MiniSafe 4800 Series Safety Light Curtains

Installation and Operating Manual

Important Note:

This manual provides installation and operating information on the following models:

Where information is common to all models the term “MS4800 system” will be used. Where information is given for a specific model the model number will be used.

Advanced	Basic	Standard
MiniSafe MS4800A-14	MiniSafe MS4800B-14	MiniSafe MS4800S-14
MiniSafe MS4800A-20	MiniSafe MS4800B-20	MiniSafe MS4800S-20
MiniSafe MS4800A-30	MiniSafe MS4800B-30	MiniSafe MS4800S-30
MiniSafe MS4800A-40	MiniSafe MS4800B-40	MiniSafe MS4800S-40
MiniSafe Cascaded MSF4800A-14	MiniSafe Cascaded MSF4800B-14	MiniSafe Cascaded MSF4800S-14
MiniSafe Cascaded MSF4800A-20	MiniSafe Cascaded MSF4800B-20	MiniSafe Cascaded MSF4800S-20
MiniSafe Cascaded MSF4800A-30	MiniSafe Cascaded MSF4800B-30	MiniSafe Cascaded MSF4800S-30
MiniSafe Cascaded MSF4800A-40	MiniSafe Cascaded MSF4800B-40	MiniSafe Cascaded MSF4800S-40

MS4800 Series Safety Light Curtain

Contents

Figures

Tables

1 IMPORTANT SAFETY WARNINGS

1

⚠ *WARNING!* ***Read and understand this section prior to installing an MS4800 system.***

An MS4800 system is a general purpose presence sensing device designed to guard personnel working around moving machinery.

Whether a specific machine application and MS4800 system installation complies with safety regulations depends on the proper application, installation, maintenance and operation of the MS4800 system. These items are the responsibility of the purchaser, installer and employer.

The employer is responsible for the selection and training of personnel to properly install, operate, and maintain the machine and its safeguarding systems. An MS4800 system should only be installed, verified and maintained by a *qualified* person. A qualified person is defined as "*an individual who understands, is trained on, and demonstrates competence with the construction, operation or maintenance of the machinery and the hazards involved.*" (ANSI/PMMI B155.1-2006)

To use an MS4800 system the following requirements must be met:

— The guarded machine must be able to stop anywhere in its cycle. Do not use a safety light curtain on a press with a full-revolution clutch.

— The guarded machine must not present a hazard from flying parts.

— The guarded machine must have a consistent stopping time and adequate control mechanisms.

— Severe smoke, particulate matter and corrosives may degrade the efficiency of a safety light curtain. Do not use an MS4800 system in this type of environment.

— All applicable governmental and local rules, codes, and regulations must be satisfied. This is the employer's responsibility.

— All safety-related machine control elements must be designed so that an alarm in the control logic or failure of the control circuit does not lead to a failure to danger.

— Additional guarding may be required for access to dangerous areas not covered by the MS4800 system.

— Perform the Omron STI test procedure at installation and after maintenance, adjustment, repair or modification to the machine controls, tooling, dies or machine, or the MS4800 system.

— Perform only the test and repair procedures outlined in this manual.

— Follow all procedures in this manual for proper operation of the MS4800 system.

The enforcement of these requirements is beyond the control of Omron STI. The employer has the sole responsibility to follow the preceding requirements and any other procedures, conditions and requirements specific to his machinery.

2 SIGNIFICANT FEATURES

2

The MS4800 light curtain family is available in three versions. These versions are identified as the MS4800A, MS4800B and the MS4800S. The set-up of the MS4800 A and B versions can be changed through the use of an external device called the Programming and Diagnostic Module (PDM). The MS4800S is configured through selector switches located under an access cover.

2.1 MS4800 SERIES FEATURE COMPARISON

Table 2-1 Feature Comparison

Feature	MS4800A	MS4800B	MS4800S
Flex Bus, Multi-Segmented Head Configurations	X	X	X
Scan Code for Cross-Talk Mitigation	X*	X*	X
EDM External Device Monitoring (MPCE Monitoring)	X**	X**	X
PDM (Programming & Diagnostic Module) Port	X	X	
Adjustable Mounting Brackets and T-slots	X	X	X
Non-shielded Main Cables	X	X	X
2-box Design	X	X	X
Two PNP Safety Outputs	X	X	X
Operating Mode	X*	X*	X
Machine Test Signal (MTS)	X*	X*	X
Auxiliary Output (PNP or NPN)	X*	X (PNP/Follow only)	X (PNP/Follow only)
Muting through RM-6 Resource Module	X*		X***
Floating Blanking	X*		X
Fixed Blanking	X*		X
Monitored Blanking	X*		
Reduced Resolution	X*		
Range Selection	X*	X*	X
Start Input Type	X*		
Response Time Adjustment	X*		
* Configured via the use of the Programming and Diagnostic Module (PDM) ** Configured via the PDM or wiring connections. *** Simple two sensor muting			

3 System Components and Indicators

3

Table 3-1 System Components Identification

Chart #			Chart #		
1	**RECEIVER**		**7**	**TRANSMITTER**	
2	Individual Beam Indicators (one for each beam) - Red		8	Detection Zone	
3	Blanking Active - Amber		9	Flip door. Access to configuration switches (on both receiver & transmitter) MS4800S version only	
4	INTERLOCK or ALARM Indicator - Yellow		10	Programming Port for PDM (on both receiver & transmitter) MS4800A and B versions only	
5	MACHINE RUN/STOP Indicator - Green/Red		11	Status Indicator - Yellow	
6	**RECEIVER CONNECTIONS M-12 (Male)**		12	Side Mounting T-Slot	
	1	+24 VDC - Brown Wire	13	**TRANSMITTER CONNECTIONS M-12 (Male)**	
	2	0 VDC - Blue Wire		1	0 VDC - Blue Wire
	3	Earth - Green Wire		2	+24 VDC - Brown Wire
	4	OSSD 2 - White Wire		3	MTS - White Wire
	5	Start or EDM (Mode Select) - Yellow Wire		4	MTS Return - Black Wire
	6	EDM - Red Wire		5	Earth - Green Wire
	7	Auxiliary Out - Pink Wire			
	8	OSSD 1 - Black Wire			

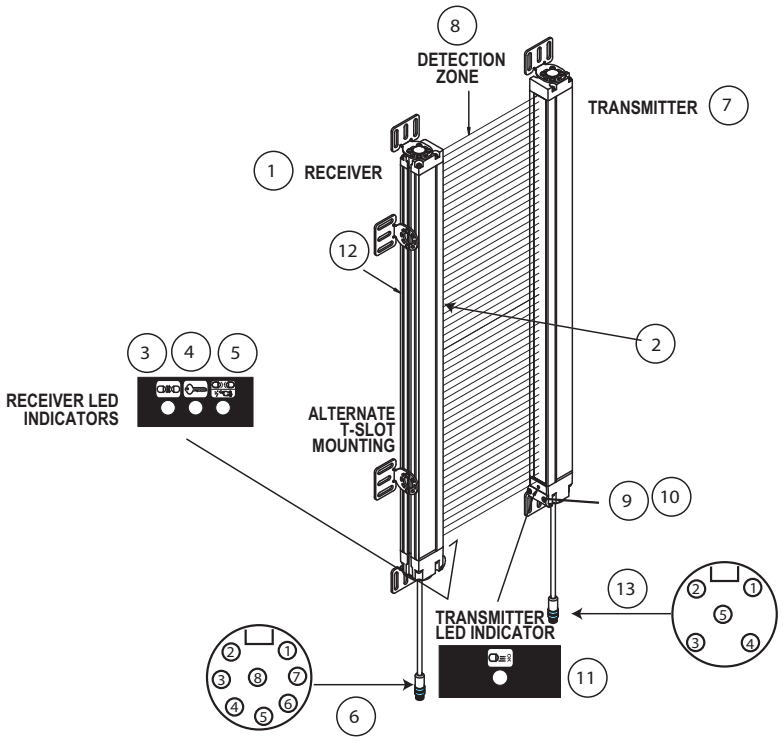


Figure 3-1 System Components

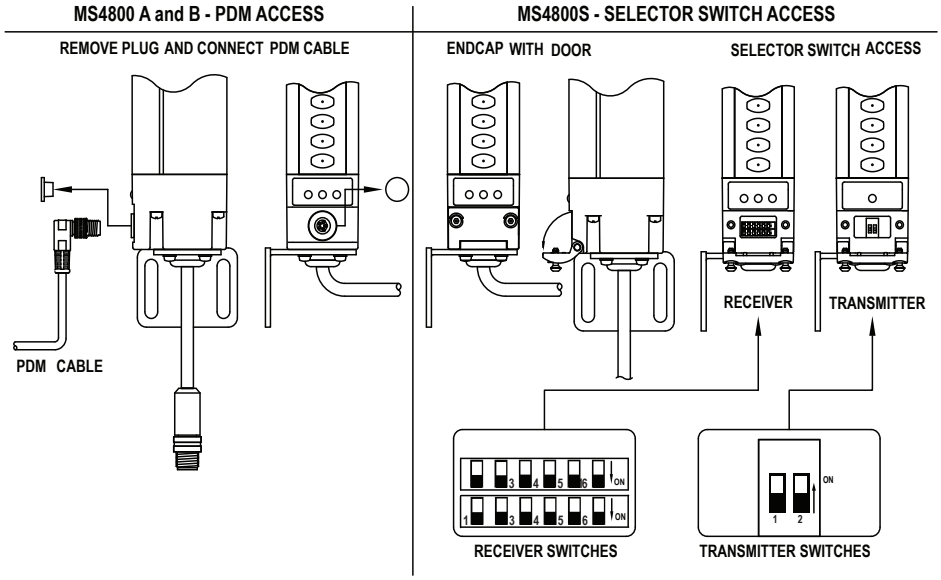


Figure 3-2 MS4800 Access to Features

4 SYSTEM OPERATION

4

The MS4800 system is a microprocessor-controlled, infrared, transmitted-beam safety light curtain. The system consists of a receiver assembly and a transmitter assembly. The receiver and transmitter assemblies are not physically interconnected.

An MS4800 system is used where personnel protection is required. Typical applications include mechanical power presses, robotic work cells, filter presses, injection molders, food processing equipment and automated assembly equipment.

4.1 OPERATING STATES

The operating condition of an MS4800 system is described in terms of states. The following operating states exist for an MS4800 system.

4.1.1 MACHINE RUN

The two receiver safety outputs are in the ON state, the green MACHINE RUN indicator is lit, and the auxiliary output is in a state consistent with its configuration. The protected machine is allowed to operate. Pressing and releasing the start button has no effect.

4.1.2 MACHINE STOP

The two receiver safety outputs are in the OFF state, the red MACHINE STOP indicator is lit, and the auxiliary output is in a state consistent with its configuration. The protected machine is not allowed to operate.

4.1.3 INTERLOCK

The two receiver safety outputs are in the OFF state, the red MACHINE STOP indicator and yellow INTERLOCK indicator are lit. The auxiliary output is in a state consistent with its configuration. The INTERLOCK state does not allow the protected machine to operate until the detection zone is clear of obstructions and the start button is pressed and released.

4.1.4 ALARM

The two receiver safety outputs are in the OFF state, the red MACHINE STOP indicator is lit, the yellow INTERLOCK indicator is flashing, and the auxiliary output is in the OFF state. The alarm state does not allow the protected machine to operate. The primary difference between alarm and INTERLOCK is that the MS4800 system will remain in the alarm state until the alarm is corrected, regardless of power cycling or an external start button press and release.

4.2 OPERATING MODES

System operating modes determine the start-up and operating behavior of an MS4800 system. Operating mode definitions rely on the operating states presented above. Operating mode selection may be performed via a Programming and Diagnostics Module (PDM) on the MS4800A and MS4800B or via configuration switches on the MS4800S in the receiver and transmitter.

NOTE! If internal alarms are detected by the system during power-up or operation, it will enter the ALARM state with its safety outputs in the OFF state.

4.2.1 AUTOMATIC START

Automatic Start is available on MS4800A, MS4800B and MS4800S systems.

The MS4800 will power-up with its safety and auxiliary outputs OFF, and, if the detection zone is not obstructed, enters the MACHINE RUN state. In this state, when an object is sensed entering the detection zone, the MS4800 system will change from MACHINE RUN to MACHINE STOP and remain in this state until the obstruction is removed. Once the detection zone is clear, the MS4800 system will automatically change from MACHINE STOP to MACHINE RUN.

4.2.2 START INTERLOCK

Start Interlock is only available on MS4800A systems.

The MS4800A will power up with its safety outputs off and enter the INTERLOCK state if the detection zone is clear (or the Fixed or Monitoring Blanking pattern is satisfied, if enabled) and no alarms are detected. To initially enter the MACHINE RUN state the operator must press and release the Start button. Once in the MACHINE RUN state, when an object is sensed entering the detection zone, the system will change to MACHINE STOP state. When the detection zone is cleared, the system will automatically change to MACHINE RUN.

4.2.3 START/RESTART INTERLOCK

Start /Restart Interlock is available on MS4800A, MS4800B and MS4800S systems.

The MS4800 will power up with its safety outputs off and enter the INTERLOCK state if the detection zone is clear (or the Fixed or Monitoring Blanking pattern is satisfied, if enabled) and no alarms are detected. To initially enter the MACHINE RUN state the operator must press and release the Start button. Once in the MACHINE RUN state, when an object is sensed entering the detection zone, the system will change to the MACHINE STOP state. When the detection zone is cleared, the system will not automatically change to MACHINE RUN but enter the INTERLOCK state instead. The operator must always press and release the Start button to enter MACHINE RUN. If the detection zone is not clear the Start button will have no effect.

NOTE! The definitions above mention a start button. See Section 12–"Connecting to the Machine Control Circuit" for wiring of the start button.

4.3 MSF4800 CASCADED SERIES

The MiniSafe 4800 series safety light curtain is available in a "cascaded" version, referred to as the MSF4800 series. The MSF4800 series allows multiple transmitters/receivers to be "daisy-chained" in series. This type of arrangement permits the MSF4800 to guard multiple areas of a machine.

4.3.1 MSF4800 REQUIREMENTS

The MSF4800 is offered in protective heights ranging from 240mm to 1800mm for 14/20mm resolutions, 240mm to 2120mm for 30mm, and resolutions and from 360mm to 2040mm for 40mm resolutions.

- An MSF4800 system has a maximum size limitation based on the number of beams. A single master segment cannot exceed 180 beams and the total of the combined segments cannot exceed 256 beams.
- A single slave segment cannot exceed 128 beams.
- An MSF4800 system may have up to four daisy-chained segments, including the first segment. As long as the total number of beams does not exceed 256.
- The interconnect cable length limitation between any two segments is 10 meters.
- It is possible to mix segments with different resolutions within an MSF4800 system.

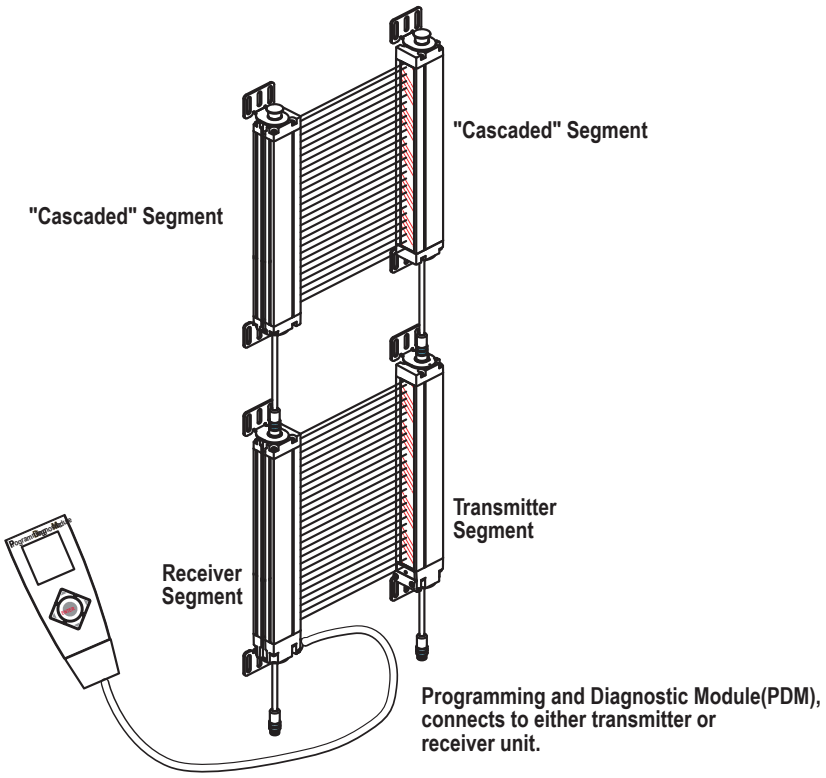


Figure 4-1 Connecting PDM to MSF4800

4.3.2 MSF4800 Segment Reduction Restart procedure

If you reduce the number of cascaded segments while power is on, you cause a flex bus fault. The MSF4800 will enter a fault condition, indicated by error code “95” on the PDM and on the IBIs as well. After power cycling the system to clear the flex fault, fault code “100” will be displayed. If the number of segments is reduced while power is off, the light curtain will power on with fault code “100”. This fault code indicates that there was a reduction in the number of cascaded segments. There are two possible methods to clear this fault and restore operation on the reduced size MSF4800. The PDM or the Start input line can be used.

When a PDM is available, the fault code "100" will be cleared when you load the configuration from the light curtain and save the new reduced system configuration.

If a PDM is not available the start input can be used. The start switch needs to be pressed while the power is applied. The three indicator LEDs (red, yellow, amber) will flash for approximately three seconds. The start switch must be released within 2 seconds, while the LEDs are flashing to clear fault code “100”. Since the MSF4800 has a configurable start input, care must be taken to ensure that the correct contact configuration is used and that it is wired properly.

The transmitter will not fault if the number of segments is reduced. However, to operate normally the transmitter must always match the receiver in the number of segments and beams.

5 DETECTION OPTIONS

5

⚠ *Warning!* ***Use of Fixed or Floating Blanking, Floating Blanking and Reduced Resolution will make an MS4800 system less sensitive to objects in the detection zone. Improper use of these features can result in severe injury to personnel. Fixed Blanking may require a hard barrier guard. Fixed Blanking, Floating Blanking and Reduced Resolution may require an increase in the safety distance. Read the following section carefully.***

5.1 FIXED BLANKING

Fixed Blanking is only available on MS4800A and MS4800S systems.

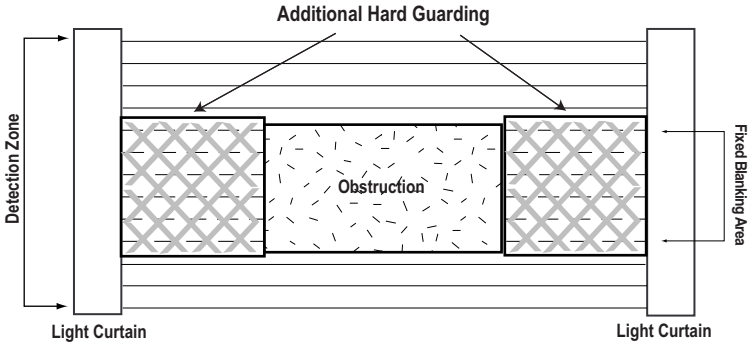


Figure 5-1 Adding Hard Guarding to Light Curtain when Using Fixed Blanking

Fixed Blanking allows a system to blank optical beams and record the exact pattern. A system can record and store a single pattern. The protected zone's object detection is then based on the stored pattern. All obstructed optical beams recorded during the selection must remain blocked and all clear beams recorded during the selection must remain clear for the system to enter or remain in the MACHINE RUN state.

A Fixed Blanking pattern may consist of more than one Fixed Blanked area. Individual Fixed Blanked areas must be separated by at least one beam that is always clear. A Fixed Blanking area may not crossover between "flexible" segment boundaries.

"Each Fixed Blanked area has a size and positional tolerance of +/-1 beam to allow for small positional variations where only the beams on the edges of the blanked area are allowed to change. Because of this position tolerance, a reduction of the optical resolution occurs on the border areas of the Fixed Blanking patterns. See Table 5-1 *Tolerance Effect of Fixed Blanked area on Resolution*. The effect of this tolerance also allows the number of blocked beams to change by +/- 1 beam. For example, a Fixed Blanked area of 8 blanked beams is allowed to increase to 9 beams or decrease to 7 beams and the light curtain will remain in MACHINE RUN." If there is a one or two beam gap between objects the objects cannot use their beam tolerances to close the gap and combine into one single fixed blanking area. In addition if there is a one beam gap between objects, the object closest to the entry encap cannot use the clear beam towards its tolerance even if the adjacent object moved in the same direction by one beam.

Table 5-1 Tolerance Effect of Fixed Blanked area on Resolution

Standard Resolution	Effective Resolution at Ends of Fixed Blanked Area
14mm	34mm
20mm	40mm
30mm	60mm
40mm	80mm

Note: The tolerance does not reduce the resolution of the entire light curtain, only the ends of Fixed Blanked Areas. The user must consider the increased resolution of the two beams at the ends of each Fixed Blanked Area.

The minimum number of beams in a Fixed Blanking area is one. If only one beam is blanked,there is no positional tolerance. The beam programmed to be blocked must remain blocked. The number of blocked beams has a size tolerance of +1/–0 meaning the number of blocked beams can increase to two but the area cannot be completely eliminated.

The Fixed Blanking pattern must not prevent the light curtain from synchronizing. This means that the size of the blanked object can not exceed certain limits as long as synchronization is maintained, see *Table 5-11*.

Fixed Blanking is allowed during all modes of operation (Automatic Start, Start, Start Interlock, and Start/Restart Interlock.)

To use Fixed Blanking, the operator enables the option using either the PDM or selector switches. A new Fixed Blanking pattern is recorded when the MS4800 receiver is in MACHINE STOP, the blanking function is active and the Program function is activated. If the Fixed Blanking feature is disabled, the stored protected zone patterns are cleared.

5.1.1 Selecting Fixed Blanking with a PDM (MS4800A)

The obstruction is placed within the detection zone and the receiver goes to a MACHINE STOP state.

An authorized user then connects the PDM to the receiver and logs in with the supervisor access level. (Config User)

The user then:

1. Loads the light curtain configuration to the PDM
2. Navigates to the Edit Configuration menu and selects Fix/Mon Blank, select Fixed Blank ON. The system enters a configuration state.
3. Saves the configuration to the light curtain.
4. Navigates to the Fixed Blanking Programming menu. (PROG FIXED BLANK in Main Menu)
5. Selects the Program option, waits until the LEDs start flashing.
6. Selects Finish, the light curtain will then automatically start–up .

5.1.2 Selecting Fixed Blanking with Selector Switches (MS4800S)

The obstruction is placed within the detection zone and the receiver goes to MACHINE STOP state. An authorized user then sets the selector switches in the receiver endcap to select Fixed Blanking Enable. The MS4800 enters a fault state and power is cycled or the Start switch is activated to clear

the fault. When the receiver powers up it will be in Fixed Blanking mode with the red and amber LEDs lit. See Figure 5-2 *Selecting Fixed Blanking Procedure 1*.

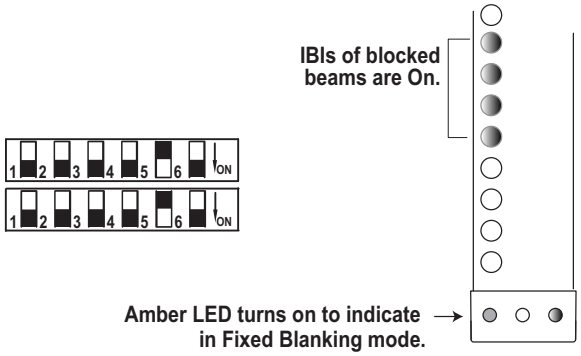


Figure 5-2 Selecting Fixed Blanking Procedure 1

The authorized user then enables the Program switch by setting both Fixed Blanking switches to the off position and then both to the on position. When the first Fixed Blanking switch is flipped, the red LED begins flashing at a rate of 3 Hz. When the final Fixed Blanking switch is flipped, both the red and amber LEDs and the IBIs of the blocked beams start flashing to indicate the Program switch is enabled. The authorized user has 10 minutes to complete the programming of a pattern. See Figure 5-3 *Selecting Fixed Blanking Procedure 2*.

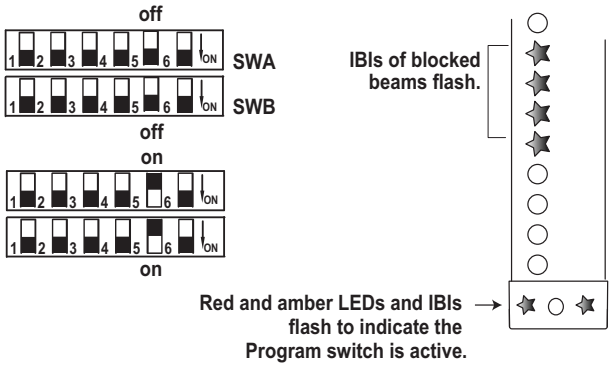


Figure 5-3 Selecting Fixed Blanking Procedure 2

To program a pattern, the authorized user must flip (off/on or on/off) the Program switch once. Once a pattern is programmed the yellow LED (INTERLOCK) turns on. During the 10 minute period, the user may program as many times as needed, allowing for adjustment in the placement of the obstruction. See Figure 5-4 *Selecting Fixed Blanking Procedure 3*.

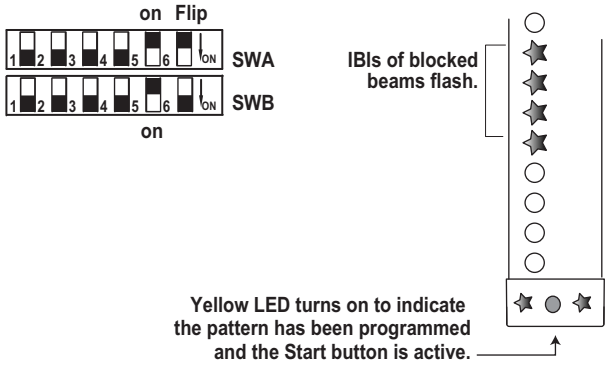


Figure 5-4 Selecting Fixed Blanking Procedure 3

The user must then press and release the START button or perform a power cycle. The MS4800 receiver then resets. If no faults are detected and the state of the optical beams matches the recorded Fixed Blanking pattern, the receiver will enter the INTERLOCK or MACHINE RUN condition depending upon the selected Start Mode. The amber receiver Blanking Active LED will be on. See Figure 5-5 - *Selecting Fixed Blanking Procedure 4*.

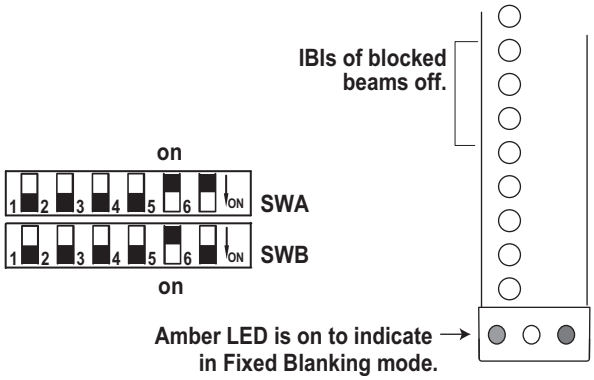


Figure 5-5 Selecting Fixed Blanking Procedure 4

If the 10 minute period expires, the amber LED and IBIs quit flashing and the yellow LED (INTERLOCK) goes on. The user can start another programming sequence by setting both Fixed Blanking switches off and then on. The user may start normal operation by a press and release of the Start button or by performing a power cycle. See Figure 5-6 - *Selecting Fixed Blanking Procedure 5*.

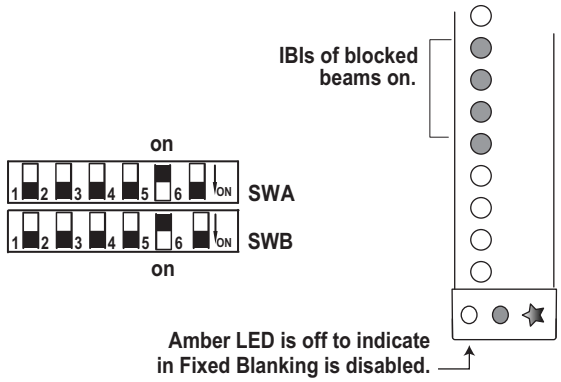


Figure 5-6 Selecting Fixed Blanking Procedure 5

To exit Fixed Blanking the user sets both selector switches to the off position, then either presses and releases the Start button or performs a power cycle. The receiver will power up with the amber LED off.

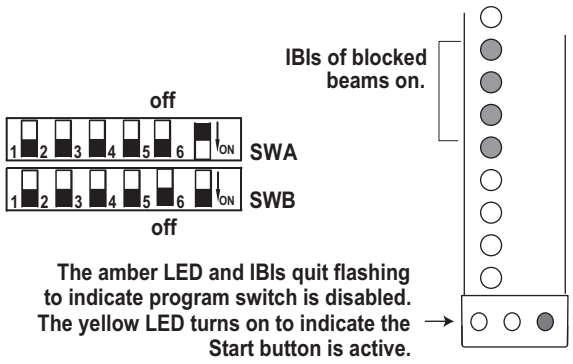


Figure 5-7 Selecting Fixed Blanking Procedure 6

Table 5-2 Diagram of Operation

No Fixed Blanking	Fixed Blanking Enabled	Fixed Blanking Enabled	Fixed Blanking Enabled	Fixed Blanking Enabled	Fixed Blanking Enabled
○	○	○	○	⊠	○
○	⊠	○	○	⊠	⊠
○	⊠	○	●	⊠	●
●	⊠	⊠	⊠	⊠	⊠
○	○	○	⊠	○	○
MACHINE STOP	**MACHINE RUN**	**MACHINE RUN**	**MACHINE RUN**	**MACHINE STOP**	**MACHINE STOP**

○ Clear Optical Channel ● Blocked Optical Channel ⊠ Optical Channel Selected by Fixed Blanking

5.2 FLOATING BLANKING

⚠ *Warning!* ***Use of Fixed Blanking, Monitored Blanking, Floating Blanking and Reduced Resolution will make the MS4800 system less sensitive to objects in the detection zone. Improper use of these features can result in severe injury to personnel. Fixed Blanking and Monitored Blanking may require a hard barrier guard. Fixed Blanking, Floating Blanking and Reduced Resolution may require an increase in the safety distance. Read the following section carefully.***

Up to two channels can be obstructed at any location in the detection zone (one channel on MS4800S) as long as synchronization is maintained, see *Table 5-11*.

This means that an object can freely float from one end of the protective field to the other without the MS4800 system entering the MACHINE STOP state. The obstructed channels are not fixed at a single location but "float" through the detection zone.

See *Table 5-3* for a diagram of MS4800 system response during operation with Floating Blanking active.

5.2.1 SELECTING FLOATING BLANKING WITH PDM (MS4800A)

Using the PDM an authorized user can activate the Floating Blanking function. This allows the system to operate with up to two obstructed optical beams anywhere within the protected zone. The operator may select one or two obstructed beams. These obstructions are permitted anywhere within the protected zone and are permitted to move over time. For two-beam Floating Blanking, the two obstructed beams do not have to be adjacent. After sending the configuration to the light curtain the PDM requests that the receiver perform a reset. The receiver then enters the Power-On Self Test state and if no faults are detected enters the INTERLOCK or MACHINE RUN condition depending upon the selected operating mode. The receiver Blanking Active LED will turn on.

5.2.2 SELECTING FLOATING BLANKING WITH SELECTOR SWITCHES (MS4800S)

Using the selector switches an authorized user can activate the Floating Blanking function. This allows the system to operate with one obstructed optical beam anywhere within the protected zone. This obstruction is permitted anywhere within the protected zone and is permitted to move over time. After setting the appropriate selector switches, the receiver enters the Power-On Self Test state and if no faults are detected the receiver shall enter the INTERLOCK or MACHINE RUN condition depending upon the selected operating mode.

Note: Two-Beam Floating Blanking is not available on the MS4800S.

Table 5-3 System Response to Floating Blanking

	Floating Blanking Inactive	1 Channel Floating Blanking Active	1 Channel Floating Blanking Active	1 Channel Floating Blanking Active	1 Channel Floating Blanking Active	2 Channel Floating Blanking Active	2 Channel Floating Blanking Active	2 Channel Floating Blanking Active	2 Channel Floating Blanking Active	2 Channel Floating Blanking Active	2 Channel Floating Blanking Active	2 Channel Floating Blanking Active
Channel 1	○	○	○	○	○	○	○	○	○	○	○	⊠
Channel 2	○	○	○	⊠	⊠	○	○	⊠	⊠	⊠	⊠	○
Channel 3	⊠	○	⊠	⊠	○	○	⊠	⊠	○	⊠	○	⊠
Channel 4	○	○	○	○	⊠	○	○	○	⊠	⊠	⊠	○
Channel 5	○	○	○	○	○	○	○	○	○	○	⊠	⊠
System Response	1 Exception MACHINE STOP	0 Exceptions Machine Run	1 Exception Machine Run	2 Exceptions MACHINE STOP	2 Exceptions MACHINE STOP	0 Exceptions Machine Run	1 Exception Machine Run	2 Exceptions Machine Run	2 Exceptions Machine Run	3 Exceptions MACHINE STOP	3 Exceptions MACHINE STOP	3 Exceptions MACHINE STOP

○ Clear Optical Channel ⊠ Optical Channel Selected by Fixed Blanking

Table 5-4 Floating Blanking Effects on Resolution

Floating Blanking Effects on Minimum Object Resolution		
Standard Minimum Objection Resolution (No Floating Blanking)	Minimum Object Resolution with 1 Beam Floating	Minimum Object Resolution with 2 Beam Floating
14mm	24mm	34mm
20mm	30mm	40mm
30mm	50mm	70mm
40mm	70mm	100mm

5.3 Fixed Blanking with Floating Blanking

⚠ *Warning! **Use of Fixed Blanking, Monitored Blanking, Floating Blanking and Reduced Resolution will make the MS4800 system less sensitive to objects in the detection zone. Improper use of these features can result in severe injury to personnel. Fixed Blanking and Monitoried Blanking may require a hard barrier guard. Fixed Blanking, Monitored Blanking, Floating Blanking and Reduced Resolution may require an increase in the safety distance. Read the following section carefully.***

Table 5-5 Possible Blanking Function Combinations

	Possible Blanking Function Combinations			
Function	Fixed Blanking	Floating Blanking	Monitored Blanking	Reduced Resolution
Fixed Blanking	N/A	Yes	No	No
Floating Blanking	Yes	N/A	Yes	No
Monitored Blanking	No	Yes	N/A	No
Reduced Resolution	No	No	No	N/A

When both Fixed Blanking and Floating Blanking are selected, the floating channels are allowed to occur anywhere within the detection zone except the area selected by Fixed Blanking.

5.3.1 The Effect of Fixed or Monitored Blanking or Floating Blanking on Minimum Object Resolution

When Fixed Blanking and/or Floating Blanking are active, the safe mounting distance is affected. Fixed and Floating Blanking desensitize the light curtain and increase the size of the minimum detectable object. The increase is equal to the beam spacing distance for each beam that is disabled.

• A MiniSafe MS4800-20 system with one beam disabled has a minimum object resolution of:

20 mm + 10 mm = 30 mm (1.18 inches).

• A MiniSafe MS4800-20 system with two beams disabled has a minimum object resolution of:

20 mm + 10 mm + 10 mm = 40 mm (1.57 inches).

If the size of the object detected by the system increases, the minimum safe distance must also be increased. Use the minimum object sensitivity given in *Tables 5-4 through 5-7* to determine the new figure to use when computing the safety distance.

Note: In some cases the use of mechanical hard guards may be needed to insure that the blanked areas are adequately guarded.

Table 5-6 Sample S and D_{pf} Factors for MS4800-14 System

Total Number of Beams Disabled by Fixed and/or Floating Blanking	Minimum Object Resolution S	Depth Penetration Factor, Dpf for use with ANSI Formula (Dpf = 3.4 (S-.276) inches)
None	14 mm (0.55 inches)	0.93 inches (24 mm)
1 Beam	24 mm (0.94 inches)	2.26 inches (57 mm)
2 Beams	34 mm (1.34 inches)	3.62 inches (92 mm)
3 Beams	44 mm (1.73 inches)	4.94 inches (125 mm)
4 Beams	54 mm (2.13 inches)	6.3 inches (160 mm)
5 Beams	64 mm (2.52 inches)	7.6 inches (193 mm)
	>64 mm (2.52 inches)	36 inches (900 mm)

Table 5-7 Sample S and D_{pf} Factors for MS4800-20 System

Total Number of Beams Disabled by Fixed and/or Floating Blanking	Minimum Object Resolution S	Depth Penetration Factor, Dpf for use with ANSI Formula (Dpf = 3.4 (S-.276) inches)
None	20 mm (0.79 inches)	1.75 inches (43 mm)
1 Beam	30 mm (1.18 inches)	3.1 inches (78 mm)
2 Beams	40 mm (1.57 inches)	4.4 inches (111 mm)
3 Beams	50 mm (1.97 inches)	5.76 inches (146 mm)
4 Beams	60 mm (2.36 inches)	7.1 inches (180 mm)
	>64 mm (2.52 inches)	36 inches (900 mm)

Table 5-8 Sample S and D_{pf} Factors for MS4800-30 System

Total Number of Beams Disabled by Fixed and/or Floating Blanking	Minimum Object Resolution S	Depth Penetration Factor, Dpf for use with ANSI Formula (Dpf = 3.4 (S-.276) inches)
None	30 mm (1.18 inches)	3.1 inches (78 mm)
1 Beam	50 mm (1.97 inches)	5.76 inches (146 mm)
	>64 mm (2.52 inches)	36 inches (900 mm)

Table 5-9 Sample S and D_{pf} Factors for MS4800-40 System

Total Number of Beams Disabled by Fixed and/or Floating Blanking	Minimum Object Resolution S	Depth Penetration Factor, Dpf for use with ANSI Formula (Dpf = 3.4 (S-.276) inches)
None	40 mm (1.57 inches)	4.4 inches (112 mm)
	>64 mm (2.52 inches)	36 inches (900 mm)

5.4 Monitored Blanking

Monitoring Blanking is only available on the MS4800A system.

This feature allows pre-determined objects to move within the detection zone in pre-determined areas while the light curtain remains in the RUN State. Monitored Blanking is similar to Fixed Blanking since it requires that the pre-determined objects remain present within the detection zone. However, it differs since it allows these objects to move within the detection zone.

Each system segment will allow multiple Monitored Blanking areas within its detection zone. The minimum number of beams within a Monitored blanked area is one; in this case the size tolerance is +1 and -0. A Monitored Blanking area larger than one beam has a size tolerance of +/– 1 beam. The size tolerance only applies to the beams on the edges of the monitored object.

The Monitored Blanking pattern must not prevent the light curtain from synchronizing. This means that the size of the blanked object can not exceed certain limits, refer to *Table 5-11*. Blanking is allowed during all modes of operation (Automatic Start, Start, Start Interlock, and Start/Restart Interlock.)

5.4.1 Selecting Monitored Blanking

The obstruction is placed in the detection zone and the receiver goes to the MACHINE STOP state.

Using the PDM, an authorized user selects Monitoring Blanking Enable. Then the user programs the monitored blanking area with a three step process:

First the object is inserted into the detection zone at one limit of the desired monitored area and the authorized user selects Program Begin. Next, without removing the object from the detection zone, the user moves the object to the other limit of the desired monitored area and select Program End. The final step is to select Finish on the PDM.

The object movement seen during this process will define the Monitored blanking area so the size of the intended objects must remain constant during this recording phase.

After performing these operations, the PDM requests that the system perform a restart. If no faults are detected and the state of the optical beams matches the recorded Monitored Blanking pattern then the receiver enters the INTERLOCK or MACHINE RUN condition depending upon the selected operating mode. The receiver Blanking Active LED will turn on. Subsequent power-cycles to the receiver will result in operation in accordance with its configured starting and operation modes. If the Monitored Blanking option is disabled the stored protected zone pattern is cleared from the system.

Monitored Blanking can be combined with Floating Blanking, but it can not be combined with Reduced Resolution or fixed blanking. (note: fixed blanking is the same as stationary monitored blanking).

5.4.2 Operation with Monitored Blanking

The Monitored Blanking optical channel pattern is stored in memory and remains unchanged when power is cycled on the receiver. On power-up the receiver recalls the recorded Monitored Blanking pattern. If the protected zone blocked and unblocked beams do not match the selected Monitored Blanking pattern, the receiver transitions to the MACHINE STOP state. The stored pattern is cleared from memory whenever the Monitored Blanking feature is disabled. As factory-shipped, the receiver is configured with the Monitored Blanking feature disabled with no pre-recorded protected zone obstructions.

5.5 REDUCED RESOLUTION

Reduced Resolution Blanking is available on all MS4800A systems. Reduced resolution changes the optical resolution of the light curtain, this selection is available from 1 to 3 beams allowing the light curtain to ignore obstructions of 1, 2 or 3 beams. There can be any number of ignored beams anywhere in the protection field, as long as the maximum number of adjacent blocked beams is not exceeded.

5.5.1 SETTING REDUCED RESOLUTION

An authorized user sets the PDM to the programming mode and selects Reduced Resolution Enable. The user then selects the number of beams of resolution reduction. After performing these operations the PDM requests that the MS4800 receiver perform a restart. If no faults are detected, any objects within the detection zone with a size less than the selected beam resolution will be ignored and the machine will enter an INTERLOCK or MACHINE RUN state depending upon the selected start mode. The MS4800 receiver Blanking Active LED will light to indicate Reduced Resolution.

NOTE: When reduced resolution is used on a cascaded MSF4800 with multiple resolutions, the largest resolution should be used to calculate the safe mounting distance. Example: It is possible for the first segment to have a resolution of 14mm and the second to have a resolution of 30mm. Refer to Table 5-10 *Reduced Resolution* if reduced resolution must be used.

5.5.2 OPERATION

On applications where light curtains are used for control purposes (e.g. stroke operation), light curtains with an optical resolution greater than 30mm are not allowed. When Reduced Resolution is enabled, objects under a certain size may enter into the light curtain's detection zone and the light curtain will remain in the MACHINE RUN state (OSSDs On). The allowed beam reduction and the resulting effective resolution as well as the maximum size of movable objects within the detection zone are shown in Table 5-10 *Reduced Resolution*. When Reduced Resolution is enabled, Fixed blanking, Monitored blanking or Floating Blanking will not be allowed. The PDM is required to select and enable Reduced Resolution function.

Table 5-10 Reduced Resolution

	Optical Resolution							
Reduced resolution	14 mm		20 mm		30 mm		40 mm	
	Effective resolution	Maximum undetected	Effective resolution	Maximum undetected	Effective resolution	Maximum undetected	Effective resolution	Maximum undetected
1 beam	24 mm	6 mm	27 mm	3 mm	47 mm	13 mm	67 mm	23 mm
2 beams	34 mm	16 mm	37 mm	13 mm	67 mm	33 mm	97 mm	53 mm
3 beams	44 mm	26 mm	47 mm	23 mm	87 mm	53 mm	127 mm	83 mm

Note: On applications where light curtains are used for control purposes (e.g. stroke operation), light curtains with an optical resolution greater than 30mm are not allowed.

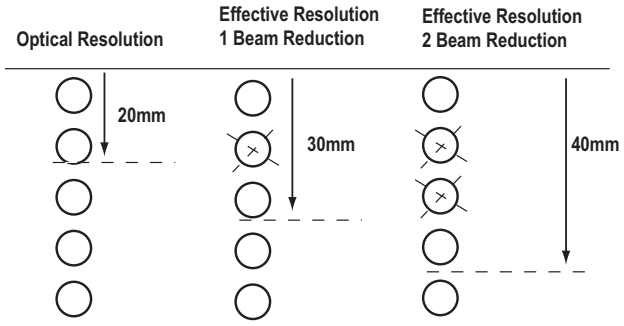


Figure 5-8 Reduced Resolution

5.6 Optical Synchronization

The synchronization between the MS4800 system transmitter and receiver is optical so the system does not use one specific beam. To establish synchronization the system needs to have a certain number of consecutive clear beams (Table 5-11 *Synchronization Requirements*) within the first master segment. If they are not satisfied, the system will enter a Machine Stop state and every other individual beam indicator will light. When the beams are clear, the system will re-synchronize itself and enter a state consistent with its operating mode. Once the synchronization is established, it can be maintained as long as the required number of consecutive clear beams can be satisfied anywhere in the system (including flex systems).

Because of this restrictions, when programming a fixed or monitored blanking object(s), the size of the fixed or monitored b lanking object(s) must comply with the number of consecutive clear beams stated in *Table 5-11* within the first segment.

In addition to that, there must be at least two (2) clear beams on each flex segment.

Table 5-11 Synchronization Requirements

Light Curtain Beam Count	Synchronization Beam Requirement
12- 16 beams	6 consecutive clear beams
17 - 32 beams	7 consecutive clear beams
33 - 64 beams	8 consecutive clear beams
65 - 128 beams	9 consecutive clear beams
129 - 256 beams	10 consecutive clear beams

6 Diagnostic and Test Features

6

6.1 Individual Beam Indicators

All MS4800 systems have a visible, red, Individual Beam Indicator (IBI) adjacent to each infrared beam. These IBIs are located on the receiver. The IBI will light when the infrared beam fails to meet the conditions necessary for the system to remain in the MACHINE RUN state. When less than 10 consecutive beams are clear, every other IBI will light indicating that the MS4800 is not synchronized. IBIs are not a safety critical component. An IBI failure will not cause an alarm condition and the system will continue to operate.

6.2 External Device Monitoring (EDM) - also known as MPCE Monitoring

EDM is an important safety function. It monitors the MS4800 system interface to the guarded machine, checks to ensure that the control elements are responding correctly to the light curtain and detects any inconsistency between the two external control devices. This is necessary to detect a malfunction within the interface which prevents a stop signal from reaching the machine controller. Connections for EDM are made at the receiver. On power-up, the MS4800 system looks for a closed to 0VDC condition. If this is found, it will enter a state consistent with the selected operating mode. When the MS4800 system enables its safety outputs, it monitors the external devices for a closed-to-open transition. This transition must occur within 300 ms or the MS4800 system will then enter an alarm state. Additionally, if the EDM connections are incorrectly wired, the system will enter an alarm state.

NOTE! For proper operation of the MS4800 system when EDM is not active, the EDM input must be wired to the MS4800 system 0VDC line.

6.2.1 ENABLING AND DISABLING EDM

The external device monitoring function is enabled in the following ways:

On the MS4800B (without a PDM), the EDM function is controlled by using the START line. This feature is called External EDM Select. At start-up if the start line is connected to 0VDC, the EDM function is disabled. If at start-up the start line is connected to +24V, the EDM function is enabled. When using the start line to configure the EDM function the start input will be inaccessible.

Note: When External EDM Select is used the start line must be connected to +24V or 0V. Otherwise a fault will occur.

On the MS4800A and B (with PDM), the EDM function can be activated and deactivated using the PDM. See Section 8 - *Programming and Diagnostics Module*.

On the MS4800S (with selector switches), the EDM function can be activated and deactivated using the selector switches. See Section 7 - *Using Selector Switches To Set Features*.

6.3 MACHINE TEST SIGNAL (MTS)

Some applications require that the machine guarding system be tested by the machine controller during a non-hazardous portion of the machine cycle to verify that the guarding system is functioning properly. The MTS option on the transmitter provides this capability. MTS is provided by placing a normally-closed switch across the MTS and MTS Return lines of the transmitter. When the transmitter recognizes a close-to-open transition on this switch a beam block state will be simulated on the transmitter and the receiver will enter the MACHINE STOP state. MTS is active as long as the switch is held open.

6.4 RANGE SELECTION

The MS4800 offers operating range selection: short range is 8m and long range is 20m. This function is useful when there are many light curtains operating within a small space and the possibility of cross-talk is likely.

6.5 RESPONSE TIME ADJUSTMENT (ONLY AVAILABLE ON THE MS4800A)

The MS4800 allows the user to slow down the scan rate of the safety light curtain for maximum immunity against environmental interference. When the slow response rate is activated an additional 9ms to 40ms (16 beams to 256 beams) are added to the normal response time. This function may be used in harsh environment conditions where electrical noise, ambient smoke, or dust and flying debris interfere with the light curtain. See *Table 16-3* for more information.

⚠ ***WARNING: This feature requires that the safe mounting distance be re-calculated to compensate for the additional time. The safety distance must be increased. Failure to do so may cause serious injury.***

6.6 START/RESTART SELECTION OPTIONS (ONLY AVAILABLE ON THE MS4800A)

The MS4800A offers four Start/Restart input type selections. The start function type default is NC (Pulled Low). The description for each specific start input are shown below. All four of the configurations will reset on the trailing edge, on press and release of the restart switch.

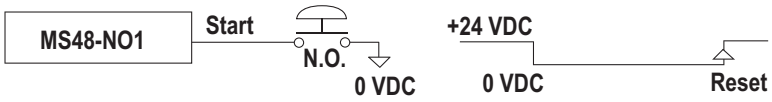


Figure 6-1 NO1- Normally Open Option (Pulled Low to 0VDC)

Figure 6-2 NO2-Normally Open Option (Pulled High to +24VDC)

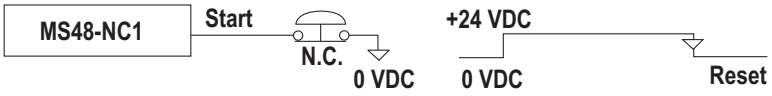


Figure 6-3 NC1- Normally Closed (Pulled Low to 0VDC)

Figure 6-4 NC2- Normally Closed (Pulled High +24VDC)

7 USING SELECTOR SWITCHES TO SET FEATURES

7

Note: This section only applies to the MS4800S.

7.1 MANUAL SELECTOR SWITCH VERSION

The operating parameters of the MS4800S Series light curtains are configured via selector switches. See below.

7.2 ACCESS TO THE SELECTOR SWITCHES

The switches are located behind a flip door on both the transmitter and receiver. The flip up doors are opened by loosening two retaining screws. (see illustration below)

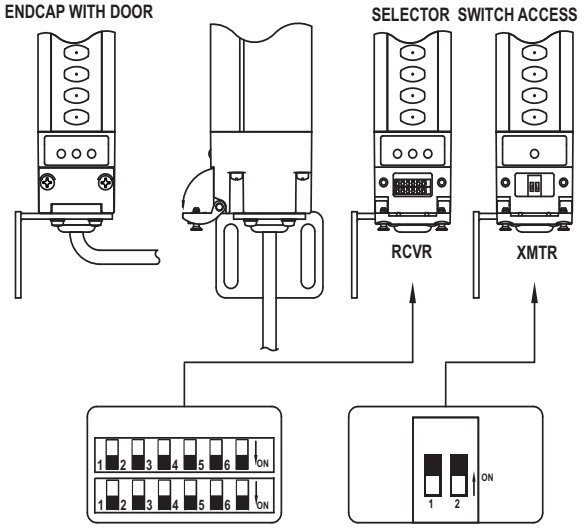


Figure 7-1 MS4800S Selector switches

7.2.1 TRANSMITTER SELECTOR SWITCH SETTINGS

Switch Position	Function	Factory Default
1	SCAN CODE	SCAN CODE A
2	MTS	MTS OFF

Table 7-1 Transmitter Selector Switch Settings

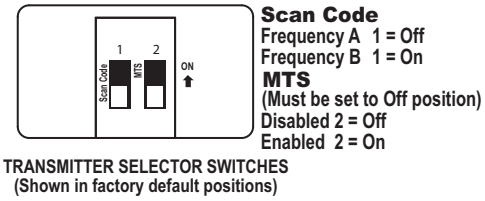


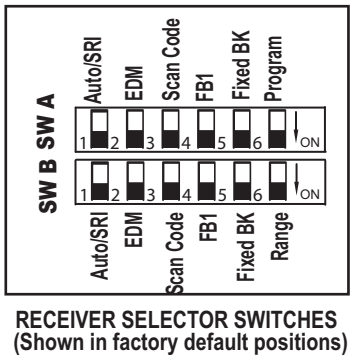
Figure 7-2 Transmitter Selector Switches

7.2.2 Receiver Selector Switch Settings

Table 7-2 Receiver Selector Switch Settings

Switch A Position	Function	Switch B Position	Function	Factory Default
1	Auto Start or Start/Restart Interlock	1	Auto Start or Start/Restart Interlock	Auto Start
2	EDM	2	EDM	Disabled
3	Scan Code	3	Scan Code	Scan Code A
4	Floating Blanking 1	4	Floating Blanking 1	Disabled
5	Fixed Blanking	5	Fixed Blanking	Disabled
6	Program (Toggle)(Non-safety)	6	Range (Non-safety)	Long Range

Note: 1. Program and Range are non-safety signals and are not redundant



Operating Mode	SW A	SW B
Automatic Start	1 = Off	1 = Off
Start/Restart Int	1 = On	1 = On
EDM Disabled	2 = Off	2 = Off
EDM Enabled	2 = On	2 = On
Scan Code A	3 = Off	3 = Off
Scan Code B	3 = On	3 = On
FB1 Disabled	4 = Off	4 = Off
FB1 Enabled	4 = On	4 = On
Fixed Blanking		
Disabled	5 = Off	5 = Off
Enabled	5 = On	5 = On
Program	6 = Toggle	
Opera		
Short Range		6 = Off
Long Range		6 = On

Figure 7-3 Receiver Selector Switch Settings

7.3 Operating Mode Selection

The Operating mode is selected by setting position 1 of Switches A and B, located on the receiver. Refer to Figure 7-3 *Receiver Selector Switch Settings*. Any mismatch between the settings of switches A and B will result in an alarm condition. The available operating modes are Automatic Start and Start/Restart Interlock.

7.4 Selecting and Programming Fixed Blanking

Refer to section 5.2.1 *Selecting Floating Blanking with PDM (MS4800A)* for programming instructions.

NOTE! When Fixed Blanking is active, the amber LED will illuminate to indicate that the system is operating in a less sensitive state.

7.5 Selecting Floating Blanking

Floating Blanking is activated by setting position 4 of Switches A and B located on the receiver. Refer to Table 7-2 *Receiver Selector Switch Settings*.

NOTE! When Floating Blanking is active, the amber LED will illuminate to indicate that the system is operating in a less sensitive state.

7.6 Selecting External Device Monitoring (EDM)

EDM is activated by setting position 2 of Switches A and B located on the receiver. Any mismatch between the settings of Switches A and B will result in an alarm condition. Refer to Table 7-2 *Receiver Selector Switch Settings*.

7.7 Selecting Machine Test Signal (MTS)

MTS is activated by setting position 2 located on the transmitter end cap. Refer to Figure 7-2 *Transmitter Selector Switches*.

7.8 Selecting Scan Codes

The MS4800S receiver and transmitter offer scan code selection to minimize cross-talk. On the transmitter this is activated by setting position 1. On the receiver this is activated by setting position 3 of switch A and switch B. ***NOTE: Both receiver and transmitter must be set to the same code.***

8 PROGRAMMING AND DIAGNOSTICS MODULE

8

Note: This section only applies to MS4800A and MS4800B systems

8.1 PROGRAMMING AND DIAGNOSTICS MODULE (PDM)

The MS4800 A and B Series light curtains require the use of a PDM to access and program the operating parameters of the light curtain. In addition to light curtain configuration, this module also serves as a diagnostics device, allowing the user to retrieve fault information.

The Programming and Diagnostic module:

- Displays programming and diagnostics information on a multi-line LCD display.
- Supports a variety of languages including English, Spanish, German, French, Chinese, Japanese.*
- Housing is rated IP65 allowing permanent mounting near the light curtain.

The light curtain does not require the PDM to operate. The factory default settings allow for basic guarding operation.

NOTE: *To be supported in the near future.

8.2 PDM NAVIGATION BUTTONS

The PDM has five buttons that allow navigation through the set-up menus. A description of these buttons is provided in Figure 8-1 - *PDM Navigation Buttons*.

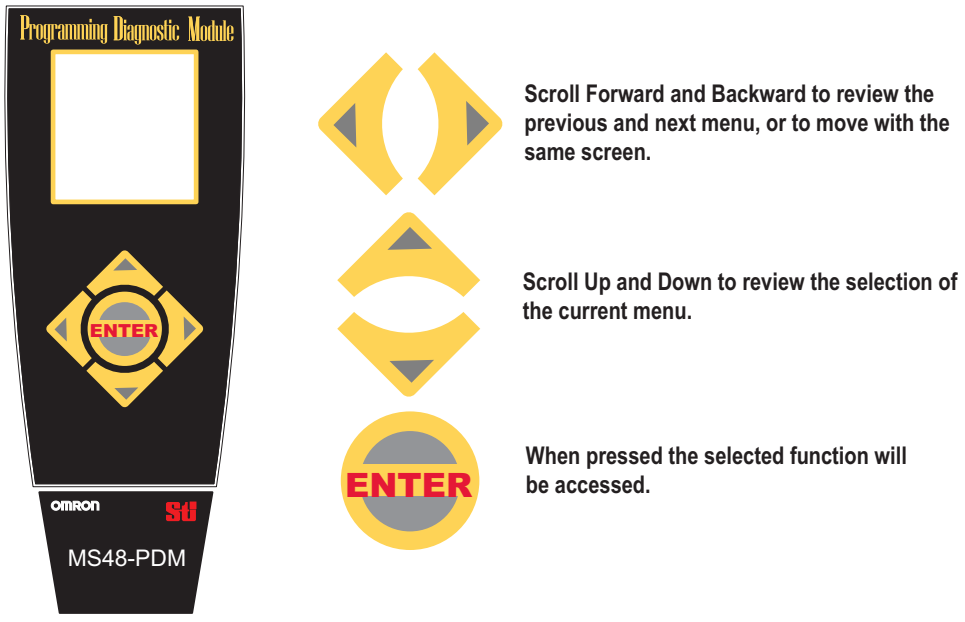


Figure 8-1 PDM Navigation Buttons

8.3 Description of Status Screen

Table 8-1 Status Screen Description

Field Name	Description
State	Run-time system state
Beams	Total number of beams
Segs/Code	Total number of segments/Scan Code*
Mute	Displays Mute status only if Mute is enabled
Sensors	Display only if Mute Enable is on. Mute sensors are numbered 1 - 4 from left to right indicating B (blocked) or C (clear)
Fault	Only if there is a fault. Fault information.

*Alternates from number of segments to active Scan Code

Table 8-2 Sample Status Screen

STATUS RXA 1.42
STATE: FAULT
BEAMS: 48 SEGS: 2
MUTE: OK
SENSORS: BBCC
FAULT: 42 EDM
LOGIN
PDM 1.17

8.4 Description of Main Menu Functions

- Load Config– To load a configuration from one of the three sources.
  - — The light curtain
  - — Factory default
  - — Custom configuration saved by user.
- View/Edit Config – To view and edit configuration parameters.
- Save Config – To save the new configuration to one of the two destinations.
  - — The light curtain
  - — Custom configuration
- Program Blanking – To program the Fixed Blanking pattern or the Monitored Blanking pattern.
  - — For Fixed Blanking, use the sequence:
    - •Program – to program snapshot
    - •Finish – to end program and reset
  - — For Monitored Blanking, use the sequence:
    - •Program Begin – to begin programming the movement range
    - •Program End – to end programming the movement range
    - •Finish – to end program and reset
- System – To access the maintenance functions.
- Logout – To logout and go back to the status screen.

8.4.1 VIEW MENU SELECTION

Table 8-3 MS4800 Receiver PDM Selectable Options

Option Name	Description	Comments
Operating Mode	Select from Automatic, Start INTERLOCK or Start/Restart INTERLOCK modes.	Default is Automatic.
**EDM (MPCE monitoring)	Select from On, Off or by Wire	Default is by wire.
Flixed/Monitoring Blanking - Off - Fixed Blank - Monitored Blank	Select from Off, Fixed Blanking (Channel Select) or Monitored Blank	Default is Off.
Floating Blanking	Select from Off, 1-channel blanking or 2-channel blanking	Default is Off.
Reduced Resolution	Select from Off, or 1 or 2 or 3 beam reduction.	Default is Off.
Response Time	Select from Normal or Slow	Default is Normal.
Aux. Output	Select from: FOLLOW OSSD PNP FOLLOW OSSD NPN ALARM PNP ALARM NPN	Default is Follow OSSD PNP
Start Input	Select from: NC 0V NC 24V NO 0V NO 24V	Default is NC 0V
**RX Scan Code	Select from code A or B	Default is code A.
**Range	Select operating range from Short or Long	Default is Long.
Mute options	Mute Enable - On or Off	Default is Off.
	Mute Mode - 2-sensor, 3-sensor, 4-sensor, 2X sensor, 4-sensor forward, 2X sensor forward	Default is 2-sensor
	Mute Timeout - 2 min. no timeout	Default is 2 min.
	Mute Bypass - On or Off	Default is Off
	Mute Sensor Response Time 50ms to 500ms in 50ms increments	Default is 50ms

** MS4800B only has access to EDM, operating mode, Scan Code and Range.

Table 8-4 MS4800 Transmitter Selectable Options

Option Name	Description	Comments
TX Scan Code	Select from code A or B	Default is code A.
MTS Enable	Machine Test signal. Select from On or Off	Default is off.

8.4.2 PDM Menu Screen

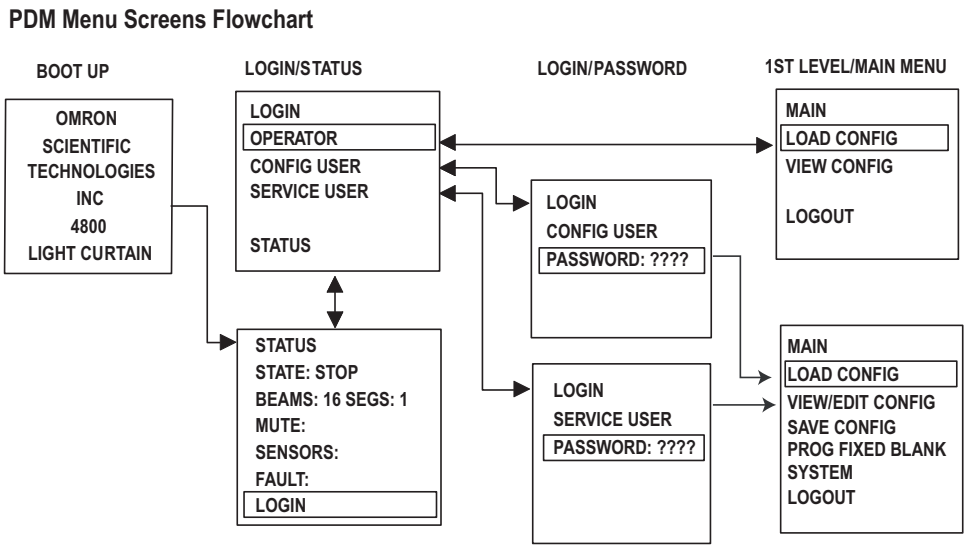


Figure 8-2 PDM Menu Screen

8.4.3 The Password

Due to the safety function of the MS4800 all users who can change the configuration must log-in with a password. The password grants the user the right to view the configuration and the right to modify the configuration. The configuration includes all the parameters that have been defined to safely guard an application. The password is coded into the PDM and not to the MS4800. The PDM is shipped with a default password of "0000".

There are two user access levels:

•Operator Access - The operator can access the MS4800 in a monitor mode. This mode does not require a password as the operator cannot make any changes to the light curtain parameters.

• Supervisory (Configuration User) Access - Supervisors and maintenance personnel may access the MS4800 and perform a variety of functions. They may stop the light curtain, download, modify an existing configuration or create a new one.

Note: Service User Access is for Omron STI service personnel usage ONLY.

8.4.4 Changing the Password

The default password can be changed, allowing supervisory personnel to restrict the access of unauthorized persons. To change the password, the user must log-in at the supervisor access level, using the default password (0000).

Note: The password is a 4-digit number.

To change the password:

7. Navigate through the "System - Change Password"
8. At the "ENTER NEW:????" line, set the password and press ENTER. Use the ^, v to change the selected digit as desired, use the > to continue to other digits
9. At the "RE ENTER NEW:????" line, enter password again and press ENTER to confirm and save the new password.

8.4.5 Forgot the Password?

In STATUS screen, press^ 7 times consecutively and the password will be reset to default.

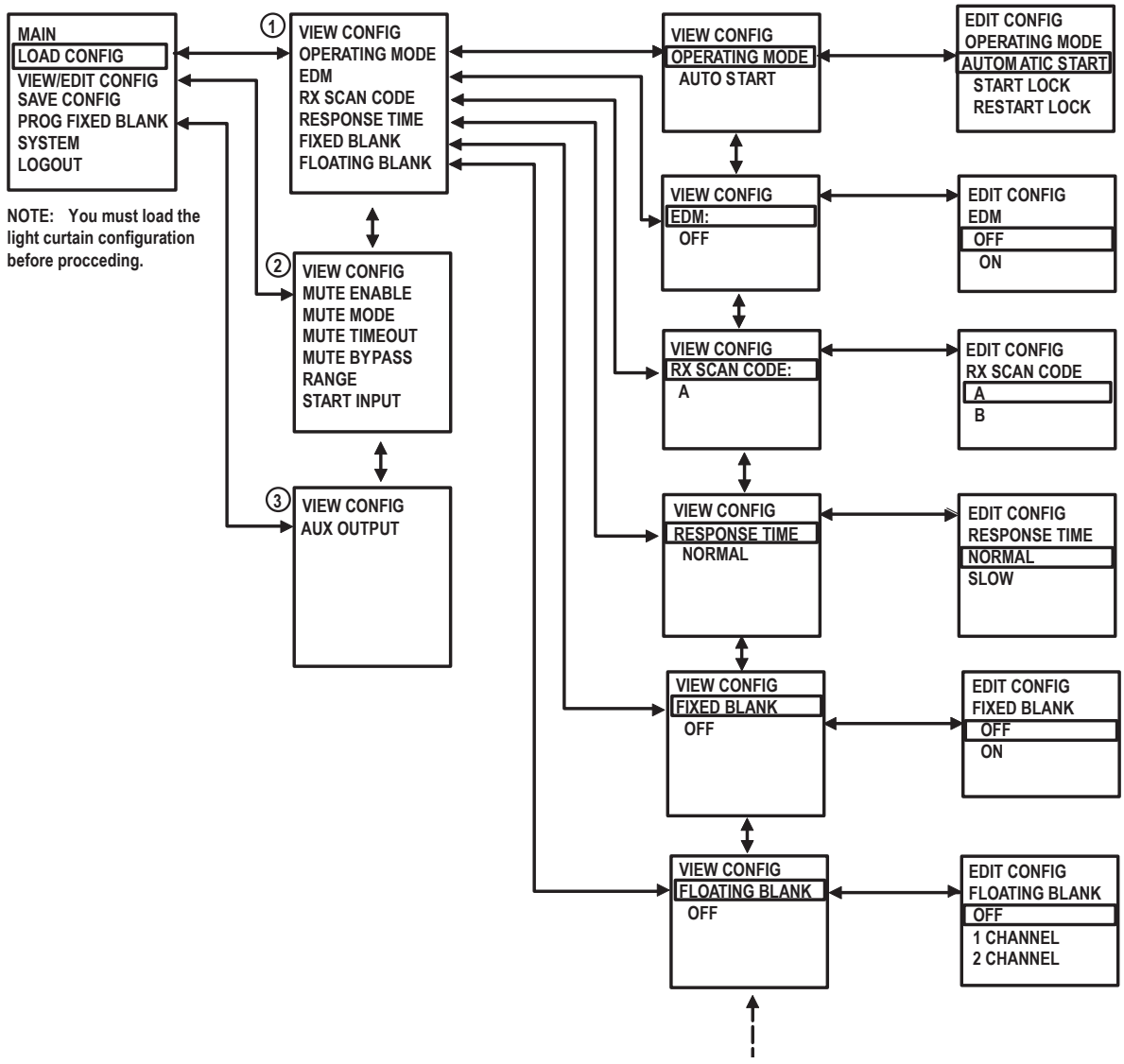


Figure 8-3 PDM Receiver Configuration/ View and Edit (1)

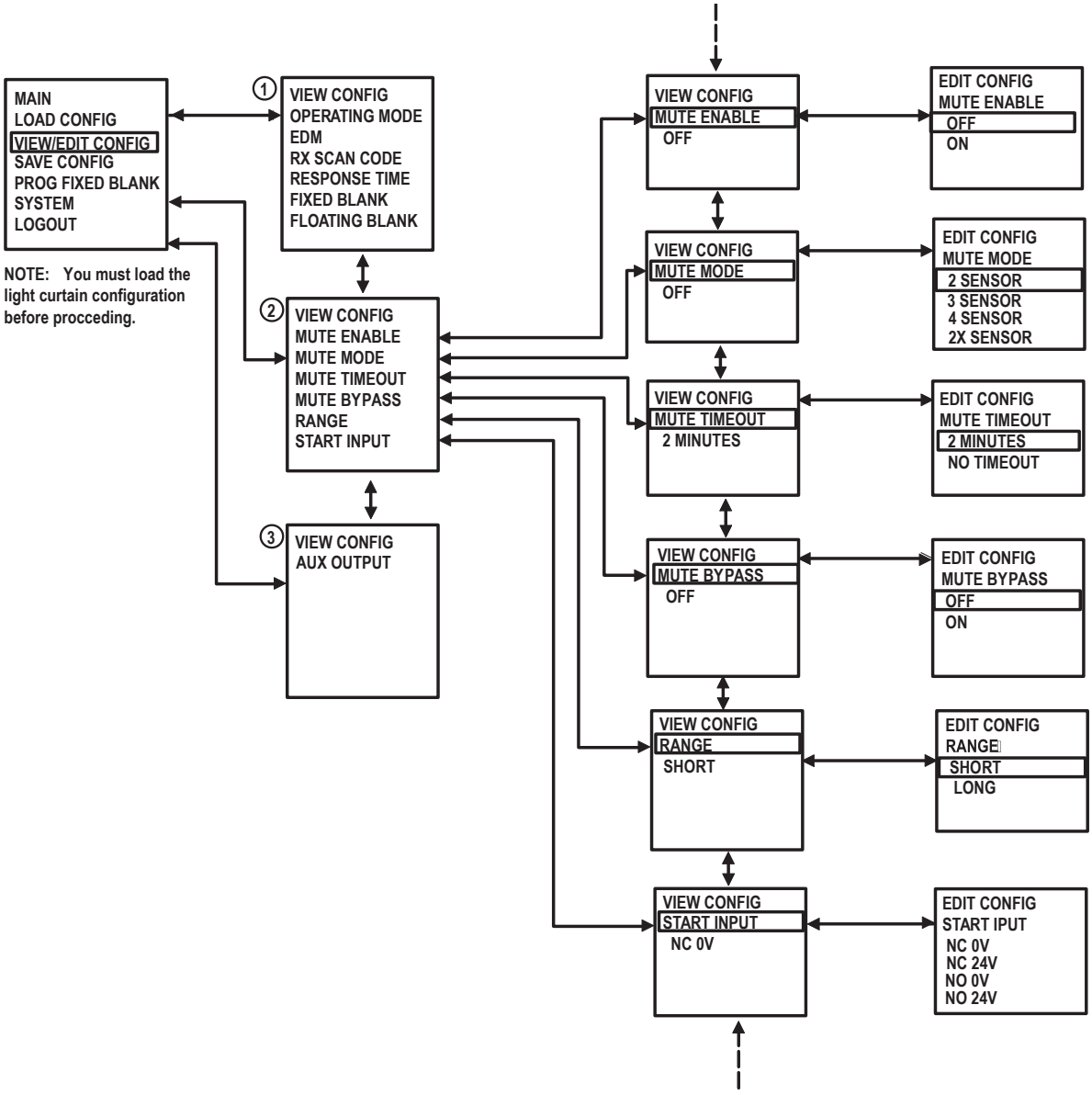


Figure 8-4 PDM Receiver Configuration/ View and Edit (2)

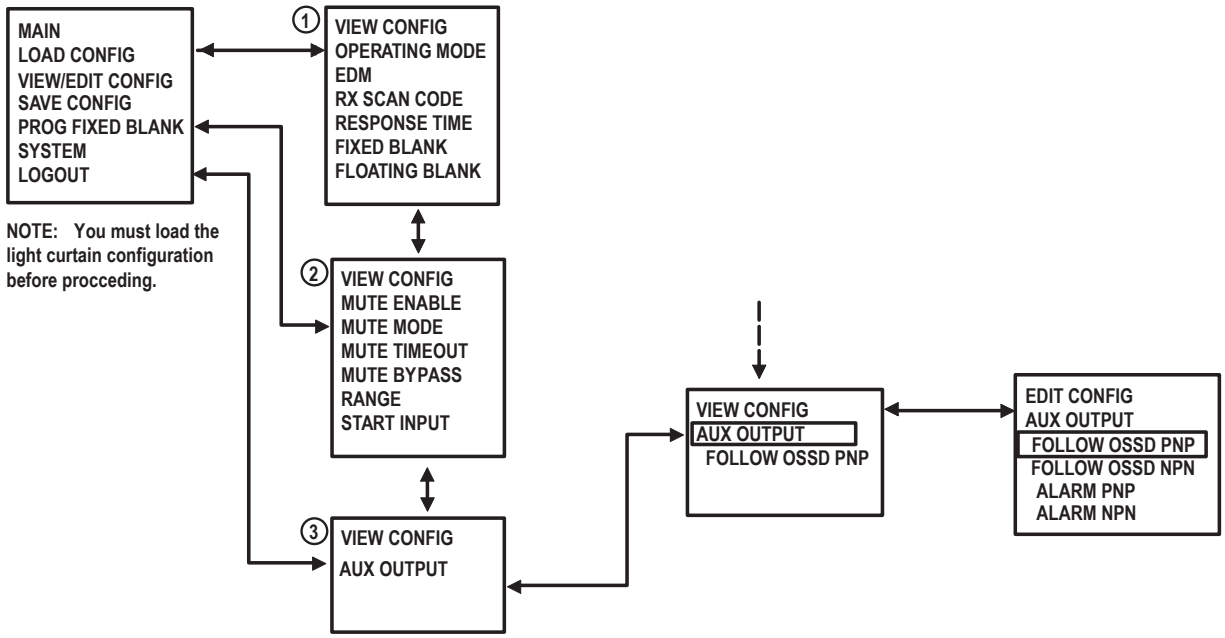


Figure 8-5 PDM Receiver Configuration/ View and Edit (3)

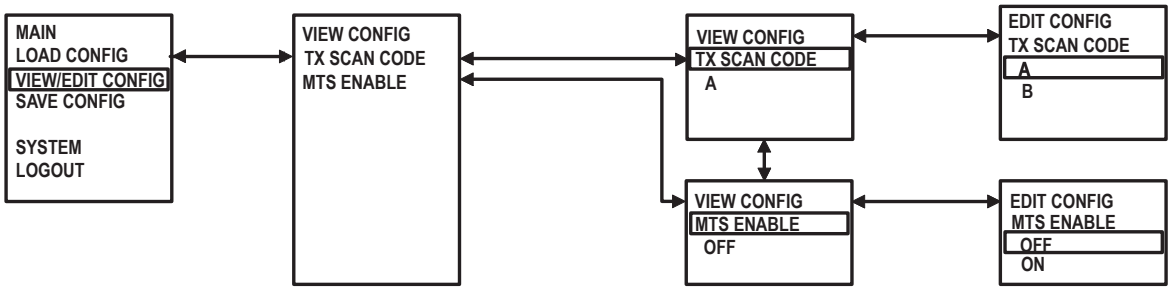


Figure 8-6 PDM Transmitter Configuration/ View and Edit

9 OUTPUTS

9

9.1 SAFETY OUTPUTS

⚠ WARNING! ***This product is designed for use on a 24 VDC, negative ground (protective earth) electrical system only. Never connect the MS4800 system to a positive ground (protective earth) system. With a positive ground (protective earth) wiring scheme, certain simultaneous shorts of both safety outputs may not be detected and the guarded machine may not stop, resulting in severe operator injury.***

The MS4800 system receiver supplies two independent PNP-type, safety outputs to provide run/stop signals to the guarded machine. In the MACHINE RUN state, the safety outputs are electrically conducting and source 625mA of current at 24 VDC. In the MACHINE STOP state, the outputs are not electrically conducting.

9.2 AUXILIARY OUTPUT

This is not a safety output. The MS4800 system supplies one auxiliary output. The configuration of this output at time of order is PNP Follow. On MS4800A systems it can be switched to other configurations using the Programming and Diagnostics Module.

9.2.1 PNP, FOLLOW

In the on state, this PNP output will source up to 100 mA at 24 VDC. In this configuration the auxiliary outputs will be on when the safety outputs are on.

9.2.2 NPN, FOLLOW

This auxiliary output configuration is only available on MS4800A systems. In the on state this NPN output will sink up to 100 mA. In this configuration the auxiliary outputs will be on when the safety outputs are on.

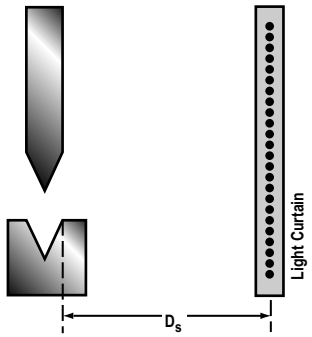
9.2.3 PNP, ALARM

This auxiliary output configuration is only available on MS4800A systems. In the on state this PNP output will source up to 100 mA at 24 VDC. In this configuration the auxiliary outputs will be on only when the MS4800 system is in the alarm state.

9.2.4 NPN, ALARM

This auxiliary output configuration is only available on MS4800A systems. In the on state this NPN output will sink up to 100 mA. In this configuration the auxiliary outputs will be on only when the MS4800 system is in the alarm state.

10 SAFE MOUNTING DISTANCE



D_S is the minimum safe distance between the light curtain sensing field and the point of operation hazard (pinch point).

Figure 10-1 Safe Mounting Distance

WARNING! Never install an MS4800 system without regard to the safety distance. If the MS4800 system is mounted too close to the point of operation hazard, the machine may not stop in time to prevent an operator injury.

An MS4800 system must be mounted far enough from the machine danger zone so the machine will stop before a hand or other body part reaches the hazardous area. This distance is called the safety distance. It is a calculated number based on a formula. See *Figure 10-1* for an illustration of the safety distance.

Regardless of the calculated distance, an MS4800 system should never be mounted closer to the point of operation hazard than specified by Table 0-10 in OSHA 1910.217.

10.1 US SAFETY DISTANCE FORMULAS

In the United States two formulas exist to properly determine the safety distance. Omron STI recommends the formula provided by the American National Standards Institute (ANSI) which incorporates additional factors when compared to the formula required by OSHA.

The ANSI formula given below is for a normal approach to the light curtain.

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

Where:

D_s = minimum safety distance, in inches, between the MS4800 detection zone and the nearest point of operation hazard.

K = hand speed constant in inches per second. The ANSI standard value is 63 inches/second which assumes the operator starts a hand motion toward the point of operation from rest. According to ANSI B11.19-2003, the following factors should be considered when determining K:

a) Hand and arm movement

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

c) Walking or running.

One of the accepted values for ***K*** is the hand speed constant (it is usually considered as the horizontal motion of the hand and arm while seated). Its common value is 63 in/s (1.6 m/s) although other values (typically greater) are also used. The hand speed constant does not include other body movements, which can affect the actual approach speed. Consideration of the above factors should be included when determining the speed constant for a given application.

T_s = the stop time of the press (or machine) in seconds, measured from the final de-energized control element. Measured at maximum closing velocity.

T_c = the response time, in seconds, of the press or machine control circuit to activate the machine's brake.

NOTE! $T_s + T_c$ is usually measured together by a stop time measuring device.

T_r = the response time of the MS4800 system, in seconds. This response time is given in *Table 16-1*.

⚠ *WARNING!* ***When using an Omron STI RM-X, RM-1 or RM-2AC with the MS4800 system, add 8ms to the response times stated in*** *Table 16-1*.

T_{bm} = the additional stopping time, in seconds, allowed by the brake performance monitor before it detects stop time deterioration.

The T_{bm} factor allows consideration for brake wear, adding extra stop time allowed by the brake monitor. Therefore, T_{bm} = Brake monitor set point - ($T_s + T_c$).

NOTE! If the guarded machine is not equipped with a stop time performance monitor, a percentage increase factor should be applied to the stop time of the machine to allow for braking system wear. Contact your machine manufacturer for information.

D_{pf} = This is related to the minimum object sensitivity of the MS4800 system. By knowing the minimum object sensitivity, S, of the MS4800 system, D_{pf} is read directly from *Table 5-6*, *Table 5-7*, *Table 5-8* or *Table 5-9* depending on the minimum object sensitivity of the system being installed.

10.2 European Safety Distance Formulas

The following discussion is based on standard EN999 and applies to light curtains used in industrial environments.

10.2.1 Safety Distance Formula for Systems with a Minimum Object Resolution of 40 mm or Less

When the minimum object resolution of the system is 40 mm or less, use the following formula:

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

where:

S = the minimum distance in millimeters, from the danger zone to the detection point, line, plane or zone.

K = 2000 mm/s

T = the overall system stopping performance in seconds.

$T = t_1 + t_2$

t_1 = response time of the safety light curtain in seconds. This response time is given in *Table 16-1*.

t_2 = maximum stopping time of the machine in seconds.

C = 8(d-14 mm), but not less than zero.

d = the minimum object resolution of the MS4800 system in millimeters. therefore,

$S = (2000 \text{ mm/s} \times T) + 8(d - 14 \text{ mm})$

This formula applies for all minimum distances of S up to and including 500 mm. The minimum value of S shall not be less than 100 mm.

If S is found to be greater than 500 mm using the formula above, then the formula below can be used. In this case the minimum value of S shall not be less than 500 mm.

$S = (1600 \text{ mm/s} \times T) + 8(d - 14 \text{ mm})$

10.2.2 Safety Distance Formula for Systems with a Minimum Object Resolution Greater Than 40 mm

When the minimum object resolution of the system is greater than 40 mm, use the following formula:

S = (K x T) + C

where:

S = the minimum distance in millimeters, from the danger zone to the detection point, line, plane or zone.

K = 1600 mm/s

T = the overall system stopping performance in seconds.

$T = t_1 + t_2$

t_1 = response time of the safety light curtain in seconds. This response time is given in *Table 16-1*.

t_2 = maximum stopping time of the machine in seconds.

C = 850 mm.

i.e.:

S = (1600 mm/s x T) + 850 mm

10.2.3 Factors Affecting the Safety Distance Formula

When light curtains are used for machine initiation, their minimum object resolution must be 30 mm or smaller (based on EN 999, other standards may vary). In this case the formula given in section *10.2.1* applies except that the minimum distance S shall be greater than 150 mm.

For parallel approach the formula for C becomes:

C = 1200 mm – (0.4 x H), but not less than 850 mm

H = the height of the detection zone above the floor in mm.

11 INSTALLATION

11.1 REFLECTIVE SURFACE INTERFERENCE

A reflective surface adjacent to the detection zone can deflect the optical beam and may cause an obstruction in the zone not to be detected. (See *Figure 11-1* through *Figure 11-5*.) The reflective surface may be part of the machine, mechanical guard or workpiece. Therefore, a minimum distance (d) must exist between the reflective object and the center line of the detection zone. The Test Procedure (Appendix B) must be used to test for this condition.

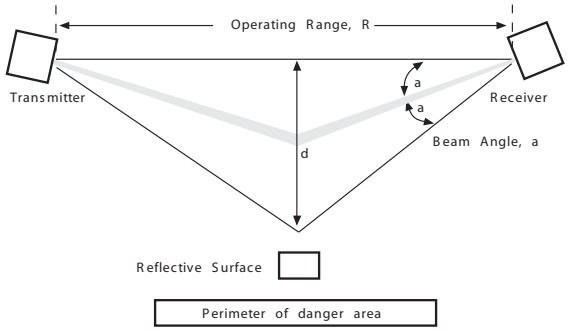


Figure 11-1 Worst Case Alignment Example

The interruption is clearly detected. The reflective object is outside of the beam angle.

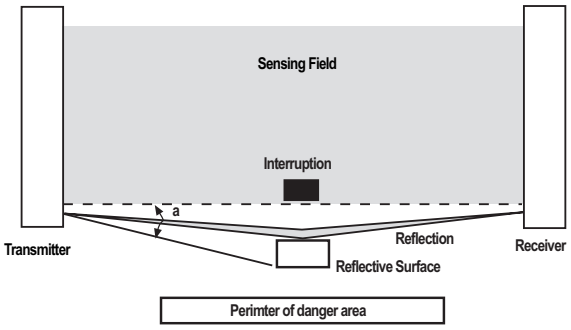


Figure 11-2 Unsafe Mounting Example (1)

The interruption is not detected because of the reflection. The reflective object is inside the beam angle.

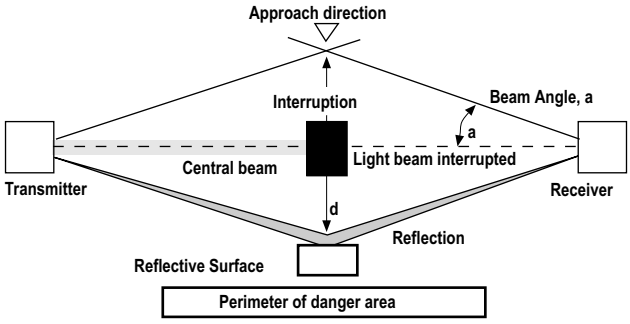


Figure 11-3 Unsafe Mounting Example (2)

Interruption is not detected because of the reflection. Reflective surface interference may also appear above and below the sensing field

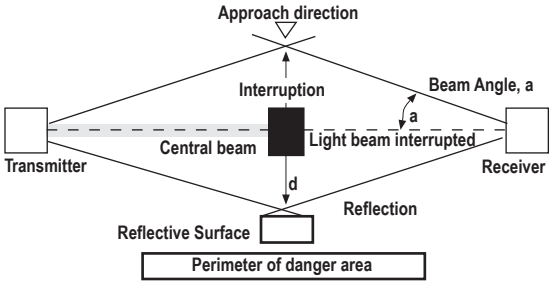


Figure 11-4 Correct Mounting Example with Proper Alignment

This example shows the minimum distance from the reflective surface, d, to one side of the beam center line.

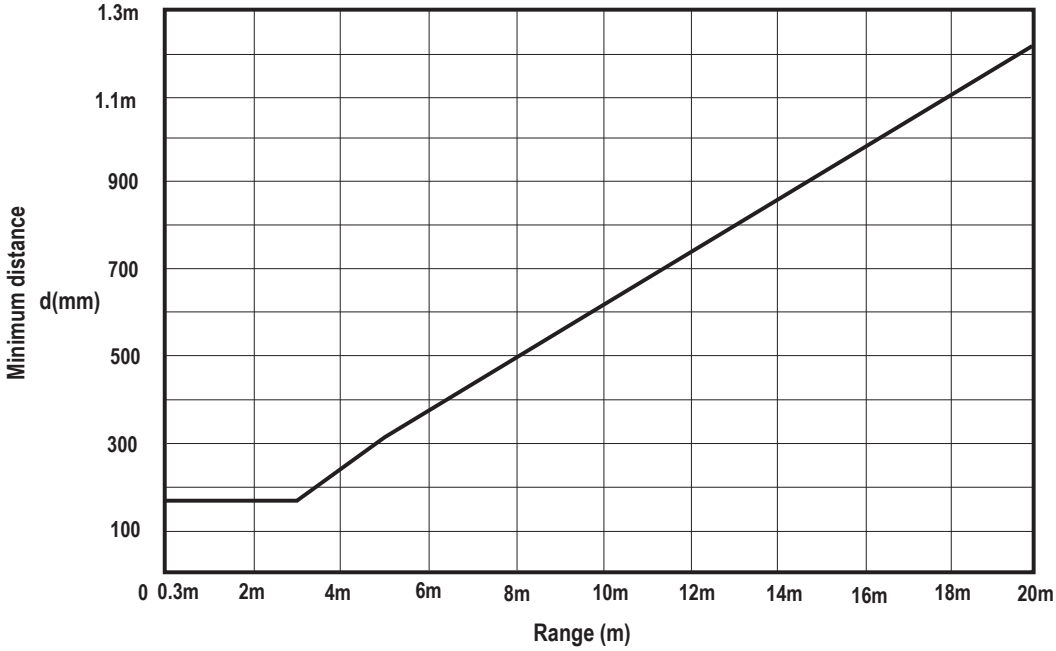


Figure 11-5 Minimum Distance from a Reflective Surface as a Function of Range

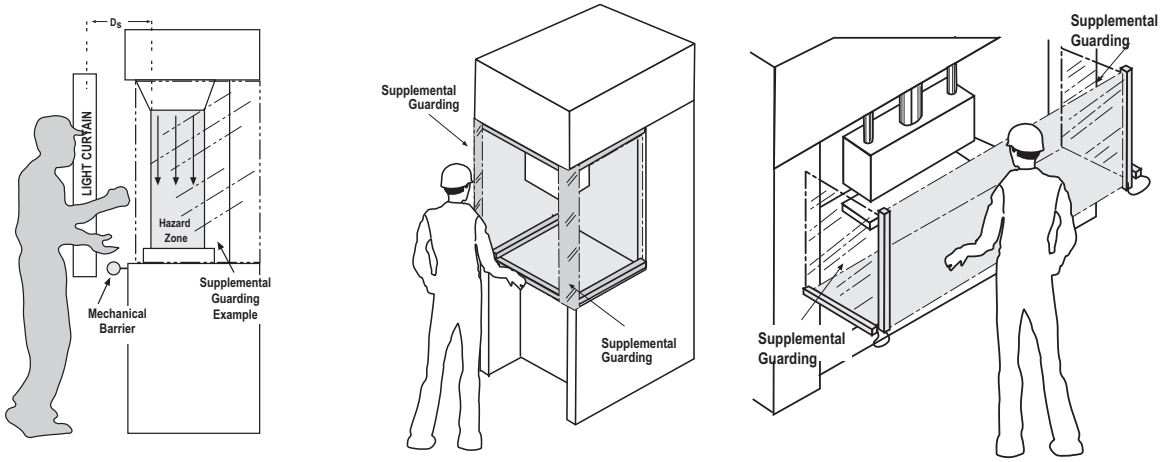
11.2 Cross Talk Mitigation

To mitigate interference from other light curtains, the MS4800 has two possible scan codes, A and B. The transmitter and receiver units must be set to the same scan code for the receiver to enter the MACHINE RUN state.

11.3 General Mounting Considerations

11.3.1 Additional Guarding

Areas of access to the point of hazardous operation not guarded by the MS4800 system must be protected by suitable means such as a fixed barrier guard, an interlocked guard or a safety mat. See *Figure 11-6*.



MS4800 Point of Operating Guarding | MSF4800 3-Sided Guarding | MSF4800 2-Axis Guarding

Figure 11-6 Correct Light Curtain Installation Example

11.3.2 Added Mounting Rigidity

It is recommended that when installing a MS4800 larger than 1000mm (40 in) in length, you use an additional mounting bracket. This is to be installed using the T-slot on the backside of the transmitter and receiver.

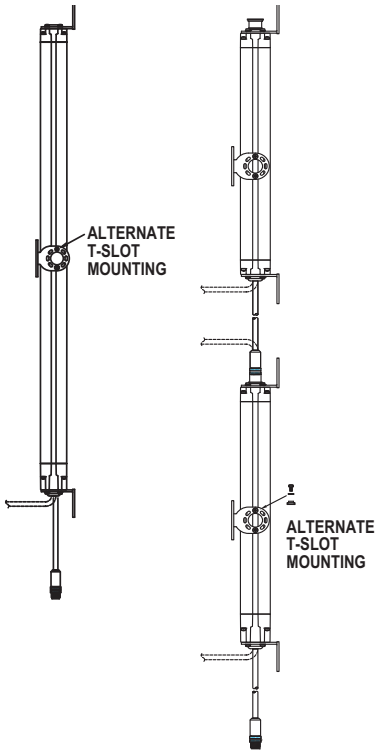


Figure 11-7 Adding Mounting Bracket

11.3.3 Installation of Multiple Systems

When two or more MS4800 systems with the same scan code are mounted in close proximity and in alignment with each other, precautions should be taken to avoid one system interfering with another. This can be corrected by mounting the transmitters and receivers back-to-back or stacked.

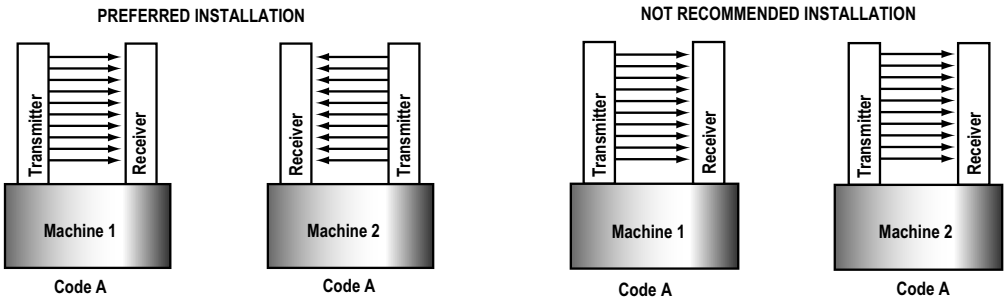


Figure 11-8 Multiple Light Curtain Installation Configurations

The scan coding feature of the MS4800 system allows for placement of systems in close proximity and in line with each other. The distinctive coding of the beams provide for unique operation of a system while in view of another system with a different scan code. Two unique codes are available on the MS4800.

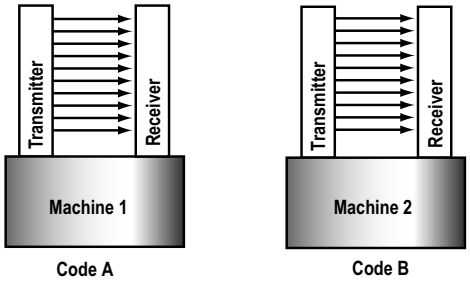


Figure 11-9 Multiple Light Curtain Installation Configurations using Scan Codes

11.3.4 Detection Zone

The system detection zone is delineated by the inside edge of the transmitter and receiver endcaps. The area outside these marks is not protected. Position the system so that it is only possible to access the danger point through the detection zone.

11.3.5 Alignment

Physical alignment of the transmitter and receiver is easiest when the system is in the automatic start operating mode with Fixed Blanking inactive. The units should be in the same plane and at equal height.

The Individual Beam Indicators will light when a beam is out of alignment. See Section 6.1 - *Individual Beam Indicators* for details.

11.3.6 Input Power Requirements

The system operates directly from 24 VDC ±20%. Power to the system must come from a 24VDC SELV power supply which meets the voltage interruptions and dip requirements of IEC 61496-1 (per section 4.3.22 and 5.4.3.2) and IEC 60204-1 (per section 4.3.3) , Omron STI part number 42992 or equivalent.

11.3.7 Requirements for Perimeter Guarding

In perimeter guarding applications the MS4800 system detection zone is placed around the outside perimeter of a guarded machine or robot. This placement leaves space for personnel to stand between the detection zone and the hazardous machine.

In this case, the guarded machine must only be restarted using a switch located outside and with a full view of, the area of hazardous motion. Operation of the MS4800 system in theStart/Restart Interlock operating mode is suitable for perimeter guarding.

11.3.8 Marking Minimum Object Resolution

Serial number labels on the transmitter and receiver indicate 4 possible minimum object resolutions. During installation, use a permanent marker to obscure the object resolutions not set. This will depend on whether no floating blanking, 1-beam or 2-beam floating blanking is set. See section 5.3.1 for information.

11.3.9 Presence Sensing Device Initiation

Using the light curtain to initiate a machine cycle after an object is removed from the sensing area is called Presence Sensing Device Initiation (PSDI). Use of PSDI places additional requirements on the guarding and safety controls. It can restrict advanced light curtain features such as Floating Blanking and Fixed Blanking. Contact Omron STI for further information. Good sources of reference for PSDI include: ANSI RIA 15.06-1999, OSHA 1910.217(h), and ANSI B11.2-1995 (R2005).

12 CONNECTING TO THE MACHINE CONTROL CIRCUIT

12

⚠ WARNING! ***This product is designed for use on a 24 VDC, negative ground (protective earth) electrical system only. Never connect the MS4800 system to a positive ground (protective earth) system. With a positive ground (protective earth) wiring scheme, certain simultaneous shorts of both safety outputs may not be detected and the guarded machine may not stop, resulting is severe operator injury.***

⚠ WARNING! ***Never use only a single safety output to control the machine. Should this single output fail, the machine may not stop, resulting in severe operator injury. The machine must be connected using both safety outputs.***

12.1 CONNECTING TO A SAFETY MONITORING DEVICE

The wiring from the MS4800 system to the machine control circuit must be control reliable as described in ANSI B11.19-2003. Normally PLCs are not designed to be control reliable. Safety devices such as the MS4800 system should not depend on a PLC to stop a guarded machine.

However, safety related monitoring devices are now available. See *Figure 12-1* for connection to such a device. Note that all safety inputs are directed to the monitoring device which also performs the EDM monitoring function.

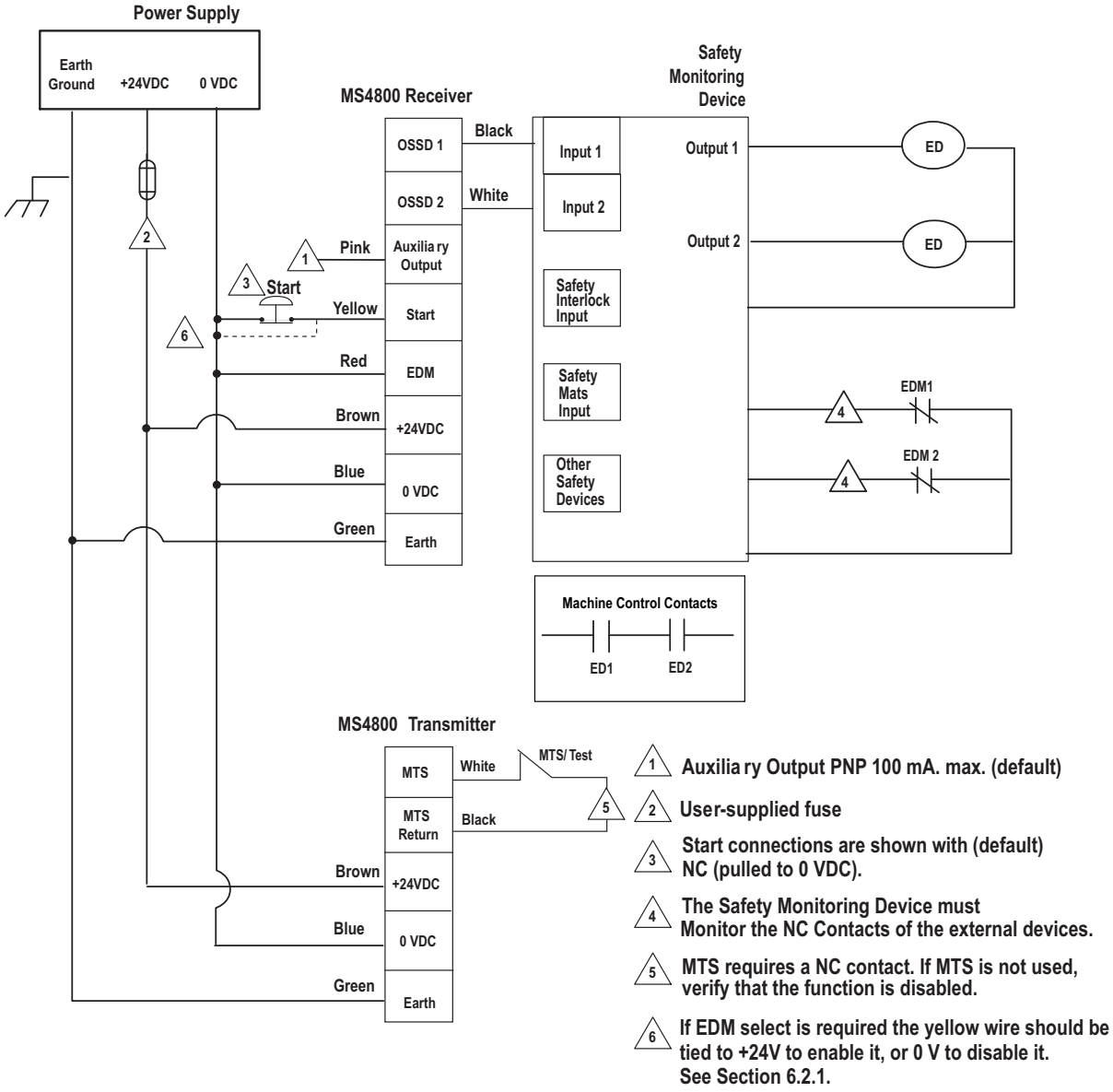


Figure 12-1 Connecting to a Safety Monitoring Device

12.2 Connecting Via an RM-1 Module

The Omron STI RM-1 Module provides force-guided relay outputs for machine control. OSSD Safety outputs 1 and 2 are connected to the RM-1 and provide the power necessary to energize its relays. See *Figure 12-2* for the preferred connection method using the RM-1. The auxiliary non-safety output of the MS4800 system can be used to signal light curtain status to a PLC.

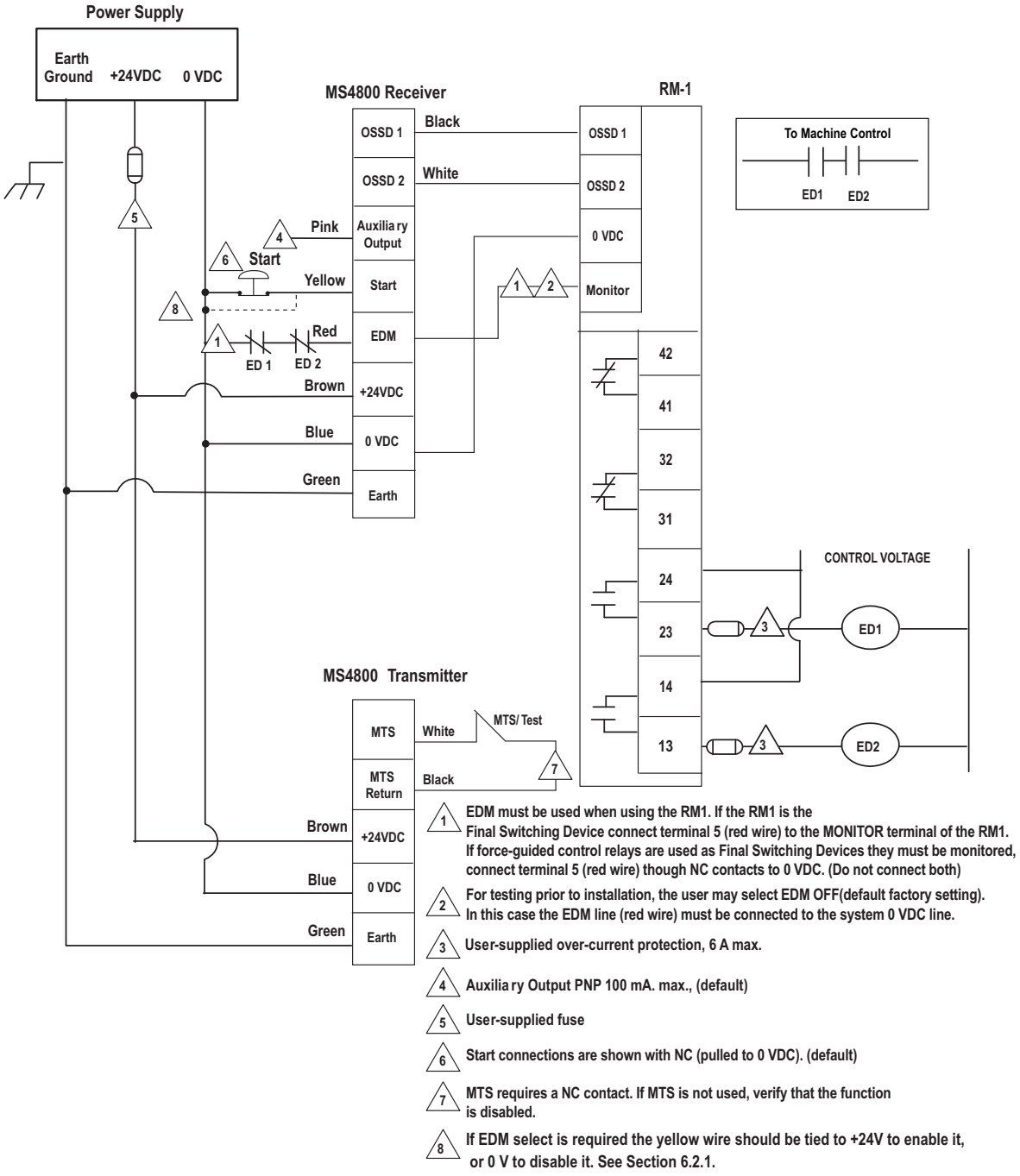


Figure 12-2 Connecting via an RM-1 Module

12.3 Connecting Via an RM-2AC Module

The Omron STI RM-2AC module provides force-guided relay outputs for machine control as well as a convenient location to terminate all outputs and inputs from MS4800 system. See *Figure 12-3* for the preferred connection method using the RM-2AC.

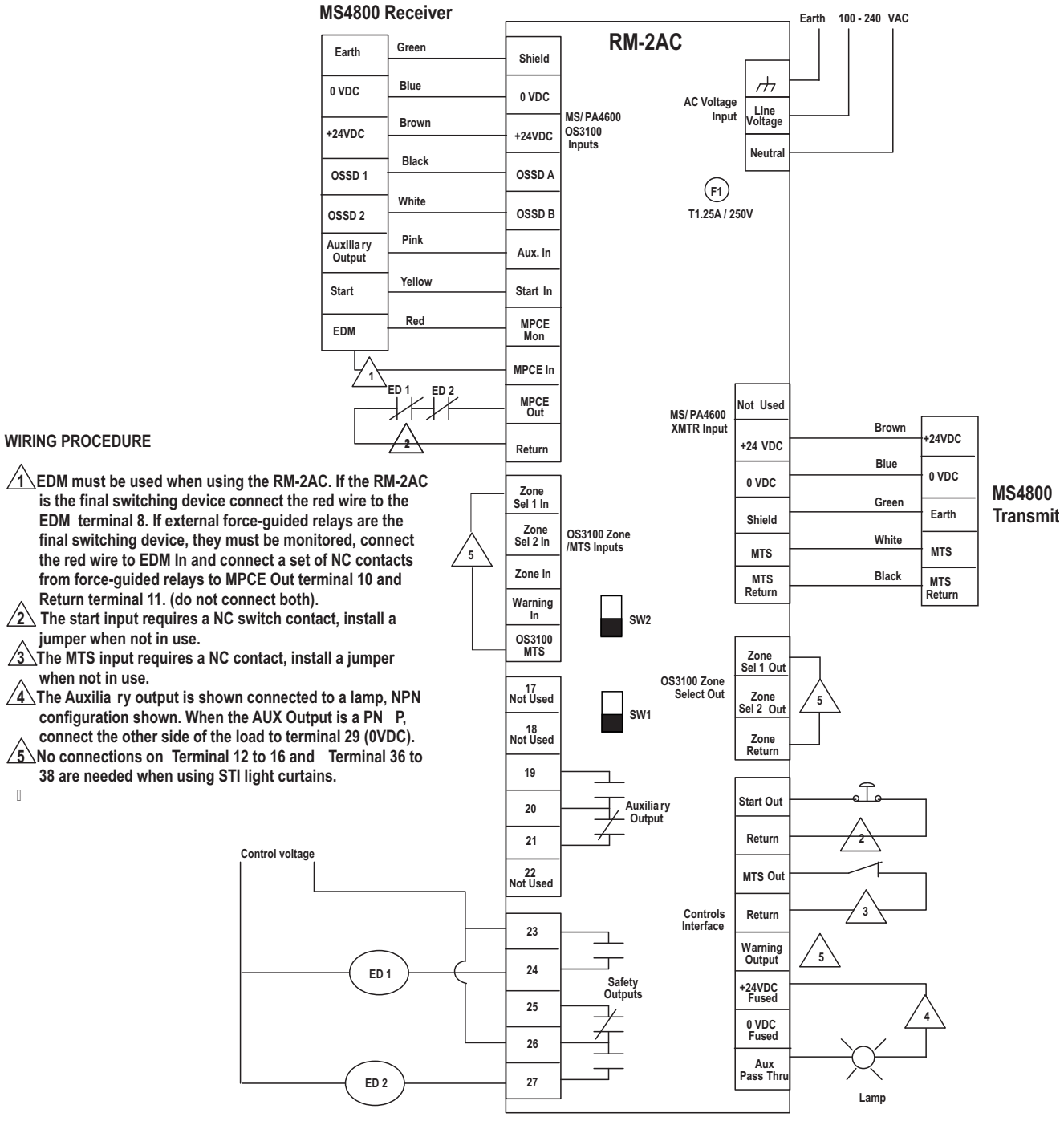


Figure 12-3 Connecting via an RM-2AC Module

12.4 Connecting Via Two Force-Guided Relays

FGR series relays provides force-guided relay outputs for machine control. See *Figure 12-4* for the preferred connection method using two force-guided relays.

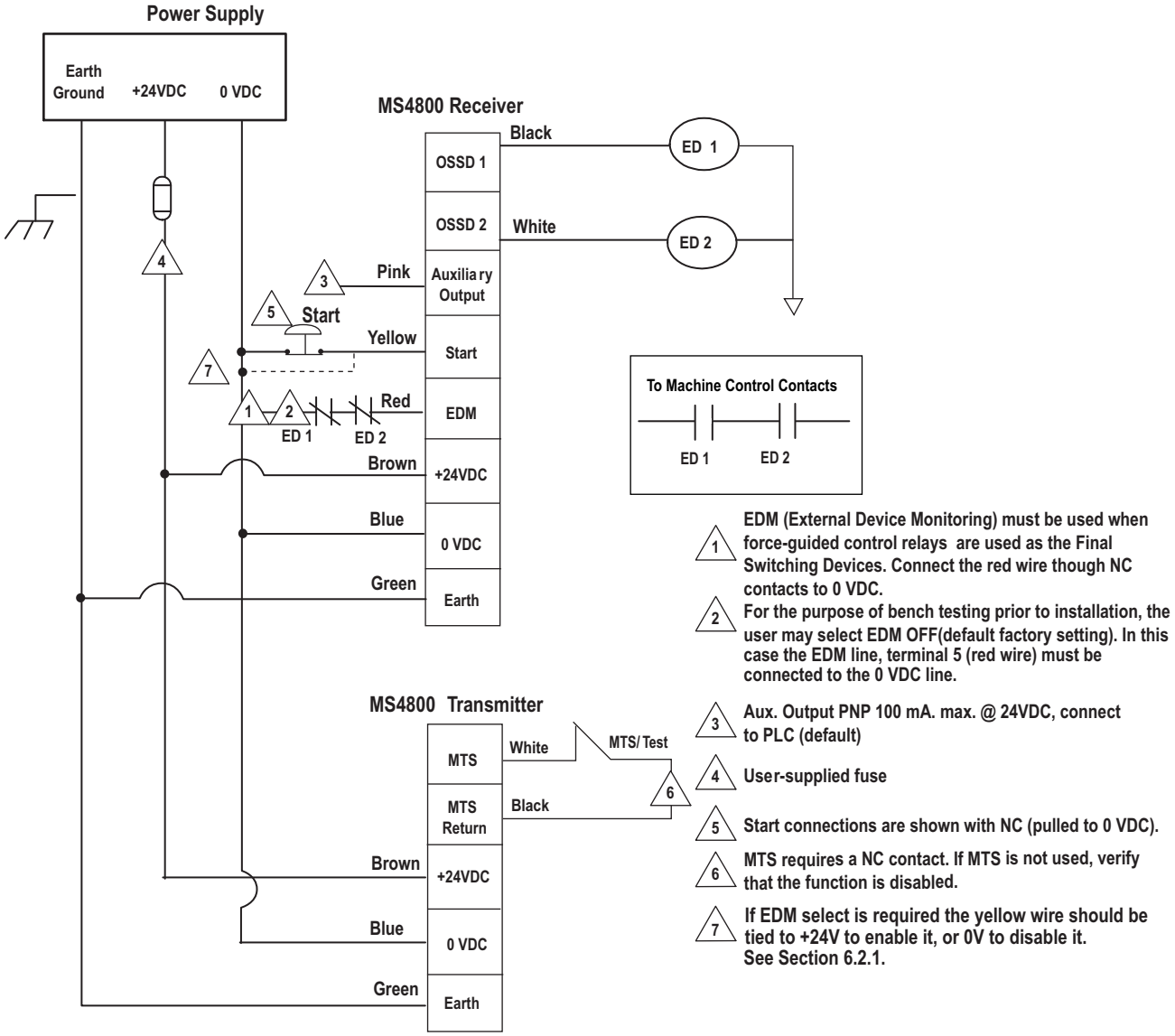


Figure 12-4 Connecting Via Two Force-guided Relays

12.5 Connecting To an RM-6 Module (for MSF4800A and MSF4800S)

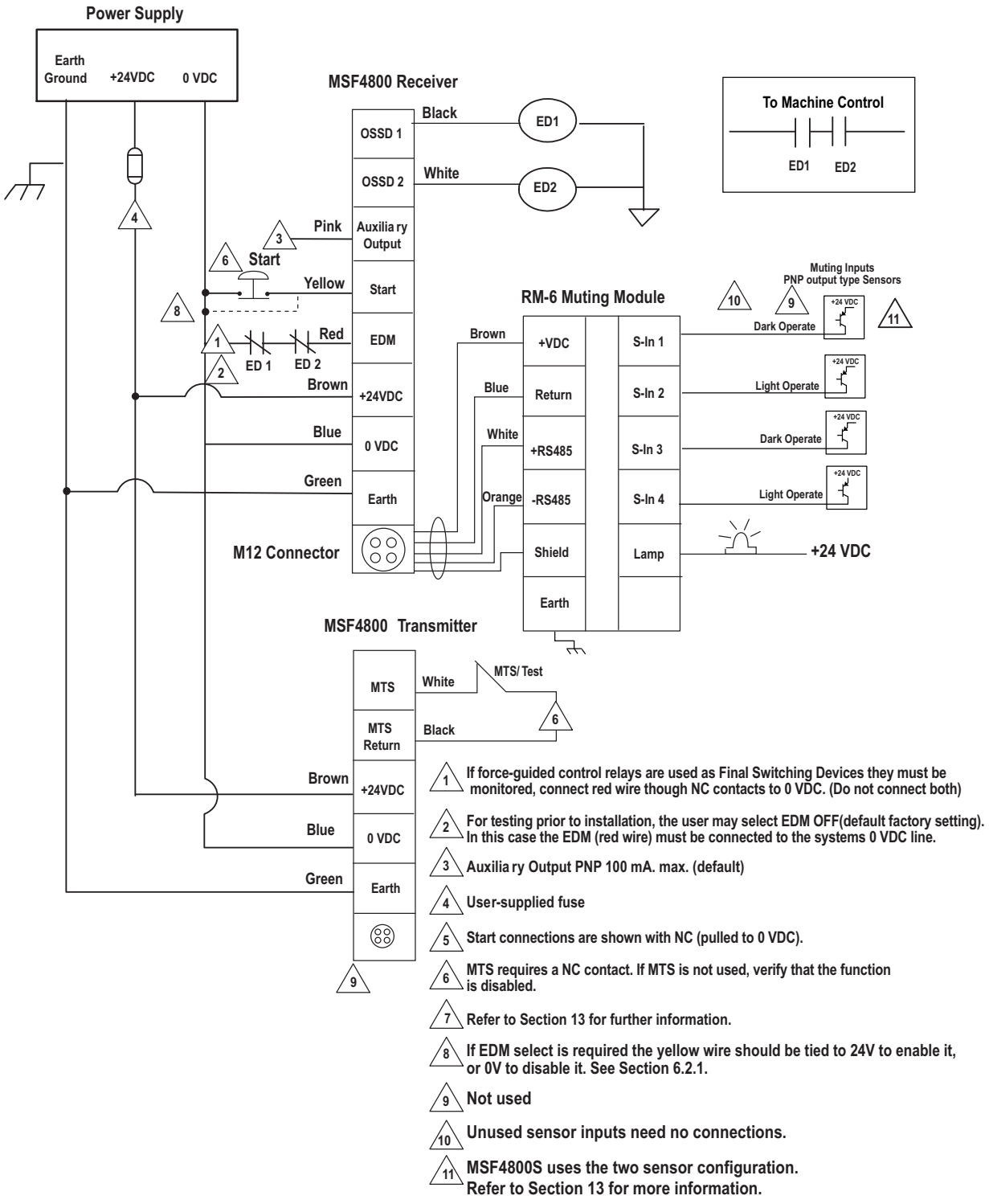


Figure 12-5 Connecting Via an RM-6 Module

12.6 Connecting Via An RM-2AC-IP

- EDM (SW1): select either internal (INT) or external (EXT). By default, this is set to INT. EDM must be enabled on the MS4800.
- AUX (SW2): The auxiliary output of the RM-2AC-IP needs to be configured based on the MS4800 being installed. If you are using the MS4800B or MS4800S, the AUX needs to be set to PNP. For an MS4800A, the auxiliary output could be either PNP or NPN, depending on your configuration.
- F3SJ (SW3): Make sure this switch is set to "NO".

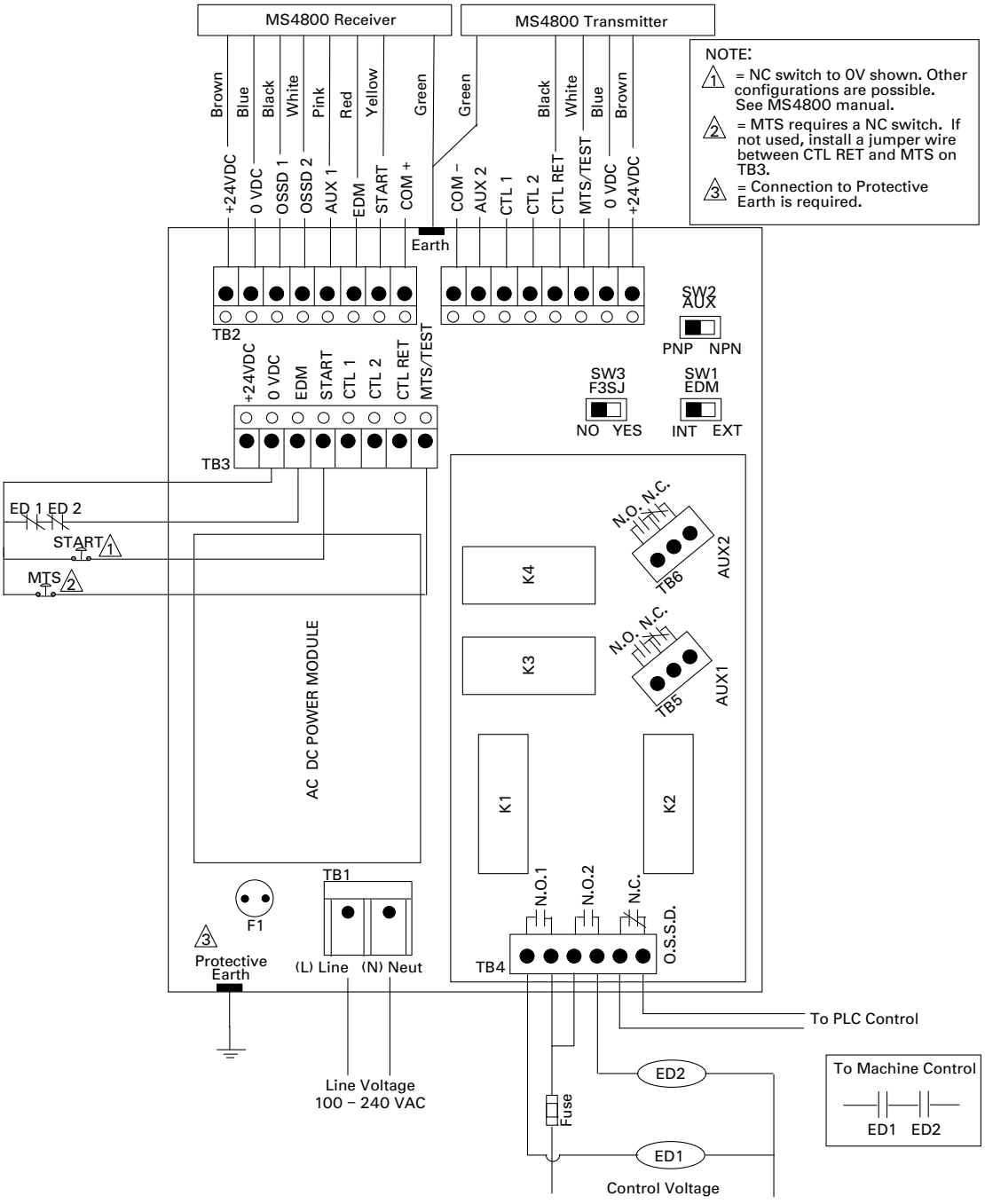


Figure 12-6 Connecting Via An RM-2AC-IP Module

12.7 Connecting To an RM-X Module (for MSF4800A and MSF4800S)

The Omron STI RM-X Module provides force-guided relay outputs for machine control. OSSD Safety outputs 1 and 2 are connected to the RM-X and provide the power necessary to energize its relays. See *Figure 12-7* for the preferred connection method using the RM-X. The auxiliary non-safety output of the MS4800 system can be used to signal light curtain status to a PLC.

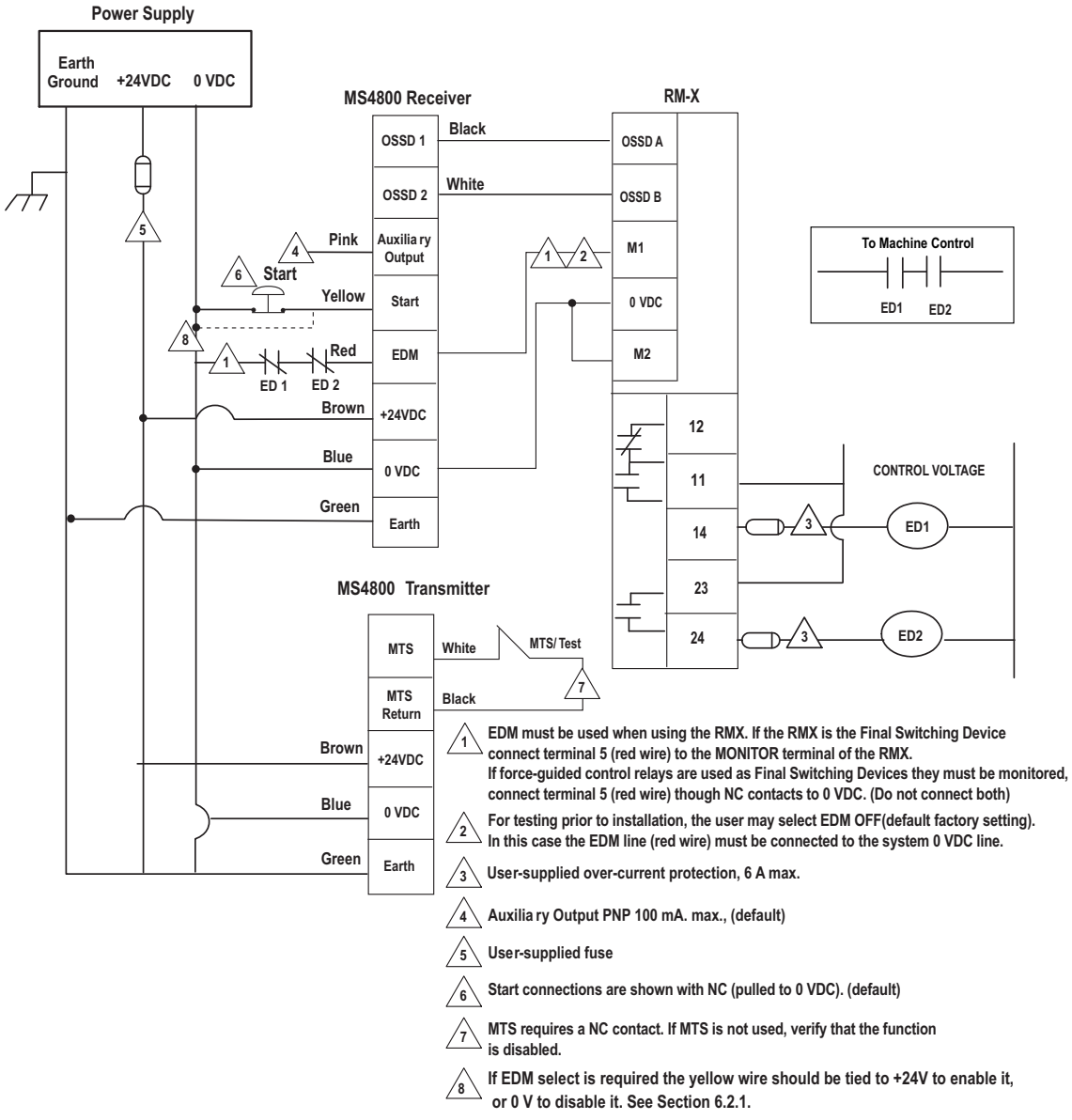


Figure 12-7 Connecting Via An RM-X Module

12.8 External Cable Connections

The primary cables for the MS4800 series are industry standard non-shielded cables with an M12 female connector. The receiver and transmitter incorporate a 0.3 m (12 in.) pigtail with an M12 male connector. The following table lists the pin assignments.

Table 12-1 MS4800 Receiver Pin Assignments

M12 Pin Numbers	Wire Colors	Function	Signal Name
1	Brown	Input Power	+24VDC
2	Blue	Input Power	0VDC
3	Green	Input Power	Functional Earth
4	White	Outputs Signals	OSSD 2
5	Yellow	Input Control Signal	START or EDM Mode
6	Red	Input Control Signal	EDM Monitor
7	Pink	Outputs Signals	AUXILIARY VC/LC
8	Black	Outputs Signals	OSSD 1

Table 12-2 MS4800 Transmitter Pin Assignments

M12 Pin Numbers	Wire Colors	Function	Signal Name
1	Blue	Input Power	0 VDC
2	Brown	Input Power	+24 VDC
3	White	Test Input	MTS
4	Black	Test Input	MTS Return
5	Green	Test Input	Functional Earth

12.9 Interconnect Cables for Cascaded MSF4800 Series

The segment-to-segment cable has a 4-contact M12 connector on each end. The maximum cable length is 10-meters between segments.

The extension cables are available in lengths of 0.3, 0.5, 1.0, 2.0, 3.0, 5.0 and 10.0 meters. An MSF4800 does not require an extension cable; it has a 150 mm (6 in.) integrated cable (pigtail).

MSF4800 systems are designed with internal circuit protection to protect from damage when they are connected and disconnected (hot-swap) during normal operation.

13 MUTING

Muting with the RM-6 is available on MSF4800A and MSF4800S systems. Muting for MS4800B systems can be achieved using the RM-3; this is not covered in this manual. The MSF4800A and MSF4800S series provide the muting function through the use of an RM-6 resource module. The RM-6 serves as a termination point for the muting sensors and muting lamp. The RM-6 connects to the end connector of an MSF4800 receiver. The drawing below illustrates how the RM-6 connects to the MSF4800A and MSF4800S, see Figure 12-5 *Connecting Via an RM-6 Module*.

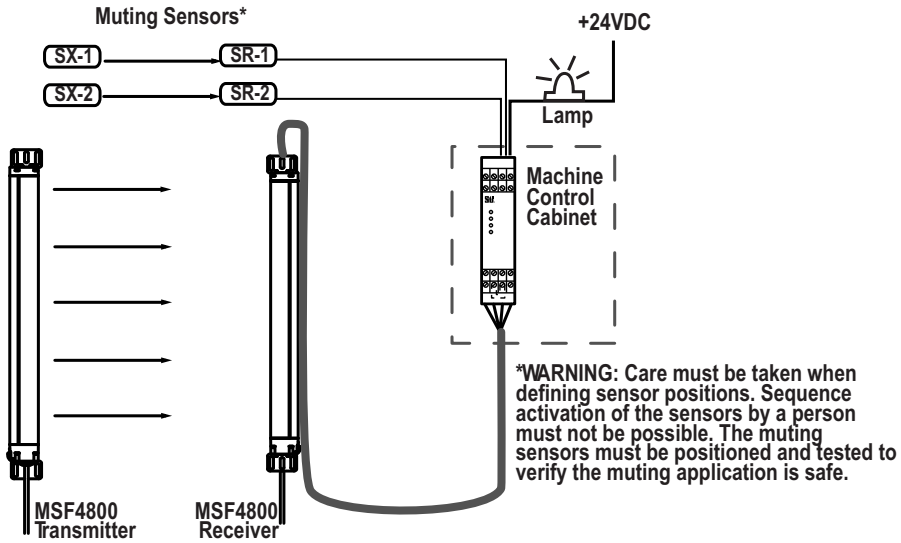


Figure 13-1 Muting Function using RM-6

13.1 MUTING OVERVIEW

Use of a muting function requires special precautions by the safety system machine controller, installer, operator and employer. The following is only a partial list of requirements when utilizing muting and is not intended to be a complete guide to muting standards. The employer must contact the local safety authority for specific requirements regarding the machine, machine controller and safety-related control system. Omron STI provides the following information for user reference only and makes no claim regarding the accuracy, completeness or effectiveness for a specific application.

- Muting of the light curtain is only permitted during the nonhazardous portion of the machine cycle.
- If the machine tool has reversing capability where a muting hazard is possible the control shall include an automatic means through which muting is only permitted in the forward direction.
- One or more visual indicator(s) shall be provided which are illuminated when the light curtain is in a muted condition.
- Any fault condition of the mute indicator(s) shall not allow the light curtain to enter a mute condition.
- The mute indicator(s) should be readily visible from any normal machine operator position and from the position at which any adjustment of the muting is normally carried out.
- At least two, independent muting signal sources must be used with the RM-6. A single, simple cam-operated limit switch is inadequate as a muting signal source since its failure can remain undetected.

- The guarded machine must be able to stop anywhere in its cycle. Do not use an MSF4800 system on a press with a full-revolution clutch.
- Additional guarding may be required for access to dangerous areas not covered by the safety device system.

The enforcement of these requirements is beyond the control of Omron STI. The employer has the sole responsibility to follow the preceding requirements and any other procedures, conditions and requirements specific to his machinery.

13.2 MUTING WITH MSF4800

13.2.1 MUTING WITH THE MSF4800A

The MSF4800A and an RM-6 offer a full selection of muting configurations. The following list describes the muting functions that can be achieved with the MSF4800A.

- 2 Sensor muting
- 3 Sensor muting
- 4 Sensor muting: (bi-directional or uni-directional selectable)
- 2X (4 Sensor) muting: (bi-directional or uni-directional selectable)
- Adjustable sensor input filtering: (50 to 500ms)
- Mute Bypass allowed
- Mute Timeout limit: (2 minutes or no-timeout selectable)

The muting functions above are activated with the use of the PDM (Programming and Diagnostics Module), refer to section 8 for more information.

13.2.2 MUTING WITH THE MSF4800S

The MSF4800S and an RM-6 offer a limited set of muting functions, “simple muting”. The following lists the muting functions of the MSF4800S.

- 2 Sensor muting
- 50ms sensor input filtering (no adjustment)
- Mute bypass allowed (configurable using Sensor 4 input, +24Vdc = Enabled, 0V or unconnected = Disabled)
- Mute timeout limit (configurable using Sensor 3 input, +24Vdc = No Limit, 0V or unconnected = 2 minute time option)

The MSF4800S requires a specific sequence to activate the muting function after the RM-6 is connected. Once the RM-6 is connected the system will not operate until either the mute module is removed or the following sequence is followed:

- The MSF4800S will fault “71”, (mute module enable and configuration required)
- With the power off, the start button must be pressed and remain pressed while the power is applied.
- The three LEDs on the receiver end-cap will start flashing.
- The start button must be released within 2 seconds after the LEDs start flashing

When this sequence is properly completed, the system shall enable muting. This is similar to the process used to recover from a reduction in flex segments (See Section *4.3.2*).

13.3 Application Examples

13.3.1 Application Information

The following section contains several examples of how the RM-6 may be used with various sensor arrangements to start and end the muting sequence.

Although photoelectric sensors are used in the example, other types of sensors, such as limit switches, inductive proximity sensors and ultrasonic sensors may be used as sensor inputs to the RM-6.

13.3.2 Selection and Orientation of the Muting Sensors

The objective of muting sensor selection and orientation is to always recognize the presence of the workpiece material as the intended means to start or stop the muting sequence. The presence of any person in the detection zone of the muting sensors must never be able to initiate a muting sequence.

The proper selection, installation and orientation of the muting sensors are the sole responsibility of the employer and installer. The following recommendations must be observed, especially in applications involving conveyors.

- The muting sensors should detect the material, and not the transportation means, such as a pallet, cart or other transport device. Ensure that a person on the transport device cannot initiate muting and enter the hazardous area.
- Do not allow interruption in the sensing of the material while passing the muting sensors. The detection of the material should be continuous over its length.
- If using photoelectric sensors, do not allow reflective material to interrupt or cause optical short circuits among different sensors. Do not allow sensors in adjacent areas to interfere or provide false indication.
- Position the sensors such that before a new load of material is detected by the first sensor, the prior material has passed the last sensor and all muting sensors are deactivated for a period of time.
- Consider the overall speed and cycle of the material as it moves through the process. Time must be allowed for evaluating the muting sensors output prior to the material reaching the safeguarding device.
- Access by persons into the hazardous area of the machine must be prevented or detected such that the safeguarding device is able to send a stop signal to the machine before entry into the hazardous area. Other safeguarding methods, such as physical barriers or fences, may be necessary.

13.4 Two Sensor Muting System (For MSF4800A and MSF4800S)

WARNING! ***Muting sensors must be positioned so that personnel cannot activate the sensors in a sequence which allows them to pass through the light curtain protection field undetected.***

The figure below illustrates one application of a conveyor belt muting system using a two sensor configuration. The two sensor configuration muting system is bi-directional.

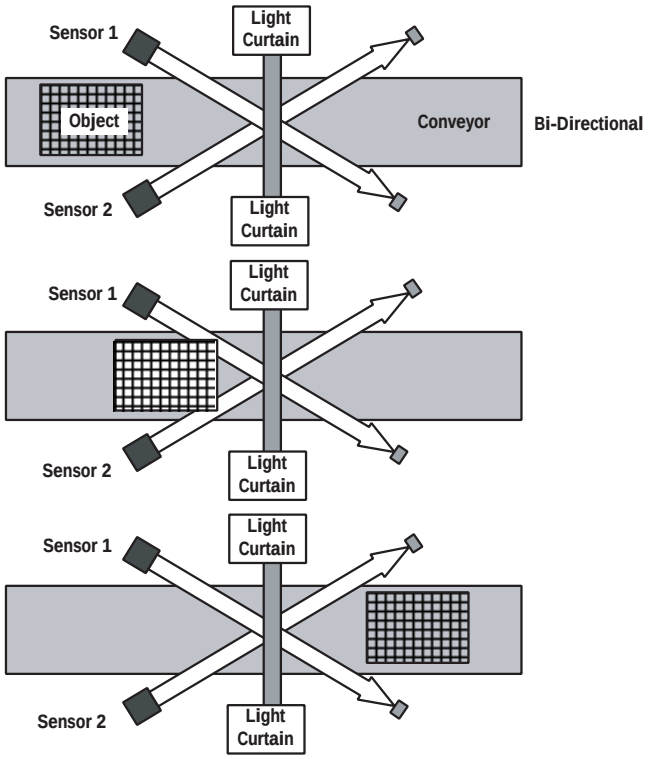


Figure 13-2 Two Sensor System Diagram

The figure below illustrates muting on a mechanical press using two switches to sense when to enter the Muting state. Bottom Dead Center (BDC) is the point at which the tool is closest to the die. Top Dead Center (TDC) is the point at which the tool is furthest from the die.

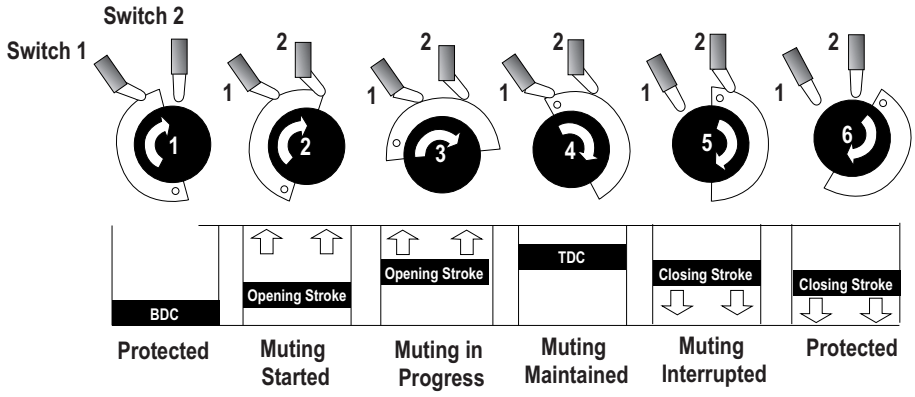


Figure 13-3 Muting a Mechanical Press

Table 13-1 Conditions required to transition to Muting state - Two Sensor System

No. of Sensors	State	Mute Enable	Sensor 1	Sensor 2	Sensor 3	Sensor 4	System Status
2 Sensor System	State 1	OFF	X	X	X	X	Protected
	State 2	ON	OFF	OFF	XX	XX	Protected
	State 3	ON	OFF	ON	XX	XX	Protected
	State 4	ON	ON	OFF	XX	XX	Protected
	State 5	ON	ON	ON	XX	XX	Muted

X = Sensor can be in any state, does not apply to selected mode.

XX = Under normal conditions, these Sensor Inputs should not be connected. When the mute has been enabled through the PDM, if at anytime these Sensor Inputs become active, the Muting system will transition to the LOCKOUT (FAULT) state.

13.4.1 SENSOR REQUIREMENTS

Sensor 1 must be a Dark-On type sensor with PNP-type output or a switch that closes its contact to provide +24 VDC when it is OK to mute.

Sensor 2 must be a Light-On type sensor with PNP-type output or a switch that opens its contact when it is OK to mute.

In a two sensor system, each sensor must transition to the ON state within 3 seconds of each other for the muting state to occur.

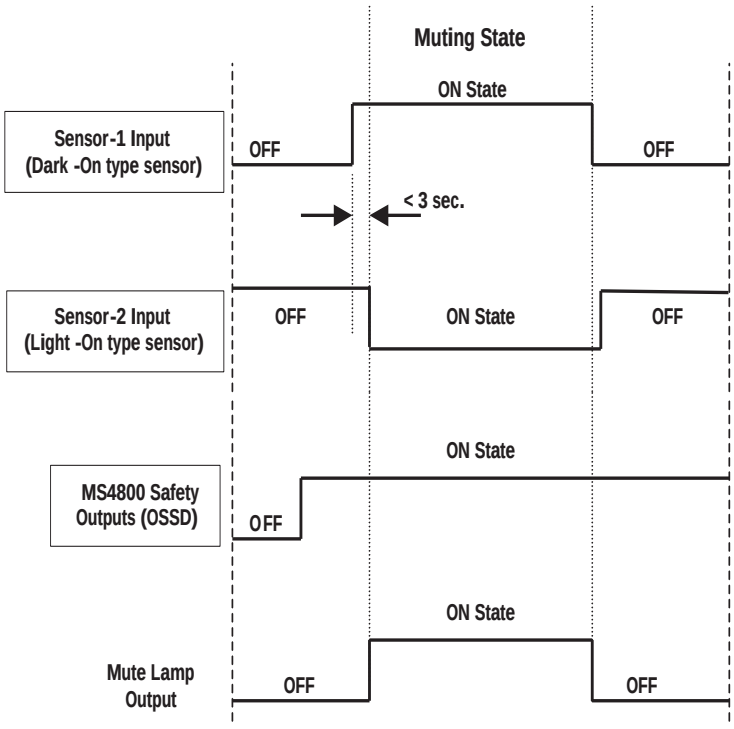


Figure 13-4 Two Sensor Muting System Waveform Diagram

13.5 THREE SENSOR MUTING SYSTEM (FOR MSF4800A ONLY)

WARNING! Muting sensors must be positioned so that personnel cannot activate the sensors in a sequence which allows them to pass through the light curtain protection field undetected.

Three sensor system is uni-directional. In this application Sensor 3 is used as a direction detector, and must transition to the ON state prior to activation of sensor pairs Sensor 2 and Sensor 1. Sensor pairs Sensor 2 and Sensor 1 must activate within 3 seconds of each other and Sensor 3 must turn OFF before Sensor 2 or Sensor 1 turn OFF. The figure below illustrates a muting system used in a three Sensor conveyor belt configuration.

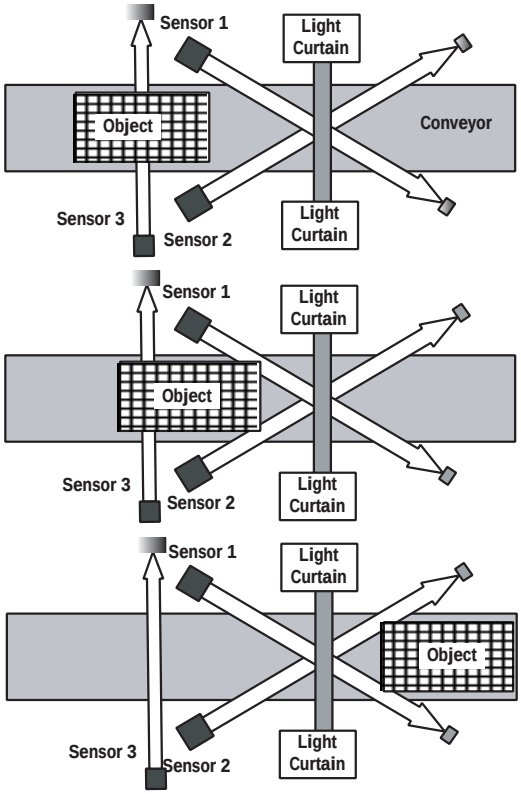


Figure 13-5 Three Sensor System Design

Table 13-2 Conditions required to transition to Muting State - Three sensor system

No. of Sensors	State	Mute Enable	Sensor 1	Sensor 2	Sensor 3	Sensor 4	System Status
3 Sensor System	State 1	OFF	X	X	X	X	Protected
	State 2	ON	OFF	OFF	OFF	XX	Protected
	State 3	ON	OFF	OFF	ON	XX	Protected
	State 4	ON	ON	ON	ON	XX	Muted
	State 5	ON	ON	ON	OFF	XX	Muted*

X = Sensor can be in any state, does not apply to selected mode.

XX = Under normal conditions, these Sensor Inputs should not be connected. When the mute has been enabled through the PDM, if at anytime these Sensor Inputs become active, the Muting system will transition to the LOCKOUT (FAULT) state.

* Muting will occur if sensor 3 was on in proper sequence as detailed in this section.

13.5.1 SENSOR REQUIREMENTS

The following conditions must be met for muting state to occur:

— Sensors 1 & 3 must be a Dark-On type sensor with PNP-type output or a switch that closes its contact to provide +24 VDC when it is OK to mute.

— Sensor 2 must be a Light-On type sensor with PNP-type output or a switch that opens its contact when it is OK to mute.

— Sensor 3 must activate at least 0.05 seconds before sensors 1 and 2.

— Concurrence of activation of the sensor pair, Sensor 1 and 2, must be within 3 seconds of each other.

— Sensor 3 must remain active until both sensors 1 and 2 activate.

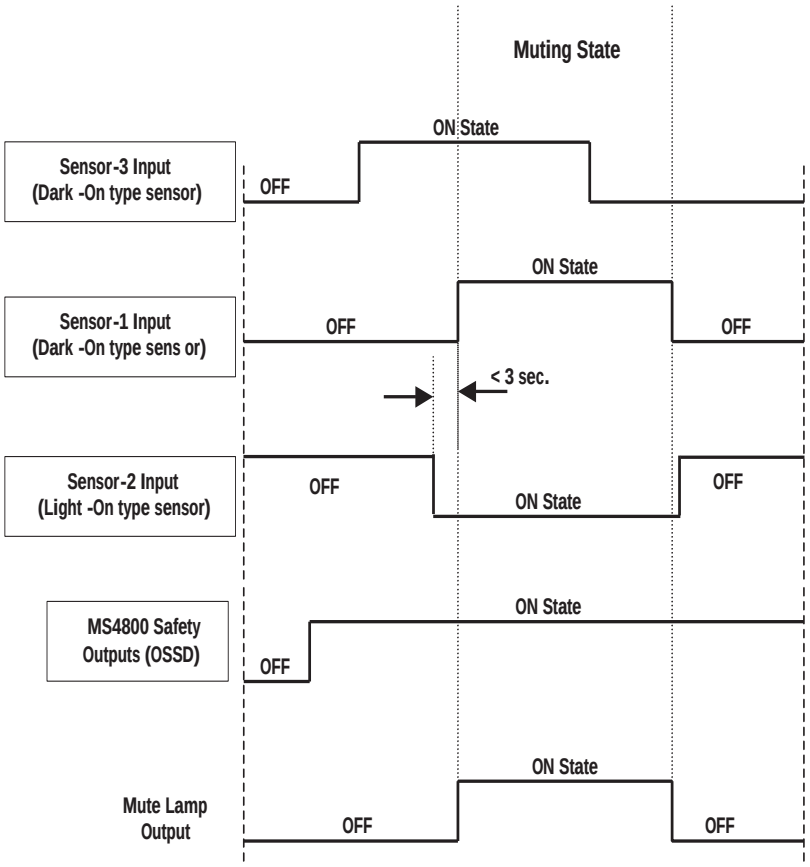


Figure 13-6 Three Sensor Muting System Waveform Diagram

13.6 FOUR SENSOR MUTING SYSTEM (FOR MSF4800A ONLY)

WARNING! ***Muting sensors must be postponed so that personnel cannot activate the sensors in a sequence which allows them to pass through the light curtain protection field undetected.***

The MSF4800A and the RM-6 can be configured with the PDM to function in a bi-directional or uni-directional configuration. Since the conveyor is bidirectional either Sensor 1 or Sensor 4 can be activated first in the sequence, a sensor pair (Sensor 1 and Sensor 2 or Sensor 3 and Sensor 4) must transition to the ON state and concur within 3 seconds.

Note: this is not available on the MSF4800S system

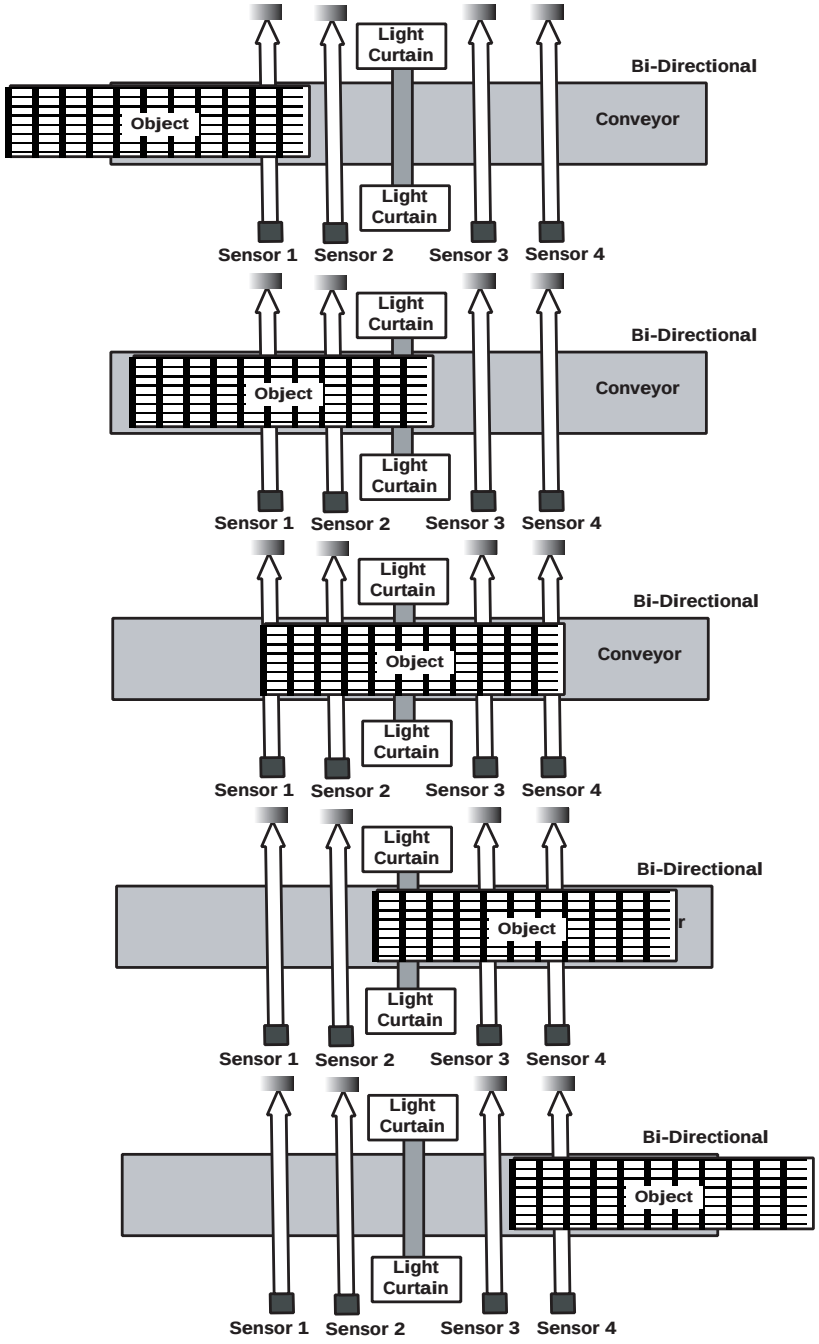


Figure 13-7 Four Sensor System Diagram

Table 13-3 Conditions required to transition to Muting State - Four sensor system

No. of Sensors	State	Mute Enable	Sensor 1	Sensor 2	Sensor 3	Sensor 4	System Status
4 Sensor System	State 1	OFF	X	X	X	X	Protected
	State 2	ON	OFF	OFF	OFF	OFF	Protected
	State 3	ON	ON	OFF	OFF	OFF	Protected
	State 4	ON	ON	ON	OFF	OFF	Muted
	State 5	ON	ON	ON	ON	OFF	Muted
	State 6	ON	ON	ON	ON	ON	Muted
	State 7	ON	OFF	ON	ON	ON	Muted
	State 8	ON	OFF	OFF	ON	ON	Muted
	State 9	ON	OFF	OFF	OFF	ON	Protected

x = Sensor can be in any state, does not apply to selected mode.

13.6.1 SENSOR REQUIREMENTS

The following conditions must be met for the MSF4800/RM-6 to enter or remain in the muting state:

— Sensors 1 and 3 must be a Dark-On type sensor with PNP-type output or a switch that closes its contact to provide +24 VDC when it is safe to mute.

— Sensors 2 and 4 must be a Light-On type sensor with PNP-type output or a switch that opens its contact when it is safe to mute.

— Concurrence of activation of sensor pair Sensor 1 and Sensor 2 must be within 3 seconds and the concurrence of activation of sensor pair Sensor 3 and Sensor 4 must be within 3 seconds.

— Sequence of sensor activation is Sensor 1 before Sensor 2, before Sensor 3, before Sensor 4 or the sequence may be in reverse order, Sensor 4 before Sensor 3, before Sensor 2, before Sensor 1. The time difference between sensor activation must be at least 0.05 seconds.

— To stay in muting state sensor pair Sensor 1 and Sensor 2 must remain active until sensor pair Sensor 3 and Sensor 4 activate. In reverse order, sensor pair Sensor 3 and Sensor 4 must remain active until sensor pair Sensor 1 and Sensor 2 activate.

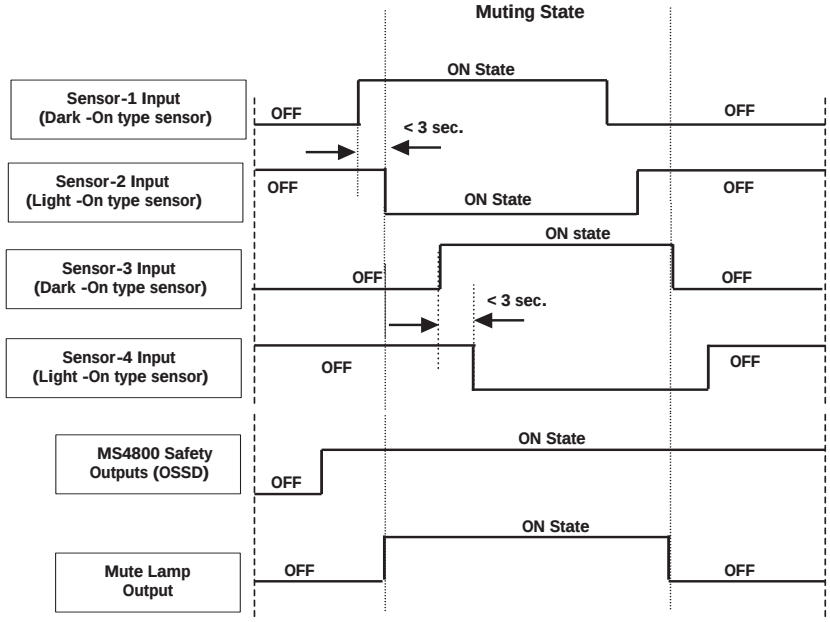


Figure 13-8 Four Sensor Muting System Waveform Diagram

13.7 Dual X 4-Sensor Muting System (For MSF4800A Only)

WARNING! ***Muting sensors must be positioned so that personnel cannot activate the sensors in a sequence which allows them to pass through the light curtain protection field undetected.***

The MSF4800A and the RM-6 can be configured with the PDM to function in a bi-directional or uni-directional configuration. The only difference between the Dual X 4-Sensor configuration and the Four Sensor configuration is that the Dual X 4-Sensor does not require the time sequence between sensors within each sensor pair. The figure below illustrates that the sensors within each sensor pair are set in a 'X' configuration.

Note: this is not available on the MSF4800S system

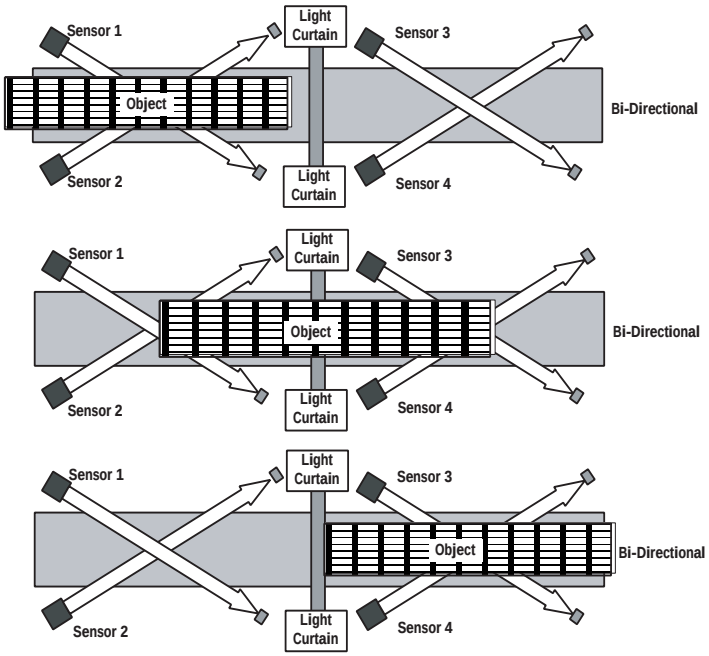


Figure 13-9 Dual X 4-Sensor System Diagram

Table 13-4 Conditions required to transition to Muting State - Dual X 4-sensor system

No. of Sensors	State	Mute Enable	Sensor 1	Sensor 2	Sensor 3	Sensor 4	System Status
4 Sensor System	State 1	OFF	X	X	X	X	Protected
	State 2	ON	OFF	OFF	OFF	OFF	Protected
	State 3	ON	ON	OFF	OFF	OFF	Protected
	State 4	ON	OFF	ON	OFF	OFF	Protected
	State 5	ON	ON	ON	OFF	OFF	Muting
	State 6	ON	ON	ON	OFF	ON	Muting
	State 7	ON	ON	ON	ON	ON	Muting
	State 8	ON	ON	OFF	ON	ON	Muting
	State 9	ON	OFF	ON	ON	ON	Muting
	State 10	ON	OFF	OFF	ON	ON	Muting
	State 11	ON	OFF	OFF	OFF	ON	Protected
	State 12	ON	OFF	OFF	ON	OFF	Protected

x = Sensor can be in any state, does not apply to selected mode.

13.7.1 Dual X 4-Sensor Requirements

The following conditions must be met for the MSF4800A/RM-6 to enter or remain in the Muting state:

- Sensor 1 and 3 must be Dark-On type sensors with PNP-type output or a switch that closes its contact to provide +24 VDC when it is OK to mute.
- Sensors 2 and 4 must be Light-On type sensors with PNP-type output or a switch that opens its contact when it is OK to mute.
- Concurrence of activation of sensor pair Sensor 1 and Sensor 2 must be within 3 seconds, with either sensor within the pair activating first. Sensor pair Sensor 3 and Sensor 4 must comply with the same requirements of activating within 3 seconds of each other and either sensor may activate first.
- Sequence activation of sensor pair 1 and 2 before sensor pair 3 and 4 or the sequence may be in reverse direction, sensor pair 3 and 4 before sensor pair 1 and 2.
- To stay in Muting state sensor pair 1 and 2 must remain active until sensor pair 3 and 4 become active. In reverse direction sensor pair 3 and 4 must remain active until sensor pair 1 and 2 become active for RM-6 to remain in the Muting state.
- To stay in the Muting State any sensor that is no longer controlling the muting sequence and has transitioned to an inactive state must remain in the inactive state until the current controlling muting sensors have become inactive.

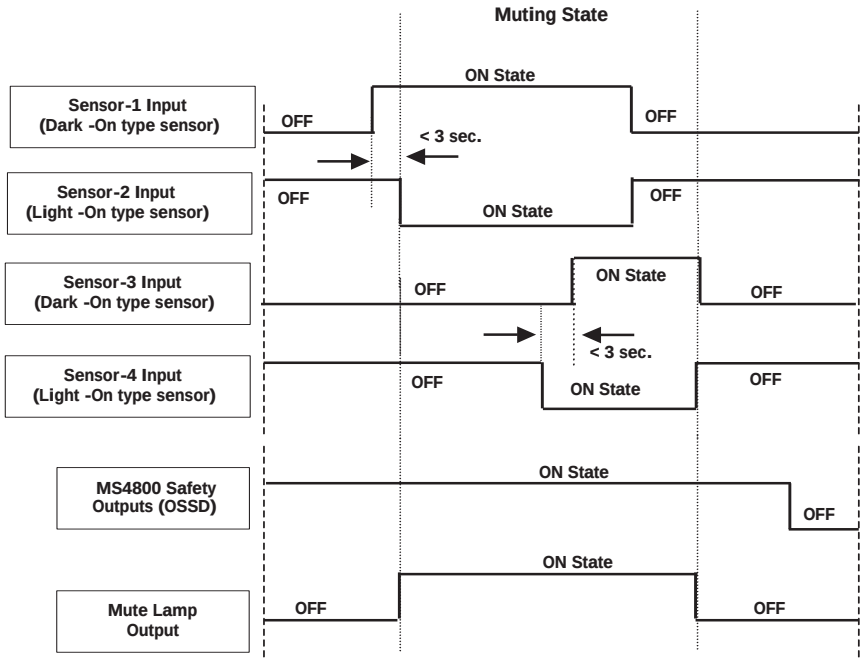


Figure 13-10 Dual X 4-Sensor Muting System Waveform Diagram

13.8 Description of the Bypass-Allowed Feature (For MSF4800A and MSF4800S)

The MSF4800/RM-6 allows supervisory personnel to momentarily override the MACHINE STOP signal of the MSF4800/RM-6. This function is used during instances where processing sequence operations did not allow an automatic transition to the muting state and the MSF4800/RM-6 safety outputs are in the OFF state.

The MSF4800/RM-6 will enter the Bypass-Allowed state under the following conditions:

- The light curtain safety output (OSSD) are in the Off state and a minimum of one mute sensor is active.

The MSF4800/RM-6 signals that it is in the Bypass-Allowed state by the following indications:

- The mute lamp will flash at about a 1-second interval.

To allow the MSF4800/RM-6 to transition to the Muting state the supervisory personnel must press and release the start button. When entering the Muting state through the Bypass-Allowed feature the following will occur:

- The mute lamp will now be on continuously.
- If the light curtain is clear of obstructions before all of mute sensors have cleared then the MSF4800/RM-6 will leave the Muting state and enter the MACHINE RUN state. Note, all of the mute sensors must clear for the MSF4800A/RM-6 to automatically enter the Muting state during the next process cycle.
- If all of the mute sensors clear of obstructions before the light curtain has cleared then the MSF4800/RM-6 will leave the Muting state and enter the MACHINE STOP state.
- When the Muting state is entered through the Bypass-Allowed state then the maximum time for the MSF4800/RM-6 to be continuously in the Muting state is 10 minutes.
- If the 10 minute time limit is exceeded the MSF4800/RM-6 will automatically change from the Muting state to the Bypass-Allowed state.
- There is no limit on the number of times that the MSF4800/RM-6 can enter the Bypass-Allowed state and then with the press and release of the Start button, transition into the Muting state.

13.8.1 Muting Time out (For MSF44800A and MSF4800S)

This feature allows supervisory personnel to set a pre-determined mute time limit. If the Mute Time Limit is enabled, it maintains the default mute state for 2 minutes after the proper sensor sequence. After the 2 minutes, the MSF4800A or MSF4800S with RM-6 will switch the OSSDs from RUN to STOP. The external Mute Active light will flash at a 1-2 Hz rate. If the Mute time limit is disabled the mute state will be maintained as long as the sensors remain in a muting condition.

Table 13-5 Bypass-Allowed Example

Conveyor System Condition	Muting Sensor Condition			Light Curtain Condition	RM-6 Response to these conditions
	Sensor 1	Sensor 2	Sensor 3		
System power is restored	Sensor is clear	Sensor is clear	Sensor is blocked	Curtain is cleared	Powers-up and enters INTERLOCK state and senses that Sensor 3 is active.
Supervisor verifies that system is safe to start, the MS4800/RM-6 Start button is pressed and released	Sensor is clear	Sensor is clear	Sensor is blocked	Curtain is cleared	Enters MACHINE RUN state, safety outputs (OSSD) switch to On-state and conveyor motors start.
Conveyor motors are running	Sensor becomes blocked	Sensor becomes blocked	Sensor becomes clear	Curtain becomes blocked	Enters MACHINE STOP (Bypass-Allowed) state since muting Sensor 3 was not inactive at power-up, safety outputs (OSSD) switch to Off-state.
Conveyor motors stop	Sensor is blocked	Sensor is blocked	Sensor is clear	Curtain is blocked	MS4800/RM-6 indicates Bypass-Allowed by blinking mute lamp is lit.
Supervisor verifies that system is safe to bypass, the MS4800/RM-6 Start button is pressed and released	Sensor is blocked	Sensor is blocked	Sensor is clear	Curtain is blocked	Enters Muting state, safety outputs (OSSD) switch to On-state, mute lamp is lit.
Conveyor motors are running	Sensor is blocked	Sensor is blocked	Sensor is clear	Curtain becomes cleared	Enters MACHINE RUN state, mute lamp turns off.
Conveyor motors are running	Sensor becomes clear	Sensor becomes clear	Sensor is clear	Curtain is cleared	Stays in MACHINE RUN state and is ready to automatically enter muting when next object passes through sensors.

14 CHECKOUT AND TEST PROCEDURES

14

14.1 CHECKOUT PROCEDURE

Once the MS4800 system has been configured, mounted, aligned and properly connected to the machine control system, the initial Checkout Procedure detailed in Appendix A must be performed by qualified personnel. A copy of the checkout results should be kept with the machine records.

14.2 TEST PROCEDURE

⚠ WARNING! ***The tests outlined in the Test Procedure in Appendix B must be performed at installation, according to the employer's regular inspection program and after any maintenance, tooling change, set up, adjustment, or modification to the MS4800 system or the guarded machine. Where a guarded machine is used by multiple operators or shifts, it is suggested that the test procedure be performed at each shift or operator change. Testing ensures that the light curtain and the machine control system work properly to stop the machine. Failure to test properly could result in serious injury to personnel.***

The Test Procedure must be performed by qualified personnel. To test the MS4800 system with Fixed Blanking and Floating Blanking disabled, use the Omron STI-supplied test object. For applications where Fixed Blanking or Floating Blanking are enabled, see *Table 5-7* to determine the proper size test object.

When using an MS4800 system set for Automatic Start Mode operation, in conjunction with an RM-1 or RM-2AC relay module, it is necessary to verify that the RM-1 or RM-2AC outputs can properly change state by causing an intentional beam break at least every change of shift or 24 hours of operation.

14.3 Using the Test Object

When using the test object, guide it through the detection zone as shown below.

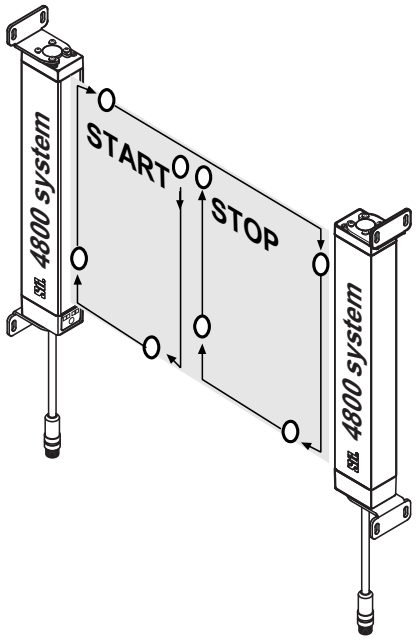


Figure 14-1 Test Object Pattern

15 Cleaning

15

Accumulation of oil, dirt and grease on the front window of the MS4800 transmitter and receiver can effect the system operation. Clean the window with a mild detergent or glass cleaner. Use a clean, soft, lint-free cloth. Painted MS4800 surfaces may be cleaned with a mild de-greasing cleaner or detergent.

16 SPECIFICATIONS AND ADDITIONAL INFORMATION

16

16.1 SYSTEM SPECIFICATIONS

Table 16-1 System Specifications

Performance:	
Protective Height	240-1800mm (14/20mm res.), 280-2120mm (30mm Res.), 360-2040mm (40mm Res.)
Object Resolution	14, 20, 30, and 40mm
Operating Range	14mm resolution - 0.3 to 7m (1 to 23 ft.) default; 0.3 to 3m (1 to 10 ft.) 20, 30 and 40mm resolution - 0.3 to 20m (1 to 65 ft.) default; 0.3 to 8m (1 to 26 ft.)
Effective Aperture Angle	± 2.5° maximum, transmitter and receiver at operating range greater than 3 meters per IEC 61496-2.
Safety Output	Two PNP outputs, each sourcing 500mA nom., 625mA max @ 24 VDC. Short circuit protected. Load capacitance 4.7uF max. Off-state voltage is 2V max. (See note 2)
Response Time	See *Table 16-3*
Auxiliary (Non-Safety) Output	One NPN output sinking 100mA @ 24 VDC or PNP output sourcing 100 mA @ 24 VDC. Both available in follow or fault operating mode. (See note 2)
EDM Monitor	50 mA @24 VDC
Start/Restart	NO Input. Momentary Contact (10mA consumption)
Light Source	Infrared Light Emitting Diode, 880 nm
Transmitter Indicator Lights	Active (Yellow)
Receiver Indicator Light	MACHINE RUN/Stop (green/red), INTERLOCK/Alarm (Yellow), Blanking (amber)
Electrical:	
Power Input Transmitter:	24 VDC ± 20% 285 mA max.
Power Input Receiver:	24 VDC ± 20% 1.8A max. (receiver 450mA + OSSD1 625 mA max. + OSSD2 625 mA max. + auxiliary 100 mA max). (See note 1)
Muting Option (RM-6)	24 VDC ± 20% 30 mA max.
Power Supply	Must meet requirements of IEC 60204-1 and IEC 61496. Omron STI part number 42992 or equivalent. (See note 1).
Mechanical:	
Construction	Polyurethane powder painted aluminum
Cable length	Available in 10, 15, and 30 m lengths, unshielded. (See note 3).
Wiring Connections	M12 connectors: 8-pin receiver and 5-pin transmitter.
Environmental:	
Enclosure rating	IP65
Operating Temperature	-10 to 55° C (14 to 131 F)
Storage Temperature	-25 to 75° C (-14 to 167 F)
Relative Humidity	95% maximum, non-condensing
Vibration	10 - 55 Hz maximum on all 3 axes

Shock	10g for 0.016 seconds; 1,000 shocks for each of three axes

Conformity/Approvals	
Conforming to standards	ANSI R15.6-1999, ANSI B11.19-2003, OSHA 1910.217(c).
Other approvals:	All systems have been EC type examined to the requirements of IEC 61496-1, -2 for a Type 4 ESPE. TUV Registration No. BB600166650001. UL61496-1 & -2. IEC 61508 (SIL3)
	Specifications subject to change

Note 1: The system operates directly from 24 VDC ±20%. Power to the system must come from a 24VDC SELV power supply which meets the voltage interruptions and dip requirements of IEC 61496-1 (per section 4.3.2.2 and 5.4.3.2) and IEC 60204-1 (per section 4.3.3), Omron STI part number 42992 or equivalent. The power supply size is dependent on the total current required by two solid-state safety outputs and the auxiliary output should not exceed 1.35 A. Total system current requirements is the sum of transmitter (285mA), receiver (450mA), OSSD1 (625mA), OSSD2 (625mA) and Aux. Output (100mA).

Note 2: 24 VDC is nominal. Actual OSSD voltage is dependent upon supply, $V_{OSSD} = V_{supply}$- 1V. Maximum current rating of 625mA is for resistive load. For inductive load, maximum switch-off energy is 0.7J at 500mA (single pulse).

Note 3: When using a Omron STI-supplied 30 meter receiver cable the total load current is limited to 1.2A at 24V (nominal). See Section 16.2 when using customer supplied cables.

Table 16-2 RM-6 Specifications

Environmental	
Input Power	24 VDC +/- 20%, 30mA max.
Temperature	0° C to 55°C
Humidity	Less than 95% non-condensing
Storage Temperature	- 25°C to 75°C
Vibration	In accordance with IEC 68-2-6, 0.35mm displacement, 10 to 55 Hz.
Shock	In accordance with IEC 68-2-29, 10g, 16msec pulse, 1000/axis.
Enclosure	IP-20
Mute Sensor	PNP 24 VDC (11mA consumption)
Mute Lamp Output	10 - 100mA (NPN), 30 VDC max. [1]
Safety Category	Type 4 per IEC 61496-1
Note 1: The external lamp must provide a current load between 10mA to 100mA for the lamp monitoring circuit to sense proper operation of the mute lamp.	

Table 16-3 Response Time of MS/MSF4800 System

One Segment System				Two Segment System			
Minimum Beam Count	Maximum Beam Count	Response Time (ms)		Minimum Beam Count	Maximum Beam Count	Response Time (ms)	
		Normal	Slow*			Normal	Slow*
0	16	14	23	0	65	23	38
17	71	23	38	66	120	32	53
72	126	32	53	121	174	41	68
127	180	41	68	175	229	50	83
181	235	50	83	230	256	59	99
236	256	59	99				
Three Segment System				**Four Segment System**			
Minimum Beam Count	Maximum Beam Count	Response Time (ms)		Minimum Beam Count	Maximum Beam Count	Response Time (ms)	
		Normal	Slow*			Normal	Slow*
0	59	23	38	0	53	23	38
60	114	32	53	54	108	32	53
115	168	41	68	109	162	41	68
169	223	50	83	163	217	50	83
224	256	59	99	218	256	59	99

Note: Refer to Section 16 - *Specifications and Additional Information* to determine number of beams in your system.
*See 6.5 - *Response Time Adjustment (only available on the MS4800A)* for more information on this feature.

16.2 Cable Lengths (Customer Supplied Cables)

The table below lists the maximum specified lengths and wire gauges of the MS4800 input & output signals.

Table 16-4 MS4800 Input & Output Signal Cable Lengths

MS4800	Signal Names	Wire Gauge	Specified Maximum Length
MS4800 Receiver	OSSD 1 & 2 Outputs	22 AWG (0.32mm^2) wire	300mA load: 45 meter (147 ft) 625mA: 22 meter (72 ft)
	Auxiliary Output	22 AWG (0.32mm^2) wire	50 meter (164 ft)
	Start Input	24 AWG (0.20mm^2) wire	50 meter (164 ft)
	EDM Input	24 AWG (0.20mm^2) wire	50 meter (164 ft)
	24 VDC Input Power & Return	20 AWG (0.52mm^2) wire	1.8 Amp load: 12.5 meter (41 ft) 1 Amp load: 22 meter (72 ft)
MS4800 Transmitter	24 VDC Input Power & Return	22 AWG (0.32mm^2) wire	0.3 Amp: 47 meter (150 ft)
	MTS	22 AWG (0.32mm^2) wire	50 meter (164 ft)

16.3 MiniSafe MS4800 Dimensional Drawings

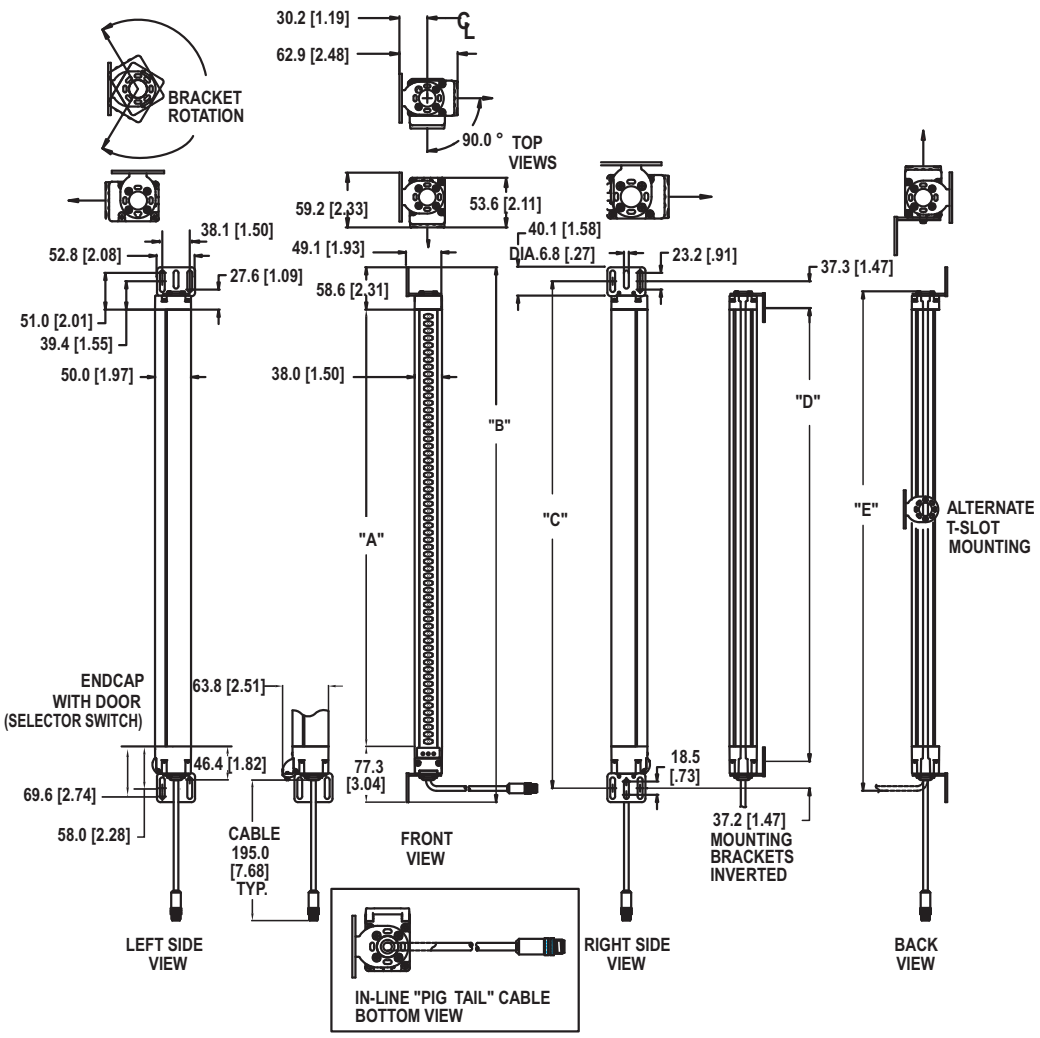


Figure 16-1 MS4800 Dimensional Drawing

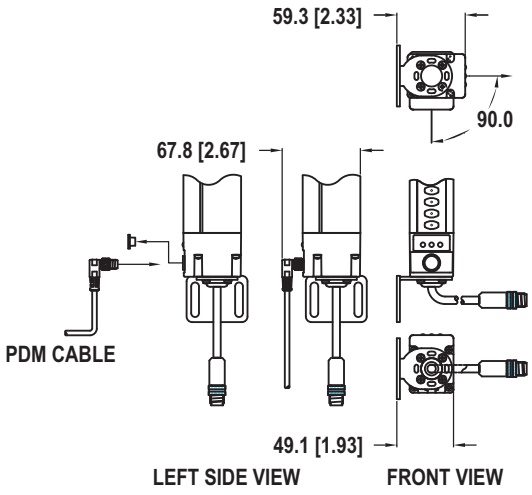


Figure 16-2 Endcap without Door

Table 16-5 MS4800-14/20 Transmitter and Receiver Dimensions

	280mm	320mm	360mm	400mm	440mm	480mm	520mm	560mm
A	284.4/11.2	324.8/12.8	364.5/14.4	404.2/15.9	443.9/17.5	484.3/19.1	523.4/20.6	563.7/22.2
B	420.4/16.6	460.8/18.1	500.5/19.7	540.2/21.3	579.9/22.8	620.3/24.4	659.4/26.0	699.7/27.6
C	381.7/15.0	422.1/16.6	461.8/18.2	501.5/19.7	541.2/21.3	581.6/22.9	620.7/24.4	661.0/26.0
D	307.3/12.1	347.7/13.7	387.4/15.3	427.1/16.8	466.8/18.4	507.2/19.9	546.3/21.5	586.6/23.1
E	371.3/14.6	411.7/16.2	451.4/17.8	491.1/19.3	530.8/20.9	571.2/22.5	610.3/24.0	650.6/25.6

	600mm	640mm	680mm	720mm	760mm	800mm	840mm	880mm
A	604.1/23.8	643.9/25.4	683.6/26.9	724.0/28.5	762.0/30.0	803.5/31.6	843.4/31.6	882.8/34.8
B	740.1/29.1	779.9/30.7	819.6/32.3	860.0/33.9	898.0/35.4	939.5/37.0	979.8/38.6	1018.8/40.1
C	701.4/27.6	741.2/29.2	780.9/30.7	821.3/32.3	859.3/33.8	900.8/35.5	941.1/37.1	980.1/38.6
D	627.0/24.7	666.8/26.3	706.5/27.8	746.9/29.4	784.9/30.9	826.4/32.5	866.7/34.1	905.7/35.7
E	691.0/27.2	730.8/28.8	770.5/30.3	810.9/31.9	848.9/33/42	890.4/35.1	930.7/36.6	969.7/38.2

	920mm	960mm	1000mm	1040mm	1080mm	1120mm	1160mm	1200mm
A	922.5/36.3	963.6/37.9	1002.6/39.5	1042.9/41.1	1083.9/42.7	1122.3/44.2	1162.7/45.8	1203.8/47.4
B	1058.5/41.7	1099.6/43.3	1138.6/44.8	1178.9/46.4	1219.9/48.0	1258.3/59.4	1298.7/51.1	1339.8/52.7
C	1019.8/40.2	1060.9/41.8	1099.9/43.3	1140.2/44.9	1181.2/46.5	1219.6/48.0	1260.0/49.6	1301.1/51.2
D	945.4/37.2	986.5/38.8	1025.5/40.4	1065.8/42.0	1106.8/43.6	1145.2/45.1	1185.6/46.7	1226.7/48.3
E	1009.4/39.7	1050.5/41.4	1089.5/42.9	1129.8/44.5	1170.8/46.1	1209.2/47.6	1249.6/49.2	1290.7/50.8

	1240mm	1280mm	1320mm	1360mm	1400mm	1440mm	1480mm	1520mm
A	1242.1/48.9	1281.8/50.5	1323.6/52.1	1362.0/53.6	1401.7/55.2	1443.4/56.8	1481.8/58.3	1521.5/59.9
B	1378.1/54.3	1417.8/55.8	1459.6/57.5	1498.0/59.0	1537.7/60.5	1579.4/62.2	1617.8/63.7	1657.5/65.3
C	1339.4/52.7	1379.1/54.3	1420.9/55.9	1459.3/57.5	1499.0/59.0	1540.7/60.7	1579.1/62.2	1618.8/63.7
D	1265.0/49.8	1304.7/51.4	1346.5/53.0	1384.9/54.5	1424.6/56.1	1466.3/57.7	1504.7/59.2	1544.4/60.1
E	1329.0/52.3	1368.7/53.9	1410.5/55.5	1448.9/57.0	1488.6/58.6	1530.3/60.2	1568.7/61.8	1608.4/63.3

	1560mm	1600mm	1640mm	1680mm	1720mm	1760mm	1800mm
A	1563.3/61.6	1600.9/63.0	1641.3/64.6	1683.1/66.3	1720.8/67.8	1760.5/69.3	1802.9/71.0
B	1699.3/66.9	1736.9/68.4	1777.3/70.0	1819.1/71.6	1856.8/73.1	1896.5/74.7	1938.9/76.3
C	1660.6/65.4	1698.2/66.9	1738.6/68.5	1780.4/70.0	1818.8/71.6	1857.8/73.1	1900.2/74.8
D	1586.2/62.5	1623.8/63.9	1664.2/65.5	1706.0/67.2	1743.7/68.7	1783.4/70.2	1825.8/71.9
E	1650.2/65.0	1687.8/66.5	1728.2/68.0	1770.0/69.7	1807.7/71.2	1847.4/72.7	1889.8/74.4

Table 16-6 MS4800-30 Transmitter and Receiver Dimensions

	280mm	320mm	360mm	400mm	440mm	480mm	520mm	560mm
A	284.4/11.2	324.8/12.8	364.5/14.4	404.2/15.9	443.9/17.5	484.3/19.1	523.4/20.6	563.7/22.2
B	420.4/16.6	460.8/18.1	500.5/19.7	540.2/21.3	579.9/22.8	620.3/24.4	659.4/26.0	699.7/27.6
C	381.7/15.0	422.1/16.6	461.8/18.2	501.5/19.7	541.2/21.3	581.6/22.9	620.7/24.4	661.0/26.0
D	307.3/12.1	347.7/13.7	387.4/15.3	427.1/16.8	466.8/18.4	507.2/19.9	546.3/21.5	586.6/23.1
E	371.3/14.6	411.7/16.2	451.4/17.8	491.1/19.3	530.8/20.9	571.2/22.5	610.3/24.0	650.6/25.6

	600mm	640mm	680mm	720mm	760mm	800mm	840mm	880mm
A	604.1/23.8	643.9/25.4	683.6/26.9	724.0/28.5	762.0/30.0	803.5/31.6	843.4/31.6	882.8/34.8
B	740.1/29.1	779.9/30.7	819.6/32.3	860.0/33.9	898.0/35.4	939.5/37.0	979.8/38.6	1018.8/40.1
C	701.4/27.6	741.2/29.2	780.9/30.7	821.3/32.3	859.3/33.8	900.8/35.5	941.1/37.1	980.1/38.6
D	627.0/24.7	666.8/26.3	706.5/27.8	746.9/29.4	784.9/30.9	826.4/32.5	866.7/34.1	905.7/35.7
E	691.0/27.2	730.8/28.8	770.5/30.3	810.9/31.9	848.9/33/42	890.4/35.1	930.7/36.6	969.7/38.2

	920mm	960mm	1000mm	1040mm	1080mm	1120mm	1160mm	1200mm
A	922.5/36.3	963.6/37.9	1002.6/39.5	1042.9/41.1	1083.9/42.7	1122.3/44.2	1162.7/45.8	1203.8/47.4
B	1058.5/41.7	1099.6/43.3	1138.6/44.8	1178.9/46.4	1219.9/48.0	1258.3/59.4	1298.7/51.1	1339.8/52.7
C	1019.8/40.2	1060.9/41.8	1099.9/43.3	1140.2/44.9	1181.2/46.5	1219.6/48.0	1260.0/49.6	1301.1/51.2
D	945.4/37.2	986.5/38.8	1025.5/40.4	1065.8/42.0	1106.8/43.6	1145.2/45.1	1185.6/46.7	1226.7/48.3
E	1009.4/39.7	1050.5/41.4	1089.5/42.9	1129.8/44.5	1170.8/46.1	1209.2/47.6	1249.6/49.2	1290.7/50.8

	1240mm	1280mm	1320mm	1360mm	1400mm	1440mm	1480mm	1520mm
A	1242.1/48.9	1281.8/50.5	1323.6/52.1	1362.0/53.6	1401.7/55.2	1443.4/56.8	1481.8/58.3	1521.5/59.9
B	1378.1/54.3	1417.8/55.8	1459.6/57.5	1498.0/59.0	1537.7/60.5	1579.4/62.2	1617.8/63.7	1657.5/65.3
C	1339.4/52.7	1379.1/54.3	1420.9/55.9	1459.3/57.5	1499.0/59.0	1540.7/60.7	1579.1/62.2	1618.8/63.7
D	1265.0/49.8	1304.7/51.4	1346.5/53.0	1384.9/54.5	1424.6/56.1	1466.3/57.7	1504.7/59.2	1544.4/60.1
E	1329.0/52.3	1368.7/53.9	1410.5/55.5	1448.9/57.0	1488.6/58.6	1530.3/60.2	1568.7/61.8	1608.4/63.3

	1560mm	1600mm	1640mm	1680mm	1720mm	1760mm	1800mm	1840mm
A	1563.3/61.6	1600.9/63.0	1641.3/64.6	1683.1/66.3	1720.8/67.8	1760.5/69.3	1802.9/71.0	1840.6/72.5
B	1699.3/66.9	1736.9/68.4	1777.3/70.0	1819.1/71.6	1856.8/73.1	1896.5/74.7	1938.9/76.3	1976.6/77.8
C	1660.6/65.4	1698.2/66.9	1738.6/68.5	1780.4/70.0	1818.8/71.6	1857.8/73.1	1900.2/74.8	1937.9/76.3
D	1586.2/62.5	1623.8/63.9	1664.2/65.5	1706.0/67.2	1743.7/68.7	1783.4/70.2	1825.8/71.9	1863.5/73.4
E	1650.2/65.0	1687.8/66.5	1728.2/68.0	1770.0/69.7	1807.7/71.2	1847.4/72.7	1889.8/74.4	1927.5/75.9

	1880mm	1920mm	1960mm	2000mm	2040mm	2080mm	2120mm
A	1880.3/74.0	1922.8/75.7	1960.4/77.2	2000.1/78.7	2042.6/80.4	2079.6/81.8	2120.0/83.5
B	2016.3/79.4	2058.8/81.1	2096.4/82.5	2136.1/84.1	2178.6/85.8	2215.6/87.2	2256.0/88.8
C	1977.6/77.9	2020.1/79.5	2057.7/81.0	2097.4/82.6	2139.9/84.3	2176.9/85.7	2217.3/87.3
D	1903.2/74.9	1945.7/76.6	1983.3/78.1	2023.0/79.7	2065.5/81.3	2102.9/82.8	2142.9/84.4
E	1967.2/77.5	2009.7/79.1	2047.3/80.6	2087.0/82.2	2129.5/83.8	2166.5/85.3	2206.9/86.9

Table 16-7 MS4800-40 Transmitter and Receiver Dimensions

	360mm	480mm	600mm	720mm	840mm	960mm	1080mm	1200mm
A	364.5/14.4	484.3/19.1	604.1/23.8	724.0/28.5	843.4/31.6	963.6/37.9	1083.9/42.7	1203.8/47.4
B	500.5/19.7	620.3/24.4	740.1/29.1	860.0/33.9	979.8/38.6	1099.6/43.3	1219.9/48.0	1339.8/52.7
C	461.8/18.2	581.6/22.9	701.4/27.6	821.3/32.3	941.1/37.1	1060.9/41.8	1181.2/46.5	1301.1/51.2
D	387.4/15.3	507.2/19.9	627.0/24.7	746.9/29.4	866.7/34.1	986.5/38.8	1106.8/43.6	1226.7/48.3
E	451.4/17.8	571.2/22.5	691.0/27.2	810.9/31.9	930.7/36.6	1050.5/41.4	1170.8/46.1	1290.7/50.8

	1320mm	1440mm	1560mm	1680mm	1800mm	1920mm	2040mm
A	1323.6/52.1	1443.4/56.8	1563.3/61.6	1683.1/66.3	1802.9/71.0	1922.8/75.7	2042.6/80.4
B	1459.6/57.5	1579.4/62.2	1699.3/66.9	1819.1/71.6	1938.9/76.3	2058.8/81.1	2178.6/85.8
C	1420.9/55.9	1540.7/60.7	1660.6/65.4	1780.4/70.0	1900.2/74.8	2020.1/79.5	2139.9/84.3
D	1346.5/53.0	1466.3/57.7	1586.2/62.5	1706.0/67.2	1825.8/71.9	1945.7/76.6	2065.5/81.3
E	1410.5/55.5	1530.3/60.2	1650.2/65.0	1770.0/69.7	1889.8/74.4	2009.7/79.1	2129.5/83.8

16.4 MiniSafe Cascaded MSF4800 Dimension Drawings

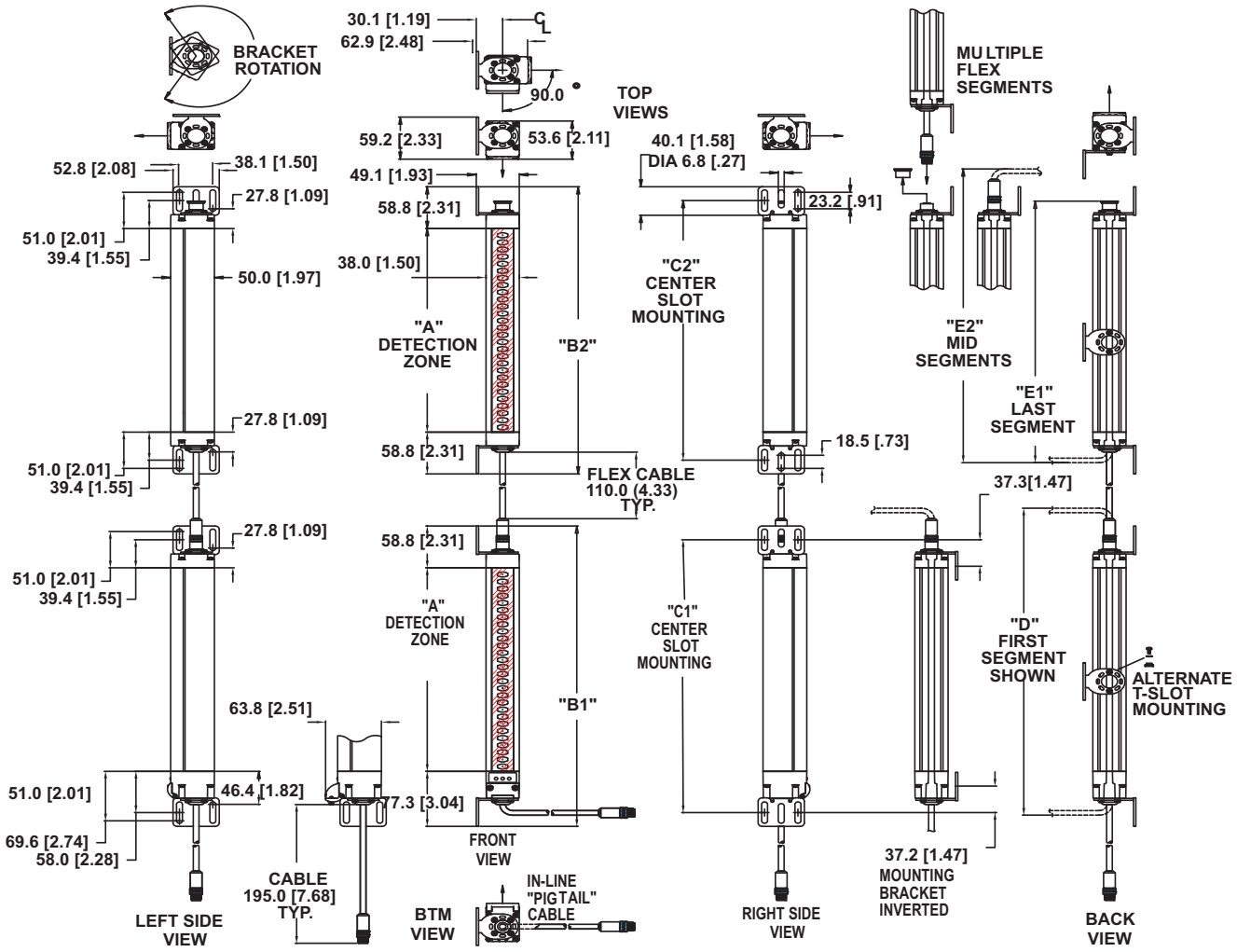


Figure 16-3 MSF4800 Dimension Drawings

Table 16-8 MSF4800-14/20 Transmitter and Receiver Dimensions

	240mm	280mm	320mm	360mm	400mm	440mm	480mm	520mm
A	244.6/9.6	284.4/11.2	324.8/12.8	364.5/14.4	404.2/15.9	443.9/17.5	484.3/19.1	523.4/20.6
B1	380.6/15.0	420.4/16.6	460.8/18.1	500.5/19.7	540.2/21.3	579.9/22.8	620.3/24.4	659.4/26.0
B2	362.1/14.3	401.9/15.8	442.3/17.4	482.0/19.0	521.7/20.5	561.4/22.1	601.8/23.7	640.9/25.2
C1	341.9/13.5	381.7/15.0	422.1/16.6	461.8/18.2	501.5/19.7	541.2/21.3	581.6/22.9	620.7/24.4
C2	323.3/12.7	363.1/14.3	403.5/15.9	443.2/17.5	482.9/19.0	522.6/20.6	563.0/22.2	602.1/23.7
D	400.2/15.8	440.0/17.3	480.4/18.9	520.1/20.5	559.8/22.0	599.5/23.6	639.9/25.2	679.0/26.7
E1	327.9/12.9	367.7/14.5	408.1/16.1	447.8/17.6	487.5/19.2	527.2/20.8	567.6/22.4	606.7/23.9
E2	381.6/15.0	421.4/16.6	461.8/18.2	501.5/19.7	541.2/21.3	580.9/22.9	621.3/24.5	660.4/26.0

	560mm	600mm	640mm	680mm	720mm	760mm	800mm	840mm
A	563.7/22.2	604.1/23.8	643.9/25.4	683.6/26.9	724.0/28.5	763.0/30.0	803.5/31.6	843.8/33.2
B1	699.7/27.6	740.1/29.1	779.9/30.7	819.6/32.3	860.0/33.9	898.0/35.4	939.5/37.0	979.8/38.6
B2	681.2/26.8	721.6/28.4	761.4/30.0	801.1/31.5	841.5/33.1	880.5/34.7	921.0/36.3	961.3/37.9
C1	661.0/26.0	701.4/27.6	741.2/29.2	780.9/30.7	821.3/32.3	860.3/33.9	900.8/35.5	941.1/37.1
C2	642.4/25.3	682.8/26.9	722.6/28.4	762.3/30.0	802.7/31.6	841.7/33.1	882.2/34.7	922.5/36.3
D	719.3/28.3	759.7/30.0	799.5/31.5	839.2/33.0	879.6/34.6	918.6/36.2	959.1/37.8	999.4/39.4
E1	647.0/25.5	687.4/27.1	727.2/28.6	766.9/30.2	807.3/31.8	846.3/33.3	886.8/34.9	927.1/36.5
E2	700.7/27.6	741.1/29.2	780.9/30.7	820.6/32.3	861.0/33.9	900.0/35.4	940.5/37.0	980.8/38.6

	880mm	920mm	960mm	1000mm	1040mm	1080mm	1120mm	1160mm
A	882.8/34.8	922.5/36.32	963.6/37.9	1002.6/39.5	1042.9/41.1	1083.9/42.7	1122.3/44.2	1162.7/45.8
B1	1018.8/40.1	1058.5/41.7	1099.6/43.3	1138.6/44.8	1178.9/46.4	1219.9/48.0	1258.3/49.5	1298.7/51.1
B2	1000.3/39.4	1040.0/41.0	1081.1/42.7	1120.1/44.1	1160.4/45.7	1201.4/47.3	1239.8/48.8	1280.2/50.4
C1	980.1/38.6	1019.8/40.2	1060.9/41.8	1099.9/43.3	1140.2/44.9	1181.2/46.5	1219.6/48.0	1260.0/49.6
C2	961.5/37.9	1001.2/39.5	1042.3/41.0	1081.3/42.6	1121.6/44.2	1162.6/45.8	1201.0/47.3	1241.4/48.9
D	1038/40.9	1078.1/42.5	1119.2/44.1	1158.2/45.6	1198.5/47.2	1239.5/48.8	1277.9/50.3	1318.3/51.9
E1	966.1/38.0	1005.8/39.6	1046.9/41.2	1085.9/42.8	1126.2/44.3	1167.2/46.0	1205.6/47.5	1246.0/49.1
E2	1019.8/40.2	1059.9/41.7	1100.6/43.3	1139.6/44.8	1179.9/46.5	1220.9/48.1	1259.3/49.6	1299.7/51.2

	1200mm	1240mm	1280mm	1320mm	1360mm*	1400mm*	1440mm*	1480mm*
A	1203.8/47.4	1242.1/48.9	1281.8/50.5	1323.6/52.1	1362.0/53.6	1401.7/55.2	1443.4/56.8	1481.8/58.3
B1	1339.8/52.8	1378.1/54.3	1417.8/55.8	1459.6/57.5	1498.0/59.0	1537.7/60.5	1579.4/62.2	1617.8/63.7
B2	1321.3/52.0	1359.6/53.5	1399.3/55.1	1441.1/56.7	1479.5/58.3	1519.2/59.8	1560.9/61.5	1599.3/63.0
C1	1301.1/51.2	1339.4/52.7	1379.1/54.3	1420.9/55.9	1459.3/57.5	1499.0/59.0	1540.7/60.7	1579.1/62.2
C2	1282.5/50.5	1320.8/52.0	1360.5/53.6	1402.3/55.2	1440.7/56.7	1480.4/58.3	1522.1/59.9	1560.5/61.4
D	1359.4/53.5	1397.7/55.0	1437.4/56.6	1479.2/58.2	1517.6/59.8	1557.3/61.3	1599.0/63.0	1637.4/64.5
E1	1287.1/50.8	1325.4/52.2	1365.1/53.8	1406.9/55.4	1445.3/56.9	1485.0/58.5	1526.7/60.1	1565.1/61.6
E2	1340.8/52.8	1379.1/54.3	1418.8/55.9	1460.6/57.5	1499.0/59.0	1538.7/60.6	1580.4/62.2	1618.8/63.7

	1520mm*	1560mm*	1600mm*	1640mm*	1680mm*	1720mm*	1760mm*	1800mm*
A	1521.5/59.9	1563.3/61.6	1600.9/63.0	1641.3/64.6	1683.1/66.3	1720.8/67.8	1760.5/69.3	1802.9/71.0
B1	1657.5/65.3	1699.3/66.9	1736.9/68.4	1777.3/70.0	1819.1/71.6	1856.8/73.1	1896.5/74.7	1938.9/76.3
B2	1639.0/64.5	1680.8/66.2	1718.4/67.7	1758.8/69.2	1800.6/70.9	1838.3/72.4	1878.0/73.9	1920.4/75.6
C1	1618.8/63.7	1660.6/65.4	1698.2/66.9	1738.6/68.5	1780.4/70.1	1818.1/71.6	1857.8/73.1	1900.2/74.8
C2	1600.2/63.0	1642.0/64.6	1679.6/66.1	1720.0/67.7	1761.8/69.4	1799.5/70.8	1839.2/72.4	1881.6/74.1
D	1677.1/66.0	1718.9/67.7	1756.5/69.2	1796.9/70.7	1838.7/72.4	1876.4/73.9	1916.1/75.4	1958.5/77.1
E1	1604.8/63.2	1646.6/64.8	1684.2/66.3	1724.6/67.9	1766.4/69.5	1804.1/71.0	1843.8/72.6	1886.2/74.3
E2	1658.5/65.3	1700.3/66.9	1737.9/68.4	1778.3/70.0	1820.1/71.7	1857.8/73.1	1897.5/74.7	1939.9/76.4

*Not available as a mid-segment.

Table 16-9 MSF4800-30 Transmitter and Receiver Dimensions

	240mm	280mm	320mm	360mm	400mm	440mm	480mm	520mm
A	244.6/9.6	284.4/11.2	324.8/12.8	364.5/14.4	404.2/15.9	443.9/17.5	484.3/19.1	523.4/20.6
B1	380.6/15.0	420.4/16.6	460.8/18.1	500.5/19.7	540.2/21.3	579.9/22.8	620.3/24.4	659.4/26.0
B2	362.1/14.3	401.9/15.8	442.3/17.4	482.0/19.0	521.7/20.5	561.4/22.1	601.8/23.7	640.9/25.2
C1	341.9/13.5	381.7/15.0	422.1/16.6	461.8/18.2	501.5/19.7	541.2/21.3	581.6/22.9	620.7/24.4
C2	323.3/12.7	363.1/14.3	403.5/15.9	443.2/17.5	482.9/19.0	522.6/20.6	563.0/22.2	602.1/23.7
D	400.2/15.8	440.0/17.3	480.4/18.9	520.1/20.5	559.8/22.0	599.5/23.6	639.9/25.2	679.0/26.7
E1	327.9/12.9	367.7/14.5	408.1/16.1	447.8/17.6	487.5/19.2	527.2/20.8	567.6/22.4	606.7/23.9
E2	381.6/15.0	421.4/16.6	461.8/18.2	501.5/19.7	541.2/21.3	580.9/22.9	621.3/24.5	660.4/26.0

	560mm	600mm	640mm	680mm	720mm	760mm	800mm	840mm
A	563.7/22.2	604.1/23.8	643.9/25.4	683.6/26.9	724.0/28.5	763.0/30.0	803.5/31.6	843.8/33.2
B1	699.7/27.6	740.1/29.1	779.9/30.7	819.6/32.3	860.0/33.9	898.0/35.4	939.5/37.0	979.8/38.6
B2	681.2/26.8	721.6/28.4	761.4/30.0	801.1/31.5	841.5/33.1	880.5/34.7	921.0/36.3	961.3/37.9
C1	661.0/26.0	701.4/27.6	741.2/29.2	780.9/30.7	821.3/32.3	860.3/33.9	900.8/35.5	941.1/37.1
C2	642.4/25.3	682.8/26.9	722.6/28.4	762.3/30.0	802.7/31.6	841.7/33.1	882.2/34.7	922.5/36.3
D	719.3/28.3	759.7/30.0	799.5/31.5	839.2/33.0	879.6/34.6	918.6/36.2	959.1/37.8	999.4/39.4
E1	647.0/25.5	687.4/27.1	727.2/28.6	766.9/30.2	807.3/31.8	846.3/33.3	886.8/34.9	927.1/36.5
E2	700.7/27.6	741.1/29.2	780.9/30.7	820.6/32.3	861.0/33.9	900.0/35.4	940.5/37.0	980.8/38.6

	880mm	920mm	960mm	1000mm	1040mm	1080mm	1120mm	1160mm
A	882.8/34.8	922.5/36.3	963.6/37.9	1002.6/39.5	1042.9/41.1	1083.9/42.7	1122.3/44.2	1162.7/45.8
B1	1018.8/40.1	1058.5/41.7	1099.6/43.3	1138.6/44.8	1178.9/46.4	1219.9/48.0	1258.3/49.5	1298.7/51.1
B2	1000.3/39.4	1040.0/41.0	1081.1/42.7	1120.1/44.1	1160.4/45.7	1201.4/47.3	1239.8/48.8	1280.2/50.4
C1	980.1/38.6	1019.8/40.2	1060.9/41.8	1099.9/43.3	1140.2/44.9	1181.2/46.5	1219.6/48.0	1260.0/49.6
C2	961.5/37.9	1001.2/39.5	1042.3/41.0	1081.3/42.6	1121.6/44.2	1162.6/45.8	1201.0/47.3	1241.4/48.9
D	1038/40.9	1078.1/42.5	1119.2/44.1	1158.2/45.6	1198.5/47.2	1239.5/48.8	1277.9/50.3	1318.3/51.9
E1	966.1/38.0	1005.8/39.6	1046.9/41.2	1085.9/42.8	1126.2/44.3	1167.2/46.0	1205.6/47.5	1246.0/49.1
E2	1019.8/40.2	1059.9/41.7	1100.6/43.3	1139.6/44.8	1179.9/46.5	1220.9/48.1	1259.3/49.6	1299.7/51.2

	1200mm	1240mm	1280mm	1320mm	1360mm*	1400mm*	1440mm*	1480mm*
A	1203.8/47.4	1242.1/48.9	1281.8/50.5	1323.6/52.1	1362.0/53.6	1401.7/55.2	1443.4/56.8	1481.8/58.3
B1	1339.8/52.8	1378.1/54.3	1417.8/55.8	1459.6/57.5	1498.0/59.0	1537.7/60.5	1579.4/62.2	1617.8/63.7
B2	1321.3/52.0	1359.6/53.5	1399.3/55.1	1441.1/56.7	1479.5/58.3	1519.2/59.8	1560.9/61.5	1599.3/63.0
C1	1301.1/51.2	1339.4/52.7	1379.1/54.3	1420.9/55.9	1459.3/57.5	1499.0/59.0	1540.7/60.7	1579.1/62.2
C2	1282.5/50.5	1320.8/52.0	1360.5/53.6	1402.3/55.2	1440.7/56.7	1480.4/58.3	1522.1/59.9	1560.5/61.4
D	1359.4/53.5	1397.7/55.0	1437.4/56.6	1479.2/58.2	1517.6/59.8	1557.3/61.3	1599.0/63.0	1637.4/64.5
E1	1287.1/50.8	1325.4/52.2	1365.1/53.8	1406.9/55.4	1445.3/56.9	1485.0/58.5	1526.7/60.1	1565.1/61.6
E2	1340.8/52.8	1379.1/54.3	1418.8/55.9	1460.6/57.5	1499.0/59.0	1538.7/60.6	1580.4/62.2	1618.8/63.7

	1520mm*	1560mm*	1600mm*	1640mm*	1680mm*	1720mm*	1760mm*	1800mm*
A	1521.5/59.9	1563.3/61.6	1600.9/63.0	1641.3/64.6	1683.1/66.3	1720.8/67.8	1760.5/69.3	1802.9/71.0
B1	1657.5/65.3	1699.3/66.9	1736.9/68.4	1777.3/70.0	1819.1/71.6	1856.8/73.1	1896.5/74.7	1938.9/76.3
B2	1639.0/64.5	1680.8/66.2	1718.4/67.7	1758.8/69.2	1800.6/70.9	1838.3/72.4	1878.0/73.9	1920.4/75.6
C1	1618.8/63.7	1660.6/65.4	1698.2/66.9	1738.6/68.5	1780.4/70.1	1818.1/71.6	1857.8/73.1	1900.2/74.8
C2	1600.2/63.0	1642.0/64.6	1679.6/66.1	1720.0/67.7	1761.8/69.4	1799.5/70.8	1839.2/72.4	1881.6/74.1
D	1677.1/66.0	1718.9/67.7	1756.5/69.2	1796.9/70.7	1838.7/72.4	1876.4/73.9	1916.1/75.4	1958.5/77.1
E1	1604.8/63.2	1646.6/64.8	1684.2/66.3	1724.6/67.9	1766.4/69.5	1804.1/71.0	1843.8/72.6	1886.2/74.3
E2	1658.5/65.3	1700.3/66.9	1737.9/68.4	1778.3/70.0	1820.1/71.7	1857.8/73.1	1897.5/74.7	1939.9/76.4

	1840mm	1880mm	1920mm	1960mm	2000mm	2040mm	2080mm	2120mm
A	1840.6/72.5	1880.3/74.0	1922.8/75.7	1960.4/77.2	2000.1/78.7	2042.6/80.4	2079.6/81.9	2120.0/83.5
B1	1976.6/77.8	2016.3/79.4	2058.8/81.1	2096.4/82.5	2136.1/84.1	2178.6/85.8	2215.6/87.2	2256.7/88.8
B2	1958.1/77.1	1997.8/78.7	2040.3/80.3	2077.9/81.8	2117.6/83.4	2160.1/85.0	2197.1/86.5	2237.5/88.1
C1	1937.9/76.3	1977.6/77.9	2020.1/79.5	2057.7/81.0	2097.4/82.6	2139.9/84.3	2176.9/85.7	2217.3/87.3
C2	1919.3/75.6	1959.0/77.1	2001.5/78.8	2039.1/80.3	2078.8/81.8	2121.3/83.5	2158.3/85.0	2198.7/86.6
D	1996.2/78.6	2035.9/80.2	2078.4/81.8	2116.0/83.3	2155.7/84.9	2198.2/86.5	2235.2/88.0	2275.6/89.6
E1	1923.9/75.7	1963.6/77.3	2006.1/79.0	2043.7/80.5	2083.4/82.0	2125.9/83.7	2162.9/85.2	2203.3/86.7
E2	1977.6/77.9	2017.3/79.4	2059.8/81.1	2097.4/82.6	2137.1/84.1	2179.6/85.8	2216.6/87.3	2257.0/88.9

Table 16-10 MSF4800-40 Transmitter and Receiver Dimensions

	360mm	480mm	600mm	720mm	840mm	960mm	1080mm	1200mm
A	364.5/14.4	484.3/19.1	604.1/23.8	724.0/28.5	843.8/33.2	963.6/37.9	1083.9/42.7	1203.8/47.4
B1	500.5/19.7	620.3/24.4	740.1/29.1	860.0/33.9	979.8/38.6	1099.6/43.3	1219.9/48.0	1339.8/52.8
B2	482.0/19.0	601.8/23.7	721.6/28.4	841.5/33.1	961.3/37.9	1081.1/42.7	1201.4/47.3	1321.3/52.0
C1	461.8/18.2	581.6/22.9	701.4/27.6	821.3/32.3	941.1/37.1	1060.9/41.8	1181.2/46.5	1301.1/51.2
C2	443.2/17.5	563.0/22.2	682.8/26.9	802.7/31.6	922.5/36.3	1042.3/41.0	1162.6/45.8	1282.5/50.5
D	520.1/20.5	639.9/25.2	759.7/30.0	879.6/34.6	999.4/39.4	1119.2/44.1	1239.5/48.8	1359.4/53.5
E1	447.8/17.6	567.6/22.4	687.4/27.1	807.3/31.8	927.1/36.5	1046.9/41.2	1167.2/46.0	1287.1/50.8
E2	501.5/19.7	621.3/24.5	741.1/29.2	861.0/33.9	980.8/38.6	1100.6/43.3	1220.9/48.1	1340.8/52.8

	1320mm	1440mm*	1560mm*	1680mm*	1800mm*	1920mm	2040mm
A	1323.6/52.1	1443.4/56.8	1563.3/61.6	1683.1/66.3	1802.9/71.0	1922.8/75.7	2042.6/80.4
B1	1459.6/57.5	1579.4/62.2	1699.3/66.9	1819.1/71.6	1938.9/76.3	2058.8/81.1	2178.6/85.8
B2	1441.1/56.7	1560.9/61.5	1680.8/66.2	1800.6/70.9	1920.4/75.6	2040.3/80.3	2160.1/85.0
C1	1420.9/55.9	1540.7/60.7	1660.6/65.4	1780.4/70.1	1900.2/74.8	2020.1/79.5	2139.9/84.3
C2	1402.3/55.2	1522.1/59.9	1642.0/64.6	1761.8/69.4	1881.6/74.1	2001.5/78.8	2121.3/83.5
D	1479.2/58.2	1599.0/63.0	1718.9/67.7	1838.7/72.4	1958.5/77.1	2078.4/81.8	2198.2/86.5
E1	1406.9/55.4	1526.7/60.1	1646.6/64.8	1766.4/69.5	1886.2/74.3	2006.1/79.0	2125.9/83.7
E2	1460.6/57.5	1580.4/62.2	1700.3/66.9	1820.1/71.7	1939.9/76.4	2059.8/81.1	2179.6/85.8

16.5 RM-6 DIMENSIONS

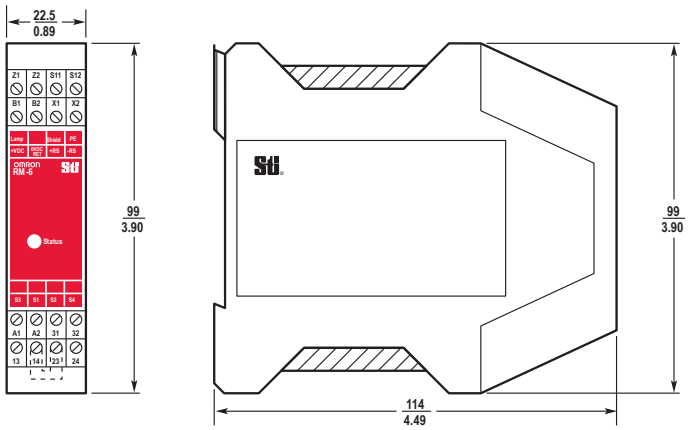


Figure 16-4 RM-6 Dimensions

16.6 MS46EP EXPLOSION-PROOF ENCLOSURE

16.6.1 MS48EP-14/20-320

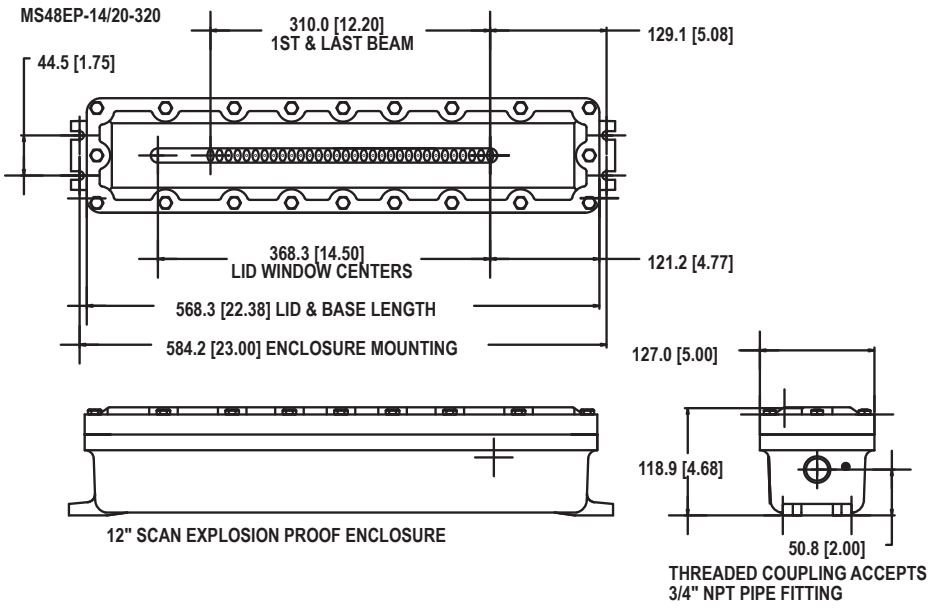


Figure 16-5 MS48EP-14/20-320 Dimensions

16.6.2 MS48EP-30-640

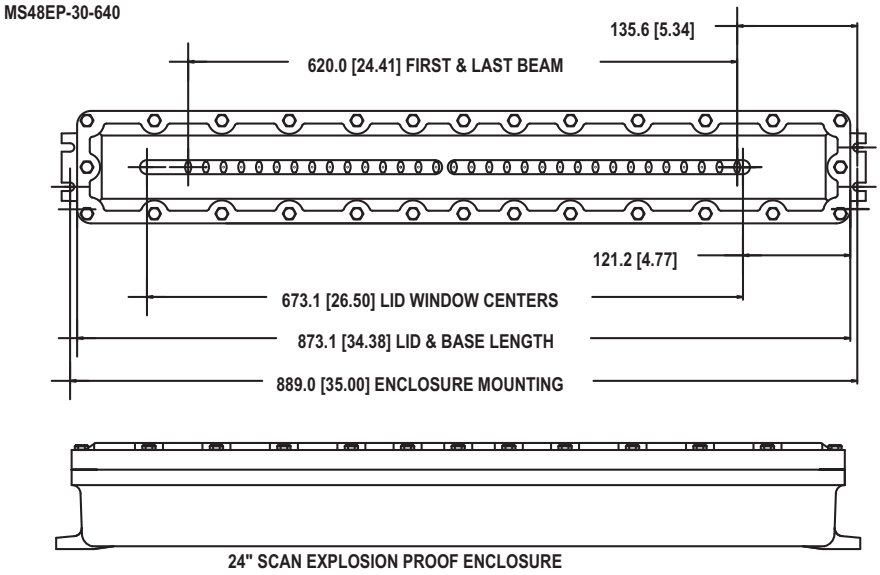


Figure 16-6 MS48EP-30-640 Dimensions

16.6.3 MS48EP-30-960

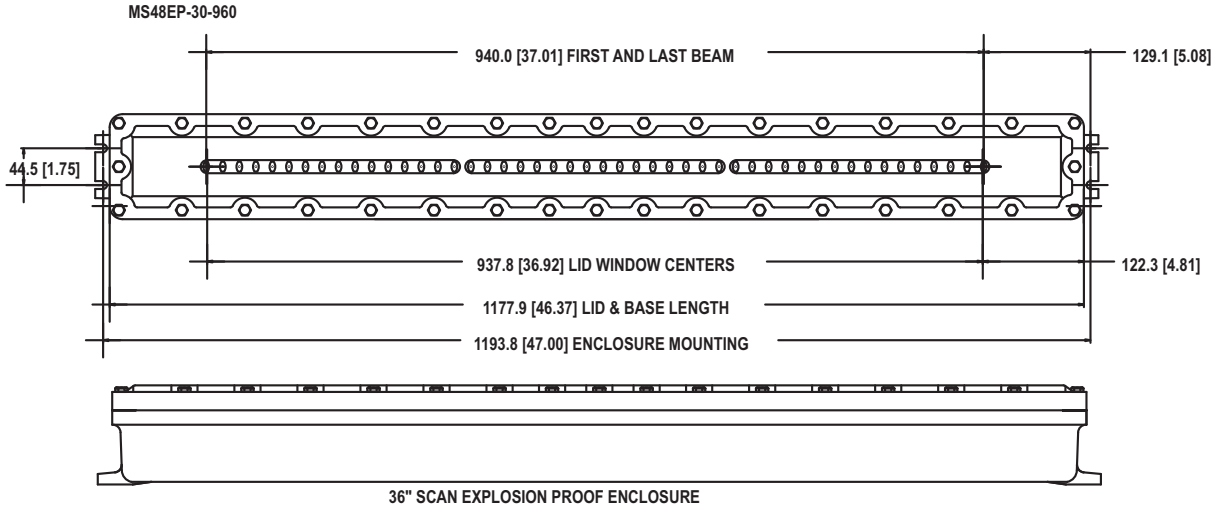


Figure 16-7 MS48EP-30-960 Dimensions

16.6.4 MS48EP-30-1240

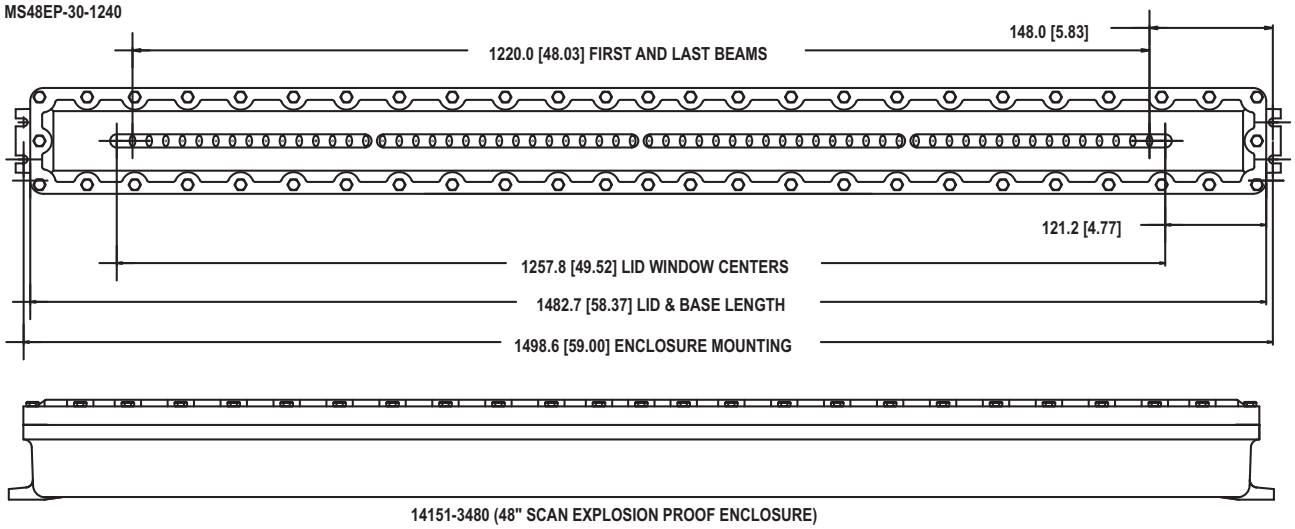


Figure 16-8 MS48EP-30-1240 Dimensions

16.7 SPARE PARTS

16.7.1 TRANSMITTER MODEL NUMBERS

To order a spare transmitter, read the part number from your existing transmitter, or build a model number from the options given in the table below:

MS4800 Sequence:

___ - ____ - ____ - ____

(1) (2) (3) (4)

MSF4800 sequence:

___ - ____ - ____ - ____

(1) (2) (3) (4)

(1) Information required. Represents the system type:

Designator	Description
MS4800A	Advanced, PDM configured
MS4800B	Basic, PDM configured
MS4800S	Standard, selector switch configured
MSF4800A	Advanced, cascaded, PDM configured
MSF4800B	Basic, cascaded, PDM configured
MSF4800S	Standard, cascaded, selector switch configured

(2) Information required. Represents the minimum object resolution of the system.

Designator	Minimum Object Resolution
14	14 mm (0.55 in.)
20	20 mm (0.79 in.)
30	30 mm (1.18 in.)
40	40 mm (1.57 in)

(3) Information required for 14/20mm resolution, represents the protection height:

Designator	Description	No. of Beams
0240**	240 mm (9.4 in.)	24
0280	280 mm (11.0 in.)	28
0320	320 mm (12.6 in.)	32
0360	360 mm (14.1 in.)	36
0400	400 mm (15.7 in.)	40
0440	440 mm (17.3 in.)	44
0480	480 mm (18.9 in.)	48
0520	520 mm (20.5 in.)	52
0560	560 mm (22.0 in.)	56
0600	600 mm (23.6 in.)	60
0640	640 mm (25.2 in.)	64
0680	680 mm (26.8 in.)	68
0720	720 mm (28.3 in.)	72
0760	760 mm (29.9 in.)	76
0800	800 mm (31.5 in.)	80

Designator	Description	No. of Beams
0840	840 mm (33.0 in.)	84
0880	880 mm (34.6 in.)	88
0920	920 mm (36.2 in.)	92
0960	960 mm (37.8 in.)	96
1000	1000 mm (39.4 in.)	100
1040	1040 mm (40.9 in.)	104
1080	1080 mm (42.5 in.)	108
1120	1120 mm (44.1 in.)	112
1160	1160 mm (45.8 in.)	116
1200	1200 mm (47.2 in.)	120
1240	1240 mm (48.8 in.)	124
1280	1280 mm (50.4 in.)	128
1320*	1320 mm (52.0 in.)	132
1360*	1360 mm (53.5 in.)	136
1400*	1400 mm (55.1 in.)	140
1440*	1440 mm (56.7 in.)	144
1480*	1480 mm (58.3 in.)	148
1520*	1520 mm (59.8 in.)	152
1560*	1560 mm (61.4 in.)	156
1600*	1600 mm (63.0 in.)	160
1640*	1640 mm (64.6 in.)	164
1680*	1680 mm (66.1 in.)	168
1720*	1720 mm (67.7 in.)	172
1760*	1760 mm (69.3 in.)	176
1800*	1800 mm (70.9 in.)	180

** Only available as an X2/R2 mid-segment.

* Not available for X2/R2 mid-segment configurations.

(3) Information required for 30mm resolution, represents the protection height:

Designator	Description	No. of Beams
0280	280 mm (11.0 in.)	14
0320	320 mm (12.6 in.)	16
0360	360 mm (14.1 in.)	18
0400	400 mm (15.7 in.)	20
0440	440 mm (17.3 in.)	22
0480	480 mm (18.9 in.)	24
0520	520 mm (20.5 in.)	26
0560	560 mm (22.0 in.)	28
0600	600 mm (23.6 in.)	30
0640	640 mm (25.2 in.)	32
0680	680 mm (26.8 in.)	34
0720	720 mm (28.3 in.)	36
0760	760 mm (29.9 in.)	38
0800	800 mm (31.5 in.)	40
0840	840 mm (33.0 in.)	42
0880	880 mm (34.6 in.)	44

Designator	Description	No. of Beams
0920	920 mm (36.2 in.)	46
0960	960 mm (37.8 in.)	48
1000	1000 mm (39.4 in.)	50
1040	1040 mm (40.9 in.)	52
1080	1080 mm (42.5 in.)	54
1120	1120 mm (44.1 in.)	56
1160	1160 mm (45.8 in.)	58
1200	1200 mm (47.2 in.)	60
1240	1240 mm (48.8 in.)	62
1280	1280 mm (50.4 in.)	64
1320	1320 mm (52.0 in.)	66
1360	1360 mm (53.5 in.)	68
1400	1400 mm (55.1 in.)	70
1440	1440 mm (56.7 in.)	72
1480	1480 mm (58.3 in.)	74
1520	1520 mm (59.8 in.)	76
1560	1560 mm (61.4 in.)	78
1600	1600 mm (63.0 in.)	80
1640	1640 mm (64.6 in.)	82
1680	1680 mm (66.1 in.)	84
1720	1720 mm (67.7 in.)	86
1760	1760 mm (69.3 in.)	88
1800	1800 mm (70.9 in.)	90
1840	1840 mm (72.4 in.)	92
1880	1880 mm (74.0 in.)	94
1920	1920 mm (75.6 in.)	96
1960	1960 mm (77.2 in.)	98
2000	2000 mm (78.7 in.)	100
2040	2040 mm (80.3 in.)	102
2080	2080 mm (81.9 in.)	104
2120	2120 mm (83.5 in.)	106

(3) Information required for 40mm resolution, represents the protection height:

Designator	Description	No. of Beams
0360	360 mm (14.1 in.)	12
0480	480 mm (18.9 in.)	16
0600	600 mm (23.6 in.)	20
0720	720 mm (28.3 in.)	24
0840	840 mm (33.0 in.)	28
0960	960 mm (37.8 in.)	32
1080	1080 mm (42.5 in.)	36
1200	1200 mm (47.2 in.)	40
1320	1320 mm (52.0 in.)	44
1440	1440 mm (56.7 in.)	48
1560	1600 mm (63.0 in.)	52

Designator	Description	No. of Beams
1680	1680 mm (66.1 in.)	56
1800	1800 mm (70.9 in.)	60
1920	1920 mm (75.6 in.)	64
2040	2040 mm (80.3 in.)	68

(4) Information Required.

Designator	Description
X	MS4800 transmitter
R	MS4800 receiver
X1	MSF4800 transmitter first segment
R1	MSF4800 receiver first segment
X2	MSF4800 transmitter mid segment
R2	MSF4800 receiver mid segment

16.8 Spare Parts and Accessories

Model Number	Description
Receiver Cables	
MS4800-CBLRX-10M	Receiver Cable, 10 meter (32.8 ft.)
MS4800-CBLRX-15M	Receiver Cable, 15 meter (49.2 ft.)
MS4800-CBLRX-30M	Receiver Cable, 30 meter (98.5 ft.)
Transmitter Cables	
MS4800-CBLTX-10M	Transmitter Cable, 10 meter (32.8 ft.)
MS4800-CBLTX-15M	Transmitter Cable, 15 meter (49.2 ft.)
MS4800-CBLTX-30M	Transmitter Cable, 30 meter (98.5 ft.)
Transmitter Interconnect Cables (for cascading)	
MS4800-CBLTXIC-003M	Transmitter Interconnect Cable, .3 m (12 in.)
MS4800-CBLTXIC-005M	Transmitter Interconnect Cable, .5 m (20 in.)
MS4800-CBLTXIC-01M	Transmitter Interconnect Cable, 1 m (3.3 ft.)
MS4800-CBLTXIC-02M	Transmitter Interconnect Cable, 2 m (6.6 ft.)
MS4800-CBLTXIC-03M	Transmitter Interconnect Cable, 3 m (10 ft.)
MS4800-CBLTXIC-05M	Transmitter Interconnect Cable, 5 m (16 ft.)
MS4800-CBLTXIC-10M	Transmitter Interconnect Cable, 10 m (33 ft.)
Receiver Interconnect Cables (for cascading)	
MS4800-CBLRXIC-003M	Receiver Interconnect Cable, .3 m (12 in.)
MS4800-CBLRXIC-005M	Receiver Interconnect Cable, .5 m (20 in.)
MS4800-CBLRXIC-01M	Receiver Interconnect Cable, 1 m (3.3 ft.)
MS4800-CBLRXIC-02M	Receiver Interconnect Cable, 2 m (6.6 ft.)
MS4800-CBLRXIC-03M	Receiver Interconnect Cable, 3 m (10 ft.)
MS4800-CBLRXIC-05M	Receiver Interconnect Cable, 5 m (16 ft.)
MS4800-CBLRXIC-10M	Receiver Interconnect Cable, 10 m (33 ft.)
RM-6 (mute) Cables	
MS4800-CBLMT-10M	MSF48 to RM-6 Cable, 10 m (33 ft.)
MS4800-CBLMT-20M	MSF48 to RM-6 Cable, 15 m (49.2 ft.)
MS4800-CBLMT-30M	MSF48 to RM-6 Cable, 30 m (98.5 ft.)
Double-ended Transmitter Cable	
MS4800-CBLTXT-05M	Double-ended, Quick Disconnect, 5 meter (16.4 ft), Transmitter
MS4800-CBLTXT-10M	Double-ended, Quick Disconnect, 10 meter (32.8 ft), Transmitter
MS4800-CBLTXT-15M	Double-ended, Quick Disconnect, 15 meter (49.2 ft), Transmitter
MS4800-CBLTXT-25M	Double-ended, Quick Disconnect, 25 meter (82.0 ft), Transmitter
Double-ended Receiver Cable	
MS4800-CBLRXT-05M	Double-ended, Quick Disconnect, 5 meter (16.4 ft), Receiver
MS4800-CBLRXT-10M	Double-ended, Quick Disconnect, 10 meter (32.8 ft), Receiver
MS4800-CBLRXT-15M	Double-ended, Quick Disconnect, 15 meter (49.2 ft), Receiver
MS4800-CBLRXT-25M	Double-ended, Quick Disconnect, 25 meter (82.0 ft), Receiver

Model Number	Description
Bulkhead Connectors	
MS4800-PMCTX-01M	Transmitter Bulkhead Connector, 1 meter (3.28 ft.) Leads
MS4800-PMCTX-05M	Transmitter Bulkhead Connector, 5 meter (16.4 ft.) Leads
MS4800-PMCTX-01M	Receiver Bulkhead Connector, 1 meter (3.28 ft.) Leads
MS4800-PMCTX-05M	Receiver Bulkhead Connector, 5 meter (16.4 ft.) Leads
Adapter Connectors	
MS4800-ADPT-TXS	Transmitter (standard) cable adapter MS46 TO MS48
MS4800-ADPT-TXM	Transmitter (MTS) cable adapter MS46 TO MS48
MS4800-ADPT-RX	Receiver cable adapter MS46 TO MS48
Resource Modules	
RM-1	RM-1 Resource Module
RM-2	RM-2 Resource Module
RM-2AC	RM-2AC Resource Module/Power Supply
RM-2AC-IP	RM-2AC Resource Module/Power Supply, IP65 Enclosure
RM-3	RM-3 Mute Module
RM-4	RM-4 Resource Module
RM-X	RM-X Safety Relay, 22.5 mm DIN enclosure
MS4800-RM6	RM-6 Mute Module (only for MSF4800A)
MS4800-PDM	Programming and Diagnostics Module (only for MS4800A & B)
Mute Lamp Kits	
MT-LEDC-RM3	LED clear mute lamp kit for RM-3
MT-LEDA-RM3	LED amber mute lamp kit for RM-3
SB12-CLED00	LED clear mute lamp for RM-6
SB12-ALED00	LED amber mute lamp for RM-6
Test Objects	
STI-TO14	14mm Test Object
STI-TO20	20mm Test Object
STI-TO30	30mm Test Object
STI-TO24	24mm Test Object
STI-TO34	34mm Test Object
STI-TO40	40mm Test Object
Bracket Mounting Kits	
MS4800-SDM-KT1	Middle Support Bracket Kit (2 heads)
MS4800-SDM-KT2	T-slot Mounting (2 heads)
MS4800-MKT1	End Bracket Kit (1-head)
MS4800-MKT2	End Bracket Kit (2 heads)

Model Number	Description
Explosion-Proof Enclosure, Aluminum Cast Housing	
MS4800-EPKT-0320	EP Enclosure for MS4800-14/20/30/40-320 (320mm)
MS4800-EPKT-0640	EP Enclosure for MS4800-30-640 (640mm)
MS4800-EPKT-0960	EP Enclosure for MS4800-30-960 (960mm)
MS4800-EPKT-1240	EP Enclosure for MS4800-30-1240 (1240mm)
IP67 Enclosures for MS4800 (non-cascaded) versions	
MS4800-IP67-0240	IP67 Protective Enclosure Kit MS4800 240 mm
MS4800-IP67-0280	IP67 Protective Enclosure Kit MS4800 280 mm
MS4800-IP67-0320	IP67 Protective Enclosure Kit MS4800 320 mm
MS4800-IP67-0360	IP67 Protective Enclosure Kit MS4800 360 mm
MS4800-IP67-0400	IP67 Protective Enclosure Kit MS4800 400 mm
MS4800-IP67-0440	IP67 Protective Enclosure Kit MS4800 440 mm
MS4800-IP67-0480	IP67 Protective Enclosure Kit MS4800 480 mm
MS4800-IP67-0520	IP67 Protective Enclosure Kit MS4800 520 mm
MS4800-IP67-0560	IP67 Protective Enclosure Kit MS4800 560 mm
MS4800-IP67-0600	IP67 Protective Enclosure Kit MS4800 600 mm
MS4800-IP67-0640	IP67 Protective Enclosure Kit MS4800 640 mm
MS4800-IP67-0680	IP67 Protective Enclosure Kit MS4800 680 mm
MS4800-IP67-0720	IP67 Protective Enclosure Kit MS4800 720 mm
MS4800-IP67-0760	IP67 Protective Enclosure Kit MS4800 760 mm
MS4800-IP67-0800	IP67 Protective Enclosure Kit MS4800 800 mm
MS4800-IP67-0840	IP67 Protective Enclosure Kit MS4800 840 mm
MS4800-IP67-0880	IP67 Protective Enclosure Kit MS4800 880 mm
MS4800-IP67-0920	IP67 Protective Enclosure Kit MS4800 920 mm
MS4800-IP67-0960	IP67 Protective Enclosure Kit MS4800 960 mm
MS4800-IP67-1000	IP67 Protective Enclosure Kit MS4800 1000 mm
MS4800-IP67-1040	IP67 Protective Enclosure Kit MS4800 1040 mm
MS4800-IP67-1080	IP67 Protective Enclosure Kit MS4800 1080 mm
MS4800-IP67-1120	IP67 Protective Enclosure Kit MS4800 1120 mm
MS4800-IP67-1160	IP67 Protective Enclosure Kit MS4800 1160 mm
MS4800-IP67-1200	IP67 Protective Enclosure Kit MS4800 1200 mm
MS4800-IP67-1240	IP67 Protective Enclosure Kit MS4800 1240 mm
MS4800-IP67-1280	IP67 Protective Enclosure Kit MS4800 1280 mm
MS4800-IP67-1320	IP67 Protective Enclosure Kit MS4800 1320 mm
MS4800-IP67-1360	IP67 Protective Enclosure Kit MS4800 1360 mm
MS4800-IP67-1400	IP67 Protective Enclosure Kit MS4800 1400 mm
MS4800-IP67-1440	IP67 Protective Enclosure Kit MS4800 1440 mm
MS4800-IP67-1480	IP67 Protective Enclosure Kit MS4800 1480 mm
MS4800-IP67-1520	IP67 Protective Enclosure Kit MS4800 1520 mm
MS4800-IP67-1560	IP67 Protective Enclosure Kit MS4800 1560 mm
MS4800-IP67-1600	IP67 Protective Enclosure Kit MS4800 1600 mm
MS4800-IP67-1640	IP67 Protective Enclosure Kit MS4800 1640 mm
MS4800-IP67-1680	IP67 Protective Enclosure Kit MS4800 1680 mm
MS4800-IP67-1720	IP67 Protective Enclosure Kit MS4800 1720 mm
MS4800-IP67-1760	IP67 Protective Enclosure Kit MS4800 1760 mm

Model Number	Description
MS4800-IP67-1800	IP67 Protective Enclosure Kit MS4800 1800 mm
MS4800-IP67-1840	IP67 Protective Enclosure Kit MS4800 1840 mm
MS4800-IP67-1880	IP67 Protective Enclosure Kit MS4800 1880 mm
MS4800-IP67-1920	IP67 Protective Enclosure Kit MS4800 1920 mm
MS4800-IP67-1960	IP67 Protective Enclosure Kit MS4800 1960 mm
MS4800-IP67-2000	IP67 Protective Enclosure Kit MS4800 2000 mm
MS4800-IP67-2040	IP67 Protective Enclosure Kit MS4800 2040 mm
MS4800-IP67-2080	IP67 Protective Enclosure Kit MS4800 2080 mm
MS4800-IP67-2120	IP67 Protective Enclosure Kit MS4800 2120 mm
IP67 Enclosures for MSF4800 (cascaded) versions	
MSF4800-IP67-0240	IP67 Protective Enclosure Kit MSF4800 240 mm
MSF4800-IP67-0280	IP67 Protective Enclosure Kit MSF4800 280 mm
MSF4800-IP67-0320	IP67 Protective Enclosure Kit MSF4800 320 mm
MSF4800-IP67-0360	IP67 Protective Enclosure Kit MSF4800 360 mm
MSF4800-IP67-0400	IP67 Protective Enclosure Kit MSF4800 400 mm
MSF4800-IP67-0440	IP67 Protective Enclosure Kit MSF4800 440 mm
MSF4800-IP67-0480	IP67 Protective Enclosure Kit MSF4800 480 mm
MSF4800-IP67-0520	IP67 Protective Enclosure Kit MSF4800 520 mm
MSF4800-IP67-0560	IP67 Protective Enclosure Kit MSF4800 560 mm
MSF4800-IP67-0600	IP67 Protective Enclosure Kit MSF4800 600 mm
MSF4800-IP67-0640	IP67 Protective Enclosure Kit MSF4800 640 mm
MSF4800-IP67-0680	IP67 Protective Enclosure Kit MSF4800 680 mm
MSF4800-IP67-0720	IP67 Protective Enclosure Kit MSF4800 720 mm
MSF4800-IP67-0760	IP67 Protective Enclosure Kit MSF4800 760 mm
MSF4800-IP67-0800	IP67 Protective Enclosure Kit MSF4800 800 mm
MSF4800-IP67-0840	IP67 Protective Enclosure Kit MSF4800 840 mm
MSF4800-IP67-0880	IP67 Protective Enclosure Kit MSF4800 880 mm
MSF4800-IP67-0920	IP67 Protective Enclosure Kit MSF4800 920 mm
MSF4800-IP67-0960	IP67 Protective Enclosure Kit MSF4800 960 mm
MSF4800-IP67-1000	IP67 Protective Enclosure Kit MSF4800 1000 mm
MSF4800-IP67-1040	IP67 Protective Enclosure Kit MSF4800 1040 mm
MSF4800-IP67-1080	IP67 Protective Enclosure Kit MSF4800 1080 mm
MSF4800-IP67-1120	IP67 Protective Enclosure Kit MSF4800 1120 mm
MSF4800-IP67-1160	IP67 Protective Enclosure Kit MSF4800 1160 mm
MSF4800-IP67-1200	IP67 Protective Enclosure Kit MSF4800 1200 mm
MSF4800-IP67-1240	IP67 Protective Enclosure Kit MSF4800 1240 mm
MSF4800-IP67-1280	IP67 Protective Enclosure Kit MSF4800 1280 mm
MSF4800-IP67-1320	IP67 Protective Enclosure Kit MSF4800 1320 mm
MSF4800-IP67-1360	IP67 Protective Enclosure Kit MSF4800 1360 mm
MSF4800-IP67-1400	IP67 Protective Enclosure Kit MSF4800 1400 mm
MSF4800-IP67-1440	IP67 Protective Enclosure Kit MSF4800 1440 mm
MSF4800-IP67-1480	IP67 Protective Enclosure Kit MSF4800 1480 mm
MSF4800-IP67-1520	IP67 Protective Enclosure Kit MSF4800 1520 mm
MSF4800-IP67-1560	IP67 Protective Enclosure Kit MSF4800 1560 mm
MSF4800-IP67-1600	IP67 Protective Enclosure Kit MSF4800 1600 mm

Model Number	Description
MSF4800-IP67-1640	IP67 Protective Enclosure Kit MSF4800 1640 mm
MSF4800-IP67-1680	IP67 Protective Enclosure Kit MSF4800 1680 mm
MSF4800-IP67-1720	IP67 Protective Enclosure Kit MSF4800 1720 mm
MSF4800-IP67-1760	IP67 Protective Enclosure Kit MSF4800 1760 mm
MSF4800-IP67-1800	IP67 Protective Enclosure Kit MSF4800 1800 mm
MSF4800-IP67-1840	IP67 Protective Enclosure Kit MSF4800 1840 mm
MSF4800-IP67-1880	IP67 Protective Enclosure Kit MSF4800 1880 mm
MSF4800-IP67-1920	IP67 Protective Enclosure Kit MSF4800 1920 mm
MSF4800-IP67-1960	IP67 Protective Enclosure Kit MSF4800 1960 mm
MSF4800-IP67-2000	IP67 Protective Enclosure Kit MSF4800 2000 mm
MSF4800-IP67-2040	IP67 Protective Enclosure Kit MSF4800 2040 mm
MSF4800-IP67-2080	IP67 Protective Enclosure Kit MSF4800 2080 mm
MSF4800-IP67-2120	IP67 Protective Enclosure Kit MSF4800 2120 mm
Weld Shields	
MS4800WS-0240	Lexan Weld Shield pair MS4600, 240 mm length
MS4800WS-0280	Lexan Weld Shield pair MS4800, 280 mm length
MS4800WS-0320	Lexan Weld Shield pair MS4800, 320mm length
MS4800WS-0360	Lexan Weld Shield pair MS4800, 360 mm length
MS4800WS-0400	Lexan Weld Shield pair MS4800, 400 mm length
MS4800WS-0440	Lexan Weld Shield pair MS4800, 440 mm length
MS4800WS-0480	Lexan Weld Shield pair MS4800, 480 mm length
MS4800WS-0520	Lexan Weld Shield pair MS4800, 520 mm length
MS4800WS-0560	Lexan Weld Shield pair MS4800, 560 mm length
MS4800WS-0600	Lexan Weld Shield pair MS4800, 600 mm length
MS4800WS-0640	Lexan Weld Shield pair MS4800, 640 mm length
MS4800WS-0680	Lexan Weld Shield pair MS4800, 680 mm length
MS4800WS-0720	Lexan Weld Shield pair MS4800, 720 mm length
MS4800WS-0760	Lexan Weld Shield pair MS4800, 760 mm length
MS4800WS-0800	Lexan Weld Shield pair MS4800, 800 mm length
MS4800WS-0840	Lexan Weld Shield pair MS4800, 840 mm length
MS4800WS-0880	Lexan Weld Shield pair MS4800, 880 mm length
MS4800WS-0920	Lexan Weld Shield pair MS4800, 920 mm length
MS4800WS-0960	Lexan Weld Shield pair MS4800, 960 mm length
MS4800WS-1000	Lexan Weld Shield pair MS4800, 1000 mm length
MS4800WS-1040	Lexan Weld Shield pair MS4800, 1040 mm length
MS4800WS-1080	Lexan Weld Shield pair MS4800, 1080 mm length
MS4800WS-1120	Lexan Weld Shield pair MS4800, 1120 mm length
MS4800WS-1160	Lexan Weld Shield pair MS4800, 1160 mm length
MS4800WS-1200	Lexan Weld Shield pair MS4800, 1200 mm length
MS4800WS-1240	Lexan Weld Shield pair MS4800, 1240 mm length
MS4800WS-1280	Lexan Weld Shield pair MS4800, 1280 mm length
MS4800WS-1320	Lexan Weld Shield pair MS4800, 1320 mm length
MS4800WS-1360	Lexan Weld Shield pair MS4800, 1360 mm length
MS4800WS-1400	Lexan Weld Shield pair MS4800, 1400 mm length

Model Number	Description
MS4800WS-1440	Lexan Weld Shield pair MS4800, 1440 mm length
MS4800WS-1480	Lexan Weld Shield pair MS4800, 1480 mm length
MS4800WS-1520	Lexan Weld Shield pair MS4800, 1520 mm length
MS4800WS-1560	Lexan Weld Shield pair MS4800, 1560 mm length
MS4800WS-1600	Lexan Weld Shield pair MS4800, 1600 mm length
MS4800WS-1640	Lexan Weld Shield pair MS4800, 1640 mm length
MS4800WS-1680	Lexan Weld Shield pair MS4800, 1680 mm length
MS4800WS-1720	Lexan Weld Shield pair MS4800, 1730 mm length
MS4800WS-1760	Lexan Weld Shield pair MS4800, 1760 mm length
MS4800WS-1800	Lexan Weld Shield pair MS4800, 1800 mm length
MS4800WS-1840	Lexan Weld Shield pair MS4800, 1840 mm length
MS4800WS-1880	Lexan Weld Shield pair MS4800, 1880 mm length
MS4800WS-1920	Lexan Weld Shield pair MS4800, 1920 mm length
MS4800WS-1960	Lexan Weld Shield pair MS4800, 1960 mm length
MS4800WS-2000	Lexan Weld Shield pair MS4800, 2000 mm length
MS4800WS-2040	Lexan Weld Shield pair MS4800, 2040 mm length
MS4800WS-2080	Lexan Weld Shield pair MS4800, 2080 mm length
MS4800WS-2120	Lexan Weld Shield pair MS4800, 2120 mm length

16.9 WARRANTY

Omron STI warrants its products to be free from defects of material and workmanship and will, without charge, replace or repair any equipment found defective upon inspection at its factory, provided the equipment has been returned, transportation prepaid, within one year from the date of installation and not to exceed 18 months from date of factory shipment.

The foregoing warranty is in lieu of and excludes all other warranties not expressly set forth herein, whether expressed or implied by operation of law or otherwise including but not limited to any implied warranties of merchantability or fitness for a particular purpose. No representation or warranty, express or implied, made by any sales representative, distributor, or other agent or representative of Omron STI which is not specifically set forth herein shall be binding upon Omron STI. Omron STI shall not be liable for any incidental or consequential damages, losses or expenses directly or indirectly arising from the sale, handling, improper application or use of the goods or from any other cause relating thereto and Omron STI's liability hereunder, in any case, is expressly limited to repair or replacement (at Omron STI's option) of goods.

Warranty is specifically at the factory or an Omron STI authorized service location. Any on site service will be provided at the sole expense of the Purchaser at standard field service rates.

All associated equipment must be protected by properly rated electronic/electrical protection devices. Omron STI shall not be liable for any damage due to improper engineering or installation by the purchaser or third parties. Proper installation, operation and maintenance of the product becomes the responsibility of the user upon receipt of the product.

16.10 PATENTS

Elements of the electronics and optics essential to meet the specifications and performance standards of Omron STI controls are covered by one or more of the following U.S. Patent Numbers: 3,774,039; 3,867,628; 3,967,111; 3,996,476; 4,007,387; 4,101,784; 5,015,840; Design 255,031, and other patents pending.

16.11 TRADEMARKS

MiniSafe™, is a trademark of Omron Scientific Technologies, Inc.

16.12 REPAIRS

Omron STI offers product repair service at our factory. If you need repairs made to any Omron STI product contact our Customer Service Department.

16.13 DOCUMENTATION CRITERIA

This publication has been carefully checked for accuracy and is believed to be fully consistent with the products it describes. However, Omron STI does not assume liability for the contents of this publication, the examples used within, or the use of any product described herein. Omron STI reserves the right to make changes to products and/or documentation without further notification.

16.14 COMPLIANCE WITH ROHS

The MS4800 product was developed in compliance with the ‘restriction of the use of certain hazardous substances’ (RoHS).

17 GLOSSARY

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17.1 GLOSSARY DEFINITIONS

Automatic Start: Upon completion of power-up, the ESPE will enter the MACHINE RUN state as soon as the detection zone is clear of opaque objects of the specified size.

Detection Zone: The IR light sensing area of the ESPE. When a specified test piece enters this area then the ESPE must detect its presence and set its safety outputs to the OFF-state.

Electro-Sensitive Protective Equipment (ESPE): An assembly of devices and/or components working together for protective tripping or presence sensing purposes and comprising as a minimum:

- a sensing device
- controlling/monitoring devices
- output signal switching devices

LOCKOUT Condition: When the ESPE detects a fault, it transitions to this state. The OSSD will be held to the OFF state and the ESPE will not attempt to leave this state without performing a comprehensive power-up self-test. A power-up self-test will be initiated by either cycling the ESPE power or by a Start signal transition.

MACHINE RUN: When the ESPE is in this state the two OSSD are both active. In this state the Green MACHINE RUN LED is on, the Red MACHINE STOP LED is off and the Yellow INTERLOCK LED is off.

MACHINE STOP: When the ESPE is in this state the two OSSD are both inactive. In this state the Green MACHINE RUN LED is off, the Red MACHINE STOP LED is on.

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 completed and permits the flow of current.

Output Signal Switching Device (OSSD): The safety output of the ESPE that is used to enable and disable the guarded machine.

PDM: Programming and Diagnostic Module used to select light curtain configuration options and read the diagnostic information.

Response Time: The maximum amount of time required for the ESPE to set its OSSD outputs to the OFF-state once the detection zone is blocked by an opaque object of the specified size.

Start INTERLOCK: Upon completion of power-up, the ESPE must go to the “INTERLOCK” state. A Start signal transition must occur before going to MACHINE RUN for the first time. Once the first Start condition has been met, the ESPE will operate in the Automatic Start mode.

Start/Restart INTERLOCK: The ESPE will go into the INTERLOCK state upon completion of power-up and during zone violations which causes a transition to the MACHINE STOP state. A Start signal transition must occur before returning to MACHINE RUN following any transition to MACHINE STOP.

18 DIAGNOSTICS & TROUBLESHOOTING

18.1 DIAGNOSTICS

The diagnostic fault codes are given in the following table. These codes are displayed via the IBIs and PDM. The normal operation codes are NOT displayed on the IBIs.

Table 18-1 Diagnostic Codes

Code Group	Status Code	Description of Status Code
Normal Operation Status Codes Display only on PDM	88/v3	During power-up all of the segments are lit and then the software version is displayed
	-1	In the Interlock state and waiting for Start Input
	-2	Floating Blanking enabled
	-3	Fixed Blanking enabled
	-4	Floating Blanking and Fixed Blanking enabled
	-5	Muting enabled

Code Group	Error Code	Description of Error Code	Corrective Action Needed
Configuration Switch Faults (MS4800S only)	21	Invalid mode selection setting	Verify switch setting. See user manual.
	22	Configuration switch settings changed during operation	Verify switch setting. See user manual.
	23	Configuration switch settings do not match	Verify switch setting. See user manual.
	24	Corrupted EEPROM configuration.	Reset the system configuration to factory default.
	26	Invalid scan code setting	Verify switch setting. See user manual.
Safety Output (OSSD) Faults	31	Safety outputs 1 & 2 are shorted together	Check and correct wiring of safety outputs 1 and 2.
	32	Safety output 1 shorted to power	Check and correct wiring of safety output 1.
	33	Safety output 2 shorted to power	Check and correct wiring of safety output 2.
	34	Safety output 1 shorted to ground	Check and correct wiring of safety output 1.
	35	Safety output 2 shorted to ground	Check and correct wiring of safety output 2.
EDM Faults	41	EDM circuit did not open before transition to MACHINE RUN State	Check and correct EDM wiring.
	42	EDM circuit did not open after transition to MACHINE RUN state	Check and correct EDM wiring.
	43	EDM circuit was in wrong state during power-up	Check and correct EDM wiring.
	44	EDM fault at power-up	Check start input wire or EDM function selection.
Controller Fault	50	Control logic fault	Call Omron STI(888-510-4357) or return receiver to Omron STI for evaluation
Setup Error	60	Possible crosstalk	Possible crosstalk

Code Group	Error Code	Description of Error Code	Corrective Action Needed
Muting Faults	70	General muting fault	Check wiring of unused mute sensors.
	71	Mute sensors activated in the wrong sequence	Check mounting of mute sensors for correct sequence.
	74	Mute lamp burned out or not connected	Check status of mute lamp.
Cascaded System Faults	80	Configuration error	Call Omron STI for troubleshooting assistance (888-510-4357)
	81	Second segment or mute module error	Check all cable connections. Call Omron STI (888-510-4357)
	82	Third segment or mute module error	Check all cable connections. Call Omron STI (888-510-4357)
	83	Fourth segment or mute module error	Check all cable connections. Call Omron STI (888-510-4357)
	84	Mute module error	Check all cable connections to mute module. Call Omron STI (888-510-4357)
	85	Configuration error	Call Omron STI for troubleshooting assistance (888-510-4357)
	86	Second segment or mute module firmware not compatible with first segment	Replace with compatible component or return system to Omron STI for upgrade.
	87	Third segment or mute module firmware not compatible with first segment	Replace with compatible component or return system to Omron STI for upgrade.
	88	Fourth segment or mute module firmware not compatible with first segment	Replace with compatible component or return system to Omron STI for upgrade.
	89	Mute module firmware not compatible with first segment	Replace with compatible component or return system to Omron STI for upgrade.
	90	Incorrect segment type in position two, three, or four	Confirm that all segments are of the same type; either all transmitters or all receivers.
	91	Segment 2 type does not match segment 1 type	Confirm that segment 2 is the same type (transmitter or receiver) as segment 1.
	92	Segment 3 type does not match segment 1 type	Confirm that segment 3 is the same type (transmitter or receiver) as segment 1.
	93	Segment 4 type does not match segment 1 type	Confirm that segment 4 is the same type (transmitter or receiver) as segment 1.
	95	Error in flex segment or mute during operation	Check connections. Call Omron STI (888-510-4357)
	96	Error in segment 2 during operation	Check connections to segment 2. Replace segment 2 with known good segment. Call Omron STI (888-510-4357).
	97	Error in segment 3 during operation	Check connections to segment 3. Replace segment 3 with known good segment. Call Omron STI (888-510-4357).
	98	Error in segment 4 during operation	Check connections to segment 4. Replace segment 4 with known good segment. Call Omron STI (888-510-4357).
	100	Number of segments in system has been reduced	Segment count is less than original configuration. Add required segment(s) or program system for current configuration.
	101	Too many flex nodes or mute modules in the flexbus	Make sure of total of 4 segments with only one mute module.

18.2 Receiver Diagnostic Information

The receiver first segment uses the IBI to indicate diagnostic codes. The IBI will only indicate fault codes, when in the Fault state. In this state the yellow INTERLOCK LED will be flashing and the first 10 IBIs are used to display the fault code, see Figure 18-1 - *Example of IBI LED's used to Show Fault Code*.

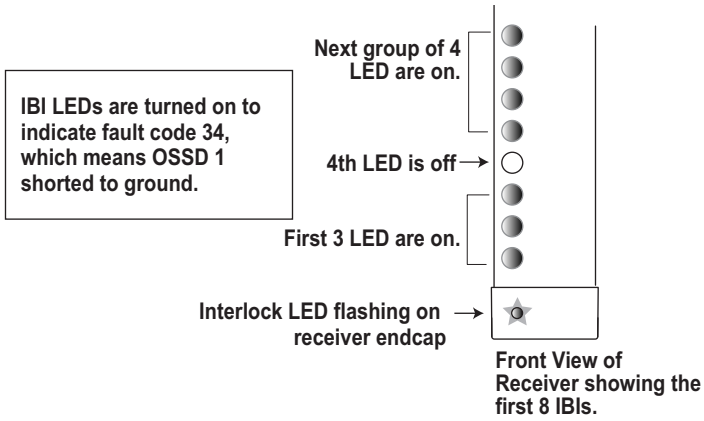

Figure 18-1 Example of IBI LED's used to Show Fault Code

18.3 Receiver Endcap Indicator Lights

1. GREEN – The MS4800 is in the MACHINE RUN state.
2. RED - The MS4800 is in the MACHINE STOP state.
3. YELLOW INTERLOCK- The light curtain is waiting for the start button to be pushed. If the LED is blinking, the light curtain is in a alarm condition.
4. AMBER – The light curtain is operating in a reduced resolution mode: Floating Blanking, Fixed Blanking, Monitored Blanking and Reduced Resolution.

18.3.1 Receiver Troubleshooting

If the yellow INTERLOCK LED is blinking:

1. Check the configuration for MPCE Monitoring. If MPCE Monitoring is inactive (via receiver selector switches), the input (pink wire) must be connected to system ground. If MPCE is active, the input must be connected to the normally closed contacts of the control relays of the guarded machine or the monitor terminal of the RM module. See Section 12 - *Connecting To The Machine Control Circuit* for an example.
2. Make sure both selector switches in the receiver endcap have been set properly and identically. See Table 7-2 - *Receiver Selector Switch Settings* in manual.
3. Verify the power supply is within specified limits, see Section 16.1 - *System Specifications*.
4. Verify the light curtain is properly connected to the control relays of the guarded machine. If the light curtain is not intended to be connected to control relays, see Section 12.1 - *Connecting to a Safety Monitoring Device* of the manual for instruction.
5. Verify the control relays are within operating limits of the safety outputs. See Section 16 - *Specifications and Additional Information*.

Note: The pull-in voltage requirement of the relays must be satisfied. The 4800 provides $V=V_{supply}–2V$ on each solid-state safety output.

6. Verify the cable lengths from the light curtain to the control relays are within specified limits. See Section 16.1 - *System Specifications*.
7. Call Omron STI's Application Engineering Department at 1/888/510-4357.

18.4 TROUBLESHOOTING THE TRANSMITTER

If the yellow LED is off:

1. Verify the cable is connected.
2. Verify the power supply is within limits (+24V ± 20%).
3. Call Omron STI's Application Engineering Department at 1/888/510-4357.

If the yellow LED is blinking:

1. Verify the power supply is within limits (+24V ± 20%).
2. Call Omron STI's Application Engineering Department at 1/888/510-4357.

APPENDIX A —CHECKOUT PROCEDURE

A.1 CHECKOUT PROCEDURE LOG

The following checkout procedure must be performed by qualified personnel during initial MS4800 system installation and at least every three months or more frequently depending on machine usage and company guidelines.

Machine Identification:_____Date:_____

Item	Condition	Comments
1. Verify that the guarded machine is compatible with the type of machine which maybe used with the MS4800 system. See Section 1 - *Important Safety Warnings* for further information.	__ Pass __ Fail	
2. Verify that the mounting distance of the MS4800 system is equal to or greater than the minimum safe distance from the danger point. See Section 10 - *Safe Mounting Distance* for further information.	__ Pass __ Fail	
3. Determine that all access to the danger point not protected by the MS4800 system is guarded by other means, such as gates, fencing or other approved methods. Verify that all additional guarding devices are installed and operating properly.	__ Pass __ Fail	
4. Make sure the operator is not able to stand between the MS4800 system detection zone and the machine danger point. Verify that the light curtain can only be reset from a position outside and within view of the hazardous machine area.	__ Pass __ Fail	
5. Inspect the electrical connections between the guarded machine's control system and the MS4800 system. Verify that they are properly connected to the machine such that a stop signal from the MS4800 system results in an immediate halt of the machine's cycle. See Section 12 - *Connecting To The Machine Control Circuit*.	__ Pass __ Fail	
6. If the EDM monitoring feature is not used, proceed to step 7. To test the EDM feature, verify that the feature has been enabled. Turn the machine power on. Cycle the machine. Place a temporary jumper wire between the EDM connections. The MS4800 should enter an alarm condition. Remove the temporary jumper. Press and release the start button.	__ Pass __ Fail	
7. Record the test results in the machine log, then perform the Test Procedure.	__ Pass __ Fail	

Technician
Signature:_____

APPENDIX B —TEST PROCEDURE

B.1 TEST PROCEDURE LOG

The following test procedure must be performed by qualified personnel during initial MS4800 system installation, according to the employer's regular inspection program and after any maintenance, adjustment or modification to the MS4800 system or the guarded machine. Testing ensures that the light curtain, safety system, and machine control system work together to properly stop the machine. Failure to test properly could result in serious injury to personnel. To test the MS4800 system, use the correct size test object.

Machine Identification:_____Date:_____

Item	Condition	Comments
1. Disable the guarded machine. Apply power to the MS4800 system.	__ Pass __ Fail	
2. Visually inspect the machine to ensure that access to the danger point is only through the MS4800 detection zone. If not, additional guarding, including mechanical barriers may be required. Verify that all additional guarding devices and barriers are installed and operating properly.	__ Pass __ Fail	
3. Verify that the mounting distance of the MS4800 system is equal to or greater than the calculated minimum safety distance from the danger point. See Section 10 - *Safe Mounting Distance* for further information. Ensure that the operator is not able to stand between the 4800 detection zone and the danger point.	__ Pass __ Fail	
4. Check for signs of external damage to the MS4800 system, the machine and the electrical cables and wiring. If damage is found, lock the machine off and report to the supervisor.	__ Pass __ Fail	
5. Interrupt the MS4800 system detection zone with the proper size test object. Move the test object inside the perimeter (along the top, sides and bottom) of the detection zone and up and down through the center. At least one Individual Beam Indicator must be lit while the test object is anywhere in the detection zone. If in automatic start mode, verify that the red MACHINE STOP light is lit. If in start/restart INTERLOCK mode, verify that the red MACHINE STOP and yellow INTERLOCK lights are on. Press and release start button before proceeding to step 6.	__ Pass __ Fail	
6. Start the machine. While the machine is in motion, interrupt the detection zone with the test object. The machine should stop immediately. Never insert the test object into the dangerous parts of the machine. With the machine at rest, interrupt the detection zone with the test object. Verify that the machine will not start with the test object in the detection zone.	__ Pass __ Fail	
7. Verify that the braking system is working properly. If the machine does not stop fast enough, adjust the braking system or increase the distance from the detection zone to the danger point.	__ Pass __ Fail	
8. If the safety devices or the machine fails any of these tests, do not run the machine. Immediately tag or LOCKOUT the machine to prevent its use and notify the supervisor.	__ Pass __ Fail	

Technician
Signature:_____

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