MINI-SCREEN® System
Instruction Manual
European UK English Version

For use with Controller types:
MSCB-1.. MSCD-2..
MSCT-1.. MSDINT-1..
MSCT-2.. MDSDINT-1..

Emitter/Receivers for use in pairs
Types:
MSE... MSR...
MSXLE.... MSXLR....
MSXLDHDE..... MSXLDHDR.....

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48992 rev. F 22.10.03
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1 SAFETY INFORMATION

1.1 GENERAL
This block details all the necessary safety information relating to the MINI-SCREEN® System and its intended use.

For Information on general machine safety relating to the products, refer to the information contained in the MACHINE SAFETY Catalogue.

1.2 SAFETY NOTICES

1.2.1 Types
In order to install and operate the product in a safe and efficient way, safety notices are displayed on the product and throughout this Instruction Manual.

The Safety Notices are categorised as follows:

**WARNING!**
This type of notice is posted:

- Where potential hazards or unsafe practices exist which COULD result in severe personal injury or death if the warning is ignored
- Where there is a risk of serious injury or death if instructions are not followed; e.g. warning to disconnect power before accessing the inside of an electrical cabinet

The WARNING is on a YELLOW background.

**CAUTION!**
This type of notice is posted:

- Where hazards or unsafe practices exist which could result in minor or moderate injury if the caution is ignored

The CAUTION is on a YELLOW background.

The text in the notice contains the following information:

- The NATURE of the HAZARD (electrical, crushing, chemical, heat, fumes, dust, flying debris, toxic, overhead load, laser, radiation, magnetic field, biological, etc.)
- The MAGNITUDE OF HARM if the warning is ignored
- An instruction pointing out HOW TO AVOID the harm

**NOTE:**
- This type of notice is posted where the information is purely advisory and is classified as a Note.

### TABLE 1 Label Identification

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Location/ Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Yellow background" /></td>
<td>Located on Control box types MSDINT-1.. and MSDINT-1..</td>
</tr>
<tr>
<td><img src="image" alt="Yellow background" /></td>
<td>Indicates the following important information:</td>
</tr>
<tr>
<td><img src="image" alt="Yellow background" /></td>
<td>1. SHOCK HAZARD MAY EXIST IN THIS EQUIPMENT.</td>
</tr>
<tr>
<td><img src="image" alt="Yellow background" /></td>
<td>2. CORRECT USE OF THIS CONTROL DEVICE IS AN ESSENTIAL PART OF PROPER MACHINE CONTROL. SEE THE INSTRUCTION MANUAL PACKED WITH THIS DEVICE FOR ALL INSTALLATION DETAILS, WIRING DIAGRAMS, OPERATING INSTRUCTIONS, PERIODIC CHECKOUT PROCEDURES AND WARNINGS. FAILURE TO FOLLOW ALL INSTRUCTIONS OR WARNINGS COULD LEAD TO SERIOUS BODILY INJURY OR DEATH.</td>
</tr>
<tr>
<td><img src="image" alt="Yellow background" /></td>
<td>3. FOR CONTROL RELIABLE OPERATION ALWAYS FOLLOW THE INSTRUCTIONS IN THE MANUAL.</td>
</tr>
<tr>
<td><img src="image" alt="Yellow background" /></td>
<td>LASER LIGHT LAT-1-MS DO NOT STARE INTO BEAM. CLASS 2 LASER PRODUCT</td>
</tr>
<tr>
<td><img src="image" alt="Yellow background" /></td>
<td>Peak Power: 2.8 mW, 640-660 nm 33 MHz 25%, duty cycle</td>
</tr>
<tr>
<td><img src="image" alt="Yellow background" /></td>
<td>COMPLIES WITH 21 CFR PART 1040.10 &amp; EN60825-1:1994</td>
</tr>
<tr>
<td><img src="image" alt="Yellow background" /></td>
<td>AVOID EXPOSURE - LASER LIGHT EMITTED FROM THIS APERTURE</td>
</tr>
<tr>
<td><img src="image" alt="Yellow background" /></td>
<td>REMOVED TWO PHILIPS SCREWS FOR BATTERY ACCESS BELOW</td>
</tr>
<tr>
<td><img src="image" alt="Yellow background" /></td>
<td>REQUIRES ONE 9V BATTERY</td>
</tr>
</tbody>
</table>

**1.3 PRODUCT SAFETY LABELLING INFORMATION**

Table 1 on Page 1 lists the labels used on the product together with their descriptions and locations.
1.4 WARNINGS & NOTES USED IN THE MANUAL

Mandatory WARNING! notices are written and positioned prior to the information they are applicable to throughout the Manual to indicate potential danger or hazards.

There are three different types used in this Manual:

- General WARNING! indicated by the symbol (see example Warning page 3)
- Electrical Shock Hazard WARNING! indicated by the symbol (see example Warning page 38)
- Laser Light Emission WARNING! indicated by the symbol (see example Warning page 33)

The User must read the relevant WARNING! appertaining to the event before proceeding further.

Notes are also written and positioned prior to the information they are applicable to throughout the Manual but are non-mandatory.

Table 1 Label Identification

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Location/ Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Yellow background" /></td>
<td>ELECTRICAL SHOCK HAZARD EXISTS WHEN CONTROL BOX DOOR IS OPEN. USE EXTREME CAUTION. ACCESS TO THE CONTROL BOX INTERIOR TO BE BY QUALIFIED SERVICE PERSONNEL ONLY (SEE INSTRUCTION MANUAL). ALWAYS DISCONNECT ALL POWER FROM THE MINI-SCREEN SYSTEM AND FROM THE MACHINE. FAILURE TO COMPLY COULD RESULT IN SEVERE PERSONAL INJURY OR DEATH.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Yellow background" /></td>
<td>ATTENTION MACHINE OPERATOR POWER-UP TEST PROCEDURE (SEE block 5.2.1 on page 56 OR block 6.1.2 on page 59) MUST BE PERFORMED AT EVERY POWER-UP, SHIFT CHANGE AND MACHINE SET UP CHANGE. IN CERTAIN APPLICATIONS FAILURE TO PERFORM THIS TEST PROCEDURE CAN LEAD TO SERIOUS BODILY INJURY OR DEATH.</td>
</tr>
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</table>
1.5 SAFETY STANDARDS

The MINI-SCREEN System complies with the following Safety Standards:

**98/37/EEC**
Safety of Machinery, Section 1.7.4 - Instructions

**89/336/EEC**
EMC Directive

**73/23/EEC**
Low Voltage Directive

Safety of Machinery – Electro-sensitive Protection Equipment

**IEC 60529 (2001-02-27)**
Ingress Protection Provided by Enclosures

**ISO 13849-1 (1999)**
Safety of Machinery – Safety Related Parts of Control Systems

**IEC 60204-1 (2005-10-25)**
Safety Electrical Equipment

For complete MINI-SCREEN System compliance information refer to block 3.1.4 on page 17.

Further information and guidance may be found in the following Standards:

**ISO 12100-1 (2003)**
Safety of Machinery – Basic Concepts, General Principles for Design Part 1: Basic Terminology, Methodology

**ISO 12100-2 (2003)**
Safety of Machinery – Basic Concepts, General Principles for Design Part 2: Technical Principles and Specifications

**ISO 13852 (1996)**
Safety of Machinery – Safety Distances to Prevent Danger Zones Being Reached by the Upper Limbs

**ISO 13850 (1996)**
Safety of Machinery – Electrical, Manually Controlled Emergency Stopping Devices, Functional Aspects – Principles for Design

**ISO 13853 (1998)**
Safety of Machinery – Safety Distances to Prevent Danger Zones Being Reached by the Lower Limbs

**ISO 13855 (2002)**
Safety of Machinery – The Positioning of Protective Equipment in Respect to Approach Speeds of Parts of the Human Body

**ISO 14121 (1999)**
Safety of Machinery – Principles of Risk Assessment

**ISO 14119 (1998)**
Safety of Machinery – Interlocking Devices Associated with Guards – Principles for Design and Selection

**IEC/EN 60947-5-1 (2003-11-12)**
Low Voltage Switch Gear – Electromechanical Control Circuit Devices

Low Voltage Switch gear – General Rules

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**1.6 INGRESS PROTECTION RATINGS**

The MINI-SCREEN System meets the following Ingress Protection Classes for the enclosures as per IEC 60529:

- Emitter/Receivers
  - IP65
- MSDINT-1.. & MDSDINT-1..Controllers
  - IP20
- MSC-... Controller
  - IP64

---

**1.7 EMERGENCY STOP CONTROL**

**WARNINGS!**

**E-STOPS**

Whenever two or more E-STOPS are connected to the same MINI-SCREEN Controller, contacts of the corresponding poles of each switch or button must be connected together in series. This series combination is then wired to the respective module input. Never connect the contacts of multiple E-Stops in parallel to the MINI-SCREEN Controller inputs. Parallel connection of two or more E-Stops to one MINI-SCREEN Controller defeats the switch or button contact monitoring ability of the module and creates an unsafe condition which could result in serious injury or death.

When two or more E-Stops are used, each switch or button must be individually actuated (engaged), then reset and the MINI-SCREEN Controller reset. This allows the Controller to verify each switch and its wiring to detect faults.

Failure to test each switch or button individually in this manner could result in undetected faults and create an unsafe condition which could result in serious injury or death.

This check must be performed during periodic check-outs (block 6.1.2 on page 59 and block 6.1.3 on page 61).

The E-Stop Button Stop function of this Controller is ineffective if the contacts of any muting or bypass circuitry is wired in parallel with the FSD contacts.

Before connecting E-Stops, read the information contained in block 1.7 on page 3.

Button Stop function of this Controller is ineffective if the contacts of any muting or bypass circuitry is wired in parallel with the FSD contacts.

Before connecting E-Stops, read the information contained in block 1.7 on page 3.

E-Stops can only be configured with type MDSDINT-1T2 MDSDINT-1L2 Controllers.

For E-stop requirements, refer to reference ISO 13850.

Both contacts of the E-stop must be used.

The switch in Figure 39 on Page 37 is shown in its armed position with both contacts closed.

Multiple E-stop switches connected to one module must use a series connection (see Warning, above).

E-stop requirements contained within reference ISO 13850 and IEC 60204-1 should be met. Some applications may have additional requirements. The User must refer to all relevant regulations and applicable C standards.

Jumpers for terminals are provided and must be installed if an E-Stop is not used (at terminals 45, 46, 48 and 49).

A Key Reset (as detailed in block 4.7 on page 50) is required after re-arming (closing) the E-Stop (see also block 6.2.1.1 on page 63).
Safety Information

MINI-SCREEN® System

E-Stop contacts a/b and c/d must open simultaneously, or a lockout condition occurs.

The MINI-SCREEN Controller offers an input circuit for connection of an optional customer-supplied E-Stop (at terminals 45, 46, 48 and 49). The E-Stop must provide two separate contacts as shown in Figure 39 on Page 37, which are closed when the switch or button is in the RUN (armed or disengaged) position. Once engaged, the E-Stop must mechanically trip both contacts in the open position. The switch or button may be returned to the closed-contact position only by a deliberate action such as twisting, pulling, unlocking, etc.

Additionally, IEC 60204-1, Section 10.7 specifies the following requirement:

- E-Stops shall be located at each operator control station and at other operating stations where an E-Stops shall be required

1.8 ELECTRICAL SAFETY

The MINI-SCREEN System has been designed to meet with the Electrical Safety Standards as detailed in block 3.1.4 on page 17.

1.9 LIST OF POTENTIALLY HAZARDOUS EQUIPMENT

The following equipment included in the MINI-SCREEN System could be classed as potentially hazardous if the proper safety precautions are NOT observed:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Potential Hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSC.-... Controller</td>
<td>Exposure to high voltage</td>
</tr>
<tr>
<td>MSDINT-1.. Controller</td>
<td>Exposure to high voltage</td>
</tr>
<tr>
<td>MDSINT-1.. Controller</td>
<td>Exposure to high voltage</td>
</tr>
</tbody>
</table>

1.10 MACHINE MINIMUM SAFETY DISTANCE

**WARNINGS!**

DANGER ZONE ACCESS

Where it is foreseeable that access to the danger zone can be gained over the top of the Detection Zone, then the minimum height of the uppermost beam shall be not less than the values given in Standards ISO 13852 and ISO 13853 or additional safeguarding shall be provided to prevent access.

GAPS ADJACENT TO DETECTION ZONE

Where it is foreseeable that any gaps adjacent to Detection Zone of MINI-SCREEN shall be greater than Object Detection Capability (ODC) allowing access to the danger zone, then do ONE of the following:

- Reduce size of gaps to no more than ODC
- Use access gap dimensions as notional ODC of MINI-SCREEN System
- Provide additional safeguards to prevent access without detection.

MEASUREMENT OF STOP TIME

The measurement of stop time (\(T_s\)) must include the response time of all devices or controls that react to stop the machine. If all devices are not included, the calculated minimum safety distance (S) can be too short. This can lead to serious bodily injury or death.

APPLICATIONS IN NON-INDUSTRIAL ENVIRONMENTS

For applications in non-industrial environments please refer to Standard ISO 13855 Section 6.1.1. For such applications, the approach speed \(K\) must be 2000 mm/s and at least 75 mm must be added to the calculated minimum safety distance.

OPENINGS IN FIXED GUARDS

Openings in fixed guards should comply with ISO 13852 (1996). Where it is possible to stand between the light curtain and the machine, additional means (for example, additional safety light curtains), shall be provided to detect a person standing in the danger zone.

FLOATING BLANKING

Floating blanking increases the intrusion depth factor (\(C = 850\) mm). The MINIMUM SAFETY DISTANCE must be recalculated whenever floating blanking is used. Failure to comply could result in minor or moderate injury. Always turn floating blanking off when it is not required.

HIGHLY REFLECTIVE SURFACES

It may be possible for a highly reflective surface (such as a shiny workpiece or machine surface) to reflect sensing light around an object in the Detection Zone, thus preventing that object from being detected.

The MINI-SCREEN System must be able to react fast enough, when a hand or other object is inserted into the Detection Zone, to send a stop signal to the guarded machine and for that machine to come to a complete stop or remove the hazard before the object or hand reaches the closest hazard point on the machine.

The MINIMUM SAFETY DISTANCE is the shortest distance from the beam centre line of the Detection Zone to the closest reachable danger point.

The MINIMUM SAFETY DISTANCE required depends upon several factors, including the speed of the hand (or object), the overall response time (of which there are several response time components), and the intrusion depth factor which is derived from the MINI-SCREEN System ODC.

If a CEN ‘C’ standard exists for the type of machine on which a MINI-SCREEN System is being installed, the greater of the MINIMUM SAFETY DISTANCE specified by that standard should be utilised or, the MINIMUM SAFETY DISTANCE calculated using the formula in Standard ISO 13855.

The Danger Zone may be approached in one of three ways. The MINIMUM SAFETY DISTANCE depends on the direction of approach.

---

48992 rev. F 22.10.03 INSTRUCTION MANUAL - EUROPEAN VERSION
Normal Approach e.g. vertical light curtain (Figure 1 on Page 5)

Parallel Approach e.g. horizontal light curtain (Figure 2 on Page 5)

Angled Approach (see Figure 3 on Page 5)

The MINI-SCREEN System may also be mounted such that it can be rotated between the horizontal and vertical. In these circumstances both the normal and parallel approach minimum safety distances must be satisfied. If a combination of multiple light curtains is required, then the MINIMUM SAFETY DISTANCE for each should be calculated using the formula relative to that device.
1.10.1 Normal Approach

For Normal Approach (as shown in Figure 4 on Page 6), Standard ISO 13855 gives following formula:

\[ S = K \times T + C \]

- **S** = MINIMUM SAFETY DISTANCE in millimetres; from Danger Zone to centre line of Detection Zone. Minimum allowable safety distance is 100 mm (175 mm for non-industrial applications) regardless of calculated value.

- **K** = Standard maximum hand speed in millimetres per second according to Standard ISO 13855. K = 2000 mm/s for values of S between 100 mm and 500 mm. If S > 500 mm, then K may be reduced to 1600 mm/s but S must remain > 500 mm.

- **T** = Overall response time of machine, time between physical initiation of safety device and machine coming to a stop or risk being removed. This can be broken down into two parts: \( T_s \) and \( T_r \), where \( T = T_s + T_r \).

- **T_s** = Response time of machine measured between application of stop signal from MINI-SCREEN System and machine coming to a stop or risk being removed (including stop times of all relevant control elements, and measured at maximum machine velocity). \( T_s \) is usually measured by a stop-time measuring device. If specified machine stop time is used, it is recommended that at least 20% be added as a safety factor to account for clutch/brake system deterioration.

- **T_r** = Response time of MINI-SCREEN System (see Table 2 on Page 6):

### Table 2 Response Time of MINI-SCREEN System

<table>
<thead>
<tr>
<th>Emitter/Receiver</th>
<th>( T_r ) (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSXLHDE4012Y &amp; MSXLHDR4012Y</td>
<td>0.060</td>
</tr>
<tr>
<td>MSXLHDE4812Y &amp; MSXLHDR4812Y</td>
<td>0.060</td>
</tr>
<tr>
<td>MSXLHDE5612Y &amp; MSXLHDR5612Y</td>
<td>0.060</td>
</tr>
<tr>
<td>MSXLHDE6412Y &amp; MSXLHDR6412Y</td>
<td>0.060</td>
</tr>
<tr>
<td>MSXLHDE7212Y &amp; MSXLHDR7212Y</td>
<td>0.072</td>
</tr>
<tr>
<td><strong>Floating Blanking OFF</strong></td>
<td></td>
</tr>
<tr>
<td><strong>One-Beam Floating Blanking ON</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Two-Beam Floating Blanking ON</strong></td>
<td></td>
</tr>
</tbody>
</table>

- **C** = Additional distance in millimetres, based on intrusion of hand or object towards Danger Zone prior to actuation of safety device.

If ODC is not greater than 40 mm: \( C = 8 (d - 14) \) but not less than 0 where \( d \) = the ODC of the device in millimetres (see values in Table 3 on Page 6).

### Table 3 Sensing Values for Normal Approach

<table>
<thead>
<tr>
<th>E/R Standard Value C (mm)</th>
<th>E/R Long Range Value C (mm)</th>
<th>E/R Heavy Duty Value C (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floating Blanking OFF</td>
<td>40</td>
<td>91</td>
</tr>
<tr>
<td>One-Beam Floating Blanking ON</td>
<td>142</td>
<td>193</td>
</tr>
<tr>
<td>Two-Beam Floating Blanking ON</td>
<td>850</td>
<td>850</td>
</tr>
</tbody>
</table>
The formula used to calculate MINIMUM SAFETY DISTANCE (S) is:

\[ S = K \times (T_s + T_r) + C \]

The example below shows how to use formula above to calculate MINIMUM SAFETY DISTANCE (S). The following values are used for variables in formula:

- \( K = 2000 \text{ mm/s for values of } S \text{ between 100 mm and 500 mm} \)
- \( T_s = 0.170 \text{ s (total stop time of example machine, specified by machine manufacturer)} \)
- \( T_r = 0.048 \text{ s, 0.060 s or 0.072 s (response time of MINI-SCREEN System)} \)

For this particular example, types used are MSE2424Y and MSR2424Y Standard Emitter and Receiver, with a response time of 0.060 s. The exact same principles apply when calculating MINIMUM SAFETY DISTANCE for Long Range and Heavy Duty Emitters/Receivers.

The values should be substituted into formula as follows:

\[ S = 2000 \times (0.170 \times 1.2^* + 0.060) + 40 = 568 \text{ mm} \]

In this example, S value is > 500 mm. Using a value of 1600 mm/s, MINIMUM SAFETY DISTANCE can be recalculated:

\[ S = 1600 \times (0.170 \times 1.2^* + 0.060) + 40 = 462.4 \text{ mm} \]

As S now becomes less than 500 mm the MINIMUM SAFETY DISTANCE must be set at 500 mm.

Therefore, in this example, MINI-SCREEN System Emitter and Receiver must be mounted such that no part of Detection Zone is closer than 500 mm to closest reachable Danger Zone on guarded machine.

\* 20% safety factor (see \( T_s \) on Page 6)

### 1.10.2 Parallel Approach

**WARNING!**

INSTALLATION HEIGHT

If the installation height is greater than 300 mm (200 mm for non-industrial applications) there is risk of inadvertent undetected access beneath the MINI-SCREEN System. This should be taken into account in the risk assessment.

For Parallel Approach (see Figure 5 on Page 7) MINIMUM SAFETY DISTANCE (see Figure 6 on Page 8 and Figure 7 on Page 8) from Danger Zone to outermost beam is in some part dependent on object detection capabilities of light curtain and part of body detected, i.e. height of light curtain above reference plane.

The MINIMUM SAFETY DISTANCE shall be calculated using the formula:

\[ S = K \times T + C \]

where:

- \( K = 1600 \text{ mm/s} \)
- \( T = \text{Overall response time of the machine; } T = T_s + T_r \)
- \( C = 1200 \text{ mm} - 0.4 \text{H but not less than 850 mm where:} \)
- \( H = \text{The installation height of the light curtain in metres} \)

This is the distance between the reference plane (the floor) and the beam centre line of the Detection Zone. The installation height shall be a maximum of 1000 mm

Standard ISO 13855 also specifies a lowest allowable installation height depending on the ODC of the light curtain.
The lowest allowable height shall be calculated using the formula:

\[ H = 15 \text{ (ODC-40 mm)} \] as per ISO 13855

This means that for the MINI-SCREEN System, the allowable installation height is anywhere between ground level and the 1000 mm upper limit when floating blanking is not in use and between 60 and 1000 mm when floating blanking is used.

**1.10.2.1 MINIMUM SAFETY DISTANCE calculation examples**

The following formula and numbers are used to calculate MINIMUM SAFETY DISTANCE \( S \):

- \( K = 1600 \text{ mm/s} \)
- \( T_s = 0,170 \text{ s (the total stop time of the example machine, specified by the machine manufacturer)} \)
- \( T_r = 0,048 \text{ s, 0,060 s or 0,072 s (the specified response time of the MINI-SCREEN System)} \)
- \( H = 900 \text{ mm} \)

The numbers should be substituted into the formula as follows:

\[ S = K \times (T_s + T_r) + C \]

\[ C = (1200 - 0,4 \times 900) = 840 \text{ mm} \]

\( \textbf{C cannot be less than 850 mm, therefore 850 mm is used.} \)

\[ S = 1600 \times (0,170 \times 1,2^* + 0,072) + 850 \text{ mm} = 1291,6 \text{ mm} \]

The maximum allowable gap between the closest beam and the machine is 75 mm as per \textit{BS EN 693 (2001)}.

The 1219 mm MINI-SCREEN System may be used on this machine. Alternatively, a smaller MINI-SCREEN System may be used if a horizontal guard is fixed between the MINI-SCREEN System and the machine (see Figure 6 on Page 8).

\* 20% safety factor
1.10.3 Angled Approach

If the MINI-SCREEN System is installed so that the angle of approach to the Detection Zone is within ±5° to their designed approach, then they shall not be considered as Angled Approach (see Figure 8 on Page 9) and the relevant formula applies (i.e., normal or parallel).

For MINI-SCREEN Systems which are positioned at angles greater than ±5° to the direction of approach, the user must take into account the risk associated with the methods of approach and use the most appropriate formula.

As a guide, angles of approach less than 30° should be considered as Parallel Approach and angles of approach more than 30° should be considered Normal Approach (see Figure 3 on Page 5).

When an Angled Approach MINI-SCREEN System is considered as Parallel Approach, the MINIMUM SAFETY DISTANCE formula shall apply to the beam farthest from the hazard and shall use the height of that beam up to a maximum of 1000 mm. When blanking is used, the lowest beam must be set to a minimum of 60 mm above the reference plane to adhere to the formula:

\[
H = 15 \times (ODC-40 \text{ mm})
\]

\[
H = 15 \times (44-40) = 60 \text{ mm}
\]

1.10.4 Dual Position Devices

It may be advantageous to mount the MINI-SCREEN System so that it can be rotated to either normal or parallel approach (see Figure 9 on Page 9). The MINIMUM SAFETY DISTANCES for both conditions shall be applied. The axis of rotation should be at the point where both requirements can be achieved (it need not necessarily be the last beam).
Where it is possible to stand between the light curtain and the machine, a supplementary presence-sensing device such as a horizontal safety light curtain shall be provided, in order to detect a person standing in the Danger Zone. Banner offers a dual Controller in the MINI-SCREEN System series to facilitate this application. The MDSDINT-1T2 allows you to connect two MINI-SCREEN System Systems to the same Controller and achieve a significant cost saving without any reduction in safety (see Figure 10 on Page 10). The MDSDINT-1T2 may also be used to guard two areas on the same machine.

**WARNING!**

**POINT OF OPERATION**

The point of operation must be accessible only through the Detection Zone. Before operating machine/equipment, check that the Detection Zone is the only point of access. Mechanical barriers (screens, bars, etc.), or supplementary presence-sensing devices (supplementary guarding) must be installed, wherever needed, to prevent any person from reaching around, under, or over the Detection Zone and into the point of operation and also to prevent any person from entering the space between the Detection Zone and the point of operation. The use of mechanical barriers for this purpose is called fixed guarding. There must be no gaps between the fixed guarding and the edges of the Detection Zone. Openings in the fixed guard material must meet these criteria as specified in Standard ISO 13852. Supplementary safety presence-sensing devices must be used if the space between the Detection Zone and the nearest hazard point is large enough to allow a person to stand undetected by the minimum safety distance. Failure to meet these criteria could result in serious injury or death.

Standard ISO 13855 requires that all areas of entry to the point of operation not protected by the presence-sensing device shall be otherwise safeguarded. The hazard point must be accessible only through the Detection Zone. This means that mechanical barriers (screens, bars, etc.), or supplementary presence-sensing devices (supplementary guarding) must be installed, wherever needed, to prevent any person from reaching around, under, or over the Detection Zone and into the hazard point. The use of mechanical barriers for this purpose is called fixed or hard guarding (see Figure 11 on Page 10).

There must be no gaps between the fixed guarding and the edges of the Detection Zone which are greater than the MINI-SCREEN System ODC. Also, Standard ISO 13852 specifies a relationship between the distance of the fixed guard barrier from the point of operation and the maximum allowable size of openings in that barrier. Openings in the fixed guard material must meet these criteria.
MINI-SCREEN® System

1.12 CONDITIONS OF EQUIPMENT USE

⚠️ WARNING!

PROCEDURES

IF ALL MOUNTING, INSTALLATION, INTERFACING AND CHECKOUT PROCEDURES ARE NOT FOLLOWED PROPERLY THE MINI-SCREEN SYSTEM CANNOT PROVIDE THE PROTECTION FOR WHICH IT WAS DESIGNED. IT IS THE USER’S RESPONSIBILITY TO ENSURE THAT ALL NATIONAL AND INTERNATIONAL LAWS AND STANDARDS RELATING TO THE INSTALLATION AND THE USE OF THIS CONTROL SYSTEM IN ANY PARTICULAR APPLICATION IS SATISFIED. FAILURE TO FOLLOW THE INSTRUCTIONS AS OUTLINED IN block 4 on page 29 COULD RESULT IN SERIOUS BODILY INJURY OR DEATH. READ block 4 carefully BEFORE INSTALLING THE MINI-SCREEN SYSTEM.

The MINI-SCREEN System is a machine-guarding device. Its ability to perform this function depends on the appropriateness of the application and upon the MINI-SCREEN System’s proper mechanical and electrical installation and interfacing to the machine to be guarded.

The user has the sole responsibility to ensure that the Banner MINI-SCREEN System is installed and interfaced to the guarded machine by competent persons in accordance with this manual and in accordance with the Standard IEC 61496-1 and IEC 61496-2. Please refer also to the same standard for the definition of a competent person or refer to block 1.13.1 on page 11 of this manual.

MINI-SCREEN Systems are typically used in the following applications:

- Hydraulic and pneumatic power presses
- Molding presses
- Automated production equipment

MINI-SCREEN System may NOT be used with the following machinery:

- Any machine that cannot be stopped immediately after a stop signal is issued, such as single stroke (also known as FULL-REVOLUTION) clutched machinery
- Any machine with inadequate or inconsistent machine response time and stopping performance
- Any machine that ejects materials or component parts through the detection zone
- In addition, MINI-SCREEN Systems may not be used in any environment that is likely to adversely affect photoelectric sensing system efficiency. For example, corrosive chemicals or fluids or unusually severe levels of smoke or dust, if not controlled, may degrade the efficiency of Banner MINI-SCREEN Systems

Banner MINI-SCREEN Systems must not be used as machine restart devices to initiate machine motion (PSD) applications as stated in European Safety Standard IEC 61496-1.

1.13 SECURITY PROTOCOL

Type MSC.-... Heavy-Duty Metal Box Controllers have a lockable cover and a key-operated front-panel Reset switch.

Type MSDINT-1.. and MDSDINT-1.. Controllers have a front cover which can be removed only by means of a tool (a screwdriver). Both designs meet the standard reference ISO 12100-2 (Safety of Machinery), Annex A, Section 1.4.3.

As the Heavy-Duty Metal Box Controllers are usually mounted near the hazardous location, a User-supplied lock should be used to prevent access by unauthorised personnel. The key or combination to this lock should be kept in the possession of a Competent Person (block 1.13.1 on page 11 refers). This person should also be competent to carry out the Daily and 6 Monthly Checkouts.

The key to the Reset switch (either on the front panel of the Heavy-Duty Metal Box Controllers, or mounted remotely in a convenient location for DIN-mountable Controllers) should be available to the Designated Person (block 1.13.1 on page 11 refers). This person should also be trained to carry out Daily Check-outs and Resets.

1.13.1 Designated & Competent Persons

A Designated Person can be defined as a person or persons identified and designated in writing, by the employer, as being appropriately trained and qualified to perform a specific checkout procedure.

A Competent Person can be identified as a person or persons who, by possession of a recognised degree or certificate of professional training, or who, by extensive knowledge, training and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work.
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MINI-SCREEN® System

Introduction

2 INTRODUCTION

This Chapter details information of an introductory nature to the
equipment.

2.1 ABOUT THIS MANUAL

This Manual consists of a number of Chapters.

A block numbering system is also used in the Manual to assist
in easy location and readability of information in a logical way.

Chapters are numbered 1, 2, 3 and so forth.

Block numbering is broken down into up to 4 levels of informa-
tion as follows:

<table>
<thead>
<tr>
<th>Level</th>
<th>Title in Upper Case 13 PT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1.1</td>
<td>Title in Upper Case 10 PT</td>
</tr>
<tr>
<td>Level 1.1.1</td>
<td>Title in Title Case 10 pt</td>
</tr>
<tr>
<td>Level 1.1.1.1</td>
<td>Title in Title Case 8 pt</td>
</tr>
</tbody>
</table>

Illustrations are numbered 1, 2, 3, 4, etc. throughout the Man-
ual.

Tables are numbered 1, 2, 3, 4, etc. throughout the Manual.

For ON LINE versions of the Manual, there is an interactive Ta-
ble of Contents (Bookmarks) on the left hand side, which breaks
down into 4 block levels as well as Figure and Table Listings.

If the bookmarks are not visible when the document is opened:
they may be activated by clicking Window then Bookmarks
from the menu. Clicking a bookmark directs the Reader to the
information.

For printed versions of this document, there is a conventional
Table of Contents on Page 2.

For Readers of the ON LINE version of this document, Cross
References are identified in blue type and are hypertexed. That
is to say, when scrolling through the document using the
mouse, the cursor changes from ☰ to ☰. At this point if the
mouse is clicked, the document is routed directly to that partic-
ular reference. The Reader can return to the original place in the
document by clicking on the Bookmark or alternatively clicking on the highlighted book-
mark.

In general emphasis is used to emphasize information of medi-
um importance such as Machine functions etc.

In general bold emphasis is used to emphasize information of partic-
ular importance such as Machine commands, titles etc.

Change bars are also used in the document to indicate revi-
sions. They are positioned in the left or right hand margins ad-
jaent to the change.

At the end of the Manual there are a number of Appendices.

WARNING!

EMITTER/RECEIVER CONNECTION

WITH THE EXCEPTION OF TYPE MDSD... CONTROLLERS, DO NOT CONNECT MULTIPLE PAIRS OF
EMITTER/RECEIVERS TO ONE CONTROLLER. THE MINI-SCREEN SYSTEM USES ONE PAIR OF EMIT-
TER/RECEIVERS CONNECTED TO ONE CONTROLLER. FAILURE TO COMPLY CAN RESULT IN SERIOUS
INJURY OR DEATH, AND IS PROHIBITED.

The Banner MINI-SCREEN System is a microprocessor-control-
led opposed-mode opto electronic curtain of light. It is designed
for use as a point-of-operation guarding device, and is especial-
ly suited to smaller production machinery.

The Banner MINI-SCREEN System is a modular Machine Guard
System.

2.2 MINI-SCREEN SYSTEM

The MINI-SCREEN System incorporates the following main fea-
tures:

- Rugged and compact Light Screen suitable for heavy-duty
  machine guarding applications
- Each system includes Emitter(s), Receiver(s), Controller,
  and Interconnecting Cables
- 12 Standard Light Screen sizes available from 114 mm to
  1,2 m with either:
  - 9 m range with 19,1 mm ODC* or 18 m range with 25,4 mm
    ODC*
- 4 Heavy-duty light screen heights from 610 mm to 1829 mm
  with:
  - 18 m range with 38 mm ODC*
- All controllers feature floating blanking and selectable Auto
  Power-Up; other features (depending on model) include:
  - Trip or Latch outputs
  - Fixed-beam blanking
  - One or two Light Screens per controller
- All components FMEA tested to ensure control reliability,
  and third-party certified to IEC 61496-1 and IEC 61496-2
- System design meets applicable requirements of CE
- Explosion-proof and tubular sensor enclosures optionally
  supplied
- ODC assumes no blanking in use.

The Banner MINI-SCREEN System is a modular Machine Guard
System.

2.2.1 MINI-SCREEN System Main Features

The MINI-SCREEN System incorporates the following main fea-
tures:

- Rugged and compact Light Screen suitable for heavy-duty
  machine guarding applications
- Each system includes Emitter(s), Receiver(s), Controller,
  and Interconnecting Cables
- 12 Standard Light Screen sizes available from 114 mm to
  1,2 m with either:
  - 9 m range with 19,1 mm ODC* or 18 m range with 25,4 mm
    ODC*
- 4 Heavy-duty light screen heights from 610 mm to 1829 mm
  with:
  - 18 m range with 38 mm ODC*
- All controllers feature floating blanking and selectable Auto
  Power-Up; other features (depending on model) include:
  - Trip or Latch outputs
  - Fixed-beam blanking
  - One or two Light Screens per controller
- All components FMEA tested to ensure control reliability,
  and third-party certified to IEC 61496-1 and IEC 61496-2
- System design meets applicable requirements of CE
- Explosion-proof and tubular sensor enclosures optionally
  supplied
- ODC assumes no blanking in use.
2.2.2 Main Components

Each system consists of the following (see also Figure 12 on Page 14):

Emitter & Receiver Types:

Controller Types:

Cabling

Each system consists of the following (see also Figure 12 on Page 14):

Total cable length (Emitter cable length plus Receiver cable length) must be > 53 m. Emitter/Receiver cable runs of < 15 m must have an overall cable diameter of 13 mm.

For detailed information on Model/Type numbering, refer to block 3.3 on page 22.
The three MINI-SCREEN System components are interconnected using two 5-wire shielded cables with QD (Quick Disconnect) connectors on their Emitter and Receiver ends (see overview Figure 13 on Page 15).

The floating blanking feature of the MINI-SCREEN System allows for the movement of multiple workpieces through the screen at any point (see Figure 14 on Page 15). With the 2-beam floating blanking feature ON, the minimum object sensitivity of the MINI-SCREEN System is 44 mm (or 51 mm for the XL models). Objects with a size of 20 mm pass undetected (16.5 mm for the XL models). With the floating blanking feature OFF, the guaranteed minimum object detection size is 19 mm (or 25 mm, in the case of XL models).

Some models also allow fixed blanking. Fixed blanking allows fixed objects (such as brackets, fixtures, etc.) to be ignored in the Detection Zone, as long as they never move or change size (see Figure 15 on Page 15).

Emitters have a row of synchronized modulated infrared (invisible) light emitting diodes (LEDs) in a compact rectangular metal housing. Receiver units have a corresponding row of synchronized photo transistors. Emitters and Receivers are available in 12 lengths, ranging from 114 mm to 1219 mm (based on the height of the defined area). The rectangular Emitter/Receivers have a swivel bracket at each end for quick mounting and easy alignment. Controller and Receiver have LED indicators for system operating status and alignment. Each Receiver has three sets of status LEDs (front and both sides) for high visibility. Emitters have POWER ON indicators.
The Controller contains a power supply (to power the Controller itself, the Emitter and the Receiver), a microprocessor Controller board to control sensing logic, and a replaceable relay board with forced-guided output relays. Diagnostic LEDs on the Controller board (visible through a clear window in the control box cover) identify eight trouble causes. A remote keyed switch is supplied (control box types MSDINT-1.. and MSDINT-1.. only) or fixed to the front panel of the heavy-duty metal control box (all other models) for resetting the system at power-up or from fault (lockout) conditions.

The Banner MINI-SCREEN System is rated for a sensing range (distance between Emitter and Receiver) of 9 m (or 18 m for long-range models). The patented modulated Receiver design produces exceptionally high immunity to ambient light interference.

Emitter and Receiver circuits are designed to meet high standards for vibration resistance. Every MINI-SCREEN System Emitter, Receiver, and Controller is serialised and undergoes extensive testing at the factory.

Matching sets of MINI-SCREEN System Emitters and Receivers are not required. Any Emitter and Receiver (as long as they are of equal length and both are standard, long-range or heavy duty models) may be used together with any Controller.

For MINI-SCREEN System dimension drawings, see Figure 20 on Page 24, Figure 21 on Page 24, Figure 24 on Page 26 and Figure 26 on Page 27. For specifications, see block 3.2.1 on page 19.

MINI-SCREEN System components may be purchased separately, or they may be purchased bundled together in kit form. The components are listed in block 3.4.1 on page 24 and block 3.4.2 on page 26.
3 GENERAL INFORMATION

This Chapter details information of a general nature on the equipment.

3.1 PRODUCT

This block details product information such as CE and Product Identification Plates together with their location.

3.1.1 CE Marking Plate

The CE Mark is directly displayed on the Controllers as shown in Figure 17 on Page 17 and Figure 18 on Page 17.

3.1.2 Product Identification Plate

These plate(s) are located on the product equipment as shown in Figure 16 on Page 17, Figure 17 on Page 17 and Figure 18 on Page 17.

Emitter and Receiver

Controller Type MSC.-...

Controller Type MSDINT-1.. and MDSDINT-1..

3.1.3 Certificate of Adequacy

The MINI-SCREEN System Instruction Manual (48992 Rev F 22.10.03) satisfies the requirements of Machine Directive 98/37/EC, Safety of Machinery, Section 1.7.4 - Instructions.

3.1.4 Declaration of Conformity

The MINI-SCREEN System is delivered with a Certificate of Conformity as shown in Figure 19 on Page 18. This certificate is delivered to the Customer to certify that the product complies with the CE-Norm.

3.1.5 Trademarks

MINI-SCREEN® is a registered trademark of Banner Engineering Corp. with the U.S. Patent and Trademark Office.
Declaration of Conformity

Manufacturer:
Banner Engineering Corp.
9714 10th Ave N.
Minneapolis, MN 55441 USA

MINI-SCREEN
(Photoelectric Safety Light Curtain)

Herewith declares that:
- is in conformity with the provisions of the Machinery Directive (Directive 98/37/EEC), and all Essential Health and Safety Requirements have been met.
- is in conformity with the provisions of the following other EEC Directives:

and that:
- the following (parts/ clauses of) harmonized standards have been applied:

- the following (parts/ clauses of) national technical standards and specifications have been used:

EU Notified Body:
SGS United Kingdom Ltd.
Certificates: MDC 221 Rev 02

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s)

R. Bimbaum / Quality Manager

Figure 19 Declaration of Conformity
MINI-SCREEN® System

3.1.6 Control Reliability

3.1.6.1 Redundancy and Checking

MINI-SCREEN Systems meet international standards IEC 61496-1 and IEC 61496-2. Banner MINI-SCREEN Systems must reliably send a stop signal to a guarded machine as follows:

The MINI-SCREEN System must provide a stop signal to the guarded machine within 48 ms, 60 ms or 72 ms (depending on Emitter/Receiver length, Table 4 on Page 19) whenever the Detection Zone is interrupted. In order for the machinery guarded by the MINI-SCREEN System to be stopped as described, the guarded machine must be capable of stopping at any point in its machine cycle. This means that the MINI-SCREEN System cannot be used with certain types of machinery, such as single stroke (also known as full-revolution clutched) machinery, or any machine with inconsistent machine response time and stopping performance. If there is any doubt about whether or not your machinery is compatible, contact the Banner factory application engineers (see Customer Service Information in Appendix A 3)

The MINI-SCREEN System must provide a stop signal to the guarded machine when internal component failures have occurred which compromise the integrity of the MINI-SCREEN System itself.

This type of component failure includes any internal MINI-SCREEN System failure which could prevent or delay the output relays of the MINI-SCREEN System from going to a trip condition or a lockout condition in response to a situation which, in normal operation, would cause them to do so. The ability of the MINI-SCREEN System to send a stop signal even when such a component failure has occurred is guaranteed by the design principle of redundancy.

Redundancy requires that MINI-SCREEN System circuit components be backed up to the extent that, if the failure of any single component prevents effective stopping action when needed, that component must have a redundant counterpart which performs the same function.

The microprocessor-controlled MINI-SCREEN System is designed with diverse redundancy. Diverse redundant components are of different designs, and microprocessor programs used by them run from different instruction sets.

Redundancy must be maintained for as long as the MINI-SCREEN System is in operation. Since a redundant system is no longer redundant once a component has failed, MINI-SCREEN System are designed to be continuously self-checking. A component failure detected by or within the self-checking system causes a stop signal to be sent to the guarded machine and puts the MINI-SCREEN System into a lockout condition.

Recovery from this type of lockout condition requires replacement of the failed component (to restore redundancy) and a Key Reset (as detailed in block 4.7 on page 50). Possible causes of lockout conditions are listed in Table 21 on Page 64 which is a breakdown of the diagnostic display of the Controller used for internal diagnosis.

3.2 TECHNICAL SPECIFICATIONS

This block details the most important technical data for the product.

3.2.1 Specifications

Table 4 on Page 19 lists the specifications for the MINI-SCREEN System Emitter/Receivers.

Table 5 on Page 20 lists the specifications for the MINI-SCREEN System Controllers.

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Value/Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum object detection capability:</td>
<td>Standard (range up to 9 m)</td>
</tr>
<tr>
<td></td>
<td>19,1 mm with floating blanking OFF</td>
</tr>
<tr>
<td></td>
<td>31,8 mm with 1-beam floating blanking ON</td>
</tr>
<tr>
<td></td>
<td>44,5 mm with 2-beam floating blanking ON</td>
</tr>
<tr>
<td>Emitter/Receiver separation:</td>
<td>150 mm to 9 m</td>
</tr>
<tr>
<td>Response time:</td>
<td>Length 114 mm to 406 mm</td>
</tr>
<tr>
<td></td>
<td>48 ms</td>
</tr>
<tr>
<td>Self-checking interval:</td>
<td>20 ms</td>
</tr>
<tr>
<td>Ambient light immunity:</td>
<td>&gt; 10.000 lux at 5º angle of incidence</td>
</tr>
<tr>
<td>Strobe light immunity:</td>
<td>Immune as per IEC 61496-2</td>
</tr>
</tbody>
</table>
### General Information

**MINI-SCREEN® System**

**Table 4 MINI-SCREEN Emitter/Receiver Specifications**

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Standard (range up to 9 m)</th>
<th>Long-Range (range up to 18 m)</th>
<th>Heavy Duty (range up to 18 m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emitter elements:</td>
<td>Infrared LEDs; 880 nm peak emission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Status LEDs:</td>
<td>Emitter: green LED for power ON indication</td>
<td>Receiver: red, yellow and green status LEDs with same functions as those on Controller (see Controller specifications). Yellow also indicates alignment. LEDs are visible on three sides of Receiver base.</td>
<td></td>
</tr>
<tr>
<td>Enclosures:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emitter and Receiver:</td>
<td>Size: see Figure 21 on Page 24</td>
<td>Material: aluminium extrusion with black anodised or yellow polyester painted finish; acrylic lens cover</td>
<td>Protection class: IP65</td>
</tr>
<tr>
<td>Mounting hardware:</td>
<td>Emitter and Receiver are each supplied with a pair of mounting brackets. Mounting brackets are 2.37 mm thick cold-rolled black zinc chromate finished steel. A set of 4 anti-vibration mounts is also supplied.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 5 MINI-SCREEN System Controller Specifications.**

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Type MSCB-1..</th>
<th>Type MSCT-1..</th>
<th>Type MSCT-2..</th>
<th>Type MSCD-2..</th>
<th>Type MSDINT-1.. &amp; MDSDINT-1..</th>
</tr>
</thead>
<tbody>
<tr>
<td>System power requirements:</td>
<td>230 V ±15%, 10% maximum ripple, 1.5 A max</td>
<td>24 VDC ±15%, 10% maximum ripple, 1.5 A max</td>
<td>24 VDC ±15%, 10% maximum ripple, 1.5 A max</td>
<td>115/230 VAC ±15%, 10% maximum ripple, 1.5 A max</td>
<td>24 VDC ±15%, 10% maximum ripple, 1.5 A max</td>
</tr>
<tr>
<td>Fuse rating:</td>
<td>250 mA, 250 V (5x20 mm slow blow)</td>
<td>2 A, 250 V (5x20 mm slow blow)</td>
<td>2 A, 250 V (5x20 mm slow blow)</td>
<td>115 VAC: 1 A, 250 V (5x20 mm slow blow)</td>
<td>2 A, 250 V (5x20 mm slow blow)</td>
</tr>
<tr>
<td>Output type:</td>
<td>MSCB-1: Trip</td>
<td>MSCT-1: Trip</td>
<td>MSCT-2: Trip</td>
<td>MSCT-2T3: Trip</td>
<td>MSDINT-1: Trip</td>
</tr>
<tr>
<td></td>
<td>MSCB-1L2: Latch</td>
<td>MSCT-1T3: Trip</td>
<td>MSCT-2T3: Trip</td>
<td>MSCT-2T3: Trip</td>
<td>MSDINT-1L2: Latch</td>
</tr>
<tr>
<td></td>
<td>MSCB-1L2: 2 N.O. or 1 N.C. Aux</td>
<td>MSCT-1T3: 2 N.O. or 1 N.C. Aux</td>
<td>MSCT-2T3: 2 N.O. or 1 N.C. Aux</td>
<td>MSCT-2T3: 2 N.O. or 1 N.C. Aux</td>
<td>MSDINT-1L2: 2 N.O.</td>
</tr>
<tr>
<td>Floating blanking:</td>
<td>2-beam</td>
<td>2-beam</td>
<td>1- or 2-beam</td>
<td>1- or 2-beam</td>
<td></td>
</tr>
<tr>
<td>Fixed blanking:</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>E-stop input:</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>MSDINT-1: No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MSDINT-1L2: No</td>
</tr>
<tr>
<td>No. of light screens per Controller:</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>MSDINT-1: 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MSDINT-1L2: 1</td>
</tr>
<tr>
<td>Status LEDs:</td>
<td>Controller and Receiver:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>red = BLOCKED</td>
<td>flashing red = LOCKOUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>green = CLEAR</td>
<td>flashing green = BLANKING ON</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>yellow = RESET</td>
<td>double-flashing yellow = waiting for Power-up Manual Key Reset</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>single-flashing yellow = ALIGNMENT</td>
<td>flash rate increases with the number of sensing beams made, solid yellow when aligned and detection zone is clear.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emitter has green status LED to indicate power ON.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Diagnostic Display:
- 4 LEDs, visible through a window in Controller cover, indicates cause of lockout (see Table 21 on Page 64).
- 2 digit numerical display, visible through a window in Controller cover, indicates cause of lockout (see Table 21 on Page 64).
- For type MDSDINT-1T2 & MDSDINT-1L2, there is also a x1 digit numerical display, visible through a window in Controller cover, indicates cause of lockout (see Table 21 on Page 64).

### Controls and adjustments:
- Keyed Reset of system lockout conditions
- Blanking selection switches
- Auto Power-Up On-Off switches
- Floating Blanking selection switches and Fixed Blanking programming switches
- Auto Power-Up On-Off switches
- Keyed Reset of system lockout conditions
- Blanking selection switches
- Auto Power-Up On-Off switches

### Test input:
Terminals must be closed for a minimum of 0.05 s in order to guarantee a test input signal. The switching device used must be capable of switching 15 VDC to 50 VDC @ 20 mA to 100 mA.

> Use of Test Input is optional and not required for normal operation of the system.

### Auxiliary monitor relay:
- Reed relay; 125 VAC or VDC max., 500 mA max. (10 VA maximum, resistive load)

### Output configuration:
- Positively guided contact relays, 250 VAC max., 4 A max. (resistive load).
- Mechanical life 10,000,000 operations (minimum).
- Electrical life (at full rated load) 100,000 operations (typical).
- Arc suppression is recommended when switching inductive loads (see Figure 64 on Page 75, Figure 65 on Page 76 and Figure 66 on Page 77).

### Enclosure:
- Size: see Figure 24 on Page 26 and Figure 25 on Page 27
- Material: Welded steel box with black polyester powder paint finish
- Protection class: IP64

### Operating temperature:
0° C to +50° C.

### Relative humidity:
95% maximum (non-condensing)

### FMEA tested:
Per requirements IEC 61496-1 (type 4)

### Cables:
- Use only Banner cables, which incorporate a Twisted Pair for noise immunity on RS485 data communication lines. Use of other cables may result in nuisance lockouts
- All cables are PVC jacketed and have a straight quick-disconnect (QD) connector moulded onto the Emitter/Receiver end
- Total cable length (Emitter cable length plus Receiver cable length) must be less than 53 m. Emitter/Receiver cable runs of < 15 m must have an overall cable diameter of 13 mm.

---

Table 5  MINI-SCREEN System Controller Specifications.

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Type MSCB-1..</th>
<th>Type MSCT-1..</th>
<th>Type MSCT-2..</th>
<th>Type MSCD-2..</th>
<th>Type MSDINT-1.. &amp; MDSDINT-1..</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic Display</td>
<td>4 LEDs, visible through a window in Controller cover, indicates cause of lockout (see Table 21 on Page 64).</td>
<td>2 digit numerical display, visible through a window in Controller cover, indicates cause of lockout (see Table 21 on Page 64).</td>
<td></td>
<td></td>
<td>4 LEDs, visible through a window in Controller cover, indicates cause of lockout (see Table 21 on Page 64).</td>
</tr>
<tr>
<td>Controls and adjustments:</td>
<td>• Keyed Reset of system lockout conditions • Blanking selection switches • Auto Power-Up On-Off switches</td>
<td>• Keyed Reset of system lockout conditions • Floating Blanking selection switches and Fixed Blanking programming switches • Auto Power-Up On-Off switches</td>
<td>• Keyed Reset of system lockout conditions • Blanking selection switches • Auto Power-Up On-Off switches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test input:</td>
<td>Terminals must be closed for a minimum of 0.05 s in order to guarantee a test input signal. The switching device used must be capable of switching 15 VDC to 50 VDC @ 20 mA to 100 mA.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auxiliary monitor relay:</td>
<td>Reed relay; 125 VAC or VDC max., 500 mA max. (10 VA maximum, resistive load)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output configuration: (FSD1, FSD2, and SSD relays)</td>
<td>Positively guided contact relays, 250 VAC max., 4 A max. (resistive load). Mechanical life 10,000,000 operations (minimum). Electrical life (at full rated load) 100,000 operations (typical). Arc suppression is recommended when switching inductive loads (see Figure 64 on Page 75, Figure 65 on Page 76 and Figure 66 on Page 77).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enclosure:</td>
<td>Size: see Figure 24 on Page 26 and Figure 25 on Page 27 Material: Welded steel box with black polyester powder paint finish Protection class: IP64</td>
<td></td>
<td></td>
<td></td>
<td>Size: See Figure 26 on Page 27 and Figure 27 on Page 27 Material: Polycarbonate Protection class: IP20</td>
</tr>
<tr>
<td>Operating temperature:</td>
<td>0° C to +50° C.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative humidity:</td>
<td>95% maximum (non-condensing)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FMEA tested:</td>
<td>Per requirements IEC 61496-1 (type 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cables:</td>
<td>• Use only Banner cables, which incorporate a Twisted Pair for noise immunity on RS485 data communication lines. Use of other cables may result in nuisance lockouts • All cables are PVC jacketed and have a straight quick-disconnect (QD) connector moulded onto the Emitter/Receiver end Total cable length (Emitter cable length plus Receiver cable length) must be less than 53 m. Emitter/Receiver cable runs of &lt; 15 m must have an overall cable diameter of 13 mm.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MINI-SCREEN Systems are sold as kits and include the following equipment:

- Controller
- Emitter and Receiver of equal length and resolution
- Emitter/Receiver mounting hardware
- Two cables quick-disconnect connectors

Cables are interchangeable between the Emitter and the Receiver if they have the same kind of connectors. Refer to the Banner Machine Safety Products Catalogue for a complete list of available kits. Components are also available separately.

For Emitter, Receiver and Controller listings refer to Table 6 on Page 22, Table 7 on Page 22, Table 8 on Page 23 and Table 9 on Page 23.

### Table 6 MINI-SCREEN Emitters (E) and Receivers (R) Standard Series

<table>
<thead>
<tr>
<th>Model No. (yellow painted finish)</th>
<th>Order No.</th>
<th>Model No. (black anodised finish)</th>
<th>Order No.</th>
<th>Detection Zone (mm)</th>
<th>No. of Beams</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSE424Y</td>
<td>30 476 50</td>
<td>MSE424</td>
<td>30 374 44</td>
<td>114</td>
<td>8</td>
</tr>
<tr>
<td>MSR424Y</td>
<td>30 476 51</td>
<td>MSR424</td>
<td>30 374 45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSE824Y</td>
<td>30 476 52</td>
<td>MSE824</td>
<td>30 374 46</td>
<td>215</td>
<td>16</td>
</tr>
<tr>
<td>MSR824Y</td>
<td>30 476 53</td>
<td>MSR824</td>
<td>30 374 47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSE1224Y</td>
<td>30 476 54</td>
<td>MSE1224</td>
<td>30 374 48</td>
<td>305</td>
<td>24</td>
</tr>
<tr>
<td>MSR1224Y</td>
<td>30 476 55</td>
<td>MSR1224</td>
<td>30 374 49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSE1624Y</td>
<td>30 476 56</td>
<td>MSE1624</td>
<td>30 374 50</td>
<td>406</td>
<td>32</td>
</tr>
<tr>
<td>MSR1624Y</td>
<td>30 476 57</td>
<td>MSR1624</td>
<td>30 374 51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSE2024Y</td>
<td>30 476 58</td>
<td>MSE2024</td>
<td>30 374 52</td>
<td>508</td>
<td>40</td>
</tr>
<tr>
<td>MSR2024Y</td>
<td>30 476 59</td>
<td>MSR2024</td>
<td>30 374 53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSE2424Y</td>
<td>30 476 60</td>
<td>MSE2424</td>
<td>30 374 54</td>
<td>610</td>
<td>48</td>
</tr>
<tr>
<td>MSR2424Y</td>
<td>30 476 61</td>
<td>MSR2424</td>
<td>30 374 55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSE2824Y</td>
<td>30 476 62</td>
<td>MSE2824</td>
<td>30 374 56</td>
<td>711</td>
<td>56</td>
</tr>
<tr>
<td>MSR2824Y</td>
<td>30 476 63</td>
<td>MSR2824</td>
<td>30 374 57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSE3224Y</td>
<td>30 476 64</td>
<td>MSE3224</td>
<td>30 374 58</td>
<td>813</td>
<td>64</td>
</tr>
<tr>
<td>MSR3224Y</td>
<td>30 476 65</td>
<td>MSR3224</td>
<td>30 374 59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSE3624Y</td>
<td>30 476 66</td>
<td>MSE3624</td>
<td>30 374 60</td>
<td>914</td>
<td>72</td>
</tr>
<tr>
<td>MSR3624Y</td>
<td>30 476 67</td>
<td>MSR3624</td>
<td>30 374 61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSE4024Y</td>
<td>30 476 68</td>
<td>MSE4024</td>
<td>30 374 62</td>
<td>1016</td>
<td>80</td>
</tr>
<tr>
<td>MSR4024Y</td>
<td>30 476 69</td>
<td>MSR4024</td>
<td>30 374 63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSE4424Y</td>
<td>30 476 70</td>
<td>MSE4424</td>
<td>30 374 64</td>
<td>1118</td>
<td>88</td>
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<tr>
<td>MSR4424Y</td>
<td>30 476 71</td>
<td>MSR4424</td>
<td>30 374 65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSE4824Y</td>
<td>30 476 72</td>
<td>MSE4824</td>
<td>30 374 66</td>
<td>1219</td>
<td>96</td>
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<tr>
<td>MSR4824Y</td>
<td>30 476 73</td>
<td>MSR4824</td>
<td>30 374 67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 7 MINI-SCREEN Emitters (E) and Receivers (R) Long Range Series

<table>
<thead>
<tr>
<th>Model No. (yellow painted finish)</th>
<th>Order No.</th>
<th>Model No. (black anodised finish)</th>
<th>Order No.</th>
<th>Detection Zone (mm)</th>
<th>No. of Beams</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSE424Y</td>
<td>30 476 50</td>
<td>MSXLE424</td>
<td>30 526 25</td>
<td>114</td>
<td>8</td>
</tr>
<tr>
<td>MSR424Y</td>
<td>30 476 51</td>
<td>MSXLR424</td>
<td>30 526 26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSE824Y</td>
<td>30 476 52</td>
<td>MSXLE824</td>
<td>30 526 27</td>
<td>215</td>
<td>16</td>
</tr>
<tr>
<td>MSR824Y</td>
<td>30 476 53</td>
<td>MSXLR824</td>
<td>30 526 28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSE1224Y</td>
<td>30 476 54</td>
<td>MSXLE1224</td>
<td>30 526 29</td>
<td>305</td>
<td>24</td>
</tr>
<tr>
<td>MSR1224Y</td>
<td>30 476 55</td>
<td>MSXLR1224</td>
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## MINI-SCREEN System

### General Information

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<th>Model No. (yellow painted finish)</th>
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<th>Model No. (black anodised finish)</th>
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<th>Detection Zone (mm)</th>
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### Table 8 MINI-SCREEN Emitters (E) and Receivers (R) Heavy Duty Series

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<td></td>
<td></td>
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<tr>
<td>MSXLDE4812Y</td>
<td>30 689 69</td>
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<td>48</td>
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### Table 9 MINI-SCREEN Controller Versions

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<th>Trip</th>
<th>Latch</th>
<th>Fixed Blanking</th>
<th>DIN rail 24 VDC</th>
<th>Steel 115/230 VAC, 230 VAC or 24 VDC</th>
<th>Ident. No.</th>
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<td></td>
<td>230 VAC</td>
<td></td>
<td>30 619 96</td>
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<td>MSCB-1T3</td>
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<td></td>
<td>230 VAC</td>
<td></td>
<td>30 596 93</td>
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<tr>
<td>MSCT-1</td>
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<td></td>
<td>24 VDC</td>
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<td>30 435 36</td>
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<td>MSCT1T3</td>
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<td></td>
<td></td>
<td>24 VDC</td>
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<td>30 704 99</td>
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<tr>
<td>MSCD-2</td>
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<td>•</td>
<td></td>
<td>115/230 VAC</td>
<td></td>
<td>30 457 07</td>
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<tr>
<td>MSCD-2T3</td>
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<td>•</td>
<td></td>
<td>115/230 VAC</td>
<td></td>
<td>30 601 26</td>
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<tr>
<td>MSCT-2</td>
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<td>•</td>
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<td>24 VDC</td>
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<td>30 457 11</td>
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Table 9 MINI-SCREEN Controller Versions

<table>
<thead>
<tr>
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<th>Trip</th>
<th>Latch</th>
<th>Fixed Blanking</th>
<th>DIN rail 24 VDC</th>
<th>Steel 115/230 VAC, 230 VAC or 24 VDC</th>
<th>Ident. No.</th>
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<td>30 453 27</td>
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3.4 COMPONENT DIMENSIONS

3.4.1 Emitters & Receivers Including Brackets

Refer to Figure 20 on Page 24, Figure 21 on Page 24, Table 10 on Page 25 and Table 11 on Page 25.
### Table 10 MINI-SCREEN Standard/Long Range Emitter (E) and Receiver (R) Dimensions

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<th></th>
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<tbody>
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<td>MSE424Y</td>
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<td>MSXLE424Y</td>
<td>153 (mm)</td>
<td>188 (mm)</td>
<td>130 (mm)</td>
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<td>MSE824Y</td>
<td>MSR824Y</td>
<td>MSE824Y</td>
<td>MSXLE824Y</td>
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<td>287 (mm)</td>
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<tr>
<td>MSE1224Y</td>
<td>MSR1224Y</td>
<td>MSE1224Y</td>
<td>MSXLE1224Y</td>
<td>356 (mm)</td>
<td>389 (mm)</td>
<td>333 (mm)</td>
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<tr>
<td>MSE1624Y</td>
<td>MSR1624Y</td>
<td>MSE1624Y</td>
<td>MSXLE1624Y</td>
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<td>490 (mm)</td>
<td>434 (mm)</td>
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<td>MSE2024Y</td>
<td>MSXLE2024Y</td>
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<td>536 (mm)</td>
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<td>MSE2424Y</td>
<td>MSXLE2424Y</td>
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<td>693 (mm)</td>
<td>637 (mm)</td>
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<td>MSE2824Y</td>
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<td>MSE2824Y</td>
<td>MSXLE2824Y</td>
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<td>MSR3224Y</td>
<td>MSE3224Y</td>
<td>MSXLE3224Y</td>
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<td>896 (mm)</td>
<td>838 (mm)</td>
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<td>MSE3624Y</td>
<td>MSXLE3624Y</td>
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<td>998 (mm)</td>
<td>940 (mm)</td>
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<td>MSE4024Y</td>
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<td>MSE4024Y</td>
<td>MSXLE4024Y</td>
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<td>1100 (mm)</td>
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<td>MSE4424Y</td>
<td>MSXLE4424Y</td>
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<td>MSR4824Y</td>
<td>MSE4824Y</td>
<td>MSXLE4824Y</td>
<td>1267 (mm)</td>
<td>1300 (mm)</td>
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### Table 11 MINI-SCREEN Heavy Duty Emitter (E) and Receiver (R) Dimensions

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<th>Housing Length</th>
<th>Enclosure Length</th>
<th>Mounting Length (brackets facing outwards)</th>
<th>Mounting Length (brackets facing inwards)</th>
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<tr>
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<td>1469 (mm)</td>
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### 3.4.1.1 Emitter/Receiver Model Identification

Figure 22 on Page 26 gives a breakdown of a typical Model Number for Emitters and Receivers.

#### Figure 22 Emitter/Receiver Model Number Breakdown

- **MINI-SCREEN**
- **Max. Emitter/Receiver Separation:**
  - Blank = 9 m
  - XL = 18 m
  - XLHD = Heavy Duty 18 m
- **Emitter or Receiver**
- **Light screen height (inches)**
- **Beams per foot:**
  - 24 = Standard & Long-Range series
  - 12 = Heavy Duty series
- **Emitter/Receiver Finish:**
  - Blank = Black anodized
  - Y = Yellow polyester paint

### 3.4.2 Controllers

Refer to Figure 24 on Page 26, Figure 25 on Page 27 and Figure 26 on Page 27.

#### 3.4.2.1 Controller Model Identification

Figure 23 on Page 26 gives a breakdown of a typical Model Number for Controllers.

#### Figure 23 Controller Model Number Breakdown

- **MINI-SCREEN System:**
- **Supply voltage:**
  - B = 230 VAC
  - D = 115/230 VAC
  - T = 24 VDC
- **Fixed blanking:**
  - 1 = No fixed blanking
  - 2 = With fixed blanking
- **Trip/Latch:**
  - T = Trip
  - L = Latch
- **Controller type:**
  - C = Heavy duty controller
  - DIN = Controller with DIN rail
- **No. of Output Contacts:**
  - 2 = With fixed blanking

#### Figure 24 Dimensions for Type MSC-... Heavy Metal Controllers

- **Dimensions in mm**
  - 7.0 (H)
  - 210
  - 222.3
  - 244
  - 84
  - (2) 101.6
  - (2) 152.4
  - 210

**BANNER ENGINEERING CORPORATION**

222,3
7,9 (8)
(2) 152.4
210
84
(2) 101.6
**General Information**

**MINI-SCREEN® System**

---

**Figure 25** Type MSC-... Heavy Metal Controller Cable Entry Hole Locations

**Figure 26** Dimensions for Type MSDINT-1.. Controllers

**Figure 27** Dimensions for Type MSDINT-1.. Controllers

---

**Dimensions in mm**

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**Dimensions in mm**

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**Dimensions in mm**

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<td>7.1</td>
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<tr>
<td>28.7</td>
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</tr>
</tbody>
</table>

---

**Wiring terminal blocks can be unplugged from the module leaving wiring intact for easy module replacement**

---

**Recommended torque: 1.8 Nm to 2.25 Nm**

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**INSTRUCTION MANUAL - EUROPEAN VERSION**

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3.5 EQUIPMENT NOISE IMMUNITY LEVELS

The MINI-SCREEN System is designed and manufactured to be highly resistant to noise and to operate reliably in industrial settings.

3.6 EQUIPMENT VIBRATION LEVELS

The MINI-SCREEN System is in compliance with IEC 61496-1 and IEC 61496-2 for shock and vibration levels.

3.7 EQUIPMENT RADIATION LEVELS

3.7.1 Electromagnetic

The MINI-SCREEN System is in compliance with IEC 61496-1 and 61496-2 for electro-magnetic levels.

3.7.2 Laser

The Alignment Tool used for aligning the MINI-SCREEN System is in compliance with reference IEC 60825-1 for laser radiation levels.

3.8 CUSTOMER SERVICE INFORMATION

Refer to Customer Service Information in Appendix A 3 at the end of this book.
4 INSTALLATION INFORMATION

WARNING!

SAFETY INFORMATION

BEFORE INSTALLING THIS EQUIPMENT READ THE SAFETY INFORMATION in Chapter 1.

FLOATING BLANKING

FLOATING BLANKING INCREASES THE INTRUSION DEPTH FACTOR (C = 850 MM) (SEE BLOCK 1.10 ON PAGE 4). THE MINIMUM SAFETY DISTANCE MUST BE RECALCULATED WHENEVER FLOATING BLANKING IS USED. FAILURE TO COMPLY COULD RESULT IN MINOR OR MODERATE INJURY. ALWAYS TURN FLOATING BLANKING OFF WHEN IT IS NOT REQUIRED.

This potentially dangerous condition can be avoided by carrying out the Trip Test as described in the Commissioning Checkout Procedure (block 4.6.3 on page 50), the Alignment Procedure (block 4.6.2 on page 46), and the Periodic Checkout Procedures (block 6.1.2 on page 59 and block 6.1.3 on page 61). For additional information, please refer to block 4.1.3 on page 30, on adjacent reflective surfaces.

This Chapter details all information necessary for installing the equipment.

4.1 GENERAL

4.1.1 Mechanical Installation Considerations

The factors that influence the layout of the MINI-SCREEN System’s mechanical installation the most are:

- MINIMUM SAFETY DISTANCE (see block 1.10 on page 4)
- Fixed guarding (see block 1.11 on page 10)
- Emitter/Receiver orientation
- Adjacent reflective surfaces
- Use of corner mirrors

4.1.2 Emitter & Receiver Orientation

WARNING!

EMITTER/RECEIVER INSTALLATION

THE EMITTERS AND RECEIVERS OF THE MINI-SCREEN SYSTEM MUST BE INSTALLED WITH THEIR CORRESPONDING ENDS POINTING IN THE SAME DIRECTION. FAILURE TO MEET THESE CRITERIA COULD RESULT IN SERIOUS INJURY OR DEATH. BEFORE OPERATING THE MACHINE, ALWAYS CHECK FIRST THAT THE EMITTERS AND RECEIVERS ARE INSTALLED CORRECTLY.

It is absolutely necessary that the Emitter and Receiver are mounted perfectly parallel to each other and aligned in a common plane with both cable ends pointing in the same direction. Never mount the Emitter with its cable end oriented opposite to the cable end of the Receiver, or there may be voids in the light curtain through which objects can pass undetected (see Figure 28 on Page 29 and Figure 29 on Page 29).

The Emitter and Receiver can be oriented in a vertical or horizontal plane, or at any angle between horizontal and vertical. Always be certain that the light curtain completely covers all access to the hazard point which is not already protected by fixed guarding or another means of supplementary guarding.
4.1.3 Adjacent Reflective Surfaces

**WARNING!**

**REFLECTION PROBLEMS**

When there are problems concerning reflective surfaces, they must be eliminated. Failure to comply could result in personal injury. If possible, relocate the Emitter/Receivers to move the light curtain beams away from the reflective surface(s). If relocating the Emitter/Receivers, be careful to retain at least the required MINIMUM SAFETY DISTANCE (see block 1.10 on page 4). Alternatively, paint, mask, or roughen the interfering shiny surface to reduce its reflectivity. Use the trip test to verify that these changes have eliminated reflection problems (see block 4.6.2 on page 46).

If the workpiece is especially reflective and comes close to the light curtain, perform the trip test with the shiny workpiece in place.

A reflective surface located adjacent to the Detection Zone may deflect one or more beams of the light curtain around an object which is in the Detection Zone. In the worst case, an object may pass through the Detection Zone undetected. A reflective surface may be a part of the machine or the workpiece and may include shiny metal, shiny plastic or surfaces with glossy paint.

For this reason, a minimum standoff distance (A) should be observed so that beams from the light curtain cannot be deflected.

For MINI-SCREEN Emitter/Receivers (Type 4 ESPs) the EAA (Effective Aperture Angle) specified is ±2.5° which meets the requirements specified in standard IEC 61496-2, Section 5.2.9 (Type 4).

For distances of 0.2 m to 3.0 m, the Standoff Distance (A) is 135 mm (see Figure 30 on Page 30).

For distances of more than 3 m, a simple formula calculates the standoff distance A, derived from the Emitter/Receiver Separation Distance (S), and the EAA of the MINI-SCREEN System (Type 4) (see Figure 30 on Page 30). To calculate the Standoff Distance use the following formula:

\[
\text{Standoff Distance } A = \tan 2.5° \times S (\text{mm})
\]

Example With an Emitter/Receiver Separation Distance of 3.5 m (3500 mm):

\[
\text{Standoff Distance } A = 0.044 \times 3500 = 0.154 \text{ m (154 mm)}
\]

This calculation should not be confused with the MINIMUM SAFETY DISTANCE calculation as outlined in block 1.10 on page 4.

Where possible, reflective surfaces which are adjacent to the Detection Zone should be roughened or covered with a dull material. Where this is not possible (as with a reflective workpiece), the Emitter/Receiver mounting should include a means of restricting the field of view of the Receiver or the spread of the light from the Emitter.

Beams deflected by reflective surfaces are discovered using the trip test as described in the commissioning checkout procedure (block 4.6.3 on page 50), the Alignment Procedure (block 4.6.2 on page 46), and the Periodic Checkout Procedures (block 6.1.2 on page 59 and block 6.1.3 on page 61).

Figure 30 Typical Example of a Reflective Surface Close to a Detection Zone
4.1.4 Use of Corner Mirrors

**WARNING!**

**RETRO REFLECTIVE MODE**

The MINI-SCREEN System is not designed for use in a retro reflective mode where the Emitter/Receivers are mounted adjacent to each other and the light from the Emitter is bounced back directly to the Receiver by a mirror or other reflective surface. Sensing is unreliable in this mode and could result in serious injury or death. Never use MINI-SCREEN Emitter/Receivers in a retro reflective mode, as illustrated in Figure 31 on Page 31.

MINI-SCREEN System Emitter/Receivers may be used with one or more corner mirrors. The use of corner mirrors somewhat reduces the maximum specified Emitter/Receiver separation. Corner mirrors and stands are available from Banner. See Table 26 on Page 71 and Table 27 on Page 71 of the manual or contact your local representative for information (see Customer Service Information in Appendix A 3).

![Figure 31 Forbidden Use of Retro Reflective Mode](image)
4.1.5 Multiple MINI-SCREEN Systems

Whenever the Emitter and Receiver pairs of two or more MINI-SCREEN Systems are adjacent to one another, there is potential for optical crosstalk to take place between systems. To minimise optical crosstalk, it is recommended to alternate Emitters and Receivers. Figure 32 on Page 32 shows an example of multiple MINI-SCREEN Systems incorrectly installed. Figure 33 on Page 32 shows an example of multiple MINI-SCREEN Systems correctly installed.

When three or more systems are installed in one line, optical crosstalk may occur between those Emitter/Receiver pairs whose Emitter and Receiver lenses are oriented in the same direction. In this situation, optical crosstalk may be controlled by mounting these Emitter/Receiver pairs exactly in line with each other within the same plane, or by adding a mechanical light barrier between the pairs.

Figure 32 Example of Incorrect Installation of Multiple MINI-SCREEN Systems

Figure 33 Example of Correct Installation of Multiple MINI-SCREEN Systems
**WARNING!**

**ALIGNMENT TOOL**

The LAT-1-MS ALIGNMENT TOOL is fitted with a Class 2 Laser Diode. Laser light is emitted from the aperture. AVOID EXPOSURE AND DO NOT STARE INTO THE BEAM.

For specific dimensions of mounting brackets and Emitter/Receivers refer to Figure 20 on Page 24, Figure 21 on Page 24, Table 10 on Page 25 and Table 11 on Page 25.

Banner MINI-SCREEN System Emitters and Receivers are small, lightweight, and easy to handle during mounting. The mounting brackets (supplied) allow ±30° rotation for easy alignment.

The Emitter and Receiver must be mounted parallel to each other with their centres aligned.

1) From a common point of reference, make measurements to locate Emitter and Receiver in same plane with their mid-points directly opposite each other.

The connector ends of both Emitter/Receivers must point in the same direction (see Figure 28 on Page 29 and Figure 29 on Page 29).

2) Referring to Figure 34 on Page 33, mount Emitter and Receiver brackets with M6 bolts and nuts (supplied).

While the internal circuits of the Emitter and Receiver are able to withstand heavy impulse forces, the vibration isolators dampen impulse forces and prevent possible damage due to resonant vibration of the Emitter or Receiver assembly.

3) Mount Emitter and Receiver in their brackets and position red lenses of two units directly facing each other.

4) Measure from one or more reference planes (e.g. building floor) to same point(s) on Emitter and Receiver to verify their mechanical alignment.

5) Check alignment using a spirit level, straight edge or string extended between the Emitter/Receivers. Alternatively, use special Laser Alignment Tool LAT-1-MS (30 714 42) for positioning (refer to block 4.6.2.2 on page 48 for instructions).

6) Check also by eye for line-of-sight alignment. Make any necessary final mechanical adjustments, and hand-tighten bracket hardware. A detailed alignment procedure is given in block 4.6.2 on page 46.

7) Connect shielded cables to Emitter and Receiver and route them (as per local wiring code for low-voltage DC control cables) to Controller mounting location taking into consideration clearance dimensions as shown in Figure 35 on Page 33.

**Heavy-duty metal boxes only:** Emitter and Receiver cables must be routed to the control box cable entries closest to terminal barrier TB3; see Figure 25 on Page 27. The same cable type is used for both Emitter and Receiver (two cables required per system). Cables may be cut to length at the time of installation. Emitter and Receiver cable lengths may not exceed 16 m (each). Do not trim the cables until it is certain that all cables have been routed properly. The cable braid at the Controller connection points may be either removed or twisted together with the earth wire for attachment to the wiring block.
4.2.2 Controller Mounting

DIN Controllers Type MSDINT-1.. and MDSDINT-1..

1) Mount Controller (type MSDINT-1.. or MDSDINT-1..) (Figure 26 on Page 27) inside a suitable lockable cabinet.

**WARNING!**

**MOUNTING THE REMOTE KEY RESET SWITCH**

THE REMOTE KEY RESET SWITCH MUST BE MOUNTED OUTSIDE THE GUARDED AREA. FAILURE TO DO SO COULD RESULT IN SERIOUS INJURY OR DEATH. BEFORE OPERATING EQUIPMENT/MACHINE, ENSURE REMOTE KEY RESET SWITCH IS MOUNTED OUTSIDE THE GUARDED AREA.

- The position of the key switch (Figure 36 on Page 34) should be such that the view of the guarded area is unobstructed. Otherwise additional means (e.g. safety mats or safety light curtains) shall be provided to detect a person standing in the guarded area. In addition, it must NOT be possible to reach the Key Reset switch from inside the guarded area.

2) Mount Key Switch (supplied with system) at a convenient location (see Note on Page 34).

Heavy Duty Controllers Type MSC-...-

- The Controller must be positioned at a location which provides an unobstructed view of the hazardous area. All Controllers must be configured before initial checkout and use. Controller configuration is done at the row of DIP switches along the edge of the Controller module (see Figure 41 on Page 42 and Figure 42 on Page 42). The Controller automatically senses the length of the Emitter and Receiver and sets its response time accordingly.

1) Mount Controller (type MSC-...) (Figure 24 on Page 26) in a convenient location that is free from heavy impulse force and high-amplitude vibration.

4.3 ELECTRICAL CONNECTION

**WARNING!**

**ELECTRICAL CONNECTION**

ELECTRICAL CONNECTION MUST BE MADE BY A QUALIFIED ELECTRICIAN, AND MUST COMPLY TO NATIONAL STANDARDS. CONNECTION OF OTHER WIRING OR EQUIPMENT TO THE MINI-SCREEN SYSTEM COULD RESULT IN SERIOUS BODILY INJURY OR DEATH. ALWAYS USE A QUALIFIED ELECTRICIAN FOR ELECTRICAL CONNECTION.

**WARNINGS!**

**ELECTRICAL CONNECTION PROCEDURE**

PERFORM ELECTRICAL CONNECTION INSTRUCTIONS IN THE ORDER PRESENTED (I.E. block 4.3 on page 34) OTHERWISE DAMAGE COULD RESULT.

**CHECK WIRING**

DOUBLE-CHECK YOUR WIRING. INCORRECT WIRING CAN LEAD TO COMPONENT DAMAGE. THERE ARE NO USER ADJUSTMENTS OR CONNECTIONS INSIDE THE MINI-SCREEN EMITTERS AND RECEIVERS THEMSELVES.
4.3.1 Initial Connection

Only Emitter, Receivers and Key Switch (if applicable) are connected to the Controller at this stage.

4.3.1.1 Emitter/Receiver Connection

Type MSC.-... Controllers

**WARNING!**

**REMOVING HEAVY DUTY CONTROLLER BLANKS**

When removing metal blanks (knockouts) from the cable entry holes of type MSC.-..., heavy duty Controllers, there is a risk of damaging the internal components. Exercise care when removing these blanks.

For Controllers type MSC.-..., several cable entry holes (knockouts) are provided around the sides of the Controller. As wiring is completed, hole locations should be selected that are closest to the internal Controller board connection points that need to be accessed (see Figure 25 on Page 27). Two cable gland strain-relief fittings are supplied with each Controller for the entrance of Emitter and Receiver cables.

Except for Emitter and Receiver cable entries (for which cable glands are supplied), it is the User’s responsibility to maintain IP64 sealing at all cable entries into the Controller. The wiring terminals of all Controllers can accept conductors no larger than 1,6 mm². Also the wires used should have an insulation temperature rating of at least 90 °C.

Only Emitter and Receivers are connected to the Controller at this stage.

Referring to Figure 37 on Page 35, connect type MSC.-... Controllers as follows:

1) Prepare and connect Emitter and Receiver cables (supplied with system) to TB3 (refer to Figure 37 on Page 35) taking care to match colour coded wiring and corresponding terminals.

**Type MSDINT-1.. & MDSDINT-1..Controllers**

Referring to Figure 38 on Page 36 and Figure 39 on Page 37, connect type MSDINT-1.. and MDSDINT-1.. Controllers as follows:

1) Prepare and connect Emitter and Receiver cables (supplied with system) (refer to Figure 37 on Page 35) taking care to match colour coded wiring and corresponding terminals to:

- Terminals 11 thru’ to 15 (type MSDINT-1..)
- Terminals 16 thru’ to 20 (Screen 2) and terminals 22 thru’ to 26 (Screen 1) (type MDSDINT-1..)
**WARNING!**  

The remote Key Reset switch must be mounted outside the guarded area. Failure to do so could result in serious injury or death. Before operating equipment/machine, ensure key reset switch is mounted outside the guarded area.

A remote Key Reset can only be used with type MSDINT-1.. and MDSDINT-1.. Controllers.

Wiring is supplied by the user. Shielded cable and/or separate, grounded conduit is recommended.

1) Using shielded cable or separate wiring in a grounded conduit and referring to Figure 38 on Page 36 and Figure 39 on Page 37 as applicable, connect Key Switch to:

- Terminals 8 and 9 (type MSDINT-1..)
- Terminals 11 and 12 (type MDSDINT-1..)

![Diagram of MINI-SCREEN System Electrical Connections Types MSDINT-1 & MSDINT-1L2](image-url)
### 4.3.2 Power Supply Temporary Connection

Before the MINI-SCREEN System is connected to the Machine control via the MPCEs monitor contacts, the functioning of the system in its final mounting position should first be tested using a temporary connection. Permanent power connection is made after the MINI-SCREEN System Initial Checkout, and is detailed in block 4.4.1 on page 38.

Normal connection of the power supply from the MINI-SCREEN System Controller is via the MPCEs monitor contacts of the guarded machine but should not be connected to the MPCEs at this stage.

Proceed as follows:

1) For type MSCD-2 and MSCD-2T3 Controllers only, open Controller door and set 115 V/230 V Switch (located bottom right) to required voltage.

2) Temporarily connect a 230 VAC (type MSC.-... Controllers) or 24 VDC (type MSDINT-1.. and MDSDINT-1.. Controllers) power supply to the following terminals:

   - **Terminal Block TB1 L, N and ground (earth) terminals (type MSC.-.. Controllers)**
   - Terminals 32 (+24VDC), 33 (DC common) and 34 (PE ground) (type MSDINT-1..)
   - Terminals 50 (+24VDC) and 51 (DC common) and 52 (PE ground) (type MDSDINT-1..)
4.4 SYSTEM CHECKOUT

4.4.1 Initial Checkout

![WARNING!]

SHOCK HAZARD

A shock hazard exists while the lockable door of the type MSC-... CONTROLLERS is open. Before continuing, verify that the door is closed and locked. Failure to do so could lead to serious injury or death.

![WARNING!]

COMPETENT PERSON

This procedure must be performed by a Competent Person as specified in block 1.13.1 on page 11.

RESPONDING TO TRIP TEST

If MINI-SCREEN System does not respond properly to trip test, do not attempt to use system. Serious bodily injury or death could result. Before operating machine/equipment, investigate cause of trip failure.

Before performing Initial Checkout Procedure on type MSDINT-1.. and MDSDINT-1.. Controllers, the supplied Key Switch must be connected as detailed in block 4.3.1.2 on page 36.

This Initial Checkout must be performed after connecting the Emitter/Receiver (see block 4.3.1 on page 35) and temporary power (see block 4.3.2 on page 37) to the MINI-SCREEN Controller but before the MINI-SCREEN System is connected to the machine control.

For an explanation of LED status refer to Table 19 on Page 53 in conjunction with Figure 56 on Page 54.

The MINI-SCREEN System has three operating modes, POWER UP, KEY RESET, and RUN.

While performing the checkout, the three status LEDs (red, yellow and green), located on the Controller front panel and also on the receiver, should be monitored. See also Figure 56 on Page 54.

1) Enter POWER UP mode by applying power to the Controller. With Auto Power-Up OFF, system powers up in a lockout condition and LED double-flashes yellow.

With Auto Power-Up ON, system automatically enters RUN mode.

2) Perform Key Reset procedure as detailed in block 4.7 on page 50.

If red LED (only) flashes when system goes into RUN mode, an internal lockout condition exists. Refer to block 6.2.1.1 on page 63 to determine the cause of the lockout.

3) When Emitter and Receiver are aligned properly, tighten Emitter and Receiver mountings in position.

4) Repeat Step 1) and Step 2).

On some Controllers, a two-digit numeric display, visible through a window on the front, indicates the total number of blocked beams.

7) Verify that when test piece is removed from Detection Zone, the LEDs show steady green and yellow after Step 3) has been performed (green LED flashes if blanking is ON, and yellow LED comes ON steady). If the MINI-SCREEN System is being set up for the first time, or if the green and yellow LEDs do not come ON in Step 3), perform the alignment procedure in block 4.6.2 on page 46.

Trip Test

Table 12 Trip Test Pieces

<table>
<thead>
<tr>
<th>Floating Blanking Program</th>
<th>Standard Emitter/Receiver Test</th>
<th>Long Range Series Emitter/Receiver Test</th>
<th>Heavy Duty Series Emitter/Receiver Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floating blanking OFF</td>
<td>19,1 mm diameter model STP-2</td>
<td>25,4 mm diameter model STP-7</td>
<td>38 mm diameter model STP-1</td>
</tr>
<tr>
<td>1-beam floating blanking</td>
<td>31,8 mm diameter model STP-4</td>
<td>38,1 mm diameter model STP-1</td>
<td>62,2 mm diameter model STP-12</td>
</tr>
<tr>
<td>2-beam floating blanking</td>
<td>44,5 mm diameter model STP-3</td>
<td>50,8 mm diameter model STP-8</td>
<td>88,9 mm diameter model STP-10</td>
</tr>
</tbody>
</table>

Using the specified Test Pieces supplied with the Controller (see Table 12 on Page 38), perform Trip Test on the MINI-SCREEN for ODC as follows.

5) Set Key Switch to RUN position. Check yellow LED is ON steady, and green LED is either ON (steady to indicate blanking OFF) or flashing (to indicate blanking ON).

6) Referring to Figure 40 on Page 38, pass specified Test Piece, very slowly, down length of Detection Zone in three paths:

- Close to Emitter
- Close to Receiver
- Midway between Emitter and Receiver. Check that red LED comes ON when Test Piece enters Detection Zone, and remains ON for as long as test piece is in Detection Zone.

![Figure 40 MINI-SCREEN Trip Test]
Responsibility of the Installer and End User.

The tails of wiring of the MINI-SCREEN system to any particular machine is solely the installer's responsibility. To observe this warning could result in serious injury or death. The actual device of a short circuit. If installed directly across the contacts of a MINI-SCREEN system switching device, it is possible for suppressors to fail as a short circuit. If installed directly across the contacts of a MINI-SCREEN system switching device, a short-circuited suppressor creates an unsafe condition, which could lead to serious injury or death. Before operating machine/equipment verify suppressors are fitted correctly.

When the MINI-SCREEN system is in use, the machine manufacturer is responsible for the proper design and construction of the machine. The manufacturer must ensure that the machine is safe for use and that it is properly guarded. If the machine documentation leaves any doubt about the proper connection points for the MINI-SCREEN System output relay contacts, do not connect it to the machine. Contact the machine manufacturer for clarification regarding connections to the MPCEs and MSCE.

The SSD (Secondary Switching Device) output relay connects to the MSCE (Machine Secondary Control Element) on the guarded machine. The MSCE is an electrically powered element of the guarded machine (in a different control path from the MPCEs) that directly controls the normal operating motion of the guarded machine that is last (in time) to operate when motion is either initiated or arrested. The output contact of relay SSD2 must be connected, as shown in Figure 64 on Page 75, Figure 65 on Page 76 and Figure 66 on Page 77, to control power to MPCE 2. The switching capacity of relay SSD2 is 250 VAC max., 4 A max. (resistive load).

Many different types of mechanisms are used to arrest dangerous machine motion. Examples include mechanical braking systems, clutch mechanisms, and combinations of brakes and clutches. Additionally, control of the arresting scheme may be hydraulic or pneumatic. As a result, MPCEs may be of several control types, including a wide variety of contactors and electro-mechanical valves.

4.4.2 Output Relays FSD1, FSD2 & SSD

The output relays of the MINI-SCREEN system must be the final switching devices for the machinery being guarded. Never wire an intermediate device (for example a programmable logic controller - PLC) between either FSD and the machine control element it switches, unless the intermediate device is a safety relay. Connection of the output relays to the guarded machine must be direct and must produce immediate stopping action. Always respect any national or international standards for proper wiring of the switching devices. Failure to do so could lead to serious bodily injury or death. Verify that the output relays are the final switching devices.

The SSD output relay connects to MPCE 2 on the guarded machine. MPCE 2 is an electrically powered element of the guarded machine (in a different control path from MPCE 1) that directly controls the normal operating motion of the machine so that it is last (in time) to operate when motion is either initiated or arrested. The output contact of relay SSD1 must be connected, as shown in Figure 64 on Page 75, Figure 65 on Page 76 and Figure 66 on Page 77, to control power to MPCE 1. The switching capacity of relay SSD1 is 250 VAC max., 4 A max. (resistive load).

The warning is strongly recommended that one normally open and one normally closed auxiliary contact of each MPCE be wired (as shown in Figure 64 on Page 75, Figure 65 on Page 76 and Figure 66 on Page 77) as MPCE monitor contacts. If this is done, any inconsistency of action between the MPCEs removes power from the MINI-SCREEN system, causing a lock-out condition. The use of MPCE auxiliary contacts as MPCE monitor contacts is necessary in order to maintain redundancy. MPCE auxiliary contacts used for this purpose must be rated at 55 VA minimum. In order to maintain redundancy, the MPCE monitor contacts must be wired as described in block 4.4.2 on page 39.

 Throughout this MINI-SCREEN® System Instruction Manual - European Version 48992 rev. F 22.10.03 39
Installation Information

MINI-SCREEN® System

Figure 64 on Page 75, Figure 65 on Page 76 and Figure 66 on Page 77 show output relay connections in a generic interfacing situation. The connections between the MINI-SCREEN System outputs and the machine primary and secondary control elements must be direct, and arranged so that any single line fault or earth fault does not result in a circuit failure to a potentially dangerous state.

4.4.2.1 Connection

It is not possible to specify terminal connection for the MPCE 1, MPCE 2 and MPCE 3 as they are Guarded Machine dependant.

Type MSC-... Controllers

1) Referring to Figure 64 on Page 75 and guarded machine electrical circuit diagram, connect Output Relays as appropriate:
   - MPCE 1 cables (from guarded machine) to TB1 FSD1 terminals a & b
   - MPCE 2 cables (from guarded machine) to TB1 FSD2 terminals a & b
   - MSCE cables (from guarded machine) to TB1 SSD terminals a & b

Type MSDINT-1.. and MDSDINT-1.. Controllers

1) Referring to Figure 65 on Page 76, Figure 66 on Page 77, and guarded machine electrical circuit diagram, connect Output Relays (FSD1, FSD2 and SSD):
   - Terminals 18 and 19 (SSD), terminals 22 and 23 (FSD2) and 27 and 28 (FSD1) (type MSDINT-1..)
   - Terminals 27 and 28 (SSD), terminals 29 and 30 (FSD2) and 36 and 37 (FSD1) (type MDSDINT-1..)

These relays are energised (contacts closed) in normal operation with no obstructions in the Detection Zone. All relays become de-energised (their contacts open) in a lockout condition. Only FSD relays de-energise in a trip condition.

4.4.3 E-Stop Connection

**WARNING!**

E-STOPS

Whenver two or more E-STOPs are connected to the same MINI-SCREEN Controller, contacts of the corresponding poles of each switch or button must be connected together in series. This series combination is then wired to the respective module input. Never connect the contacts of multiple E-STOPs in parallel to the MINI-SCREEN Controller inputs. Parallel connection of two or more E-STOPs to one MINI-SCREEN Controller defeats the switch or button contact monitoring ability of the module and creates an unsafe condition which could result in serious injury or death. When two or more E-STOPs are used, each switch or button must be individually actuated (engaged), then reset and the MINI-SCREEN Controller reset. This allows the Controller to check each switch and its wiring to detect faults. Failure to test each switch or button individually in this manner could result in undetected faults and create an unsafe condition which could result in serious injury or death. This check must be performed during periodic check-outs (block 6.1.2 on page 59 and block 6.1.3 on page 61). The E-Stop Input function of this Controller is ineffective if the contacts of any muting or bypass circuitry is wired in parallel with the FSD contacts. Before connecting E-STOPs, read the information contained in block 1.7 on page 3. Button stop function of this Controller is ineffective if the contacts are wired in parallel with the FSD contacts. Before connecting E-STOPs, read the information contained in block 1.7 on page 3.

E-Stop can only be configured with type MDSDINT-1T2 MDSDINT-1L2 Controllers.

1) Connect the two poles to terminals 45, 46, 48, and 49 of E-Stop or Manual Control (actuator) as shown in Figure 39 on Page 37.

4.4.4 Power Supply Permanent Connection

4.4.4.1 General

**WARNING!**

EARTH CONNECTION

There is a risk of electrical shock if the MINI-SCREEN System is not connected with an earth (ground) connection. Failure not to do so could lead to serious bodily injury or death. Ensure the MINI-SCREEN System is connected with an earth ground connection.

Following Initial Checkout (block 4.4 on page 38), the power supply to the MINI-SCREEN System should be connected permanently through the MPCE monitor contacts of the guarded machine as this ensures that any inconsistency in action between the two MPCEs removes power from the system. (See Note on page 39 regarding MPCE monitoring wiring in).
**SYSTEM VERIFICATION**

After power has been connected to the MINI-SCREEN System and the output relay contacts have been connected to the machine to be controlled, the operation of the MINI-SCREEN System with the guarded machine must be verified before the combined system may be put into service. To do this, a Competent Person as specified in block 1.13.1 on page 11 must perform the commissioning checkout procedure described in block 4.6.3 on page 50.

- Frequency setting is universal.

1) Remove temporary power supply.

**Type MSC.-... Controllers**

2) Referring to Figure 37 on Page 35, connect power supply cable to terminals L and N (or + and -) on TB1.

3) For type MSCD-2 and MSCD-2T3 Controllers only, open Controller door and ensure voltage 115 V/230 V Switch (located bottom right) is set to required voltage.

**Type MSDINT-1.. and MDSDINT-1.. Controllers**

4) Referring to Figure 38 on Page 36 and Figure 39 on Page 37, connect power supply cable to:
   - Terminals 32 (+24 VDC), 33 (VDC common) and 34 (PE earth) (type MSDINT-1..)
   - Terminals 50 (+24 VDC), 51 (VDC common) and 52 (PE earth) (type MDSDINT-1..)

**All Types**

5) Connect power cable to MPCEs monitor contacts of Guarded Machine (refer to Guarded Machine Documentation for details).

**4.4.5 Auxiliary Monitor Relay**

**4.4.5.1 General**

The action of the Auxiliary monitor relay contact follows the action of output relays FSD1 and FSD2. The Auxiliary monitor relay contact is a light-duty contact used for control functions that are not safety-related. A typical use is to communicate with a programmable logic Controller (PLC). The switching capacity of the Auxiliary monitor relay is 125 VAC or VDC max., 500 mA max.

**4.4.5.2 Connection**

**Type MSC.-... Controllers**

1) Referring to Figure 37 on Page 35, connect non-safety functions to terminal TB4 (optional, not required for normal operation):

**Type MSDINT-1.. and MDSDINT-1.. Controllers**

2) Referring to Figure 38 on Page 36 and Figure 39 on Page 37 connect non-safety functions to:
   - AUX or ALARM terminals 1 and 2 (type MSDINT-1..)
   - Aux1 terminals 1 and 2, Aux 2 terminals 4 and 5 (type MDSDINT-1..)

**4.4.6 Accessory Connections**

**4.4.6.1 Remote Test Input**

A Remote Test Input is provided on the Controllers. When connected together (shorted) for a minimum of 50 ms, these terminals provide the MINI-SCREEN System with the equivalent of a BLOCKED beam condition, for testing purposes.

The switch or switching device used to short the TEST contacts must be capable of switching 15 VDC to 50 VDC at 20 to 100 mA. The use of this input is optional because the MINI-SCREEN System is a Type 4 device, i.e. completely self-checking, and does not require an external test signal.

The connections are identified as follows:

**Type MSC.-... Controllers (Figure 37 on Page 35)**

1) Connect Remote Input to TB2 TEST 1 and TEST 2 (optional, not required for normal operation)

**Type MSDINT-1.. and MDSDINT-1.. Controllers (Figure 38 on Page 36 and Figure 39 on Page 37)**

2) Connect Test Input (optional, not required for normal operation) to:
   - Type MSDINT-1..
     - Test1 or LATCH RESET1 terminal 4, Test1 or LATCH RESET1 terminal 5
   - Type MDSDINT-1..
     - Test1 terminal 8, Test 2 terminal 9
4.5 CONTROLLER CONFIGURATION

WARNING!

CONFIGURATION SETTINGS
Changing switch settings with power ON causes a lockout condition. Possible damage could result. Power to the MINI-SCREEN System must always be OFF when changing switch settings.

The following functions can be configured using the DIP switch settings:

- 1-beam floating blanking ON or OFF (model dependant)
- 2-beam floating blanking ON or OFF
- Auto Power-Up ON or OFF
- Fixed blanking (selective models)
- Light Screen 1 ON or OFF (model dependant)
- Light Screen 2 ON or OFF (model dependant)

The factory setting for all functions is OFF.

The Controllers all have two DIP switch banks (A and B) which must be set identically because of redundant microprocessor circuitry (see Figure 41 on Page 42, Figure 42 on Page 42 and Figure 43 on Page 43).

Failure to set both banks identically causes a lockout condition when power is applied to the Controller.

Set DIP Switches as follows:

Type MSC-... Controllers

1) Open front door of Controller.

Type MSDINT-1.. & MDSDINT-1.. Controllers

1) Using a screwdriver, open front cover of Controller.

All

2) Locate configuration switches in banks A and B as shown in Figure 41 on Page 42, Figure 42 on Page 42 and Figure 43 on Page 43.

3) Set the DIP switches ON or OFF identically at both Banks A & B as required.

Figure 41 DIP Switch Layout for Type MSC-... Controllers

Figure 42 DIP Switch Layout for Type MSDINT-1.. Controllers

Figure 43 DIP Switch Layout for Type MDSDINT-1.. Controllers
4.5.1 Floating Blanking

4.5.1.1 General

**WARNING!**

FLOATING BLANKING

When floating blanking increases the ODC above 40 mm (Table 14 on Page 43 refers), the intrusion depth factor (C) becomes 850 mm (see block 1.10 on page 4). The minimum safety distance must be recalculated whenever floating blanking is used. Failure to comply could result in minor or moderate injury. Always turn floating blanking off when it is not required.

**OBJECT DETECTION CAPABILITY**

Be aware of the differences in object detection capability (ODC), penetration factor, and required light curtain safety distance between the settings (see block 1.10 on page 4).

- Always turn floating blanking OFF when not required.

MINI-SCREEN Systems may be configured to be blind to the passage of multiple objects of limited size through the Detection Zone. This is useful in press brake and other applications where multiple blanked zones (moveable or stationary) are needed.

- Blanking ON is indicated by a flashing green receiver or Controller status LED.

Floating Blanking is the blinding of groups of one or two adjacent sensing beams. These appear to change position (float) in order to allow multiple objects (usually workpiece material) to move through the Detection Zone, at any point, without tripping the final switching device relays of the MINI-SCREEN System. With floating blanking configured ON, any and every 1- or 2-beam blockage(s) are ignored.

Floating blanking causes the MINI-SCREEN System to ignore objects of Maximum sizes as listed in Table 13 on Page 43.

**Table 13 Floating Blanking - Maximum Object Size Non-Detection**

<table>
<thead>
<tr>
<th>Floating Blanking Program</th>
<th>Standard Emitter/Receiver (mm)</th>
<th>Long Range Series Emitter/Receiver (mm)</th>
<th>Heavy Duty Series Emitter/Receiver (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-beam floating blanking ON</td>
<td>7,6</td>
<td>3,8</td>
<td>15</td>
</tr>
<tr>
<td>2-beam floating blanking ON</td>
<td>20</td>
<td>16,5</td>
<td>40</td>
</tr>
</tbody>
</table>

The minimum ODC sizes are listed in Table 14 on Page 43.

**Table 14 Floating Blanking - Minimum ODC Sizes**

<table>
<thead>
<tr>
<th>Floating Blanking Program</th>
<th>ODC (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Emitter/Receiver</td>
<td>Long Range Series Emitter/Receiver</td>
</tr>
<tr>
<td>Floating blanking OFF</td>
<td>19,1</td>
</tr>
<tr>
<td>1-beam floating blanking ON</td>
<td>31,8</td>
</tr>
</tbody>
</table>
Floating blanking preferences (ON or OFF) are set via a pair of DIP switches on the Controller board inside the Controller (see Figure 41 on Page 42, Figure 42 on Page 42 and Figure 43 on Page 43).

Both 1- and 2-beam floating blanking switches set to ON causes a lockout.

### 4.5.1.2 Setting Floating Blanking

Floating blanking preferences (ON or OFF) are set via a pair of DIP switches on the Controller board inside the Controller (see Figure 41 on Page 42, Figure 42 on Page 42 and Figure 43 on Page 43).

Both 1- and 2-beam floating blanking switches set to ON causes a lockout.

### 4.5.2 Fixed Blanking

#### 4.5.2.1 General

**WARNINGS!**

**FIXED GUARDING**

Fixed guarding may also be required. If any object that is to be ignored by fixed blanking does not, itself, completely prevent access to the hazard point(s), fixed guards must be installed to prevent access past the object. Openings in the material of the fixed guards must meet European standard criteria; see reference ISO 13852). Failure to comply could lead to serious injury or death.

**OPENINGS IN FIXED GUARDS**

Openings in fixed guards should comply with ISO 13852. Where it is possible to stand between the light curtain and the machine, additional means (for example, additional safety light curtains), shall be provided to detect a person standing in the danger zone.

- **Fixed Blanking only available on Controllers type MSCD-.. and MSCT-..**

<table>
<thead>
<tr>
<th>Floating Blanking Program</th>
<th>ODC (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard Emitter/Receiver</td>
</tr>
<tr>
<td>2-beam floating blanking ON</td>
<td>44,5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 15 Fixed Blanking Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Beams in Light Screen</td>
</tr>
<tr>
<td>----------------------------------</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>16</td>
</tr>
<tr>
<td>24</td>
</tr>
<tr>
<td>32</td>
</tr>
<tr>
<td>40 to 96</td>
</tr>
</tbody>
</table>

If the application requires Fixed Blanking of a greater number of beams contact Banner (see Customer Service Information in Appendix A 3).

#### 4.5.2.2 Programming for Fixed Blanking

- Fixed Blanking must be set within 4 minutes of turning the Program/Run switch to PROGRAM, or a lockout occurs, and the procedure must be restarted.

Floating Blanking can be selected to eliminate nuisance lockouts resulting from unstable clear beams at the edge of fixed objects (see Warning page 43).

Any fixed object in the Detection Zone must occupy the entire width (from Emitter to Receiver) of the Detection Zone. Otherwise, Fixed Guarding must be added to fill any opening in the Detection Zone created by Fixed Blanking (see Warning page 44).

The green status LED flashes to indicate use of Fixed and/or Floating Blanking.

Fixed Blanking programming is achieved by performing a Teach function using the Diagnostic Display in conjunction with the configuration (program) switches located on the Controller board (see Figure 41 on Page 42).

**Preparation for Programming**

1) Remove all power from Controller (and from machine to be controlled, if system is already connected to machine).

2) Repeating to Figure 41 on Page 42, ensure the following:

- Auto Power-Up Bank A & B DIP switches to **OFF**
- Floating Blanking Bank A & B DIP switches to **OFF**
- Program/Run configuration switch to **RUN**

On some models Fixed Blanking, as defined on Page 80, is available. The fixed blanking feature may be programmed if beams are blocked by one or more fixed objects. Fixed Blanking requires an Emitter/Receiver pair with 16 or more beams (see Table 6 on Page 22 and Table 7 on Page 22).

Fixed Blanking is limited to 30% of the total number of beams up to a maximum of 12 (see Table 15 on Page 44).
MINI-SCREEN® System

Installation Information

Programming

**WARNING!**

**POTENTIAL SHOCK HAZARD**

A potential shock hazard exists while the lockable door of the type MSC.-... controllers is open. Only a Competent Person as specified in block 1.13.1 on page 11 should work inside the controller with the power ON. Failure to observe this could lead to serious injury or death.

- Programming is rejected if the Program/Run switch is held depressed too long, or not long enough.
- If too many beams are blocked, programming is also rejected and the diagnostic display flashes error code 10. If this occurs, check Emitter/Receiver alignment and valid blanking criteria (see Table 15 on Page 44).

3) Apply power to Controller (only). Yellow Status LED double-flashes to indicate that system is ready for a Key Reset (do NOT perform a Key Reset at this time).

4) Select Program/Run switch on Controller to Program position (Figure 41 on Page 42). The Program Mode LED flashes and Diagnostic Display indicates total number of beams blocked (for example).

5) Simulate any mechanical vibration or shock which might be encountered in application and verify that read-out of beams blocked remains stable. If necessary, eliminate any intermittent beams.

6) When satisfied that number of beams blocked is stable, press Program switch for 0.5 s to 2 s. and release. If programming is accepted, the Program Mode LED stops flashing and glows steady.

7) Select Program/Run switch to RUN position. The Program/Run LED goes OFF.

8) Perform Key Reset as detailed in block 4.7 on page 50.

9) Remove power from Controller and reconfigure Auto Power-Up and Floating Blanking as required for application.

10) Re-apply power and if Auto Power-Up is not in use, perform a Key Reset (block 4.7 on page 50).

Clearing Fixed Blanking

- If alternative length Emitter/Receivers are to be installed, the following procedure must be carried out before replacement:

1) Remove power from Controller.

2) Remove all objects in Detection Zone.

3) Using procedure outlined in block 4.5.2 on page 44, re-program for a configuration of zero beams in Fixed Blanking.

For error codes associated with programming (10, 11, 12 etc.) see Table 21 on Page 64.

4.5.3 Auto Power-Up

**WARNINGS!**

**AUTO POWER-UP**

When using Auto Power-Up, application of power to the MINI-SCREEN System must NOT initiate dangerous machine motion. This could result in serious bodily injury or death. Before operating machine/equipment verify electrical configuration.

Auto Power-Up is not permissible in installations where it is possible to stand undetected inside the guarded area. This could result in serious bodily injury or death. Before operating machine/equipment verify situation.

Machine control circuitry must be designed so that one or more initiation devices be engaged to start the machine, after the MINI-SCREEN System is placed in Run mode.

4.5.3.1 General

Normal operation of the MINI-SCREEN System requires a Key Reset (block 4.7 on page 50) each time power is applied to the system. This is usually a normal response to a power failure or interrupt, and is required by some design standards. In applications where a Key Reset is difficult to perform, the Auto Power-Up feature puts the MINI-SCREEN System directly into RUN mode when power is applied.

Auto Power-Up is enabled or disabled via a pair of DIP switches located on Controller board inside Controller. See Figure 41 on Page 42, Figure 42 on Page 42 and Figure 43 on Page 43 for location of switches.

4.5.3.2 Auto Power-Up Feature ON or OFF

- The Auto Power-Up DIP switches have a protective coating to indicate factory default setting (OFF).

If protective coating is missing and it is necessary to determine whether Auto Power-Up is ON or OFF, proceed as follows:

If Auto Power-Up is ON, when power is applied to MINI-SCREEN System, Controller automatically resets after performing an internal system checkout.

If Auto Power-Up is OFF, Initial Reset is done manually (via Key Reset switch).

Regardless of this switch setting, a Key Reset (block 4.7 on page 50) is always necessary to recover from an internal lock-out condition.

Changing Auto Power-Up Setting

1) Remove power from Controller.

2) Remove protective sealing on Switch 1 Banks A & B and set them to ON.

- Banks A and B must be set in identical positions.

3) Restore power to Controller.
4.6 ALIGNMENT & CHECKOUT PROCEDURES

4.6.1 General

It is recommended that this procedure is studied before proceeding practically. All queries should be referred to the local representative. (Refer to Customer Service Information in Appendix A 3).

Block 4.6.2 on page 46 details the procedure for optically aligning the MINI-SCREEN System.

Block 4.6.3 on page 50 details the checkout procedures to be performed at the time of installation.

Block 6.1.2 on page 59 and block 6.1.3 on page 61 details the Daily and 6 Monthly checkout procedures.

4.6.2 MINI-SCREEN System Optical Alignment

WARNING!

BEFORE ALIGNING MINI-SCREEN SYSTEM

The machinery that the MINI-SCREEN System is connected to must be switched OFF and disabled during the alignment procedure (block 4.6.2 on page 46 refers) as personnel may be working close to the hazardous area of the machine. Aligning the MINI-SCREEN System while the hazardous machinery is operational could result in serious bodily injury or death.

It is assumed that the MINI-SCREEN System has been mounted and mechanically aligned as detailed in block 4.2.1 on page 33.

Only a Competent Person as specified in block 1.13.1 on page 11 may optically align the MINI-SCREEN System.

If there are reflective surfaces near the Detection Zone, the Trip Test should be performed first (Trip Test as detailed on Page 38) before proceeding further, to prevent possible reflection problems. See also block 4.1.3 on page 30 which deals with reflective surfaces.

To maximise MINI-SCREEN System Excess Gain, first follow procedures outlined below:

1) Turn OFF power to MINI-SCREEN System.
2) Turn OFF power to Guarded Machine and disable.
3) Power up MINI-SCREEN System only.

MINI-SCREEN System powers up into a power-up lockout condition (unless Auto Power-Up is ON).

4) Remove all obstructions from Detection Zone.

Reset MINI-SCREEN System as follows:

5) Perform Key Reset as detailed in block 4.7 on page 50.

On completion of Key Reset, MINI-SCREEN System indicates either a BLOCKED or a CLEAR condition (see Figure 56 on Page 54 or Figure 57 on Page 55).

BLOCKED Condition: Indicated by red Status LED OFF and yellow Status LED flashing at a rate which is proportional to the number of beams which are aligned and un-blocked.

For Controllers with a 2-digit diagnostic display (except for types MSCD-2..., MSCT-2... and MSCC-2 when the Fixed Blank-
4.6.2.1 Use of Corner Mirrors

WARNING!

CORNER MIRRORS

Use with supplementary sensing devices if necessary. For non-latching controllers, supplementary presence-sensing devices, such as safety mats, must be used if any space between either detection zone and any danger point is large enough to allow a person to stand undetected by the MINI-SCREEN System. Failure to observe this warning could result in serious injury or death. Before operating machine/equipment investigate situation.

MINI-SCREEN System Emitter/Receivers may be used with one or more MSM or SSM Series corner mirrors for guarding along more than one side of an area.

In Table 26 on Page 71 and Table 27 on Page 71 the 12 available lengths of corner mirrors for Emitter/Receivers up to 1295 mm long are listed. These rear-surface glass mirrors are rated at 85% efficiency; sensing range (and consequently excess gain) is reduced when using mirrors. Table 16 on Page 47 lists the resultant range when from one to four MSM or SSM Series corner mirrors are used in either sensing path.

Table 16 Corner Mirror Resultant Ranges

<table>
<thead>
<tr>
<th>Maximum Emitter &amp; Receiver Separation</th>
<th>E &amp; R Range</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9 m</td>
<td>8.5 m</td>
<td>7.8 m</td>
<td>7.2 m</td>
<td>6.7 m</td>
</tr>
<tr>
<td></td>
<td>18 m</td>
<td>16.8 m</td>
<td>15.5 m</td>
<td>14.3 m</td>
<td>13.1 m</td>
</tr>
</tbody>
</table>

Mirror Manual Alignment

Mirrors should be securely mounted to a solid, vibration-free surface. The mirror(s) should be mounted exactly parallel to (in the same plane as) the Emitter/Receiver using a level, with the midpoint of the mirror(s) directly in line with the midpoint of the Emitter/Receiver’s Detection Zone. The upper and lower limits of the Detection Zone of MINI-SCREEN Emitter/Receivers are indicated by the ends of each Emitter/Receiver window, and are dimensioned in Figure 21 on Page 24 in conjunction with Table 10 on Page 25 and Table 11 on Page 25.

1) Adjust corner mirror(s) so that angle of incidence of light to mirror equals angle of reflection from mirror.

2) Referring to Figure 46 on Page 47, sight from behind the Emitter or Receiver directly towards mirror (or first mirror in line).

When alignment is correct, the straight and centred reflection of the lens of the other Emitter/Receiver in the mirror can be seen.

3) For final alignment, use yellow alignment Status LED on Receiver or on Controller corresponding to light curtain being aligned. Also, for Controllers with a 2-digit diagnostic display, indicates total number of blocked beams.

For complete information on use of corner mirrors, refer to information packed with each MSM or SSM Series corner mirror.
### Installation Information

#### 4.6.2.2 Optical Alignment Using Alignment Tool

**WARNING!**

The LAT-1-MS ALIGNMENT TOOL is fitted with a CLASS 2 LASER DIODE. LASER LIGHT IS EMITTED FROM APERTURE. AVOID EXPOSURE AND DO NOT STARE INTO BEAM.

The optionally supplied Laser Alignment Tool, (model LAT-1-MS 30 714 42), is available to greatly assist alignment (see Table 29 on Page 72).

The useable range of Laser Alignment Tool (LAT-1-MS) (red dot viewed at target) depends on the following factors:

- Colour and reflectance of the target
- Level of ambient light present
- Presence of airborne contaminants

With a 90 percent reflectance white test card, under average lighting and with no airborne contaminants, the red dot is viewable at approximately 45 m or more. For longer ranges, lighting should be dimmed or retro reflective targets should be used.

The optional clip-on retro reflective target can increase the target area and visibility of red dot created by laser beam (see Figure 47 on Page 48).

To align proceed as follows:

1) Attach Laser Alignment Tool to housing of Emitter, using bracket clip included with tool (see Figure 48 on Page 48).

2) Place a target at arm’s reach, look alongside Laser Alignment Tool, and slowly raise target until red dot appears on it.

Using this method and rotating Emitter sends beam in approximate direction of Receiver.

3) If dot still cannot be located at Receiver (or mirror), walk target down path of beam, while keeping dot centered on target, until desired range is reached.

4) If no corner mirrors are used in application, attach or hold a piece of reflective material, such as white paper, reflective tape included with Laser Alignment Tool, or optional clip-on reflective target, to Receiver at beam location.

- Do not affix self-adhesive backing of reflective material to Emitter/Receiver windows or to mirror surfaces; adhesive residue may not be easy to remove (see Figure 49 on Page 48).

5) If corner mirrors are used, attach or hold reflective material at beam height in the approximate centre of mirror 1.

The Laser Alignment Tool emits a bright red pinpoint of light along the same path as Emitter Beam.

6) Adjust Emitter tilt and rotation until Laser Alignment Tool beam is centered over Receiver (or mirror) beam location.

7) Partially tighten Emitter mounting hardware to prevent misalignment when Laser Alignment Tool is later removed. If mirrors are used, proceed to Step 8). If no mirrors are used, proceed to Step 9).

8) After Emitter Beam is aligned on first mirror, remove reflective material from that mirror and repeat process on second mirror. Repeat process for each mirror in succession, until laser beam shines on reflective material positioned at Receiver Beam location.

9) Position Laser Alignment Tool on Receiver housing, centered over Beam location.

10) Align Receiver beam as described in Step 6) for Emitter (mirrors, if used, normally should not require realignment).

11) Partially tighten Receiver mounting hardware to prevent misalignment when Laser Alignment Tool is removed.

12) Remove Laser Alignment Tool.
For general overview using the Laser Alignment Tool see Figure 49 on Page 48.

Figure 50 Optical Aligning with Laser Alignment Tool Systems
4.6.3 Commissioning Check-out

**WARNING!**

COMMISSIONING CHECK-OUTS

If all commissioning check-outs cannot be verified, MINI-SCREEN System and/or guarded machine should not be used until defect or problem has been corrected (see block 6.2.1 on page 63). Attempts to use guarded machine under such conditions could result in serious bodily injury or death. Before operating machine/equipment all commissioning check-outs should be verified.

- This Commissioning Checkout should be performed at time of installation.
- This Commissioning Checkout should be performed by a Competent Person as specified in block 1.13.1 on page 11.
- A copy of checkout results should be kept in Employer's files.

1) For Commissioning Checkout carry out procedures detailed in block 6.1.3 on page 61.

4.7 RESET PROCEDURE

To perform a manual Reset:

**Type MSC.-... Controllers**

1) Turn key to **RESET** (clockwise) position (yellow LED goes **ON** steady).
2) Wait at least 0.5 s, then turn key to the **RUN** (counter clockwise) position.

**Type MSDINT-1.. & MDSDINT-1.. Controllers**

3) If using a non Banner supplied remote Reset Switch, close switch for 0.5 s to 2 s, then open switch again.
4) If using a Banner supplied Reset Switch (type MGA-KS0-1) (Table 22 on Page 69 refers), turn key 1/4 turn clockwise to **RESET** position (Controller yellow Status LED goes **ON** steady), hold for 0.5 s to 2 s, then turn key counter clockwise to its **RUN** (original position).
5 OPERATING INSTRUCTIONS

This Chapter details all information necessary for operating the MINI-SCREEN System in a safe and correct way.

WARNING!

OPERATING SAFETY

BEFORE OPERATING THIS EQUIPMENT READ THE Safety Information in Chapter 1.

5.1 EQUIPMENT CONTROLS & INDICATION

The basic MINI-SCREEN System shown in Figure 51 on Page 51 consists of following equipment:

- Emitter
- Receiver
- Controller

The Controller provides the electronic safety interface between Guarded Machine and MINI-SCREEN System.

There are two main types of Controller and their variants that can be used with the MINI-SCREEN System:

- Controller Heavy Duty Metal Box type MSC.-...
- Controller DIN type MSDINT-1.. or MDSDINT-1..

The Controllers have the following controls and indications (see Figure 52 on Page 51):

5.1.1 Controllers

Used on type MSC.-.. Controllers only.

Allows entry to RUN mode and is also used for a Reset of the MINI-SCREEN System after an error.

5.1.1.1 Key Reset Switch

Supplied for use with type MSDINT-1.. and MDSDINT-1.. Controllers only and remotely situated outside the Detection Zone.

5.1.1.2 Remote Key Reset Switch

Allows entry to RUN mode and is also used for a Reset of the MINI-SCREEN System after an error.
5.1.1.3 Diagnostic Display

On type MSCD-2.., MSCT-2.., and MDSINT-1.. Controllers, there is a red two-digit numeric display, visible through a transparent window in the MINI-SCREEN Controller cover, which indicates an error code corresponding to the cause of a fault (lockout) condition.

Error codes are listed and interpreted in Table 21 on Page 64.

During programming of fixed blanking this display indicates the number of blanked beams.

During normal operation, the display indicates the total number of blocked beams, including fixed blanked beams.

There is also a red decimal point indicator which flashes to indicate a high level of electrical or optical interference in the area of the MINI-SCREEN System.

Under normal RUN conditions, and with no beams blocked, the right-hand digit displays a horizontal red bar (i.e. the centre segment of the display is lit).

5.1.1.4 Diagnostic LEDs

The Diagnostic LEDs as shown in Figure 53 on Page 52, are used to indicate the following:

- Various error situations
- Power supply to CPU (green LED only)
- Presence of optical noise (Binary Value 4 LED only flashing)

See Table 21 on Page 64 for further breakdown of Diagnostic Indicator.

5.1.1.5 Status LEDs

The system Status LEDs are shown in Figure 54 on Page 52. See Table 17 on Page 52 for basic indications. See block 5.1.4 on page 53 for detailed functionality.

5.1.2 Receiver

The yellow, red and green system Status LEDs are visible from three sides of the Receiver. See Table 18 on Page 52 for basic indications. See block 5.1.4 on page 53 for detailed functionality.

5.1.3 Emitter

The green system status LED only, visible from three sides of the Emitter, indicates power ON.
### 5.1.4 Indicator LEDs Operational Status

Table 19 on Page 53 in conjunction with Figure 56 on Page 54 and Figure 57 on Page 55 gives a breakdown of the LED status displayed on the Controller and Receiver.

**Table 19 LED Status Breakdown**

<table>
<thead>
<tr>
<th>LED Status</th>
<th>Action</th>
<th>Fault/Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Red</strong> <strong>ON</strong> steady and yellow single-flashing <strong>(*)</strong> (Blocked).</td>
<td>The MINI-SCREEN System has been <strong>Reset</strong> and is in <strong>RUN</strong> mode.</td>
<td>Either there is an obstruction in Detection Zone or Emitter and Receiver are misaligned. <strong>FSD1</strong> and <strong>FSD2</strong> contacts are open (de-energised). <strong>SSD</strong> relay is closed (energised).</td>
</tr>
<tr>
<td><strong>Flashing yellow</strong></td>
<td>Emitter/Receiver alignment.</td>
<td>The faster the flash rate, the more beams are <strong>made</strong> and the fewer beams are blocked or <strong>not made</strong>. ☚ <strong>This feature is very helpful for Emitter/Receiver alignment</strong> (block 4.6.2 on page 46). When alignment is correct, green LED comes <strong>ON</strong> (to join yellow ) when obstruction is removed. If alignment is not correct, green LED remains <strong>OFF</strong> when obstruction is removed.</td>
</tr>
<tr>
<td><strong>Red</strong> . <strong>green</strong> <strong>,</strong> and yellow <strong>ON</strong> steady (latching output models)</td>
<td>MINI-SCREEN System has been <strong>Reset</strong> and is in <strong>RUN</strong> mode.</td>
<td>System is waiting for a latch reset input. <strong>Detection Zone</strong> is clear of obstructions, and Emitter and Receiver are properly aligned. <strong>FSD1</strong> and <strong>FSD2</strong> contacts are open (de-energised). The <strong>SSD</strong> contact is closed (energised).</td>
</tr>
<tr>
<td><strong>Green</strong> <strong>,</strong> and yellow <strong>ON</strong> steady</td>
<td>The MINI-SCREEN System has been <strong>reset</strong> and is in <strong>RUN</strong> mode.</td>
<td>The detection zone is clear of obstructions, and the emitter and receiver are properly aligned. <strong>SSD</strong>, <strong>FSD1</strong>, and <strong>FSD2</strong> contacts are closed (energised).</td>
</tr>
<tr>
<td><strong>Red</strong> (only) <strong>ON</strong> and flashing</td>
<td>Not Applicable.</td>
<td>A lockout condition due to an internal MINI-SCREEN System problem exists. <strong>SSD</strong>, <strong>FSD1</strong>, and <strong>FSD2</strong> are all open (de-energised).</td>
</tr>
<tr>
<td><strong>Yellow</strong> (only) <strong>ON</strong> and double-flashing</td>
<td>Not Applicable.</td>
<td>A power-up or power interrupt lockout condition. These lockouts occur in the normal course of powering up the MINI-SCREEN System or for an interruption of power to the System (except if <strong>Auto Power-Up</strong> is <strong>ON</strong>; see block 4.5.3 on page 45). <strong>SSD</strong>, <strong>FSD1</strong> and <strong>FSD2</strong> contacts are open (de-energised).</td>
</tr>
<tr>
<td><strong>Yellow</strong> (only) <strong>ON</strong> steady</td>
<td>Key Switch switched to <strong>RESET</strong> position at power-up.</td>
<td><strong>Key Switch</strong> has been switched to <strong>RESET</strong> position at power-up. <strong>FSD1</strong> and <strong>FSD2</strong> contacts are open (de-energised). <strong>SSD</strong> contact is closed (energised).</td>
</tr>
</tbody>
</table>
**Figure 56 Operating Status Conditions for Type MSC. ... Trip & Latch Controllers**

<table>
<thead>
<tr>
<th>Operator Mode</th>
<th>Normal Operation</th>
<th>LED Status</th>
<th>Trip Controllers</th>
<th>*Latch Controllers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Up</td>
<td>Apply power to Controller</td>
<td>LOCK OUT STATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Key Reset</td>
<td>Turn key to RESET position</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Run</td>
<td>Detection zone is CLEAR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Run</td>
<td>Detection zone is Blocked (TRIP)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal System fault (LOCKOUT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **LED Status**: BLOCKED Red, CLEAR Green, RESET Yellow
- **FSD1**: Red, Green, Yellow
- **FSD2**: Red, Green, Yellow
- **SSD**: Red, Green, Yellow
- **AUX MONITOR**: Red, Green, Yellow
- **ALARM**: Red, Green, Yellow

- **LED OFF**: Key must be in the RUN position at power-up. If the key is inadvertently turned to RESET while the system is operating normally, the MINI-SCREEN System goes into a LOCKOUT condition and the RED (only) status indicator LED flashes. To return the MINI-SCREEN System to the RUN condition, the key must again be turned to RESET, and then back to RUN.
- **LED ON steady**: If Auto Power-Up is ON when power is applied to MINI-SCREEN System, the Controller performs an Automatic Reset after passing an internal system check-out (Key Reset not needed). Auto Power-Up is discussed in block 4.5.3 on page 45. A Key Reset is always required to recover from a LOCKOUT condition.
- **LED ON double flashing**: Latching Controllers: the red LED remains ON following a latch condition and goes OFF after a Key Reset.
- **LED ON single flashing**: Green flashes if blanking is ON.
- **Yellow**: OFF if the System is powered up without alignment.

- **Key must be in the RUN position at power-up.** If the key is inadvertently turned to RESET while the system is operating normally, the MINI-SCREEN System goes into a LOCKOUT condition and the RED (only) status indicator LED flashes. To return the MINI-SCREEN System to the RUN condition, the key must again be turned to RESET, and then back to RUN.
**Figure 57 Operating Status Conditions for Type MSDINT-1.. & MSDINT-1.. Trip & Latch Controllers**

### Operator Mode

**Normal Operation**

- **Power Up**: Apply power to Controller **LOCK-OUT STATE**
- **Key Reset**: Turn key to **RESET** position
- **Run**: Turn key to **RUN** position

### LED Status

- **Clear**: Red, Green, Yellow
- **Blocked**: Red, Green, Yellow
- **Trip Controllers**: FSD1, FSD2, SSD, AUX. MONITOR
- **Latch Controllers**: ALARM

### Key to Symbols

- **LED OFF**: Red, Green, Yellow
- **LED ON steady**: Red, Green, Yellow
- **LED ON single flashing**: Red, Green, Yellow
- **LED ON double flashing**: Red, Green, Yellow

#### Normal Operation

- Detection zone is **CLEAR**

#### Key Reset

- Detection zone is blocked (TRIP or LATCHED)

#### Run

- Detection zone is CLEAR but LATCHED

- Internal System fault (LOCKOUT)

### Notes

- A Key Reset is always required to recover from a LOCKOUT condition.
- There are two auxiliary monitor contacts - one for each light screen.
- Controller dependent. Latch Output models require a Latch Reset following Key Reset (see block 4.2.2 on page 34).
- The red LED indicator is ON following Key Reset but goes OFF after Latch Output Reset. The alarm contact for Latch Output models closes when defined area is blocked (system becomes latched) and opens when Latch Output is Reset (see block 4.4.5 on page 41 Auxiliary Monitor Relay or Alarm Relay and block 4.4.6.1 on page 41 Remote Test Input or Latch

- **Trip Controllers**: Latching Controllers: the red LED remains ON following a latch condition and goes OFF after a Key Reset.
- **Latch Controllers**: Green flashes if blanking is ON.

- **LED OFF**: Red, Green, Yellow
- **LED ON steady**: Red, Green, Yellow
- **LED ON single flashing**: Red, Green, Yellow
- **LED ON double flashing**: Red, Green, Yellow

- Key must be in the RUN position at power-up. If the key is inadvertently turned to **RESET** while the system is operating normally, the MINI-SCREEN System goes into a LOCKOUT condition and the RED (only) status indicator LED flashes. To return the MINI-SCREEN System to the RUN condition, the key must again be turned to **RESET**, and then back to **RUN**.
5.2 NORMAL OPERATION

**WARNING!**

**CORRECT OPERATION**

The Banner MINI-SCREEN System can only do the job for which it was designed if it and the guarded machine are operating properly, both separately and together. It is the user’s responsibility to verify this, on a regular basis, as instructed in block 4.6 on page 46 and block 6.1.1 on page 57. Failure to correct such problems can result in serious bodily injury or death. Before the system is put back into service, it must be ensured that the MINI-SCREEN System and the guarded machine perform exactly as outlined in the checkout procedures and any problem(s) found corrected.

5.2.1 Power-Up

- If Auto Power-Up feature is ON when AC or DC power is applied to System, Controller performs a system checkout and resets itself, without need for a Key Reset.

  If Auto Power-Up feature is OFF when AC or DC power is applied to the MINI-SCREEN System, it is normal for it to power up into a lockout condition.

  For Controllers, without a Key Reset Switch, DC power is automatically applied to Controller via relay when power is applied to MINI-SCREEN System providing Controller is configured for Auto Mode on DIP Switches (see block 4.5 on page 42).

  To prepare MINI-SCREEN System for operation after a power-up lockout, the Designated Person as specified on page 11 must perform a Key Reset.

For Controllers configured for non Auto Power-Up, proceed as follows:

1) Perform Key Reset as detailed in block 4.7 on page 50.
2) Perform checkout as detailed in block 4.6.3 on page 50.

5.2.2 Fixed Blanking Operation

- Only available on some Controller models (see Table 5 on Page 20 for details).

  The fixed blanking feature of some Controllers allows the MINI-SCREEN System to be programmed to ignore permanent objects (e.g. brackets or fixtures) which are present in the detection zone. For the description of fixed blanking see Fixed Blanking Description on Page 15. For programming information see block 4.5.2 on page 44.

5.2.3 Floating Blanking Operation

- Up to 12 beams or 30% of the total number of beams in the Emitter/Receiver may be fixed blanked (whichever is less). If Fixed Blanking for a greater number of beams is required, contact Banner (see Customer Service Information in Appendix A 3).

- Use of floating blanking increases minimum ODC of light curtain which in turn requires MINIMUM SAFETY DISTANCE to be increased.

5.2.4 Emergency Stop Switch or Button (if fitted)

1) Press E-stop Button and check that both FSD output contacts open within 15 milliseconds. Verify also that guarded machine stops with no apparent delay.

   See block 4.4.3 on page 40 for wiring information.

2) Reset as necessary.

5.2.5 Normal Shutdown

To shutdown the MINI-SCREEN System:

1) Switch OFF power supply to guarded machine.
6 MAINTENANCE

WARNS!NS!

MAINTENANCE SAFETY
Before carrying out maintenance on this equipment read the Safety Information in Chapter 1.

BYPASSING SAFETY DEVICES
Attempts to operate machinery by bypassing the MINI-SCREEN System are dangerous and could result in serious bodily injury or death. Do not bypass the MINI-SCREEN System.

SWITCHING OFF EQUIPMENT
When carrying out maintenance or part replacement, the MINI-SCREEN System and the machinery that is connected to must be switched off, otherwise serious bodily injury or death could result and possible damage to the equipment.

NON APPROVED REPLACEMENT PARTS
Do not use non approved replacement parts. Failure to do so could impair the operation of the MINI-SCREEN System and could result in serious bodily injury or death. Always use only genuine Banner-supplied replacement parts.

WARNING!

LETHAL VOLTAGES
Lethal voltages are present inside the MINI-SCREEN System controller whenever AC power to the machine control elements is on and could result in serious bodily injury or death. Exercise extreme caution whenever AC voltage is or may be present! Always disconnect all power from the MINI-SCREEN System and the guarded machine before making any wire connections or before replacing any component. The controller should be opened and/or serviced only by a Competent Person as specified in block 1.13.1 on page 11.

6.1 PREVENTIVE MAINTENANCE

This block details information and instructions for tasks that must be performed on the equipment on a regular basis.

6.1.1 Periodic Checkout Requirements

FUNCTIONING OF THE MINI-SCREEN SYSTEM
The functioning of the MINI-SCREEN System and the guarded machine must be verified on a regular, periodic basis to ensure proper operation. This is absolutely vital. Failure to do so may lead to serious injury or death. Before operating machine/equipment, periodic verification should be up-to-date.

In addition to the Check-Outs to the MINI-SCREEN System that are performed by a Competent Person as specified in block 1.13.1 on page 11 or persons at installation and servicing, the functioning of the MINI-SCREEN System and the Guarded Machine must be verified on a regular, periodic basis to ensure proper operation.

Check-Outs/Maintenance must be performed as follows:

• By a Designated Person as specified on page 11 at every Shift Change or Machine Setup Change (use Checkout procedure block 6.1.2 on page 59)
• By a Competent Person as specified in block 1.13.1 on page 11 6 monthly following installation of the MINI-SCREEN System (use Checkout procedure block 6.1.3 on page 61)
Intentionally left blank
6.1.2 Daily/Shift Change Checkout

THIS CHECKOUT PROCEDURE SHOULD BE PERFORMED AT EVERY POWER-UP, SHIFT CHANGE AND MACHINE/EQUIPMENT SETUP

![WARNING!]

EMPLOYER DESIGNATED PERSON

AN EMPLOYER Designated Person as specified on page 11 of the Instruction Manual must perform these procedures and in strict order of sequence.

VERIFICATION OF CHECKS

If all of the checks cannot be verified, do not use the MINI-SCREEN System or guarded machine/equipment until the defect or problem has been corrected. Doing so could result in serious bodily injury or death. Maintain proper minimum safety distance. Failure to maintain appropriate minimum safety distance (as indicated above) can result in serious injury or death.

FIXED GUARDING

Fixed guarding may also be required. If any object that is to be ignored by fixed blanking does not, itself, completely prevent access to the hazard point(s), fixed guards must be installed to prevent access past the object. Openings in the material of the fixed guards must meet European Standard criteria; see reference ISO 13852. Failure to comply could lead to serious injury or death.

INSERTING TEST PIECES

Do not attempt to insert the test piece into the hazardous parts of the guarded machine/equipment.

HIGHLY REFLECTIVE SURFACES

It may be possible for a highly reflective surface (such as a shiny workpiece or machine surface) to reflect sensing light around an object in the detection zone, thus preventing that object from being detected.

![WARNING!]

SHOCK HAZARD

A shock hazard exists while the lockable door of the type MSC-... Controllers is open. Before continuing, verify that the door is closed and locked. Failure to do so could lead to serious injury or death.

During continuous machine/equipment running periods, this checkout must be performed at intervals not exceeding 24 hours.

A copy of the checkout results should be kept on or near the machine/equipment as detailed in European Safety Standard IEC 61496-1.

For information on calculating MINIMUM SAFETY DISTANCE, refer to block 1.10 on page 4 of the Instruction Manual.

1) Verify that all fixed guards, supplementary guards and devices for hazardous parts of guarded machine/equipment other than that protected by MINI-SCREEN System are in place and operating correctly (see Figure 58 on Page 59).

2) Verify that MINIMUM SAFETY DISTANCE from closest hazard point of guarded machine/equipment to Detection Zone is not less than calculated distance (see Figure 58 on Page 59).

3) Record calculated MINIMUM SAFETY DISTANCE for guarded machine/equipment here __________ at the time of installation. See block 1.10 on page 4 of Instruction Manual for more information.

4) For Non-Latching Controllers, verify that it is not possible for a person to stand between Detection Zone and dangerous parts of guarded machine/equipment. Verify also that supplementary presence-sensing devices, such as safety mats, are in place and functioning properly.

5) For Latching Controllers, verify that remote Key Reset switch or integral Controller Key Reset (Controller Model dependant) is mounted outside guarded area at a location which provides an unobstructed view of entire guarded area or verify that supplementary presence-sensing devices, such as safety mats, are in place and functioning properly. In addition, verify that it is also NOT possible to reach Key Reset switch from inside guarded area.

6) Verify that enclosure for MINI-SCREEN System is closed and locked and key (or combination/tool) to locking mechanism is in the possession of a Competent Person as specified in block 1.13.1 on page 11.

7) Verify power is on to MINI-SCREEN System.

8) Select correct test piece for system configuration as specified (Table 20 on Page 59).

Table 20 Trip Test Pieces - Daily/Shift Change Checkout

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Floating blanking OFF</td>
<td>Ø19.1 mm model STP-2</td>
<td>Ø25.4 mm model STP-7</td>
<td>Ø38.1 mm model STP-1</td>
</tr>
<tr>
<td>1-beam floating blanking ON</td>
<td>Ø31.8 mm model STP-4</td>
<td>Ø38.1 mm model STP-1</td>
<td>Ø62.2 mm model STP-12</td>
</tr>
<tr>
<td>2-beam floating blanking ON</td>
<td>Ø44.5 mm model STP-3</td>
<td>Ø50.8 mm model STP-8</td>
<td>Ø88.9 mm model STP-10</td>
</tr>
</tbody>
</table>

and yellow status LEDs ON.

9) Verify that MINI-SCREEN System is in RUN mode (green and yellow status LEDs ON).
The Auto Power-up feature is OFF when power is applied to the System and therefore normal for it to power up into a lockout condition. A Key Reset should therefore be performed as follows:

**Type MSC.-... Controllers**

10) Turn key to **RESET** (clockwise) position (yellow LED goes ON steady). ❑
11) Wait at least 0.5 s, then turn key to **RUN** (counter clockwise) position. ❑

**Type MSDINT-1.. & MDSDINT-1.. Controllers**

12) If using a non Banner supplied remote **Reset Switch**, close switch for 0.5 s to 2 s, then open switch again. ❑
13) If using a Banner supplied **Reset Switch** (type MGA-KS0-1) (Table 22 on Page 69 refers), turn key 1/4 turn clockwise to **RESET** position (Controller yellow Status LED goes ON steady), hold for 0.5 s to 2 s, then turn key counter clockwise to its **RUN** (original position). ❑

14) Verify guarded machine/equipment is disabled. ❑
15) Pass appropriate specified **Test Piece** downward through **Detection Zone** at three points (see Figure 59 on Page 60):
   - Close to Receiver
   - Close to Emitter
   - Midway between Emitter and Receiver ❑

16) Check in each case, red Status LED comes ON and remains ON for as long as **Test Piece** is within **Detection Zone**. ❑
17) For **Latching Controllers** check red Status LED remains ON until a Key Reset (block 4.7 on page 50) has been performed. ❑
18) Check green Status LED comes ON only when **Test Piece** is withdrawn from **Detection Zone**. ❑

If green Status LED comes ON at any time when **Test Piece** is within **Detection Zone**, this may be due to light reflected from Emitter to Receiver by a nearby reflective surface or unguarded areas created because fixed blanking (type MSCD-... & MSCT-... Controllers only) is in use (see block 4.1.3 on page 30 and block 4.5.2 on page 44).

Be sure to maintain at least required **MINIMUM SAFETY DISTANCE** (see block 1.10 on page 4).

**Do not continue until situation is corrected.**

- Yellow Status LED comes ON steady if Detection Zone is clear and flashes when test piece is within Detection Zone. Yellow Status LED only goes OFF if Detection Zone is entirely blocked.

19) With guarded machine/equipment disabled, insert specified test piece into **Detection Zone** and verify that it is not possible for equipment to be enabled while specified test piece is within **Detection Zone**. ❑

**E-stop Button Test (for use with type MDSDINT-1.. Controllers only)**

Test **E-stop Button** (if connected via a MINI-SCREEN System) as follows:

20) With equipment running, press **E-stop Button** (to open its contacts). Verify that guarded machine/equipment stops with no apparent delay. When two or more switches are series-connected to a MINI-SCREEN Controller, test each **E-stop Button**, individually. See also **Warning page 3** regarding wiring of two or more **E-stop Buttons**. ❑

**General**

21) Look carefully for external signs of damage to MINI-SCREEN System, including electrical wiring. Any damage found should be immediately reported to management. ❑

If it is suspected there are problems with reflections refer to block 4.1.3 on page 30.

**WARNING!**

**VERIFICATION OF CHECKS**

If all of the checks cannot be verified, do not use the MINI-SCREEN System or guarded machine/equipment until the defect or problem has been corrected. Doing so could result in serious bodily injury or death.
6.1.3 Six Monthly Checkout

THIS CHECKOUT SHOULD BE PERFORMED AT 6-MONTHLY INTERVALS

⚠️ WARNING!

SHOCK HAZARD

A shock hazard exists while the lockable door of the type MSC... controllers is open. Before continuing, verify that the door is closed and locked. Failure to do so could lead to serious injury or death.

⚠️ WARNINGS!

COMPETENT PERSON

This procedure must be performed by a Competent Person as specified in block 1.13.1 on page 11.

MINIMUM SAFETY DISTANCE

CALCULATE THE MINIMUM SAFETY DISTANCE VERY CAREFULLY TO MAINTAIN PROPER MINIMUM SAFETY DISTANCE. FAILURE TO MAINTAIN APPROPRIATE MINIMUM SAFETY DISTANCE CAN RESULT IN SERIOUS INJURY OR DEATH.

☛ A copy of the checkout results should be kept in the Employer’s files in accordance with the European Safety Standard IEC 61496-1.

☛ For information on calculating MINIMUM SAFETY DISTANCE, refer to block 1.10 on page 4 of the Instruction Manual.

1) Examine guarded machine/equipment to verify that it is of a type and design that is compatible with MINI-SCREEN System.

2) Examine electrical wiring connections between MINI-SCREEN System output relays and guarded machine/equipment control elements to verify that requirements stated in block 4.3 on page 34 of Instruction Manual are met.


4) Remove electrical power from MINI-SCREEN System. All output relays should immediately de-energise, and should not be capable of being reactivated until power is re-applied and a Key Reset is performed (unless Auto Power-Up feature is ON).

5) Test machine stopping response time using an instrument designed for that purpose to verify that it is the same or less than overall system response time specified by machine manufacturer. If any decrease in machine braking ability has occurred, make necessary clutch/break repairs, re-calculate MINIMUM SAFETY DISTANCE, readjust S appropriately (see Figure 60 on Page 61) and again perform Step 1 thru’ to Step 4. If MINIMUM SAFETY DISTANCE has changed, record new distance on Daily Checkout Card.

* Banner’s Applications Engineering Department can recommend a suitable instrument for testing the stop response time (contact Customer Service Information in Appendix A 3).

6) Examine and test MPCEs in accordance with the Guarded Machine Documentation to ensure that they are functioning correctly and are not in need of maintenance or replacement.

7) Inspect guarded machine/equipment to ensure that there are no other mechanical or structural problems that would prevent machine/equipment from stopping or assuming an otherwise safe condition when signalled to do so by MINI-SCREEN System.

8) Examine and inspect machine/equipment controls and connections to MINI-SCREEN System to ensure that no modifications have been made which adversely affect system.

9) Examine electrical wiring connections between MINI-SCREEN output relays and guarded machine’s control elements to verify requirements stated in block 4.4.2 on page 39 of Instruction Manual.

⚠️ WARNING!

VERIFICATION OF CHECKS

IF ALL OF THE CHECKS CANNOT BE VERIFIED, DO NOT USE THE MINI-SCREEN SYSTEM OR GUARDED MACHINE/EQUIPMENT UNTIL THE DEFECT OR PROBLEM HAS BEEN CORRECTED. DOING SO COULD RESULT IN SERIOUS BODILY INJURY OR DEATH.
6.2 CORRECTIVE MAINTENANCE

6.2.1 Troubleshooting

6.2.1.1 Lockout Conditions

WARNING!

POWER FAILURES

Power failures or other MINI-SCREEN System lockout conditions should always be investigated immediately by a competent person. Never bypass the MINI-SCREEN System or any of its components, as this creates a dangerous situation which could result in serious bodily injury or death.

With the exception of lockout conditions 1 and 2 (Figure 61 on Page 64 and Table 21 on Page 64), lockout is a positive indication of a problem and should be investigated at once.

A lockout condition of the MINI-SCREEN System causes all of its output relays to open, sending a stop signal to the guarded machine. A lockout condition occurs:

- Routinely upon power-up of the MINI-SCREEN System (unless Auto Power-Up is ON; see Figure 56 on Page 54)
- If power to the MINI-SCREEN System is interrupted (unless Auto Power-Up is ON; see Figure 56 on Page 54)
- If the Controller Key switch is in the RESET position at power-up, (with Auto Power-Up ON); or if the Key switch is switched to RESET while the system is in RUN mode
- If the Program/Run switch (Figure 41 on Page 42) is in the PROGRAM position at power-up
- If floating blanking switches are in the ON position when the Program/Run switch is switched to the PROGRAM position
- If both 1-beam and 2-beam floating blanking switches are in the ON position
- If fixed blanking is NOT SET within approximately 4 minutes of moving the Program/Run switch to the PROGRAM position
- If fixed blanking has been programmed, and any fixed object is removed from or moved within the detection zone
- If an FSD relay does not drop out within its specified time
- If the SSD relay has de-energised
- If the Controller switch settings are inconsistent with each other or if they are changed while the system is in RUN mode
- If the self-checking circuits of the microprocessor detect a component failure within the MINI-SCREEN System itself, or
- If either (or both) E-stop Button contacts open

A lockout condition causes output relays FSD1, FSD2, and SSD to open, shutting down the MPCEs and MSCE of the guarded machine. A lockout condition resulting from an internal system fault is indicated by the red status (only) flashing.

Power-up/power interrupt lockouts are normal (Auto Power-Up OFF; conditions 1 and 2 above, yellow status LED only double-flashing and require a Key RESET for operation to continue.

Use the following procedure to resume operation after a power interruption (condition 2):

1) Turn the key to the RESET position (yellow status LED should light).

2) Wait at least one-half second and then turn the key to the RUN position. If the detection zone is clear and the Emitter and Receiver are properly aligned, the green and yellow LEDs light.

If the lockout condition was due to a momentary power interruption that has been corrected, the MINI-SCREEN System now operates normally.

Upon recovery from a power interruption, the checkout procedure in block 6.1.2 on page 59 must be performed.

For latching Controllers the System requires a Key Reset of the latch to resume operation following a latch condition.
6.2.1.2 Diagnostic Indicator for Lockout Conditions

**Type MSC.-…& MDSDINT-… Controllers Only**

A lockout condition resulting from an internal system fault is indicated by the Controller and Receiver red status LEDs flashing (refer to Table 17 on Page 52 and Table 18 on Page 52) and an error code number which appears in the diagnostic display (see Figure 61 on Page 64). In this case, the Competent Person as specified in block 1.13.1 on page 11 must note the error code and interpret the cause of the lockout from the information shown in Table 21 on Page 64. This diagnostic table is also found inside Controller or on back side of cover plate.

The MINI-SCREEN System does not operate if self-checking circuits detect an internal problem. A Key Reset has no effect until problem has been corrected.

After receiving the visual warning proceed as follows:

1) Take corrective measure(s) corresponding to the error code and then perform a Key Reset (block 4.7 on page 50 refers).

2) If further assistance is required, contact a Banner Field Service Engineer or the Factory Applications Engineering Department (see Banner Address Listing block 3.8 on page 28).

**Noise Indicator**

- If no status LEDs are ON, power to system may have been lost. Power supply presence is indicated by a green LED on power supply board of Controller (door/cover removed). It is possible for power to be present at input of power supply even if power LED is OFF.

**For Type MDSDINT-…Controllers**

3) Check for voltage across +24 VDC and DC common terminals 50 and 51 (type MDSDINT-… Figure 38 on Page 36) terminals 32 and 33 (type MDSDINT-… Figure 39 on Page 37). If voltage is not present, power to MINI-SCREEN System has been lost, and cause is outside system. If 24 VDC is present, turn OFF power to Controller and check fuse. If fuse is blown, replace it (block 6.2.2.1 on page 65). If fuse is OK, and 24 VDC is present at terminals 38 and 39, an internal power supply failure has occurred.

**For Type MSC.-…Controllers**

4) Check carefully for voltage across L and N (or + and -) terminals of Terminal Block TB1 (see Figure 37 on Page 35). If voltage is not present at L and N, power to MINI-SCREEN System has been lost, and cause is outside system. Check for 12 VDC at Terminal Block TB3. If 12 VDC is not present there, turn OFF power to Controller and check fuse. If fuse is blown, replace it (block 6.2.2.1 on page 65). If fuse is OK, and no 12 VDC is present at TB3, a power supply failure within Controller has occurred.

### Table 21 Diagnostic Display Breakdown

<table>
<thead>
<tr>
<th>Error No.</th>
<th>Error Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (*)</td>
<td>E-Stop Button open:</td>
<td>• Check E-stop circuit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace Controller</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace relay/power supply</td>
</tr>
<tr>
<td>1</td>
<td>Relay signal error:</td>
<td>• Check relay/power supply</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace Controller</td>
</tr>
<tr>
<td>2</td>
<td>Key input error:</td>
<td>• Check Key position</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Invalid Key Reset</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace Key switch</td>
</tr>
<tr>
<td>3</td>
<td>Controller error:</td>
<td>• Replace Controller</td>
</tr>
<tr>
<td>4</td>
<td>Receiver error:</td>
<td>• Check Receiver cable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace Receiver</td>
</tr>
<tr>
<td>5</td>
<td>Emitter error:</td>
<td>• Check Emitter cable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace Emitter</td>
</tr>
<tr>
<td>6</td>
<td>Communication error:</td>
<td>• Check cable connections</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Observe noise indicator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace Emitter/Receiver</td>
</tr>
<tr>
<td>7</td>
<td>DIP switch error:</td>
<td>• Check switch settings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace Controller</td>
</tr>
<tr>
<td>8</td>
<td>CPU error:</td>
<td>• Replace Controller</td>
</tr>
<tr>
<td>9</td>
<td>E-Stop Button input error:</td>
<td>• Check circuit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace Controller</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace relay/power supply</td>
</tr>
<tr>
<td>10</td>
<td>System error:</td>
<td>• Check fixed beams</td>
</tr>
<tr>
<td>11</td>
<td>Power-up error:</td>
<td>• Check Program/Run switch</td>
</tr>
<tr>
<td>12</td>
<td>Programming error:</td>
<td>• Timeout</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Floating blanking ON</td>
</tr>
</tbody>
</table>

* For type MDSDINT-1T2 and MDSDINT-1L2 Controllers only. 2-digit code sequentially displayed. The 2nd digit indicates which screen has the error.

**Electrical and Optical Noise**

Check the following if the red decimal point of the diagnostic display is flashing:

- Poor connection between Controller and earth ground.
- Earth wire of Emitter and/or Receiver not connected (see Figure 37 on Page 35 and Figure 38 on Page 36).
- Emitter/Receiver wires or output wires routed too close to noisy wiring.
- Optical interference from adjacent light curtains or other photoelectrics.
6.2.1.3 Effects of Electrical & Optical Noise
Severe electrical and/or optical noise from guarded machine or adjacent light curtains, photo-electric’s etc. may cause a random trip condition. In very extreme cases, a lockout is possible. In order to minimise effects of transitory noise, MINI-SCREEN System responds to noise only if noise is detected on multiple consecutive scans.

Decimal point of diagnostic display flashes to indicate presence of electrical or optical noise. This indicator can be used to track down particular noise sources (see Table 21 on Page 64). Simply observe decimal point indicator while shutting down or isolating the suspected sources.

If decimal point is flashing the following items should be checked to eliminate problem:

- Check for poor connection between controller and earth ground
- Check drain wire of Emitter and/or Receiver is connected (see Figure 37 on Page 35, Figure 38 on Page 36 and Figure 39 on Page 37)
- Check routing of Emitter/Receiver or output wires being too close to noisy wiring
- Check for optical interference from adjacent light curtains or other photo-electric’s

6.2.2 Spare Part Replacement

Do not open the emitter or receiver housing. The emitter and receiver contain no field-replaceable components. If repair is necessary, return the unit to the factory. Do not attempt to repair an emitter or receiver yourself.

Contact Customer Service Information in Appendix A 3 for instructions before returning any MINI-SCREEN System component

6.2.2.1 Fuse Replacement

Fuse type 3AG or 5x20 mm slow-blow

TYPE MDSINT-...CONTROLLERS

1) Turn off power to Controller and machine being controlled.
2) Remove cover plate by gently prying it up and off using a flat-blade screwdriver or similar tool.
3) Locate fuse in fuse holder on power supply board, immediately beneath removable top cover plate.
4) Visually inspect fuse and/or test its conductivity using an ohmmeter or a continuity tester. If necessary, replace fuse.
5) Refit cover plate.
6) Re-apply power.

TYPE MSC.-...CONTROLLERS

1) Turn off power to Controller and machine being controlled.
2) Open front cover.
3) Referring to Figure 37 on Page 35, remove fuse from holder.
4) Visually inspect the fuse and/or test its conductivity using an ohmmeter or a continuity tester. If necessary, replace fuse.
5) Close cover.
6) Re-apply power.

6.2.2.2 Controller Board & Relay/Power Supply Replacement

MINI-SCREEN Systems are designed for reliability. While replacement of the Controller or relay/power supply boards is not normally required, these components have been designed to be easily replaceable as a convenience to the user. See the instructions included with the replacement board. To maintain control reliability, use only Banner-supplied replacement relays with positively guided contacts (see WARRANTY: on Page 69).

For board type numbers, part numbers and applicability, refer to Table 22 on Page 69.

Proceed as follows:

TYPE MSC.-...CONTROLLERS

1) Turn OFF power to Controller and machine being controlled.
2) Open front cover.

Controller Board

3) Referring to Figure 37 on Page 35, remove Controller Board (item 9) from Controller by gently rocking board to loosen it and then sliding board out of module.
4) Slide the new board in the guide rails then push firmly to fully locate.
5) Set DIP switches as necessary (see Figure 41 on Page 42).

Relay/Power Supply Board

The output relays are mounted on one board.

6) Referring to Figure 37 on Page 35, remove Relay Board (item 2) by removing 9,5 mm nylon hex nuts and gently sliding board out of Controller to disconnect it from mother board.
7) Press new board firmly and evenly onto its connector pins and re-secure hex nuts.

Do not over tighten.
TYPE MSDINT-1.. CONTROLLERS

- To replace the Relay/Power Supply Board, the Controller Board must be removed first for access.

1) Turn off power to Controller and machine being controlled.

2) Remove cover plate by gently prying it up and off using a flat-bladed screwdriver or similar tool.

3) Identify terminal blocks before removal.

Controller Board & Relay/Power Supply Board Removal

4) Gently unplug terminal block from Controller Board.

5) Using a screwdriver, carefully prise casing sides away to release Controller Board and slide it out.

For Relay/Power Supply Board Replacement Only

6) Referring to Figure 62 on Page 66, unclip x2 flat cables from connectors on Relay/Power Supply Board.

7) Gently unplug terminal block from Relay/Power Supply Board.

8) Using a screwdriver, gently prise casing sides away to release Relay/Power Supply Board and slide it out.

9) Slide in replacement Relay/Power Supply Board between guides ensuring board is secured in place by sides of casing.

10) Identify and plug in terminal block to Relay/Power Supply Board.

11) Reconnect flat cables to Relay/Power Supply Board.

Applicable to All Board Installations

12) Referring to Figure 62 on Page 66, slide in replacement or original Controller Board (as required) between guides ensuring board is secured in place by sides of casing.

13) Identify and plug in terminal block to Controller Board.

14) Set DIP switches as necessary (see Figure 43 on Page 43).

15) Test Controller as detailed in block 6.1.2 on page 59.

MSDINT-1T2 CONTROLLERS

- To replace Relay/Power Supply Board, Controller Board must be removed first for access.

1) Turn off power to Controller and machine being controlled.

2) Remove x4 screws at each corner of plastic cover.

3) Remove cover plate by gently prying it out using a flat-blade screwdriver or similar tool.

4) Identify terminal blocks before removal.

Controller & Relay/Power Supply Board

5) Gently unplug terminal block from Controller Board.

6) Using a screwdriver, gently prise casing sides away to release Controller Board and slide it out.
For Relay/Power Supply Board Replacement Only

7) Referring to Figure 63 on Page 67, unclip x2 flat cables from connectors on Relay/Power Supply Board.

8) Gently unplug terminal block from Relay/Power Supply Board.

9) Using a screwdriver, gently prise casing sides away to release Relay/Power Supply Board and slide it out.

10) Slide in replacement Relay/Power Supply Board between guides ensuring board is secured in place by sides of casing.

11) Identify and plug in terminal block to Relay/Power Supply Board.

12) Reconnect flat cables to Relay/Power Supply Board.

Applicable to All Board Installations

13) Referring to Figure 63 on Page 67, slide in replacement or original Controller Board (as required) between guides ensuring board is secured in place by sides of casing.

14) Identify and plug in terminal block to Controller Board.

15) Set DIP switches as necessary (see Figure 43 on Page 43).

16) Test Controller(s) as detailed in block 6.1.2 on page 59.

6.2.3 Cleaning

TYPE MSDINT-1.. & MSDINT-1T2CONTROLLERS
This type of Controller is constructed of black polycarbonate and rated IP20. Normally this type of Controller is mounted in a proper enclosure, and cleaning of this module should not be necessary.

TYPE MSC.-...CONTROLLERS
This type of Controller is constructed of heavy-duty metal and rated IP65. These types may be cleaned using mild detergent or glass cleaning fluid and a soft cloth. Care should be taken to prevent any moisture from entering the Controller.

EMITTERS & RECEIVERS
MINI-SCREEN System Emitters and Receivers are constructed of aluminium with a yellow painted finish and are rated IP65. Lens covers are acrylic. Emitters and receivers are best cleaned using mild detergent or window cleaner and a soft cloth.

Avoid cleaners containing alcohol, as they may damage the acrylic lens covers. For harsh environments, it is recommended the use of lens shields, which protect the acrylic lenses of the MINI-SCREEN System from being damaged. Refer to Table 23 on Page 70 or check with your local representative for more information.
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6.3 SPARE PARTS INFORMATION

WARNING!

SPARE PARTS

If spare parts are ever required, always use only genuine Banner-supplied replacement parts (see block 6.3.1 on page 69). Do not attempt to substitute parts from another manufacturer. To do so could impair the operation of the MINI-SCREEN System and could result in serious bodily injury or death. Always disconnect all power from the MINI-SCREEN System and the guarded machine before replacing any of the components. After servicing, replace all covers or close and lock doors before re-applying the power to the system and the guarded machine.

This block details Spare Parts and Special Tools information for the MINI-SCREEN System.

WARRANTY:

Banner Engineering Corp. warrants its products to be free from defects for a period of one year. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture found to be defective at the time it is returned to the factory during the warranty period. This warranty is necessarily limited to the quality of materials and workmanship in MINI-SCREEN Systems as they are supplied to the original purchaser. Proper installation, operation and maintenance of the MINI-SCREEN System becomes the responsibility of the user upon receipt of the system. This warranty does not cover damage or liability for the improper application of the MINI-SCREEN System. This warranty is in lieu of any other warranty either expressed or implied.

6.3.1 Spare Parts

Spare parts are listed in the following tables:

Table 22 General Replacement Parts

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Description</th>
<th>Order Part No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGA-GS-1</td>
<td>Earth strap, controller door</td>
<td>30 278 50</td>
<td>-</td>
</tr>
<tr>
<td>MGA-K-1</td>
<td>Replacement key</td>
<td>30 285 13</td>
<td>-</td>
</tr>
<tr>
<td>MGA-KSD-1</td>
<td>Key switch</td>
<td>30 301 40</td>
<td>-</td>
</tr>
<tr>
<td>MSA-KS-1</td>
<td>Key switch pre-wired</td>
<td>30 390 23</td>
<td>-</td>
</tr>
<tr>
<td>BA2MB</td>
<td>Mounting hardware kit for one emitter or receiver</td>
<td>30 400 91</td>
<td>-</td>
</tr>
<tr>
<td>MSA-MH-1</td>
<td>Controller mounting hardware</td>
<td>30 390 24</td>
<td>-</td>
</tr>
<tr>
<td>MSA-RM-1</td>
<td>Relay module for type MSC.-2 controllers</td>
<td>30 390 25</td>
<td>-</td>
</tr>
<tr>
<td>MSA-RM-2</td>
<td>Relay module for type MSC.-3 controllers</td>
<td>30 596 89</td>
<td>-</td>
</tr>
<tr>
<td>MSA-PSB-1</td>
<td>Power supply board 230 VAC for type MSCB-1 controllers</td>
<td>30 390 28</td>
<td>-</td>
</tr>
<tr>
<td>MSA-PSB-2</td>
<td>Relay/Power supply board 230 VAC for type MSCB-1L2 controllers</td>
<td>*</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 22 General Replacement Parts

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Description</th>
<th>Order Part No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA-PSD-2</td>
<td>Relay/Power supply board 115/230 VAC for type MSCD-2.. controllers</td>
<td>30 473 77</td>
<td>-</td>
</tr>
<tr>
<td>MSA-PST-1</td>
<td>Relay/Power supply board 24 VDC for type MSC-2 controllers</td>
<td>30 437 38</td>
<td>-</td>
</tr>
<tr>
<td>MSA-PST-2</td>
<td>Relay/Power supply board 24 VDC for type MSC-2 controllers</td>
<td>30 473 76</td>
<td>-</td>
</tr>
<tr>
<td>MSA-DM-1</td>
<td>Relay/Power supply board 24 VDC for type MSCT-2 controllers</td>
<td>30 482 25</td>
<td>-</td>
</tr>
<tr>
<td>MSA-DM-2</td>
<td>Controller board for use with type MSC.-2 controllers</td>
<td>30 390 29</td>
<td>-</td>
</tr>
<tr>
<td>MSA-DM-3</td>
<td>Controller board for use with type MSC.-2 controllers</td>
<td>30 473 81</td>
<td>-</td>
</tr>
<tr>
<td>MSA-DM-4</td>
<td>Controller board for use with type MDST-2 controllers</td>
<td>30 484 25</td>
<td>-</td>
</tr>
<tr>
<td>MSA-DM-5</td>
<td>Controller board for use with type MDST-2 controllers</td>
<td>30 657 85</td>
<td>-</td>
</tr>
</tbody>
</table>

Positively Guided Contactors*

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Description</th>
<th>Order Part No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-BG00-31-A12060</td>
<td>120 VAC 10 A, 3 N.O. &amp; 1 N.C.</td>
<td>30 696 81</td>
<td>-</td>
</tr>
<tr>
<td>11-BG00-31-D024</td>
<td>24 VDC 10 A, 3 N.O. &amp; 1 N.C.</td>
<td>30 696 82</td>
<td>-</td>
</tr>
<tr>
<td>11-BF1651-12060</td>
<td>120 VAC 16 A**, 3 N.O. &amp; 1 N.C.</td>
<td>30 696 82</td>
<td>-</td>
</tr>
<tr>
<td>11-BF16C01-024</td>
<td>24 VDC 16 A**, 3 N.O. &amp; 1 N.C.</td>
<td>30 69 687</td>
<td>-</td>
</tr>
</tbody>
</table>

Auxiliary Contacts for Positively Guided Contactors

* Part number issued on receipt of order.
** N.C. contact rated at 10 A.
### Table 22 General Replacement Parts

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Description</th>
<th>Order Part No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-BGX10-40</td>
<td>4 N.O. contacts, no positive guidance. Used with 11-BG Series.</td>
<td>30 696 85</td>
<td></td>
</tr>
<tr>
<td>11-G484-30</td>
<td>3 N.O. contacts, with positive guidance. Used with 11-BF Series.</td>
<td>30 696 88</td>
<td></td>
</tr>
</tbody>
</table>

**Suppressors for Positively Guided Contactors**

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Description</th>
<th>Order Part No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-BGX77-048</td>
<td>48 VDC used with 11-BG00-31-A12060</td>
<td>30 696 83</td>
<td></td>
</tr>
<tr>
<td>11-BGX77-240</td>
<td>125 VAC to 240 VAC used with 11-BG00-31-D-024</td>
<td>30 696 84</td>
<td></td>
</tr>
<tr>
<td>11-G318-48</td>
<td>48 VDC used with 11-BF1601-12060</td>
<td>30 696 84</td>
<td></td>
</tr>
<tr>
<td>11-G477-240</td>
<td>125 VAC to 240 VAC used with 11-BF16C01-024</td>
<td>30 696 90</td>
<td></td>
</tr>
<tr>
<td>MSA-RM-1†</td>
<td>Module relay</td>
<td>30 390 25</td>
<td></td>
</tr>
<tr>
<td>MSA-RM-2‡</td>
<td>Module relay</td>
<td>30 596 89</td>
<td></td>
</tr>
</tbody>
</table>

†With additional complementary normally closed output and 6 amp FSDs.
‡For installation instructions, refer to Datasheet Supplement 40842.

### Table 23 MINI-SCREEN Lens Shields

<table>
<thead>
<tr>
<th>Model No.</th>
<th>E/R Ht. (mm)</th>
<th>Shield Ht. (mm)</th>
<th>Part No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSS4</td>
<td>102</td>
<td>137</td>
<td>30 443 08</td>
<td></td>
</tr>
<tr>
<td>MSS8</td>
<td>204</td>
<td>239</td>
<td>30 443 09</td>
<td></td>
</tr>
<tr>
<td>MSS12</td>
<td>306</td>
<td>340</td>
<td>30 443 10</td>
<td></td>
</tr>
<tr>
<td>MSS16</td>
<td>406</td>
<td>442</td>
<td>30 443 11</td>
<td></td>
</tr>
<tr>
<td>MSS20</td>
<td>508</td>
<td>544</td>
<td>30 443 12</td>
<td></td>
</tr>
<tr>
<td>MSS24</td>
<td>610</td>
<td>643</td>
<td>30 443 13</td>
<td></td>
</tr>
<tr>
<td>MSS28</td>
<td>711</td>
<td>744</td>
<td>30 443 14</td>
<td></td>
</tr>
<tr>
<td>MSS32</td>
<td>813</td>
<td>846</td>
<td>30 443 15</td>
<td></td>
</tr>
<tr>
<td>MSS36</td>
<td>914</td>
<td>947</td>
<td>30 443 16</td>
<td></td>
</tr>
<tr>
<td>MSS40</td>
<td>1016</td>
<td>1049</td>
<td>30 443 17</td>
<td></td>
</tr>
<tr>
<td>MSS44</td>
<td>1118</td>
<td>1151</td>
<td>30 443 18</td>
<td></td>
</tr>
<tr>
<td>MSS48</td>
<td>1219</td>
<td>1252</td>
<td>30 443 19</td>
<td></td>
</tr>
</tbody>
</table>

### Table 24 Heavy Duty MINI-SCREEN Lens Shields

<table>
<thead>
<tr>
<th>Model No.</th>
<th>E/R Ht. (mm)</th>
<th>Shield Ht. (mm)</th>
<th>Part No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSHDS24</td>
<td>610</td>
<td>660</td>
<td>30 705 07</td>
<td></td>
</tr>
<tr>
<td>MSHDS32</td>
<td>813</td>
<td>864</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>MSHDS40</td>
<td>1016</td>
<td>1067</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>MSHDS48</td>
<td>1219</td>
<td>1270</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>MSHDS56</td>
<td>1422</td>
<td>1473</td>
<td>30 705 11</td>
<td></td>
</tr>
<tr>
<td>MSHDS64</td>
<td>1626</td>
<td>1676</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>MSHDS72</td>
<td>1829</td>
<td>1880</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

* Part number issued on receipt of order.

### Table 25 Cables & Connectors

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Description</th>
<th>Order Part No.</th>
<th>Connector &amp; Cable Dimensions (mm)</th>
<th>Pinout</th>
</tr>
</thead>
<tbody>
<tr>
<td>QDC-515C</td>
<td>5 m cable cut to length ø 0,813 mm wire, 5 pin Mini-Style QD straight female connector on one end</td>
<td>30 374 42</td>
<td><a href="#">Dimensions in mm</a></td>
<td></td>
</tr>
<tr>
<td>QDC-525C</td>
<td>8 m cable cut to length ø0,813 mm wire, 5 pin Mini-Style QD straight female connector on one end</td>
<td>30 374 43</td>
<td><strong><a href="#">Dimensions in mm</a></strong></td>
<td></td>
</tr>
<tr>
<td>QDC-550C</td>
<td>15 m cable cut to length ø0,813 mm wire, 5 pin Mini-Style QD straight female connector on one end</td>
<td>30 374 98</td>
<td><a href="#">Dimensions in mm</a></td>
<td></td>
</tr>
<tr>
<td>QDC-5100</td>
<td>30 m cable cut to length Ø1,29 mm wire, 5 pin Mini-Style QD straight female connector on one end</td>
<td>30 353 39</td>
<td><a href="#">Dimensions in mm</a></td>
<td></td>
</tr>
<tr>
<td>QDC-5150</td>
<td>45 m cable cut to length Ø1,29 mm wire, 5 pin Mini-Style QD straight female connector on one end</td>
<td>30 353 41</td>
<td><a href="#">Dimensions in mm</a></td>
<td></td>
</tr>
</tbody>
</table>

Total cable length (Emitter cable length plus Receiver cable length) must be less than 53 m. Cable runs of > 15 m for Emitter or Receiver must be Ø1,29 mm wire.
### Table 26 MSM Series Corner Mirrors

<table>
<thead>
<tr>
<th>Mirror Model</th>
<th>Reflective Area Y (mm)</th>
<th>Mounting L1 (mm)</th>
<th>Height L2 (mm)</th>
<th>Order Part No.</th>
<th>Dimensions (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSM4A</td>
<td>165</td>
<td>221</td>
<td>191</td>
<td>30 431 62</td>
<td></td>
</tr>
<tr>
<td>MSM8A</td>
<td>267</td>
<td>323</td>
<td>292</td>
<td>30 431 63</td>
<td></td>
</tr>
<tr>
<td>MSM12A</td>
<td>356</td>
<td>411</td>
<td>381</td>
<td>30 431 64</td>
<td></td>
</tr>
<tr>
<td>MSM16A</td>
<td>457</td>
<td>513</td>
<td>483</td>
<td>30 431 65</td>
<td></td>
</tr>
<tr>
<td>MSM20A</td>
<td>559</td>
<td>615</td>
<td>584</td>
<td>30 431 66</td>
<td></td>
</tr>
<tr>
<td>MSM24A</td>
<td>660</td>
<td>716</td>
<td>686</td>
<td>30 431 67</td>
<td></td>
</tr>
<tr>
<td>MSM28A</td>
<td>762</td>
<td>818</td>
<td>787</td>
<td>30 431 68</td>
<td></td>
</tr>
<tr>
<td>MSM32A</td>
<td>864</td>
<td>919</td>
<td>889</td>
<td>30 431 69</td>
<td></td>
</tr>
<tr>
<td>MSM36A</td>
<td>965</td>
<td>1021</td>
<td>991</td>
<td>30 431 70</td>
<td></td>
</tr>
<tr>
<td>MSM40A</td>
<td>1067</td>
<td>1123</td>
<td>1092</td>
<td>30 431 71</td>
<td></td>
</tr>
<tr>
<td>MSM44A</td>
<td>1168</td>
<td>1224</td>
<td>1194</td>
<td>30 431 72</td>
<td></td>
</tr>
<tr>
<td>MSM48A</td>
<td>1270</td>
<td>1326</td>
<td>1295</td>
<td>30 431 73</td>
<td></td>
</tr>
</tbody>
</table>

### Table 27 SSM Series Corner Mirrors

<table>
<thead>
<tr>
<th>Mirror Model</th>
<th>Reflective Area Y (mm)</th>
<th>Mounting L1 (mm)</th>
<th>Height L2 (mm)</th>
<th>Order Part No.</th>
<th>Dimensions (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSM-100</td>
<td>100</td>
<td>211</td>
<td>178</td>
<td>30 618 90</td>
<td></td>
</tr>
<tr>
<td>SSM-150</td>
<td>150</td>
<td>261</td>
<td>228</td>
<td>30 618 91</td>
<td></td>
</tr>
<tr>
<td>SSM-250</td>
<td>250</td>
<td>361</td>
<td>328</td>
<td>30 618 92</td>
<td></td>
</tr>
<tr>
<td>SSM-375</td>
<td>375</td>
<td>486</td>
<td>453</td>
<td>30 618 93</td>
<td></td>
</tr>
<tr>
<td>SSM-475</td>
<td>475</td>
<td>586</td>
<td>553</td>
<td>30 618 94</td>
<td></td>
</tr>
<tr>
<td>SSM-550</td>
<td>550</td>
<td>661</td>
<td>628</td>
<td>30 618 95</td>
<td></td>
</tr>
<tr>
<td>SSM-675</td>
<td>675</td>
<td>786</td>
<td>753</td>
<td>30 618 96</td>
<td></td>
</tr>
<tr>
<td>SSM-825</td>
<td>825</td>
<td>936</td>
<td>903</td>
<td>30 618 96</td>
<td></td>
</tr>
<tr>
<td>SSM-975</td>
<td>975</td>
<td>1086,4</td>
<td>1053</td>
<td>30 618 98</td>
<td></td>
</tr>
<tr>
<td>SSM-1175</td>
<td>1175</td>
<td>1286,4</td>
<td>1253</td>
<td>30 618 98</td>
<td></td>
</tr>
<tr>
<td>SSM-1275</td>
<td>1275</td>
<td>1386,4</td>
<td>1353</td>
<td>30 619 00</td>
<td></td>
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<tr>
<td>SSM-1475</td>
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<td>1586,4</td>
<td>1553</td>
<td>30 619 01</td>
<td></td>
</tr>
<tr>
<td>SSM-1675</td>
<td>1675</td>
<td>1786,4</td>
<td>1753</td>
<td>30 619 02</td>
<td></td>
</tr>
<tr>
<td>SSM-1900</td>
<td>1900</td>
<td>1945</td>
<td>1978</td>
<td>30 619 03</td>
<td></td>
</tr>
</tbody>
</table>
Table 28 MSM Series Stands

<table>
<thead>
<tr>
<th>Stand Model</th>
<th>Stand Height (mm)</th>
<th>Mirror Length (brackets outward) (mm)</th>
<th>Mirror Length (brackets inward) (mm)</th>
<th>E &amp; R Length (brackets outward) (mm)</th>
<th>E &amp; R Length (brackets inward) (mm)</th>
<th>Order Part No.</th>
<th>Dimensions (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA-S24-1</td>
<td>610</td>
<td>102 to 203</td>
<td>102 to 305</td>
<td>102 to 306</td>
<td>102 to 406</td>
<td>30 431 74</td>
<td></td>
</tr>
<tr>
<td>MSA-S42-1</td>
<td>1067</td>
<td>102 to 610</td>
<td>102 to 711</td>
<td>102 to 813</td>
<td>102 to 914</td>
<td>30 431 75</td>
<td></td>
</tr>
<tr>
<td>MSA-S66-1</td>
<td>1676</td>
<td>102 to 1219</td>
<td>102 to 1219</td>
<td>102 to 1219</td>
<td>102 to 1219</td>
<td>30 431 76</td>
<td></td>
</tr>
<tr>
<td>MSA-S84-1</td>
<td>2134</td>
<td>102 to 1219</td>
<td>102 to 1829</td>
<td>102 to 1829</td>
<td>102 to 1829</td>
<td>30 523 97</td>
<td></td>
</tr>
</tbody>
</table>

6.3.2 Special Tools & Material

**WARNING!**

The LAT-1-MS Alignment Tool is fitted with a Class 2 Laser Diode. Laser light is emitted from aperture. Avoid exposure and do not stare into the beam.

Table 29 Laser Alignment Tool

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Part Description</th>
<th>Order Part No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>STP-1</td>
<td>Specified test piece, 38 mm dia. (see Table 12 on Page 38)</td>
<td>30 438 35</td>
<td>-</td>
</tr>
<tr>
<td>STP-2</td>
<td>Specified test piece, 19.1 mm dia. (see Table 12 on Page 38)</td>
<td>30 390 26</td>
<td>-</td>
</tr>
<tr>
<td>STP-3</td>
<td>Specified test piece, Ø44.5 mm (see Table 12 on Page 38)</td>
<td>30 399 11</td>
<td>-</td>
</tr>
<tr>
<td>STP-4</td>
<td>Specified test piece, Ø31.8 mm (see Table 12 on Page 38)</td>
<td>30 438 36</td>
<td>-</td>
</tr>
<tr>
<td>STP-6</td>
<td>Specified test piece, Ømm (see Table 12 on Page 38)</td>
<td>30 438 38</td>
<td>-</td>
</tr>
</tbody>
</table>
The following documentation is supplied with each MINI-SCREEN System. Additional copies are available at no charge.

**Instruction Manual for MINI-SCREEN Systems:**
Order Part No. 48992 rev. E 08.03 (this manual)

**Checkout Procedure Card (Daily):**
Order Part No. 42587 rev. E 08.03

**Checkout Procedure Card (Six Monthly):**
Order Part No. 42586 rev. E 08.03

### Table 29 Laser Alignment Tool

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Part Description</th>
<th>Order Part No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>STP-7</td>
<td>Specified test piece, Ø25 mm (see Table 12 on Page 38)</td>
<td>30 489 81</td>
<td>-</td>
</tr>
<tr>
<td>STP-8</td>
<td>Specified test piece, Ø50,8 mm (see Table 12 on Page 38)</td>
<td>30 491 26</td>
<td>-</td>
</tr>
<tr>
<td>STP-10</td>
<td>Specified test piece, Ø88,9 mm (see Table 12 on Page 38)</td>
<td>30 620 26</td>
<td>-</td>
</tr>
</tbody>
</table>
**A 1 WIRING DIAGRAMS**

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**Figure 64 MINI-SCREEN Metal Box Controller Models MSC.-.- Generic Machine Interface**

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Figure 65 MINI-SCREEN DIN Controller Models MSDINT-1.. Generic Machine Interface
Figure 66 MINI-SCREEN DIN Controller Models MDSDINT-1.. Generic Machine Interface
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**A 2 GLOSSARY & ABBREVIATIONS**

**List of Abbreviations**

**DIN**  German Industry Standard  
**DIS**  Development Information System  
**FMEA**  Failure Mode and Effects Analysis  
**FSD**  Final Switching Device  
**IEC**  International Electro technical Commission  
**IP**  Ingress Protection (Class)  
**ISO**  International Organisation for Standardisation  
**EN**  European Norm  
**LED**  Light Emitting Diode  
**MODS**  Minimum Object Detection Size = ODC  
**MSCE**  Machine Secondary Control Element  
**MPCE**  Machine Primary Control Element  
**N.C.**  Normally Closed  
**N.O.**  Normally Open  
**ODC**  Object Detection Capability  
**PLC**  Programmable Logic Controller  
**PSDI**  Presence-Sensing-Device Initiation  
**PVC**  Polyvinyl chloride  
**QD**  Quick Disconnect  
**RS 485**  Serial Data Transfer Terminology  
**SSD**  Secondary Switching Device  
**VAC**  Voltage Alternating Current  
**VDC**  Voltage Direct Current

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**Glossary of Terms**

Terms shown in italics in the definitions below are themselves defined elsewhere in the glossary.

**Auto Power-up** A feature which, when switched ON, enables the safety device to be powered up (and recover from a power interruption) without the necessity of a Key Reset. When *Auto Power-Up* is ON, the safety device automatically begins internal diagnostics upon power-up, and automatically resets the system if it passes the diagnostic check. With *Auto Power-Up* OFF, a *Manual Reset* is required.

**Auxiliary Monitor or Alarm Contact** A low-load-capacity, non-safety-related relay contact whose primary purpose is to communicate system status to a PLC.

**Blanking** See Fixed Blanking, as defined on Page 80, and Floating Blanking on Page 80.

**Competent Person** A person or persons who, by possession of a recognised degree or certificate of professional training, or who, by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work (See *Designated Person* as specified on page 79).

**Controller Board** A removable printed circuit board, located within the Controller, which contains the microprocessors and related electronic circuits.

**Controller** Contains the circuitry that provides the proper voltage to the system, controls the sensing units, receives and processes information from the sensing units and the safety monitoring means and provides outputs to interface to the machine. It should be noted that sometimes the controller circuit is built-in.

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

**Designated Person** A person or persons identified and designated in writing, by the employer, as being appropriately trained and qualified to perform a specified check-out procedure (See *Competent Person* as specified in block on page 79).

**Detection Zone** The curtain of light generated by the safety light screen. When the *Detection Zone* is interrupted by an opaque object of a specified cross section or larger, a trip condition (or latch condition) results.

**DIP (switch)** Type of switch used for configuration settings.

**Diverse Redundancy** A design feature in which two components of different design, running from two different instruction sets (if programmed components), constantly check all system components, including each other.
Appendix 2

**E-stop Button** The function offered by some controllers which produces a lockout condition when an (optional) E-Stop is engaged. The E-Stop must meet certain mechanical and electrical requirements, as described in block 1.7 on page 3.

**Emitter** The light-emitting component of a safety light curtain, consisting of a row of synchronised modulated infrared LEDs. The Emitter, together with the Receiver (placed opposite), creates a light curtain called the Detection Zone.

**Fixed Blanking** A feature that allows the safety light curtains to be programmed to ignore objects (such as brackets or fixtures) that are always present within the Detection Zone, so that the presence of these objects does not cause the switching outputs to trip (see Trip Condition on Page 81). If any of the fixed objects are moved within or removed from the Detection Zone, a lockout condition results.

**Final Switching Device** The two output relays (FSD1 and FSD2) of the safety device which respond to an intrusion of the detection zone by interrupting the circuit connecting them to the MPCEs of the guarded machine.

**Fixed Guarding/Hard Guarding** Screens, bars, or other mechanical barriers that prevent a person from reaching over, under, or around the point of operation of the guarded machine.

**Floating Blanking** A feature that allows safety light curtains to be programmed to produce an intentionally disabled light beam within its light curtain, which appears to move up and down (float) in order to allow the feeding of an object through the light curtain (Detection Zone) at any point along the length of the light curtain without causing a trip or latch condition.

Some systems offer one- or two-beam floating blanking to allow multiple objects (usually workpiece material) to move through the detection zone without tripping the Final Switching Devices depending on configuration.

**Failure Mode and Effects Analysis** A testing procedure by which potential failure modes in a system are analysed to determine their results or effects on the system. Component failure modes that produce either no effect or a lockout condition are permitted; failures which cause an unsafe condition (a failure to danger) are not. All Banner safety devices are extensively FMEA tested.

**Full-Revolution Devices** A type of machine drive arranged such that, once started, the machine can only be stopped when the full cycle is complete. Examples include positive key clutches and similar mechanisms. Typically, safety light screens may not be used with full revolution devices.

**Guarded Machine** The machine whose point of operation is guarded by a safety device, and whose MPCEs and MSCE are connected to the FSDs of the safety devices.

**Internal Lockout** A lockout condition that occurs due to an internal problem, typically indicated by the red status LED flashing.

**Key Reset** A key-operated switch used to restore the FSDs and SSD to the ON state from a lockout condition. Also refers to the act of using the switch to reset the safety device.

**Latch Condition** In latching output models, the FSD output operates when an object equal to or greater than the diameter of the specified test piece enters the Detection Zone. In a latch condition, the outputs simultaneously de-energise and open. The latch must be reset after the Detection Zone is cleared by momentarily closing the normally open contact of the Latch Reset switch (see also Trip Condition on Page 81).

**Lockout Condition** A condition that is automatically attained both (1) when its power supply is interrupted and restored, and (2) in response to certain failure signals. When a lockout condition occurs, a Key Reset is required to return the system to the RUN condition.

**Machine Primary Control Element** An electrically powered element which directly controls the machine’s normal operating motion in such a way that it is last (in time) to operate when motion is either initiated or arrested.

**Machine Response Time** The time between the interruption by the FSDs of the electrical supply to the MPCEs and the instant when the dangerous parts of the machine reach a safe state by being brought to rest.

**Machine Secondary Control Element** A machine control element independent of the MPCEs, capable of removing the source of power from the prime mover of the relevant dangerous machine parts.

**MINIMUM SAFETY DISTANCE** That distance, along the direction of approach, between the outermost position at which the appropriate test piece is just detected and the nearest dangerous machine part(s).

**Minimum Object Detection Size** See Object Detection Capability on page 80.

**Non-latching Controllers** See Trip Condition on Page 81.

**Object Detection Capability** The minimum diameter object that a light curtain system can reliably detect. Objects of this diameter or greater are detected anywhere in the sensing field. A smaller object can pass undetected through the light curtain if it passes exactly midway between two adjacent light beams. See also Specified Test Piece on page 81.

**Output Relays** The devices that are used to initiate a stop signal. The output relays (FSD1, FSD2, and SSD) use positively guided contacts.

**Point of Operation** The area of the guarded machine where a workpiece is positioned and a machine function (i.e., shearing, forming, punching, assembling, welding, etc.) is performed upon it.

---

**Detection Zone**

Floating Blanking

Internal Lockout

Key Reset

Latch Condition

Lockout Condition

Machine Primary Control Element

Machine Secondary Control Element

MINIMUM SAFETY DISTANCE

Minimum Object Detection Size

Non-latching Controllers

Object Detection Capability

Output Relays

Point of Operation
**Positively Guided Contacts** Relay contacts that are mechanically linked together, so that when the relay coil is energised or de-energised, all of the linked contacts move together. If one set of contacts in the relay becomes immobilised, no other contact of the same relay is able to move. The function of positively guided contacts is to enable the safety circuit to check the status of the relay. Positively guided contacts are also known as captive contacts, locked contacts, forced-guided contacts or safety relays.

**Presence-Sensing-Device Initiation** An application in which a presence-sensing device is used to actually start the cycle of a machine. In a typical situation, an operator manually positions a part in the machine for the operation. When the operator moves out of the danger area, the presence-sensing device starts the machine (no start switch is used). The machine cycle runs to completion, and the operator can then insert a new part and start another cycle. The presence-sensing device continually guards the machine. Single break mode is used when the part is automatically ejected after the machine operation. Double break mode is used when the part is both inserted (to begin the operation) and removed (after the operation) by the operator.

**Receiver** The light-receiving component, consisting of a row of synchronised photo transistors. The Receiver, together with the Emitter (placed opposite), creates a light curtain called the Detection Zone.

**Secondary Switching Device** The output relay of the MINI-SCREEN System which, in a lockout condition, interrupts the circuit connecting it to the MSCE.

**Self-checking (circuitry)** A circuit with the capability to electronically verify that all of its own critical circuit components, along with their redundant backups, are operating properly. Banner MINI-SCREEN Systems are self-checking.

**Single-stroke Press** See Full-Revolution Device on page 80.

**Specified Test Piece**: An opaque object of the minimum cross section required to place the MINI-SCREEN System into a trip or latch condition when inserted into any part of the detection zone. See also Object Detection Capability on page 80.

**Supplementary Guarding** Additional safety device(s), possibly employed along with fixed guarding measures, used for the purpose of preventing a person from reaching over, under, or around the detection zone of an installed MINI-SCREEN System and into the point of operation of the guarded machine.

**Trip Condition** In trip output models, the response of the FSD relays when an object equal to or greater than the diameter of the specified test piece enters the detection zone. In a trip condition, FSD1 and FSD2 simultaneously de-energise and open their contacts. A trip condition clears automatically when the object is removed from the detection zone. See also Latch Condition on page 80.

**MSCD** Type of heavy duty electronic controller (230 VAC) used with the MINI-SCREEN System.

**MSDINT** Type of electronic controller (24 VDC) used with the MINI-SCREEN System.
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