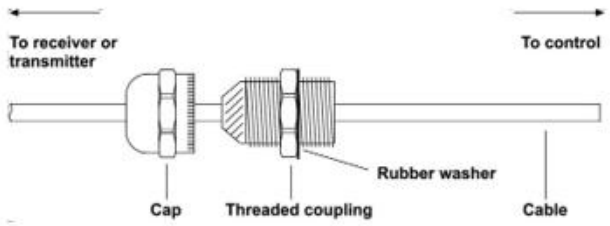


Figure 4-21. Cable Being Threaded through Top of Gland Nut and Threaded Coupling

NOTICE
When removing insulation, be careful not to cut into the conductors.

7. Remove the first 4 1/2 in. of black PVC cable jacket insulation.

NOTICE
When tightening the gland nut cap and coupling, make sure to turn cap and coupling in opposite directions at the same time.

8. Slide the gland nut cap and threaded coupling down the cable (toward the control) until the end of the coupling is flush with the point at which you cut the cable jacket. Thread the cap onto the coupling, and tighten the two components by hand, securing the cable as you do so.
9. Tighten the cap onto the coupling, using a wrench.
10. Remove 3/16 to 1/4 in. of insulation from the ends of each conductor wire, using a wire stripper.
11. Insert the gland nut coupling through the selected knockout in the control box.
12. From inside the control, thread locknut through the bundle of connectors until it contacts the coupling, then tighten the nut onto the threads with your hands.
13. Tighten the nut securely with a wrench.
14. Connect receiver wires to terminal block TB4 on the Shadow 10 control box terminal board, as shown in the appropriate table below, and Figure 1, 2, 3, or 4 at the end of the manual.
15. Repeat steps 6-13 for the transmitter cable.
16. Connect transmitter wires to the appropriate terminal block on the Shadow 10 control main board, as shown in Table 2-5 and Figure1, 2, 3, or 4 at the end of the manual.
17. When you have finished, double-check all connections.
18. Repeat steps 1-17 for each pair of heads.

Table 4-4. Shadow 10 RX 1 (First Receiver) Wiring Connections

Wire Color	Signal Label (TB4)
N/C	(1) +24V
N/C	(2) INTRLK
GRN	(3) AUX
WHT	(4) FCH
YEL	(5) RESET
GRY	(6) OSSD1
PNK	(7) OSSD2
BLU	(8) GND
BRN	(9) +24V
RED	(10) CHASS

N/C indicates no connection

Table 4-5. Shadow 10 TX 1 (First Transmitter) Wiring Connections

Wire Color	Signal Label (TB3)
WHT	(1) CS1
BLK	(2) TEST
BLU	(3) GND
BRN	(4) +24V
GRY	(5) CHASS

Table 4-6. Shadow 10 RX 2 (Second Receiver) Wiring Connections

Wire Color	Signal Label (TB5)
N/C	(1) +24V
N/C	(2) INTRLK
GRN	(3) AUX
WHT	(4) FCH
YEL	(5) RESET
GRY	(6) OSSD1
PNK	(7) OSSD2
BLU	(8) GND
BRN	(9) +24V
RED	(10) CHASS

N/C indicates no connection

Table 4-7. Shadow 10 TX 2 (Second Transmitter) Wiring Connections

Wire Color	Signal Label (TB3)
WHT	(1) CS1
BLK	(2) TEST
BLU	(3) GND
BRN	(4) +24V
GRY	(5) CHASS

Table 4-8. Shadow 10 RX 3 (Third Receiver) Wiring Connections

Wire Color	Signal Label (TB6)
N/C	(1) +24V
N/C	(2) INTRLK
GRN	(3) AUX
WHT	(4) FCH
YEL	(5) RESET
GRY	(6) OSSD1
PNK	(7) OSSD2
BLU	(8) GND
BRN	(9) +24V
RED	(10) CHASS

N/C indicates no connection

Table 4-9. Shadow 10 TX 3 (Third Transmitter) Wiring Connections

Wire Color	Signal Label (TB8)
WHT	(1) CS1
BLK	(2) TEST
BLU	(3) GND
BRN	(4) +24V
GRY	(5) CHASS

Table 4-10. Shadow 10 RX 4 (Fourth Receiver) Wiring Connections

Wire Color	Signal Label (TB7)
N/C	(1) +24V
N/C	(2) INTRLK
GRN	(3) AUX
WHT	(4) FCH
YEL	(5) RESET
GRY	(6) OSSD1
PNK	(7) OSSD2
BLU	(8) GND
BRN	(9) +24V
RED	(10) CHASS

N/C indicates no connection

Table 4-11. Shadow 10 TX 4 (Fourth Transmitter) Wiring Connections

Wire Color	Signal Label (TB8)
WHT	(1) CS1
BLK	(2) TEST
BLU	(3) GND
BRN	(4) +24V
GRY	(5) CHASS

Connecting AC Wiring to the Optional Shadow 10 Control Box

WARNING

GUARD AGAINST ELECTRIC SHOCK HAZARD

- Ensure that the power source is off before you make any wiring connections.
- Turn off and disconnect power from the Shadow 10 safety light curtain and from the machinery it is connected to, including the machine control and motor, before making any wiring connections.
- Ensure that all procedures are performed by qualified personnel.
- Complete all installation procedures before connecting wires to the AC power source.

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

The control is wired to a 115-230 VAC power source (see *Optional Control Box Specifications*, page 95). Bring AC wiring to the control following these guidelines:

- All wires can be run through flexible liquid-tight conduit provided all circuits are in the same voltage range. If your emergency stop circuits are low voltage circuits (such as 24 VDC), run two conduits–for instance, one for 115 VAC wires and one for 24 VDC wires.
- Bring the wiring connections for AC power to a convenient point so that you can connect them to the appropriate connector. No. 16 wire is recommended for these circuits; use No. 14 if local codes require it.

Perform the following steps to connect AC wiring to the Shadow 10 control:

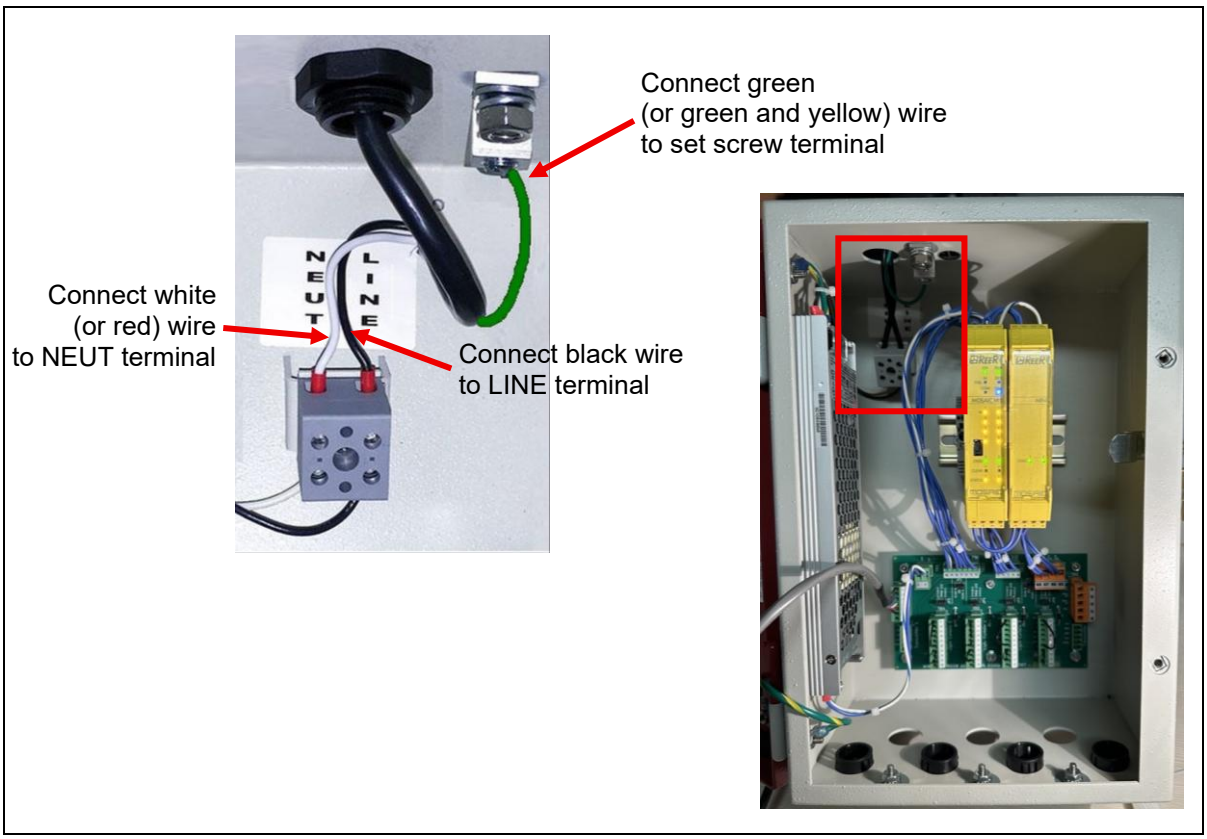


Figure 4-22. Shadow 10 AC Wiring Connections

1. Determine how you will bring wiring from your 115 VAC power source (or 230 VAC source, if applicable) to the appropriate knockout at the bottom of the unit. These wires should be connected directly to the press control transformer. For 115 VAC, you need three wires— line (black), neutral (white) and ground (green). For 230 VAC, high and neutral wires are black and red, the ground wire green or green-and-yellow.
2. Run the power wires to the control box. If your stop circuits are 115 VAC, the AC wiring and stop circuits will be run through the same flexible, liquid-tight conduit and will enter the enclosure ideally through the top left knockout. To maintain the control box's IP65 rating, you must use conduit of the same rating and make proper connections to the control.
3. Remove the knockout(s) you plan to use for your AC wiring and stop circuits. You remove the inner disk in combo knockouts from inside the control box, the outer diameter from outside the control box. To remove a knockout, tap with a hammer and screwdriver around the circumference of the disk. When removing the inner disk of a combo knockout, be sure the control box is well-supported.
4. Connect the black wire to the "L" terminal on TB1, the white (or red) wire to the "N" terminal, as shown in Figure 4-22, and in Figure 9 at the end of the manual.
5. Connect the green (or green-and-yellow) electric service ground wire to the set screw terminal on the top (ceiling) of the enclosure, as shown in Figure 4-22.
6. Leave a service loop at the control to allow for later adjustment of the conduit. Cut the wires as necessary.

WARNING

GUARD AGAINST ELECTRIC SHOCK HAZARD

Do not connect wires to AC power source until you are done with all other installation procedures.

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

Connecting Stop Circuits to the Shadow 10 Optional Control Box

⚠ DANGER

DO NOT USE SHADOW LIGHT CURTAINS ON FULL-REVOLUTION POWER PRESSES

- DO NOT use Shadow 10 safety light curtains on full-revolution clutched machinery, which cannot be stopped in mid-stroke.
- Use Shadow 10 safety light curtains only on machinery that can be stopped at any point in the stroke or cycle.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

PREVENT PRESS FROM BEING ABLE TO MOVE AFTER INTRUSION

- Ensure that Shadow 10 is wired to the immediate stop circuitry of the press.
- Ensure that any stop initiated by the light curtain is an immediate stop, one that occurs immediately after the stop signal is sent to the machinery. If the light curtain is not correctly wired in this way, the press may continue its stroke after an intrusion is detected.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

AVOID WIRING STOP CIRCUITS THAT ARE NON-OPERATIVE IN SOME MODES

Wire the light curtain in series with your press control circuit so the stop signal from the light curtain stops the machine immediately in all modes of operation, including Inch.

Failure to comply with these instructions will result in death or serious injury.

WARNING

GUARD AGAINST ELECTRIC SHOCK HAZARD

- Ensure that the power source is off before you make any wiring connections.
- Turn off and disconnect power from the Shadow 10 safety light curtain and from the machinery it is connected to, including the machine control and motor, before making any wiring connections.
- Ensure that all procedures are performed by qualified personnel.

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

Wiring the control into your press's emergency stop or equivalent circuitry ensures that whenever an obstruction or intrusion is detected, the press will stop as quickly as its clutch/ brake system (or other system) permits.

Follow these guidelines when making connections:

- Bring the wiring connections for the immediate stop circuits to a convenient point so that you can tie them to the appropriate connector. No. 16 wire is recommended for these circuits. No. 14 should be used if local codes require it.
- Determine how you will connect the wires from the control to your press control immediate stop circuit. Refer to Figure 9 at the end of this manual and your press control manual or other electrical prints. You need two wires for the immediate stop circuit.
- If your stop circuits are 115 VAC, the AC wiring and stop circuits can enter the control in the same conduit through the same knockout. If the stop circuits are 24 VDC, then 115-230 VAC wiring goes through a knockout different from the 24 VDC wiring.

Wiring Shadow 10 to the Stop Circuit(s)

To connect to your machine's stop circuit, perform the following steps:

1. Locate terminal block TB9 on the Shadow 10 control main board, Figure 4-20, page 64.
2. Connect according to wiring diagram Figure 9 at the end of the manual. Figure 4-23, below, shows the relevant section of Figure 9.
3. When you have finished wiring the relays, remember to leave a service loop at the control to allow for later adjustment of the conduit. Cut the wires as necessary.

When wiring Shadow 10 into the machine's stop circuit, you should ensure that the light curtain is active in all modes of operation. This includes Inch, Single-stroke, and Continuous. Following this practice provides safety for setup personnel as well as operators. In some cases, having Shadow 10 active in all modes may even eliminate the need for lockout during a die change. See OSHA 1910.147 "Lockout/Tagout" for details.

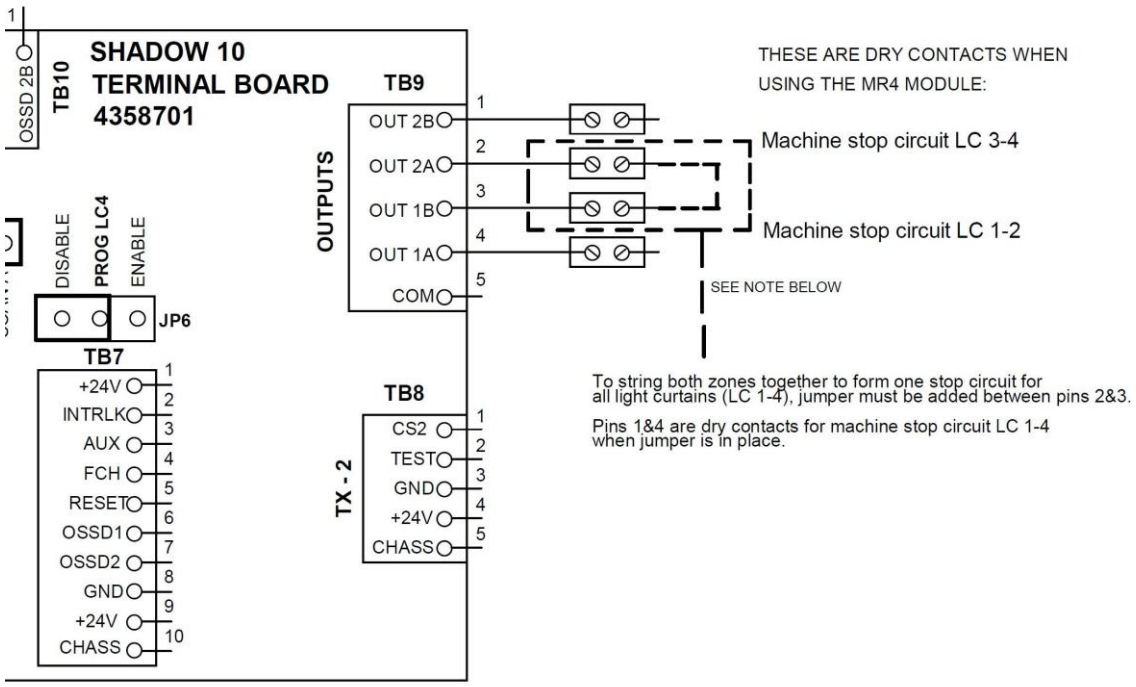


Figure 4-23. Wiring to Machine Stop Circuits (from Figure 9)

Chapter 5 – Parameterization

All the operation parameters of the Shadow 10 safety light curtains can be configured according to the particular requirements of the end user's application. This chapter describes the configuration procedures for each function of the Shadow 10.

⚠ DANGER

Changes to the configuration of the safety light curtain may adversely affect the effectiveness of the protective function!

After any change to the configuration parameters, you must always perform a verification test according to the procedures described in Chapter 7 – in order to check the functionality and performance of the protective device.

Default Factory Settings

When the Shadow 10 safety light curtains are delivered, its operation parameters are pre-set at the factory as detailed on the following sections (*Transmitter Head Configuration* and *Restoring Factory Configuration)*.

For receiver heads, the default factory settings can be restored at any time through a special procedure. Please refer to *Restoring Factory Configuration*, page 78, for detailed information.

Transmitter Head Configuration

The only configurable parameter on transmitter heads is the scan code, which can be chosen between two possible options: CODE A and CODE B. The default scan code is CODE A.

The default scan code can be changed to the alternate code through the CS input on the main connector. If you need to change the scan code, make sure that the scan code on the transmitter head matches with that of its corresponding receiver head.

At power-up, the transmitter head will select its operating scan code based on the logic level detected at the CS input. Any change of the voltage level on this terminal after the power-up will bring the transmitter head into lockout state.

If a high logic level is detected (the input is connected to 24 V DC), the transmitter head will use CODE B. Otherwise, if the input is left open or connected to 0 V DC, the default scan code (CODE A) will be used.

Please refer to *Transmitter Head Wiring Diagram*, page 58, for connection details.

Receiver Head Configuration

Local Parameterization Procedure

⚠ WARNING

PARAMETERIZATION CONFIGURATION MAY AFFECT SAFETY

Parameterization configuration might affect the detection capability and other safety features of the light curtain. Careful assessment is required before using these features.

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

The local parameterization of the Shadow 10 is carried out through a special signaling sequence applied to the FCN and AUX inputs. The signaling is done using a Function button and a PROG/RUN key-switch provided by either the optional Shadow 10 control box or a Teach Tool (Figure 5-3).

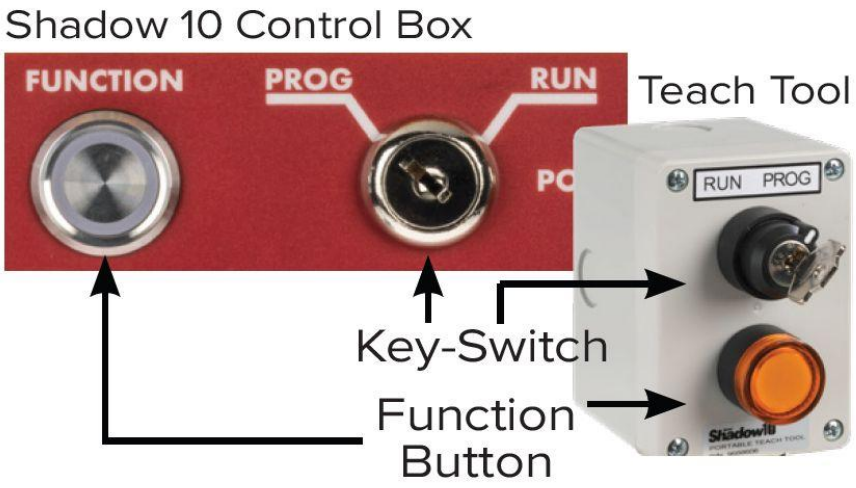


Figure 5-1. Function Button and Key-Switch on Control Box and Teach Tool.

NOTICE

The key-switch on the Teach Tool has RUN on the left and PROG on the right, opposite from the key-switch on the optional Shadow 10 control box.

Prepare for parameterization in one of the following ways:

- If the light curtain is connected to a Shadow 10 control box, go to *Preparing for Parameterization with Optional Shadow 10 Control Box*, next section
- If the light curtain is not connected to a Shadow 10 control box, go to *Preparing for Parameterization Using a Teach Tool*, page 75

Preparing for Parameterization with Optional Shadow 10 Control Box

Before you set parameters for a light curtain connected to a Shadow 10 control box, you must enable this process. Find jumpers JP3 through JP6 on the control box board. Each is located above the terminal block for the light curtain it enables and disables. See Table 5-1 and Figure 5-2, below, and Figure 4-20, page 64.

Table 5-1. Light Curtains and Corresponding Jumpers

Light Curtain	Terminal block	Jumper
1	TB4	JP3
2	TB5	JP4
3	TB6	JP5
4	TB7	JP6

Figure 5-2. Jumpers JP3 – JP6, showing JP3 in the Enable Position

For the light curtain you want to program, move the corresponding jumper (JP 3 - 6) from DISABLE to ENABLE.

To complete the parameterization procedure, go to *Setting Parameters for a Light Curtain*, page 76.

NOTICE

After you finish setting parameters for this light curtain, be sure to place the jumper back in the DISABLE position to prevent unintentional changes.

Preparing for Parameterization Using a Teach Tool

Figure 5-3. Teach Tool

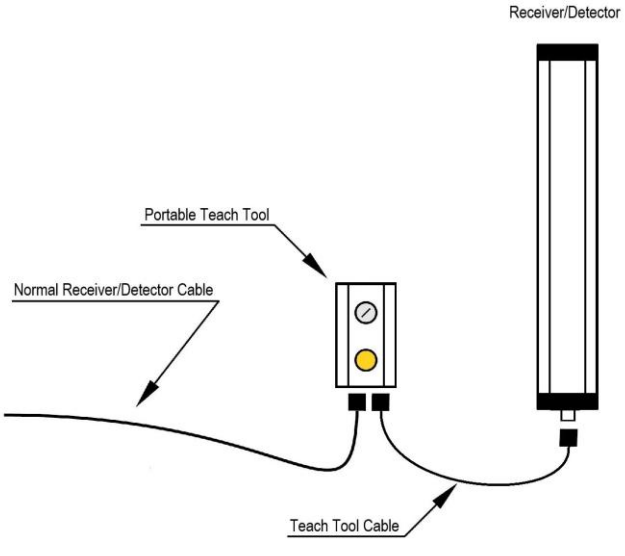


Figure 5-4. Teach Tool Setup

If you do not have an optional Shadow 10 control box, use the teach tool, Figure 5-3, available from Wintriss Controls. Connect your teach tool to the receiver (detector) head of the light curtain as follows.

1. Remove the detector cable from the receiver head and connect it to the teach tool.
2. Connect the teach tool cable from the teach tool to the receiver, as shown in Figure 5-4.

To complete the parameterization procedure, go to *Setting Parameters for a Light Curtain*, next section.

Setting Parameters for a Light Curtain

NOTICE

PARAMETERS QUICK REFERENCE TABLE AVAILABLE

The table on page 100 in Appendix B, provides a quick reference table with all the parameters on a single sheet. Print a copy and keep it handy during the parameterization.

See *Parameter Descriptions*, page 79, for details about the parameters. The parameter configuration process is carried out as follows:

1. Perform the preparation as instructed in the appropriate section:
   - *Preparing for Parameterization with Optional Shadow 10 Control Box*, page 74
   - *Preparing for Parameterization Using a Teach Tool*, previous section.
2. Power off the system, then turn the key-switch to PROG.

NOTICE

The key-switch on the Teach Tool has RUN on the left and PROG on the right, opposite from the key-switch on the optional Shadow 10 control box.

3. Power the system back on. Wait for a flashing “P” to be shown on the receiver light curtain display.

NOTICE

If there is no activity for 1 minute, Program mode times out and displays a 3 with a yellow light.

4. Press the Function button 3 times. A solid “P” appears on the display after the button is pressed 3 times, indicating the system is ready to be programmed.
5. Press the Function button to cycle through the parameters. The number of the selected parameter shows on the receiver/detector head display. When the last parameter is reached, the cycle continues from the first one.

NOTICE

In this example, Parameter 2 Interlock Function is used to illustrate the configuration procedure. When enabled, Start and Restart Interlock Functions require an external reset switch to clear lockout when the sensing field is interrupted. Leave Parameter 2 disabled when not in use.

For external reset switch wiring, see Figure 1 at the end of the manual.

6. Press and hold the function button to maintain the current parameter selection and toggle the key-switch to change the configuration options.

Figure 5-5. Holding Function Button and Toggling Key-Switch

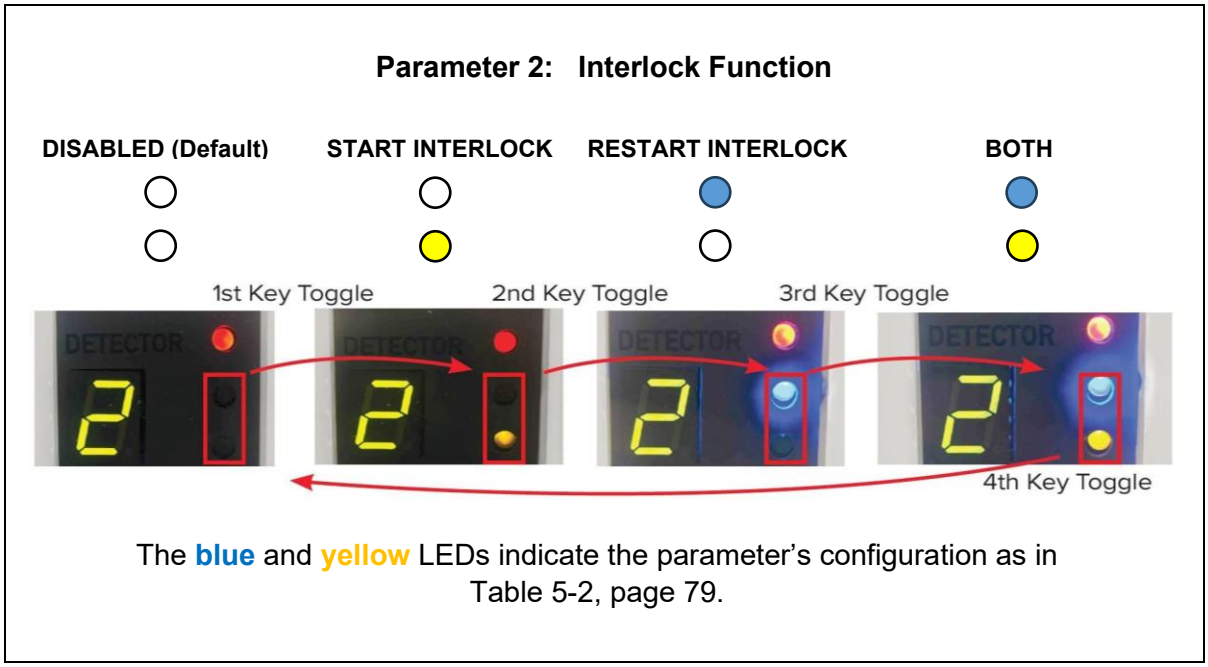


Figure 5-6. Parameter Setting Example: Parameter 2

7. Release the Function button. Then turn the Key-Switch to RUN to save the configuration. The light curtain restarts with the new parameter configurations.

The illustration below shows a simplified timing diagram of a typical parameterization sequence:

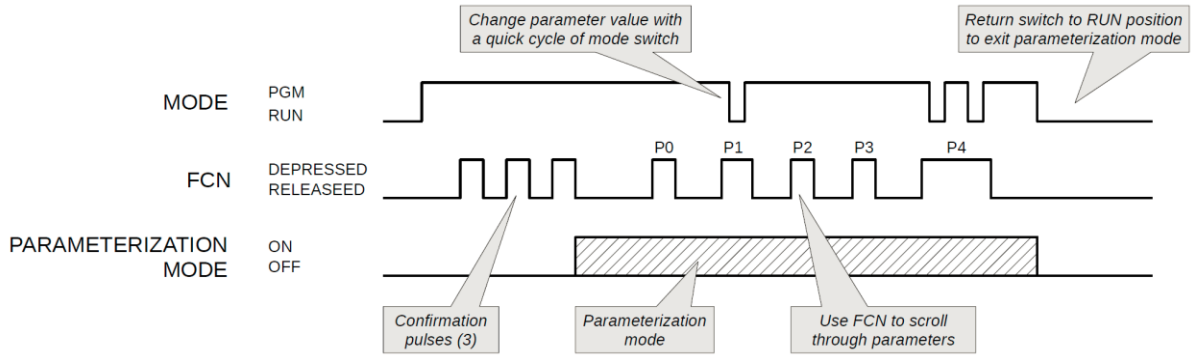


Figure 5-7. Example of a Parameterization Sequence

Restoring Factory Configuration

Should it be necessary, all the configurable function parameters can be restored to their default values (as shipped from factory) by using the following procedure:

1. Turn off the Shadow 10 system and turn the PROG/RUN key-switch to its PROG position; then depress and hold the FCN button while turning on the power supply.
2. After the power-up, a flashing '[' appears on the display. From this point, you have 30 seconds to confirm the clearing operation by releasing and pressing the FCN button three times in succession. The length of the pulses and the time between them must be at least 0.2 seconds (and 3 seconds maximum). The pulses are ignored if you do not meet these timing requirements.

   If the push-button pulse sequence is properly applied, the blinking '[' on the display changes to a steady state and all the user parameters are restored to their factory default state.
3. After returning the PROG/RUN switch to the RUN position the Shadow 10 restarts automatically with the factory default configuration.

Clearing All Blanking

To remove all blanking settings, follow the instructions below. For details on how to make changes to your light curtain parameters, refer to the instructions under *Local Parameterization Procedure*, page 74.

- If no obstructions are between the light curtain heads, use *Method 1 - No Obstructions*, next section.
- If there is any obstruction between the light curtain heads, use *Method 2 - Obstructed*, page 79.

Method 1 - No Obstructions

1. Clear the protective field of any obstructions.
2. Turn the key-switch to PROG and press the Function button 3 times.
3. Turn the key-switch to RUN.

All blanking configurations are then deleted, and the protective field is back to its default state.

Method 2 - Obstructed

1. Turn the key-switch to PROG and press the Function button 3 times.
2. Press and hold the Function button. After 3 seconds, the solid yellow light starts blinking.
3. While continuing to hold the Function button, turn the key-switch to RUN to clear all blanking configurations.

All blanking configurations are then deleted, and the protective field is back to its default state

Parameter Descriptions

This section provides a short description of each receiver parameter. Each description includes a table summarizing the parameter code and its allowed values, along with the LED indication for each value of the parameter as shown in parameterization mode (the ○ symbol represents a turned off LED while the ◉ symbol represents an illuminated LED). The default factory setting for each parameter is also indicated.

In *Appendix B – Parameters Quick* Reference, page 99, you will find a quick reference table with all the parameters on a single sheet. Print a copy and keep it handy during the parameterization.

Parameter Code 1: Scan Code

If you need to change the scan code, make sure that the scan code on the receiver head matches that of its corresponding transmitter head.

Table 5-2. Parameter – Scan Code

Parameter		Options		
Code	**Name**	**Value**	**BLUE**	**YELLOW**
1	Scan code	CODE A (Default)	○	○
		CODE B	○	◉

Parameter Code 2: Interlock function

This parameter enables or disables the two modes of the interlock function. For further information on the interlock functions, see *Start and Restart Interlocks*, page 30.

Table 5-3. Parameter – Start Interlock

Parameter		Options		
Code	**Name**	**Value**	**BLUE**	**YELLOW**
2	Interlock function	DISABLED (Default)	○	○
		START INTERLOCK	○	◉
		RESTART INTERLOCK	◉	○
		BOTH	◉	◉

Parameter Code 3: EDM Function

This parameter enables or disables the external device monitoring function. For further information on this function contact Wintriss Tech Support.

Table 5-4. Parameter – EDM Function

Parameter		Options		
Code	**Name**	**Value**	**BLUE**	**YELLOW**
3	EDM Function	DISABLED (Default)	○	○
		ENABLED (see below)	○	◉

If the yellow LED flashes when enabling the EDM function, this indicates that the EDM input signal is not properly wired. This can lead to a lock-out condition if the wiring is not corrected.

Parameter Code 4: Percent Beam Blanked Settings

Sometimes there may be misalignment at the bottom part of the light curtains and the operator may want to blank (teach) the misaligned section part to allow the press to run. This parameter sets the percentage of the beams to be taught. As shown in Table 5-5, the default is 25 percent.

Table 5-5. Percent Beam Blanked Settings

Parameter		Options		
Code	**Name**	**Value**	**BLUE**	**YELLOW**
4	Fully Monitored Blanking	00 (Teach Disabled)	○	○
		01 (Teach 25% Max Beams) (Default)	◉	○
		02 (Teach 50% Max Beams)	○	◉
		03 (Teach 100% Max Beams, Except Sync Beam)	◉	◉

Parameter Code 6: Fixed Blanking Tolerance, Positive

This parameter configures the positive blanking tolerance, in beams, for the fixed blanking function. For further details on the use of blanking tolerances, see *Teach-in Considerations*, page 36.

Table 5-6. Parameter – Fixed Blanking Tolerance, Positive

Parameter		Options		
Code	**Name**	**Value**	**BLUE**	**YELLOW**
6	Blanking tolerance, positive	0 beam	○	○
		1 beam (Default)	◉	○
		2 beams	○	◉
		3 beams	◉	◉

Parameter Code 7: Fixed Blanking Tolerance, Negative

This parameter configures the negative blanking tolerance, in beams, for the fixed blanking function. For further details on the use of blanking tolerances, see *Blanking Tolerance*, page 36.

Table 5-7. Parameter – Fixed Blanking Tolerance, Negative

Parameter		Options		
Code	**Name**	**Value**	**BLUE**	**YELLOW**
7	Blanking tolerance, negative	0 beam	○	○
		1 beam (Default)	◉	○

Parameter Code 8: Floating Blanking

This parameter configures the floating blanking function by selecting the number of floating beams allowed. The floating blanking function is described in *Floating Blanking (Reduced Resolution)*, page 38.

Table 5-8. Parameter – Floating Blanking

Parameter		Options		
Code	**Name**	**Value**	**BLUE**	**YELLOW**
8	Floating blanking	0 beam (Default)	○	○
		1 beam	◉	○
		2 beams	○	◉
		3 beams	◉	◉

Parameter Code 9: Floating Mode

This parameter is shown only when the floating blanking is enabled (number of floating beams > 0) and it specifies the number of floating objects allowed. The floating blanking function is described in *Floating Blanking (Reduced Resolution)*, page 38.

Table 5-9. Parameter – Floating Mode

Parameter		Options		
Code	**Name**	**Value**	**BLUE**	**YELLOW**
9	Floating mode	SINGLE (Default)	○	○
		MULTIPLE	◉	○

Chapter 6 – Commissioning

⚠ DANGER

Before putting the Shadow 10 into operation for the first time, the entire setup and the integration of the AOPD into the machine control system shall be inspected and tested by qualified personnel to verify that it operates as intended.

An improper setup or configuration can cause a person to go undetected, resulting in serious injury.

Before powering up the Shadow 10 for the first time and while the transmitter and receiver heads are being aligned, it must also be ensured that the outputs of the AOPD do not have any effect on the machine. The switching elements that set the dangerous machine in motion must be safely switched off and secured against restarting.

Optical Alignment

⚠ DANGER

TURN OFF HAZARDOUS EQUIPMENT DURING ALIGNMENT

Remove power from the press and other hazardous machinery while you are aligning the light curtain transmitter and receiver.

Failure to comply with these instructions will result in death or serious injury.

After the Shadow 10 safety light curtain has been mounted and the electrical connections have been completed, the transmitter and receiver heads must be aligned to ensure proper system operation.

An optimal alignment is obtained when the optical axes of the first and last beam from the transmitter head coincide with those of their corresponding beams on the receiver head.

The transmitter and receiver heads must be mounted at the same height or, if installed in a horizontal position, be at the same distance from the reference surface and slightly fastened at first. The small, specified angle of beam spread of ± 2.5° requires increased precision in aligning the two heads with each other before the heads are tightly secured into place.

The optical alignment procedure shall be carried out with no blanked areas (if needed, you can erase all blanking patterns by restoring the default factory configuration as indicated in *Restoring Factory Configuration*, page 78). Before starting the alignment, check that there are no interruptions on the protective field and that the optical surfaces of the transmitter and receiver heads are clean.

- Start the procedure by checking the alignment of the sync beam. If it is not properly aligned (or obstructed), the '⁼' symbol will be shown on the display. Adjust the relative position of both heads until the display symbol is turned off. Once the sync beam has been aligned, fix the receiver head into place, while taking care not to change the alignment display status.
- Without changing the relative position of the sync beam, slightly adjust the position of the transmitter head until all the beam status indicators on the receiver head are turned off and the OSSD LED changes to green (if interlock function is enabled, the OSSD LED will stay red, and the yellow LED will start blinking).
- If using split collar brackets, slightly turn the transmitter head until the '⁼' symbol appears on the display. Note this position and turn the transmitter in the opposite direction until the display symbol goes off and then continue until the '⁼' symbol is shown again. Now turn

back the transmitter to the center of the two positions found and fix the brackets so they cannot be moved. This step shall be repeated for the receiver head.

- Once the optimal adjustment is achieved, all the mounting brackets must be securely fastened while checking that the alignment condition is not changed.

Chapter 7 – Inspection and Maintenance

Pre-Commissioning Tests

⚠ DANGER

MAKE SURE TO PERFORM SAFETY SYSTEM TESTS

Make sure to test the operation of the safety light curtain after installation to verify that it operates as intended. Make sure to stop the machine until the test is complete. Unintended function settings can cause a person to go undetected, resulting in serious injury.

- Perform the checkout and test procedures below when you have completed installation of your light curtain and before operating the equipment it is connected to.
- Operate your machinery only after your safety system meets all the requirements of the checkout and test procedures.
- Perform the test procedure whenever repair, maintenance or modification is performed on your light curtain or the machinery it is connected to.

Failure to comply with these instructions will result in death or serious injury.

⚠ DANGER

CHANGE IN STOPPING TIME REQUIRES SAFETY DISTANCE ADJUSTMENT

- Repair your machinery stopping mechanism if its stopping time increases beyond the acceptable limit.
- Re-calculate the light curtain safety distance, using the new stopping time.
- Adjust the location of the light curtain(s) accordingly.
- Perform the test procedure before operating the equipment.

Failure to comply with these instructions will result in death or serious injury.

The purpose of these tests is to verify that the Shadow 10 is operating correctly in terms of functionality and performance before putting the machine into operation.

⚠ DANGER

Make sure to test the operation of the safety light curtain after installation to verify that it operates as intended. Make sure to stop the machine until the test is complete. Unintended function settings can cause a person to go undetected, resulting in serious injury.

Failure to comply with these instructions will result in death or serious injury.

The test procedure must be carried out as follows:

- Check that the safety light curtain (and any other safety device that might be part of the guarding system) have been selected in strict compliance with all the applicable machine safety standards and local regulations regarding occupational safety and that they meet the protection levels required by the risk assessment.
- Check that the safety light curtain is properly installed and integrated into the machine control system according to the instructions described in this document. Use the verification checklist in Appendix A, page 97, as a guideline.
- Check the effectiveness of the safety light curtain.

- Ensure that the operators of the guarded machine are correctly trained by qualified safety personnel before being allowed to operate the machine. Instruction of machine operators is the responsibility of the machine owner.

Daily Functional Test

This test is intended to check the effectiveness of the protective field and should be performed by qualified personnel after every system power-up and/or configuration changes. If the system is continuously powered up, the functional test should be performed at least every 24 hours.

This test is also required after every change to the configuration parameters of the safety light curtain (e.g., blanking modes) or in the guarded machine (e.g. tool changes).

The test procedure must be carried out as follows:

- Use a 0.866 in. (22 mm) diameter test rod provided with the Shadow 10 light curtain. The test rod must be free of deformations.
- Before introducing the 0.866 in. (22 mm) test rod into the protective field, verify the status of the receiver head's indicators and check that the OSSD LED (see Figure 3-3, page 26) is lit in green or, if the system is going to be tested with the interlock function enabled, verify that the interlock is engaged and that the yellow LED is blinking while the OSSD LED is lit in red. If these pre-conditions are not satisfied, the test is meaningless.
- Introduce the 0.866 in. (22 mm) test rod into the protective field and slowly move it around the detection zone. When the restart interlock function is not used, the OSSD LED will change to red as the 0.866 in. (22 mm) test rod enters into the protective field. If the restart interlock is engaged, the yellow indicator will turn off while the OSSD LED stays lit in red. Note: according to IEC 61496-2, the maximum rod speed must not exceed 5.25 ft/s (1.6 m/s).
- Throughout the entire test procedure, the OSSD LED must be constantly lit in red while the other LEDs must remain off.

⚠ DANGER

Never operate the machine if the test does not provide the expected results. If the OSSD LED turns green or the yellow LED lights up during the test, even for a short period, the installation must be verified by qualified personnel before use.

⚠ DANGER

If the fixed blanking function is in use, the test must be carried out for all sections of the protective field between the blanked areas. The same applies to all sides of the protective field defined by the use of deflection mirrors.

Periodic Inspection

Depending on the applicable regulations, particular application and operation conditions, the Shadow 10 safety light curtain must be periodically tested by qualified and trained personnel.

The purpose of these inspections is to detect changes in the operational conditions of the machine (e.g. stopping time) or manipulations to the installation or protective devices that might affect the safety. If required, light curtain effective detection capability can be verified during the light curtain start up process (value is shown on the receiver head’s display).

Maintenance

The Shadow 10 safety light curtain does not have any moving parts and so requires limited preventive maintenance.

CAUTION

PREVENT DAMAGE TO LENS WINDOWS FROM CLEANING

Use only a mild detergent and a soft cloth to clean lens windows.

DO NOT use solvents such as paint thinner, benzene, or acetone, or other chemicals. These can damage the product's resin components and paint.

Failure to comply with these instructions may result in property damage.

The front shield of the light curtain should be cleaned regularly and when dirty. Depending on the degree of dirt build up, a soft brush or a soft cloth dampened with water can be used.

In no case should aggressive or abrasive cleaning agents be used to clean the front shield, otherwise the operation range could be reduced and optical degradation may occur.

⚠ DANGER

The Shadow 10 safety light curtain does not contain any field serviceable parts. Do not try to disassemble, repair or modify this product. Doing so may cause the safety functions to stop working properly and the overall system safety cannot be guaranteed.

Any attempt by unauthorized personnel to disassemble, repair or modify the Shadow 10 safety light curtain will void the product's warranty.

The Shadow 10 safety light curtain must be replaced after reaching its maximum service life indicated on the technical specifications. For removal and disposal information, see *Chapter 9 – Decommissioning*, page 91.

Chapter 8 – Troubleshooting

⚠ DANGER

PERFORM ONLY AUTHORIZED REPAIRS

- Replace only the power fuse and control relay board.
- Obtain replacement fuse and relay board from Wintriss Controls.
- DO NOT replace any other components. If you do, this will violate the warranty.
- Ensure that repairs are made by qualified personnel. Improper repair by unqualified personnel may put operators at risk of injury.

Failure to comply with these instructions will result in death or serious injury.

⚠ WARNING

GUARD AGAINST ELECTRIC SHOCK HAZARD

- Ensure that the power source is off before checking or replacing fuses.
- Turn off and disconnect power from the Shadow 10 safety light curtain and from the machinery it is connected to, including the machine control and motor, before making any wiring connections.
- Ensure that all procedures are performed by qualified personnel.

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

CAUTION

DO NOT MAKE OR BREAK CONNECTIONS WITH POWER ON

Power down Shadow 10 before connecting or disconnecting any wiring at the control, transmitter, or receiver.

Failure to comply with these instructions could result in property damage.

Lock-out Codes

Upon the occurrence of certain faults or configuration errors, the Shadow 10 will deactivate its safety outputs and will go into lock-out state. Lock-out conditions will be indicated on the affected head by a constant illumination of the yellow indicator.

When in lock-out condition, receiver heads can also provide diagnostic information through an error code shown on the seven-segment display of the receiver head (see Table 8-1, below).

To recover from a lock-out condition, the originating cause must be removed, and the system must be restarted by switching off and on the power supply.

⚠ DANGER

Under any lock-out or error condition, the installation must be thoroughly checked and the problem investigated by qualified personnel. If the cause of the malfunction cannot be clearly identified the guarded machine should not be used.

*Table 8-1. Lock-out Codes**

Display	Meaning
1	Invalid EDM feedback (either invalid logic level or timing violation)
2	Short-circuit at OSSD(s) output(s), either to 24 V DC, 0 V DC or to the other OSSD
3	Not used
4	RST input malfunction (permanent ON state, e.g. open circuit)
5	Not used
6	Not used
7	Configuration parameters corrupted (use clearing procedure 5.3.2, p. 57)
F	System fault (Reset Shadow 10. If the problem persists, the head must be replaced)

* Press and hold the FCN button for more than 5 seconds while the system is in lock-out state to show a 4-digit error code. Record this code for use by Wintriss Technical Support.

Alignment Troubleshooting

If the system fails to align, verify that the optical path between the sync beam on both transmitter and receiver heads is free from obstructions (see *Sync Beam*, page 25). Also verify that both transmitter and receiver heads are using the same scan code settings. (see *Parameter Code* 1: Scan Code, page 79 and *Transmitter Head Configuration*, page 73).

Technical Support

If you find that an error condition cannot be clearly defined and corrected with the help of the information provided in this manual, please contact Wintriss Tech Support (see front cover for contact information).

Chapter 9 – Decommissioning

The safety light curtain may be removed only if the machinery where it is installed will be put out of service definitively. This has to be done by removing the mains supply from the machinery and it must be impossible to bring it back into service without the use of tools.

If a decommissioned safety light curtain has to be disposed of, follow the current local regulations regarding waste recycling and disposal.

Chapter 10 – Technical Specifications

General Specifications

The following table shows the general specifications common to all Shadow 10 head types.

Table 10-1. General Specifications

		Minimum	Typical	Maximum
Protective field height (depending on model)		11.8 in. (300 mm)	—	59.0 in (1500 mm)
Detection capability		⌀0.866 in. (⌀ 22 mm)		
Detection range*		3.9 in. (0.1 m)	26.25 ft (8 m)	32.8 ft (10 m)
Effective aperture angle		—	—	± 2.5°
Supply voltage (Us)		19.2 V	24 V	28.8 V
Residual input voltage ripple		—	—	± 10 %
Safety	Type according to IEC 61496	—	Type 4	—
	SIL according to IEC 61508	—	SIL 3	—
	SILCL according to IEC 62061	—	SILCL 3	—
	Performance level ISO 13849 1	—	PL e	—
	Category as per ISO 13849	—	Cat. 4	—
	Service life	—	—	20 years
	Probability of a failure to danger PFHd	—	5.5E−9 h^{-1}	—
	Probability of a failure to danger $PFD_{av}(T)$	—	4.8E−4	—
	$MTTF_d$	—	1.5E6 h	—
Environmental	Enclosure rating (IEC 60529)	IP 65		
	Protection class (IEC 50178)	III		
	Operating ambient temperature	32 °F (0 °C)	—	122 °F (50 °C)
	Storage ambient temperature	–4 °F (–20 °C)	—	140 °F (60 °C)
	Relative humidity	15 %	—	95 %
	Rigidity	5 g, 10..55 Hz as per IEC 60068 2 6		
	Shock	10 g, 16 ms, as per IEC 60068 2 29		
Material	Main body	Aluminum (epoxy coated, gray)		
	End caps	Aluminum (anodized, black)		
	Front cover	Polycarbonate		
Standards	EMC	IEC 61000 4 3/4/5/6		
	Safety	IEC 61496 1 Type 4 ESPE		
		IEC 61496 2 Type 4 AOPD		
		IEC 61508 SIL3		

*Typical value is guaranteed for all operating conditions.

Transmitter Specifications

The following table shows the specifications for Shadow 10 transmitters:

Table 10-2. Transmitter Specifications

		Minimum	Typical	Maximum
Power consumption (at 24 VDC)		—	—	0.3 A
Wavelength of IR emission		—	940 nm	—
Inputs (Test and CS)	Input voltage HIGH state	14.5 V	24 V	30 V
	Input current HIGH state	1.5 mA	5 mA	8.5 mA
	Response time (test input)	—	—	150 ms

Receiver Specifications

The following table shows the specifications for the Shadow 10 receivers:

Table 10-3. Receiver Specifications

		Minimum	Typical	Maximum
Power consumption (no load) (@ 24 VDC)		—	—	0.3 A
Ambient light resistance	White incandescent lamp	—	—	5000 lx
	Sunlight	—	—	20000 lx
OSSD Outputs	Switching current	—	—	500 mA
	Leakage current	—	—	100 µA
	OFF state voltage (inactive)	—	—	2.5 V
	ON state voltage (active)	Us – 2.5 V	24 V	US
	Load capacitance	—	—	2.2 µF
	Load inductance	—	—	2.2 H
	Load wiring resistance	—	—	2.5 Ω
	Test pulse width	100 µs	150 µs	200 µs
	Test pulse rate	—	5 s^{-1}	—
	Response time	See Table 10-5, page 95		
Inputs (all)	Input voltage HIGH state	14.5 V	24 V	30 V
	Input current HIGH state	1.5 mA	5 mA	8.5 mA
	Response time	—	—	150 ms

Optional Control Box Specifications

The following table shows the specifications for the Shadow 10 optional control box:

Table 10-4. Optional Control Box Specifications

	Shadow 10 Optional Control Box for 24VDC ESTOP	Shadow 10 Control Box for 110VAC ESTOP
Part Number	9688603	9688604
Temperature	-10 to 55°C (14 to 131°F)	-10 to 55°C (14 to 131°F)
Response Time	12.6 ms	24.6 ms
Input Power	100-240VAC 50/60Hz 0.19/0.12A	100-240VAC 50/60Hz 0.22/0.15A
Enclosure	NEMA 12	NEMA 12

Response Time

The response time of the Shadow 10 light curtain depends only on the total number of beams on the system.

The following table shows the maximum response time values of a single head system for the Shadow 10 for all available protective field lengths.

Table 10-5. Response Time as Function of Detection Capability and Protective Field Length

0.866 in. (22 mm) Detection Capability	
Protective Field Length	**Maximum Response Time (ms)**
11.8 in. (300 mm)	15
17.7 in. (450 mm)	18
23.5 in. (600 mm)	21
29.5 in. (750 mm)	25
35.4 in. (900 mm)	28
47.2 in. (1200 mm)	35
59.0 in. (1500 mm)	42

Dimensional Drawings

The following drawing shows the general dimensions of the Shadow 10 safety light curtains. The protective field height (H) and the overall head length (L) for each size of the Shadow 10 are tabulated in Table 10-6. All the mechanical dimensions apply to both transmitter and receiver heads.

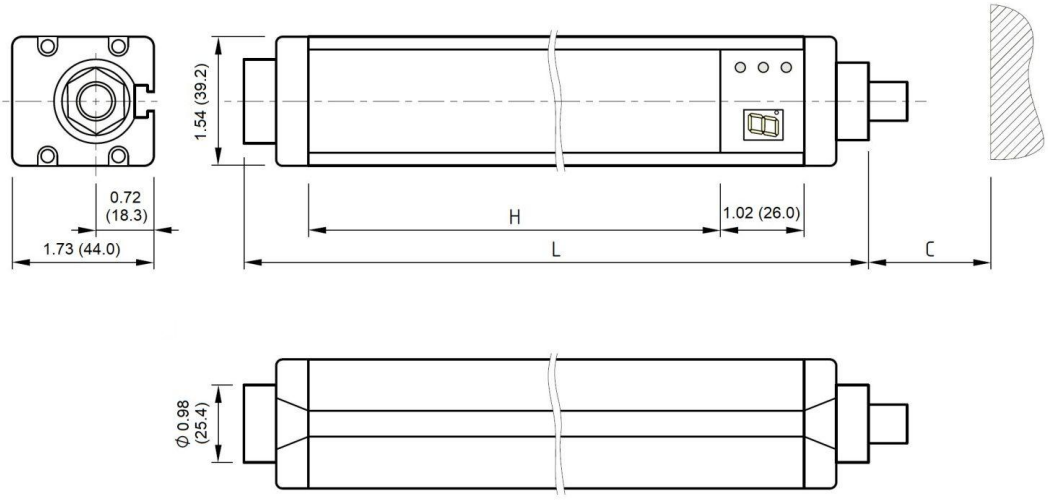


Figure 10-1. Shadow 10 Dimensions

The Shadow 10 safety light curtain can be mounted by means of split collar mounting brackets at the top and bottom caps or, by using sliding nuts in the dedicated channel at the back of the head.

When mounting the Shadow 10 safety light curtain, a minimum clearance (dimension C) of 3.9 in. (100 mm) shall be provided at the connector end(s) of the head for proper connector placement and cable dressing.

Table 10-6. Mechanical Dimensions (refer to Figure 10-1)

Shadow 10 protective field height	H in. (mm)	L in. (mm)	C in. (mm)
11.8 in. (300 mm)	11.8 (300)	14.6 (370)	3.9 (100)
17.7 in. (450 mm)	17.7 (450)	20.5(520)	3.9 (100)
23.5 in. (600 mm)	23.5 (600)	26.4 (670)	3.9 (100)
29.5 in. (750 mm)	29.5 (750)	32.3 (820)	3.9 (100)
35.4 in. (900 mm)	35.4 (900)	38.2 (970)	3.9 (100)
47.2 in. (1200 mm)	47.2 (1200)	50 (1270)	3.9 (100)
59.0 in. (1500 mm)	59.1 (1500)	61.8 (1570)	3.9 (100)

Appendix A – Verification Checklist

This checklist covers the minimum requirements for verification tests. However, since additional criteria may be necessary depending on both the machine to be guarded and the applicable standards and regulations of the country or region where the system is installed, it is strongly recommended to include in this checklist the necessary additional items based on the judgement of qualified personnel.

Once completed, this checklist should be kept on record along with the machine documentation for future reference during the subsequent regular inspections.

Table A- 1. Verification Checklist

Have the safety rules and regulations been observed in compliance with the directives and standards applicable to the machine to be guarded?	YES □ NO □
Are the applied directives and standards listed in the declaration of conformity? (for OEMs)	YES □ NO □
Are the transmitter and receiver heads properly mounted and secured to prevent displacement or rotation after the optical alignment?	YES □ NO □
Is the safety distance calculated in accordance with the valid formulas for the intended safeguarding application, while taking into account the effective detection capability and response time of the AOPD, the response time of safety interface devices (if used) and the overall stopping time of the guarded machine?	YES □ NO □
Is the minimum distance observed at all points of the protective field?	YES □ NO □
Is the AOPD effective during the entire dangerous movement of the machine?	YES □ NO □
Has the protective field been checked in compliance with the procedure described in Chapter 7?	YES □ NO □
Does the external power supply conform to the EMC and PELV/SELV directives and output specifications given in this document?	YES □ NO □
Are the electrical connections between the AOPD and machine control compliant to the circuit diagrams?	YES □ NO □
Are the safety outputs of the ESPE wired to the mainstream machine control in compliance with the required safety category?	YES □ NO □
Are all connectors and cables appropriate for the application and free from damage?	YES □ NO □
If the start interlock function is required, is the dangerous movement of the machine stopped immediately if the power supply voltage of the AOPD is interrupted and then restored?	YES □ NO □

Appendix B – Parameters Quick Reference

The table on the next page summarizes the Shadow 10 configuration parameters and the state of the LED indicators for each of their respective values. Print a copy and keep it handy during the parameterization procedure.

Table B-1. Parameters Quick Reference

Parameter		Options		
Code	**Name**	**Configuration Value**	**BLUE**	**YELLOW**
1	Scan Code	CODE A (Default)	○	○
		CODE B	○	●
2	Interlock Function	DISABLED (Default)	○	○
		START INTERLOCK	○	●
		RESTART INTERLOCK	●	○
		BOTH	●	●
3	EDM Function	DISABLED (Default)	○	○
		ENABLED	○	●
4	Fully Monitored Blanking	00 (Teach Disabled)	○	○
		01 (Teach 25% Max Beams) (Default)	●	○
		02 (Teach 50% Max Beams)	○	●
		03 (Teach 100% Max Beams - Except Sync Beam)	●	●
6	Blanking Tolerance, Positive	DISABLED	○	○
		1 Beam (Default)	●	○
		2 Beams	○	●
		3 Beams	●	●
7	Blanking Tolerance, Negative	DISABLED	○	○
		1 Beam (Default)	●	○
8	Floating Blanking	DISABLED (Default)	○	○
		1 Beam	●	○
		2 Beams	○	●
		3 Beams	●	●
9	Floating Mode	SINGLE (Default)	○	○
		MULTIPLE	●	○

Appendix C – Compliance

UL, CSA, CE, OSHA, and ANSI Compliance

Shadow 10 has undergone independent testing, certification, and/or approval by the following bodies:

1. The Shadow 10 is electro-sensitive protective equipment (ESPE) in accordance with European Union (EU) Machinery Directive Index Annex V, Item 2.
2. EC/EU Declaration of Conformity
   Wintriss declares that the Shadow 10 is in conformity with the requirements of the following EC/EU Directives:
   Machinery Directive 2006/42/EC
   EMC Directive 2004/108/EC, 2014/30/EU
3. Conforming Standards

   (1) European standards EN61496-1 (Type 4 ESPE), EN 61496-2 (Type 4 AOPD), EN61508-1 through -4 (SIL 3 for Type 4 and EN ISO 13849-1:2015 (PL e, Category 4 for Type 4)

   (2) International standards
   IEC61496-1 (Type 4 ESPE), IEC61496-2 (Type 4 AOPD), IEC61508-1 through - 4 (SIL 3 for Type 4), ISO 13849-1:2015 (PL e, Category 4 for Type 4)

   (3) North American standards
   UL61496-1(Type 4 ESPE), UL61496-2 (Type 4 AOPD), UL508, UL1998, CAN/CSA C22.2 No.14, CAN/CSA C22.2 No.0.8
4. EC Declaration of Conformity

   Wintriss Controls Group, LLC

   100 Discovery Way, Unit 110

   Acton, MA 01720

   USA

Declares that the Shadow 10 series of safety light curtains are in conformity with the requirements of the following EC machinery directives:

- 2006/42/CE Machinery Directive
- 2004/108/CE Electromagnetic Compatibility Directive
- 2006/95/CE Low Voltage Directive

and that they are developed and produced in compliance with the following standards:

- IEC 61496-1:2012 + Corr. 1:2015 and IEC 61496-2:2013
- IEC 61508-1/7:2010
- IEC 62061:2005 + Corr:2010 + AC: 2010 + A1:2013 + A2: 2015
- EN ISO 13849-1:2015
- IEC 60204-1:2009

- IEC 50178:1997
- ANSI B11.19:2010
- ANSI/RIA R15.06:2012

The conformity to the EC directives and standards of the Shadow 10 type models herein listed has been assessed and certified by TÜV Rheinland Industrie Service GmbH, Am Grauen Stein, 51105 Köln, Germany with certificate number 01/205/5263/12.

5. Third-Party Certifications

   (1) TÜV Rheinland

   - EC Type-Examination certificate: EU Machinery Directive, Type 4 ESPE (EN61496-1), Type 4 AOPD (EN 61496-2)
   - Certificate: Type 4 ESPE (EN61496-1), Type 4 AOPD (EN61496-2), EN 61508-1 through - 4 (SIL 3 for Type 4), EN ISO 13849-1:2015 (PL e, Category 4 for Type 4)

   (2) UL

   - UL Listing: Type 4 ESPE (UL61496-1), Type 4 AOPD (UL61496-2), UL508, UL1998, CAN/CSA C22.2 No.14, CAN/CSA C22.2 No.0.8

6. Other Standards
   The Shadow 10 is designed according to the standards listed below. To make sure that the final system complies with the following standards and regulations, you are asked to design and use it in accordance with all other related standards, laws, and regulations. If you have any questions, consult with specialized organizations such as the body responsible for prescribing and/or enforcing machinery safety regulations in the location where the equipment is to be used.

   - European Standards: EN692, EN693, IEC/TS 62046
   - U.S. Occupational Safety and Health Standards: OSHA 29 CFR 1910.212
   - U.S. Occupational Safety and Health Standards: OSHA 29 CFR 1910.217
   - American National Standards: ANSI B11.1 to B11.19
   - American National Standards: ANSI/RIA R15.06
   - Canadian Standards Association CSA Z142, Z432

These rules mandate that a single component failure cannot jeopardize operator safety. Critical components must be duplicated and continually cross-checked during operation to guarantee that a single component failure can never create an unsafe condition. Self-checking circuitry must be able to detect the presence of any faults and of signaling the press to stop.

Appendix D – Extracts from OSHA Regulations and ANSI Standards

⚠ WARNING

REFER TO CURRENT REVISIONS OF OSHA/ANSI DOCUMENTS

The following extracts from OSHA and ANSI documents are provided for the user's convenience only. Refer to the most recent revisions of the original OSHA safety regulations and ANSI standards to ensure that you have the most up-to-date information.

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

This appendix provides extracts from the Occupational Safety and Health Administration (OSHA) regulations and the American National Standards Institute (ANSI) standards covering presence-sensing devices.

Extracts from OSHA Regulation 1910.217

⚠ WARNING

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Reprinted below are extracts from OSHA regulation 1910.217 pertaining to the use of presence-sensing devices for point-of-operation guarding on mechanical power presses. Also reprinted here are interpretations of selected regulations provided by the Precision Metalforming Association (PMA). Extracts from the OSHA regulation are printed in the left- hand column; interpretations by PMA are shown in the right-hand column.

Wintriss makes no claim for the accuracy or effectiveness of the PMA interpretations, and persons making use of this material do so at their own risk. PMA interpretations should not be relied upon for use in any specific application. The material is provided, with PMA's permission, for informational purposes only.

Refer to the most recent versions of OSHA documents. To obtain copies of OSHA regulations, write to OSHA's Office of Information and Consumer Affairs, 200 Constitution Avenue NW, Room N3647, Washington, DC 20210. tel (202) 219-8151; toll free 800-321-6742; fax (202) 219-5986.

Extracts from OSHA Regulation 1910.217

OSHA 1910.217 (c).

(c) SAFEGUARDING THE POINT OF OPERATION. –

(1) General requirements.

(i) It shall be the responsibility of the employer to provide and insure the usage of "point of operation guards" or properly applied and adjusted point of operation devices on every operation performed on a mechanical power press. See Table 0-10.

OSHA 1910.217 (c) (3) (i) (a)

(3) Point of operation devices.

(i) Point of operation devices shall protect the operator by:

(a) Preventing and/or stopping normal stroking of the press if the operator's hands are inadvertently placed in the point of operation.

OSHA 1910.217 (c) (3) (iii)

(iii) A presence-sensing point of operation device shall protect the operator as provided in paragraph (c) (3) (i) (a) of this section, and shall be interlocked into the control circuit to prevent or stop slide motion if the operator's hand or other part of his body is within the sensing field of the device during the downstroke of the press slide.

(a) The device may not be used on machines using full revolution clutches.

(b) The device may not be used as a tripping means to initiate slide motion

(c) The device shall be constructed so that a failure within the system does not prevent the normal stopping action from being applied to the press when required, but does prevent the initiation of a successive stroke until the failure is corrected. The failure shall be indicated by the system.

(d) Muting (bypassing of the protective function) of such device, during the upstroke of the press slide, is permitted for the purpose of parts ejection, circuit checking and feeding.

(e) The safety distance (Ds) from the sensing field to the point of operation shall be greater than the distance determined by the following formula:

Ds = 63 inches/second x Ts, where

Ds = minimum safety distance (inches);

63 inches/second = hand speed constant;

and

Ts = stopping time of the press measured at approximately 90° position of crankshaft rotation (seconds).

(f) Guards shall be used to protect all areas of entry to the point of operation not protected by the presence-sensing device.

OSHA 1910.217 (c) (3) (5)

(5) Additional requirements for safe-guarding.

Where the operator feeds or removes parts by placing one or both hands in the point of operation, and a two hand control, presence-sensing device, Type B gate or movable barrier (on a part revolving clutch) is used for safeguarding:

(i) The employer shall use a control system and brake monitor which comply with paragraphs (b) (13) and (14) of this section. This requirement should be complied with by November 1, 1975.

OSHA 1910.217 (c) (3) (vii) (c)

(c) The safety distance (Ds) between each two hand control device and the point of operation shall be greater than the distance determined by the following formula:

Ds = 63 inches/second x Ts, where

Ds = minimum safety distance (inches);

63 inches/second = hand speed constant;

and

Ts = stopping time of the press measured at approximately 90° position of crankshaft rotation (seconds).

OSHA 1910.217 (e) (1)

(e) INSPECTION, MAINTENANCE, AND MODIFICATION OF PRESSES

(i) It shall be the responsibility of the employer to establish and follow a program of periodic and regular inspections of his power presses to insure that all their parts, auxiliary equipment, and safeguards are in safe operating condition and adjustment. The employer shall maintain records of these inspections and the maintenance work performed.

(ii) Each press shall be inspected and tested no less than weekly to determine the condition of the clutch/brake mechanism, anti-repeat feature and single stroke mechanism. Necessary maintenance or repair or both shall be performed and completed before the press is operated. The employer shall maintain records of these inspections and the maintenance work performed. These requirements do not apply to those presses which comply with paragraphs (b) (13) and (14) of this section.

Extracts from ANSI Standards for Presence-Sensing Devices

⚠ WARNING

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Reprinted below are the American National Standards Institute (ANSI) standards for presence-sensing devices (light curtains). ANSI, a national federation of trade associations, technical societies, professional groups, and consumer organizations, is the United States clearinghouse and coordinating body for voluntary standards activity. Approximately 1000 companies are affiliated with the Institute as company members.

ANSI creates voluntary standards to eliminate duplication and to weld conflicting standards into single, nationally accepted standards under the designation "American National Standards." The standards reflect a national consensus of manufacturers, consumers, scientific, technical, and professional organizations, and governmental agencies.

Shown below are extracts of standards requirements and explanatory information from ANSI B11.1-2009 and B11.19-2010 for presence-sensing devices (light curtains). Complete versions of these documents can be obtained by writing to: ANSI, 1430 Broadway, New York, NY 10018.

Extracts from ANSI B11.1-2009 8.6.2.1

Standards Requirements	Explanatory Information
8.6.2.1.7 Each operator's hand controls shall be located at a distance from the point-of-operation so that the operator(s) cannot release either hand actuating control and reach into the point-of-operation during the hazardous portion of the cycle.	**E8.6.2.1.7** The total stopping time of the press should include the total response time of the control system and the time it takes hazardous motion to stop. The following formula should be used when calculating the safety distance (Ds): Ds = K (Ts + Tc + Tbm) Where: K = 63 inches/second (hand speed constant). Ts = the stop time of the press measured from the final de-energized control element, usually the air valve. Tc = the response time of the control. Tbm = the additional time allowed by the stopping-performance monitor (brake monitor) before it detects stop time deterioration.

Extracts from ANSI B11.1-2009 8.6.2.1

Standards Requirements	Explanatory Information
	NOTE – Ts + Tc are usually measured by a stop time measuring device. When the press stopping-performance monitor setting is changed, the safety distance should be recalculated. See also Annex C.
8.6.3 Presence-sensing safeguarding device	
8.6.3.1 A presence-sensing device, when used for safeguarding, shall protect the operator as specified in E8.6.1 (a).	**E8.6.3.1** Various presence-sensing devices employ different sensing and adjustment techniques. The point at which a device responds to an intrusion can vary. Safety mats and area scanners may not be suitable (effective) safeguards when utilized as primary point-of-operation safeguarding. Factors which can affect this suitability include but are not limited to: a) response time; b) minimum object sensitivity; c) measurement accuracy; d) breach ability; e) penetration before detection; f) single point of failure; g) large safety distances. These devices may be utilized as supplemental safeguarding.
8.6.3.2 The device shall be interfaced with the control circuit to prevent or stop slide motion if any object is within the sensing field of the device during the hazardous portion of the cycle.	**E8.6.3.2** The device should be located or adjusted so that the device always responds to the intrusion at or prior to the safety distance Ds. Also, care should be taken when installing the device so that it does not detect false signals from other devices or equipment in the area. The presence-sensing device cannot protect against a catastrophic failure of the press, which causes unintended cycling action. See Annex A, Figure A.3.
8.6.3.3 The device shall not be used for safeguarding the point-of-operation on presses using full-revolution clutches.	

Extracts from ANSI B11.1-2009 8.6.2.1

Standards Requirements	Explanatory Information
8.6.3.4 When the sensing field has been interrupted, use of the normal press cycle-actuating means shall be required after clearing the sensing field to resume press operation. 8.6.3.5 When the device is used in the PSDI mode, re-initiation of the press motion shall be in accordance with 6.4.3.8.1.	
8.6.3.6 Muting of the device shall be permitted only during the non-hazardous portion of the press cycle	**E8.6.3.6** Muting is typically accomplished by interface circuits or auxiliary controls. The die closing portion of the cycle is always considered hazardous. In some cases, feeding and transfer automation or die features can cause additional hazardous conditions even during the opening portion of the cycle (upstroke). See also ANSI B11.19 for additional information.
8.6.3.7 Muting of the device shall be accomplished in a manner that conforms to the requirements of 6.11 and 8.8.	**E8.6.3.7** Muting is typically accomplished by interface circuits or auxiliary controls. The muting element should incorporate a similar level of control reliability as the presence-sensing device itself. A simple cam-operated limit switch wired in parallel with the device's output is inadequate, as its failure can remain undetected.
8.6.3.8 The device shall have an identifiable minimum object sensitivity so that an obstruction of an equal or greater size will be detected anywhere within the sensing field regardless of the plane of intrusion.	**E8.6.3.8** The device should have a minimum object sensitivity stated by the device supplier. For example, an electro-optical device may detect a 32 mm (1¼ inch) diameter opaque object anywhere in its sensing field but allow 25 mm (1 inch) obstructions to pass undetected at certain points in the field.
8.6.3.9 The device shall have a maximum response time, which shall not be affected by object sensitivity adjustments or environmental changes.	**E8.6.3.9** The device supplier should state the maximum total response time, including output devices, of the presence-sensing device.
8.6.3.10 Devices which require adjustments to accommodate variations in operating conditions, or which incorporate fixed blanking or floating blanking features, shall be designed so that the adjustments or features are capable of supervisory control by the user.	**E8.6.3.10** Typically, these adjustments or controls are key-operated or located under lockable covers.

Extracts from ANSI B11.1-2009 8.6.2.1

Standards Requirements	Explanatory Information
8.6.3.11 The device shall be provided with a means that visibly indicates when it is functioning properly.	**E8.6.3.11** Red and green indicators or other means that can be easily seen by the operator and others should be provided to indicate that the device is functioning.
Indication that the sensing field is being blanked shall be provided. For fixed blanking, the blanked area shall be identified. Supplemental safeguarding shall be provided to prevent access to the hazard through the fixed blanked area.	The blanking function of a presence-sensing safeguarding device desensitizes a portion of the sensing field by disabling one or more channels such that a specific interruption is ignored. Presence-sensing devices can be provided with either fixed or floating blanking. For fixed blanking, the desensitized area does not move or change once configured. Floating blanking allows the blanked area to move within the sensing field. Means to identify the desensitized area may include but are not limited to: a) Indicators within the device; b) Signage or marking of the fixed blanked area; c) The physical location of the object in the blanked area if movement or removal of the object can be detected and it results in a stop command. Means of supplemental safeguarding can include completely filling the fixed blanked area to restrict access to the hazard, installing the device at a distance that accounts for the worse case object sensitivity (see 8.6.3.16), or alternate safeguarding may be provided to prevent access to the hazard.
If means are provided to bypass the device, visible indication that the device is bypassed shall be provided	Means to provide visible indication may include but are not limited to: a) colored indicator lights; b) signage; c) physical position; d) awareness barrier (i.e., safety tape); e) other means.

Extracts from ANSI B11.1-2009 8.6.2.1

Standards Requirements	Explanatory Information
8.6.3.12 The device shall not fail to respond to the presence of the individual's hand or other body part due to the presence of a reflective object or workpiece.	
8.6.3.13 The device shall conform to the requirements of 6.11 and 8.8. In the event of a power failure to the device, the device shall initiate a stop command to the press control system.	
8.6.3.14 The interface of the presence-sensing device to the press control shall conform to the requirements of 6.11 and 8.8.	
8.6.3.15 The sensitivity of the device to intrusion shall not be adversely affected by changing conditions around the press.	
8.6.3.16 The effective sensing field of the device shall be located at distance from the nearest point-of-operation hazard so that individuals cannot reach into the point-of-operation with a hand or other body part before cessation of motion during the hazardous portion of the cycle.	**E8.6.3.16** The total stopping time of the press should include the total response time of the presence-sensing device, as stated by the supplier, the response time of the interface, the response time of the control system, and the time it takes the press to cease slide motion. The following formula should be used when calculating the safety distance: Ds = K (Ts + Tc + Tr + Tbm) + Dpf where K = 63 inches/second (hand speed constant) Ts = the stop time of the press measured from the final de-energized control element, usually the air valve Tc = the response time of the press control Tr = the response time of the presence-sensing device and its interface, if any, as stated by the supplier or measured by the user. Tbm = the additional stopping time allowed by the stopping-performance monitor before it detects stop time deterioration. Dpf = the added distance due to the penetration factor as recommended in ANSI B11.19, Annex D, Figure D.2. The minimum object sensitivity is stated by the supplier. If beam blankouts or

Extracts from ANSI B11.1-2009 8.6.2.1

Standards Requirements	Explanatory Information
	floating window features are used, these figures should be added to the object sensitivity figure before using the chart. NOTE - Ts + Tc is usually measured by a stop time measuring device. See also ANSI B11.19, Annex C and D. Whenever the press-cycle STOP command or stopping-performance monitor time or angle setting is changed, the safety distance should be recalculated. See also "stopping performance monitor" (6.12). NOTE – No increase in safety distance is required for fixed blanking applications if the blanked area is entirely occupied by the material or fixtures. In some instances, the use of blanking does not allow efficient production of certain piece parts. Horizontal placement of the sensing field, so that it detects that operator's waist area, may present a solution. In this application, the operator may freely manipulate the workpiece and operate the press as long as the operator stands outside of the horizontal sensing field. The sensing field should be located so that the operator cannot reach the point-of-operation prior to interrupting the sensing field and completion of the stopping action. Where possible, the sensing field should be of sufficient depth to prevent the operator from standing between the field and the point-of-operation. See also ANSI B11.19, Annex C and D.
8.6.3.17 If the position of the device will allow the operator or others to place themselves between the sensing field and the point-of-operation, additional means shall be provided in conjunction with the device to prevent the operator or others from exposure to the point-of-operation hazard.	**E8.6.3.17** Additional means may include manual reset outside of the sensing field of the device or additional barrier guards, safety mats, light curtains, or other devices. Operator controls for each operator located outside of the sensing field of the presence-sensing device may be used. As an alternative to the reset control and to prevent an individual from stepping behind the sensing field of a PSD, the maximum distance

Extracts from ANSI B11.1-2009 8.6.2.1

Standards Requirements	Explanatory Information
	between the light curtain and the machine structure should not exceed 75 mm (3 inches). Supplemental safeguarding may be utilized to eliminate a space greater than 75 mm.
8.6.3.18 The device shall not be affected by ambient light or by light-source decay so that the increase in response time or object sensitivity is greater than the value used to calculate the safety distance.	**E8.6.3.18** Examples of ambient light are associated with windows, light fixtures, skylights, bay doors, or die lights.
8.6.3.19 All areas of entry to the point-of-operation not protected by the presence-sensing device shall be otherwise safeguarded	**E8.6.3.19** Usually the electro-optical presence-sensing devise is used in a manner that provides a protected zone in front of the primary work area with auxiliary devices or guards used to protect secondary access areas. In some cases, mirrors may be used in conjunction with the device to provide two-, three- or four-sided protection.
8.6.3.20 Press production systems with a configuration that would allow an individual to enter, pass through, and become clear of the presence-sensing device sensing field shall not be operated in the PSDI mode of operation.	**E8.6.3.20** For PSDI applications see Clause 10.
8.6.3.21 When a device is used on a press production system and the protection of the operator is dependent upon the stopping action of the press, a stopping-performance monitor shall be required in conformance with 6.12. See section 8.3.9 for exceptions.	

Extracts from ANSI B11.19-2010 8.3

Standards Requirements	Explanatory Information
8.3 Electro-optical, RF, and area scanning presence-sensing safeguarding devices	
8.3.1 Design and construction	
8.3.1.1 The presence-sensing device shall be designed and constructed to create a field that detects the presence of an individual(s). The presence-sensing device shall not create a hazard in and of itself.	**E8.3.1.1** The presence-sensing device should be designed and constructed such that it does not present hazards to individuals from: • sharp edge or pinch point hazards; • radiated light or energy hazards; • electromagnetic interference hazards; • electrical shock hazards.
8.3.1.2 The presence-sensing device shall have a minimum object sensitivity such that an obstruction of a same or greater size will always be detected anywhere within its sensing field, regardless of the plane of intrusion. The RF (radio frequency) presence-sensing device shall provide means to adjust the sensitivity of the field. The field, once adjusted, shall not decrease in sensitivity below this established level.	**E8.3.1.2** The presence-sensing device should have a minimum object sensitivity stated by the supplier. For example, an electro-optical device may detect an opaque object with a diameter of 32 mm (1.25") anywhere in its sensing field, but allow an obstruction with a diameter of 25 mm (1") to pass undetected at certain points in the field.
8.3.1.3 The presence-sensing device shall not fail to change its output state, if not bypassed or muted, when it detects the presence of an individual.	
8.3.1.4 Adjustment or configuration of presence-sensing devices shall be capable of being supervised.	**E8.3.1.4** Methods of meeting this requirement include, but are not limited to, the use of key operated controls, controls located under lockable covers, or controls that require a tool or password to access. Adjustment or configuration should only be performed by authorized individuals. Adjustments or configuration can include, but are not limited to: • muting; • blanking; • power adjustments; • sensing field configuration; • reset functions.
8.3.1.5 The presence-sensing device shall incorporate visual means to indicate that the	**E8.3.1.5** Indicators, (usually red and green), displays or meters should be provided to

Extracts from ANSI B11.19-2010 8.3

Standards Requirements	Explanatory Information
device is detecting an individual within the effective sensing field of the device.	indicate the status of the presence-sensing device. The visual means may be integral to the presence-sensing device or part of the interface or machine control system. Due to the prevalence of color blindness (10% in males for red/green), methods such as unambiguous positioning, patterning, labeling or flashing of the indicators may be effective in providing the indication required.
8.3.1.6 The presence-sensing device shall have a maximum response time that shall not be affected by object sensitivity or environmental changes. The safeguarding supplier shall provide the maximum response time of the presence-sensing device.	
8.3.1.7 The electro-optical and area scanner presence-sensing devices shall not be affected by ambient light conditions or by changes in the device light source characteristics, such that an increase in response time or object sensitivity occurs.	**E8.3.1.7** When the electro-optical and area scanner presence-sensing devices are exposed to signals from other electro-optical presence-sensing devices or to changes in ambient light commonly associated with windows, light fixtures, skylights, bay doors or work area lights, the response time or object sensitivity should not be adversely affected.
8.3.1.8 Components, subassemblies or modules of electro-optical, RF, and area scanning presence-sensing devices shall conform to the requirements of 6.1, or shall be designed and constructed to meet the safety performance level (risk reduction) as determined by a risk assessment.	**E8.3.1.8** See also, clause 5 and ANSI B11.0 (B11.TR3).
8.3.1.9 The area scanning presence-sensing device shall provide a means or operating mode to verify the size, shape, and detection capabilities of the detection area or zone. Information shall be provided by the area scanning device supplier to identify the: • maximum safeguarding range; • minimum object sensitivity within the stated safeguarding range; • maximum field of view in degrees; • tolerance in the range measurement; and	**E8.3.1.9** These presence-sensing devices typically operate on the principle of ―diffuse reflectance," which is a principle of transmitting beam(s) of light to form a detection area or zone. When an object enters the detection area, it reflects the transmitted light back to the device, which then evaluates the object's position. The amount of reflected light (degree of reflectance in percent) that can be reliably detected typically ranges from 1.8% to over 90% and can be represented graphically by

Extracts from ANSI B11.19-2010 8.3

Standards Requirements	Explanatory Information
• detection capabilities with respect to the reflectivity of an object versus the distance to the object.	reflectivity versus distance. For more information see IEC 61496 parts 1 and 3.
8.3.2 Installation, operation and maintenance	
8.3.2.1 Exposure to the hazard(s) shall not be possible by reaching over, under or around the sensing field of the presence-sensing device. Additional guards or safeguarding devices shall be provided to protect those areas.	**E8.3.2.1** The user should select a presence-sensing device adequate to prevent individuals from reaching over, under or around the sensing field during the hazardous portion of the machine cycle. Additional safeguarding may be required in conjunction with the device to meet this requirement.
The effective sensing field shall be of adequate height, width, and depth so that entry of the individual into the hazard zone is detected.	If individuals can place themselves between the sensing field and the hazard zone, additional safeguarding should be used in conjunction with the device to prevent the individual from exposure to the hazard. It has been found by practical application that this situation can occur with as little as 75 mm (3″) depending on the positioning (e.g., height) and the minimum object sensitivity of the sensing field, and the ability of the individual to lean against the machine frame or guarding. It should not be possible to climb on or walk on the machine support structure to avoid detection by the presence-sensing device when the sensing field is orientated horizontally. When an individual can pass through the sensing field, it is considered perimeter guarding (see also, the requirements of 6.5 and 8.3.2.4). The electro-optical and area scanning presence-sensing devices may fail to detect an individual's presence due to reflective workpieces or objects in the vicinity of the device. Care should be used to ensure that these reflections do not render the device ineffective. Some examples of reflective objects include, but are not limited to: • machine surfaces; • tooling;

Extracts from ANSI B11.19-2010 8.3

Standards Requirements	Explanatory Information
	• work pieces; • hand tools; • auxiliary equipment; • workholding tables and fixtures. Testing each set-up for minimum object sensitivity should be done with an appropriate test rod, following the supplier's recommendation. Where objects are placed within the defined sensing field of an area scanner presence-sensing device, care should be taken to ensure that: • no shadows exist behind the objects such that the device is rendered ineffective; • removal of the object will not allow undetected access to a hazard zone.
8.3.2.2 The presence-sensing device shall be installed such that it does not create additional hazards.	E8.3.2.2 Some installation hazards include, but are not limited to: • pinch point hazards created by interference between the presence-sensing device and moving members of the machine; • tripping hazards; • electrical shock hazards; • overhead or other ―strike against" hazards; • thermal hazards. Where such conditions can exist, additional safeguarding may be required.
8.3.2.3 The presence-sensing device shall be installed at a location so that the effective sensing field prevents individuals from reaching the hazard(s) during the hazardous portion of the machine cycle.	**E8.3.2.3** The safety distance calculation is dependent upon the: • speed of approach of the individual; • total response time of the safeguarding device as stated by the supplier; • response time of the interface; • response time of the control system; • time it takes the machine to stop hazardous motion; and • depth penetration factor of the safeguarding device. See Annex D for further explanation and an example method to calculate the safety distance.

Extracts from ANSI B11.19-2010 8.3

Standards Requirements	Explanatory Information
	Additional methods might be used as determined by the supporting risk assessment documentation. For installations in which the direction of approach is perpendicular to the sensing field (i.e., normal approach), the minimum distance between the sensing field and the closest hazard should be no less than 100mm (4″) regardless of the outcome of a safety distance calculation. Practical application has shown that less than 100 mm (4″) of safety distance can result in increased risk of harm. See also, ISO 13855. RF presence-sensing devices have sensing fields that can vary due to: • antenna(e) design; • effects of adjacent machinery and equipment; • field sensitivity adjustments; and • environmental factors (such as humidity or temperature). Before the machine is used for production purposes, the RF presence-sensing device should be checked to ensure that the effective field protects individuals at the safety distance.
8.3.2.4 The presence-sensing device shall protect individuals from hazards by initiating an immediate stop command to the machine control system when the sensing field of the device is interrupted during the hazardous portion of the machine cycle. It shall require re-initiation of the normal actuating means prior to the start or continuation of motion of the machine.	**E8.3.2.4**
When an individual can pass through the sensing field of the presence-sensing device, the device shall initiate an immediate stop command to the machine control system and shall require that the device or machine control be manually reset before hazardous situation can occur.	The operator should ensure that no individual is in the safeguarded area before re-setting the presence-sensing device or machine control and initiating a hazardous situation.

Extracts from ANSI B11.19-2010 8.3

Standards Requirements	Explanatory Information
The reset function and devices shall comply with 6.5.	
8.3.2.5 Indication that the sensing field is being blanked shall be provided. For fixed blanking, the blanked area shall be identified. Supplemental safeguarding shall be provided to prevent access to the hazard through the fixed blanked area.	**E8.3.2.5** The blanking function of an electro-optical presence-sensing device desensitizes a portion of the sensing field by disabling one or more channels such that a specific interruption is ignored. Electro-optical presence- sensing devices can be provided with fixed or floating blanking. Floating blanking allows the blanked area to move within the sensing field. When floating blanking is enabled and the object sensitivity increases, the sensing field must be placed at a greater distance from the hazard, see 8.3.2.2 and Annex D and Figure D.1. For fixed blanking, the desensitized area does not move or change once configured. Means to identify the desensitized area may include but are not limited to: • indicators within the electro-optical presence-sensing device; • signage or marking of the fixed blanked area; • the physical location of the object in the blanked area if movement or removal of the object can be detected and results in a stop command. Means of supplemental safeguarding can include: • completely filling the fixed blanked area to restrict access to the hazard; • the electro-optical presence-sensing device installed at a distance that accounts for the worst case object sensitivity; (see 8.3.2.2) or • alternate safeguarding may be provided to prevent access to the hazard.
8.3.2.6 Components, subassemblies or modules of the interface or machine control system shall conform to the requirements of 6.1, or shall be designed and constructed to meet the safety	**E8.3.2.6** See also, clause 5 and ANSI B11.0 (B11.TR3).

Extracts from ANSI B11.19-2010 8.3

Standards Requirements	Explanatory Information
performance level (risk reduction) as determined by a risk assessment.	
8.3.2.7 Bypassing of the presence-sensing device shall comply with 6.6.	
8.3.2.8 Muting of the presence-sensing device shall comply with 6.7.	
8.3.2.9 The RF presence-sensing device shall not be adversely affected by changes around the machine that may alter the sensitivity of the device such that individuals are no longer detected in the sensing field at the proper safety distance.	**E8.3.2.9** The RF presence-sensing device may be affected by changes in the conditions around the machine such as ambient conditions, the placement of parts and tote boxes, grounding conditions of the operator, or the movement of industrial trucks. These changes should not adversely affect the performance of the device.
8.3.2.10 The total tolerance in the range measurement of an area scanning presence-sensing device shall be included in determining the distance from the nearest recognized hazard to the detection area or zone. This detection area shall be identified and tested to ensure that the device is able to detect individuals entering the detection area. The effective sensing field shall be verified for proper size and coverage upon installation, replacement, or changes of the detection area.	**E8.3.2.10** When the area scanning presence-sensing device is horizontally mounted, the detection area or zone should be visibly marked on the floor. This verification can be accomplished by using a programming device or by physically identifying the perimeter of the detection area with an appropriate test rod, following the supplier's recommendation. This verification is to ensure that a pre-programmed area scanning presence-sensing device with a small or improper detection area is not used by mistake in an installation requiring a larger field. Area scanning presence-sensing device may not be suitable (effective) safeguards when used to protect an individual's hands or fingers from hazards. Items which can affect this suitability are: • response time; • minimum object sensitivity; • measurement accuracy.

Extracts from ANSI B11.19-2010 Annex D

Annex D – Safety Distance

(Informative)

The safeguarding devices listed below do not prevent an individual from reaching into a hazard zone. In order for these devices to be effective, they must either prevent the start of, or stop hazardous motion (or situation) when an individual is exposed to the hazard. For the devices to accomplish this requirement, they must be located at a distance from the hazard such that hazardous motion (or situation) is prevented, completed or stopped before the individual can be harmed.

Devices that require location at a safety distance include, but are not limited to:

1. interlocked guards (non-locking);
2. two hand control devices;
3. two hand trip devices;
4. single control safeguarding devices;
5. electro-optical presence-sensing devices;
6. RF presence-sensing devices;
7. safety mat devices;
8. safety edge devices.

The first four devices protect individuals by positioning the individual at or beyond the safety distance before hazardous motion can be initiated, or by maintaining the individual's position at the safety distance after hazardous motion has been initiated. The remaining four devices protect individuals by detecting an individual entering (or their presence within) a hazard zone at or within the safety distance.

NOTE - Guards and movable barrier devices with various openings are located at a position away from the hazard zone based on the ability of the operator to reach through the opening. Figure D.9 is one method that may be used to locate guards.

The safety distance may be calculated using the following equation:

$Ds = K(T)$ Equation (1)

Where: Ds = the safety distance

K = the maximum speed that an individual can approach the hazard

T = the total time to stop hazardous motion which includes various factors as described below

The factor K is the speed constant and includes hand and body movements of an individual approaching a hazard zone. The following factors should be considered when determining K:

a) Hand and arm movement;

b) Twisting of the body or shoulder, or bending at the waist;

c) Walking or running.

One of the accepted values for K is the hand speed constant (it is usually considered as the horizontal motion of the hand and arm while seated). Its common value is 1.6 m/s (63 in/s) although other values (typically greater) are also used. The hand speed constant does not include other body movements,

which can affect the actual approach speed. Consideration of the above factors should be included when determining the speed constant for a given application.

The factor *T* is the total time that it takes for the hazardous motion to stop, or for the hazardous portion of the machine cycle to be completed. A power press may present a hazard during the closing portion of its cycle or a machining center may present a hazard during a tool change or while the tool is approaching the workpiece (trapping zone), but not present a hazard during the balance of the machine cycle.

T includes portions of time that vary by machine type and by the safeguarding device applied. The following affect the total stopping time:

a) Type of actuator;

I) Full revolution clutch, or machines that cannot be stopped during a machine cycle. See note 1.

II) Part revolution friction clutch, or machines that can be stopped at any point in the machine cycle or anywhere during the hazardous portion of the machine cycle. See note 2.

III) Braking mechanism. See note 3.

IV) Stopping capability of the motors and drive. See note 4.

b) Reaction time of valves. See note 5.

c) Reaction time of the machine control system. See note 6.

d) Reaction time of the safeguarding device, including its interface. See note 7.

e) Additional time required by the use of braking performance monitor. See note 8.

Note 1: Full revolution (pin) clutches have one or more engaging points within a rotation of the flywheel where the clutch can be engaged. Once engaged, the clutch completes a full revolution or cycle (stroke) before it is disengaged and brought to a stop. After the machine is tripped by the control system or mechanical treadle, pedal, hand controls or levers, the clutch typically engages after the flywheel rotates to the engaging position. Therefore, it is possible that the tripping device could have tripped the clutch just after the flywheel engaging point has passed and will not engage the clutch until the flywheel has rotated one full revolution. Assuming that the hazard exists during the closing portion of the cycle or stroke (provided that no hazards are generated during the opening portion), the time to stop hazardous motion could take up to one and a half times the time it takes the machine to complete one cycle (stroke). For clutches with only one engaging point the stopping time, *Ts*, is:

$$Ts = 1.5\ (Tmc) \qquad \text{Equation (2)}$$

Where: Tmc = the time it takes to complete a machine cycle (stroke)

Some clutches have multiple engaging points on the flywheel. Therefore, the clutch has more than one position where engagement can occur. The equation for calculation of this time, the stopping time Ts is:

$$Ts = (1/2 + 1/N)(Tmc) \qquad \text{Equation (3)}$$

Where: N = the number of engaging points on the flywheel

For machines that are tripped (or sequenced) to initiate the machine cycle, which in turn initiates immediate motion and which cannot be stopped until the completion of the machine cycle, the stopping time *Ts* is:

$$Ts = Thm \qquad \text{Equation (4)}$$

Where: *Thm* = the time, after initiation of motion, until hazardous motion is completed

Note 2: The stopping time, *Ts,* of part revolution clutch driven machines or machines that can be stopped at any point in the machine cycle or stopped anywhere during the hazardous portion of the machine cycle is equal to the time it takes to stop hazardous motion (see also, Note 3). If eddy current or other electromagnetic clutches are used, see Note 4.

Note 3: The stopping time, *Ts*, is the time it takes to disengage the clutch, the time it takes to apply the brake and the time it takes the brake to stop motion.

Note 4: The stopping time, *Ts*, for direct drive, motor driven machines utilizing full voltage motors, servo systems, vector systems or other variable speed systems, is equal to the time it takes to stop hazardous motion after a stop command or signal is given to the motor contactor or drive system. This time should take into consideration both uncontrolled stops (category 0) and controlled stops (categories 1 and 2) including dynamic braking. See ANSI / NFPA 79.

Note 5: The stopping time, *Ts*, of machines actuated or controlled by pneumatic or hydraulic valves must include the reaction time of the valve measured from the time that the valve is de-energized until motion is stopped. Stopping time for systems using valves may be affected by high or low supply pressures, exhaust restrictions, sluggish spools or poppets or performance of the pilot sections.

Note 6: Control systems inherently have a delay from the time its inputs or the system logic initiate a stop command, until the system's output de-energizes the actuator. This time, Tc, is the reaction time of the control system.

Note 7: Safeguarding devices also have a delay from the time that they sense the presence, or absence (for hand controls and trips or hostage controls) of individuals. Additionally, there may be a delay caused by the interface between the device and the control system. The interface may, as an example, include interposing relays. The interface delay must be added to the total delay time. This time, *Tr*, is the reaction time of the device and its interface. The reaction time of the device, without the interface, is stated by the device manufacturer.

Note 8: Stopping performance monitors are used to assure that a gradual increase in the stopping time caused by the degradation of components does not exceed the stopping time used to calculate the safety distance for the safeguarding device. Stopping time at the end of a machine cycle is usually different than the stopping time during the hazardous portion(s) of the cycle, and since these times may vary due to such factors as machine temperature, tool loading and energy transferred to the workpiece, a factor, *Tspm*, must be added to the total stopping time.

Tspm is a calculated factor. As an example, if the monitor is set to a point or time 5% greater than the normal stopping position or time, then *Tspm* is equal to 5% of *Ts* ...

Therefore, the total stopping time is the sum of these factors and may be represented by the following equation:

$$T = Ts + Tc + Tr + Tspm \qquad \text{Equation (5)}$$

Stop time measuring devices are normally used to measure these times. When using these devices, *Ts* can be measured from the output of the control system until motion is stopped. Likewise, *Ts* + *Tc* can be measured from the input to the control system. Some stop time measuring devices include plungers and flags that are used to simulate operation by an individual. When using this type of device, it is possible to measure *Ts* + *Tc* + *Tr*. (Use the manufacturer's value for Tr, when provided).

Substituting *Ts* + *Tc* + *Tr* + *Tspm* for *T* in Equation 1, the equation for calculating the safety distance becomes:

$$Ds = K\,(Ts + Tc + Tr + Tspm) \qquad \text{Equation (6)}$$

An additional distance needs to be added to the safety distance when using electro-optical devices, safety mats, single control safety devices and RF devices.

Electro-optical and RF devices do not detect the presence of individuals at the plane or within the field of the device until an amount of penetration into the plane or field occurs. This amount is known as the distance (depth) penetration factor. The distance that must be added is called *Dpf*. See Figures D.1 -- D.6 and D.8.

When using safety mats and single control safety devices, it is possible for the individual to be reaching into the hazardous area or stepping onto the mat beyond its edge. The amount of reach or stride should be added to the safety distance and can be called *Dpf*. See Figures D.2 and D.6.

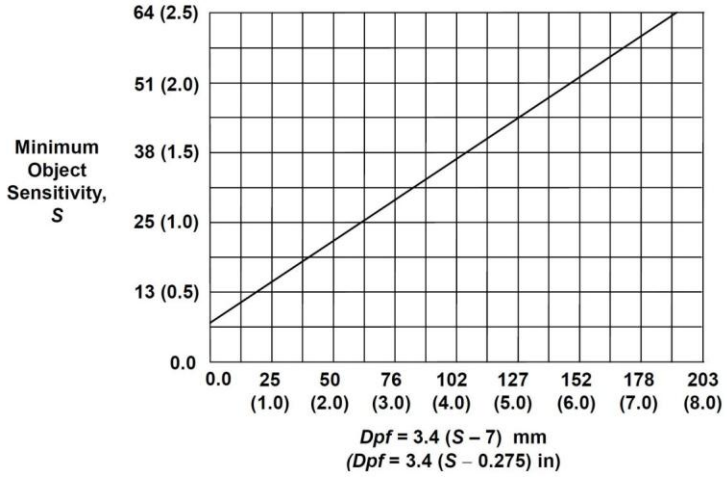
The equation for calculating the safety distance for these devices, therefore, is:

$$Ds = K\,(Ts + Tc + Tr + Tspm) + Dpf \qquad \text{Equation (7)}$$

Equation 7 can be used to calculate the safety distance for the eight safeguarding devices listed in paragraph 2 by substituting the non-zero values or combination of values as determined above.

NOTE ON THE FOLLOWING FIGURES: Figures D.1 through D.3 provide the reader with the means to find the value of *Dpf* they need to use in the safety distance formula. Figures D.4 through D.8 are examples per the different applications of how to use the safety distance formula once the reader has determined *Dpf*.

Figure D.1: Penetration factor, *Dpf*, for presence-sensing devices used in a vertical application with object sensitivity less than 64 mm (2.5 inches)



Dpf is the distance added to the safety distance due to the penetration factor that compensates for varying object sensitivities (resolution) of electro-optical presence-sensing devices.

When blanking is used and when the blanked area is not completely filled by the workpiece or part, or by mechanical guarding, the minimum object sensitivity can be calculated as:

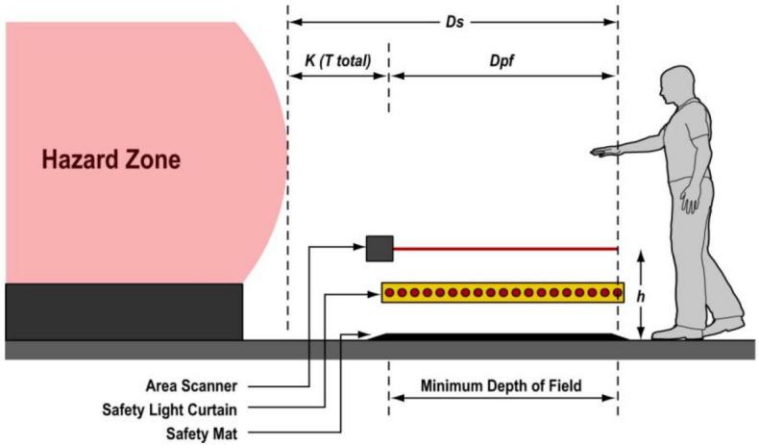
Object sensitivity = size of the blanked area plus minimum object sensitivity without blanking.

Once this value is found, then *Dpf* can be determined.

If the entire blanked area is filled with mechanical guarding or other fixed material or guards, use the minimum object sensitivity to determine *Dpf*.

Figure D.2: Dpf for ground level devices that can be reached over (30° or less).
Examples include safety mats, area scanners, and horizontally mounted electro-optical devices.

Dpf = 1200mm (48 in) for horizontal sensing field applications without vertical sensing.



Allowable Sensing Field Heights in mm. (in)
Maximum Height 1000 (39)

Objects Sensitivity (*S*)	Minimum Height (*h*)
≤ 50 (2)	0
64 (2.5)	190 (7.5)
76 (3.0)	380 (15)
89 (3.5)	570(22.5)
102 (4.0)	760 (30)
108 (4.25)	860 (33.75)
117 (4.6)	1000 (39)

Minimum mounting height (*h*) can also be determined by the following,
$h = 15 (S - 50)$ mm
$h = 15 (S - 2)$ in
where *S* is the object sensitivity.

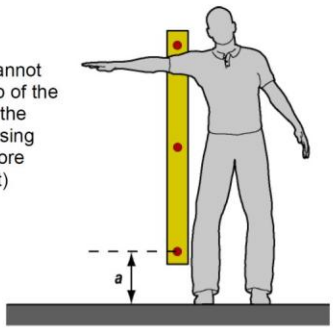
Minimum depth of field (or sensing area) must hinder an individual from stepping over the presence-sensing device or safety mat. This distance is 1.2 m (4 ft) if an individual can step over and pass unrestricted, 900 mm (3 ft) if supplemental safeguarding or physical barriers are used such that an individual must stand within the sensing area. Minimum depth of field addresses a different installation consideration than the Penetration Factor (*Dpf*).

Figure D.3: *Dpf* for object sensitivities greater than 64 mm (2.5 inches)

For electro-optical presence-sensing devices using large blanked areas, or if an individual can otherwise reach through or over the sensing field and not be detected, the distance between any two adjacent detection points shall not be greater than 600 mm (24 in), i.e., from one active point to the next active point above.

REACH-THROUGH
Dpf = 900 mm (36 in) for reach through applications.

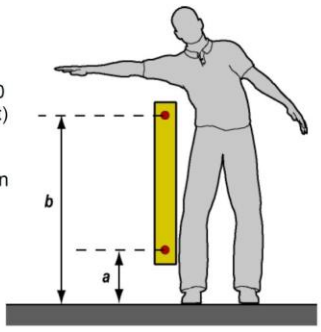
If the individual cannot reach over the top of the sensing field and the bottom of the sensing field (~~A~~") is no more than 300 mm (1 ft) above the floor.



a = Bottom of sensing field

REACH-OVER
Dpf = 1200 mm (48 in) for reach over applications.

The top of the sensing field (~~B~~") is between 900 and 1200 mm (3 and 4 ft) above the floor. The bottom of the sensing field (~~A~~") is no more than 300 mm (1 ft) above the floor.

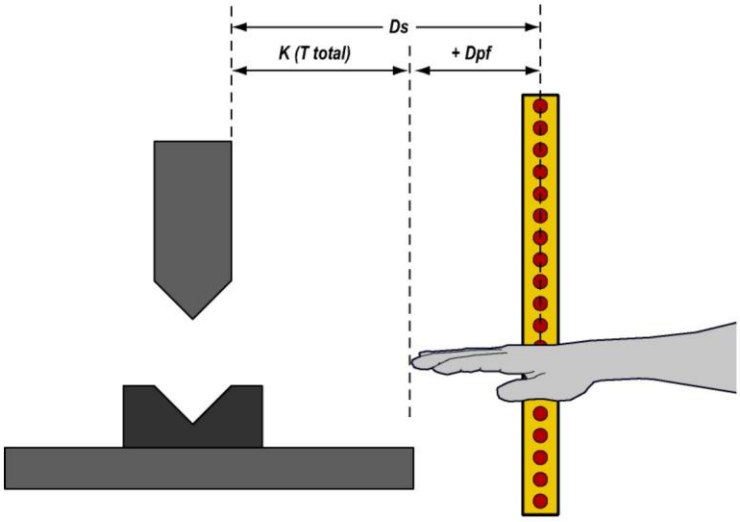


a = Bottom of sensing field
b = Top of sensing field

NOTE: An application is considered to be a reach-through if the individual cannot reach over the top of the sensing field without being detected. A reach-over application allows an individual to approach farther into the safeguarded area by binding at the waist thus requiring a larger Dpf to increase the separation between the hazard and the point of detection.

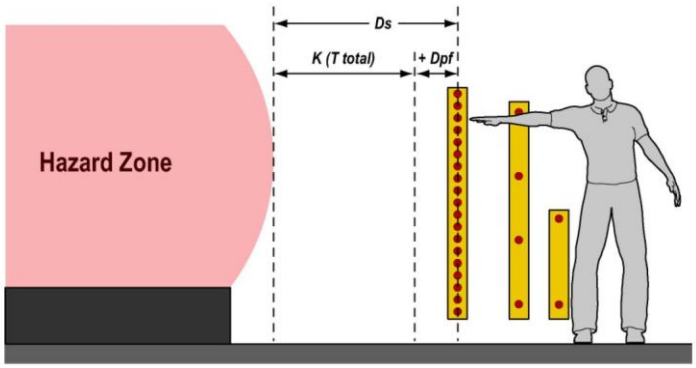
NOTE - Where individuals can place themselves between the safeguarding device and the hazard zone and remain undetected, additional measures must be taken.

Figure D.4: Example of guarding with object sensitivity less than 64 mm (2.5 inches)



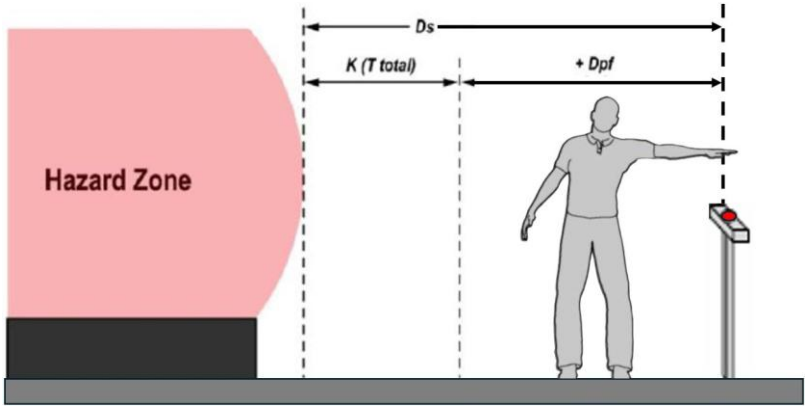
NOTE - Where individuals can place themselves between the safeguarding device and the hazard zone and remain undetected, additional measures must be taken.

Figure D.5: Example of guarding with various object sensitivities



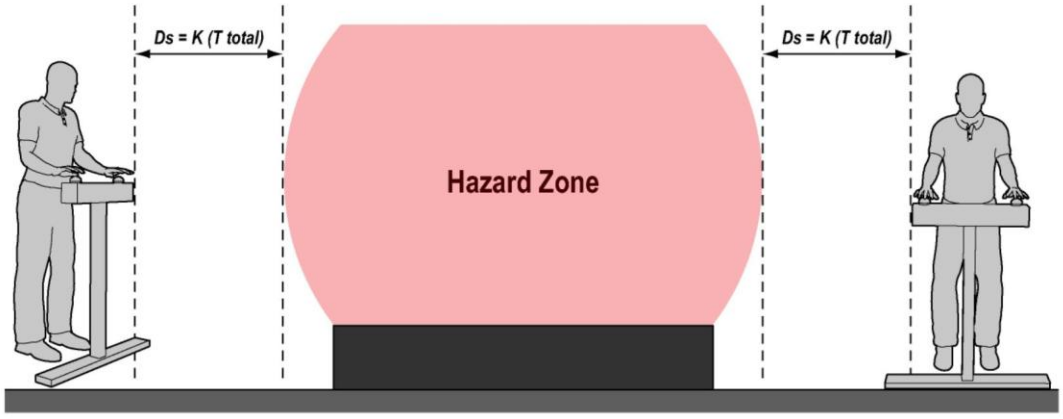
Safety Distance (Ds) for devices with a larger value for object sensitivity must be placed farther from the hazard than a device with a smaller value for object sensitivity.

Figure D.6: Example of Single Control Device (Single Beam Device)



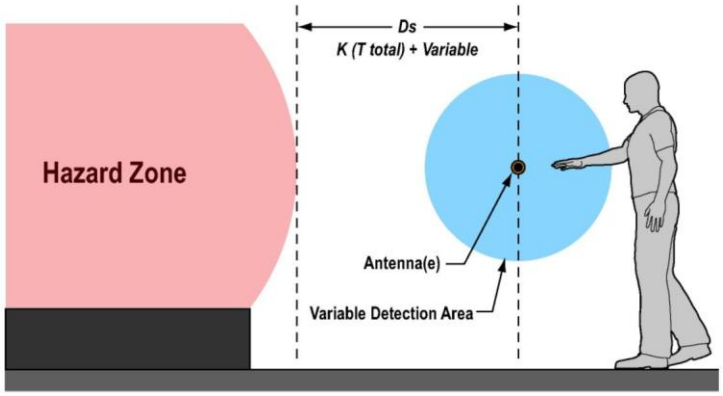
Safety Distance (Ds) for a Single Control Device includes a large Dpf of 2 meters (6.5 feet) due to the ability of the operator to stand between the device and reach towards the hazard.

Figure D.7: Two-hand Control & Two-Hand Trip Devices



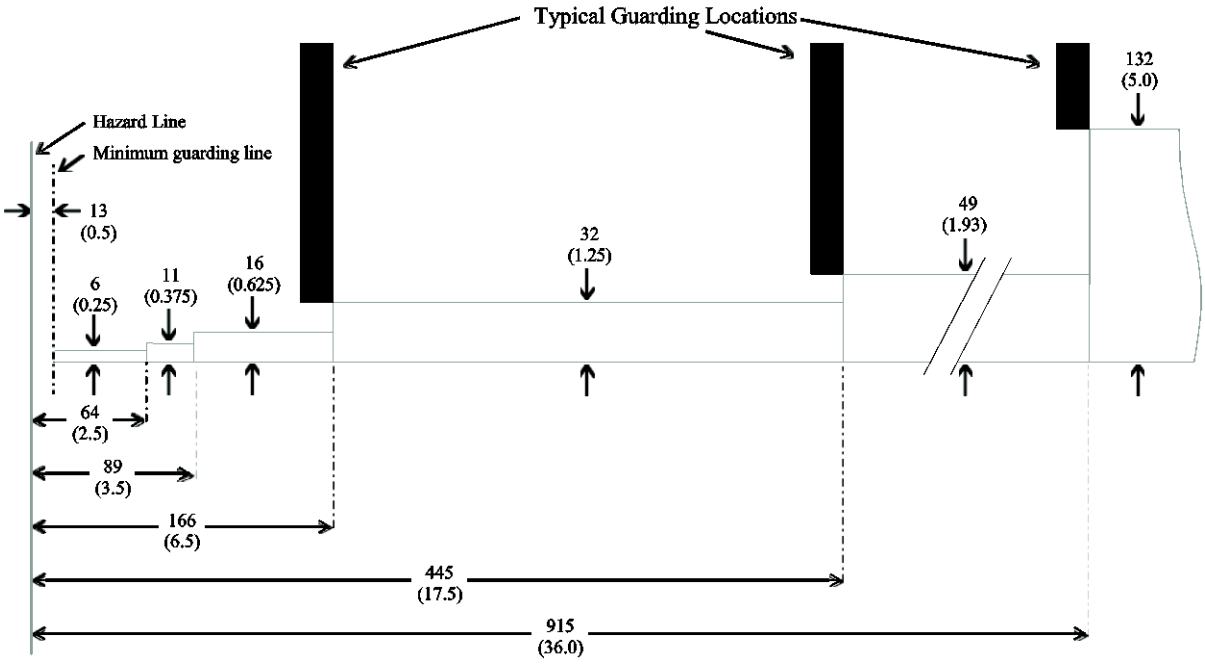
Safety Distance (*Ds*) for Two-Hand Control and Two-Hand Trip applications have a *Dpf* = 0. When used as a safeguarding device, the position must be placed such that the safety distance is measured from the closest hand control to the hazard.

Figure D.8: RF Presence-sensing Devices



The point of detection must take into account fluctuations and variances in the field density and sensitivity due to environmental conditions and physical changes in the work area. This amount must be added to *K*(*T total*) to determine the total safety distance, *Ds*.

Figure D.9a: Location of Guards vs Slotted Openings; Distance from hazard in millimeters (inches)



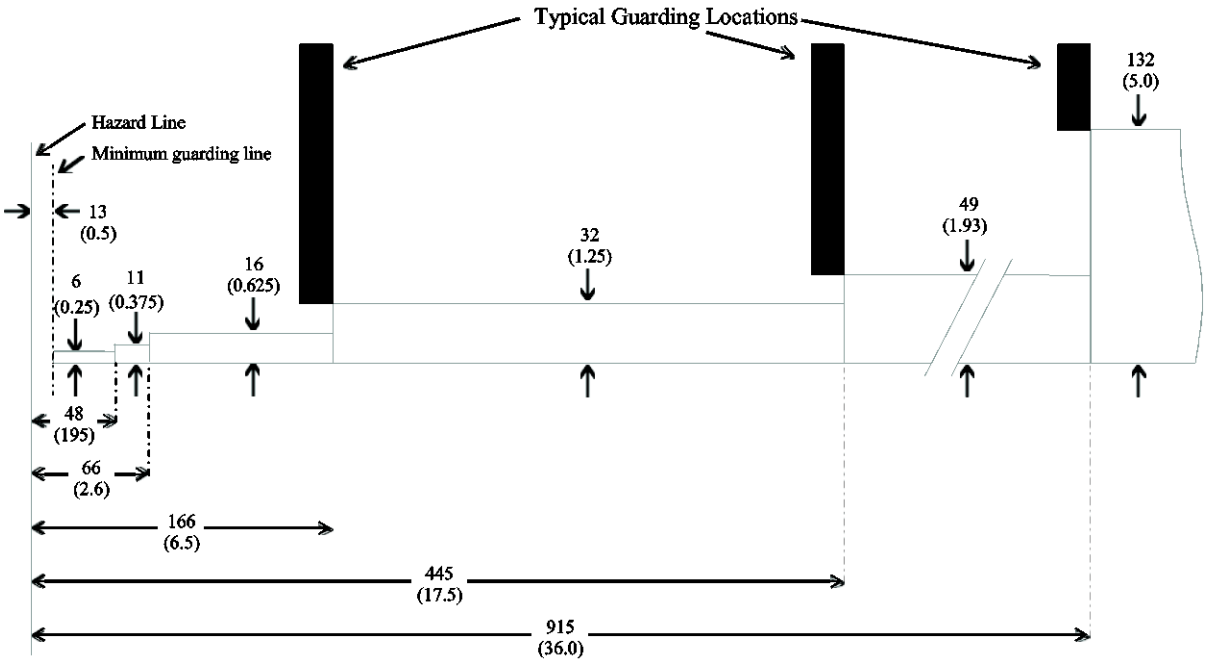
Maximum Guard slotted openings vs. Distance from Hazard Zone in millimeters (inches)

As a function of gap size				As a function of distance			
Known Gap		Minimum Distance		Known Distance		Maximum Gap	
0 – 6	(0 – 0.250)	13	(0.5)	< 13	(< 0.5)	Not permitted	
6.1 – 11	(0.251 – 0.375)	64	(2.5)	13 – 63.9	(0.5 – 2.49)	6	(0.25)
11.1 – 16	(0.376 – 0.625)	89	(3.5)	64 – 88.9	(2.5 – 3.49)	11	(0.375)
16.1 – 32	(0.626 – 1.250)	166	(6.5)	89 – 165.9	(3.5 – 6.49)	16	(0.625)
32.1 – 49	(1.251 – 1.875)	445	(17.5)	166 – 444.9	(6.5 – 17.49)	32	(1.25)
49.1 – 132	(1.876 – 5.0)	915	(36.0)	445 – 914.9	(17.5 – 35.99)	49	(1.875)
> 132	(> 5.0)	See Note below		≥ 915	(≥ 36.0)	See Note below	

NOTE: For guard openings greater than 132mm (5.0‖), a risk assessment must determine the appropriate distance from the hazard based on the guard design and human anthropometrics, or see Figure D-10 (reach over distance). These values are not intended to replace the Dpf values listed in Figures D.1, D.2 and D.3.

Based on data presented in Applied Ergonomics, Vol. 26, No 22, p.p. 141-145, A Review of Machine-Guarding Recommendations, Donald R. Vaillancourt & Stover H. Snook, The Liberty Mutual Research Center for Safety and Health; and Standard Drawing 2063-2, ©1998 Liberty Mutual Group. Used with permission.

Figure D.9b: Location of Guards vs. Square Openings; Distance from hazard in millimeters (inches)



Maximum Guard square openings vs. Distance from Hazard Zone in millimeters (inches)

As a function of gap size				As a function of distance			
Known Gap		Minimum Distance		Known Distance		Maximum Gap	
0 – 6	(0 – 0.25)	13	(0.5)	< 13	(< 0.5)	Not permitted	
6.1 – 11	(0.25 – 0.375)	48	(1.95)	13 – 47.9	(0.5 – 1.88)	6	(0.25)
11.1 – 16	(0.376 – 0.625)	66	(2.6)	48 – 65.9	(1.89 – 2.59)	11	(0.375)
16.1 – 32	(0.626 – 1.25)	166	(6.5)	89 – 165.9	(3.5 – 6.53)	16	(0.625)
32.1 – 49	(1.25 – 1.93)	445	(17.5)	166 – 444.9	(6.54 – 17.49)	32	(1.25)
49.1 – 132	(1.93 – 5.0)	915	(36.0)	445 – 914.9	(17.5 – 35.99)	49	(1.875)
> 132	(> 5.0)	See Note below		≥ 915	(≥ 36.0)	See Note below	

NOTE: For guard openings greater than 132mm (5.0‖), a risk assessment must determine the appropriate distance from the hazard based on the guard design and human anthropometrics, or see Figure D-10 (reach over distance). These values are not intended to replace the Dpf values listed in Figures D.1, D.2 and D.3.

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Appendix E – Glossary

Active Optoelectronic Protective Device (AOPD)	Device whose sensing function is performed by optoelectronic emitting and receiving elements detecting the interruption of optical radiations generated within the device by an opaque object present in the specified detection zone (or for a light beam device, on the axis of the light beam).
Detection capability (DC)	The dimension representing the diameter of the object or test piece that will actuate the sensing device when placed in the detection zone. It can also be used to mean the ability to detect an object or test piece of the specified diameter.
Detector	The light curtain head that detects the infrared light beams. Also called *Receiver*.
Effective Aperture Angle (EAA)	The maximum angle of deviation from the optical alignment of the transmitter head and the receiver head within which the AOPD continues normal operation.
Emitter	The light curtain head containing a linear array that emits beams of infrared light. Also called *Transmitter.*
Electro-Sensitive Protective Equipment (ESPE)	Assembly of devices and/or components working together for protective tripping or presence-sensing purposes and comprising as a minimum of a) a sensing device, b) controlling/monitoring devices, c) output signal switching devices.
External Device Monitoring (EDM)	Means by which the electro-sensitive protective equipment (ESPE) monitors the state of control devices which are external to the ESPE (e.g. external contacts). Call Wintriss Tech Support if you want to use EDM.
Lock-out condition	It is a condition of the safety light curtain initiated by a fault that prevents the normal operation of the ESPE. When a lock-out condition occurs, the safety outputs will be deactivated (OFF state).
OFF state	The state of the safety outputs of an ESPE in which the machine under control is caused to stop running and is prevented from starting.
ON state	The state of the safety outputs of an ESPE in which the machine under control is allowed to run.
Output Signal Switching Device (OSSD)	Component of the ESPE connected to the machine control system which, when the sensing device is actuated during normal operation, responds by going to the OFF state.
Presence Sensing Device Initiation (PSDI)	Refers to the use of the sensing devices (e.g. light curtain) to activate the machine and/or manufacturing process once it has been determined that a human is no longer in the hazard area.
Receiver	The light curtain head that detects the infrared light beams. Also called *Detector*.

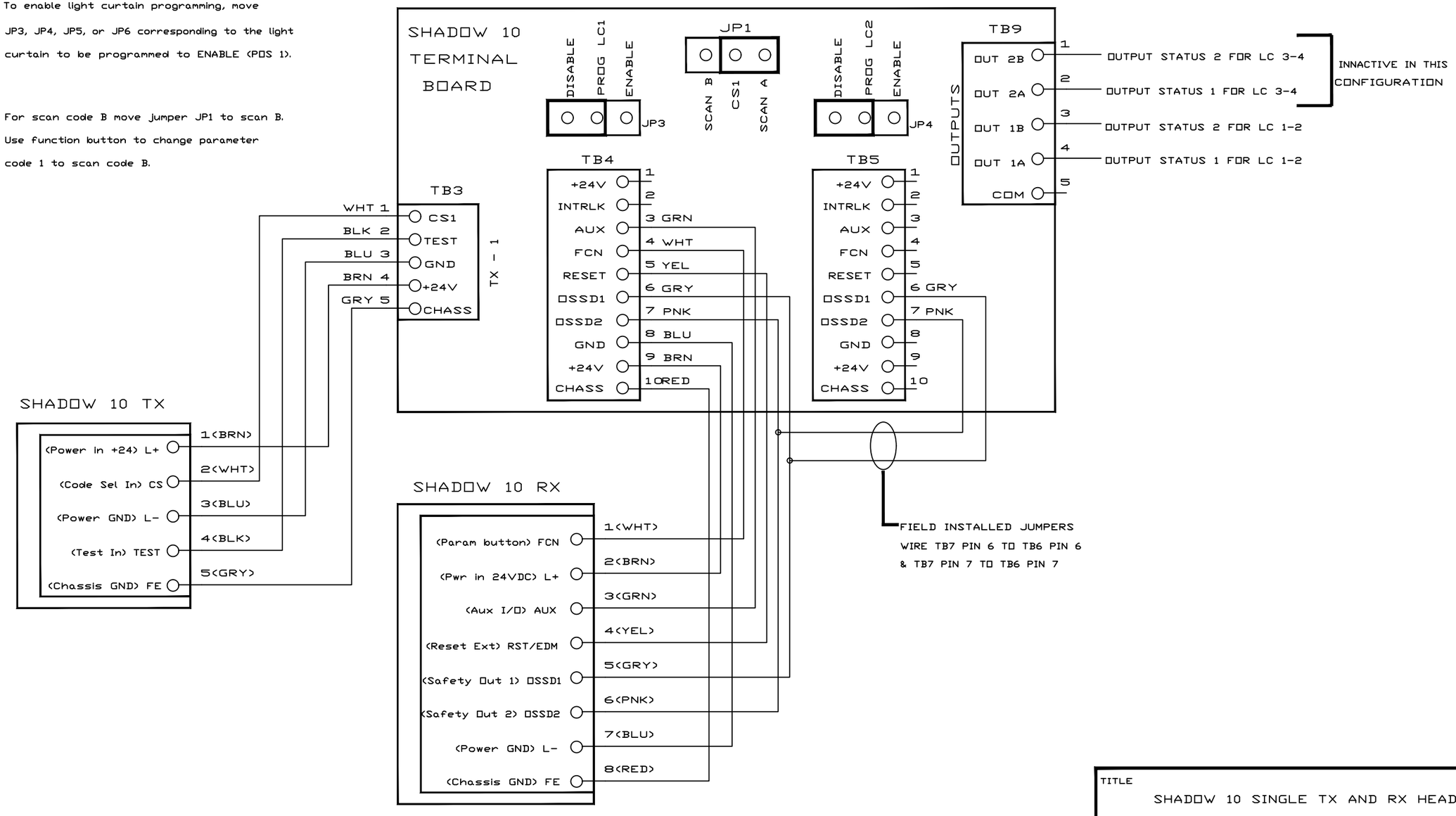
Response time (of a safety light curtain)	The maximum time between the occurrence of a detectable obstruction of the protective field and the deactivation of the OSSDs.
Transmitter	The light curtain head containing a linear array that emits beams of infrared light. Also called *Emitter*.

Index

REVISIONS			
REV	DESCRIPTION	DATE	APP'D

To enable light curtain programming, move JP3, JP4, JP5, or JP6 corresponding to the light curtain to be programmed to ENABLE (POS 1).

For scan code B move jumper JP1 to scan B. Use function button to change parameter code 1 to scan code B.

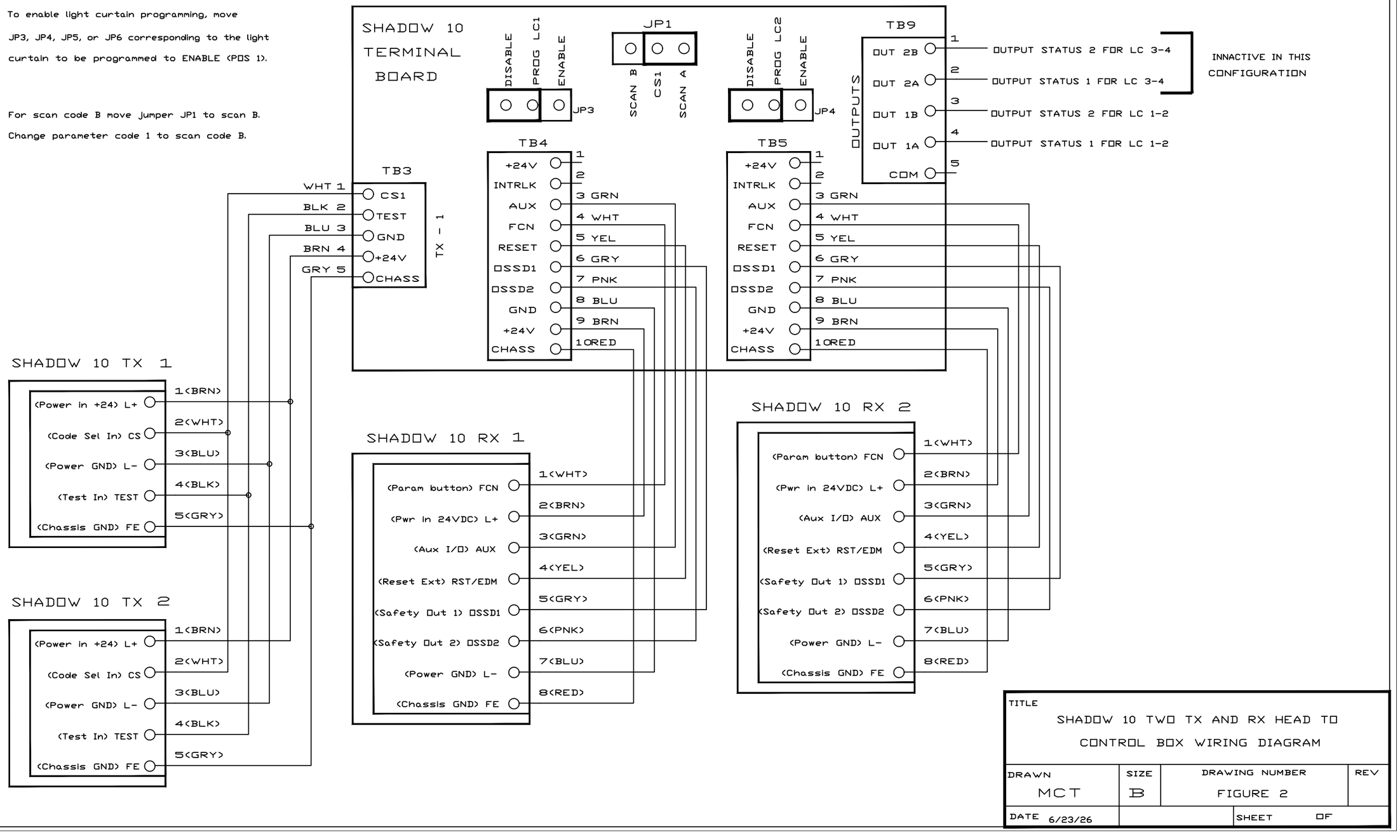


TITLE: SHADOW 10 SINGLE TX AND RX HEAD TO CONTROL BOX WIRING DIAGRAM			
DRAWN: MCT	SIZE: B	DRAWING NUMBER: FIGURE 1	REV:
DATE: 6/23/26		SHEET: OF	

REVISIONS			
REV	DESCRIPTION	DATE	APP'D

To enable light curtain programming, move JP3, JP4, JP5, or JP6 corresponding to the light curtain to be programmed to ENABLE (POS 1).

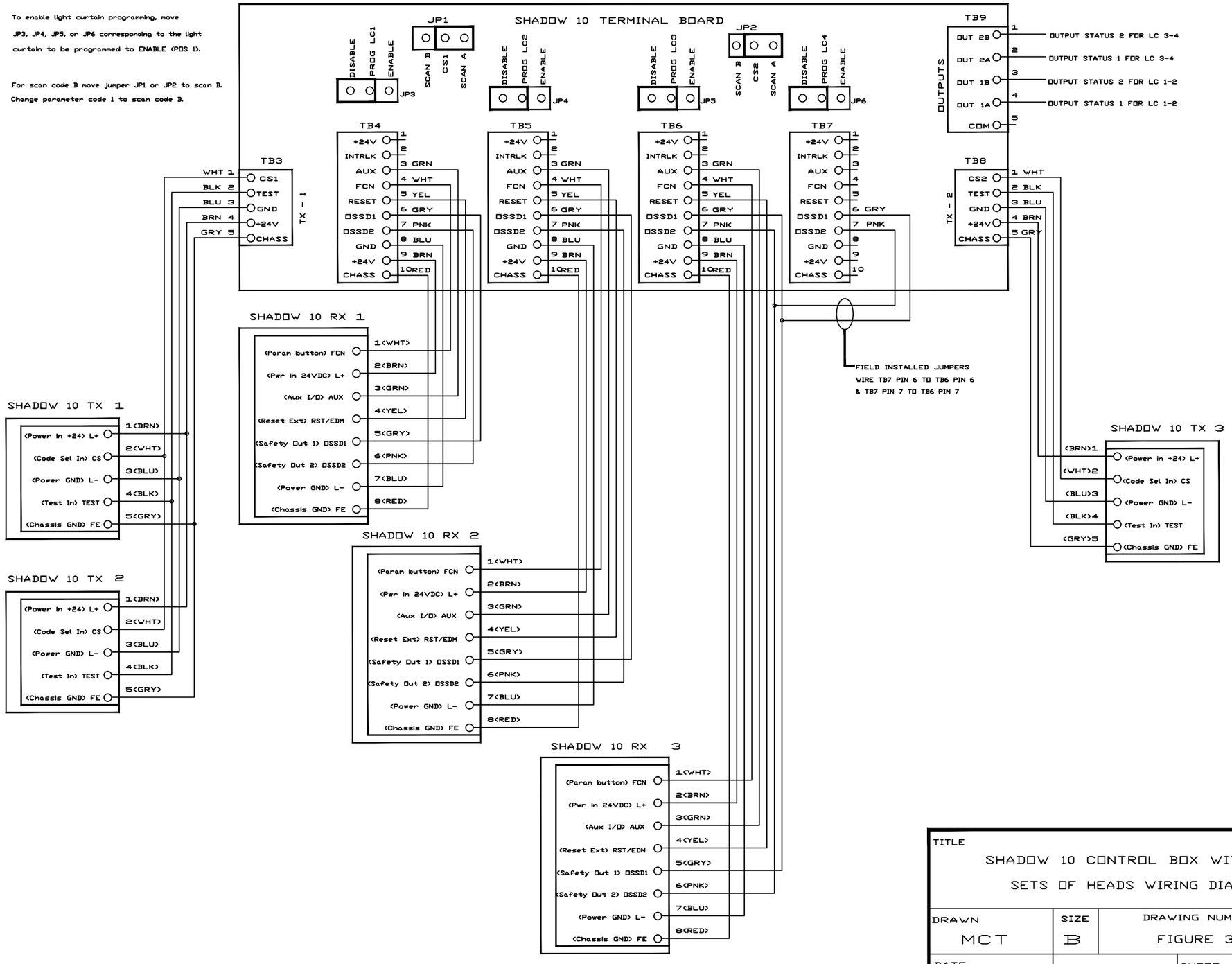
For scan code B move jumper JP1 to scan B.
Change parameter code 1 to scan code B.



TITLE: SHADOW 10 TWO TX AND RX HEAD TO CONTROL BOX WIRING DIAGRAM			
DRAWN: MCT	SIZE: B	DRAWING NUMBER: FIGURE 2	REV:
DATE: 6/23/26		SHEET: OF	

To enable light curtain programming, move JP3, JP4, JP5, or JP6 corresponding to the light curtain to be programmed to ENABLE (PINS 1).

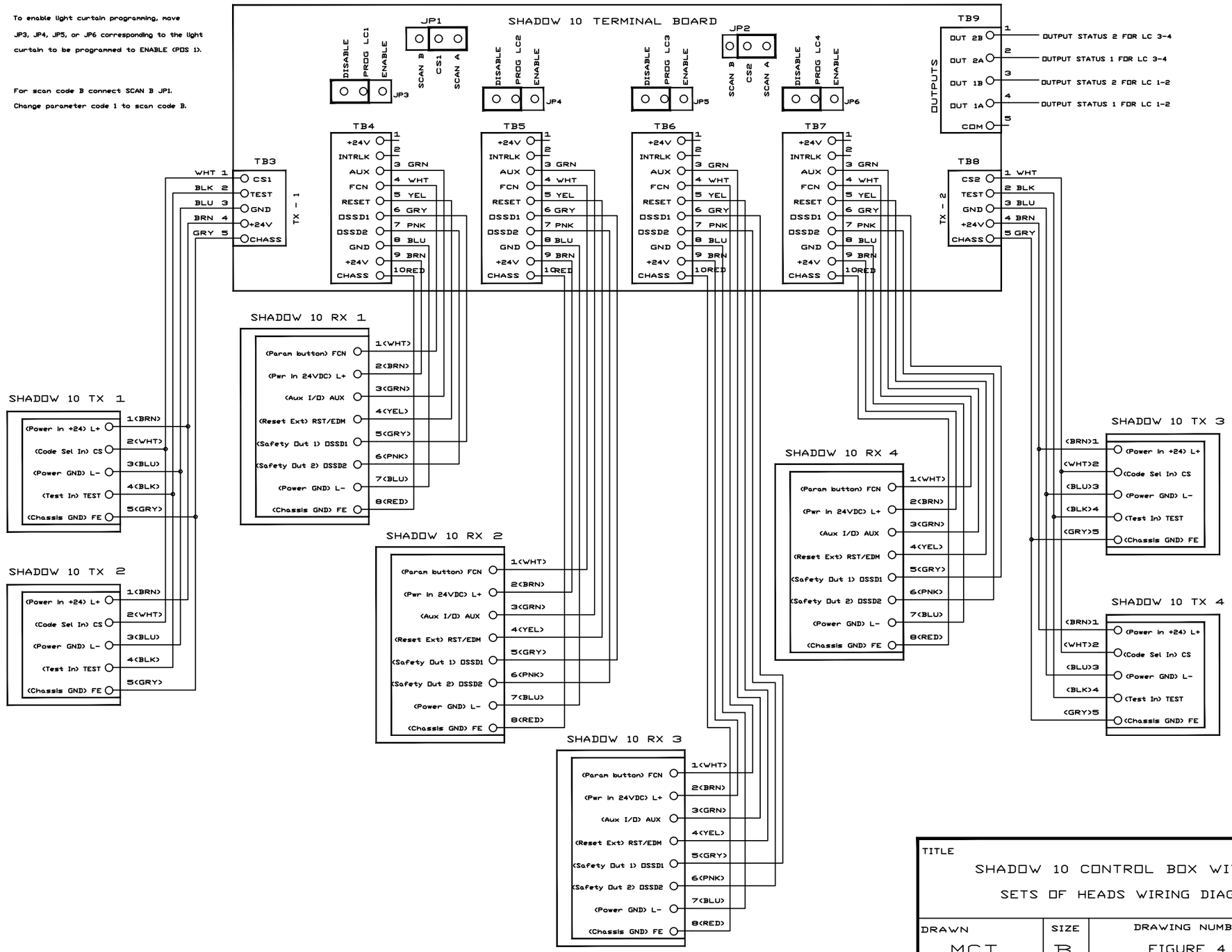
For scan code B move jumper JP1 or JP2 to scan B. Change parameter code 1 to scan code B.



TITLE: SHADOW 10 CONTROL BOX WITH THREE SETS OF HEADS WIRING DIAGRAM			
DRAWN: MCT	SIZE: B	DRAWING NUMBER: FIGURE 3	REV:
DATE: 6/23/26		SHEET: OF	

To enable light curtain programming, move JP3, JP4, JP5, or JP6 corresponding to the light curtain to be programmed to ENABLE (POS 1).

For scan code B connect SCAN B JP1.
Change parameter code 1 to scan code B.



TITLE

SHADOW 10 CONTROL BOX WITH FOUR SETS OF HEADS WIRING DIAGRAM

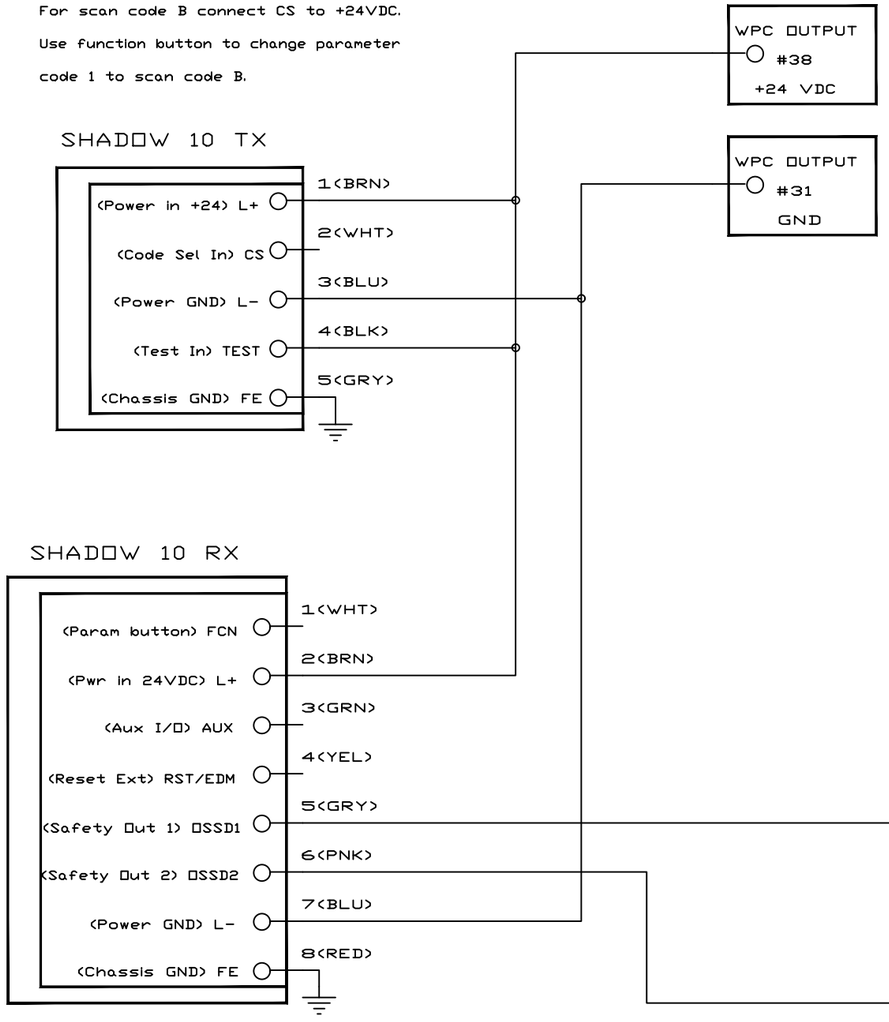
DRAWN	SIZE	DRAWING NUMBER	REV
MCT	B	FIGURE 4	
DATE 6/23/26		SHEET OF	

REVISIONS			
REV	DESCRIPTION	DATE	APP'D

Leave CS open for scan code A.

For scan code B connect CS to +24VDC.

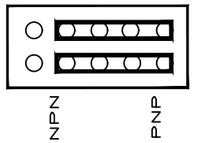
Use function button to change parameter code 1 to scan code B.



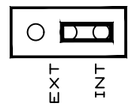
Shadow 10 Light Curtain programming can be performed utilizing the Portable Teach Tool (96886O6)

LIGHT CURTAIN MODE SWITCHES ON WPC 2000 BOARD

LIGHT CURTAIN A (J123)



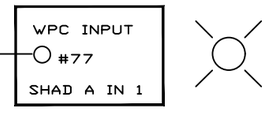
LIGHT CURTAIN A (J124)



SET TO PNP WITH INTERNAL TEST

For Shadow B see J121 and J122.

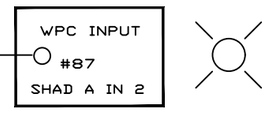
LED GROUP 7 #2



Shadow B in 2 use #88

LED Group 5 #6

LED GROUP 7 #3



Shadow B in 1 use #78

LED Group 1 #4

TITLE			
Single Shadow 10 and WPC 2000 Wiring Diagram			
DRAWN MCT	SIZE B	DRAWING NUMBER FIGURE 5	REV
DATE 6/23/26		SHEET OF	

SHADOW 10 TX 1

(Power in +24) L+ — 1(BRN)
(Code Sel In) CS — 2(WHT)
(Power GND) L- — 3(BLU)
(Test In) TEST — 4(BLK)
(Chassis GND) FE — 5(GRY)

SHADOW 10 TX 2

(Power in +24) L+ — 1(BRN)
(Code Sel In) CS — 2(WHT)
(Power GND) L- — 3(BLU)
(Test In) TEST — 4(BLK)
(Chassis GND) FE — 5(GRY)

WPC OUTPUT #38 +24 VDC

WPC OUTPUT #31 GND

Leave CS open for scan code A.

For scan code B connect CS to +24VDC.

Use function button to change parameter code 1 to scan code B.

SHADOW 10 RX 1

(Param button) FCN — 1(WHT)
(Pwr in 24VDC) L+ — 2(BRN)
(Aux I/O) AUX — 3(GRN)
(Reset Ext) RST/EDM — 4(YEL)
(Safety Out 1) OSSD1 — 5(GRY)
(Safety Out 2) OSSD2 — 6(PNK)
(Power GND) L- — 7(BLU)
(Chassis GND) FE — 8(RED)

Shadow 10 Light Curtain programming can be performed utilizing the Portable Teach Tool (9688606)

LIGHT CURTAIN MODE SWITCHES ON WPC 2000 BOARD

LIGHT CURTAIN B (J121)

LIGHT CURTAIN 2 (J122)

NPN PNP EXT INT

SET TO PNP WITH INTERNAL TEST

LIGHT CURTAIN MODE SWITCHES ON WPC 2000 BOARD

LIGHT CURTAIN A (J123)

LIGHT CURTAIN A (J124)

NPN PNP EXT INT

SET TO PNP WITH INTERNAL TEST

SHADOW 10 RX 2

(Param button) FCN — 1(WHT)
(Pwr in 24VDC) L+ — 2(BRN)
(Aux I/O) AUX — 3(GRN)
(Reset Ext) RST/EDM — 4(YEL)
(Safety Out 1) OSSD1 — 5(GRY)
(Safety Out 2) OSSD2 — 6(PNK)
(Power GND) L- — 7(BLU)
(Chassis GND) FE — 8(RED)

LED GROUP 7 #2

WPC INPUT #77 SHAD A IN 1

LED GROUP 7 #3

WPC INPUT #87 SHAD A IN 2

LED GROUP 1 #4

WPC INPUT #78 SHAD B IN 1

LED GROUP 5 #6

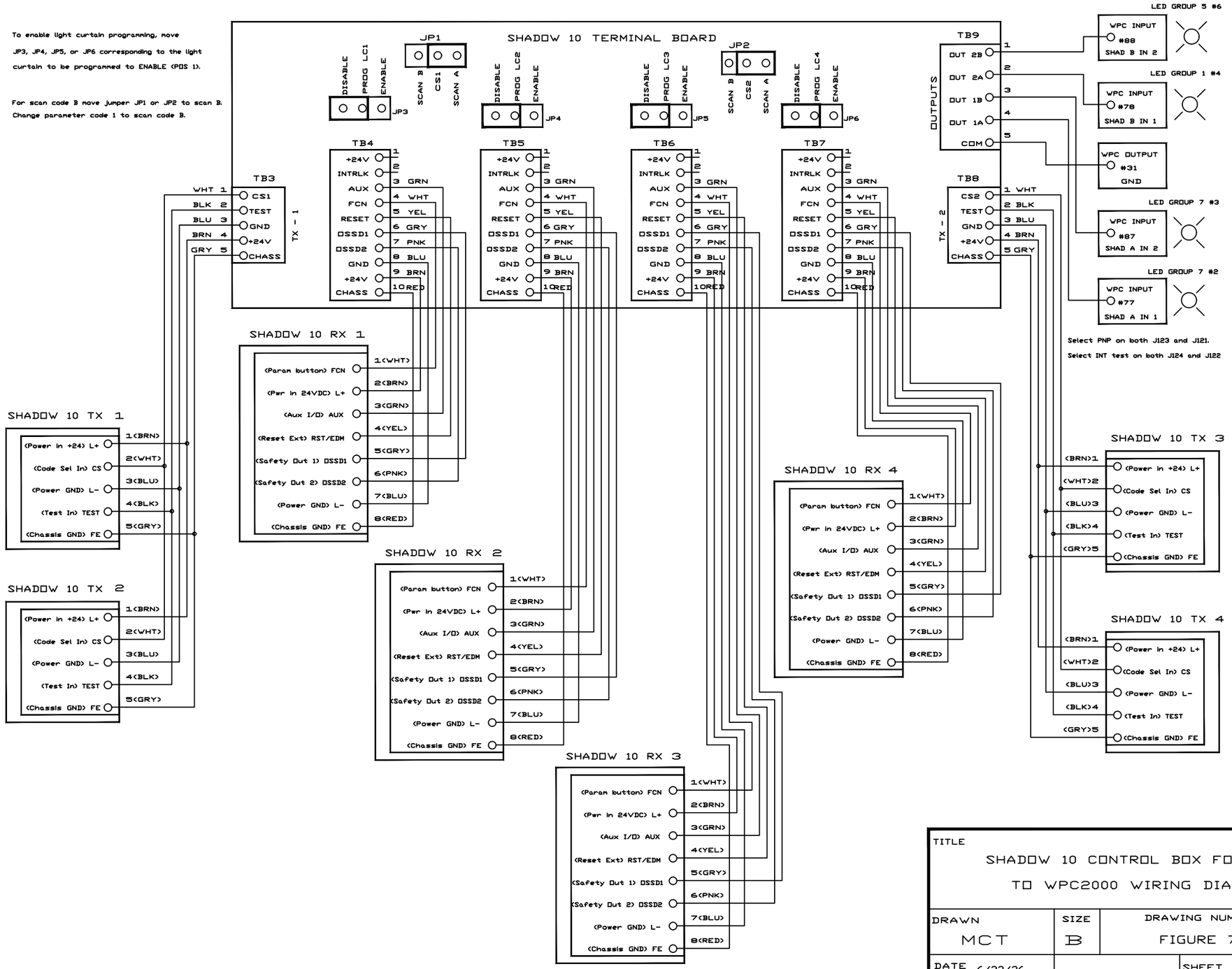
WPC INPUT #88 SHAD B IN 2

TITLE: Dual Shadow 10 and WPC 2000 Wiring Diagram

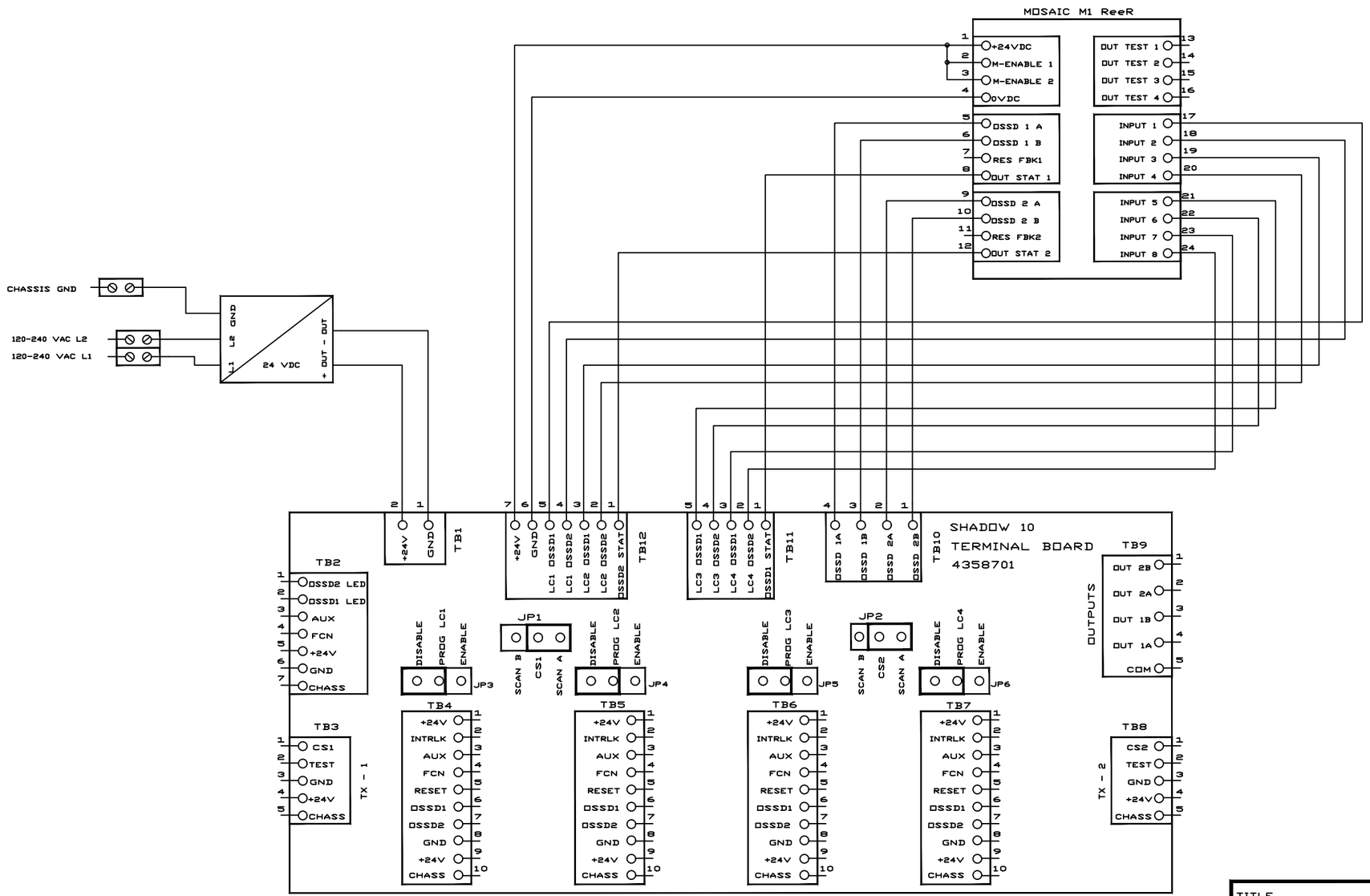
DRAWN	SIZE	DRAWING NUMBER	REV
MCT	B	FIGURE 6	
DATE 6/23/26		SHEET OF	

To enable light curtain programming, move JP3, JP4, JP5, or JP6 corresponding to the light curtain to be programmed to ENABLE (POS 1).

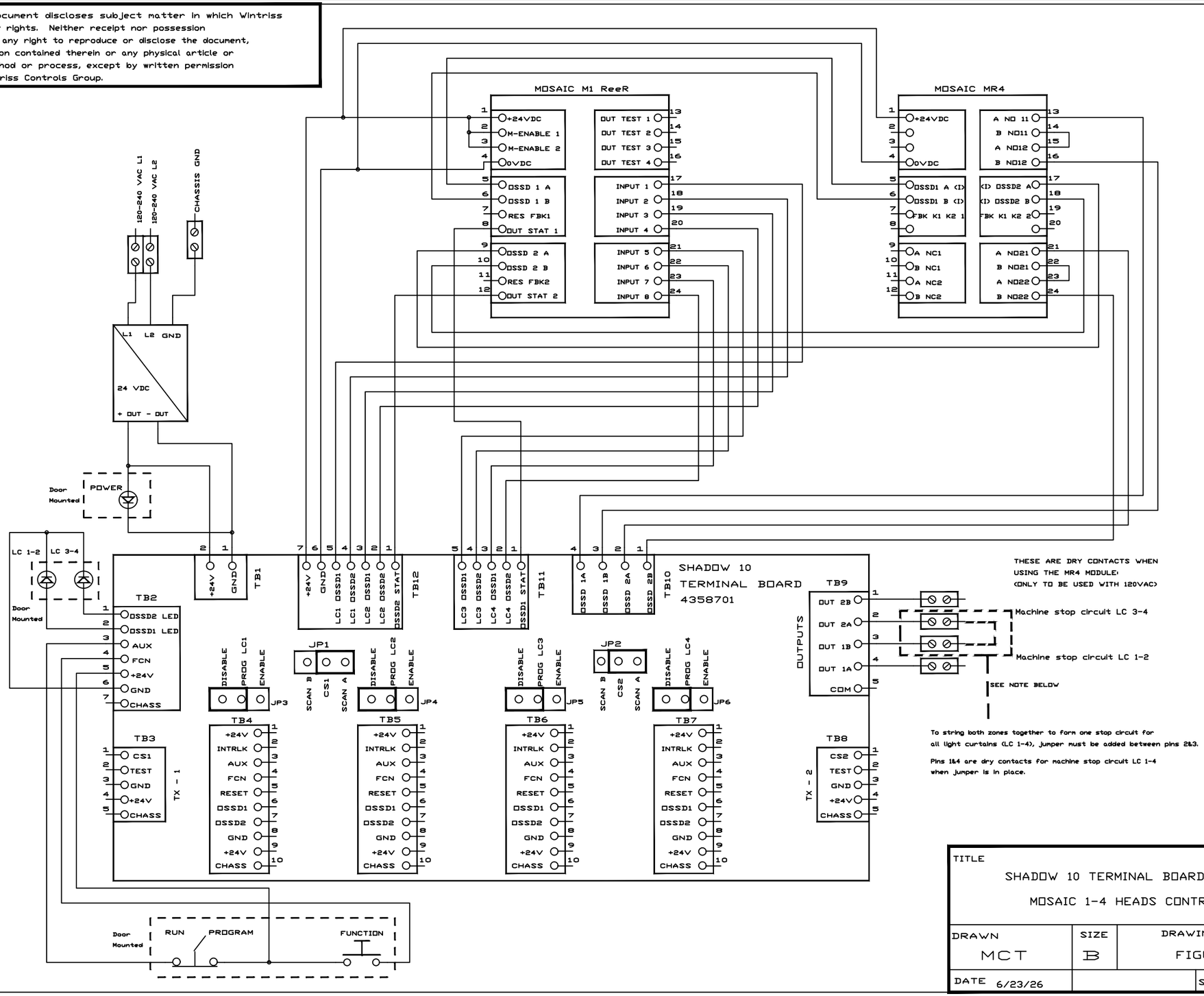
For scan code B move jumper JP1 or JP2 to scan B. Change parameter code 1 to scan code B.



TITLE	SHADOW 10 CONTROL BOX FOUR HEADS TO WPC2000 WIRING DIAGRAM
DRAWN	MCT
SIZE	B
DRAWING NUMBER	FIGURE 7
REV	
DATE	6/23/26
SHEET	OF



TITLE: SHADOW 10 TERMINAL BOARD TO M1 MOSAIC CONTROL DRAWING			
DRAWN: MCT	SIZE: B	DRAWING NUMBER: FIGURE 8	REV:
DATE: 6/23/26		SHEET: OF	



TITLE

SHADOW 10 TERMINAL BOARD WITH M1 TO MR4

MOSAIC 1-4 HEADS CONTROL DRAWING

DRAWN	SIZE	DRAWING NUMBER	REV
MCT	B	FIGURE 9	
DATE 6/23/26		SHEET OF	

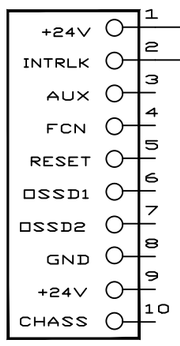
For start and restart interlock functions use a NC momentary key switch.

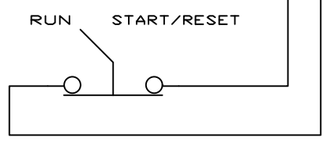
The Switch can be wired into individual TB4-TB7 interlock terminals depending on which heads you want to program or all by wiring them in parallel.

Enable functionality - refer to Parameterization Quick Guide or Manual for code 2 programming.

SHADOW 10 CONTROL BOX
TERMINAL BOARD
4358701

TB4 - TB7

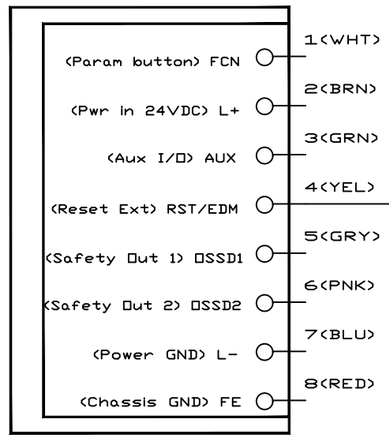


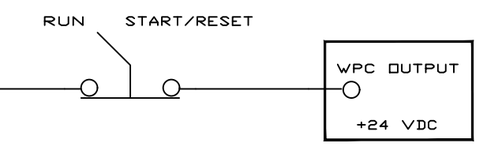


Reset switch with Shadow 10 heads and control box.

OR

WPC CONTROL
SHADOW 10 RX





Reset switch with Shadow 10 heads and WPC.

TITLE: Shadow 10 Reset Switch Wiring Options			
DRAWN: MCT	SIZE: B	DRAWING NUMBER: FIGURE 10	REV:
DATE: 6/23/26		SHEET OF	