MUTING MODULE

Types

MM-TA-12B Category 4 per EN954-1

For use with EZ-SCREEN® OSSD outputs, MINI-SCREEN®,MICRO-SCREEN®, MACHINE-GUARD® or other safety devices with hard relay contact safety output(s)

&

MM2-TA-12B Category 2 per EN954-1

For use with EZ-SCREEN® Category 2 OSSD outputs, 24 VDC signals or other safety devices with hard relay contact safety output(s)

Instruction Manual

European UK English Version

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1 SAFETY INFORMATION

This Chapter details all the necessary safety information relating to the Muting Module and its intended use.

1.1 SAFETY NOTICES

1.1.1 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.

Yellow background

- 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.

Yellow background

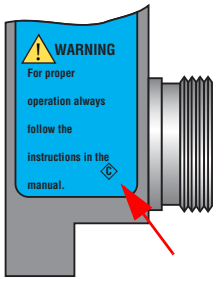
NOTE:

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

1.2 PRODUCT SAFETY LABELLING INFORMATION

Table 1 on Page 1 lists the safety labels used on the product together with their descriptions and locations.

Table 1 Label Identification Muting Module

SYMBOL	LOCATION/MEANING
Yellow background **WARNING** 	Located on Muting Module left side panel.  Indicates the following important information: **WARNING** **FOR PROPER OPERATION ALWAYS FOLLOW THE INSTRUCTIONS IN THE MANUAL**

1.3 WARNINGS & NOTES 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 two different types used in this Manual:

- General **WARNINGS!** indicted by the symbol  (see example WARNING on page 2)
- Electrical Shock Hazard **WARNINGS!** indicated by the symbol  (see example WARNING on page 25)

The User must read the relevant **WARNINGS!** 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.

1.4 SAFETY STANDARDS & EC DIRECTIVES

The Muting Module types MM-TA-12B and MM2-TA-12B comply with the following safety standards:

ISO 12100-1 (2003) & -2 (2003)
Safety of Machinery – Basic Concepts, General Principles for Design

ISO 13852 (2002)
Safety Distances - Upper Limbs

ISO 13850 (1996)
Emergency Stop Devices, Functional Aspects – Principles for Design

ISO/DIS 13851 (2002)
Two-Hand Control Devices – Functional Aspects – Principles for Design

ISO 13853 (1998)
Safety Distances - Lower Limbs

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

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

ISO 14121 (1999)
Principles of Risk Assessment

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

IEC/EN 60204-1 (2005-10)
Electrical Equipment of Machines Part 1: General Requirements

IEC/EN 61496-1 (2004-02), & IEC/EN 61496-2 (1997-11)
Electro-sensitive Protection Equipment

IEC 60529 (2001-02)
Degrees of Protection Provided by Enclosures

IEC 60947-5-1 (2003-11)
Low Voltage Switch gear – Electromechanical Control Circuit Devices

IEC 60947-1 (2004-03)
Low Voltage Switch gear – General Rules

EN954-1 (1996)
Safety of machinery. Safety related parts of control systems. General principles for design

EN 50081-2 (2005-03)
Electromagnetic compatibility

EN 55011 (1998) (CISPR11)
Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment

1.5 INGRESS PROTECTION RATINGS

The Muting Module meets the following Ingress protection class as per IEC 60529:

• IEC IP65

1.6 ELECTRICAL SAFETY

The Muting Module has been designed to meet with the Electrical Safety Standards as detailed in block 3.1.4 on Page 18.

1.7 CONDITIONS OF EQUIPMENT USE

⚠ WARNINGS

READ THIS SECTION CAREFULLY BEFORE INSTALLING THE SYSTEM

THE MUTING MODULE IS AN ACCESSORY DEVICE THAT IS TYPICALLY USED IN CONJUNCTION WITH POINT-OF-OPERATION MACHINE GUARDING DEVICE. ITS ABILITY TO PERFORM THIS FUNCTION DEPENDS UPON THE APPROPRIATENESS OF THE APPLICATION AND UPON THE MUTING MODULE'S PROPER MECHANICAL AND ELECTRICAL INSTALLATION AND INTERFACING TO THE MACHINE TO BE GUARDED. IF ALL MOUNTING, INSTALLATION, INTERFACING, AND CHECKOUT PROCEDURES ARE NOT FOLLOWED PROPERLY, THE MUTING MODULE CANNOT PROVIDE THE PROTECTION FOR WHICH IT WAS DESIGNED. THE USER HAS THE RESPONSIBILITY TO ENSURE THAT ALL LOCAL, STATE, AND NATIONAL LAWS, RULES, CODES, OR REGULATIONS RELATING TO THE INSTALLATION AND USE OF THIS CONTROL SYSTEM IN ANY PARTICULAR APPLICATION ARE SATISFIED. EXTREME CARE SHOULD BE TAKEN TO ENSURE THAT ALL LEGAL REQUIREMENTS HAVE BEEN MET AND THAT ALL TECHNICAL INSTALLATION AND MAINTENANCE INSTRUCTIONS CONTAINED IN THIS MANUAL ARE FOLLOWED. READ ALL OF THE Safety Information in Chapter 1 OF THIS MANUAL CAREFULLY BEFORE INSTALLING THE SYSTEM. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS BODILY INJURY OR DEATH. THE USER HAS THE SOLE RESPONSIBILITY TO ENSURE THAT THE BANNER MUTING MODULE IS INSTALLED AND INTERFACED TO THE GUARDED MACHINE BY A Qualified Person as specified in block 1.9.2 on Page 4.

STAND ALONE POINT OF OPERATION GUARDING

THE MUTING MODULE IS NOT A STAND ALONE POINT OF OPERATION GUARDING DEVICE, AS DEFINED BY EUROPEAN SAFETY STANDARDS. IT IS THEREFORE NECESSARY TO INSTALL POINT OF OPERATION GUARDING DEVICES, SUCH AS SAFETY LIGHT SCREENS AND/OR FIXED GUARDS, TO PROTECT PERSONNEL FROM HAZARDOUS MACHINERY. FAILURE TO PROPERLY INSTALL POINT OF OPERATION GUARDING ON HAZARDOUS MACHINERY, AS INSTRUCTED BY THE APPROPRIATE INSTALLATION MANUALS, CAN RESULT IN A DANGEROUS CONDITION WHICH COULD LEAD TO SERIOUS INJURY OR DEATH.

1.7.1 Appropriate Applications

1.7.1.1 Type MM-TA-12B

The application of the Muting Module is dependent on the type of machine and the Guarding Devices that are to be interfaced with the Module. The Module is generally interfaced with safeguards that may only be used on machinery that is capable of stopping motion immediately upon receiving a stop signal and at any point in its machine cycle. It is the User's responsibility to verify whether the safeguard is appropriate for the application and is installed as instructed by the appropriate installation manuals.

1.7.1.2 Type MM2-TA-12B

⚠ WARNINGS

MM2-TA-12B MEETS THE CATEGORY 2 REQUIREMENTS OF EN 954-1. DO NOT USE MM2-TA-12B UNLESS IT IS INSTALLED, TESTED, AND INSPECTED IN ACCORDANCE WITH THIS MANUAL. DO NOT USE MM2-TA-12B WHERE CONTROL RELIABILITY IS REQUIRED, OR WHERE CATEGORY 3, CATEGORY 4, HAVE BEEN MANDATED, OR WHERE A RISK ASSESSMENT HAS DETERMINED THAT FREQUENT ACCESS BY PERSONNEL TO THE HAZARD COULD RESULT IN AN IRREVERSIBLE OR SERIOUS INJURY.

TYPICAL USE IS FOR SAFEGUARDING IN SITUATIONS WHERE THE CONSEQUENCE OF AN ACCIDENT WILL RESULT IN ONLY SLIGHT (NORMALLY REVERSIBLE) INJURIES THAT ARE TYPICALLY TREATED BY THE NORMAL HEALING PROCESSES AND MINOR MEDICAL TREATMENT (I.E., FIRST AID, AS DEFINED BY OSHA 29CFR1904.7).

FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS BODILY INJURY OR DEATH.

The *Banner* MM2-TA-12B (the System) is intended for lower-risk machine guarding applications and other safeguarding applications, as determined by a risk assessment. It is the user's responsibility to verify whether the safeguarding is appropriate for the application and is installed, as instructed by this manual, by a Qualified Person as specified in block 1.9.2 on Page 4.

Before installing the MM2-TA-12B, read this manual in its entirety, paying particular attention to all of Section 3. The System's ability to perform its safeguarding function depends upon the appropriateness of the application and upon its proper mechanical and electrical installation and interfacing to the guarded machine. **If all mounting, installation, interfacing, and checkout procedures are not followed properly, the System cannot provide the protection for which it was designed**.

MM2-TA-12B is typically used, but is not limited to, the following applications (dependent on machine risk assessment):

- Small assembly equipment
- Automated production equipment
- "Table-top" robotic work cells
- Component insertion / "pick-and-place" machines
- Small packaging machines
- Equipment and process protection (non-personnel safety)
- Applications that could result in only slight (normally reversible) injuries (such as a bump, bruise, knock-down, trapping but not crushing, minor cuts and abrasions, etc.)

1.7.2 Non-Appropriate Applications

1.7.2.1 Type MM-TA-12B

Safety Light Screens, Single/Multiple Beam Safety Systems, or other PSSDs (see page 71) **generally may NOT be used for guarding:**

- Single stroke (also called full revolution) clutched machinery, as this type of machinery is incapable of stopping immediately.
- Certain other types of machinery, including any machine with inadequate or inconsistent stopping response time, or any machine that ejects materials or component parts through the defined area.
- Any environment likely to adversely affect the efficiency of the Guarding Device(s) or the Muting Module. For example: corrosive chemicals or fluids or unusually severe levels of smoke or dust, if not controlled, may degrade the efficiency of a Safety Light Screen.

If there is any doubt about whether or not your machinery is compatible with the Muting Module, contact Corporate Office as listed on page 73.

1.7.2.2 Type MM2-TA-12B

MM2-TA-12B may NOT be used with the following machinery or unsuitable applications:

- Interfaced with a primary safeguard in frequently accessed hazardous situations that could result in serious injuries (normally irreversible, including death); see Caution below.
- In any case where Control Reliability, Category 3, Category 4, or Type 4 AOPD (active opto-electronic protective device) have been mandated. See EN 954-1, IEC 61496-1, or other appropriate standard.
- With any machine that cannot be stopped immediately after a stop signal is issued, such as single-stroke (or "full-revolution") clutched machinery.
- With any machine with inadequate or inconsistent machine response time and stopping performance.
- With any machine that ejects materials or component parts through the defined area.
- In any environment that is likely to adversely affect the efficiency of the safeguard(s) or the MM2-TA-12B. For example, corrosive chemicals or fluids or unusually severe levels of smoke or dust, if not controlled, may degrade the efficiency of the System.

If there is any doubt about whether or not your machinery is compatible with the MM2-TA-12B Muting Module, contact Banner's Application Engineers at the factory.

1.8 SECURITY PROTOCOL

The Module should be mounted inside a lockable enclosure in order to prevent access by unauthorized personnel, if required by applicable standards.

The key (or combination) to the enclosure should be kept in the possession of a Qualified Person as specified in block 1.9 on Page 4 and only they should have access to the configuration switches. A Qualified Person as specified in block 1.9 on Page 4 is defined as an individual who, by possession of a recognized degree or certificate of professional training, or who, by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work.

1.9 DESIGNATED & QUALIFIED PERSONS

1.9.1 Designated Person

A **Designated Person** (see also page 71) is identified and designated in writing, by the employer, as being appropriately trained and qualified to perform the specified checkout procedures on the Muting Module. A machine operator so designated may be a **Designated Person**. The **Designated Person** is empowered to:

- Perform manual resets and hold possession of the reset key, code or other security means, and
- Perform the Daily Checkout Procedure (see block 6.1.3 on Page 45).

1.9.2 Qualified Person

A **Qualified Person** (see also page 72) by possession of a recognised degree or certificate of professional training, or by extensive knowledge, training and experience, has successfully demonstrated the ability to solve problems relating to the installation of the Muting Module and its integration with the guarded machine. In addition to everything for which the **Designated Person** is empowered, the **Qualified Person** is empowered to:

- Install the Muting Module
- Perform all checkout procedures (see block 6.1.3 on Page 45)
- Have access and make changes to the system configuration settings and
- Reset the system following a lockout condition.

1.10 CONTROL RELIABILITY

1.10.1 Type MM-TA12B

1.10.1.1 Redundancy & Self-Checking

The Muting Module microprocessor-based circuitry features a diverse-redundant design. In addition, the Muting Module is extensively FMEA (Failure Mode and Effects Analysis) (see FMEA on page 71) tested to establish an extremely high probability that no system component will ever (even if it does fail) cause a failure to danger. This design philosophy aids machine designers to comply with U.S. control reliability and worldwide standards for the highest level of safety.

Redundancy requires that Module circuit components be backed up to the extent that, if the failure of a single component will prevent effective machine stopping action when needed, that component must have a redundant counterpart which will perform the same function. The microprocessor-controlled Muting Module 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 Muting Module is in operation. Since a redundant system is no longer redundant once a component has failed, the Module is 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 Module into a lockout condition.

Recovery from this type of lockout condition requires replacement of the failed component (to restore redundancy) and the appropriate reset procedure (see block 4.5.1.1 on Page 27). Possible causes are listed in block 6.2.1 on Page 51. The Diagnostic Display is used to diagnose causes of a lockout condition (see block 6.2.1.1 on Page 51 and Table 14 on Page 51).

1.10.2 Type MM2-TA12B

1.10.2.1 Safety Categories

To summarize the expected safety circuit performance in high-risk situations, requirements of Control Reliability and Categories 3 and 4 (EN 954-1) demand that a reasonably foreseeable, single failure does not lead to the loss of the safety function, and does not prevent a normal or immediate stop from occurring. The failure or the fault must be detected at or before the next demand of safety (e.g. at the beginning or end of a cycle, or when a safeguard is actuated). The safety-related part of the control system then must issue an immediate stop command, or prevent the next machine cycle or hazardous situation until the failure or fault is corrected.

The effect of EN 954-1 is to place a “floor” or a baseline for situations in which a minimum level of performance has been mandated or in cases where a risk assessment has determined a need for Control Reliability, Category 3 or Category 4 level of performance.

In lower-risk safety applications, safeguards and safety circuits do not require the level of performance and fault tolerance described by Control Reliability, Category 3 or Category 4. Applications involving situations that could result in a slight or normally reversible injury (e.g., only requiring first aid) can be solved by EN 954-1 Category 2.

EN 954-1 Category 2 does not require the same level of performance and fault tolerance as required by Control Reliability, Category 3 or Category 4. Safety-related parts of control systems designed to Category 2 “shall be designed so that their function(s) are checked at suitable intervals by the machine control system.” This allows a single fault to lead to the loss of the safety function between the check [test] of the system, but the loss of safety function is detected by the check. By comparison, in a system designed to EN 954-1 Category 4, a single fault or an accumulation of faults does not lead to a loss of the safety function.

While EN 954-1 generally applies to the machine level, IEC 61496-1 and IEC 61496-2 specifies requirements for the design, construction and testing for two levels or “types” of active opto-electronic protective devices (AOPDs) or light curtains (light screens). “Type 2” and “Type 4” describe differing requirements to ensure that appropriate safety-related performance is achieved. The appropriate type is dependent on the overall degree of risk reduction, as determined by the machine's Risk Assessment (See ISO 14121).

A Type 2 Active Opto electronic Protective Devices (AOPD) relies on periodic testing to detect a failure to danger. Between tests, a single fault can result in the loss of the safety function. While this level of performance and fault tolerance is generally not allowed in Category 4 situations, it is acceptable in the lower-risk situations described by Category 2.

1.11 MUTING MODULE SAFETY FEATURES

1.11.1 Automatic or Monitored Manual Reset Select

The selectable Automatic or Monitored Manual Reset provides flexibility for the User that has applications in which the operator is continually sensed, or in applications where the operator can pass through and become clear of the sensing field. See block 1.11.17 on Page 10 Pass-Through Hazards.

The configuration is selected via two banks of DIP switches located inside the Muting Module's configuration port (see block 4.3 on Page 24).

1.11.1.1 Monitored Manual Reset

Monitored Manual Reset is typically used in situations where the individual can pass through a sensing field and become clear of a Guarding Device, such that the device can no longer prevent hazardous motion; for example, perimeter guarding. The Muting Module monitors the input for two transitions: from open-to-closed, and from closed-to-open within a certain time period. This prevents the reset button from being tied down or failing in a closed condition, and causing an unintended or automatic reset.

Upon power-up, when the Muting Module has been configured for Manual Reset, for the OSSD outputs to turn ON, both the Mutable Safety Stop Interface (MSSI) and the Universal Safety Stop Interface (USSI) (for MM-TA-12B) or the Safety Stop Interface (SSI) (for MM2-TA-12B), must both be active (closed) and a monitored Manual Reset must be accomplished. The reset is accomplished by closing the RESET input for a minimum of 1/4 second, but not longer than 2 seconds and then re-opening the input. The Output Signalling Device (OSSD) outputs turn ON once the open-closed-open action occurs.

In this configuration, the Muting Module must be manually reset after power-up, lockouts, and after the cycling of either the MSSI (not muted) or the USSI (for MM-TA-12B) and SSI (for MM2-TA-12B). The location for the manual reset device (for example: a N.O. key switch) must comply with the WARNING on page 27 and refer to that block for further information on key resets.

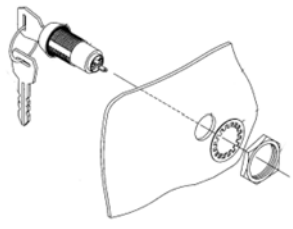


Figure 1 Typical Reset Switch

1.11.1.2 Automatic Reset

Upon power-up, when the Muting Module is configured for automatic reset, the OSSD outputs automatically turn ON once power is applied, the self-test is accomplished, and the MSSI and the USSI (for MM-TA-12B) or the SSI (for MM2-TA-12B) are active (closed). The OSSD outputs also turn ON after either interface is opened and then re-closed. In either case, no external input or reset is required.

Automatic reset is typically used in situations where the individual is continually sensed by the defined area or in situations where supplementary guarding prevents the initiation of hazardous motion while an individual is within the guarded area (for example: point-of-operation guarding).

In either case, a Manual Reset must be performed to recover from a lockout condition.

1.11.2 Lockout Conditions

A lockout condition of the Muting Module causes both OSSD outputs to go OFF and the Aux output to open. A lockout condition is indicated by a flashing Red status indicator and an error number displayed on the Diagnostic Display.

A description of possible lockouts, their causes, troubleshooting hints, and a Manual Reset routine are listed in block 6.2.1 on Page 51.

1.11.3 Mutable Safety Stop Interface (MSSI)

The Mutable Safety Stop Interface (MSSI) input is a specialised USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) that can be muted during the non-hazardous portion of the machine cycle and provides +24 VDC supply power to the primary Guarding Device that is to be muted.

The Module requires redundant input signals from the external primary guarding which is to be muted. These inputs typically are either x2 Banner solid-state safety outputs with handshake capability (for MM-TA-12B only)(i.e., OSSDs), or x2 monitored forced-guided relay outputs (i.e., FSDs) from an appropriate Guarding Device. See Table 2 on Page 19, and block 4.5.5 on Page 29 for complete information.

1.11.4 USSI's (Type MM-TA-12B) & SSI's (Type MM2-TA-12B)

The Muting Module has a provision for an additional Safety Stop Interface to connect an optional device, such as a supplementary guard, E-stop button, or safety switch(es), to issue a stop command. This dual-channel interface is similar to the MSSI, but is always functional, even when the primary Guarding Device is being muted. See Table 2 on Page 19, and block 4.5.5 on Page 29 for complete information.

1.11.4.1 Safety Interlocking Switches

The following general requirements and considerations apply to the installation of interlocked gates and guards for the purpose of guarding. In addition, the User must refer to the relevant regulations to be sure to comply with all necessary requirements.

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

The guard must be located an adequate distance from the danger zone (so that the hazard has time to stop before the guard is opened sufficiently to provide access to the hazard), and it must open either laterally or away from the hazard, not into the Guarding Device area. The guard also should not be able to close by itself and activate the interlocking circuitry. In addition, the installation must prevent personnel from reaching over, under, around or through the guard to the hazard. Any openings in the guard must not allow access to the hazard (see ISO 14119). The guard must be strong enough and designed to protect personnel and contain hazards within the guarded area, which may be ejected, dropped or emitted by the machine.

The safety interlocking switches and actuators used with the Muting Module must be designed and installed so that they cannot be easily defeated. They must be mounted securely, so that their physical position can not shift, using reliable fasteners that require a tool to remove them.

1.11.4.2 Positive-Opening Safety Interlock Switches

Safety interlock switches used with the Muting Module must satisfy several requirements. Each switch must provide electrically isolated contacts: at minimum, x2 NC contacts from x2 individually mounted switches.

The contacts must be of positive opening (see page 72) design, with one or more NC contacts rated for safety (see the Banner Safety Catalogue for examples). In addition, the switches must be mounted in a positive mode, to move/disengage the actuator from its home position and open the NC contact, when the guard opens.

1.11.5 OSSD Outputs

The Muting Module has two solid-state safety outputs, labelled OSSD 1 and OSSD 2 (see Figure 17 on Page 55). These safety outputs are actively monitored to detect short circuits to the supply voltage, to each other, and to other sources of electrical energy. If a failure is detected, the outputs switch to an OFF-state. For circuits requiring the highest level of safety and reliability, either OSSD must be capable of stopping the motion of the guarded machine in an emergency.

During the muted portion of the machine cycle, the MSSI inputs are ignored but OSSD 1 and OSSD 2 remain ON. During other portions (not muted) of the cycle, if the MSSI either opens or goes OFF, OSSD 1 and OSSD 2 go OFF.

1.11.5.1 Type MM-TA-12B Only

To ensure Safety Category 4 per ISO 13849-1, the OSSDs are compatible with the handshake protocol of Banner Engineering safety devices with USSIs. This handshake verifies that the interface of the two devices is capable of detecting certain unsafe failures that may occur, such as a short-circuit to a secondary source of power or to the other channel, high input resistance, or the loss of signal ground.

In any case, if the USSI interface opens, OSSD 1 and OSSD 2 go OFF. See Appendix A2 on page 65 for timing diagrams.

1.11.5.2 Type MM2-TA-12B Only

In any case, if the SSI interface opens, OSSD 1 and OSSD 2 go OFF. See Appendix A2 on page 65 for timing diagrams.

1.11.6 Auxiliary (Aux) Output

The Auxiliary (Aux) monitoring PNP output is intended for non-safety related purposes. The status of this auxiliary output is indicated by the green status LED. See block 1.11.10 on Page 9 for more information.

1.11.7 EDM

Two inputs are provided (see Figure 17 on Page 55) for monitoring the state of external devices, such as MPCEs. These terminals are labelled EDM 1 and EDM 2 at the Machine Interface connection. The Module's EDM inputs can be configured in three ways: One Channel, Two Channel, or No Monitoring (see Figure 8 on Page 24 for DIP switch settings and block 4.7.2 on Page 35 for external connection). One Channel and Two Channel EDM is used when the OSSD outputs directly control the de-energizing of the MPCEs or external devices.

1.11.7.1 One Channel Monitoring

A series connection of closed monitor contacts that are forced-guided (or captive contact) from each device controlled by the Muting Module. The monitor contacts should open within 200 ms of the OSSD outputs going ON (a GO condition) and should close within 200 ms of the OSSD outputs going OFF and remain closed (a STOP condition), otherwise a lockout occurs (see Table 14 on Page 51).

1.11.7.2 Two Channel Monitoring

An independent connection of closed monitor contacts that are forced-guided (or captive contact) from each device controlled by the Muting Module. While the OSSDs are ON, the inputs may change state (either both open, or both closed). If the inputs remain in opposite states for more than 200 ms, a lockout occurs. Additionally, both inputs must be closed 200 ms after the OSSD outputs go OFF or a lockout occurs (see Diagnostic Display block 6.2.1.2 on page 51).

1.11.7.3 No Monitoring

Uses the EDM Disable configuration with inputs EDM 1 and EDM 2 left open that is, not connected (see Machine Interface pin-outs Table 7 on Page 25). If the Module is set for No Monitoring, the User must ensure that any single failure of the external devices does not result in a hazardous condition and successive machine cycle(s) are prevented (see block 1.10 on Page 5).

1.11.8 Mute Devices & Mute Inputs

⚠ WARNING!

MUTING LIMITATIONS

MUTING IS ALLOWED ONLY DURING THE NON-HAZARDOUS PORTION OF THE MACHINE CYCLE. A MUTING APPLICATION MUST BE DESIGNED SO THAT NO SINGLE COMPONENT FAILURE CAN PREVENT THE STOP COMMAND OR ALLOW SUBSEQUENT MACHINE CYCLES UNTIL THE FAILURE IS CORRECTED AS PER ISO/DIS 13855.

1.11.8.1 Application of the Muting Function

To mute the primary Guarding Device appropriately, the design of a muting system must:

- Identify the non-hazardous portion of the machine cycle
- Involve the selection of the proper muting devices, and
- Include proper mounting and installation of those devices

The Module can monitor and respond to redundant signals that initiate the mute. The mute then suspends the Guarding Device function by ignoring the state of the MSSI; this allows an object or person to pass through the defined area without generating a stop command. (This should not be confused with blanking, which disables one or more beams in a safety light screen, resulting in larger minimum object sensitivity.) See A2 on Page 65 for example: mute timing sequences.

The mute may be triggered by a variety of external devices. This feature provides a variety of options (see block 1.11.8 on Page 8 and block 1.11.10 on Page 9) to tailor the System to the requirements of a specific application.

A pair of muting devices must meet the Simultaneity Requirement (see page 72). This reduces the chance of common mode failures or defeat.

1.11.8.2 Mute Devices

⚠ WARNING!

MUTE INPUTS MUST BE REDUNDANT

IT IS NOT RECOMMENDED TO USE A SINGLE SWITCH, DEVICE, OR RELAY WITH TWO N.O. CONTACTS FOR THE MUTE INPUTS AS A SINGLE DEVICE, WITH MULTIPLE OUTPUTS, MAY FAIL CAUSING THE SYSTEM TO MUTE AT AN INAPPROPRIATE TIME. THIS MAY RESULT IN A HAZARDOUS SITUATION.

The beginning and end of a mute cycle must be triggered by outputs from either pair of muting devices, depending on the application. The mute device pairs both must have normally open contacts, or have one device with a PNP output and one device with a NPN output, both of which fulfil the General Muting Device Requirements on page 8. These contacts must close (conducting) when the switch is operated to initiate the mute, and must open (non-conducting) when the switch is not operated and in a power-OFF condition.

The Module monitors the mute devices to verify that their outputs turn ON within 3 s of each other. If the inputs do not meet this Simultaneity Requirement (see page 72), a mute condition can not occur.

Several types and combinations of mute devices can be used, including, but not limited to: limit switches, photoelectric sensors, positive-drive safety switches, inductive proximity sensors, and whisker switches.

General Muting Device Requirements

The muting devices (typically sensors or switches) must, at a minimum, comply with the following requirements:

- There must be a minimum of two independent hard-wired muting devices.
- The muting devices must either both have normally open contacts; or one device with a PNP output and one device with a NPN output, both of which must fulfil the input requirements listed in Table 2 on Page 19. These contacts must close when the switch is operated, and must open (or not conduct) when the switch is not operated or in a power OFF condition.
- The activation of the inputs to the muting function must be from separate sources. These sources must be mounted separately in order to prevent an unsafe muting condition resulting from maladjustment, misalignment, or a single common mode failure. (For example: physical damage to the mounting surface could cause both muting devices to be knocked out of alignment, resulting in false muting input signals.)

  Only one of these sources may pass through, or be affected by, a programmable logic controller (PLC) or similar device.
- The muting devices must be installed so that they can not be easily defeated or bypassed.
- The muting devices must be mounted so that their physical position and alignment can not be easily changed.
- It must not be possible for environmental conditions to initiate a mute condition (for example: extreme airborne contamination).

The muting devices must not be set to use any delay or other timing functions (unless such functions are accomplished so that no single component failure prevents the removal of the hazard, subsequent machine cycles are prevented until the failure is corrected, and no hazard is created by extending the muted period).

1.11.9 Mute Enable

The Mute Enable (ME) input is a non-safety-rated input. When the input is closed, the Module allows a mute condition to occur; opening this input while the System is muted has no effect. If the application does not require ME, the input must be left open and the DIP switches configured for ME Disable = ON.

Typical uses for ME include:

- To allow the machine control logic to create a window for muting to begin
- To inhibit muting from occurring or
- To reduce the chance of unauthorized or unintended bypassing or defeat of the safety system.

1.11.9.1 Simultaneity Timer Reset Function

The ME input can also be used to reset the Simultaneity Timer of the mute inputs. If one input is active for longer than 3 s before the second input becomes active, the Simultaneity Timer prevents a mute cycle from occurring. This could be due to a normal stoppage of an assembly line that may result in blocking one mute device and the simultaneity time running out.

If the ME input is cycled (closed-open-closed) while one mute input is active, the Simultaneity Timer is reset, and if the second mute input becomes active within 3 s, a normal mute cycle begins. The timing requirement for the closed-open-closed is similar to the manual reset function. Initially, the input needs to be active (closed) for longer than 0,25 s, then open for longer than 0,25 s, but not longer than 2 s, and then must reclose to reset the Simultaneity Timer. The function can reset the timer only once per mute cycle (that is, all mute inputs M1-M4 must open before another reset can occur).

1.11.10 Mute Lamp Output

⚠ WARNING!

MUTE STATUS MUST BE READILY VISIBLE

INDICATION THAT THE SAFETY DEVICE IS MUTED MUST BE PROVIDED AND MUST BE READILY VISIBLE AS PER ISO/DIS 13855 (2002). FAILURE OF THIS INDICATION SHOULD BE DETECTABLE AND PREVENT THE NEXT MUTE, OR, THE OPERATION OF THE INDICATOR SHOULD BE VERIFIED AT SUITABLE INTERVALS.

Most applications require that a lamp (or other means) be used to indicate when the primary Guarding Device (for example: light screen) is muted. The Muting Module provides for this. This indication is selectable between a monitored or a non-monitored output signal (NPN sinking). The monitored output prevents the initiation of a mute after an indicator failure is detected (current draw falls below 10 mA or goes above 360 mA). If the muting function is to be used in a country governed by EN regulation (requiring the CE mark), Mute Lamp (ML) monitoring must be selected and the lamp used must meet applicable requirements (see block 1.11.10 on Page 9) or the operation of the indicator should be verified at suitable intervals (see block 1.11.1 on Page 6).

1.11.11 Backdoor Timer

The Backdoor Timer allows the User to select a maximum period of time that muting is allowed to occur. This feature delays the intentional defeat of the muting devices to initiate an inappropriate mute. It is also useful for detecting a common mode failure that would affect all mute devices in the application.

The timer begins when the second muting device makes the Simultaneity Requirement (see page 72), and allows a mute to continue for the predetermined time. After the timer expires, the mute ends ignoring what the signals from the mute devices indicate. If the MSSI is open, the OSSD outputs turn OFF and must be manually reset (if Module is configured for Manual Reset). The Override function can be activated (see block 1.11.13 on Page 10) to force the OSSDs to switch ON in order to clear the obstruction.

If the Backdoor Timer expires, a #50 error code is displayed until all mute device inputs are open and the MSSI is active/closed.

1.11.12 Mute On Power-Up

⚠ WARNING!

MUTE ON POWER-UP

THE MUTE ON POWER-UP FUNCTION SHOULD ONLY BE USED IN APPLICATIONS WHERE MUTING THE SYSTEM (M1 AND M2 CLOSED) WHEN POWER IS APPLIED IS REQUIRED, AND USING IT, CANNOT IN ANY SITUATION, EXPOSE PERSONNEL TO ANY HAZARD.

The Backdoor Timer DIP switch settings also enable or disable the Mute on Power-Up function (see Figure 8 on Page 24). Mute Enable must be configured functional and be closed to allow Mute on Power-Up. If selected, the Mute on Power-Up function initiates a mute when power is applied, the ME input is closed, the MSSI inputs are active (closed), and either M1-M2 or M3-M4 (but not all four) are closed.

If Auto Reset is configured, the Module allows 10 s for the MSSI and USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) to become active (closed), to accommodate systems that may not be immediately active at power-up.

If Manual Reset is configured, the first valid reset after the MSSI and USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) are active (closed) results in a mute cycle if all other conditions are satisfied.

1.11.13 Override

WARNING!

LIMITING USE OF OVERRIDE FUNCTION

THE OVERRIDE FUNCTION IS NOT FOR MACHINE SETUP OR PRODUCTION. IT IS TO BE USED ONLY TO CLEAR THE PRIMARY GUARDING DEVICE, SUCH AS IF MATERIAL BECOMES STUCK IN THE DEFINED AREA OF A SAFETY LIGHT SCREEN. WHEN OVERRIDE IS USED, IT IS THE USER'S RESPONSIBILITY TO INSTALL AND USE IT ACCORDING TO CURRENT SAFETY STANDARDS (SEE block 1.4 on Page 2). IN ADDITION, THE REQUIREMENTS LISTED IN STANDARD IEC/EN60204-1 BLOCK 9.2.4 MUST BE SATISFIED.

The Override function allows the User to manually force the OSSD outputs ON for 10 s in a situation such as an object becoming stuck in the defined area of a safety light screen after the mute ends (for example: a car body on a transfer line entering a work cell). The feature is intended to allow the User to dislodge the part out of the defined area.

This input requires two N.O. switches, both of which must be closed within 3 s of each other. The Override cycle lasts a maximum of 10 s, after which the Override input must be released for at least 3 s prior to the next Override cycle. An Override can be initiated only after tripping of the MSSI inputs causes the Module to latch its OSSDs OFF.

- *A stop command issued by the USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) cannot be overridden.*
- *When Override is used, the following precautions must be taken:*

  Prevent exposure to any hazard during an Override cycle

  Provide a readily observable indication of an Override

  Provide supplementary guarding, per IEC/EN60204-1 Block 9.2.4

The Override switches must be supervised and must prevent automatic operation.

Also, one or more of the following must be true:

- Motion is initiated by a hold-to-run or similar device
- If a portable control station (for example: an enabling device) with an emergency stop device is used, motion may be initiated only from that station
- Motion, speed, or power of the machine is limited
- The machine's range of motion is limited.

1.11.14 One Way/Two Way Muting

One-way (directional) muting allows the Guarding Device to be muted only if mute devices are operated in the order M1, M2 (mute initiated), M3 and M4. This method allows for a single-direction material flow and reduces the possibility of intentional defeat of the muting devices.

Two-way (non-directional) muting allows the Guarding Device to be muted any time the actuation of M1-M2 or M3-M4 meets the Simultaneity Requirement (see page 72). This allows the flow of material from either direction (two-way material flow).

When using four mute devices (M1, M2, M3 and M4), in order to extend the mute until the light screen is clear, the object must activate all four of the devices at one time during the mute cycle.

1.11.15 Use of Corner Mirrors with Optical Safety Systems

WARNING!

GUARDING MULTIPLE AREAS

DO NOT GUARD MULTIPLE AREAS, WITH MIRRORS OR MULTIPLE SENSING FIELDS, IF PERSONNEL CAN ENTER THE HAZARDOUS AREA WHILE THE SYSTEM IS MUTED, AND NOT BE DETECTED BY SUPPLEMENTARY GUARDING THAT ISSUES A STOP COMMAND TO THE MACHINE (SEE block 1.11.17 on Page 10, PASS THROUGH HAZARDS).

Mirrors are typically used with safety light screens and single-/multiple-beam safety systems to guard multiple sides of a hazardous area. If the safety light screen is muted, the safeguarding function is suspended on all sides. It must not be possible for an individual to enter the guarded area without being detected and a stop command issued to the machine control. This supplementary guarding is normally provided by an additional device(s) that remains active while the Primary guarding is muted and could be interfaced with the USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) input. Therefore, **mirrors are typically not allowed for muting applications**.

1.11.16 PSSDs

Muting multiple PSSDs (see page 71) **or a PSSD with multiple sensing fields is not recommended** unless it is not possible for an individual to enter the guarded area without being detected and a stop command issued to the machine control. As with the use of corner mirrors (see above), if multiple sensing fields are muted, the possibility exists that personnel could move through a muted area or access point to enter the guarded area without being detected.

For example: in an entry/exit application where a pallet initiates the mute cycle by entering a cell, if both the entry and the exit PSSDs are muted, it may be possible for an individual to access the guarded area through the exit of the cell. An appropriate solution would be to mute the entry and the exit with separate Guarding Devices.

1.11.17 Pass-Through Hazards

WARNING!

PASS-THROUGH HAZARDS, PSSD & MUTING

IF THE PSSD (see page 71) IS GUARDING AN APPLICATION IN WHICH PERSONNEL HAVE ACCESS INTO THE SENSING AREA OR FIELD (FOR EXAMPLE: A MACHINE OPERATOR AT THE POINT OF OPERATION) WHILE THE PSSD IS MUTED, ALL PASS-THROUGH HAZARDS MUST BE ELIMINATED. THE INDIVIDUAL MUST BE SENSED CONTINUALLY WHILE IN THE GUARDED AREA. THIS PREVENTS INITIATION OF A MACHINE CYCLE IF THE MUTE ENDS WHILE THE INDIVIDUAL IS WITHIN THE HAZARDOUS AREA. SEE Appendix A3 on page 67 FOR EXAMPLES. IF THE PASS-THROUGH HAZARD CANNOT BE ELIMINATED, AS IN ENTRY/EXIT APPLICATIONS, THE INDIVIDUAL MUST BE DETECTED ENTERING THE GUARDED AREA AND THE HAZARDOUS MOTION MUST STOP IMMEDIATELY.

A pass-through hazard is associated with applications where personnel may pass through a guard (at which point the hazard stops or is removed) and then may continue into the hazardous area. Subsequently, their presence is no longer detected, and the guard can not prevent the start or restart of the machine. The related danger is the unexpected start or restart of the machine while personnel are within the hazardous area.

In the use of safety light screens, a pass-through hazard typically results from large MINIMUM SAFETY DISTANCES calculated from long stopping times, large minimum object sensitivities, reach over, reach through, or other installation considerations.

A pass-through hazard can be generated with as little as 75 mm between the defined area and the machine frame or fixed guarding.

1.11.18 FSD Interfacing Connections

FSDs can take many forms, though the most common are captive contact, forced-guided relays or Interfacing Modules. The mechanical linkage between the contacts allow the device to be monitored by the external device monitoring circuit for certain failures.

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

1.11.18.1 Safety Stop Circuits

A safety stop allows for an orderly cessation of motion for safeguarding purposes, which results in a stop of motion and removal of power from the MPCEs (assuming this does not create additional hazards). A safety stop circuit typically comprises of a minimum of two N.O. contacts from captive contact, forced-guided relays, which are monitored to detect certain failures such that the loss of the safety function does not occur (that is EDM). Such a circuit can be described as a safe switching point.

Typically, safety stop circuits are either single channel (a series connection of at least two N.O. contacts); or dual channel (a parallel connection of two N.O. contacts). In either method, the safety function relies on the use of redundant contacts to control a single hazard, so that if one contact fails ON, the second contact arrests the hazard and prevents the next cycle from occurring.

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

The normally open outputs from an IM-T-9A or -11A interfacing module are a series connection of redundant contacts that form safety stop circuits and can be used in either single-channel or dual-channel control methods See Figure 37 on Page 62.

1.11.18.2 Dual-Channel Control

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

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

1.11.18.3 Single-Channel Control

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

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

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

- Physically separating interconnecting control wires from each other and from secondary sources of power.
- Routing interconnecting control wires in separate conduit, runs, or channels.
- Routing interconnecting control wires with low voltage or neutral that can not result in energizing the hazard.
- Locating all elements (modules, switches, devices under control, etc.) within the same control panel, adjacent to each other, and directly connected with short wires.
- Properly installing multi-conductor cabling and multiple wires that pass through strain-relief fittings. Over-tightening of a strain-relief can cause short-circuits at that point.
- Using positive-opening or direct-drive components installed and mounted in a positive mode.

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2 INTRODUCTION

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

2.1 PRODUCT FEATURES

2.1.1 Muting Module General

- Compact housing meets IP65 requirements; can be mounted inside or outside a control panel, near the point of guarding
- Monitors two or four inputs to automatically suspend the safety function of a Guarding Device or system
- Selectable EDM
- Selectable Automatic or Monitored Manual Reset provides flexibility for point-of-operation or perimeter guarding
- Diverse-redundant solid-state safety outputs
- Status LEDs and two-digit Diagnostic Display indicate module status
- Eight Euro-style quick-disconnect I/O ports for mute device inputs, mute lamp output, override, USSI, and reset. Moulded or field-wireable cable QDs are available.
- Two Mini-style quick-disconnects for interfacing with the safety system and machine control
- Easy configuration for:
  - Auto/manual reset
  - One-/two-channel EDM
  - One-/two-direction muting
  - Selectable mute enable
  - Monitored/non-monitored mute lamp
  - Selectable backdoor timer
- Selectable mute on power-up

2.1.2 Muting Module Type MM-TA-12B Only

The Muting Module type MM-TA-12B has the following additional product features:

- For use with EZ-SCREEN® Output Signal Switching Device (OSSD) outputs or MINI-SCREEN®, MICRO-SCREEN®, MACHINE-GUARD®, or other safety devices with hard relay contact safety output(s)
- Universal Safety Stop Interface (USSI) for connection of supplementary Guarding Devices or E-stops

2.1.3 Muting Module Type MM2-TA-12B Only

The Muting Module type MM2-TA-12B has the following additional product features:

- For use with EZ-SCREEN® Type 2 Output Signal Switching Device (OSSD) outputs, 24 VDC signals or other safety devices with hard relay contact safety output(s)
- Safety Stop Interface (SSI) for connection of supplementary Guarding Devices or E-stops

2.2 DISCLAIMER INFORMATION

Important... read this block before proceeding!

WHETHER OR NOT ANY PARTICULAR MUTING MODULE INSTALLATION MEETS ALL APPLICABLE REQUIREMENTS DEPENDS UPON FACTORS THAT ARE BEYOND THE CONTROL OF BANNER ENGINEERING CORP. THESE FACTORS INCLUDE THE DETAILS OF HOW THE MUTING MODULE IS APPLIED, INSTALLED, WIRED, OPERATED, AND MAINTAINED. IT IS THE RESPONSIBILITY OF THE PURCHASER AND USER TO APPLY THIS MUTING MODULE IN FULL COMPLIANCE WITH ALL RELEVANT APPLICABLE REGULATIONS AND STANDARDS. MUTING MODULES CAN ONLY GUARD AGAINST ACCIDENTS WHEN THEY ARE PROPERLY INSTALLED/INTEGRATED INTO THE MACHINE, PROPERLY OPERATED, AND PROPERLY MAINTAINED. BANNER ENGINEERING CORP. HAS ATTEMPTED TO PROVIDE COMPLETE APPLICATION, INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS.

THE USER HAS THE RESPONSIBILITY TO ENSURE THAT ALL LOCAL, STATE, AND NATIONAL LAWS, RULES, CODES, AND REGULATIONS RELATING TO THE USE OF THIS GUARDING SYSTEM IN ANY PARTICULAR APPLICATION ARE SATISFIED.

Extreme care is urged to ensure that all legal requirements have been met and that all installation and maintenance instructions contained in this manual are followed.

For a list of European & International standards appertaining to this equipment, refer to block 1.4 on Page 2.

2.3 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 information as follows:

Level **1** **Title in upper Case 13 pt**

Level **1.1** **Title in upper Case 10 pt**

Level **1.1.1** **Title in Title Case 10 pt**

Level **1.1.1.1** **Title in Title Case 8 pt**

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

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

For ON LINE versions of the Manual, there is an interactive Table 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 at the beginning of this document.

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 particular reference. The Reader can return to the original place in the document by clicking on the Bookmark ▼ then selecting **Go to Bookmark** or alternatively clicking on the highlighted bookmark.

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

In general **bold emphasis** is used to emphasize information of particular importance such as Machine commands, titles etc.

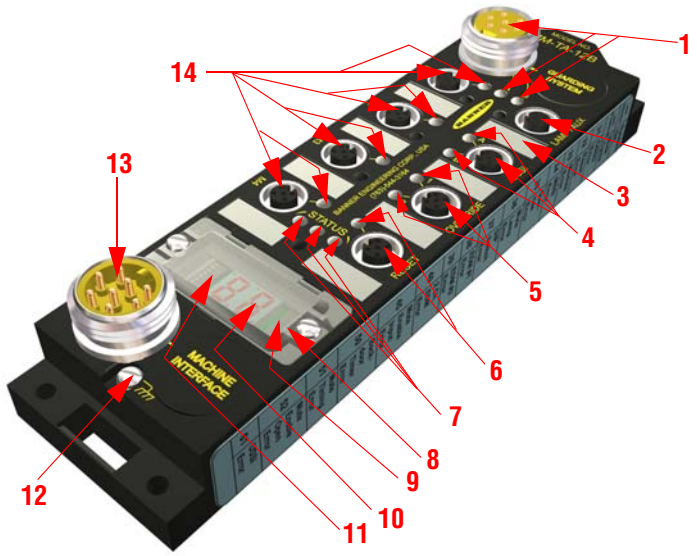
Change bars are also used in the document to indicate revisions. They are positioned in the left or right hand margins adjacent to the change.

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

2.4 SYSTEM DESCRIPTION

The Banner Muting Module shown in Figure 2 on Page 15, is an accessory component of a guarding system, and may include such primary Guarding Device as safety light screens, safety interlocked gates/guards, or other PSSDs. The Muting Module allows the machine to mute the primary guarding by monitoring redundant inputs (two or four) and automatically suspend the guarding function of a Guarding Device during the non-hazardous portion of the machine cycle.

In this manual, the term muting refers to the automatic suspension of the guarding function of the primary guarding during a non-hazardous portion of the machine cycle. During the non-hazardous portion of the machine cycle, personnel are not exposed to harm. A typical schematic layout is shown in Figure 17 on Page 55 and Figure 18 on Page 55. The muting function allows material to be manually or automatically fed into or removed from a machine process, without tripping the primary Guarding Device. The Module accomplishes this by using diverse-redundant microprocessors that monitor the status of inputs and outputs, so that a single fault causes the Module to issue a stop command to the machine.



Index to figure

1. MSSI Interface connection with channel A & B input indicators
2. Mute lamp/aux
3. User-writeable snap-in label
4. USSI input with channel A & B input indicators
5. Override input with channel 1 & 2 input indicators
6. Reset input & indicator
7. Status indicators
8. Configuration port
9. DIP Switch Bank B
10. Diagnostic display
11. DIP Switch Bank A
12. Earth ground screw
13. Machine interface connection
14. Mute device inputs with indicators

Figure 2 Muting Module Layout Types MM-TA-12B & MM2-TA-12B

2.4.1 Operating LEDs & Diagnostic Display

The Muting Module has three Operating Status LEDs, red, yellow and green, plus a 2-digit Diagnostic Display, visible through a window in the front panel. The individual LEDs provide constant, ongoing system status information at a glance. The Diagnostic Display provides error codes that correspond to the cause of a fault or configuration error which results in a lockout, and other more detailed conditions. See Chapter 5 on Page 43 and block 6.2.1 on Page 51 for further information.

2.4.2 Muting Module Features

For information on the Muting Module specific safety features see block 1.11 on Page 6.

2.4.3 Typical Muting Applications

⚠ WARNING!

MUTING LIMITATIONS

MUTING IS ALLOWED ONLY DURING THE NON-HAZARDOUS PORTION OF THE MACHINE CYCLE. A MUTING APPLICATION MUST BE DESIGNED SO THAT NO SINGLE COMPONENT FAILURE CAN PREVENT THE STOP COMMAND OR ALLOW SUBSEQUENT MACHINE CYCLES UNTIL THE FAILURE IS CORRECTED AS PER ISO/DIS 13855 (2002).

USER IS RESPONSIBLE FOR SAFE APPLICATION OF THIS PRODUCT

THE MUTING APPLICATION EXAMPLES DESCRIBED IN Appendix A3 on page 67 **DEPICT GENERALIZED GUARDING SITUATIONS. EVERY GUARDING APPLICATION HAS A UNIQUE SET OF REQUIREMENTS.EXTREME CARE IS URGED TO ENSURE THAT ALL LEGAL REQUIREMENTS ARE MET AND THAT ALL INSTALLATION INSTRUCTIONS ARE FOLLOWED. IN ADDITION, ANY QUESTIONS REGARDING GUARDING SHOULD BE DIRECTED TO THE** Corporate Office as listed on page 73**.**

The following are typical applications where muting is used. See Appendix on page 67 for more detailed information.

2.4.3.1 Entry/Exit Applications

The muting devices are placed to allow the entry or exit of a pallet or cart of work materials to enter or exit a workstation without tripping the safety light screen, and without allowing the entrance of personnel into the hazardous area (see Entry/Exit Applications on page 67).

2.4.3.2 Robot Load/Unload Station Application (type MM-TA-12B only)

The Station muting application uses independent safety light screen circuits, each with its own muting circuit and sensors to protect work locations. When a robot is active in Station A, for example: Station B safety light screen is muted (see Robot Load/Unload Applications on page 69).

2.4.3.3 Home or Station Application

The muting devices must be placed to mute the safety light screen only when a hazard does not exist or is in another area so that personnel are not exposed to any hazard.

2.4.3.4 Turret Table Application (type MM-TA-12B only)

A “Turret Table” application is similar to the Robot Load/Unload Station muting application, except that any movement of the table ends the mute.

2.4.3.5 Power Press Application (type MM-TA-12B only)

The muting devices are placed so that the mute is initiated only during the non-hazardous, opening portion of the cycle (typically the machine upstroke).

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 information is combined with Product Identification Information as shown in Figure 3 on Page 17.

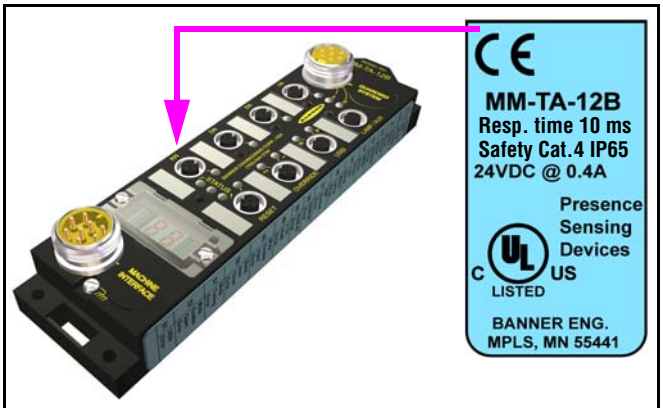


Figure 3 Muting Module Type MM-TA-12B Production Identification Plate

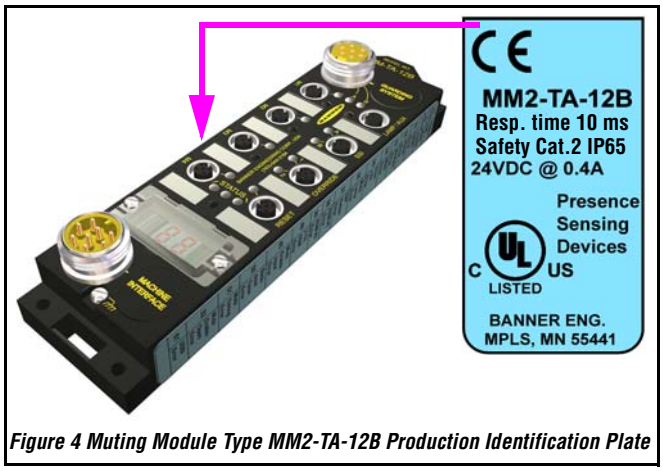


Figure 4 Muting Module Type MM2-TA-12B Production Identification Plate

3.1.2 Product Identification Plate

The Product Identification information is combined with CE Information as shown in Figure 3 on Page 17.

3.1.3 Certificate of Adequacy

The Muting Module Instruction Manual (Part No. 114134 Dated 08.07.03) satisfies the requirements of Machine Directive 98/37/EC, Safety of Machinery, Block 1.7.4 - Instructions.

3.1.4 Declaration of Conformity

The Muting Module is delivered with a Declaration of Conformity as shown in Figure 5 on Page 18. This declaration is delivered to the Customer to certify that the product complies with the CE-Norm.

Declaration of Conformity

Manufacturer: Address:	**Banner Engineering Corp.** **9714 10th Ave N.** **Minneapolis, MN 55441 USA**
Herewith declares that:	**MM-TA-12B - MUTING MODULE**
- 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:	**89/336/EEC** **73/23/EEC**
and that: - the following (parts/clauses of) harmonized standards have been applied:	**EN /IEC 61496-1-Type 4** (as applicable) **IEC 61508** **ISO 13849-1, -2** (Category 4) **TR 12100-1, -2** (as applicable) **EN 60204-1, -2** (as applicable)
- the following (parts/clauses of) national technical standards and specifications have been used:	
EU Notified Body:	**SGS United Kingdom Ltd.**
	Certificates: # MDC 228 10-18-02

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

R. Birnbaum / Quality Manager — Date: OCT / 29 / 2002

Declaration of Conformity

Attached Schedule

Muting Module

Models covered by this Declaration of Conformity:	**MM-TA-12B**

Figure 5 Declaration of Conformity for Muting Module Type MM-TA-12B

Declaration of Conformity

Manufacturer: Address:	**Banner Engineering Corp.** **9714 10th Ave N.** **Minneapolis, MN 55441 USA**
Herewith declares that:	**MM2-TA-12B – MUTING MODULE TYPE 2**
- 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:	**89/336/EEC** **73/23/EEC**
and that: - the following (parts/clauses of) harmonized standards have been applied:	**EN /IEC 61496-1-Type 2** (as applicable) **ISO 13849-1, -2** (Category 2) **TR 12100-1, -2** (as applicable) **EN 60204-1** (as applicable)
- the following (parts/clauses of) national technical standards and specifications have been used:	**SGS United Kingdom Ltd.**
EU Notified Body:	**Certificates: # MDC 363 11-04-05**

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

R. Eagle / Engineering Manager — Date: 11 / 30 / 2005

Declaration of Conformity

Attached Schedule

Muting Module Type 2

Models covered by this Declaration of Conformity:	**MM2-TA-12B**

Figure 6 Declaration of Conformity for Muting Module Type MM2-TA-12B

3.2 TECHNICAL DATA

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

3.2.1 Specifications

Table 2 on Page 19 lists the specifications for the Muting Module.

Table 2 Muting Module General Specifications

Nomenclature	Value/Meaning
System Power Requirements	+24 VDC ±15% @ 400 mA max (not including draw of MSSI power, AUX, ML, M1-M4 and OSSD connections); see block 4.4 on Page 25 for total current draw calculation.
Short Circuit Protection	All inputs and outputs are protected from short circuit to +24 VDC or DC common.
MSSI Power Connections	+24 VDC±15% @ 2.5A max. output (dependent on System power input). Resettable 2.5A fuse.
Status Indicator LEDs	**x3 Status Indicator LEDs (Red, Green and Yellow):** indicates Power ON/OFF, operating mode, lockout, override, and OSSD status **Green LEDs** adjacent to individual inputs/interfaces indicate status (ON = active/closed).
Diagnostic Code Display	Diagnostic Display is a two-digit numeric display that indicates cause of lockout conditions and amount of time, in seconds, remaining for backdoor timer.
Muting Lamp Output	A monitored or non-monitored (selectable) sinking output. If monitoring has been selected, the current draw must be 10 mA to 360 mA. Interconnect wire resistance < 30 ohms. **Maximum Switching Voltage : 30 VDC** **Maximum Switching Current : 360 mA** **Minimum Switching Current : 10 mA** **Saturation Voltage** : ≤ 1.5 VDC @ 10 mA; ≤ 5 VDC @ 360 mA
Controls and Adjustments	**Configured on x2 redundant banks of DIP switches:** Manual/auto reset One-way/two-way muting Monitored/non-monitored mute lamp output One channel/two channel/no EDM Backdoor timer Mute on power-up enable Mute enable functional/disabled
EDM	Two pairs of terminals are provided to monitor the state of external devices controlled by the OSSD outputs. Each device must be capable of switching 15 VDC to 30 VDC at 10 mA to 50 mA.
Muting Device Inputs	The muting devices work in pairs (M1 and M2, M3 and M4) and are required to meet the Simultaneity Requirement (see page 72) to initiate a mute (assuming all other conditions are met). Each muting device must be capable of switching 15 VDC to 30 VDC @ 10 mA to 50 mA.
Mute Enable Input	When Mute Enable is selected (functional), this input must have +24 VDC applied in order to start a mute; opening this input after mute has begun has no effect. If Mute Enable is disabled, this input is ignored and a mute cycle can occur regardless of the state of the mute enable input. The switching device must be capable of switching 15 VDC to 30 VDC @ 10 mA to 50 mA.
Override Inputs	The two-channel inputs must be closed within 3 s of each other (Simultaneity Requirement (see page 72) and held closed during the 10 s Override. To initiate a subsequent Override, open both channels, wait 3 s, and then re-close both channels (within 3 s). The switching devices must be capable of switching 15 VDC to 30 VDC @ 10 mA to 50 mA.
Reset Input	Terminals must be closed for a minimum of 0.25 s and not more than 2.0 s in order to guarantee a reset. The switching device must be capable of switching 15 VDC to 30 VDC at 10 mA to 50 mA.
Mounting	x4 mounting holes, 5,5 mm dia.; see block Figure 7 on Page 22.
Vibration Resistance	**Vibration:** **Frequency range:** 10 Hz to 55 Hz **Sweep rate:** 1 octave/minute **Amplitude:** 0.35 mm (interpreted as 0.70 mm peak to peak) **Number of sweeps:** 20 sweeps (10 cycles) per axis, for 3 axes (no delay at resonance) **Bump:** **Acceleration:** 10 g **Duration of pulse:** 16 ms **Number of bumps:** 1000 +/- 10 for each axis, for 3 axes **Time between bumps:** 2 s

Table 2 Muting Module General Specifications

Nomenclature	Value/Meaning
Construction	**Size:** See block Figure 7 on Page 22 for dimensions **Housing:** Glass-filled Nylon (Black) **Connectors:** Nickel-plated brass All circuitry epoxy-encapsulated.
Environmental Rating	IEC IP65
MM-TA-12B Connections	x1 8-pin Mini-style male x1 each 7-pin Mini-style female x 8 each 5-pin Euro-style female (4-pin, if earth ground connection is not used)
Operating Conditions	Temperature range: 0° to +50° C Max. Relative Humidity: 95% (non-condensing)
Application Notes	**Mute Timing Sequences** : See Appendix A1 on page 55 **Typical Muting Applications** : See Appendix A2 on page 65

Table 3 Muting Module Type MM-TA-12B Specifications Only

Nomenclature	Value/Meaning
Response Time	MSSI and USSI are less than or equal to 10 ms.
Outputs (see WARNING on page 35- OSSD Interfacing**)**	**Two diverse-redundant solid-state safety outputs:** 24 VDC, 0.5A sourcing OSSD. Compatible with Banner Safety Handshake protocol (see block 1.11.5 on Page 7). **ON-State voltage** : ≥Vin-1.5 VDC **Max. load resistance** : 1,000 ¾ **OFF-State voltage** : 1.2 VDC max. **Max. load capacitance** : 0.1 µF **Non-safety auxiliary output** : PNP solid-state output, rated at +24 VDC @ 250 mA.
Inputs	The MSSI and the USSI can be interfaced with external safety devices that have either hard contact outputs or Banner OSSD safety outputs with Safety Handshake protocol (see block 4.5.5 on Page 29). When using the MSSI or USSI sourcing outputs, the relay outputs or hard contacts must be capable of switching 15 VDC to 30 VDC at 10 mA to 50 mA. **Operating Range for MSSI and USSI Inputs** **OFF State** : 0 V to 3 V, 0 mA to 1 mA **ON State** : 12 V to 30 V, 20 mA to 50 mA **MSSI** This input consists of two channels (MSSI-A and MSSI-B), and can be muted when requirements for a mute cycle have been met. When muted, OSSDs remain ON, independent of MSSI status. If not muted, anytime either or both channels open, OSSD outputs go OFF (see block 4.5.5 on Page 29 for further information). **USSI** Input consists of x2 channels (USSI-A and USSI-B), and is always active. Any time either or both channels open, OSSD Outputs go OFF (see block 4.5.5 on Page 29 for further information).
Safety Category	Safety Category 4 per ISO 13849-1
Certifications	

Table 4 Muting Module Type MM2-TA-12B Specifications Only

Nomenclature	Value/Meaning
Response Time	MSSI and SSI are less than or equal to 10 ms.
Outputs (see WARNING on page 35- OSSD Interfacing**)**	**Two diverse-redundant solid-state safety outputs:** 24 VDC, 0.5A sourcing OSSD. Compatible with Banner Safety Handshake protocol (see block 1.11.5 on Page 7). **ON-State voltage** : ≥Vin-1.5 VDC **Max. leakage current*** : 1,2 mA **OFF-State voltage** : 1.2 VDC max. **Max. load capacitance** : 0.1 µF **Non-safety auxiliary output** : PNP solid-state output, rated at +24 VDC @ 250 mA. * Inclusive of faults (including open 0 VDC wire) **OSSD Test pulse width:** 100 µs to 300 µs **OSSD Test pulse period:** 12 ms **Non-safety auxiliary output:** PNP soild-state output, rated at +24 VDC @ 250 mA
Inputs	The MSSI and the SSI can be interfaced with external safety devices that have either hard contact outputs or Banner EZ-SCREEN Type 2/Type 4 OSSD safety outputs (see block 4.5.5 on Page 29) or 24 VDC signals. Maximum external resistance must not exceed 1000 Ω per channel. **Operating Range for MSSI and SSI Inputs** – Relay outputs or hard contacts must be capable of switching: **OFF State** : 0 V to 3 V, 0 mA to 2 mA **ON State** : 12 V to 30 V, 10 mA to 50 mA **MSSI** This input consists of two channels (MSSI-A and MSSI-B), and can be muted when requirements for a mute cycle have been met. When muted, OSSDs remain ON, independent of MSSI status. If not muted, anytime either or both channels open, OSSD outputs go OFF (see block 4.5.5 on Page 29 for further information). **SSI** Input consists of x2 channels (SSI-A and SSI-B), and is always active. Any time either or both channels open, OSSD Outputs go OFF (see block 4.5.5 on Page 29 for further information).
Safety Category	Safety Category 2 per EN954-1
Certifications	

3.2.2 Model/Type Numbering

Refer to Table 5 on Page 21.

Included with the Muting Module are the following documents (for order numbers see Table 16 on Page 54):

- Instruction Manual (this document)
- Daily/Shift Change Checkout Card
- Six Monthly Checkout Card

3.2.2.1 Muting Module Model/Type Numbering

Table 5 Muting Module

Model No.	Description	Order No.	Model
MM-TA-12B	Muting Module (Category 4 per EN 954-1)	30 635 16	
MM2-TA-12B	Muting Module (Category 2 per EN 954-1)	30 749 34	

3.2.3 Muting Module Dimensions

Figure 7 on Page 22 gives the dimensions for the Muting Module.

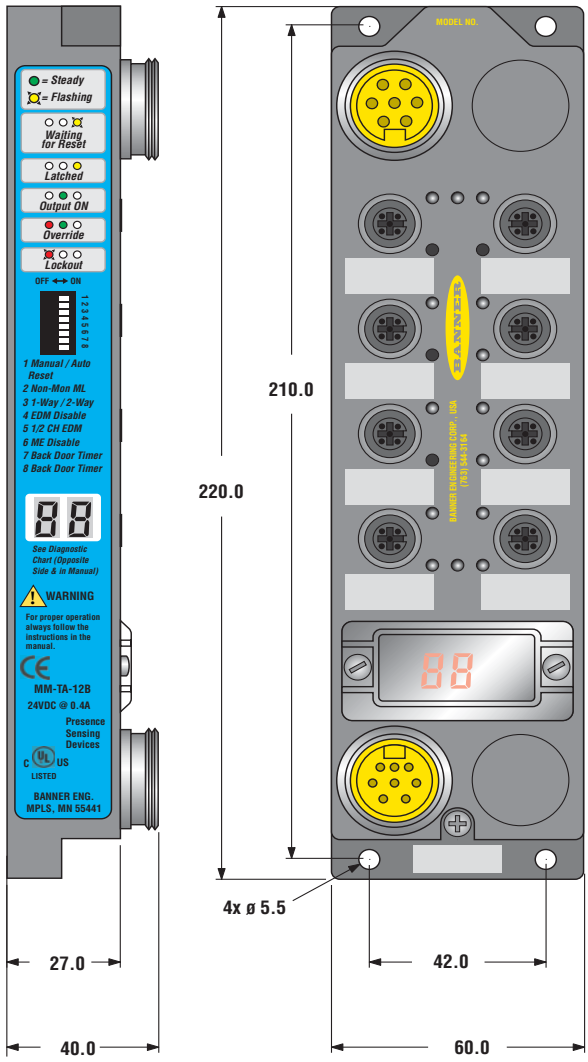


Figure 7 Muting Module Dimensions

3.3 EQUIPMENT NOISE LEVELS

The Muting Module does not generate noise and is therefore in compliance with:

- IEC/EN 61000-6-1
- EN 55011 (CISPR11)

3.4 EQUIPMENT VIBRATION LEVELS

For shock and vibration levels, the Muting Module is in compliance with:

- IEC 61496-1

3.5 EQUIPMENT RADIATION LEVELS

3.5.1 Electromagnetic Immunity Levels

For electro-magnetic levels, the Muting Module is in compliance with IEC 61496-1.

3.6 CUSTOMER SERVICE INFORMATION

For Customer service information refer to Appendix A5 on page 73.

4 INSTALLATION INFORMATION

⚠ WARNINGS!

BEFORE INSTALLING THE EQUIPMENT

READ THE SAFETY INFORMATION CONTAINED IN Chapter 1 on Page 1.

READ THIS SECTION CAREFULLY BEFORE INSTALLING THE SYSTEM

THE BANNER MUTING MODULE IS AN ACCESSORY DEVICE THAT IS TYPICALLY USED IN CONJUNCTION WITH POINT OF OPERATION MACHINE GUARDING DEVICES. ITS ABILITY TO PERFORM THIS FUNCTION DEPENDS UPON THE APPROPRIATENESS OF THE APPLICATION AND UPON THE MUTING MODULE'S (MM-TA-12B) PROPER MECHANICAL AND ELECTRICAL INSTALLATION AND INTERFACING TO THE MACHINE TO BE GUARDED.

IF ALL MOUNTING, INSTALLATION, INTERFACING, AND CHECKOUT PROCEDURES ARE NOT FOLLOWED PROPERLY, THE MUTING MODULE CANNOT PROVIDE THE PROTECTION FOR WHICH IT WAS DESIGNED. THE USER HAS THE RESPONSIBILITY THEREFORE TO ENSURE THAT ALL LOCAL, STATE, AND NATIONAL LAWS, RULES, CODES, OR REGULATIONS RELATING TO THE INSTALLATION AND USE OF THIS CONTROL SYSTEM IN ANY PARTICULAR APPLICATION ARE SATISFIED. EXTREME CARE SHOULD BE TAKEN TO ENSURE THAT ALL LEGAL REQUIREMENTS HAVE BEEN MET AND THAT ALL TECHNICAL INSTALLATION AND MAINTENANCE INSTRUCTIONS CONTAINED IN THIS MANUAL ARE FOLLOWED. READ Chapter 4 on Page 23 **(AND ITS SUBSECTIONS) OF THIS MANUAL CAREFULLY BEFORE INSTALLING THE SYSTEM. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS BODILY INJURY OR DEATH. THE USER HAS THE SOLE RESPONSIBILITY TO ENSURE THAT THE BANNER MUTING MODULE IS INSTALLED AND INTERFACED TO THE GUARDED MACHINE BY A** Qualified Person as specified in block 1.9 on Page 4.

4.1 PRE-INSTALLATION CONSIDERATIONS

4.1.1 Reducing or Eliminating Pass-Through Hazards

⚠ WARNING!

PASS-THROUGH HAZARDS, PSSDs & MUTING

IF THE PSSD (see page 71) **IS GUARDING AN APPLICATION IN WHICH PERSONNEL HAVE ACCESS INTO THE SENSING AREA OR FIELD (FOR EXAMPLE: A MACHINE OPERATOR AT THE POINT OF OPERATION) WHILE THE PSSD IS MUTED, ALL PASS-THROUGH HAZARDS MUST BE ELIMINATED. THE INDIVIDUAL MUST BE SENSED CONTINUALLY WHILE IN THE GUARDED AREA. THIS PREVENTS INITIATION OF A MACHINE CYCLE IF THE MUTE ENDS WHILE THE INDIVIDUAL IS WITHIN THE HAZARDOUS AREA. SEE** Appendix A2 on page 65 **FOR EXAMPLES. IF THE PASS-THROUGH HAZARD CANNOT BE ELIMINATED, AS IN ENTRY/EXIT APPLICATIONS, THE INDIVIDUAL MUST BE DETECTED ENTERING THE GUARDED AREA AND THE HAZARDOUS MOTION MUST STOP IMMEDIATELY. SEE ALSO** block 1.11.17 on Page 10.

Measures must be taken to eliminate or reduce pass-through hazards. One solution is to ensure that personnel are continually sensed while within the hazardous area. This can be accomplished by using supplementary guarding, including: safety mats, area scanners, and horizontally mounted safety light screens. While it is recommended to eliminate the pass-through hazard altogether, this may not be possible due to cell or machine layout, machine capabilities, or other application considerations.

An alternate method is to ensure that once the Guarding Device is tripped it latches, and requires a deliberate manual action to reset. This type of supplementary guarding relies upon the location of the Reset Switch as well as safe work practices and procedures to prevent an unexpected start or restart of the guarded machine.

The Reset switch or actuating control must be positioned outside the guarded area, and provide the switch operator with a full unobstructed view of the entire guarded area and any associated hazards as the reset is performed. The Reset switch or actuating control must not be reachable from within the guarded area and must be protected (through the use of rings or guards) against unauthorized or inadvertent operation. A key-operated reset switch provides some operator control, as it can be removed by the operator and taken into the guarded area. However, this does not prevent unauthorized or inadvertent resets due to spare keys in the possession of others, or additional personnel entering the Guarding Device area unnoticed.

The reset of a Guarding Device must not initiate hazardous motion. Also, before each reset, safe work procedures require that a start-up procedure be followed and that the individual performing the reset verifies that the entire hazardous area is clear of all personnel. If any areas can not be observed from the Reset switch location, additional supplementary guarding must be used; at a minimum, visual and audible warnings of machine start-up.

4.2 INSTALLING THE MUTING MODULE

The Muting Module may be installed within a panel or in an IP 65 environment. It must be used with a properly installed and applied Guarding Device (for example: safety light screen, interlocked barrier guard). The User must comply with all instructions contained within product manuals and relevant regulations.

The Module is designed to be mounted near the Guarding Device to be muted. It can be also mounted inside a panel, and in any orientation (see Table 2 on Page 19 for environmental and operating conditions). See Figure 7 on Page 22 for mounting hole information.

1) Mount Muting Module in a convenient location that is free from heavy impulse force and high-amplitude vibration.

4.3 MUTING MODULE CONFIGURATION

The Muting Module should be configured before Initial Check-out and use. Two banks of DIP switches are located under the access cover for the configuration port (Figure 8 on Page 24).

- *Because the Muting Module has redundant microprocessors, two DIP switch banks (Bank A and Bank B) must be set identically. Failure to set Bank A and Bank B identically results in a lockout condition.*
- *Power must be OFF when changing DIP switch settings. Changing settings while power is ON causes a lockout condition.*

To configure the DIP switches:

1) Ensure power is **OFF** to Muting Module.
2) Unscrew x2 screws on either side of cover and open.
3) Set both banks of DIP switches on factory default settings as shown in Figure 8 on Page 24.

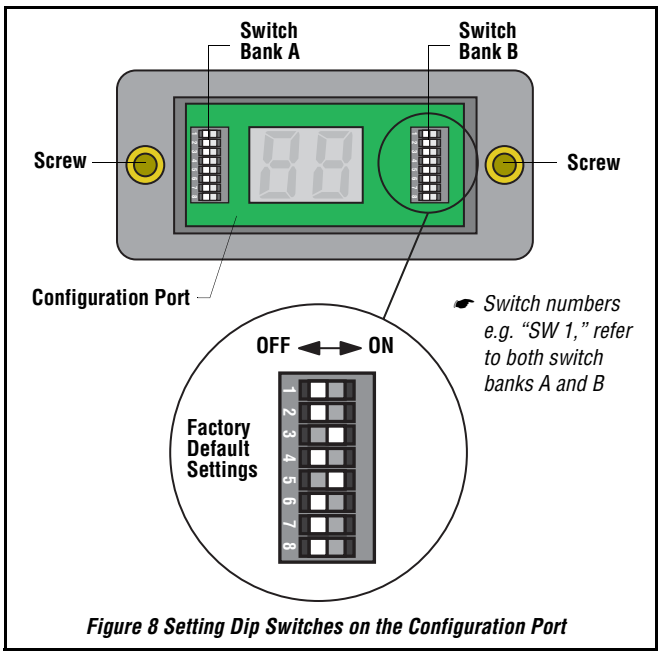


Figure 8 Setting Dip Switches on the Configuration Port

Table 6 DIP Switch Configuration

Function	Switch Setting Bank A & B
Auto/Manual Reset (see block 1.11.1 on Page 6).	**SW1 ON** = Auto Reset **SW1 OFF** = Manual Reset*
Non-Monitored Mute Lamp Output (see block 1.11.10 on Page 9)	**SW2 ON** = Mute Lamp Output not monitored **SW2 OFF** = Monitored Mute Lamp Output*
One-Way or Two-Way Mute Initiate Sequence (see block 1.11.14 on Page 10)	**SW3 ON** = Two-way muting* **SW3 OFF** = One-way muting
EDM Disable (see block 1.11.7 on Page 7)	**SW4 ON** = EDM disabled **SW4 OFF** = EDM functional*
One-Channel or Two-Channel EDM (see block 1.11.7 on Page 7)	**SW5 ON** = Two-Channel EDM* **SW5 OFF** = One-Channel EDM
Mute Enable Input (see block 1.11.9 on Page 9)	**SW6 ON** = ME disabled **SW6 OFF** = ME functional*
Backdoor Time-Out (see block 1.11.11 on Page 9 & block 1.11.12 on Page 9)	**SW7 OFF, SW8 OFF** = 30 s (Mute on Power-up Disabled)* **SW7 OFF, SW8 ON** = 60 s (Mute on Power-up Disabled) **SW7 ON, SW8 OFF** = OFF (Mute on Power-up Disabled) **SW7 ON, SW8 ON** = OFF (Mute on Power-up Enabled)

* Factory default setting

4.4 CONNECTOR PIN-OUTS & FUNCTIONS

WARNING!

PROPER ELECTRICAL CONNECTION

ELECTRICAL CONNECTION MUST BE MADE BY QUALIFIED PERSONNEL AND MUST COMPLY WITH LOCAL ELECTRICAL STANDARDS. DO NOT MAKE CONNECTIONS TO THE SYSTEM OTHER THAN THOSE DESCRIBED IN Chapter 4 on Page 23 **OF THIS MANUAL. DOING SO COULD RESULT IN SERIOUS INJURY OR DEATH.**

Table 7 Connector Pin-Outs (face views) for Muting Module Connectors

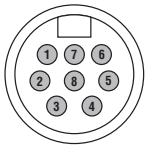
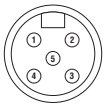
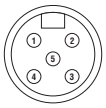
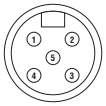
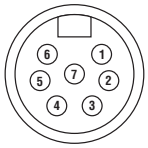
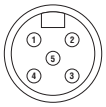
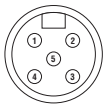
	Pin	Colour*	Function	Pin Layout
Machine Interface	1 2 3 4 5 6 7 8	Brown Orange/Black Orange White Black Blue Green/Yellow Violet	+24 VDC EDM#2 EDM#1 OSSD#2 OSSD#1 0 VDC Earth Ground Mute Enable	 **Male, Mini-Style**
Mute Inputs (M1–M4)	1 2 3 4 5	Brown White Blue Black Shield**	+24 VDC NPN Input for M2/ M4 (not used M1/ M3) 0 VDC PNP Input for M1/ M3 (not used M2/ M4) Shield, Earth Ground	 **Female, Euro-Style**
Reset Input	1 2 3 4 5	Brown White Blue Black Shield**	+24 VDC (not used) (not used) Reset Input Shield, Earth Ground	 **Female, Euro-Style**
OVERride Input	1 2 3 4 5	Brown White Blue Black Shield**	+24 VDC OVER Input B 0 VDC OVER Input A Shield, Earth Ground	 **Female, Euro-Style**
MSSI	 1 2 3 4 5 6 7	*** Grey/Black White Black Blue Brown Grey/White Green/Yellow	*** MSSI b MSSI c MSSI a 0 VDC +24 VDC MSSI d Earth Ground	 **Female, Mini-Style**
USSI (MM-TA-12B only)	 1 2 3 4 5	*** Brown White Blue Black Shield**	*** USSI b USSI c USSI d USSI a Shield, Earth Ground	 **Female, Euro-Style**

Table 7 Connector Pin-Outs (face views) for Muting Module Connectors

	Pin	Colour*	Function	Pin Layout
SSI (MM2-TA-12B only)	1 2 3 4 5	Brown White Blue Black Shield**	SSI b SSI c SSI d SSI a Shield, Earth Ground	 **Female, Euro-Style**
ML & AUX PNP Outputs	1 2 3 4 5	Brown White Blue Black Shield**	+24 VDC Mute Lamp Output 0 VDC AUX PNP Output Shield, Earth Ground	 **Female, Euro-Style**

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

*Colour code corresponds to Banner accessory QD cordsets listed in Table 15 on Page 52.

**Pin 5 is for an optional connection for shield ground in electrically noisy environments

*** The MSSI (Muteable Safety Stop Interface) and the USSI (Universal Safety Stop Interface) functions are similar functions, except that the MSSI is muteable. The MSSI and USSI are dual channel interfaces with one channel comprised of MSSIa & MSSIb or USSIa & USSIb and the second channel comprised of MSSIc & MSSId or USSIc & USSId. The function of these channels is irrelevant.
When connecting a Muting Module refer directly to Figure 25 on Page 58 thru to Figure 28 on Page 59.

All electrical connections are made through either field-wireable or moulded quick-disconnect plugs (see Table 2 on Page 19, Table 7 on Page 25 and Table 8 on Page 26).

4.4.1 Total Current Draw Calculation

The total current draw at the machine interface connector is the sum of the following:

- Muting Module (MM)
- Mute Lamp (ML)
- AUX output and mute devices (AUX)
- Guarding Device connected to MSSI, if power connections are used (MD) (MSSI)

To calculate the total current draw, add the following:

- IMM + IAUX + IML + IMD + IMSSI = Itotal

where

- IMM = 400 mA (Muting Module supply current)
- IAUX = X < 250 mA (Auxiliary device current)
- IML = X < 360 mA (Mute Lamp current)
- IMD = X < 500 mA (M1-M4 supply current)
- IMSSI= X < 2500 mA (MSSI supply current)

Table 8 Cable Rating Chart

Maximum cable length (m) versus total current draw (It) at the **Machine Interface** connector												
Cable Diameter (mm)	**Cable length (m) for 0,5 A (It)**	**Cable length (m) for 0,75 A (It)**	**Cable length (m) for 1,0 A (It)**	**Cable length (m) for 1,25 A (It)**	**Cable length (m) for 1,5 A (It)**	**Cable length (m) for 1,75 A (It)**	**Cable length (m) for 2,0 A (It)**	**Cable length (m) for 2,25 A (It)**	**Cable length (m) for 2,5 A (It)**	**Cable length (m) for 2,75 A (It)**	**Cable length (m) for 3,0 A (It)**	**Cable length (m) for 3,25 A (It)**
2.05	457	305	229	181	152	134	114	105	95	86	76	67
1.63	293	195	146	116	98	85	73	67	61	55	49	43
1.29	183	122	91	73	61	53	46	42	38	34	31	27
1.02	114	76	57	45	38	33	29	27	24	21	19	17
0.813	73	49	37	29	24	21	18	17	15	14	12	11
0.643	46	31	23	18	15	13	12	N.A.	N.A.	N.A.	N.A.	N.A.

☛ *Cable length includes power (+24 VDC) and return (0 VDC) wires at 25°C, and is intended to ensure that adequate power is available to the Module when the supply is operating at +24 VDC -15%.*

4.5 CONNECTING INPUT DEVICES

4.5.1 Manual Reset Switch

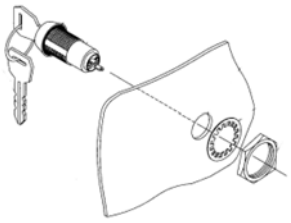
WARNING!

LOCATION OF THE MANUAL RESET SWITCH

THE Reset Switch MUST BE LOCATED OUTSIDE OF AND NOT BE ACCESSIBLE FROM WITHIN, THE AREA OF DANGEROUS MOTION, AND IT MUST BE POSITIONED SO THAT THE AREA OF DANGEROUS MOTION MAY BE OBSERVED BY THE SWITCH OPERATOR DURING THE RESET OPERATION.

The Manual Reset Switch connects to pins 1 and 4 of the Reset connector (see Figure 19 on Page 56).

Any reset switches must be located so that a Reset is possible only from outside, and in full view of, the hazardous area. The switch must also be out of reach from within the guarded area. If any hazardous areas are out of view from the switch location, additional means of guarding must be provided.



The switch should be protected from accidental or unintended actuation (for example: through the use of rings or guards).

Using a key switch provides some level of personal control, because the key may be removed. This delays a Reset while the key is under the control of an individual, but must not be relied upon solely to guard against accidental or unauthorized reset. Spare keys in the possession of others, or additional personnel entering the guarded area unnoticed may create a hazardous situation.

4.5.1.1 Reset Routine

The Muting Module requires a Manual Reset to clear a latch condition and resume operation following a stop command.

To reset the system proceed as follows:

1) If using a non Banner supplied Reset Switch, close Reset Switch for 0,25 s to 2 s, then open switch again. If using a Banner supplied Reset Switch (type MGA-KS0-1 Table 15 on Page 52 refers), turn key 1/4 turn clockwise, hold for 0,25 s to 2 s, then turn key counter clockwise to its original position.

Internal lockout conditions also require a Manual Reset to return the system to RUN mode after the failure has been corrected and the input correctly cycled.

4.5.2 Muting Devices

The User is required by European standards to arrange, install, and operate the safety system so as to protect personnel and minimize the possibility of defeating the Guarding Device.

Indication that the Guarding Device is muted must be provided and be readily observable (as per ISO/DIS 13855. Failure of this indication should be detectable and prevent the Muting Module from initiating a mute cycle. If this is not possible, the operation of the indicator should be verified at suitable intervals. Mute devices must meet the Simultaneity Requirement (see page 72) to activate muting.

4.5.2.1 General Muting Device Requirements

See General Muting Device Requirements on page 8.

4.5.2.2 Examples of Muting Sensors & Switches

WARNING!

AVOID HAZARDOUS INSTALLATIONS

TWO OR FOUR INDEPENDENT POSITION SWITCHES (AT M1-M2 OR M3-M4) MUST BE PROPERLY ADJUSTED OR POSITIONED SO THAT THEY CLOSE ONLY AFTER THE HAZARD NO LONGER EXISTS, AND OPEN AGAIN WHEN THE CYCLE IS COMPLETE OR THE HAZARD IS AGAIN PRESENT. IF IMPROPERLY ADJUSTED OR POSITIONED, INJURY OR DEATH COULD RESULT. THE USER HAS THE RESPONSIBILITY TO SATISFY ALL LOCAL, STATE, AND NATIONAL LAWS, RULES CODES, AND REGULATIONS RELATING TO THE USE OF SAFETY EQUIPMENT IN ANY PARTICULAR APPLICATION. IT IS EXTREMELY IMPORTANT TO BE SURE THAT ALL APPROPRIATE AGENCY REQUIREMENTS HAVE BEEN MET AND THAT ALL INSTALLATION AND MAINTENANCE INSTRUCTIONS CONTAINED IN THE APPROPRIATE MANUALS ARE FOLLOWED.

Photoelectric Sensors (Opposed Mode)

Opposed-mode sensors, which initiate the muted condition when the beam path is blocked, should be configured for dark operate and have open (non-conducting) output contacts in a power OFF condition.

Photoelectric Sensors (Polarized Retro reflective Mode)

The User must ensure that false proxing (activation due to shiny or reflective surfaces) is not possible. Banner LP sensors with linear polarization can greatly reduce or eliminate this effect.

Configure sensors for Light Operate (LO or N.O.) if initiating a mute when the retro reflective target or tape is detected (for example: home position). Configure sensors for Dark Operate (DO or N.C.) when a blocked beam path initiates the muted condition (for example: entry/exit). Both situations must have open (non-conducting) output contacts in a power OFF condition.

Positive-opening Safety Switches

Two (or four) independent switches, each with a minimum of one closed safety contact to initiate the mute cycle are typically used. An application using a single switch with a single actuator and two closed contacts could result in an unsafe situation.

Inductive Proximity Sensors

Typically, inductive proximity sensors are used to initiate a muted cycle when a metal surface is detected. Due to excessive leakage current causing false ON conditions, two-wire sensors are **not** to be used. Only three- or four-wire sensors that have discrete PNP, NPN, or hard-contact outputs that are separate from the input power can be used.

4.5.2.3 Muting Device Connection

The Muting Module provides supply voltage, if required, and input connections for the muting devices. One or two pairs of muting devices (typically sensors or switches) must be used; these pairs are designated M1-M2 and M3-M4. The M1 and M3 inputs are PNP (sourcing). The M2 and M4 inputs are NPN (sinking). Also available are terminals to supply power (+24 VDC) to the muting devices, which are labelled +24 VDC and 0 VDC.

The current draw of all devices must not exceed 500 mA.

Typical examples are shown in Figure 20 on Page 56, Figure 21 on Page 56 and Figure 22 on Page 56.

4.5.3 Mute Lamp Output & Auxiliary PNP Output

The Muting Module provides connection terminals for the Mute Lamp (ML) output and an Auxiliary PNP output (AUX) (see Figure 23 on Page 57).

4.5.3.1 Mute Lamp Output

The Muting Module can be configured for a Monitored or Non-Monitored mute lamp (ML) (see Table 6 on Page 24). If the installation is governed by European (CE) regulations, the mute lamp **must** be monitored (SW2 = OFF, bank A and bank B). This output may also be used as an input to control logic (for example: a PLC) if Non-Monitored is selected (SW2 = ON, bank A and bank B). The current draw of the mute lamp must not exceed 360 mA (see also block 1.11.10 on Page 9).

4.5.3.2 Auxiliary PNP Output

A non-safety-related PNP output is available at pin 4 of the ML/AUX connector. This monitoring output is for light-duty, non-safety-related control functions, such as an input to a PLC. This output follows the OSSD outputs and the Green status LED (see Figure 2 on Page 15). Maximum current draw of the AUX output is 250 mA.

4.5.4 Override Switch Connection

⚠ WARNING!

LIMITING USE OF OVERRIDE FUNCTION

THE OVERRIDE FUNCTION IS NOT FOR MACHINE SETUP OR PRODUCTION. IT IS TO BE USED ONLY TO CLEAR THE PRIMARY SAFETY DEVICE, SUCH AS IF MATERIAL BECOMES STUCK IN THE DEFINED AREA OF A SAFETY LIGHT SCREEN. WHEN OVERRIDE IS USED, IT IS THE USER'S RESPONSIBILITY TO INSTALL AND USE IT ACCORDING TO CURRENT SAFETY STANDARDS (SEE block 1.4 on Page 2). IN ADDITION, THE REQUIREMENTS LISTED IN STANDARD IEC/EN60204-1 BLOCK 9.2.4 MUST BE SATISFIED.

The Muting Module provides connection terminals for the Override switches (see Figure 24 on Page 57). See block 1.11.13 on Page 10 before connecting switches.

4.5.5 USSI & MSSI Connection (Type MM-TA-12B only)

The USSI provides for easy integration of Guarding Devices. This interface consists of two input channels (A & B), which are compatible with Banner Engineering safety devices that have solid-state OSSD outputs (with handshake verification), such as the EZ-SCREEN systems. USSI is also compatible with devices that have N.O. hard contacts or relay outputs (voltage-free).

The MSSI input is a specialized USSI that can be muted during the non-hazardous portion of the machine cycle and provides +24 VDC supply power to the primary Guarding Device that is to be muted.

The input channels (A & B) must meet the Simultaneity Requirement (see page 72). A mismatch of more than 3 seconds results in a lockout. A lockout that is due to a failure to meet the Simultaneity Requirement (see page 72) can only be cleared by cycling the MSSI (or the USSI, depending on which failed) with simultaneity being met, and when the Module is configured for Manual Reset, then performing a reset routine.

The MSSI and the USSI can be interfaced with safety interlocking switches, E-stop buttons, rope/cable pull devices, and other machine control devices. To be interfaced with a safety mat, a safety mat controller must be connected between the mat and the interface.

To ensure Safety Category 4 per ISO 13849, the USSI provides a handshake with Banner Engineering safety devices that have OSSD solid-state outputs. This handshake verifies that the interface of the two devices is capable of detecting certain unsafe failures, such as a short-circuit to a secondary source of power or to the other channel, high input resistance, or loss of signal ground (see Figure 25 on Page 58).

If OSSDs are to be used without this handshake capability that is, non-Banner Safety devices), interposing safety relays or interfacing modules must be used to provide hard contacts and be wired as shown in Figure 26 on Page 58. Alternatively the type MM2-TA-12B Muting Module may be used.

To properly interface hard contacts or relay outputs, each input channel has a corresponding handshake signal. The USSI becomes a four-wire interface to ensure the detection of unsafe failures, as mentioned above (see Figure 26 on Page 58). These contacts may come from any of a variety of devices, including process control, E-stop switches, gate switches, safety mat controls, and safety light screens.

4.5.5.1 USSI Emergency Stop Switch Connection

⚠ WARNING!

EMERGENCY STOP (E-STOP) SWITCH WIRING

WHENEVER TWO OR MORE E-Stop SWITCHES ARE CONNECTED TO THE SAME MODULE, CONTACTS OF THE CORRESPONDING POLE OF EACH SWITCH MUST BE CONNECTED TOGETHER IN SERIES. NEVER CONNECT THE CONTACTS OF MULTIPLE E-Stop SWITCHES IN PARALLEL TO ONE MODULE. SUCH A PARALLEL CONNECTION DEFEATS THE SWITCH CONTACT MONITORING ABILITY OF THE MODULE AND CREATES AN UNSAFE CONDITION WHICH COULD RESULT IN SERIOUS INJURY OR DEATH. EACH SWITCH MUST BE INDIVIDUALLY OPERATED (ENGAGED), THEN REARMED AND THE MODULE RESET. THIS ALLOWS THE CONTROLLER TO CHECK EACH SWITCH AND ITS WIRING TO DETECT FAULTS. FAILURE TO TEST EACH SWITCH INDIVIDUALLY IN THIS MANNER COULD RESULT IN UNDETECTED FAULTS AND CREATE AN UNSAFE CONDITION LEADING TO SERIOUS INJURY OR DEATH. THIS CHECK MUST BE PERFORMED DURING PERIODIC CHECK-OUTS (SEE block 6.1.2 on Page 45).

The E-stop switch must provide two contacts which are closed when the switch is armed as shown in Figure 29 on Page 60. Once activated, the E-stop switch must open all its contacts, and must be returned to the closed contact position only by means of a deliberate action (such as twisting, pulling, or unlocking). The switch should be a positive opening (see page 72) type, as described by IEC60947-5-1.

☛ *Some applications may have additional requirements. The User must refer to all relevant regulations.*

4.5.5.2 USSI/MSSI Interlocked Safety Gate Connection

⚠ WARNING!

FIXED GUARDING

IT MUST NOT BE POSSIBLE FOR PERSONNEL TO REACH ANY HAZARD POINT THROUGH AN OPENED GUARD (OR ANY OPENING) BEFORE HAZARDOUS MACHINE MOTION HAS COMPLETELY STOPPED AS STATED IN STANDARD ISO 13852.

The USSI (or MSSI) may be used to monitor interlock safety gates or guards.

Requirements vary widely for the level of control reliability or safety category per ISO 13849 in the application of interlocked guards. While Banner Engineering always recommends the highest level of safety in any application, it is the responsibility of the User to safely install, operate and maintain each safety system and comply with all relevant laws and regulations. Of the following two applications, Figure 31 on Page 60 meets or exceeds the requirements for ISO 13849.

Safety Interlocking Switch Requirements

See block 1.11.4.1 on Page 7.

Positive-opening Safety Interlocking Switches Requirements

See block 1.11.4.2 on Page 7.

Monitoring Series-Connected Safety Interlocking Switches

⚠ WARNING!

NOT A SAFETY CATEGORY 4 OR CONTROL RELIABLE APPLICATION

WHEN MONITORING MULTIPLE GUARDS WITH A SERIES CONNECTION OF MULTIPLE SAFETY INTERLOCK SWITCHES, A SINGLE FAILURE MAY BE MASKED OR NOT DETECTED AT ALL. WHEN SUCH A CONFIGURATION IS USED, PROCEDURES MUST BE PERFORMED REGULARLY TO VERIFY PROPER OPERATION OF EACH SWITCH. SEE Monitoring Series-Connected Safety Interlocking Switches on Page 30 **FOR MORE INFORMATION. FAILURE TO DO SO COULD RESULT IN SERIOUS INJURY OR DEATH.**

When monitoring two individually mounted safety switches (as shown in Figure 31 on Page 60), a faulty switch is detected if it fails to switch as the guard opens. In this case, the Muting Module de-energizes its output relays and disables its reset function until the input requirements are met (i.e., the faulty switch is replaced). However, when a series of safety interlocking switches is monitored by a single Muting Module, the failure of one switch in the system may be masked or not detected at all (refer to Figure 32 on Page 60).

Series-connected interlock switch circuits may not meet ISO13849 Safety Category 4 requirements because of the potential of an inappropriate reset or a potential loss of the safety stop signal. A multiple connection of this type should not be used in applications where loss of the safety stop signal or an inappropriate reset can lead potentially to serious injury or death. The following two scenarios assume two positive-opening safety switches on each guard:

Masking of a Failure If a guard is opened but a switch fails to open, the redundant safety switch opens and causes the Muting Module to de-energize its outputs. If the faulty guard is then closed, both Muting Module input channels also close, but because one channel did not open, the Muting Module does not reset. However, if the faulty switch is not replaced and a second good guard is cycled, opening and then closing both of the Mo-Muting Module's input channels, the Muting Module considers the failure to be corrected. With the input requirements apparently satisfied, the Muting Module allows a reset. This system is no longer redundant and, if the second switch fails, may result in an unsafe condition (i.e., the accumulation of faults results in the loss of the safety function).

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

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

Monitoring Procedure

1) Open and close each Guarding Device separately while verifying that Muting Module outputs operate correctly throughout check procedure.
2) If necessary, after closing each Guarding Device, select a Manual Reset.

☛ *If a contact set fails, the Muting Module does not enable its Reset function. If the Muting Module does not reset, a switch may have failed; that switch must be immediately replaced.*

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

4.5.5.3 USSI Supplementary Safety System Connection

A variety of safety systems can be interfaced with the MSSI and the USSI. Each safety application has a unique set of application requirements; the User is responsible to ensure proper installation, and use, and that all relevant standards and regulations are complied with. Figure 38 on Page 63 is a generic example of the flexibility of the USSI.

Entry/Exit Application with Multiple Beam Safety System (muted) and Safety Mat System

This application is widely used in a variety of situations, including manufacturing cell, robotic cells, palletizers, and de-stackers (see Appendix A3 on page 67 for more information). One of the many requirements of this muting application is that it must not be possible for personnel to walk in front of, behind, or next to the muted object (for example: the carrier basket) without being detected and stopping the hazardous motion.

Figure 38 on Page 63 shows how supplementary guarding (such as a safety mat system or horizontal safety light screen) can be interfaced to prevent personnel from entering the hazardous area during a mute condition.

4.5.6 SSI & MSSI Connection (Type MM2-TA-12B only)

The SSI provides for easy integration of Guarding Devices. This interface consists of two input channels (A & B), which are compatible with Banner EZ-SCREEN Type 2 solid-state OSSD outputs with devices that have normally open hard contacts or relay outputs (voltage-free) and with 24 VDC signals (see Figure 27 on Page 59).

The MSSI input is a specialized SSI that can be muted during the non-hazardous portion of the machine cycle and provides +24 VDC supply power to the primary Guarding Device that is to be muted.

The input channels (A & B) must meet the Simultaneity Requirement (see page 72). A mismatch of more than 3 seconds results in a lockout. A lockout that is due to a failure to meet the Simultaneity Requirement (see page 72) can only be cleared by cycling the MSSI (or the SSI, depending on which failed) with simultaneity being met, and when the Module is configured for Manual Reset, then performing a reset routine.

The MSSI and the SSI can be interfaced with safety interlocking switches, E-stop buttons, rope/cable pull devices, and other machine control devices. To be interfaced with a safety mat, a safety mat controller must be connected between the mat and the interface.

Interposing safety relays or interfacing modules with hard contacts must be wired as shown in Figure 28 on Page 59.

These contacts may come from any of a variety of devices, including process control, emergency stop switches, gate switches, safety mat controls, and safety light screens.

☛ *If the SSI is not to be used, pin 1 must be jumpered to pin 4, and pin 2 must be jumpered to pin 3 (factory default). Do not short Channel A to Channel B.*

Although the MSSI, if hooked up to the EZ-SCREEN Type 2 Light screen OSSDs, is only Safety Category 2 per EN 954-1, the SSIs, if hooked up to safety switches or E-stop buttons with dry contacts, can be Safety Category 4 per EN 954-1 (see Figure 30 on Page 60 and Figure 33 on Page 60).

4.5.6.1 SSI Emergency Stop Switch Connection

⚠ WARNING!

EMERGENCY STOP (E-STOP) SWITCH WIRING

WHENEVER TWO OR MORE E-STOP SWITCHES ARE CONNECTED TO THE SAME MODULE, CONTACTS OF THE CORRESPONDING POLE OF EACH SWITCH MUST BE CONNECTED TOGETHER IN SERIES. NEVER CONNECT THE CONTACTS OF MULTIPLE E-STOP SWITCHES IN PARALLEL TO ONE MODULE. SUCH A PARALLEL CONNECTION DEFEATS THE SWITCH CONTACT MONITORING ABILITY OF THE MODULE AND CREATES AN UNSAFE CONDITION WHICH COULD RESULT IN SERIOUS INJURY OR DEATH. EACH SWITCH MUST BE INDIVIDUALLY OPERATED (ENGAGED), THEN REARMED AND THE MODULE RESET. THIS ALLOWS THE CONTROLLER TO CHECK EACH SWITCH AND ITS WIRING TO DETECT FAULTS. FAILURE TO TEST EACH SWITCH INDIVIDUALLY IN THIS MANNER COULD RESULT IN UNDETECTED FAULTS AND CREATE AN UNSAFE CONDITION LEADING TO SERIOUS INJURY OR DEATH. THIS CHECK MUST BE PERFORMED DURING PERIODIC CHECK-OUTS (SEE block 6.1.2 on Page 45).

The E-stop switch must provide two contacts which are closed when the switch is armed as shown in Figure 30 on Page 60. Once activated, the E-stop switch must open all its contacts, and must be returned to the closed contact position only by means of a deliberate action (such as twisting, pulling, or unlocking). The switch should be a positive opening (see page 72) type, as described by IEC60947-5-1. A mechanical force applied to such a button (or switch) is transmitted directly to the contacts, forcing them open. This ensures that the switch contacts open whenever the switch is activated. IEC 60204-1, Emergency Stop Devices, specifies the following additional switch ("stop control") requirements:

• Emergency Stop push buttons shall be located at each operator control station and at other operating stations where emergency shutdown shall be required

• Stop and Emergency Stop push buttons shall be continuously operable from all control and operating stations where located. Do not connect E-stop buttons to the MSSI

• Actuators of Emergency Stop devices shall be coloured Red. The background immediately around the device actuator shall be coloured Yellow. The actuator of a push-button-operated device shall be of the palm or mushroom-head type

• The Emergency Stop actuator shall be a self-latching type

☛ *Some applications may have additional requirements. The User must refer to all relevant regulations.*

4.5.6.2 SSI/MSSI Interlocked Safety Gate Connection

⚠ WARNING!

FIXED GUARDING

IT MUST NOT BE POSSIBLE FOR PERSONNEL TO REACH ANY HAZARD POINT THROUGH AN OPENED GUARD (OR ANY OPENING) BEFORE HAZARDOUS MACHINE MOTION HAS COMPLETELY STOPPED AS STATED IN STANDARD ISO 13852.

The SSI (or MSSI) may be used to monitor interlock safety gates or guards.

Requirements vary widely for the level of control reliability or safety category per ISO 13849 in the application of interlocked guards. While Banner Engineering always recommends the highest level of safety in any application, it is the responsibility of the User to safely install, operate and maintain each safety system and comply with all relevant laws and regulations.

Safety Interlocking Switch Requirements

See block 1.11.4.1 on Page 7.

Positive-opening Safety Interlocking Switches Requirements

See block 1.11.4.2 on Page 7.

Monitoring Series-Connected Safety Interlocking Switches

⚠ WARNING!

NOT A SAFETY CATEGORY 4 OR CONTROL RELIABLE APPLICATION

WHEN MONITORING MULTIPLE GUARDS WITH A SERIES CONNECTION OF MULTIPLE SAFETY INTERLOCK SWITCHES, A SINGLE FAILURE MAY BE MASKED OR NOT DETECTED AT ALL. WHEN SUCH A CONFIGURATION IS USED, PROCEDURES MUST BE PERFORMED REGULARLY TO VERIFY PROPER OPERATION OF EACH SWITCH. SEE Monitoring Series-Connected Safety Interlocking Switches on Page 30 **FOR MORE INFORMATION. FAILURE TO DO SO COULD RESULT IN SERIOUS INJURY OR DEATH.**

When monitoring two individually mounted safety switches (as shown in Figure 33 on Page 60), a faulty switch is detected if it fails to switch as the guard opens. In this case, the Muting Module de-energizes its output relays and disables its reset function until the input requirements are met (i.e., the faulty switch is replaced). However, when a series of safety interlocking switches is monitored by a single Muting Module, the failure of one switch in the system may be masked or not detected at all (refer to Figure 34 on Page 60).

Series-connected interlock switch circuits may not meet ISO13849 Safety Category 4 requirements because of the potential of an inappropriate reset or a potential loss of the safety stop signal. A multiple connection of this type should not be used in applications where loss of the safety stop signal or an inappropriate reset can lead potentially to serious injury or death. The following two scenarios assume two positive-opening safety switches on each guard:

Masking of a Failure If a guard is opened but a switch fails to open, the redundant safety switch opens and causes the Muting Module to de-energize its outputs. If the faulty guard is then closed, both Muting Module input channels also close, but because one channel did not open, the Muting Module does not reset. However, if the faulty switch is not replaced and a second good guard is cycled, opening and then closing both of the Mo-Muting Module's input channels, the Muting Module considers the failure to be corrected. With the input requirements apparently satisfied, the Muting Module allows a reset. This system is no longer redundant and, if the second switch fails, may result in an unsafe condition (i.e., the accumulation of faults results in the loss of the safety function).

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

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

Monitoring Procedure

1) Open and close each Guarding Device separately while verifying that Muting Module outputs operate correctly throughout check procedure.
2) If necessary, after closing each Guarding Device, select a Manual Reset.

☛ *If a contact set fails, the Muting Module does not enable its Reset function. If the Muting Module does not reset, a switch may have failed; that switch must be immediately replaced.*

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

4.5.6.3 SSI Supplementary Safety System Connection

A variety of safety systems can be interfaced with the MSSI and the SSI. Each safety application has a unique set of application requirements; the User is responsible to ensure proper installation, and use, and that all relevant standards and regulations are complied with. Figure 38 on Page 63 is a generic example of the flexibility of the SSI.

Entry/Exit Application with Multiple Beam Safety System (muted) and Safety Mat System

This application is widely used in a variety of situations, including manufacturing cell, robotic cells, palletizers, and de-stackers (see Appendix A3 on page 67 for more information). One of the many requirements of this muting application is that it must not be possible for personnel to walk in front of, behind, or next to the muted object (for example: the carrier basket) without being detected and stopping the hazardous motion.

Figure 38 on Page 63 shows how supplementary guarding (such as a safety mat system or horizontal safety light screen) can be interfaced to prevent personnel from entering the hazardous area during a mute condition.

4.6 INITIAL CHECKOUT

The Initial Checkout should be carried out for the following events:

- To ensure proper installation when the System is first installed
- To ensure proper System functionality whenever any maintenance or modification is performed on the System or on the machinery being guarded by the System (see block 6.1.2 on Page 45 for a schedule of required check-outs)

The Initial Checkout must be performed by a Qualified Person as specified in block 1.9 on Page 4.

OSSD, EDM and final interface connections to the guarded machine should only be made after satisfactorily performing the this procedure.

The Machine Interface Connector (Item on page 15 refers) on the Muting Module provides the connection for the following:

- Supply power (+24 VDC, 0 VDC, and GND)
- Mute enable (ME)
- EDM #1 and EDM #2
- Safety outputs OSSD #1 and OSSD #2

4.6.1 Preparation

Verify the following:

1) Verify that power has been removed from machine or ensure that power is not available to machine controls or actuators.
2) Verify that safety systems connected to Muting Module MSSI and USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) inputs (as per Chapter 4 on Page 23) are properly installed and connected.
3) Verify that machine control (MPCEs) are not connected to or controlled by OSSD safety outputs at this time and that OSSD leads are isolated (that is, not shorted together, or to power or to ground).

☛ *DIP Switch 6 is Application dependant. If in doubt set to factory setting.*

4) Verify DIP Switches are configured for factory settings (Figure 8 on Page 24 and Table 6 on Page 24).
5) Verify that EDM#1 and EDM# 2 are not connected that is, pin 2 and pin 3 left open (see Machine Interface pin-outs Table 7 on Page 25) and also set Banks A and B DIP Switch 4 to ON to ignore EDMs.
6) Verify that all input connections have been made to Mute Input Devices (M1 – M4), USSI (for MM-TA-12B) or SSI (for MM2-TA-12B), MSSI, Manual Reset Switch, Mute Lamp, Aux Output, and Override Input (as detailed in block 4.5 on Page 27).

This allows the Muting Module and the associated safety systems to be checked out stand alone before permanent connection is made to the guarded machine.

4.6.2 Procedure

☛ *All wiring must comply with local wiring codes.*

Do not operate the Muting Module without a proper earth ground connection at pin 7 of the Machine Interface connector, or at the earth ground screw on the housing.

1) Connect system DC power to pin 1 (+24 VDC) and pin 6 (0 VDC) of Machine Interface Connector (see block 4.4 on Page 25 and Table 7 on Page 25).
2) Leaving power to guarded machine OFF, power up Muting Module and safety systems connected to MSSI and USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) inputs.
3) Perform system checkout procedures for external safety systems connected to MSSI and USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) inputs as described in appropriate manuals.

Do not proceed further until all checkout procedures are completed successfully and all problems have been corrected.

4) Verify that external safety systems are providing a Green/GO signal to MSSI and USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) inputs (that is, Banner OSSD sourcing signal or a closed contact connected to the Signal pin of each interface).
5) Verify that Channel indicators A and B on Muting Module show steady green.

MM-TA-12B MM2-TA-12B

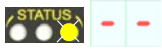
☛ *If the USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) is not to be used, pin 1 must be jumpered to pin 4, and pin 2 must be jumpered to pin 3 (factory default). Do not short Channel A to Channel B.*

Auto Reset Configuration

6) Verify that status LEDs show steady green and yellow, indicating that OSSD outputs are ON, and that a – appears on Diagnostic Display. If not, or if red status indicator begins to flash at any time, refer to block 6.2.1 on Page 51 for troubleshooting information.

Manual Reset Configuration

7) Verify that status LED is flashing yellow to indicate that a reset is being requested, and that a – appears on the Diagnostic Display.



If not, or if the status indicator shows flashing red at any time, refer to block 6.2.1 on Page 51 for troubleshooting information.

8) Perform a manual reset as detailed in block 4.5.1 on Page 27.
9) Verify that status indicator shows steady green.

☛ *OSSD Outputs should already be ON at this stage.*

10) Cycle MSSI and USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) (if used) individually and ensure that green status indicator goes OFF, and that a Reset is possible after Interface is closed.

If any of these checks fail, do not attempt to use the system until the reason for the failure(s) is identified and corrected.

☛ *If the Muting function is not used, proceed to* block 4.7 on Page 35.

11) Verify (if possible) that power has been removed or is otherwise not available to machine controls responsible for hazardous motion.

At all times ensure that personnel are not exposed to any hazard.

12) Mute system by blocking (or activating) both mute devices (typically M1- M2) simultaneously (within 3 s).

13) Verify that Mute indicator(s) show steady green. If not, check indicator(s) and wiring. Check also Diagnostic Display for error codes.

14) Generate a **stop** command from Guarding Device connected to MSSI. Verify that MSSI Channel A and B green Status indicators are OFF.

☛ *If the 30 or 60-second Backdoor Timer feature has been selected, the Diagnostic Display begins to count down; otherwise a flashing dash appears on the display.*

15) Clear or Reset Guarding Device (before Backdoor Timer expires) and verify MSSI channel indicators are steady green. Clear (deactivate) Mute devices before Backdoor Timer expires and verify Mute indicator(s) goes OFF.

Status indicator should remain steady green.

16) Verify that it is not possible for a single individual to initiate a mute condition by triggering Mute devices (for example, by blocking both photoelectric beams or actuating both switches) and access hazard without being detected and issuing a stop command to machine (where green status indicator goes OFF, and a Reset of latch condition is required).

At all times ensure that personnel are not exposed to any hazard.

17) Verify that it is not possible for personnel to pass in front of, behind, or next to the muted object without being detected and without issuing a stop command to machine.

18) If one-way (directional) muting has been selected, verify that system can not be muted by blocking (or activating) M3-M4 before M1-M2.

AT ALL TIMES ENSURE THAT PERSONNEL ARE NOT EXPOSED TO ANY HAZARD.

IF ANY OF THESE CHECKS FAIL, DO NOT ATTEMPT TO USE THE SYSTEM UNTIL THE REASON FOR THE FAILURE(S) IS IDENTIFIED AND CORRECTED.

4.7 PERMANENT ELECTRICAL CONNECTION

⚠ WARNINGS!

SHOCK HAZARD

ALWAYS DISCONNECT POWER FROM THE MUTING MODULE, SAFETY SYSTEM AND THE GUARDED MACHINE BEFORE MAKING ANY CONNECTIONS OR REPLACING ANY COMPONENT. USE EXTREME CAUTION TO AVOID ELECTRICAL SHOCK AT ALL TIMES. SERIOUS BODILY INJURY OR DEATH COULD RESULT.

PROPER WIRING

THE GENERALIZED WIRING CONFIGURATION SHOWN IN Figure 36 on Page 62 **AND** Figure 37 on Page 62 **ARE PROVIDED ONLY TO ILLUSTRATE THE IMPORTANCE OF PROPER INSTALLATION. THE PROPER WIRING OF THE SAFETY SYSTEM TO ANY PARTICULAR MACHINE IS THE SOLE RESPONSIBILITY OF THE INSTALLER AND END USER.**

☛ *The Supply Power, External Reset Switch, and other inputs (as required by each application) should have been previously connected at this point.*

The following connections should now be made:

- ME
- EDM
- MPCE
- OSSD outputs
- FSD Outputs

4.7.1 ME Connection

The Machine Interface connector provides connection for the ME (see block 1.11.9 on Page 9). ME gives the user the ability to frame or create a window of opportunity when a mute can occur. When configured, the ME input is a contact that must be closed before the Guarding Device can be muted. After the Guarding Device is muted, opening of the ME input has no effect, but it must be re-closed before the Guarding Device can be muted again.

1) If ME is not used, leave the connection open and configure DIP switch SW6 to ON (see Figure 8 on Page 24 and Table 6 on Page 24).
2) Connect ME function as detailed in Figure 35 on Page 61.

4.7.2 EDM Connection

⚠ WARNINGS!

EDM CONFIGURATION

IF THE APPLICATION DOES NOT REQUIRE THIS FUNCTION, THE EDM 1 AND EDM 2 INPUTS MUST BE LEFT OPEN AND EDM Disable = ON MUST BE CONFIGURED (SEE block 4.3 on Page 24**). IT IS THE USER'S RESPONSIBILITY TO ENSURE THAT THIS DOES NOT CREATE A HAZARDOUS SITUATION.**

EDM CONNECTION

IT IS STRONGLY RECOMMENDED THAT ONE NORMALLY CLOSED (NC), FORCED-GUIDED, MONITORING CONTACT OF EACH MPCE **OR EXTERNAL DEVICE BE WIRED IN ORDER TO MONITOR THE STATE OF THE MPCEs (AS SHOWN IN** Figure 36 on Page 62 **AND** Figure 37 on Page 62**). IF THIS IS DONE, PROPER OPERATION OF THE MPCEs IS VERIFIED. MPCE MONITORING CONTACTS MUST BE USED IN ORDER TO DETECT IMPROPER FUNCTIONING OF THE MPCEs.**

The Machine Interface connector provides connection terminals for the EDM input (EDM #1 and EDM #2).

Following the successful completion of the Initial Checkout, the EDM configuration that disabled the monitoring function must be properly re-configured. The EDM inputs then must be properly connected to the closed monitoring contacts of the MPCEs (see block 1.11.7 on Page 7). Proceed as follows:

1) Referring to Figure 8 on Page 24 and Table 6 on Page 24, connect EDM in one of three configurations as follows:

- **One Channel Monitoring**
- SW4 Bank A & Bank B = OFF
- SW5 Bank A & Bank B = OFF

(see Figure 37 on Page 62)

☛ *EDM #2 input must be left open; that is, pin 2 not connected (see Machine Interface pin-outs* Table 7 on Page 25*)*

- **Two-Channel Monitoring**
- SW4 Bank A & Bank B = OFF
- SW5 Bank A & Bank B = ON

(see Figure 36 on Page 62)

- **No Monitoring**
- SW4 Bank A & Bank B = ON
- SW5 Bank A & Bank B = ON or OFF

☛ *EDM #1 and EDM #2 inputs must be left open; that is, pin 2 and pin 3 not connected (see Machine Interface pin-outs* Table 7 on Page 25*).*

4.7.3 OSSD Output Connections

⚠ WARNING!

OSSD INTERFACING

TO ENSURE PROPER OPERATION, THE MUTING MODULE OUTPUT PARAMETERS AND MACHINE INPUT PARAMETERS MUST BE CONSIDERED WHEN INTERFACING THE SOLID-STATE OSSD **OUTPUTS TO THE MACHINE INPUTS. MACHINE CONTROL CIRCUITRY MUST BE DESIGNED SO THAT THE MAXIMUM LOAD RESISTANCE VALUE IS NOT EXCEEDED AND SO THAT THE MAXIMUM SPECIFIED OSSD OFF-STATE VOLTAGE DOES NOT RESULT IN AN ON CONDITION. FAILURE TO PROPERLY INTERFACE THE OSSD OUTPUTS TO THE GUARDED MACHINE COULD RESULT IN SERIOUS BODILY INJURY OR DEATH.**

☛ *Before making OSSD connections and interfacing the Muting Module to the machine, refer to the Output Specifications (*Table 2 on Page 19*,* Table 3 on Page 20 *&* Table 4 on Page 21*).*

1) Connect OSSD outputs such that machine's safety related control system interrupts circuit or power to MPCE, resulting in a **non**-hazardous condition. FSDs typically accomplish this when OSSDs go to an OFF state (see Figure 36 on Page 62).

4.7.4 FSD Interfacing Connections

See block 1.11.18 on Page 11.

4.8 COMMISSIONING CHECKOUT

Perform this checkout procedure as part of Guarding Device System installation (after the System has been interfaced to the guarded machine as described in block 4.5 on Page 27 and block 4.7 on Page 35), or whenever changes are made to the System (either a new configuration of the Muting Module, devices connected to it, or changes to the machine).

A Qualified Person as specified in block 1.9 on Page 4 must perform this procedure.

Checkout results should be recorded and kept on or near the guarded machine.

1) Carry out procedure as detailed in block 6.1.7.1 on Page 48, block 6.1.7.2 on Page 48 and block 6.1.7.3 on Page 49.

⚠ WARNING!

DO NOT ATTEMPT TO USE THE SYSTEM

IF ANY OF THESE CHECKS FAIL, DO NOT ATTEMPT TO USE THE SYSTEM UNTIL THE REASON FOR THE FAILURE(S) IS IDENTIFIED AND CORRECTED.

4.9 CHOOSING CORRECT CABLES & CORDSETS

4.9.1 General

This information is provided to assist in choosing suitable cables and cordsets for specific User applications together with the associated Guarding Device.

Read these notes first before proceeding:

☛ *Have the following documents available to assist in the assessment:*

- Copy of this Manual
- Copy of guarding device and associated equipment documentation

It is recommended to make a layout plan of the application complete with guarding device and connection to the MSSI and USSI (see Figure 11 on Page 39) for MM-TA-12B or SSI (see Figure 14 on Page 42) for MM2-TA-12B.

If using sensors with 4-pin QD termination for mute devices (M1 thru' to M4), verify pin-out with associated function.

Not all OFF-THE-SHELF sensors with standard 4-pin Euro-style connectors properly interface with the M1 thru' to M4 connections.

When specifying system and choosing interconnect cabling, check Guarding Device specification with respect to LO versus DO and PNP versus NPN versus Relay Output. FIC-M12M4 Field wireable connector or special QD wiring may be required. It is recommended that a Bi-polar solid-state output style of sensor is considered as a first option (e.g. MINI-Beam or Q45 sensors).

Single source supply in applications where two separate devices per input are required (e.g. opposed-mode sensors).

For bulk cable with a FIC-M12M4 Field wireable connector (or a MQDMC-4xxxx cordset), wire to a terminal strip, then to receiver and emitter. Splitters (such as Banner MDCVB4T) or Y-cables (such as the TURCK VB2 series) can be also used for a QD solution.

It is not recommended to supply power to an opposed-mode emitter from a separate source from it's receiver due to common mode failures that could result in an unintended mute cycle (see Figure 11 on Page 39 and this manual).

To comply with European Safety Standards, all muting applications must have a Mute Indicator. The Mute Lamp model SSA-ML-W with a white lens, or the SSA-ML-A with an amber lens is recommended. Alternatively, the User may provide another means of indication.

For connector accessories refer to Table 15 on Page 52.

4.9.2 Mute Timing Diagrams

For details of Mute Timing sequences refer to Appendix A2 on page 65.

4.9.3 Muting Application Examples

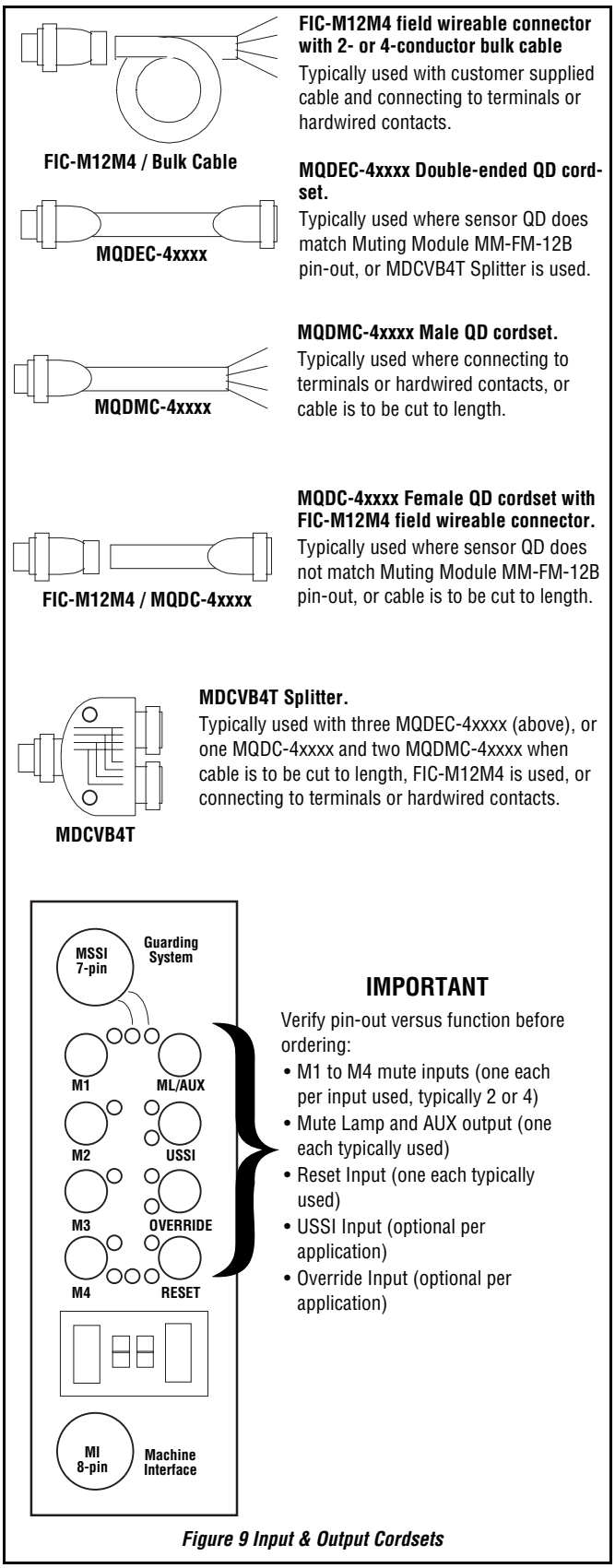
For examples of Muting Applications, refer to Appendix A3 on page 67.

4.9.4 Cordset Selection for Muting Module Type MM-TA-12B

☛ *Refer to* Figure 2 on Page 15 *when following this procedure.*

4.9.4.1 Input/output Cordsets

Normally between four and eight input and output Euro-style cordsets/connectors are required but this varies depending on the application. See Figure 9 on Page 37 for examples and Table 15 on Page 52 for more detailed information.



FIC-M12M4 field wireable connector with 2- or 4-conductor bulk cable
Typically used with customer supplied cable and connecting to terminals or hardwired contacts.

MQDEC-4xxxx Double-ended QD cordset.
Typically used where sensor QD does match Muting Module MM-FM-12B pin-out, or MDCVB4T Splitter is used.

MQDMC-4xxxx Male QD cordset.
Typically used where connecting to terminals or hardwired contacts, or cable is to be cut to length.

MQDC-4xxxx Female QD cordset with FIC-M12M4 field wireable connector.
Typically used where sensor QD does not match Muting Module MM-FM-12B pin-out, or cable is to be cut to length.

MDCVB4T Splitter.
Typically used with three MQDEC-4xxxx (above), or one MQDC-4xxxx and two MQDMC-4xxxx when cable is to be cut to length, FIC-M12M4 is used, or connecting to terminals or hardwired contacts.

IMPORTANT

Verify pin-out versus function before ordering:

- M1 to M4 mute inputs (one each per input used, typically 2 or 4)
- Mute Lamp and AUX output (one each typically used)
- Reset Input (one each typically used)
- USSI Input (optional per application)
- Override Input (optional per application)

Figure 9 Input & Output Cordsets

4.9.4.2 Guarding System Cordsets MSSI Connection (x1 cable required)

1) Measure length of cable required from position of Muting Module to position of Guarding Device = _____.
2) Referring to Figure 10 on Page 38 and Table 15 on Page 52, select suitable Cordset from following models:
   - **DESE4-5__D**
   - **DES4-5__C**
   - **QDS-7__C**

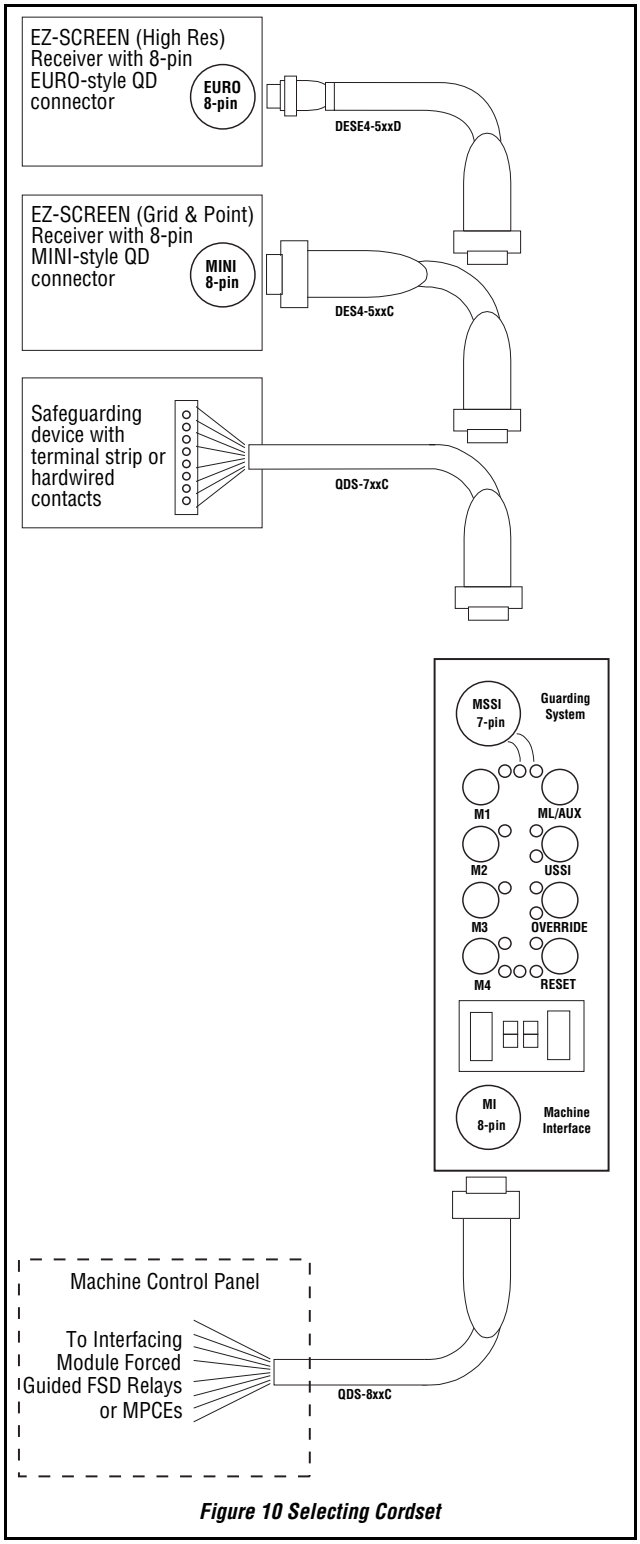


Figure 10 Selecting Cordset

4.9.4.3 Machine Interface Cordsets

Machine Interface Connection (x1 cable required)

1) Measure length of cable required from position of Muting Module to position of Control Panel = _____.

2) Referring to Figure 10 on Page 38 and Table 15 on Page 52, select suitable Cordset from following model:
   - **QDS-8__C**

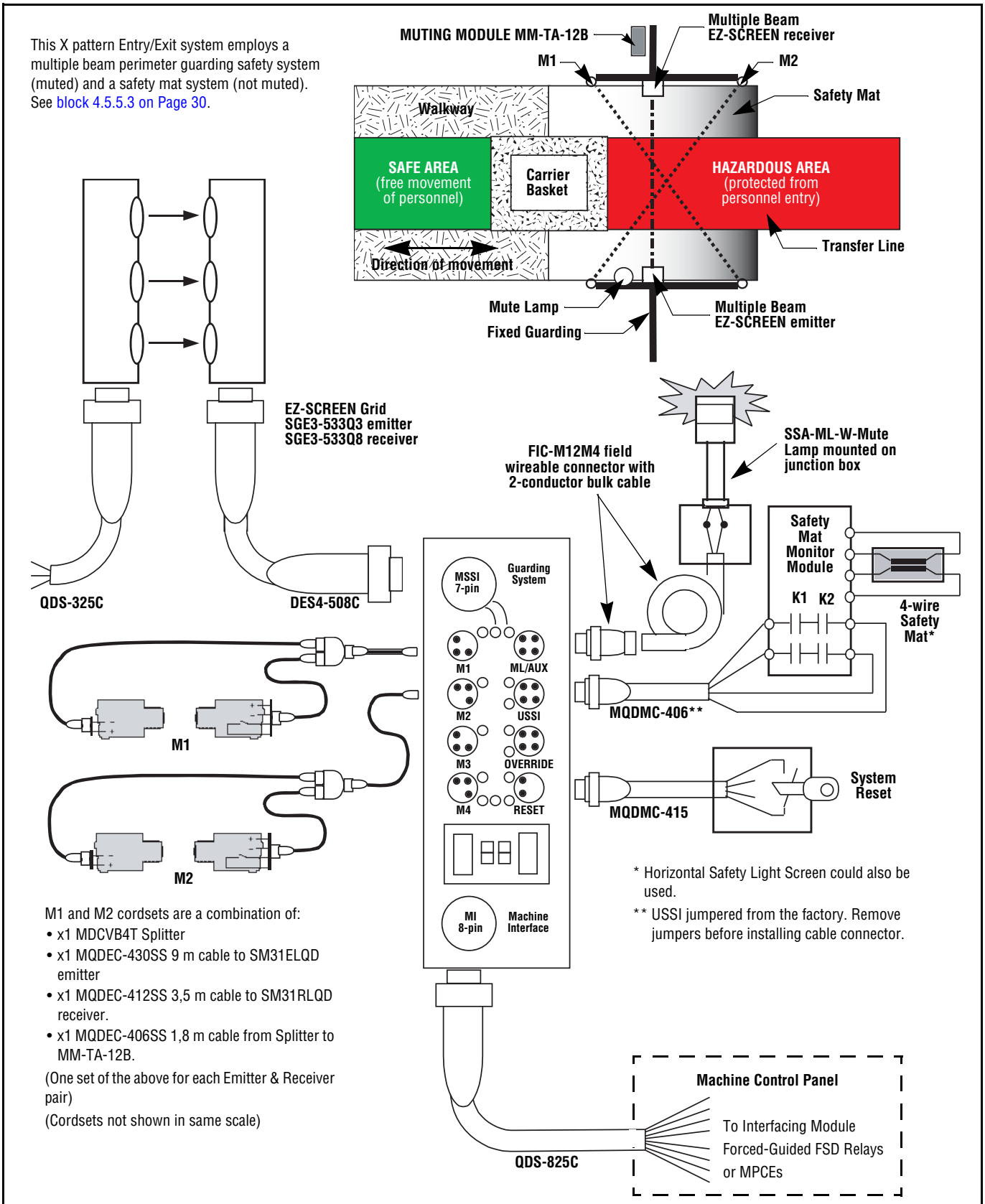


Figure 11 Muting Module MM-TA-12B - Typical Cable & Cordset Applications

4.9.5 Cordset Selection for Muting Module Type MM2-TA-12B

☛ *When following this procedure refer to* Figure 2 on Page 15 *and* Figure 12 on Page 40.

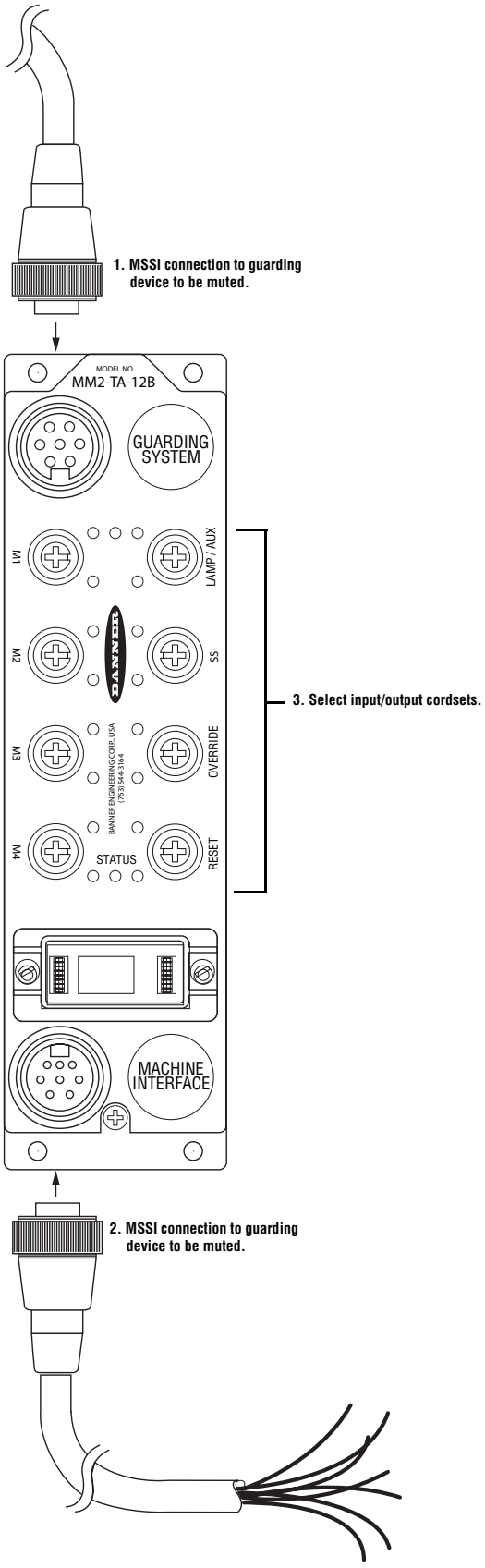


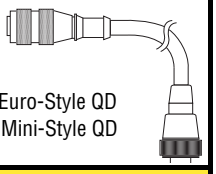
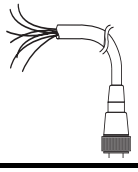
Figure 12 Initial Cordset Selections

4.9.5.1 Selecting Guarding System (MSSI) Cordset

x1 Cable Required

1) Measure cable length from Muting Module to Guarding Device or to splitter cordset and select suitable cable from Table 9 on Page 40.

Table 9 Muting Module MM2-TA-12B - Selecting Guarding System (MSSI) Cordset

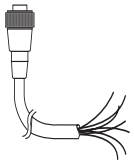
EZ-SCREEN Type 2 Receiver (To LS2..R30-..Q8 M12/Euro-Style Quick-Disconnect or to CSB-M128.. Splitter Cordset)		
Model	**Length (m)**	**Description**
DESE5-508D	2,4	 8-pin Female Euro-Style QD to 7-pin Male Mini-Style QD
DESE5-515D	5	
DESE5-525D	8	
Guarding Device with Hard-Wired Contacts/Terminals		
Model	**Length (m)**	**Description**
QDS-715C	5	 Non terminated End to 7-pin Male Mini-Style QD
QDS-725C	8	
QDS-750C	15	

4.9.5.2 Selecting Machine Interface Cordset

x1 Cable Required

1) Measure cable length from Muting Module to Control Panel and select suitable cable from Table 10 on Page 40.

Table 10 Muting Module MM2-TA-12B - Selecting Machine Interface Cordset

Machine Control Panel Interface Connection		
Model	**Length (m)**	**Description**
QDS-815	5	 8-pin Female Mini-Style Single-Ended
QDS-825	8	
QDS-850	15	

4.9.5.3 Selecting Input/Output Cordsets

⚠ WARNING!

VERIFYING CORDSET & SENSOR PINOUT(S) WITH FUNCTION

BEFORE ORDERING CORDSETS, VERIFY CORDSET AND SENSOR PINOUT(S) IN CONJUNCTION WITH THE SPECIFIC FUNCTION AS FOLLOWS:

- M1 TO M4 MUTE INPUTS (ONE CORDSET PER INPUT USED, TYPICALLY 2 OR 4), SEE Figure 13 on Page 41 AND block 4.4 on Page 25
- RESET INPUT (ONE CORDSET TYPICALLY USED)
- SSI INPUT (OPTIONAL PER APPLICATION)
- OVERRIDE INPUT (OPTIONAL PER APPLICATION)

1) Referring to Table 11 on Page 41 select Input/Output Cordset as appropriate.

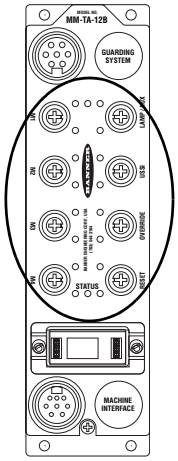


Table 11 Muting Module MM2-TA-12B - Selecting Input/Output Cordsets

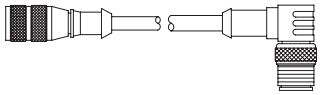
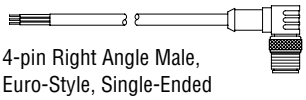
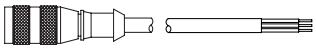
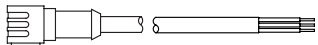
MQDEC-4.. (QD model sensor; double-ended cordset) Typically used where sensor QD matches MM2-FM-12B pinout (see Figure 13 on Page 41), or where MDCVB4T splitter is used.		
Model	**Length (m)**	**Description**
MQDEC-403SS	1	 4-pin Straight Male/Straight Female, Euro-Style, Double-Ended
MQDEC-406SS	2	
MQDEC-412SS	4	
MQDEC-420SS	6	
MQDEC-430SS	9	
MQDEC-450SS	15	
MQDEC-403RS	1	 4-pin Right-Angle Male/Straight Female, Euro-Style, Double-Ended
MQDEC-406RS	2	
MQDEC-412RS	4	
MQDEC-420RS	6	
MQDEC-430RS	9	
MQDEC-450RS	15	
MQDMC-4.. (male QD cordset) Typically used where connecting to terminals or hardwired contacts, or cable will be cut to length.		
Model	**Length (m)**	**Description**
MQDMC-406	2	 4-pin Straight Male, Euro-Style, Single-Ended
MQDEC-415	5	
MQDEC-430	9	
MQDEC-450	15	
MQDMC-406RA	2	 4-pin Right Angle Male, Euro-Style, Single-Ended
MQDEC-415RA	5	
MQDEC-430RA	9	
MQDEC-450RA	15	

Table 11 Muting Module MM2-TA-12B - Selecting Input/Output Cordsets

MQDC-4.. (female QD cordset for use with FIC-M12M4(A) field-wireable connector below) Typically used where sensor QD does not match MM2-FM-12B pinout, or cable is cut to length.		
Model	**Length (m)**	**Description**
MQDC-406	2	 4-pin Straight Female, Euro-Style, Single-Ended
MQDC-415	5	
MQDC-430	9	
MQDC-450	15	
Model	**Length (m)**	**Description**
MQDC-406RA	2	 4-pin Right Angle Female, Euro-Style, Single-Ended
MQDC-415RA	5	
MQDC-430RA	9	
MQDC-450RA	15	

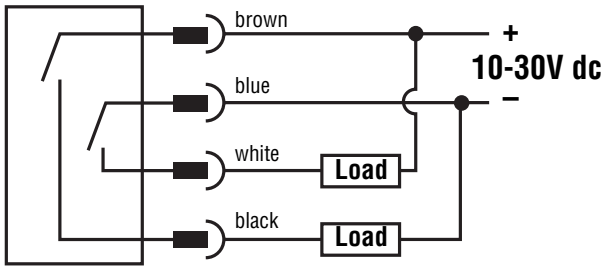
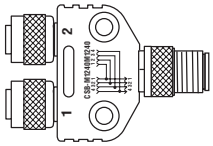
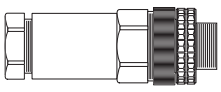
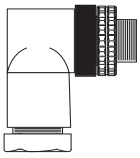


Figure 13 Typical 4-pin Euro-Style Bipolar (e.g. MINI-BEAM)

4.9.5.4 Cordset Accessories

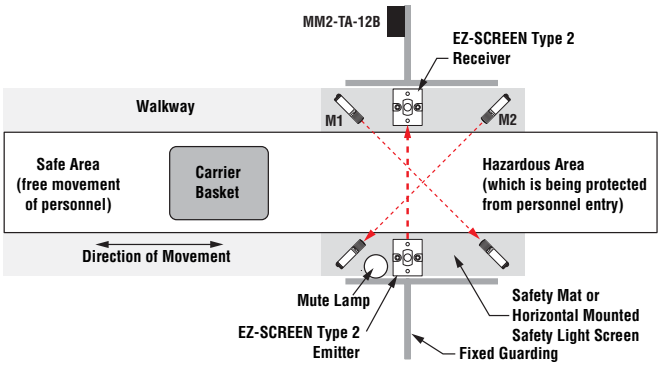
Refer to Table 12 on Page 41

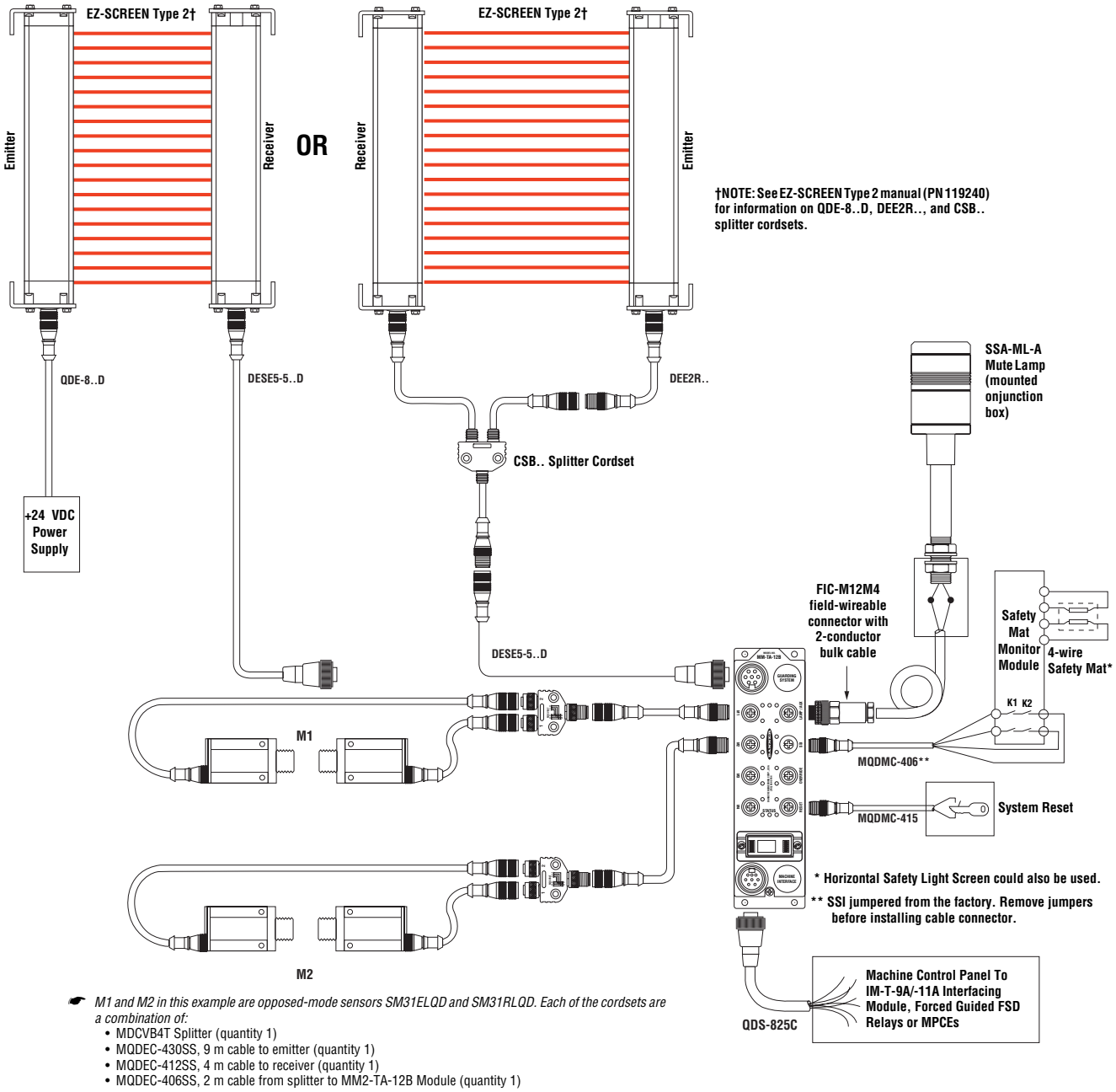
Table 12 Muting Module MM2-TA-12B - Cordset Accessories

Model	Description
CSB-M1240M1240  **(Only one FIC-M12M4 connector can be used at split connector 1 or 2)**	**Splitter: 4-pin, one male/two female, Euro-style** Typically used with three MQDEC-4.., or one MQDC-4.. and two MQDMC-4..
FIC-M12M4 	**Field-Wireable Connector: 4-pin Straight Male, Euro-style** Typically used with customer-supplied cable for connecting to terminals or hardwired contacts, or with MQDC-.. cables.
FIC-M12M4A 	**Field-Wireable Connector: 4-pin Right-Angle, Euro-style** Typically used with customer-supplied cable for connecting to terminals or hardwired contacts, or with MQDC-.. cables.

Sample Application

This “X” pattern entry/exit system employs a multiple-beam perimeter guarding safety system (muted) and a safety mat system (not muted). Cabling used to create the application at right is shown below. See block 4.5.6.3 on Page 32 and Appendix A3 on page 67 for more information.





M1 and M2 in this example are opposed-mode sensors SM31ELQD and SM31RLQD. Each of the cordsets are a combination of:

- MDCVB4T Splitter (quantity 1)
- MQDEC-430SS, 9 m cable to emitter (quantity 1)
- MQDEC-412SS, 4 m cable to receiver (quantity 1)
- MQDEC-406SS, 2 m cable from splitter to MM2-TA-12B Module (quantity 1)

Figure 14 Muting Module MM2-TA-12B Sample Muting Application and its Required Cabling

5 OPERATING INSTRUCTIONS

⚠ WARNINGS!

BEFORE OPERATING THE EQUIPMENT

READ THE SAFETY INFORMATION CONTAINED IN Chapter 1 on Page 1.

VERIFY PROPER OPERATION

THE MUTING MODULE AND SAFETY SYSTEMS CAN ONLY DO THE JOB FOR WHICH THEY WERE DESIGNED IF THEY AND THE MACHINE THEY GUARD ARE OPERATING PROPERLY, BOTH SEPARATELY AND TOGETHER. IT IS THE USER'S RESPONSIBILITY THEREFORE TO VERIFY PROPER OPERATION ON A REGULAR BASIS AS INSTRUCTED IN block 6.1.2 on Page 45. IF THE MUTING MODULE, SAFETY SYSTEMS, AND THE GUARDED MACHINE DO NOT PERFORM EXACTLY AS OUTLINED IN THE CHECKOUT PROCEDURES, THE CAUSE OF THE PROBLEM MUST BE FOUND AND CORRECTED BEFORE THE SYSTEM IS PUT BACK INTO SERVICE. FAILURE TO CORRECT SUCH PROBLEMS CAN RESULT IN SERIOUS BODILY INJURY OR DEATH.

POWER FAILURES

POWER FAILURES OR OTHER MODULE LOCKOUT CONDITIONS SHOULD ALWAYS BE INVESTIGATED IMMEDIATELY BY A Qualified Person as specified in block 1.9 on Page 4. A LOCKOUT IS A DEFINITE INDICATION OF A PROBLEM AND SHOULD BE INVESTIGATED AT ONCE. ATTEMPTS TO CONTINUE TO OPERATE MACHINERY BY BYPASSING THE MODULE ARE DANGEROUS AND COULD RESULT IN SERIOUS BODILY INJURY OR DEATH.

5.1 EQUIPMENT CONTROLS & INDICATION

5.1.1 Controls & Indications

5.1.1.1 Muting Module

There are no manual controls for the Muting Module except the Backdoor Timer as control is fully automatic. However the correct DIP switch configuration is very important for correct control of the Safety System for customised operation (see Figure 8 on Page 24 and Table 6 on Page 24).

A breakdown of the Muting Module's three status LED's is displayed on the label at the side of the Muting Module as shown in Figure 15 on Page 43.

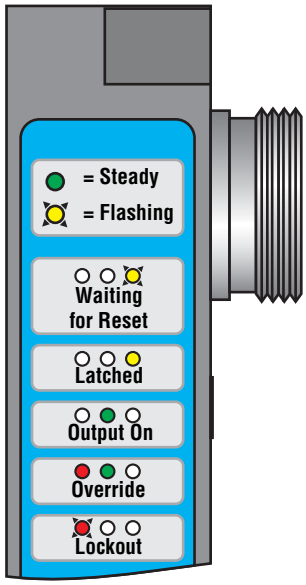


Figure 15 Status Indicators

In addition, green LED's adjacent to each of the Muting Module's inputs/interfaces come ON to verify an active state of that circuit (see also Figure 2 on Page 15 and Table 13 on Page 43.

During normal operation, the Diagnostic Display reads steady or, if during the mute cycle, flashing.

Except during the Backdoor Timer countdown, any number that appears in the Display signifies an error; see block 6.2.1.2 on Page 51 for more information.

Table 13 Muting Module Indication Breakdown

Indicator	LED	Meaning	LED Status	Condition
STATUS	● ● ● Red, green, yellow	Power ON/OFF, operating mode, lockout, override and OSSD status	STATUS OFF, OFF & flashing yellow	Waiting for reset
			STATUS OFF, OFF & yellow	Latched
			STATUS OFF, steady green & OFF	Output ON
			Steady red, steady green & OFF	Override
			STATUS Flashing red, off & OFF	Lockout
GUARDING SYSTEM A & B Channels	● Green	Activated (closed) or de-activated (open)	GUARDING SYSTEM A B Steady green	Active
			GUARDING SYSTEM A B OFF	Inactive

Table 13 Muting Module Indication Breakdown

Indicator	LED	Meaning	LED Status	Condition
M1, M2, M3 & M4 Channels	● Green	Activated (closed) or de-activated (open)	 steady green, M3 & M4	Active
			 OFF, M3 & M4 ditto	Inactive
USSI (for type MM-TA-12B only)	● Green	Activated (closed) or de-activated (open)	 Steady green	Active
			 OFF	Inactive
SSI (for type MM2-TA-12B only)	● Green	Activated (closed) or de-activated (open)	 Steady green	Active
			 OFF	Inactive
OVERRIDE	● Green	Activated (closed) or de-activated (open)	 Steady green	Active
			 OFF	Inactive
RESET	● Green	Activated (closed) or de-activated (open)	 Steady green	Active
			 OFF	Inactive

5.1.1.2 Backdoor Timer

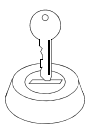
The Backdoor Timer allows the User to select a maximum period of time that muting is allowed to occur. This feature delays the intentional defeat of the muting devices to initiate an inappropriate mute. It is also useful for detecting a common mode failure that would affect all mute devices in the application.

The control for the Backdoor Timer can be set for 30 s or 60 s countdown using Bank A and Bank B DIP switches 7 and 8 (refer to Figure 8 on Page 24 and Table 6 on Page 24).

For more information refer to block 1.11.11 on Page 9.

5.1.1.3 Key Reset (optionally supplied)

The Muting Module requires a Manual Reset to clear a latch condition and resume operation following a stop command. Internal lockout conditions also require a Manual Reset to return the system to RUN mode after the failure has been corrected and the input correctly cycled.



The Key Reset is always located outside the guarded area but can be used while viewing the guarded area unobstructed.

See block 4.5.1.1 on Page 27 for information on the Reset routine.

5.1.1.4 E-Stop Switch (optionally supplied)

Used for an emergency situation only to stop the guarded machine in conjunction with the Muting Module.

The Emergency Stop is activated by pressing the Push Button Switch (Figure 16 on Page 44).

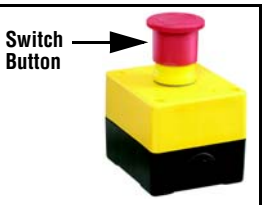


Figure 16 E-Stop Switch

The Push Button Switch has a reset function for the Emergency Stop circuit also.

5.2 NORMAL OPERATION

5.2.1 Normal Start-up

1) Carry out procedures as detailed in block 6.1.7.2 on Page 48 and block 6.1.7.3 on Page 49.

5.2.2 Running Procedures

5.2.2.1 Responding to a Lockout Condition

Refer to block 6.2.1.1 on Page 51.

5.2.3 Shutdown Procedure

1) Remove power from Muting Module.

6 MAINTENANCE

⚠ WARNINGS!

BEFORE CARRYING OUT MAINTENANCE ON THE EQUIPMENT

READ THE SAFETY INFORMATION CONTAINED IN Chapter 1 on Page 1.

SHUT DOWN MACHINERY BEFORE SERVICING

THE MACHINERY CONNECTED TO THE MODULE MUST NOT BE OPERATING AT ANY TIME DURING THIS PROCEDURE. YOU MAY BE WORKING CLOSE TO A HAZARDOUS AREA OF YOUR MACHINERY WHILE SERVICING THE MODULE. SERVICING THE MODULE WHILE THE HAZARDOUS MACHINERY IS OPERATING COULD RESULT IN SERIOUS BODILY INJURY OR DEATH.

6.1 PREVENTIVE MAINTENANCE

6.1.1 Warranty Service

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

☛ *Do not attempt any repairs to the Muting Module. It contains no field-replaceable components. Return the Module to the factory for warranty replacement.*

If it becomes necessary to return a system component to the factory, contact the Banner Corporate Office as listed on page 73.

The Banner Factory Application Engineering group will try to determine what the fault or problem is. If it is concluded that a component is defective and must be returned, an RMA (Return Merchandise Authorization) number for the paperwork will be sent, together with the shipping address for returning the defective component(s).

The component(s) should be packed carefully. Damage which occurs during return shipping is not covered by warranty.

6.1.2 Periodic Checkout Requirements

Before starting a Checkout, each procedure should be read in its entirety, to ensure understandability.

Refer all questions to the Banner Corporate Office as listed on page 73.

Check-outs must be performed as detailed in block 6.1.3 on Page 45 below and results should be recorded and kept in the appropriate place (e.g., near the machine, and/or in a technical file).

6.1.3 Schedule of Check-outs

6.1.3.1 Initial Checkout

This procedure should be performed at installation, or at any time the system, guarded machine or any part of the application has been replaced, repaired or modified.

The procedure must be performed by a Qualified Person as specified in block 1.9 on Page 4.

6.1.3.2 Commissioning Checkout

This procedure should be performed at installation or whenever changes are made to the system (either a new configuration of the Muting Module or changes to the machine).

The procedure must be performed by a Qualified Person as specified in block 1.9 on Page 4.

6.1.3.3 Daily Checkout

This procedure should be performed at least at the following intervals:

- Each shift change
- Every Machine setup change
- Whenever the system is powered up
- Daily

The procedure is detailed on the Daily Checkout Cards and must be performed by a Designated Person as specified in block 1.9 or a Qualified Person as specified in block 1.9 on Page 4.

6.1.3.4 Six Monthly Checkout

This procedure should be performed at least every six months, following installation of the System.

The procedure must be performed by a Qualified Person as specified in block 1.9 on Page 4.

6.1.4 Initial Checkout

Refer to block 4.6 on Page 33.

6.1.5 Commissioning Checkout

Refer to block 4.8 on Page 36.

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6.1.6 Daily/Shift Change Checkout

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

⚠ WARNINGS!

DO NOT USE MACHINE UNTIL SYSTEM IS WORKING PROPERLY

IF ALL OF THESE CHECKS CANNOT BE VERIFIED, DO NOT ATTEMPT TO USE THE MUTING MODULE/GUARDED MACHINE UNTIL THE DEFECT OR PROBLEM HAS BEEN CORRECTED (SEE block 6.2.1 on Page 51). ATTEMPTS TO USE THE GUARDED MACHINE UNDER SUCH CONDITIONS COULD RESULT IN SERIOUS BODILY INJURY OR DEATH.

BEFORE APPLYING POWER TO THE MACHINE

VERIFY THAT THE GUARDED AREA IS CLEAR OF PERSONNEL AND UNWANTED MATERIALS (SUCH AS TOOLS) BEFORE APPLYING POWER TO THE GUARDED MACHINE. FAILURE TO DO SO COULD RESULT IN SERIOUS BODILY INJURY OR DEATH.

1) Verify that access to guarded area is not possible from any area not protected by Guarding Device(s) interfaced with Muting Module system. ❑
2) Verify that all fixed guarding and supplementary guarding devices are in place wherever needed and operating properly to prevent any person from reaching around light grid or entering into hazard area. ❑
3) Verify that Guarding Device(s) interfaced with Muting Module system have been properly installed and maintained (refer to relevant Instruction Manuals or Data Sheets). ❑
4) Verify that Reset Switch is mounted outside guarded area, out of reach of anyone inside guarded area, and that key or other means of preventing inadvertent use is in place. ❑
5) Verify system(s) checkout procedures for external safety systems connected to MSSI and USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) inputs as described by the appropriate Manuals. ❑

Do not attempt to insert anything into dangerous parts of the machine.

6) Initiate machine motion of guarded machine and, during cycle, generate a stop command from Guarding Device(s). Upon issuing stop command, verify dangerous parts of machine come to a stop with no apparent delay. ❑
7) Upon Reset of Guarding Device(s) and Muting Module, verify that machine does not automatically restart, and that initiation devices must be engaged to restart machine. ❑
8) With guarded machine at rest, generate a stop command from Guarding Device(s) and verify that it is not possible for guarded machine to be put into motion. ❑
9) Check carefully for external signs of damage or changes to Muting Module system, interfaced Guarding Device(s), guarded machine, and their electrical wiring. Any damage or changes found should be immediately reported to management. ❑

⚠ WARNING!

DO NOT ATTEMPT TO USE THE SYSTEM

IF ANY OF THESE CHECKS FAIL, DO NOT ATTEMPT TO USE THE SYSTEM UNTIL THE REASON FOR THE FAILURE(S) IS IDENTIFIED AND CORRECTED.

6.1.7 Six Monthly Checkout

THIS CHECKOUT PROCEDURE SHOULD BE PERFORMED EVERY SIX MONTHS

⚠ WARNINGS!

DO NOT USE MACHINE UNTIL SYSTEM IS WORKING PROPERLY

IF ALL OF THESE CHECKS CANNOT BE VERIFIED, DO NOT ATTEMPT TO USE THE MUTING MODULE/GUARDED MACHINE UNTIL THE DEFECT OR PROBLEM HAS BEEN CORRECTED (SEE block 6.2.1 on Page 51). ATTEMPTS TO USE THE GUARDED MACHINE UNDER SUCH CONDITIONS COULD RESULT IN SERIOUS BODILY INJURY OR DEATH.

BEFORE APPLYING POWER TO THE MACHINE

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

PERFORMING SIX MONTHLY CHECKOUT

THE SIX MONTHLY CHECKOUT PROCEDURE MUST BE PERFORMED BY A Qualified Person as specified in block 1.9 on Page 4.

☛ *Checkout results should be recorded and kept on or near the guarded machine.*

6.1.7.1 Preparation

Prepare the Muting Module for this checkout as follows:

1) Referring to Figure 8 on Page 24 and Table 6 on Page 24 verify configuration is the same as for required machine operation. ❑

6.1.7.2 Guarding Device Checkout

1) Examine guarded machine to verify that it is of a type and design compatible with Guarding Device system that has been installed (see block 2.2 on Page 13). ❑
2) Verify system(s) checkout procedures for external safety systems connected to MSSI and USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) inputs as described by appropriate manuals. Do not proceed until all checkout procedures are completed successfully and all problems have been corrected. ❑
3) Verify that:
   - Access to any dangerous parts of guarded machine is not possible from any direction not protected by Guarding Device system, fixed guarding, or supplementary Guarding Device ❑
   - Supplementary Guarding Device and fixed guarding, as described by appropriate safety standards, are in place and functioning correctly ❑
4) Verify that Reset Switch is mounted outside guarded area, out of reach of anyone inside guarded area, and that means of preventing inadvertent use is in place. ❑
5) Examine electrical wiring connections between the Module's OSSD outputs and guarded machine's control elements to verify that wiring meets requirements stated in block 4.7 on Page 35. ❑
6) Ensure that power to guarded machine is OFF. ❑
7) Apply power to Muting Module. ❑
8) Verify that external safety systems (for example light curtain) are providing a green/Go signal to the MSSI and USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) inputs. ❑
9) Verify that Channel indicators on Muting Module show steady green. ❑

10) Verify that status LED is flashing yellow to indicate that a Reset is being requested. ❑

11) Perform a Manual Reset as detailed in block 4.5.1.1 on Page 27. ❑
12) Verify that Status indicator shows steady green. ❑

☛ *A Red flashing status indicator signifies a lockout condition. Refer to* block 6.2.1 on Page 51 *for troubleshooting information.*

13) In a non-muted condition, generate a stop command from Guarding Device connected to MSSI (for example, interrupt defined area of a safety light screen). Verify that MSSI Channel A and B and green Status indicators go OFF. ❑

14) In strict order, reset Guarding Device and then all channels of the Muting Module (using Manual Reset as detailed in block 4.5.1.1 on Page 27). ❑
15) Generate a stop command from Guarding Device connected to USSI (for MM-TA-12B) or SSI (for MM2-TA-12B); for example, operate E-stop button. Verify that USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) Channel A and B and green status indicators go OFF. ❑

16) Repeat Step 14). ❑
17) Apply power to guarded machine and verify that machine does not start up. ❑
18) Generate a stop command from Guarding Device connected to USSI (for MM-TA-12B) or SSI (for MM2-TA-12B) and MSSI in a non-muted condition. ❑
19) Verify that it is not possible for guarded machine to be put into motion while either stop commands are present. ❑
20) Repeat Step 14). ❑

Do not attempt to insert anything into the dangerous parts of the machine.

21) Initiate machine motion of guarded machine and, while it is moving, as in Step 17), Step 18) and Step 19) above, generate a stop command from each Guarding Device. ❑
22) Upon issuing a **stop** command, verify dangerous parts of machine stop with no apparent delay. ❑

23) Upon Reset of Guarding Device and Muting Module, verify that machine does not automatically restart, and that initiation devices must be engaged first to Restart machine. ❑

24) Remove electrical power to Muting Module. Verify that all OSSD outputs immediately switch OFF, and do not switch ON again until power is re-applied and a Reset is activated. ❑

25) Test machine stopping response time, using an instrument designed for that purpose, to verify that it is same or less than the overall system response time specified by the machine manufacturer (Contact Corporate Office as listed on page 73). ❑

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

6.1.7.3 Muting Checkout

1) Verify that Muting Module has been Reset and Status indicator shows steady green.

If Status indicator is flashing yellow (indicating Muting Module is waiting for a Reset of a latched condition), perform a Manual Reset.

If at any time red status indicator begins to flash, a lockout condition exists. Refer to block 6.2.1.1 on Page 51 to determine cause of lockout. ❑

At all times ensure that personnel are not exposed to any hazard.

2) Mute system by blocking (or activating) both mute devices (typically M1- M2) simultaneously (within 3 s). ❑

3) Verify that Mute indicator(s) show steady green. If not, check indicator(s) and wiring.

Check also Diagnostic Display for error codes. ❑

4) Generate a **stop** command from Guarding Device connected to the MSSI. Verify that MSSI Channel A and B are OFF and green Status indicators are ON. ❑

☛ *If the 30 or 60-second Backdoor Timer feature has been selected, the Diagnostic Display begins to count down; otherwise a flashing dash appears on the display.*

5) Clear or Reset Guarding Device (before Backdoor Timer expires) and verify MSSI channel indicators are steady green.

Clear (deactivate) Mute devices before Backdoor Timer expires and verify Mute indicator(s) goes OFF.

Status indicator should remain steady green. ❑

6) Verify that it is not possible for a single individual to initiate a mute condition by triggering Mute devices (for example, by blocking both photoelectric beams or actuating both switches) and access hazard without being detected and issuing a stop command to machine (where green status indicator goes OFF, and a Reset of latch condition is required). ❑

At all times ensure that personnel are not exposed to any hazard.

7) Verify that it is not possible for personnel to pass in front of, behind, or next to the muted object without being detected and without issuing a stop command to machine. ❑

8) If one-way (directional) muting has been selected, verify that system can not be muted by blocking (or activating) M3-M4 before M1-M2. ❑

9) If any decrease in machine braking ability has occurred, make necessary clutch/brake repairs, readjust Guarding Device MINIMUM SAFETY DISTANCE(S) appropriately, record new S calculation, and re-perform Daily Checkout procedure. ❑

6.1.7.4 General

1) Examine and test MPCEs and any intermediary controls (such as interface modules) to verify that they are functioning correctly and are not in need of maintenance or replacement. ❑

2) Inspect guarded machine to verify that no other mechanical or structural problems could prevent machine from stopping or assuming an otherwise safe condition when signalled to do so by Muting Module system. ❑

3) Examine and inspect machine controls and connections to Guarding Device system to verify that no modifications have been made which adversely affect System. ❑

⚠ WARNING!

DO NOT ATTEMPT TO USE THE SYSTEM

IF ANY OF THESE CHECKS FAIL, DO NOT ATTEMPT TO USE THE SYSTEM UNTIL THE REASON FOR THE FAILURE(S) IS IDENTIFIED AND CORRECTED.

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6.2 CORRECTIVE MAINTENANCE

6.2.1 Trouble Shooting

WARNING!

POWER FAILURES

POWER FAILURES OR OTHER MODULE LOCKOUT CONDITIONS SHOULD ALWAYS BE INVESTIGATED IMMEDIATELY BY A Qualified Person as specified in block 1.9 on Page 4. **A LOCKOUT IS A DEFINITE INDICATION OF A PROBLEM AND SHOULD BE INVESTIGATED AT ONCE. ATTEMPTS TO CONTINUE TO OPERATE MACHINERY BY BYPASSING THE MODULE ARE DANGEROUS AND COULD RESULT IN SERIOUS BODILY INJURY OR DEATH.**

WARNING!

SHOCK HAZARD

ALWAYS DISCONNECT POWER FROM THE MUTING MODULE, SAFETY SYSTEM AND THE GUARDED MACHINE BEFORE MAKING ANY CONNECTIONS OR REPLACING ANY COMPONENT. USE EXTREME CAUTION TO AVOID ELECTRICAL SHOCK AT ALL TIMES. SERIOUS BODILY INJURY OR DEATH COULD RESULT.

6.2.1.1 Lockout Conditions

A lockout condition causes the OSSD output to turn OFF, sending a stop signal to the guarded machine. A lockout condition is indicated by the Red status indicator flashing and an error code appearing in the Diagnostic Display.

To clear a lockout condition:

1) Correct cause of error.
2) If fault was due to an input failure, fully cycle associated input and/or perform Reset routine as detailed in block 4.5.1.1 on Page 27.

6.2.1.2 Diagnostic Display

The Muting Module Diagnostic Display is useful for monitoring the Guarding Device system and for quickly diagnosing problems. See Table 14 on Page 51 for a list of status codes and their meanings, along with recommended corrective actions.

A label located on the side of the Muting Module displays the error codes together with an abbreviated description of the error.

Table 14 Diagnostic Display Breakdown

Status/Error Code	Condition/ Error	Action
Steady	**System OK**	n/a
Flashing	**Mute Cycle**	n/a
3.1	**OSSD Output Error**	- One OSSD is shorted to power/ ground - OSSDs are shorted together
3.2	**Reset Input Error**	- Reset Input Shorted/Closed
3.3	**Module Error**	- Excessive EMI/RFI noise - Internal failure, replace Muting Module
3.4	**MSSI Error***	- One or both channels shorted to power or ground - Input channels shorted together - One channel did not open - Failed Simultaneity (> 3 s) - Failed Handshake (type MM-TA-12B only) - Excessive EMI/RFI noise
3.5	**Override Error**	- Override Input closed at power-up - Check Override Input wiring and connector - Excessive EMI/RFI noise
3.6	**Mute Lamp Error**	- Check/Replace Lamp (open or short) - Check wiring and connector - Check DIP switch settings
3.7	**DIP switch Error**	- Check DIP switch settings - Replace Module
3.8	**EDM 1 Error**	- Check wiring - Check operation of Device(s) under control - Check DIP switch settings - Switching transition > 200 ms - Excessive EMI/RFI noise - EDM open > 200 ms after OSSDs go OFF
3.9	**EDM 2 Error**	- Check wiring - Check operation of Device(s) under control - Check DIP switch settings - Switching transition >200 ms - Excessive EMI/RFI noise
4.0	**2-Channel EDM Error**	- Check wiring - Check operation of Device(s) under control - Failed Simultaneity between EDM1 & EDM2 (> 200 ms) - EDM open > 200 ms after OSSDs go OFF - Replace Muting Module

Table 14 Diagnostic Display Breakdown

Status/Error Code	Condition/ Error	Action
4.5.	**Mute Enable Input Error**	- Excessive EMI/RFI noise
5.0.	**Backdoor Timer Expired**	- Check muting device operation - Check muting device wiring - Check DIP switch settings - See manual block 1.11.11 on Page 9
5.1.	**Mute Timing (Simultaneity) Error**	- The second mute device of a pair (M1 to M2 or M3 to M4) did not actuate within 3 s of the first device. - Check muting device operation - Check wiring
5.2.	**Mute Enable Open Error**	- ME input was open when a mute cycle was attempted - Check Mute Enable wiring - Check DIP switch settings
6.1.	**USSI Input Error** (Type MM-TA-12b only)** **SSI Input Error** (Type MM2-TA-12b only)**	- One or both channels shorted to power or ground - Input channels shorted together - One channel did not open - Failed Simultaneity (> 3 s) - Failed Handshake (type MM-TA-12B only) - Excessive EMI/RFI noise

*Fault is cleared by cycling the input from closed-to-open-to-closed.
**Fault is cleared by cycling the input from closed-to-open.

6.2.1.3 Effects of Electrical Noise

The Module is designed and manufactured to be highly resistant to electrical noise and to operate reliably in industrial settings. However, serious electrical noise may cause a random lockout condition.

Check the following if a noise-related error code is displayed and other remedies have not cleared the problem:

1) Check for poor connection between Module and earth ground. Use a short wire from earth ground screw to nearest location on a grounded metal mounting surface.
2) Check for sensor wires or input/output wires routed too close to noisy wiring.

In extreme conditions, it may be necessary to use shielded cabling or relocate the Muting Module, mute devices, and cabling away from the source of the noise. All connectors have an earth ground connection (e.g., pin 5 of the Euro-style connectors) to assist in shielding cables, if necessary.

6.2.1.4 Wiring Information

For detailed circuit and wiring diagrams refer to Appendix A1 on page 55.

6.3 SPARE PARTS

This block details Spare Parts information for the Muting Module mostly in table format.

Table 15 Accessories for Muting Module

Type No.	Description	Length (m)	Order Part No.
Single-Ended QD Cordsets (see also Table 7 on Page 25 and block 4.9.4 on Page 37)			
QDS-715C	**7-pin Mini-Style** Male connector for MSSI connection 0,813 mm	5	30 672 09
QDS-725C		8	30 672 10
QDS-750C		15	30 672 11
QDS-815C	**8-pin Mini-Style** Female connector for Machine Interface connection 0,813 mm	5	30 672 11
QDS-825C		8	30 672 13
QDS-850C		15	30 672 14
MQDMC-406	**4-pin Euro-Style** Straight male connector for Muting Module Euro-style connections 0,643 mm	2	30 027 80
MQDMC-415		5	30 027 81
MQDMC-430		9	30 029 54
MQDMC-450		15	**
MQDMC-406RA	**4-pin Euro-Style** 90° male connector for Muting Module Euro-style connections 0,643 mm	2	30 708 99
MQDMC-415RA		5	30 709 00
MQDMC-430RA		9	30 709 67
MQDMC-450RA		15	30 709 71

Table 15 Accessories for Muting Module

Type No.	Description	Length (m)	Order Part No.
MQDC-406	**4-pin Euro-Style** Straight female connector for connections to external devices 0,643 mm *	2	30 451 36
MQDC-415		5	37 487 00
MQDC-430		9	30 271 42
MQDC-450		15	30 336 49
MQDC-406RA	**4-pin Euro-Style** 90° female connector for connections to external devices 0,643 mm *	2	30 471 04
MQDC-415RA		5	37 159 00
MQDC-430RA		9	30 270 80
MQDC-450RA		15	30 492 13
Double-Ended QD Cordsets (use with MM-TA-12B only) (see also Table 7 on Page 25 and block 4.9.4 on Page 37)			
DES4-508C	**8-pin female to 7 pin male Mini-Style** For connection to 8-pin QD EZ-SCREEN Point & Grid Receivers to Muting Module MSSI connector	2,4	30 690 19
DES4-515C		5	30 690 20
DES4-525C		8	30 690 21
DESE4-508D	**8-pin female to 7 pin male Euro-Style** For connection to 8-pin QD EZ-SCREEN (high resolution) Receivers to Muting Module MSSI connector	2,4	**
DESE4-515D		5	**
DESE4-525D		8	**

* To be used with FIC-M12M4 or FIC-M12M4A connectors. This type of connector can be used with customer supplied bulk cable.
** Order Part Number issued on receipt of order.

Table 15 Accessories for Muting Module

Type No.	Description	Length (m)	Order Part No.
Double-Ended QD Cordsets (use with MM2-TA-12B only) (see also Table 9 on Page 40 & block 4.9.5 on Page 40)			
DESE5-508D	**8-pin female to 7 pin male Mini-Style** EZ-SCREEN Type 2 Receiver (To LS2..R30-..Q8 M12/Euro-Style Quick-Disconnect or to CSB-M128.. Splitter Cordset)	2,4	30 748 30
DESE5-515D		5	30 748 31
DESE5-525D		8	30 748 32
Double-Ended QD Cordsets (use with MM-TA-12B & MM2-TA-12B) (see also Table 7 on Page 25, block 4.9.4 on Page 37 & block 4.9.5 on Page 40)			
MQDEC-403RS	**4-pin double ended male/female, Euro Style** For connection between external devices with a 4-pin Euro-style 90° male /straight female connector on Muting Module	1	30 474 56
MQDEC-406RS		2	30 474 57
MQDEC-412RS		4	30 474 58
MQDEC-420RS		6	30 474 59
MQDEC-430RS		9	**
MQDEC-450RS		15	**
MQDEC-403SS	**4-pin double ended male/female, Euro Style** For connection between external devices with a 4-pin Euro-style straight male/straight female connector on Muting Module	1	30 476 31
MQDEC-406SS		2	30 476 32
MQDEC-412SS		4	30 476 33
MQDEC-420SS		6	30 476 34
MQDEC-430SS		9	**
MQDEC-450SS		15	**

Table 15 Accessories for Muting Module

Type No.	Description	Length (m)	Order Part No.
Field-Wireable Euro Style Male Connectors (see also block 4.9.4 on Page 37)			
FIC-M12M4	male 4-pin, male threads, straight	-	30 589 10
FIC-M12M4A	male 4-pin, male threads 90°	-	30 589 11
FIC-M12M5	male 5-pin, male threads, straight	-	30 589 16
FIC-M12M5A	male 5-pin, male threads, 90°	-	30 589 17
* To be used with FIC-M12M4 or FIC-M12M4A connectors. This type of connector can be used with customer supplied bulk cable. ** Order Part Number issued on receipt of order.			
CSB-M1240M1240 (Only one FIC-M12M4 connector can be used at split connector 1 or 2)	Splitter Typically used with three MQDEC-4.., or one MQDC-4.. and two MQDMC-4..	-	30 642 06
Solid-State LED Based Mute Lamp			
SSA-ML-W	+24 VDC, white lens	-	30 620 95
SSA-ML-A	+24 VDC, amber lens	-	30 704 94
MGA-KS0-1	Switch keyed reset SPST	-	30 301 40
Interface Modules Provide forced-guided, mechanically-linked relay (safety) outputs for the EZ-SCREEN System.			
IM-T-9A	Interface module (x3 N/O redundant-output 6 amp contacts)	-	30 614 25
IM-T-11A	Interface module (x2 N/O redundant-output 6 amp contacts, plus x1 N/C auxiliary contact	-	30 614 24

Table 15 Accessories for Muting Module

Type No.	Description	Length (m)	Order Part No.
Contactors If used, two contactors per EZ-SCREEN System are required.			
11-BG00-31-D-024	10 amp positive-guided contactor x3 N/O, x1 NC	-	30 696 82
11-BF16C01-024	16 amp positive-guided contactor x3 N/O, x1 NC	-	30 696 87

Table 16 Documentation

Order Part No.	Description
114134	Instruction Manual (European version UK English)
114135	Daily Checkout Card (European version UK English)
114136	Six Monthly Checkout Card (European version UK English)
114137	Instruction Manual (European version French)
114138	Daily Checkout Card (European version French)
114139	Six Monthly Checkout Card (European version French)
114140	Instruction Manual (European version German)
114141	Daily Checkout Card (European version German)
114142	Six Monthly Checkout Card (European version German)
114143	Instruction Manual (European version Italian)
114144	Daily Checkout Card (European version Italian)
114145	Six Monthly Checkout Card (European version Italian)

A1 WIRING & SCHEMATIC DIAGRAMS

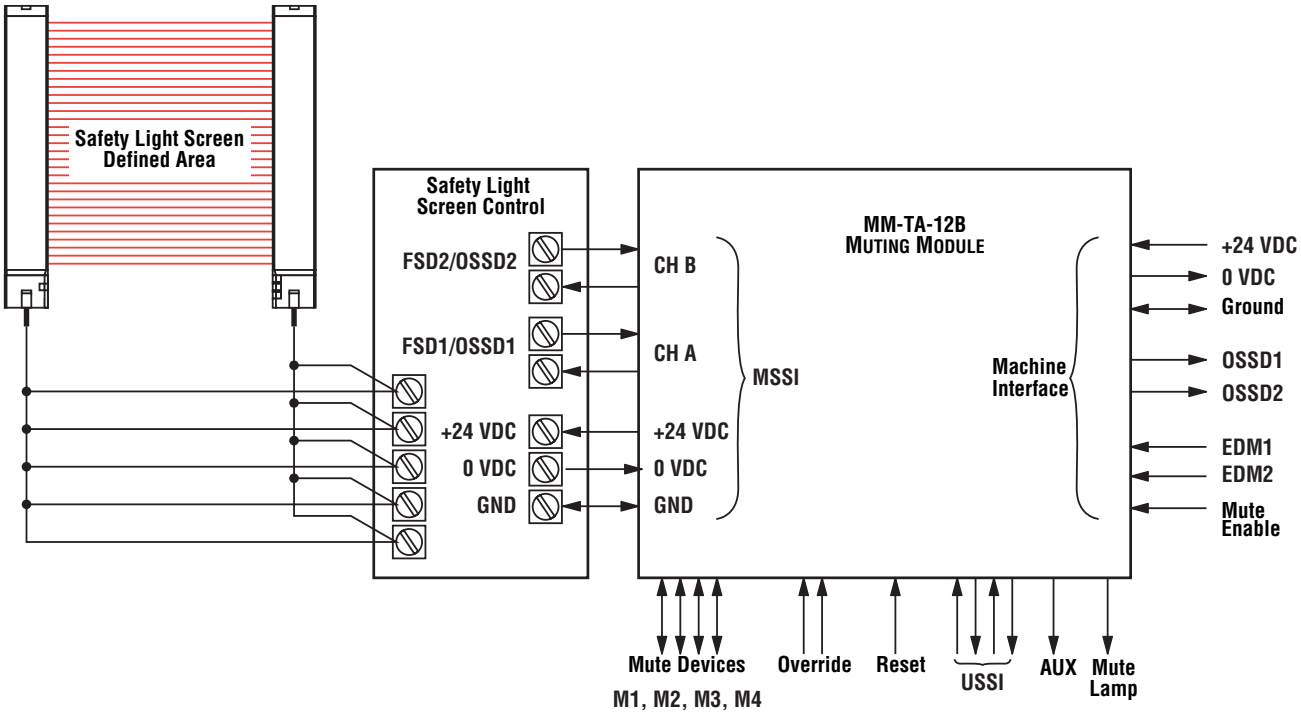


Figure 17 Muting Module Type MM-TA-12B with User Supplied Primary Safety Device Safety Light Screen Guarding System Schematic Layout

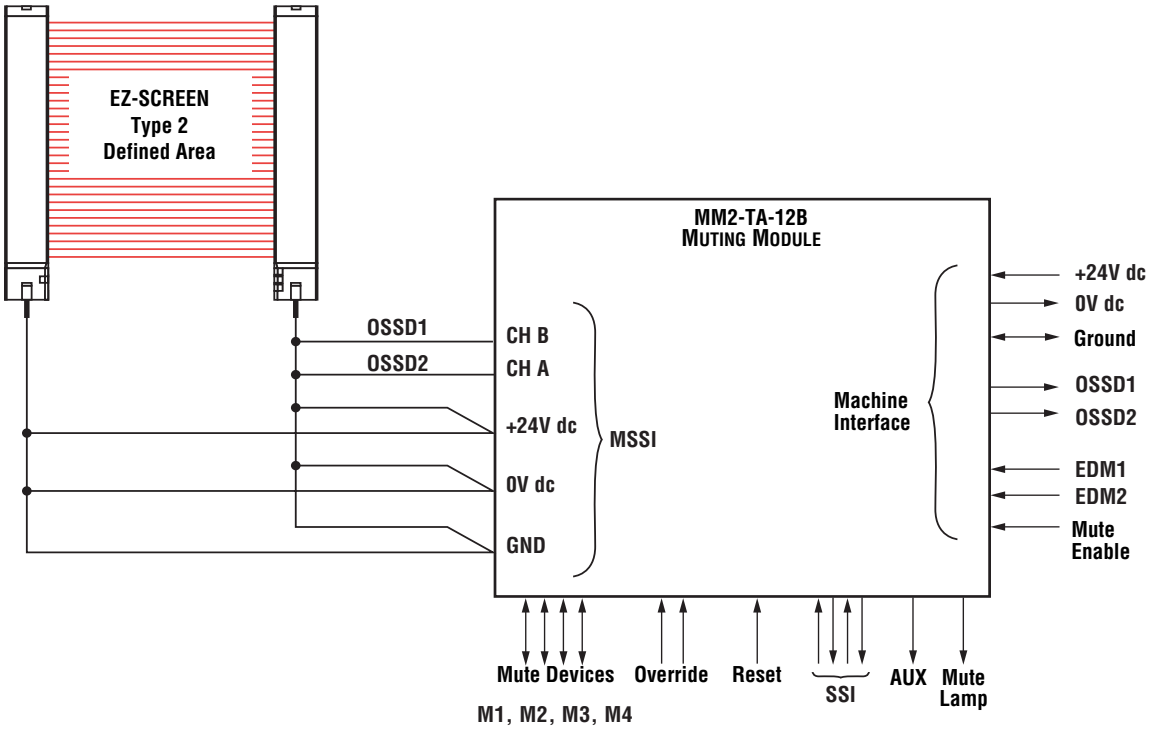


Figure 18 Guarding System with Muting Module Type MM2-TA-12B and a Safety Light Screen (User Supplied) as a Primary Safety Device

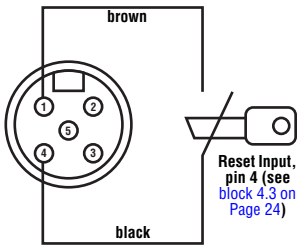


Figure 19 Manual Reset Switch Connections

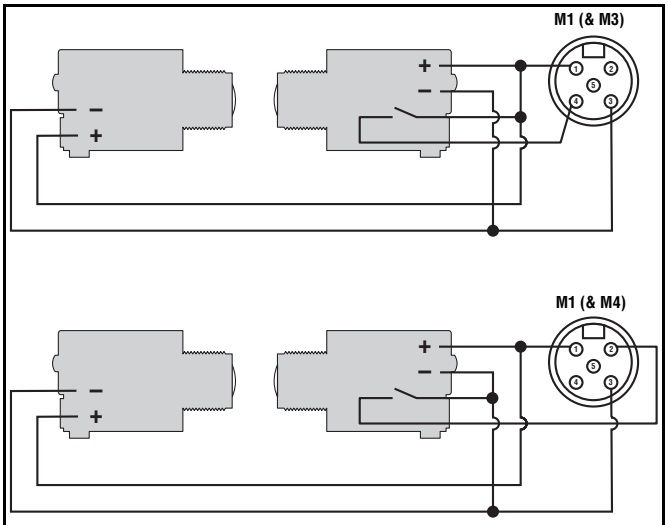


Figure 20 Two Photoelectrics as M1 & M2 (or M3 And M4) Using Relay Outputs

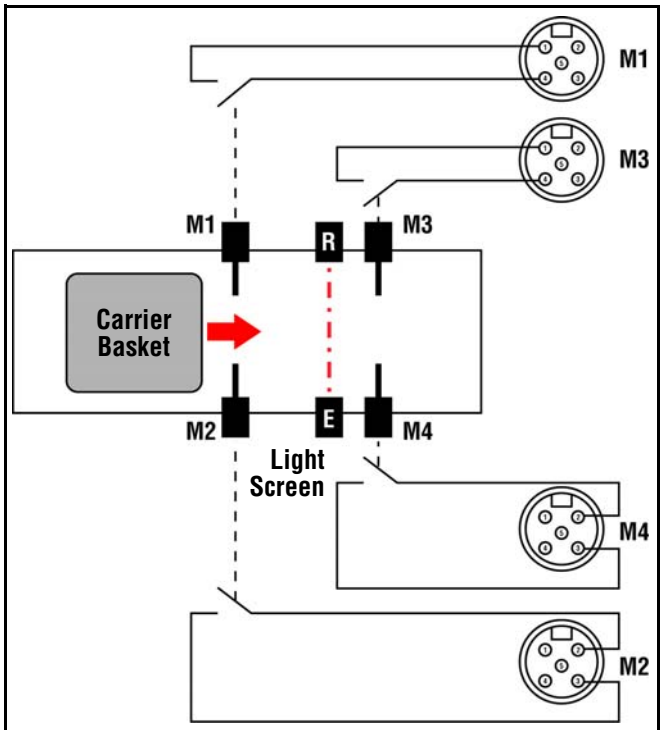


Figure 21 Four Limit Switches as M1, M2, M3 and M4

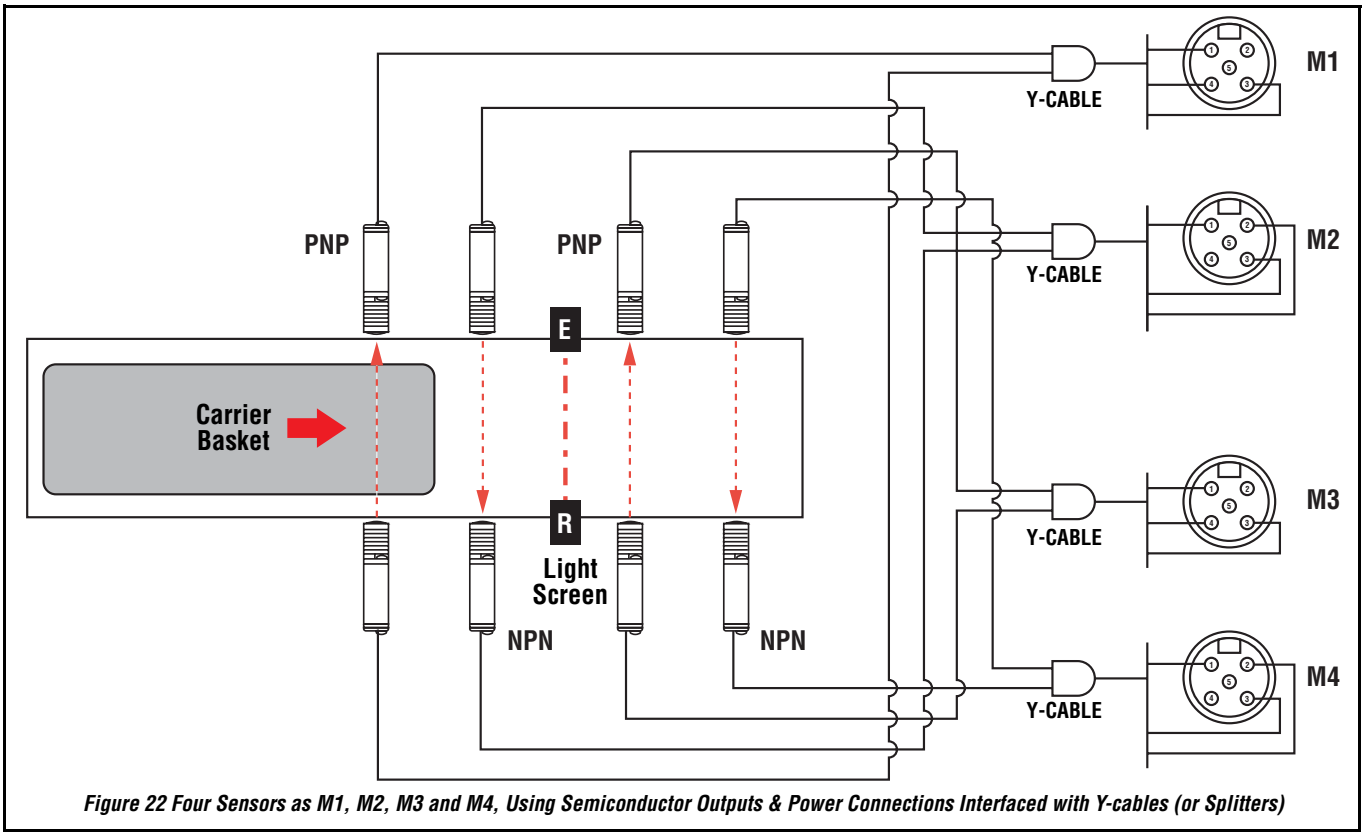


Figure 22 Four Sensors as M1, M2, M3 and M4, Using Semiconductor Outputs & Power Connections Interfaced with Y-cables (or Splitters)

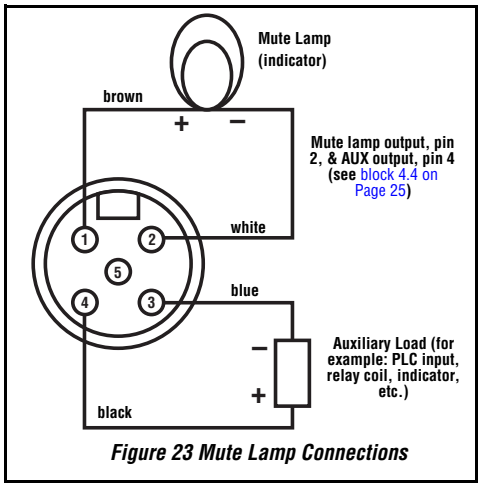


Figure 23 Mute Lamp Connections

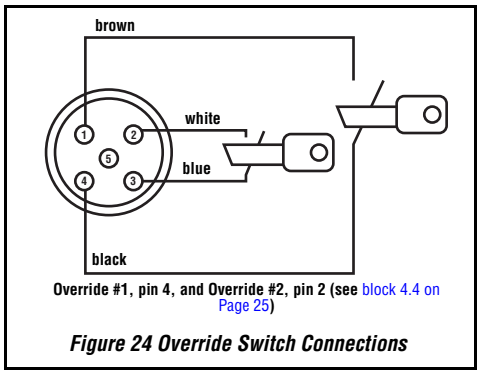
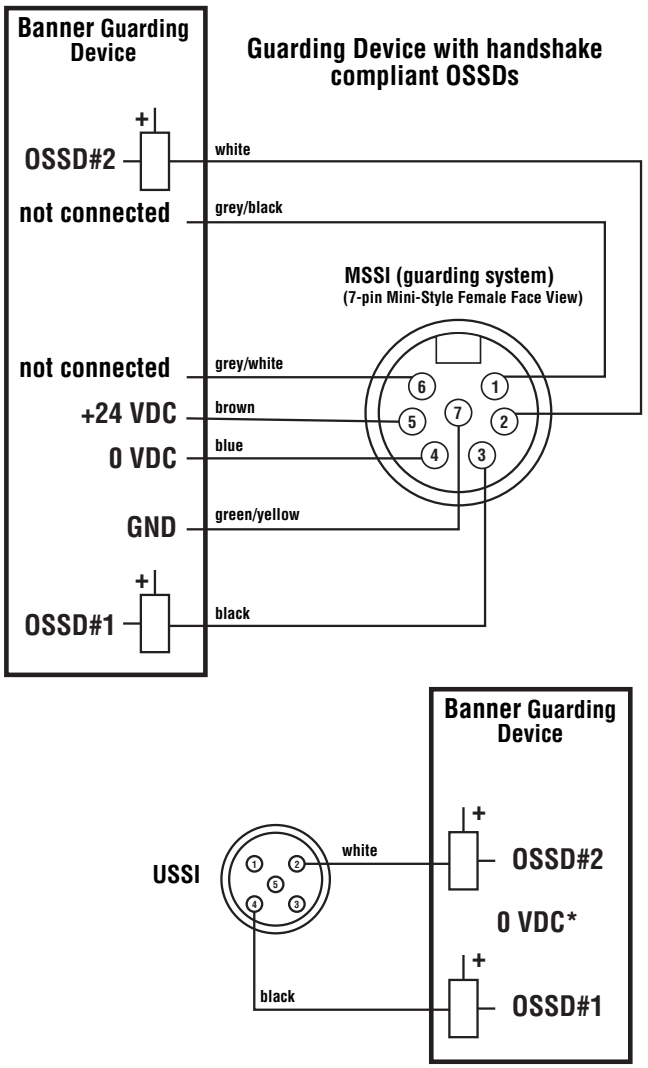


Figure 24 Override Switch Connections



*0 VDC must be common between the two devices. Connection must be made at pin 6 of the Machine Interface connector (blue wire).

Figure 25 USSI & MSSI Interfacing with Banner OSSDs (Muting Module MM-TA-12B)

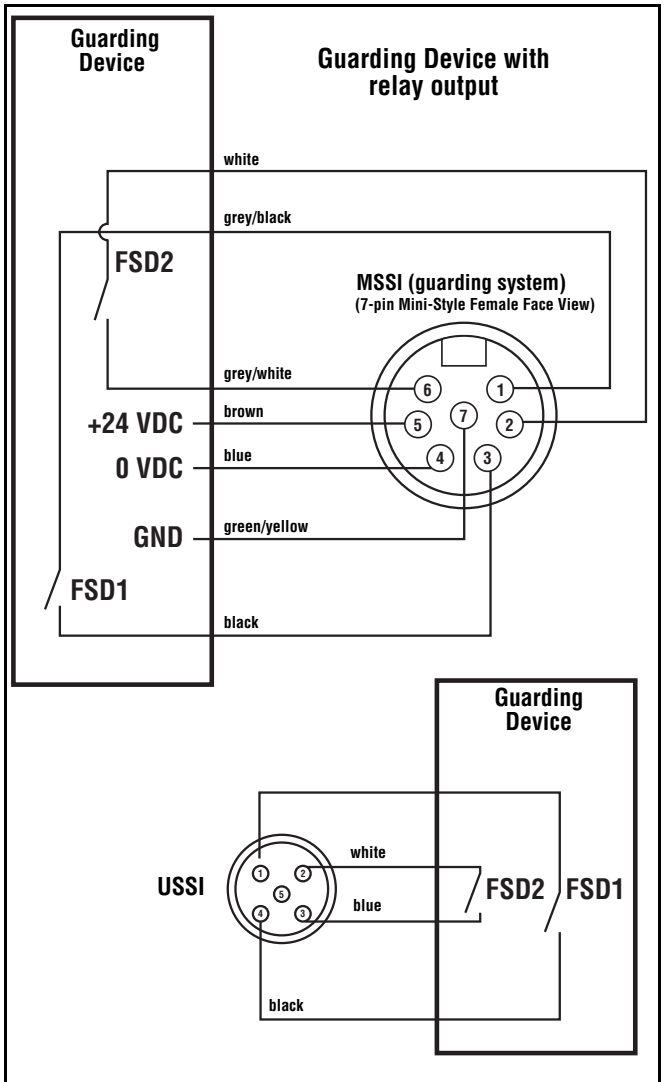
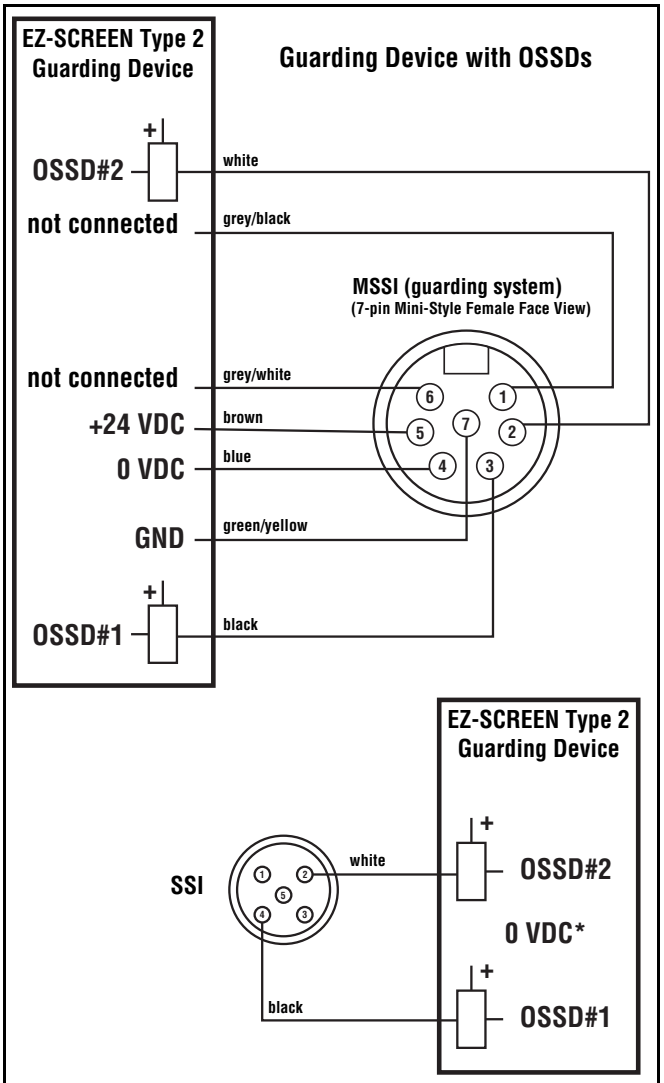


Figure 26 USSI & MSSI Interfacing with Hard Contacts (Muting Module MM-TA-12B)



*0 VDC must be common between the two devices. Connection must be made at pin 6 of the Machine Interface connector (blue wire).

Figure 27 SSI & MSSI Interfacing with Banner OSSDs (Muting Module MM2-TA-12B)

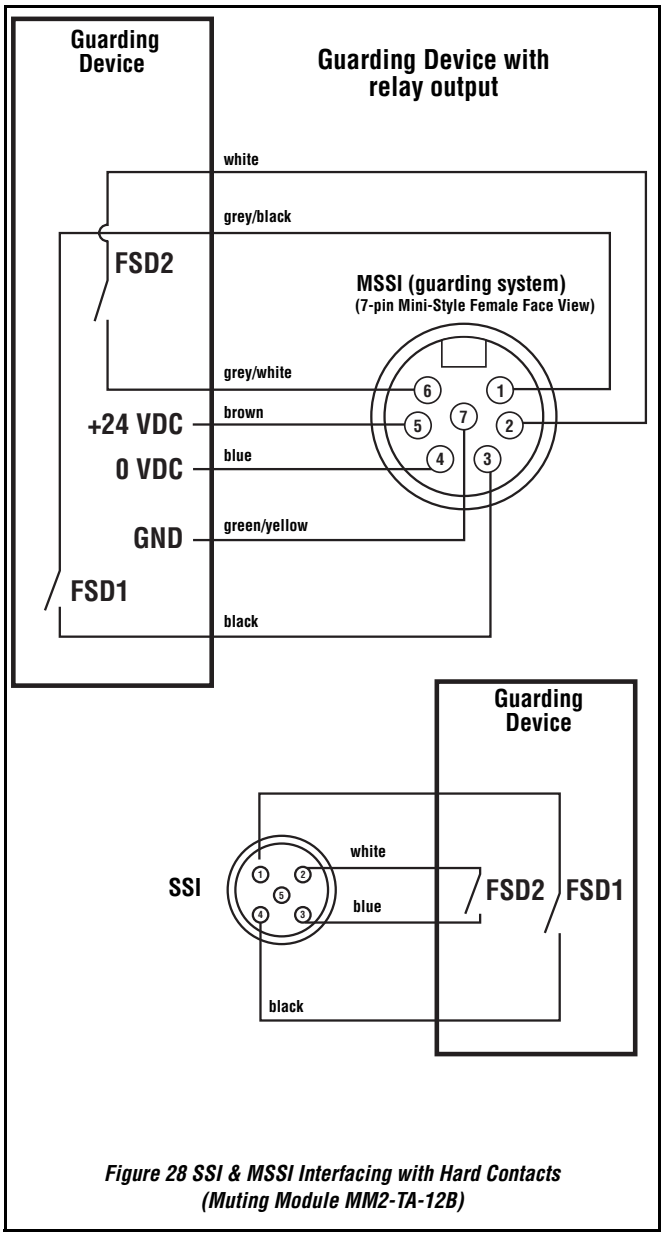
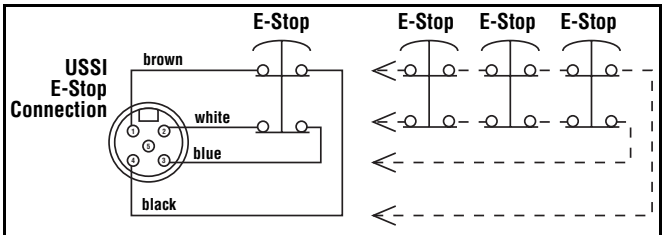
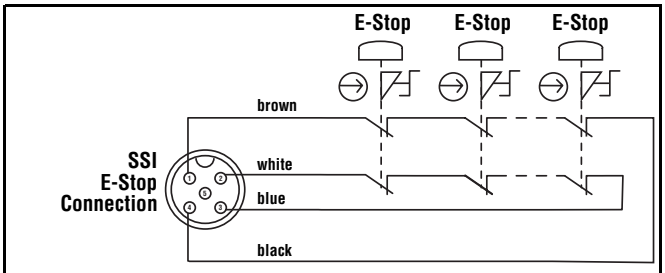


Figure 28 SSI & MSSI Interfacing with Hard Contacts (Muting Module MM2-TA-12B)



SEE WARNING on page 29

Figure 29 USSI E-Stop Switch Connection (Muting Module MM-TA-12B)



SEE WARNING on page 29

Figure 30 SSI E-Stop Switch Connection (Muting Module MM2-TA-12B)

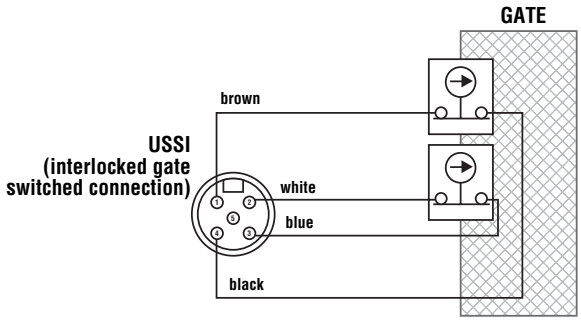
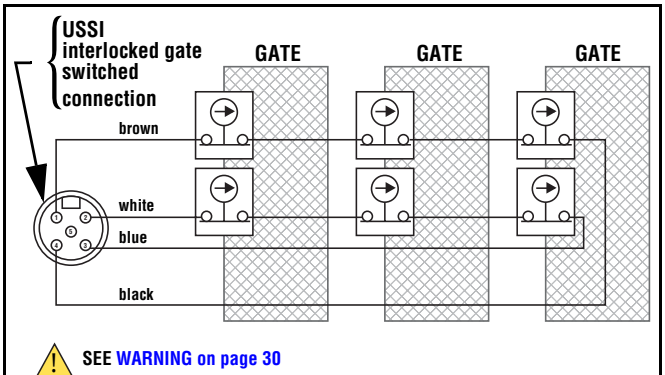


Figure 31 USSI Monitoring X2 Positive-Opening Safety Interlock Switches (Muting Module MM-TA-12B)



SEE WARNING on page 30

Figure 32 USSI Monitoring Positive-Opening Safety Interlock Switches on Multiple Gates (Muting Module MM-TA-12B)

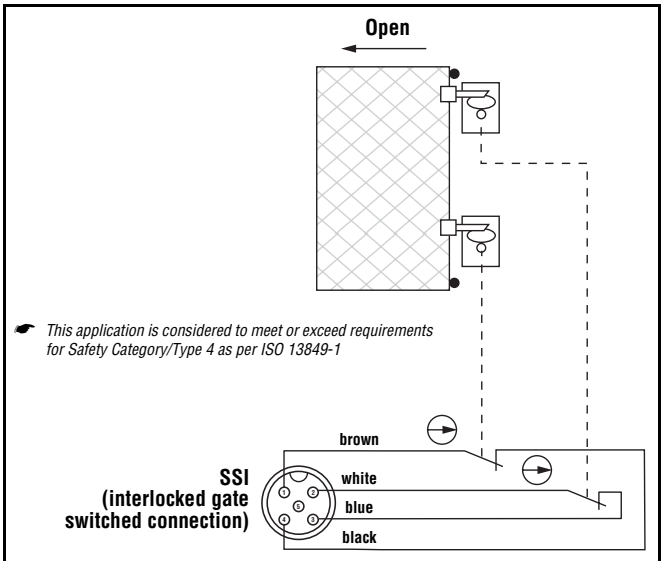
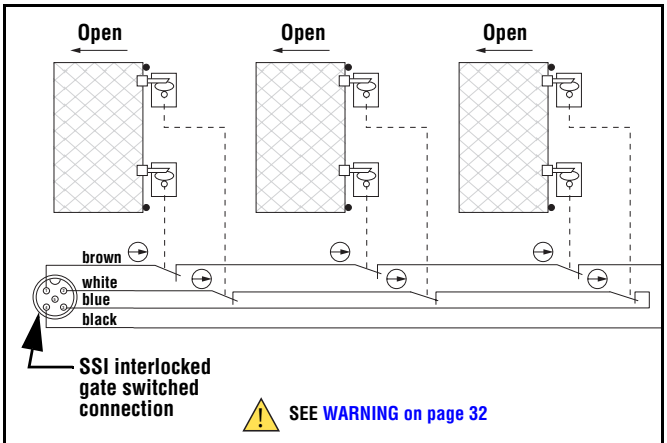


Figure 33 SSI Monitoring X2 Positive-Opening Safety Interlock Switches (Muting Module MM2-TA-12B)



SEE WARNING on page 32

Figure 34 SSI Monitoring Positive-Opening Safety Interlock Switches on Multiple Gates (Muting Module MM2-TA-12B)

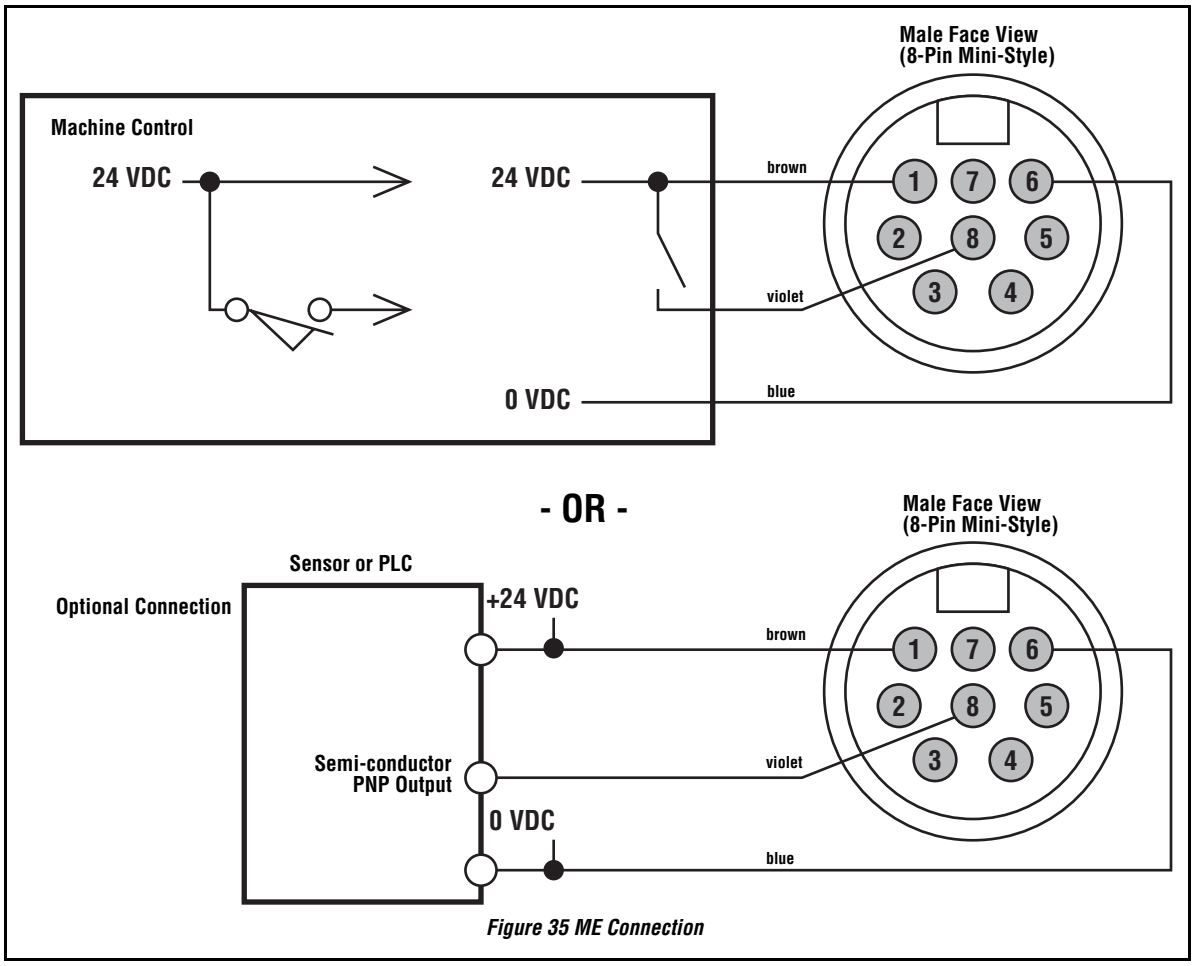
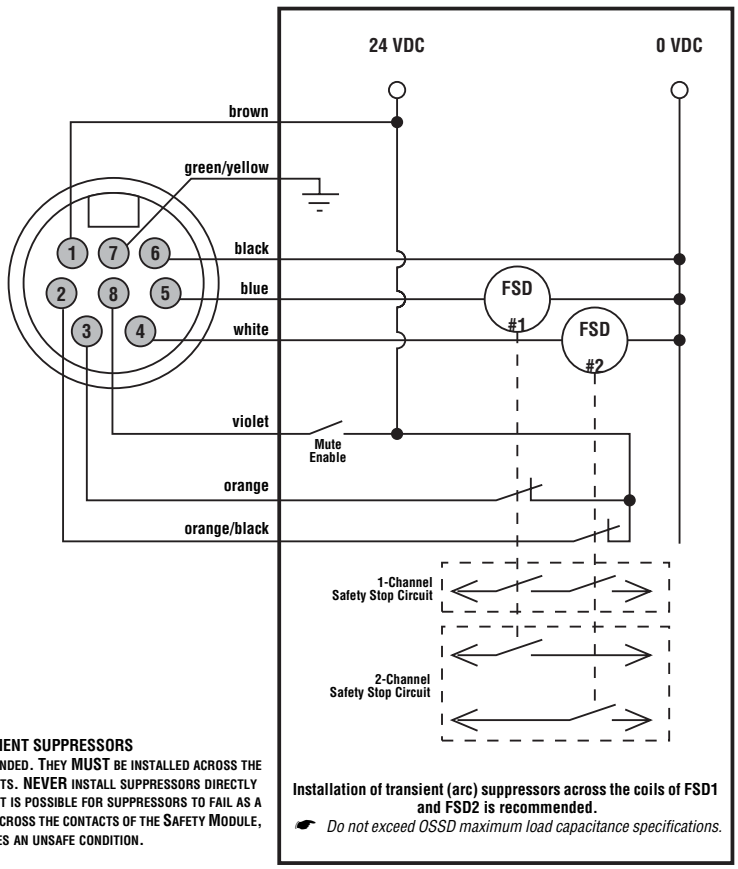


Figure 35 ME Connection

SEE WARNING on page 35 (PROPER WIRING)

SEE WARNING on page 35 (OSSD INTERFACING)

SEE WARNING on page 35 (DO NOT ATTEMPT TO USE SYSTEM)



USE OF TRANSIENT SUPPRESSORS

TRANSIENT SUPPRESSORS ARE RECOMMENDED. THEY MUST BE INSTALLED ACROSS THE COILS OF THE MACHINE CONTROL ELEMENTS. NEVER INSTALL SUPPRESSORS DIRECTLY ACROSS THE OUTPUTS OF THE MODULE! IT IS POSSIBLE FOR SUPPRESSORS TO FAIL AS A SHORT CIRCUIT. IF INSTALLED DIRECTLY ACROSS THE CONTACTS OF THE SAFETY MODULE, A SHORT-CIRCUITED SUPPRESSOR CREATES AN UNSAFE CONDITION.

Installation of transient (arc) suppressors across the coils of FSD1 and FSD2 is recommended.

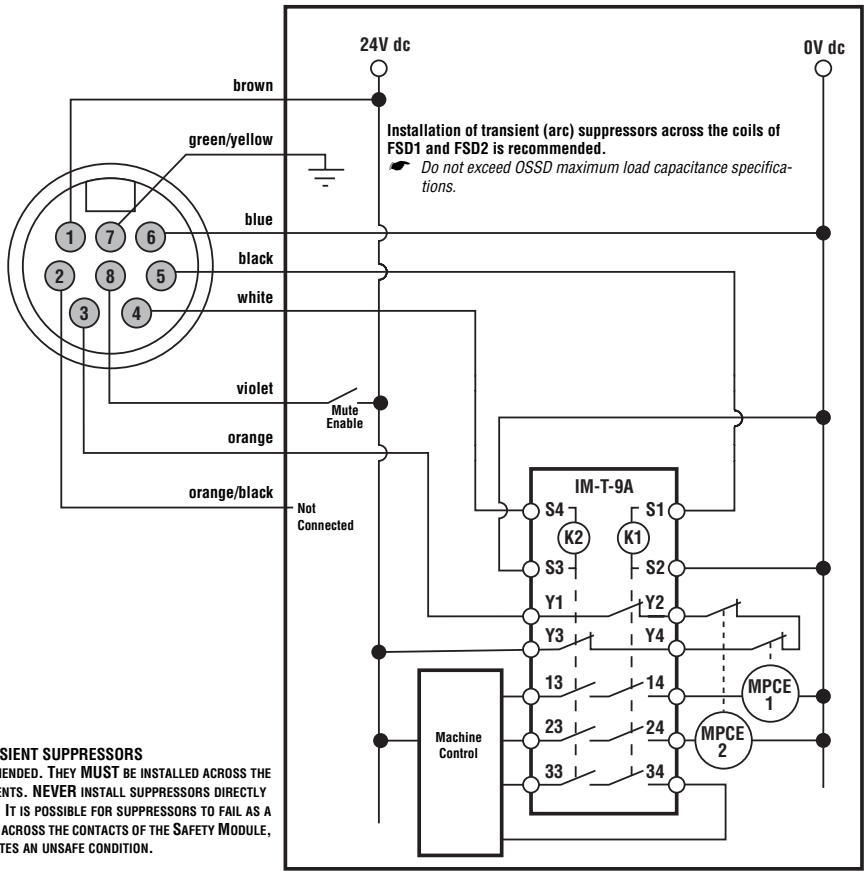
Do not exceed OSSD maximum load capacitance specifications.

Figure 36 FSD, 2-Channel EDM & ME Generic Connection

SEE WARNING on page 35 (PROPER WIRING)

SEE WARNING on page 35 (OSSD INTERFACING)

SEE WARNING on page 35 (DO NOT ATTEMPT TO USE SYSTEM)



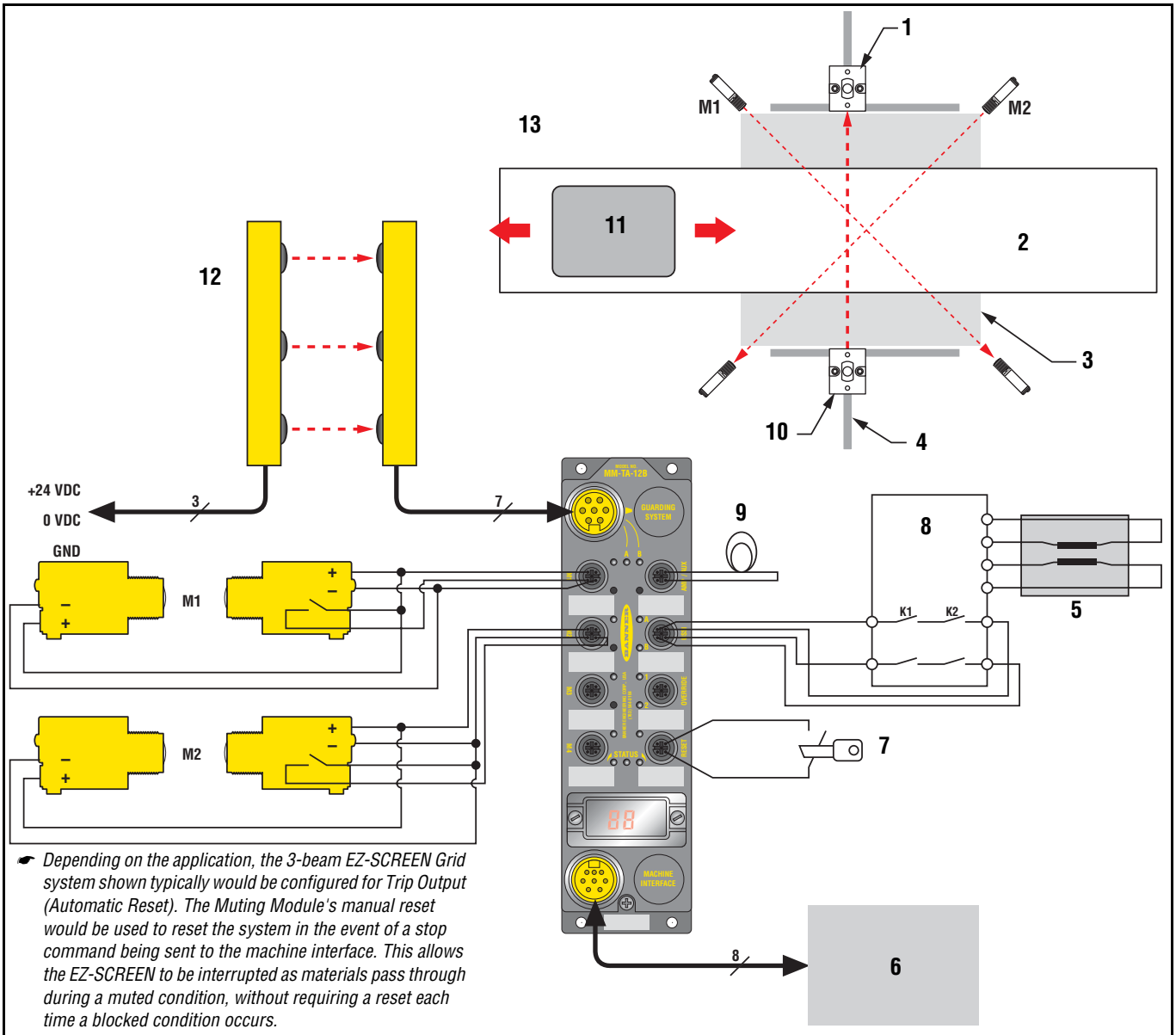
Installation of transient (arc) suppressors across the coils of FSD1 and FSD2 is recommended.

Do not exceed OSSD maximum load capacitance specifications.

USE OF TRANSIENT SUPPRESSORS

TRANSIENT SUPPRESSORS ARE RECOMMENDED. THEY MUST BE INSTALLED ACROSS THE COILS OF THE MACHINE CONTROL ELEMENTS. NEVER INSTALL SUPPRESSORS DIRECTLY ACROSS THE OUTPUTS OF THE MODULE! IT IS POSSIBLE FOR SUPPRESSORS TO FAIL AS A SHORT CIRCUIT. IF INSTALLED DIRECTLY ACROSS THE CONTACTS OF THE SAFETY MODULE, A SHORT-CIRCUITED SUPPRESSOR CREATES AN UNSAFE CONDITION.

Figure 37 Interface Module 1-Channel EDM & ME Generic Connection

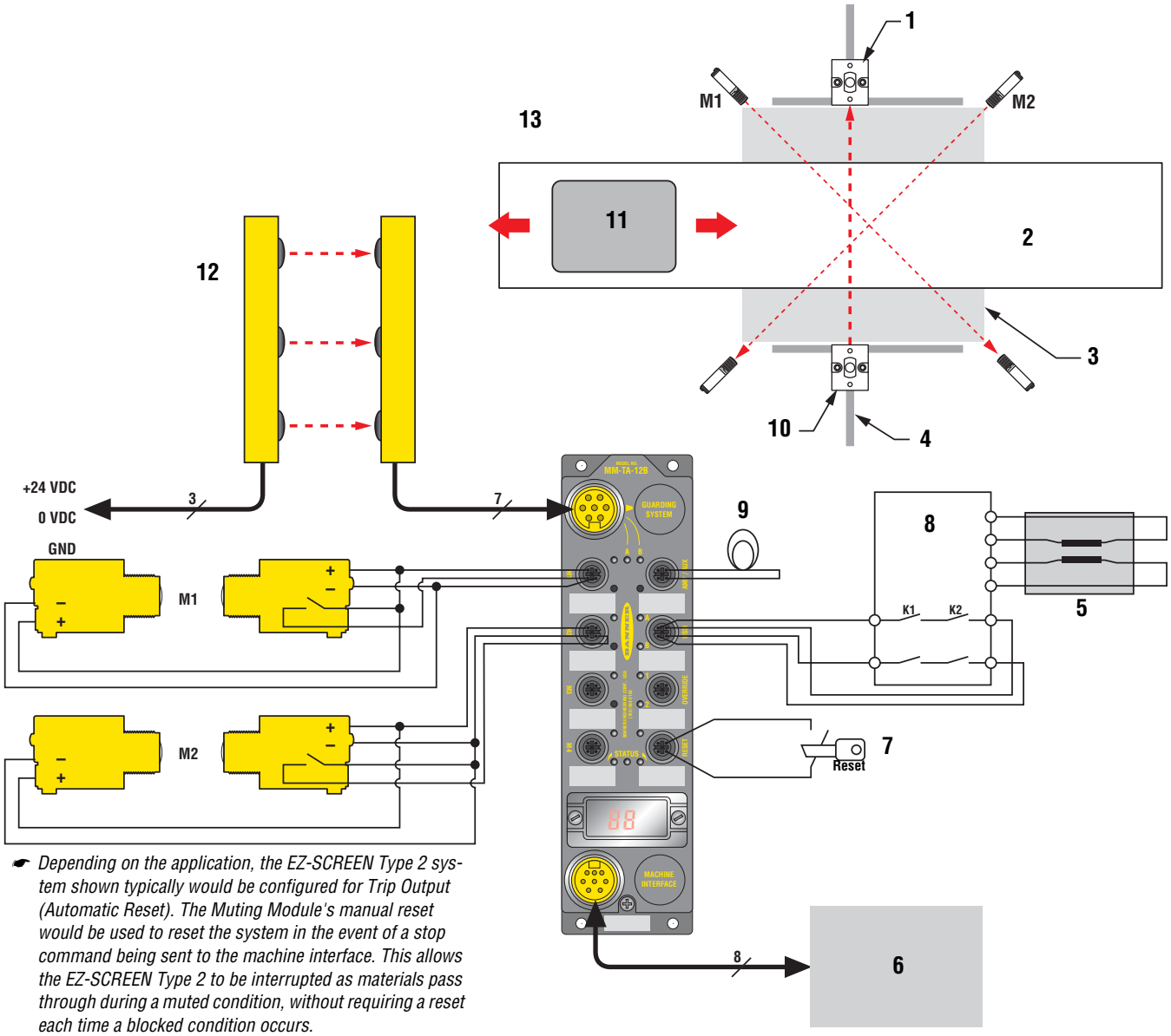


Depending on the application, the 3-beam EZ-SCREEN Grid system shown typically would be configured for Trip Output (Automatic Reset). The Muting Module's manual reset would be used to reset the system in the event of a stop command being sent to the machine interface. This allows the EZ-SCREEN to be interrupted as materials pass through during a muted condition, without requiring a reset each time a blocked condition occurs.

Index to figure

1. EZ-SCREEN Grid Receiver
2. Hazardous Area (protected from personnel entry)
3. Safety Mat (or horizontal-mounted safety light screen)
4. Fixed Guarding
5. 4-Wire Safety Mat (or horizontally-mounted safety light screen
6. Machine interface (see Figure 36 on Page 62 & Figure 37 on Page 62)
7. Reset
8. Safety Mat Monitor Module (or Light Screen Controller)
9. Mute Lamp (indicator)
10. EZ-SCREEN Grid Emitter
11. Carrier Basket
12. 3-Beam EZ-SCREEN Grid (see note)
13. Safe Area (free movement of personnel)

Figure 38 Interfacing Supplementary Guarding to Prevent Personnel from Entering the Hazardous Area During the Mute (Muting Module MM-TA-12B)



Depending on the application, the EZ-SCREEN Type 2 system shown typically would be configured for Trip Output (Automatic Reset). The Muting Module's manual reset would be used to reset the system in the event of a stop command being sent to the machine interface. This allows the EZ-SCREEN Type 2 to be interrupted as materials pass through during a muted condition, without requiring a reset each time a blocked condition occurs.

Index to figure

1. EZ-SCREEN Type 2 Receiver
2. Hazardous Area (protected from personnel entry)
3. Safety Mat (or horizontal-mounted safety light screen)
4. Fixed Guarding
5. 4-Wire Safety Mat (or horizontally-mounted safety light screen
6. Machine interface (see Figure 36 on Page 62 & Figure 37 on Page 62)
7. Reset
8. Safety Mat Monitor Module (or Light Screen Controller)
9. Mute Lamp (indicator)
10. EZ-SCREEN Grid Emitter
11. Carrier Basket
12. EZ-SCREEN Type 2 (see note)
13. Safe Area (free movement of personnel)

Figure 39 Interfacing Supplementary Guarding to Prevent Personnel from Entering the Hazardous Area During the Mute (Muting Module MM2-TA-12B)

A2 MUTE TIMING SEQUENCES

MUTING SEQUENCE WITH TWO MUTING DEVICES (Figure 40 on Page 65**)**

As an example, X-pattern Entry/Exit System (see Figure 42 on Page 67)

DIP Switch Configuration* (refer to block 4.3 on Page 24)

Manual Reset	SW1	= OFF
Monitored Muting Lamp	SW2	= OFF
Two-Way Muting	SW3	= ON
EDM Functional	SW4	= OFF
One-Channel EDM	SW5	= OFF
ME Functional	SW6	= OFF
30 Second Backdoor Timer	SW7 & 8	= OFF

*Both DIP switch Bank A and Bank B.

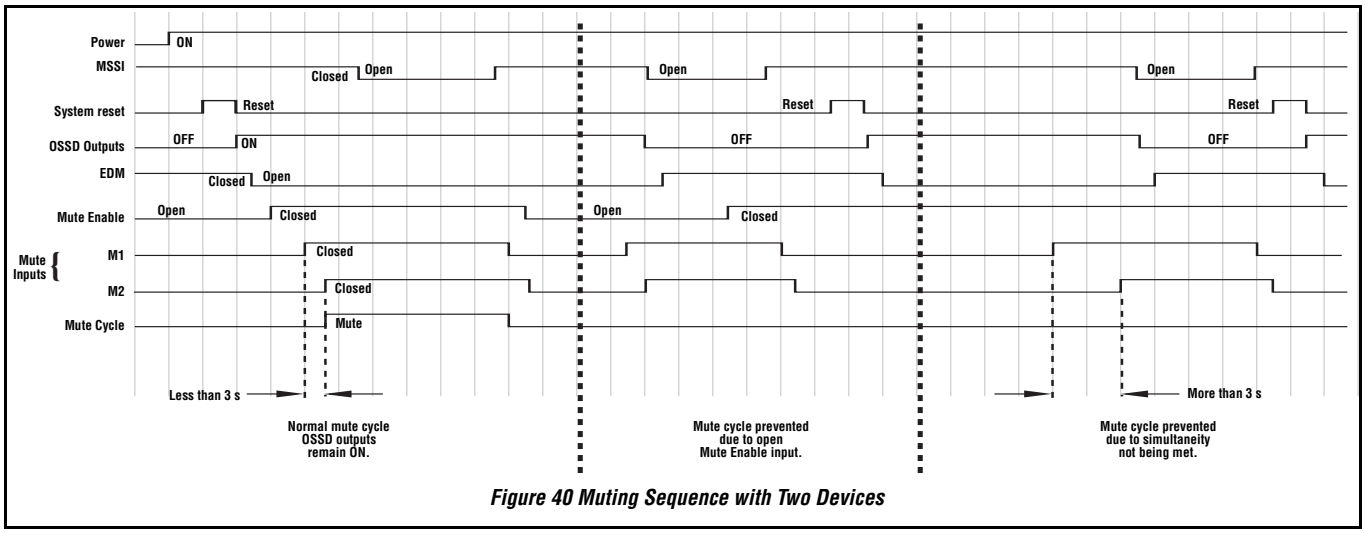


Figure 40 Muting Sequence with Two Devices

MUTING SEQUENCE WITH FOUR MUTING DEVICES (Figure 41 on Page 66**)**

As an example, an Entry/Exit System using x4 photoelectric devices (see Figure 46 on Page 68)

DIP Switch Configuration* (refer to block 4.3 on Page 24)

Manual Reset	SW1	= OFF
Monitored Muting Lamp	SW2	= OFF
Two-Way Muting	SW3	= OFF
EDM Functional	SW4	= OFF
One-Channel EDM	SW5	= OFF
ME Functional	SW6	= OFF
30 Second Backdoor Timer	SW7 & 8 = OFF	

*Both DIP switch Bank A and Bank B.

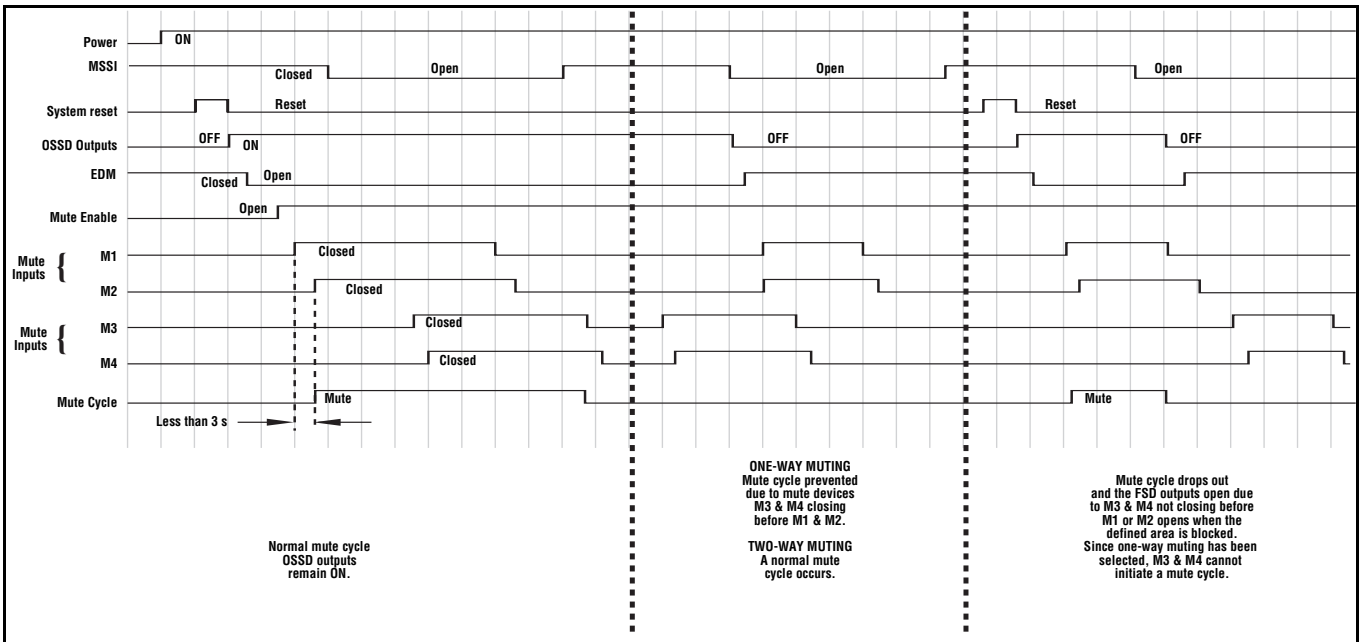


Figure 41 Muting Sequence with Four Devices

A3 TYPICAL MUTING APPLICATIONS

WARNING!

SAFETY CONSIDERATIONS

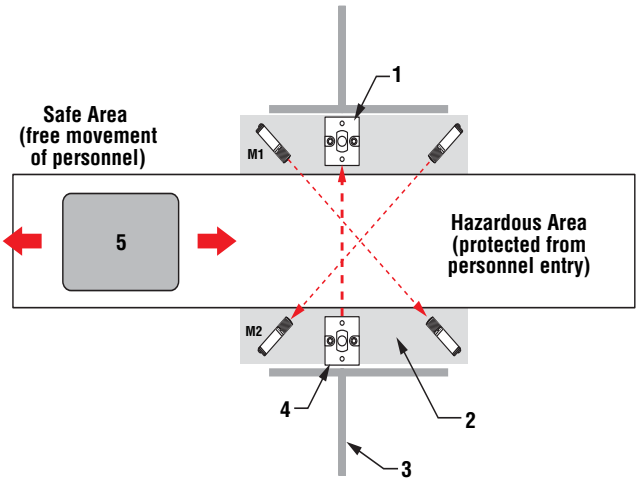
IT MUST NOT BE POSSIBLE FOR AN INDIVIDUAL TO BLOCK BOTH PHOTOELECTRIC BEAMS (DASHED DIAGONAL LINES IN Figure 42 on Page 67) AND INITIATE A MUTE CONDITION. CHECK THE INSTALLATION TO VERIFY THAT UNINTENTIONAL MUTING IS NOT POSSIBLE. THE CROSSING POINT OF THE PHOTOELECTRIC BEAMS MUST BE LOCATED IN THE HAZARDOUS AREA AND NOT BE ACCESSIBLE TO PERSONNEL (BY REACHING OVER, UNDER, THROUGH, OR AROUND). IT MUST NOT BE POSSIBLE FOR PERSONNEL TO WALK IN FRONT OF, BEHIND, OR NEXT TO THE MUTED OBJECT (FOR EXAMPLE, THE CARRIER BASKET) WITHOUT BEING DETECTED AND STOPPING THE HAZARDOUS MOTION. SUPPLEMENTARY GUARDING MUST BE USED TO PREVENT PERSONNEL FROM ENTERING THE HAZARDOUS AREA DURING A MUTE CONDITION.

Entry/Exit Applications

The muting devices must be placed to ensure that the points that trigger the mute's start and end are very close to the safety light screen's sensing field. This prevents personnel from following, or being pushed by, the object into the hazardous area without interrupting the safety light screen before the mute window opens or at the time the mute window closes.

When two pairs of opposed-mode photoelectrics are used as muting devices, as shown in Figure 42 on Page 67, the crossing point of the two sensing paths must be on the hazardous side of the safety light screen. The safety light screen is interrupted before any personnel are able to block both beams and mute the system. The devices should detect the material and not the pallet or the transport in order to delay an individual from riding into the hazardous area.

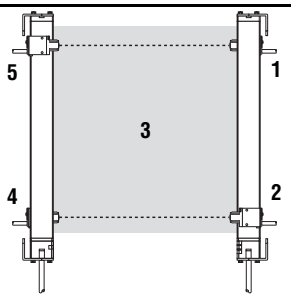
Further examples of different configurations for Entry/Exit applications are shown in Figure 42 on Page 67, Figure 43 on Page 67, Figure 44 on Page 67, Figure 45 on Page 68 and Figure 46 on Page 68.



Index to figure

1. Light screen receiver
2. Safety mat or horizontally mounted safety light curtain
3. Fixed guarding
4. Light screen emitter
5. Carrier basket

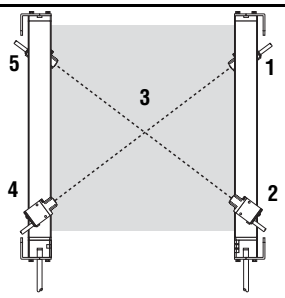
Figure 42 X-Pattern Entry/Exit System Using Two Pairs of Opposed-Mode Photoelectric Muting Devices



Index to figure

1. M1 (emitter not shown)
2. M2 (receiver)
3. Light screen defined area
4. M2 (emitter not shown)
5. M1 (receiver)

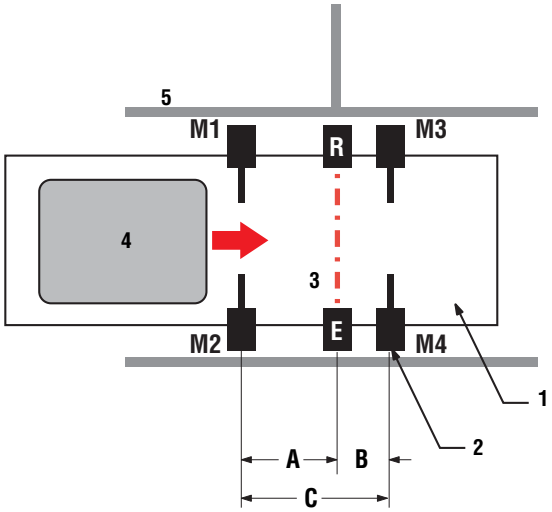
Figure 43 Horizontal Photoelectric Muting Devices Placed at Different Heights



Index to figure

1. M1 (emitter not shown)
2. M2 (receiver)
3. Light screen defined area
4. M1 (receiver)
5. M2 (emitter not shown)

Figure 44 Photoelectric Muting Devices Placed Diagonally



A > (speed of line m/s) x 0.1 s

B ≈ 76 mm (suggested position must delay personnel following muted object)

C < Length of carrier basket

The following criteria apply:

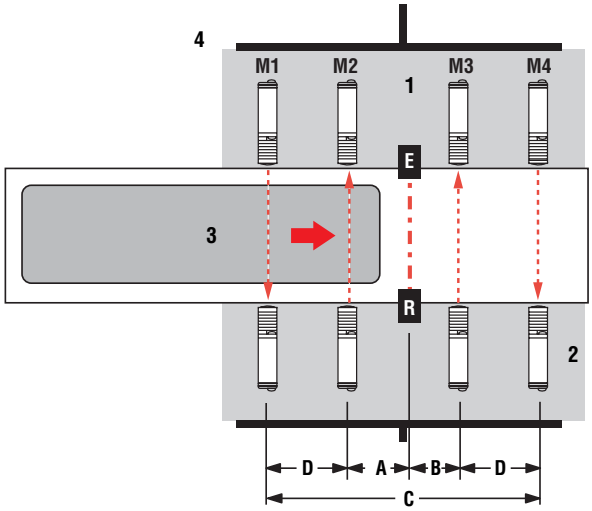
- **Trapping hazards must be avoided and clearance requirements complied with.**
- **Switch actuators can not be so long that they allow a single person to initiate a muted condition.**
- **Polarized-retro reflective (with targets mounted on carrier) and inductive proximity sensors could be used in a similar manner, if an individual can not ride into the hazardous area.**

One-way (directional) muting can be used in Exit applications to reduce the possibility of intentional defeat.

Index to figure

1. Transfer line
2. Whisker/limit switches
3. Light screen
4. Carrier basket
5. Fixed guarding

Figure 45 Entry/Exit System Using Whisker/Limit Switches as Muting Devices



A > (speed of line m/s) x 0.1 s

B ≈ 76 mm (suggested position must delay personnel following muted object)

C < Length of carrier basket

D < (speed of line m/s) x 3.0 s, but beams M1 and M2 must be far enough apart to delay an individual from triggering both sensors.

One-way (directional) muting can be used in Exit applications to reduce the possibility of intentional defeat.

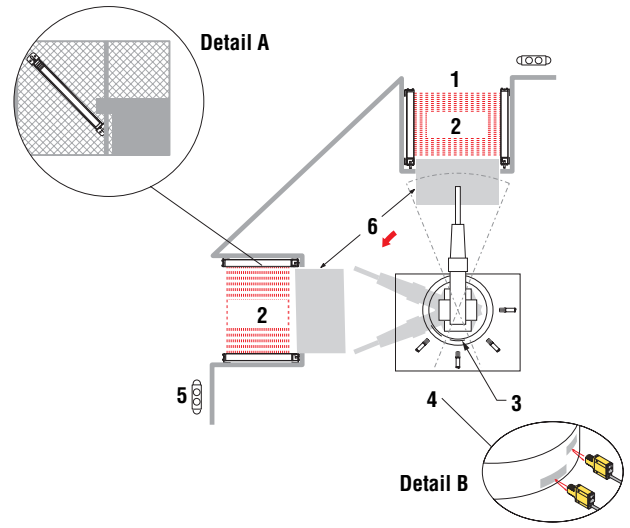
Index to figure

1. Light screen
2. Safety mat
3. Carrier basket
4. Fixed guarding

Figure 46 An Entry/Exit System Using Four Photoelectric Sensors as M1, M2, M3 and M4

Robot Load/Unload Station Application (Type MM-TA-12B only)

This Station muting application uses two independent safety light screen circuits, each with its own muting circuit and muting devices (for example; polarized-retro reflective photoelectrics). The application also includes run bars with two-hand control, auxiliary controls, and E-Stop. The two-hand control is provided at each station to safeguard the operator during the momentary clamping action of the fixture while the safety light screen is muted.



Index to figure

1. Station A
2. Angled light screen
3. Retrospectively targets
4. M1B & M2B Station B Mute Circuit
5. Station B (run-bar with 2-hand control, E-stop, & clamping manual release
6. Clamping & welding fixtures

Figure 47 Robot Load/Unload Application with Two-Station Home-Position Muting, Using Polarized Retro Reflective Photoelectrics as Muting Devices (Type MM-TA-12B only).

In Figure 47 on Page 69, the safety light screens are angled outwards (see Detail A). This provides proper MINIMUM SAFETY DISTANCE from the hazards created by the robot and the clamping/welding fixtures, while protecting against the possibility of Pass-through Hazards. In muting applications involving an operator, the operator must be continually detectable by the defined area. This ensures that if a hazard arises, causing the mute to end while the operator is present, the safety light screen immediately issues a stop command.

While the robot is at Station A, the light screen at Station B is muted (M1B and M2B are active), allowing the operator to load or unload without issuing a stop command to the robot. As the robot moves out of the A work envelope (as defined by Station B mute devices, see Detail B) the mute discontinues at Station B. If the operator is still within the protected area, a stop command is immediately issued. As the robot moves to the work envelope of Station B, the mute devices M1A and M2A activate and mute the safety light screen at Station A.

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A4 GLOSSARY & ABBREVIATIONS

List of Abbreviations

DIS Development Information System

EDM External Device Monitoring

FMEA Failure Mode & Effects Analysis

FSD Final Switching Device

IEC International Electro-technical Commission

IP… Ingress Protection (Class)

ISO International Organisation for Standardisation

EN Engineering Norm

ESPE Electro-sensitive Protective Equipment

LED Light Emitting Diode

ME Mute Enable

ML Mute Lamp

MSSI Mutable Safety Stop Interfaces

MPCE Machine Primary Control Element

OSSD Output Signal Switching Device

PLC Programmable Logic Controller

prEN preliminary Engineering Norm

PSSD Presence Sensing Safeguarding Device

PSDI Presence-Sensing-Device Initiation

QD Quick Disconnect

SFI Safety, Fibre Interlock (switch series)

SSI Safety Stop Interface

USSI Universal Safety Stop Interface

VAC Voltage Alternating Current

VDC Voltage Direct Current

Glossary of Terms

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 checkout procedure (see Designated Person as specified in block 1.9).

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

E-stop Special switch push button positioned in strategic locations and used for shutting off electrical power and motion in an emergency to the machine.

Excess Gain Term used in detecting sufficient light signal intensity in an optical fibre circuit. Can be construed as the amount of light that reaches the receiver which is in excess of the minimum required to be detected for correct operation of the circuit.

External Device Monitoring This feature allows the Muting Module to monitor the status of external devices, such as MPCEs.

Failure Mode and Effects Analysis (FMEA) 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. Banner Muting Module are extensively FMEA tested.

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

Fixed Guarding/Hard Guarding Screens, bars, or other mechanical barriers that prevent a person from entering or remaining in the hazard area undetected.

False Proxing Sensor activation due to shiny or reflective surfaces.

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 Muting Module.

Latch Condition The response of the OSSD outputs (they turn OFF) when an object blocks/interrupts a light beam of the Muting Module operating in Latch mode. A manual reset must be performed after all objects are removed (beam(s) clear) to reset the output latch and allow the outputs to turn ON.

Lockout condition A condition of the Muting Module that is automatically attained when the System detects internal or certain external errors. A lockout condition causes all of the Muting Module OSSD outputs to turn or remain OFF, sending a stop signal to the guarded machine. To restore the Muting Module to Run mode, all errors must be corrected and a manual reset must be performed.

Machine Primary Control Element (MPCE) An electrically powered element, external to the Muting Module 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 Muting Module OSSDs and the instant when the dangerous parts of the machine reach a safe state by being brought to rest.

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).

MPCE Monitor Contacts The normally closed contacts of a guarded machine's MPCEs which are connected to the Muting Module EDM inputs. These contacts must be mechanically linked to the control elements (forced-guided).

Muting Refers to the automatic suspension of the guarding function of the primary guarding during a non-hazardous portion of the machine cycle. During the non-hazardous portion of the machine cycle, personnel are not exposed to harm.

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

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

Output Signal Switching Device (OSSD) The component of the electro-sensitive protective equipment (ESPE) connected to the control system of the machine which, when the sensing device is operated normally, responds by going to the OFF-state.

Point Of Operation The area of the guarded machine where a workpiece is positioned and a machine function (for example: shearing, forming, punching, assembling, welding) is performed upon it.

Positive Opening Switch Term used with reference to E-Stops. A mechanical force applied to such a button (or switch) is transmitted directly to the contacts, forcing them open without the use of springs. This ensures that the switch contacts open whenever the switch is activated even if a contact has welded closed.

Presence-Sensing-Device Initiation (PSDI) 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 hazardous 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. Banner Muting Module may not be used as PSDI devices on mechanical power presses.

Qualified Person A person or persons who, by possession of a recognized degree or certificate of professional training, or who, by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work (see Qualified Person as specified in block 1.9 on Page 4).

Remote Display Optional component used for remotely displaying a duplicate version of the information that is displayed on the Muting Module itself.

Reset The use of a manually operated switch to restore the OSSDs to the ON state from a lockout or a latch condition.

Response Time The time between the physical initiation of the safety device and the machine coming to a stop or the risk being removed.

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 Muting Modules are self-checking.

Simultaneity Requirement The requirement for a pair of electrical devices to be activated within at least 3 seconds of each other.

Supplementary Guarding Additional electro-sensitive safety device(s), and/or fixed guarding measures, used for the purpose of preventing a person from entering or remaining in the hazard area undetected.

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 71.

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