

RM-3 Mute Module

Installation and Operating Manual





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1 IMPORTANT SAFETY WARNINGS

▲ WARNING! Read and understand this section prior to installing the RM-3 Mute Module.

1.1. SAFETY WARNINGS

The RM-3 Mute Module is an accessory device used to provide a safety-rated muting function in conjunction with Omron STI safety light curtains and single beam safety devices. *Muting* is defined as “*bypassing the protective function on safety-related control system such as a safety light curtain, during a pre-determined operation of a machine.*”

▲ WARNING! Muting can disable the safety functions of a machine. The proper installation, checkout and operation of a machine and muting system in accordance with all applicable laws and standards, is critical to the safe operation of the machine. Failure to comply with these instructions may result in severe injury to personnel.

Whether a specific machine application and RM-3 installation complies with safety regulations depends on several factors, including the proper application, installation, maintenance and operation of the RM-3 and its associated sensors. 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. The RM-3 should only be installed, verified and maintained by a qualified person, as “*a person or persons who, by possession of a recognized degree or certificate of professional training, or who, by extensive knowledge, training or experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work.*” (ANSI B30.2-1983).

1.1.1 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 from any organization:

- 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.
- Selection of the muting feature shall be by a key-operated switch under supervisory control by the employer.
- 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.
- There shall be at least two, independent muting signal sources to be used with the RM-3. A single, simple cam-operated limit switch is inadequate as a muting signal source since its failure can remain undetected.
- The muting position (of the mute signal source) shall be secured against unauthorized adjustment by provision of special tools, key entry, electronics passwords and the positioning and fixing of associated limit switches.
- The guarded machine must be able to stop anywhere in its cycle. Do not use an RM-3 on a press with a full-revolution clutch.




- The guarded machine must have a consistent stopping time and adequate control mechanisms.
- Severe smoke, particulate matter and corrosives may degrade the efficiency of the optical safety devices. Do not use optical safety devices in this type of severe environment.
- All applicable governmental, state, local and employers rules, codes and regulations must be satisfied. This is the employers responsibility.
- All safety-related machine control elements must be designed so that a fault in the control logic or failure of the control circuit does not lead to a failure or danger.
- Additional guarding may be required for access to dangerous areas not covered by the safety device system.
- Perform the Omron STI test procedure, in section 6 of this manual, at installation and after maintenance, adjustment, repair or modification to the machine controls, tooling, dies or machine, or the RM-3 and safety device system.
- Follow all procedures in this manual for proper operation of the RM-3 Mute Module.

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 DESCRIPTION OF RM-3 MUTE MODULE

2

2.1. DESCRIPTION

Power			Inputs				Mute Outputs					Outp	
17	16	15	14	13	12	11	10	9	8	7	6	5	4
	0 VDC	+24 VDC	Not Used	Mute-in-1	Mute-in-2	Start	Mute-Arm	Mute-Aux	Mute-amp-2	Mute-amp-1	AUX NPN	AUX PNP	0 VDC

STI RM-3 Mute Module
Scientific Technologies Inc.
Fremont, CA, USA
www.sti.com 1/800/556-6766

Mute Enable

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Figure 2-1 RM-3 Top Cover

2.1.1 FEATURES

- Safety rating is Category 4 (EN ISO 13849-1) and Type 4 (IEC 61496-1).
- Fast 1 ms response time.
- Works with either 1 or 2 safety devices (safety light curtain, safety controller, etc.)
- Two-channel mute sensor inputs for 2, 3 or 4 PNP-type electro-optic sensors, or limit switches or other sensing devices.

- LED indications for individual input and output status.
- Two-digit diagnostic display.
- External mute indication for operator awareness.

2.1.2 APPLICATIONS

- Automatic conveyer, stacker and palletizing machines.
- Mechanical and hydraulic presses with automatic or manual feed with the muting function is only used in the non-hazardous portion of the press cycle.
- Other machines that can be safely accessed in the non-hazardous portion of operation.

The RM-3 Mute Module is a Category 4 safety device that interfaces between a machine and certain protective safety devices to temporarily suspend those devices during the non-hazardous portion of the machine cycle. It conforms with EN ISO 13849-1 and has been certified to IEC 61496-1

When the mute mode is disabled, the RM-3 outputs are the same as those of the connected safety devices. Any entry into the guarded area will result in a stop signal being sent to the guarded machine.

The RM-3 provides two "mute safety channels", each accepts a single safety device, and either two, three or four mute sensors to activate the mute mode. The mute mode is active when the correct sequence of mute sensor input signals is achieved.

Each safety device output must be capable of supplying two 24 VDC (PNP) output signals when the sensing field is clear. Mute sensors must have PNP type outputs, sensor pairs are made-up of both "dark operate" and "light operate" sensors.

An indicator lamp for each safety channel is required to illuminate anytime the RM-3 is in the mute state. These lamps must be visible to personnel in the immediate area. The RM-3 monitors the lamp circuit to ensure the indicator is operational.

2.2. DESCRIPTION OF CONTROLS

⚠ WARNING! Muting can disable the safety functions of a machine. The proper installation, checkout and operation of a machine and muting system; in accordance with all applicable laws and standards, is critical to the safe operation of the machine. Failure to comply with these instructions may result in severe injury to personnel.

2.2.1 POWER REQUIREMENTS

The RM-3 requires a dedicated power supply of 24 VDC \pm 10 %, providing a minimum of 2 amperes.

- System Common Return

For proper operation, the power supply common, (0 VDC), must be connected to each of the components in the system, including start/enable switches, MPCE monitor, all OSSD and Auxiliary loads.

- Chassis Ground or Protective Earth (PE) Connection

The chassis ground terminal of the RM-3 must be connected to the earth ground of the installation site to ensure protection from electrical interference and high voltage transients.

2.2.2 RM-3 INPUT DEVICES

- Sensor Inputs

The RM-3 module accommodates up to two independent channels identified as Channel 1 & Channel 2. Each channel is comprised of one safety input device and either two, three, or four mute input sensors.

- Safety Input Devices (OSSD Inputs)

The RM-3 supports safety devices such as safety light curtains, safety controllers or other safety-rated devices that provide two 24 VDC inputs into the RM-3 whenever their protected area is clear.

NOTE: If using an input from a relay-type safety device, the two OSSD signals must switch to the On and Off state within 300 msec of each other to be recognized as proper OSSD inputs.

- Mute Sensor Inputs

Muting is controlled by two or more separate input sources. These devices can be optical, inductive or mechanical. Sensors S1A, S1C, S2A & S2C must have 'Dark-On' PNP type outputs, nominal 24 VDC when Ok to mute. Sensors S1B, S1D, S2B & S2D must have 'Light-On' PNP type outputs, nominal 0 volts (no current flow) when Ok to mute.

⚠ WARNING! You must have at least two independent mute sensors to activate the mute circuit. A single device with multiple outputs such as single limit switch, is inadequate as a mute sensor since its failure can remain undetected. Failure to comply with this requirement may cause the muting circuit to activate at the incorrect part of the machine cycle. Serious injury to personnel could result.

- Mute Enable / Disable

A single SPDT switch is used to enable the RM-3 to detect the mute input sensors, or disable the RM-3 from entering the mute state. When in the disable position all muting errors are cleared from the diagnostic display.

- Start Switch

A push-button switch is required to reset the RM-3 from a Start/Interlock condition, a fault interlock, or allow the Bypass feature to be used. The input is DIP switch selectable for N/O or N/C operation.

⚠ WARNING! The Start switch shall be located outside of the safeguarded area such that it cannot be reached from within the safeguarded area. The location must allow complete visibility of the guarded area. The operator must ensure that the safeguarding zone is clear before press & release of Start. This prevents the machine or muting function from starting while personnel may be in the hazardous area and avoids possible serious injury to personnel.

2.2.3 RM-3 OUTPUTS

⚠ WARNING! Muting is only allowed during the non-hazardous portion of the machine cycle! A muting application must be designed so that no single component failure can prevent the stop command or allow subsequent cycles until the failure is corrected. (OSHA 1910.217(c)(3)(iii) (d), ANSI B11.19-1990 section 4.2.3.3.7) Failure to comply with this requirement may cause the muting circuit to activate at the incorrect part of the machine cycle, serious injury to personnel could be resulted.

- Output Signal Switching Devices (OSSD's)

The RM-3 uses two solid-state outputs to send a stop signal to the guarded machine. When the RM-3 is in the normal Run mode with the safety device(s) clear, or in the Mute mode regardless of the safety device(s) status, the OSSD outputs are turned on, sourcing 24 VDC @ a maximum of 625 mA.

Solid-state outputs achieve their safety ratings by periodically switching the output state and verifying that the device did indeed switch. This operation is performed periodically and is essentially transparent to the machine control circuit.

⚠ WARNING! You Must Use both OSSD safety outputs from the RM-3! Each output must be wired such that it is capable of stopping the guarded machine. Failure to use both RM-3 safety outputs may prevent the machine from stopping, resulting in possible severe injury to personnel.

- Auxiliary Outputs

The RM-3 provides non-safety auxiliary outputs in both PNP and NPN configurations. The PNP output source 24 VDC @ 500 mA, the NPN output sinks up to 100 mA.

The auxiliary outputs are user selected to either follow the OSSD outputs, or activate when a fault condition is detected.

- Mute Lamp Outputs 1 & 2

A visible mute lamp is required for each channel of the RM-3 to indicate the mute function is active. Mute Lamp outputs are NPN current sinking inputs. Each input is monitored to ensure 40-300 mA is flowing through the circuit when Mute is activated. If the required current is not detected, then the RM-3 will not enter the Muting state and will display diagnostic codes. If a current is detected when the mute function is NOT activated, the RM-3 will enter the Lockout state.

⚠ WARNING! An indication that the protected area is muted must be provided and readily observable to the machine operator. The mute lamp is an important warning device to the machine operator, indicating that muting is active.

- Mute Indicator Auxiliary Outputs

Mute Auxiliary and Mute Armed functions are available as non-safety-rated outputs. Each is configured as NPN sinking at a maximum of 100 mA. Mute Aux will indicate whenever the RM-3 is in the Muting state. Mute Armed will indicate the RM-3 is Mute Enabled.

- MPCE Monitor

The RM-3 OSSD outputs are designed to connect directly to the machine primary control element, or MPCE. MPCE monitoring is the capability to directly monitor machine control devices and ensure their operation coincides with the commands of the RM-3.

2.3. ADJUST TO SAFE MOUNTING DISTANCE

2.3.1 USING THE RM-3 WITHOUT MECHANICAL RELAYS

The RM-3, when used without mechanical relays, will add 1 millisecond (0.001 sec) to the overall response time of the safety control system. This will increase the safe mounting distance of the safety sensing device. See the installation manual of the safety sensing device for further information on calculating the proper safeguarding distance.

2.3.2 USING THE RM-3 WITH THE RM-X

The RM-3 will add 1 millisecond (0.001 sec) and the N/O contacts of the RM-X adds an additional 10 milliseconds (0.01 sec) for a total of 11 milliseconds (0.011 sec) to the response time of the safety control system. This additional time will increase the safe mounting distance of the safety sensing device. See the installation manual of the safety device for further information on calculating the proper safe mounting distance.

2.3.3 USING THE RM-3 WITH SAFETY MECHANICAL RELAYS

The RM-3 itself adds 1 millisecond (0.001 sec) to the response time of the safety control system. Additionally, you must also add the response time of the mechanical relays to determine the total impact on the safety control system. This will increase the safe mounting distance of the safety device.

The RM-3 should only be used with safety rated mechanical relays employing force guided contacts. Contact the relay supplier for the safety rating suitability and response time.

Refer to the installation manual of the safety sensing device for further information on the safe mounting distance.

⚠ WARNING! The system installer and employer are responsible for the proper selection, installation and orientation of the muting sensors are critical to ensure that muting can never be initiated by personnel attempting access through the safeguarding device. Serious injury to personnel may result.

3 APPLICATION EXAMPLES

3.1. APPLICATION INFORMATION

The following section contains several application examples of how the RM-3 may be used with various arrangements of sensors 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-3, provided that they met the electrical requirements of *Section 2.2.2* on page 8.

3.1.1 SELECTION AND ORIENTATION OF THE MUTING SENSORS

The object of the correct 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, or otherwise bypass the safe guarding device.

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 conveyORIZED applications.

- 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. Likewise, 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 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 a safeguarding device is able to send a stop signal to the machine before entering into the hazardous area. Other safeguarding methods, such as physical barriers or fences, may be necessary.

3.2. TWO SENSOR MUTING SYSTEM

▲ 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 protected 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.

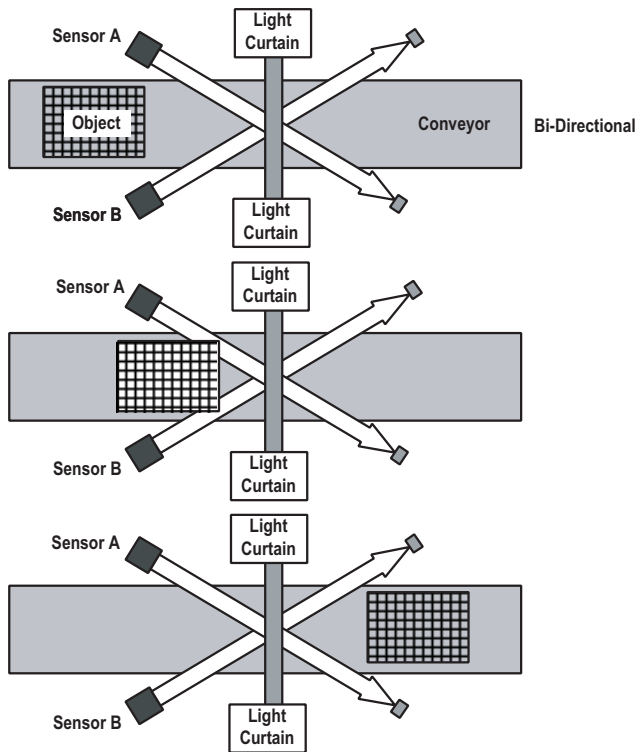


Figure 3-1 Two Sensor System Diagram

The figure below illustrates muting on a mechanical press using two switches to sense when to enter 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.

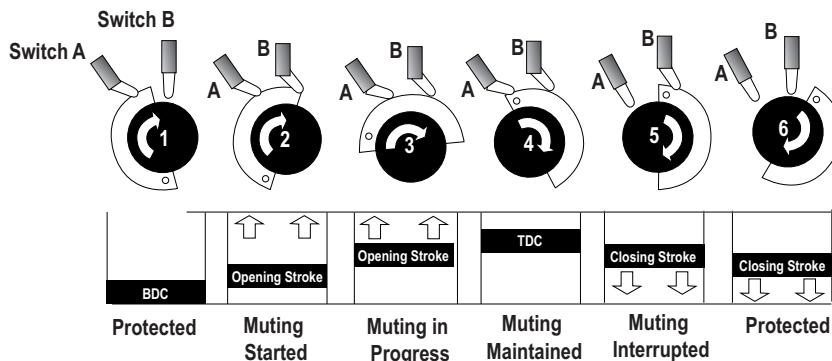


Figure 3-2 Muting a Mechanical Press

Table 3-1 Conditions required to transition to Muting state, Two Sensor System

No. of Sensors	State	Mute Enable	Sensor A	Sensor B	Sensor C	Sensor D	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	Muting

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-ENABLE input is active, if at anytime these Sensor Inputs become active, the Muting system will transition to the LOCKOUT (FAULT) state.

3.2.1 SENSOR REQUIREMENTS

Sensor A 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 B 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.

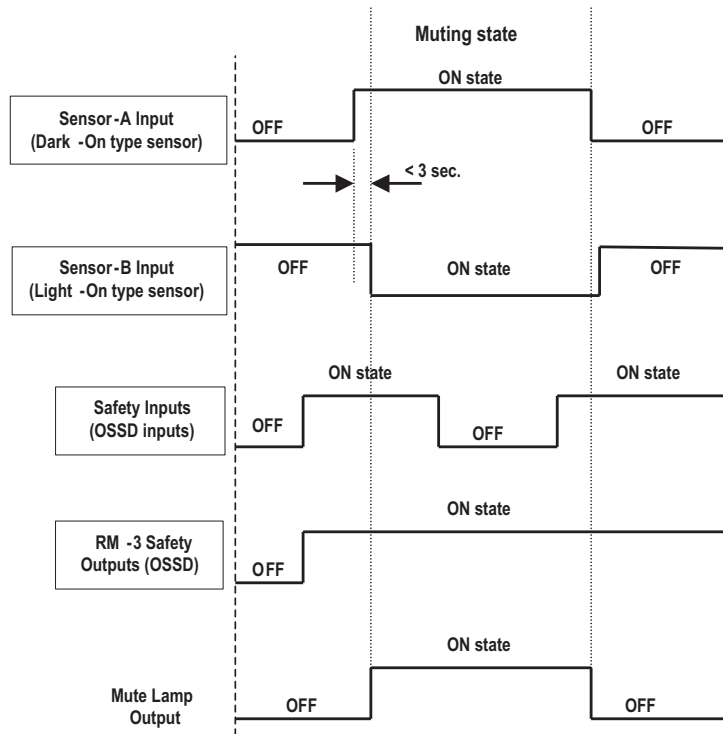


Figure 3-3 Two Sensor Muting System Waveform Diagram

3.3. THREE SENSOR MUTING SYSTEM

▲ 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 protected field undetected.

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

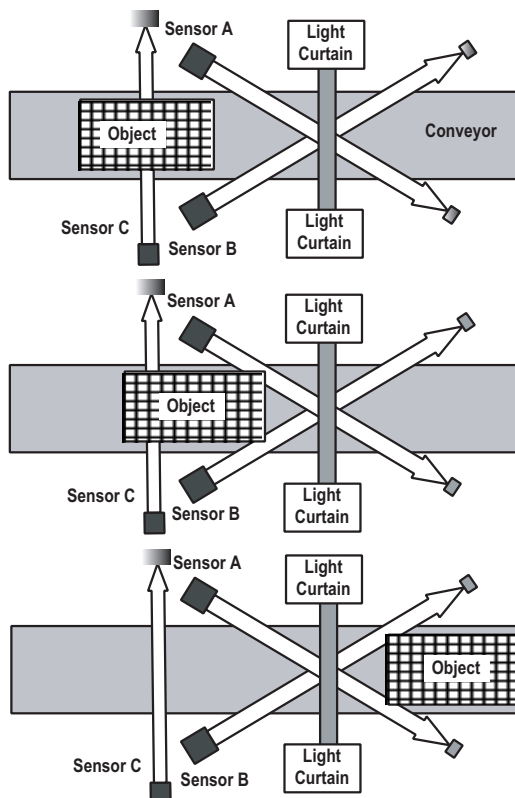


Figure 3-4 Three Sensor System Design

Table 3-2 Conditions required to transition to Muting State - Three sensor system

No. of Sensors	State	Mute Enable	Sensor A	Sensor B	Sensor C	Sensor D	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	Muting
	State 5	ON	ON	ON	OFF	XX	Muting

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-ENABLE input is active, if at anytime these Sensor Inputs become active, the Muting system will transition to the LOCKOUT (FAULT) state.

3.3.1 SENSOR REQUIREMENTS

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

- Sensors A & C 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 B 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 C must activate at least 0.05 seconds before sensors A & B.
- Concurrence of activation of the sensor pair, sensor A & B, must be within 3 seconds of each other.
- Sensor C must remain active until both sensors A & B activate.

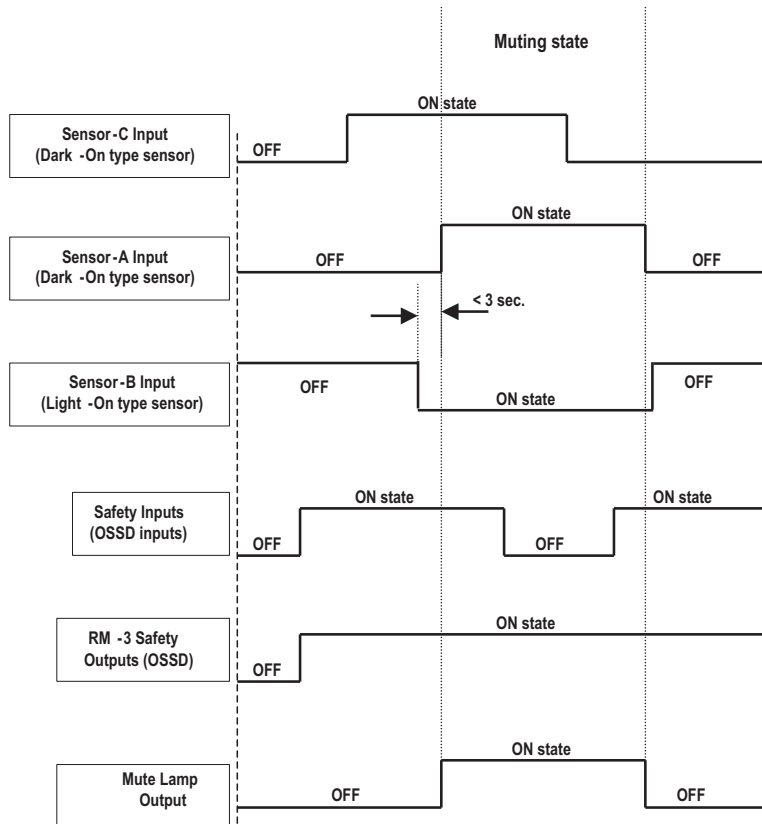


Figure 3-5 Three Sensor Muting System Waveform Diagram

3.4. FOUR SENSOR MUTING SYSTEM



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 protected field undetected.

To mute in this bi-directional configuration, a sensor pair (Sensor A & Sensor B or Sensor C & Sensor D) must transition to the ON state and concur within 3 seconds. Since conveyor is bi-directional either Sensor A or Sensor D can first be active in the sequence. The figure below illustrates a Muting system used in a four sensor conveyor belt configuration.

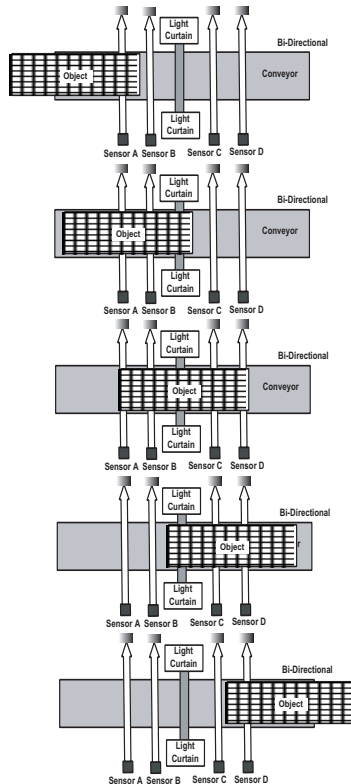


Figure 3-6 Four Sensor System Diagram

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

No. of Sensors	State	Mute Enable	Sensor A	Sensor B	Sensor C	Sensor D	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	Muting
	State 5	ON	ON	ON	ON	OFF	Muting
	State 6	ON	ON	ON	ON	ON	Muting
	State 7	ON	OFF	ON	ON	ON	Muting
	State 8	ON	OFF	OFF	ON	ON	Muting
	State 9	ON	OFF	OFF	OFF	ON	Protected

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

3.4.1 SENSOR REQUIREMENTS

The following must be met for the RM-3 to enter or remain in the muting state:

- Sensors A & C 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.
- Sensors B & D must be a Light-On type sensor with PNP type output or a switch that opens its contact when it is Ok to mute.
- Concurrence of activation of sensor pair Sensor A & Sensor B must be within 3 seconds and the concurrence of activation of sensor pair Sensor C & Sensor D must be within 3 seconds.
- Sequence of sensor activation is Sensor A before Sensor B before Sensor C before Sensor D or the sequence may be in reverse direction, Sensor D before Sensor C before Sensor B before Sensor A. The time difference between sensor activation must be at least 0.05 seconds.
- To stay in muting state sensor pair Sensor A & Sensor B must remain active until sensor pair Sensor C & Sensor D activate. In reverse direction sensor pair Sensor C & Sensor D must remain active until sensor pair Sensor A & Sensor B activate.

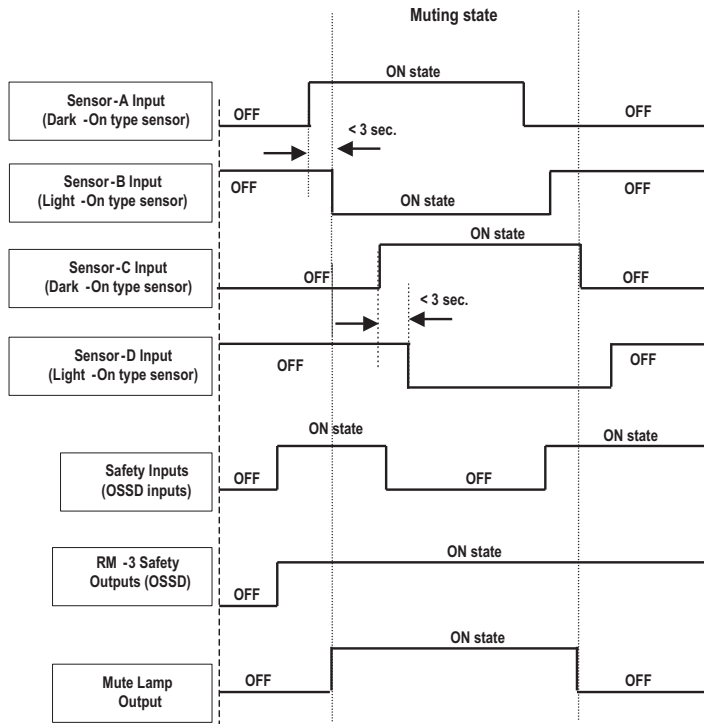


Figure 3-7 Four Sensor Muting System Waveform Diagram

3.5. DUAL X 4-SENSOR MUTING SYSTEM

⚠ 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 protected field undetected.

The figure below illustrates that the sensors within each sensor pair are set in a 'X' configuration. The Dual X4-Sensor configuration Muting System is a bi-directional system.

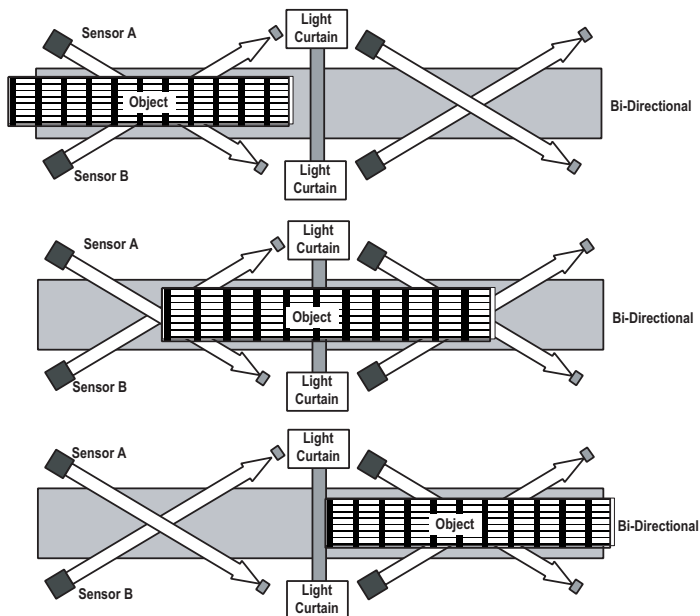


Figure 3-8 Dual X 4-Sensor System Diagram

Table 3-4 Conditions required to transition to Muting State - Dual X 4-sensor system

No. of Sensors	State	Mute Enable	Sensor A	Sensor B	Sensor C	Sensor D	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	OFF	ON	Protected

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

3.5.2 DUAL X 4-SENSOR REQUIREMENTS

The following must be met for the RM-3 to enter or remain in the Muting state:

- Sensor A & C must be Dark-On type sensors with PNP type output or a switch that closes its contact to provide +24 VDC when it is okay to mute.
- Sensors B & D must be Light-On type sensors with PNP type output or a switch that opens its contact when it is okay to mute.
- Concurrence of activation of sensor pair Sensor A and Sensor B must be within 3 seconds, either sensor within the pair activating first. Sensor pair Sensor C and Sensor D 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 A and B before sensor pair C and D or the sequence may be in reverse direction, sensor pair C and D before sensor pair A and B.

- To stay in Muting state sensor pair A and B must remain active until sensor pair C and D become active. In reverse direction sensor pair C and D must remain active until sensor pair A and B become active for RM-3 to reemain in Muting state.
- To stay in 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.

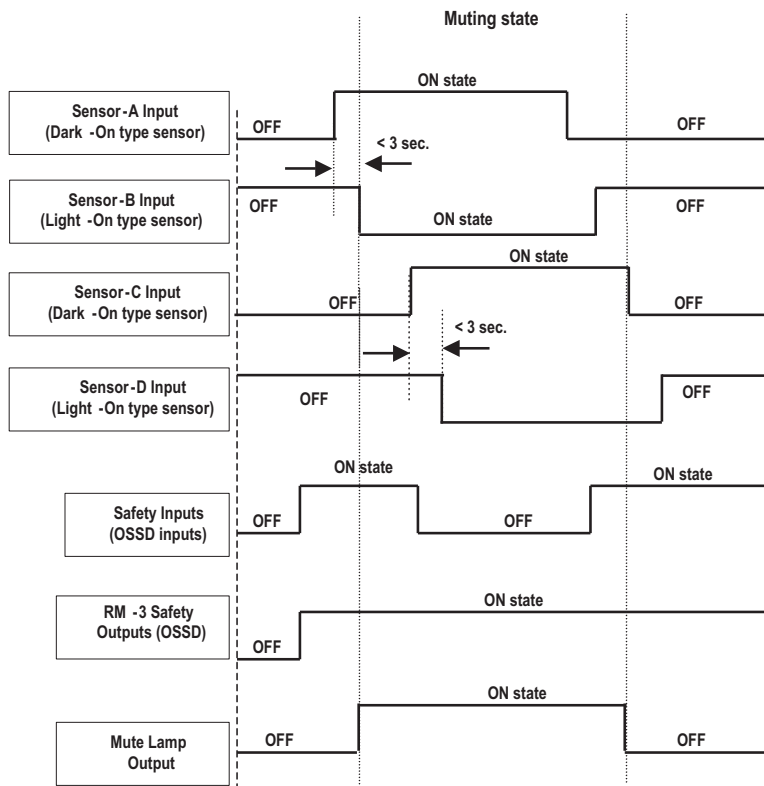


Figure 3-9 Dual X 4-Sensor Muting System Waveform Diagram

3.6. DESCRIPTION OF THE BYPASS-ALLOWED FEATURE

The RM-3 allows supervisory personnel to momentarily override the machine stop signal of the RM-3. This function is used during instances where processing sequence operations did not allow an automatic transition to the muting state and the RM-3 safety outputs are in the Off state.

The RM-3 will enter the Bypass-Allowed state under the following conditions:

- Redundant DIP switches must be set to enable Bypass-Allowed feature to occur.
- The mute enable inputs are active.
- The light curtain safety output (OSSD) are in the Off state and a minimum of one mute sensor is active in the effected safety channel.

The RM-3 signals that it is in the Bypass-Allowed state by the following indications:

- The mute lamp of the effected safety channel will flash at about a 1-second interval.
- The Mute Aux output will switch between active and inactive at about a 1 Hz rate.
- The diagnostic display will show a code of 03.

To allow the RM-3 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 of the effected safety channel will now be On continuously.
- The Mute Aux output will now be continuously in the active state.
- The diagnostic display will show a code of 02.
- If the light curtain is clear of obstructions before all of mute sensors have cleared then the RM-3 will leave the Muting state and enter the Machine

Run state. Note, all of the mute sensors must clear for the RM-3 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 RM-3 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 RM-3 to be continuously in the Muting state is 10 minutes.
- If the 10 minute time limit is exceeded the RM-3 will automatically change from the Muting state to the Bypass-Allowed state.
- There is no limit on the number of times that the RM-3 can enter the Bypass-Allowed state and then with the press-and-release of the Start button into the Muting state.

3.6.1 EXAMPLE OF BYPASS-ALLOWED

A conveyor is operated with an RM-3 that has one light curtain and three mute sensors connected. The RM-3 is set to Start Interlock mode and Bypass-Allowed is enable.



Table 3-5 Bypass-Allowed Example

Conveyor System Condition	Muting Sensors Condition			Light Curtain Condition	RM-3 Response to these conditions
	Sensor A	Sensor B	Sensor C		
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 C is active.
Supervisor verifies that system is safe to start, the RM-3 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 C 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	RM-3 indicates Bypass-Allowed by blinking mute lamp and diagnostic code of "03" is displayed.
Supervisor verifies that system is safe to bypass, the RM-3 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 and diagnostic code of "02" is displayed.
Conveyor motors are running.	Sensor is blocked	Sensor is Blocked	Sensor is Clear	Curtain becomes Cleared	Enters Machine Run state, mute lamp turns off and diagnostic code of "00" is displayed.
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.

4 TECHNICAL SPECIFICATIONS

4.1. TECHNICAL RATINGS

Response Time	Less than 1 msec.
Input Power	24 VDC +/- 10%, 50 Watts max. (a)
Operating Temperature	0 deg C to 55 deg C.
Humidity	Less than 95% Non Condensing
Storage Temperature	-25 deg C to 75 deg 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, 16 msec pulses, 1000/axis.
Enclosure	IP-20 (Unit to be installed in enclosure with min. IP54)
Outputs	
Safety Outputs (OSSD)	Two independent 625 mA (max.) current sources (PNP), 24 VDC.
Auxiliary Outputs	Auxiliary NPN output: 100 mA (max.) current sink, 30 VDC max. Auxiliary PNP output: 500 mA (max.) current source, 24 VDC.
Mute-Lamp	Two (NPN) Outputs 40-300 mA, 30 VDC Max. (b)
Mute Auxiliary	NPN Output 100 mA (max.), 30 VDC Max
Mute-Armed	NPN Output 100 mA (max.), 30 VDC Max
MPCE Monitor	24 VDC, 50 mA (sourced by RM-3)
Inputs	
Safety Devices (OSSD Inputs)	PNP 24VDC @ 50 mA Machine Run, 0 volts Machine Stop
Mute Sensor	PNP 24 VDC (20 mA consumption)
Mute-Enable	SPDT Key-Operated Switch, Maintained Contacts
Start / Restart	Either N/O or N/C Momentary Contact (10 mA consumption)
Approvals	CE, TUV, UL
Conformities	ESPE Type 4 (IEC61496-1 /-2), Category 4 / PL e (EN ISO 13849-1), SIL 3 / SIL3 CL3 (IEC61508 / EN 62061) when used with an OMRON STI SIL3 product.
Safety Related Parameters	PFH = 1.32 E= 0 1/h Proof Test Interval = 10 years MTTFd = 100 years

(a) Power to the RM-3 must come from a dedicated power supply that meets the requirements of IEC 60204-1 and IEC 61496-1, STI part number 42992 or equivalent.

(b) The external lamp must provide a current load between 40 mA and 300 mA for the lamp monitoring circuit to sense proper operation of the mute lamp.

4.2. TERMINAL ASSIGNMENTS

PIN #	FUNCTION	ASSIGNMENT		PIN #	FUNCTION	ASSIGNMENT
1	RM-3 Outputs & MPCE Input	OSSD A		34	DeviceNet Interface (Optional)	+V
2		OSSD B		33		CAN HIGH
3		MPCE MON		32		SHIELD
4		0 VDC		31		CAN LOW
5		AUX-PNP		30		-V
6		AUX-NPN		29		OSSD2A
7	Mute Outputs	MUTE-LAMP 1		28	Mute Input Channel 2	OSSD 2B
8		MUTE-LAMP 2		27		SENSOR 2A
9		MUTE-AUX		26		SENSOR 2B
10		MUTE-ARMED		25		SENSOR 2C
11	RM-3 Control Inputs	START		24	Mute Input Channel 1	SENSOR 2D
12		MUTE-ENABLE HI		23		OSSD 1A
13		MUTE-ENABLE LO		22		OSSD 1B
14	Power	Not used		21	SENSOR 1A	
15		+ 24 VDC		20	SENSOR 1B	
16		0VDC		19	SENSOR 1C	
17		Earth Ground		18	SENSOR 1D	

- The RM-3 power input return (0 VDC) must be connected to the overall system component returns. Safety Light curtains, start switch, MPCE monitor, OSSD loads and auxiliary loads must be all connected in common for proper system operation.
- The Earth Ground terminal of the RM-3 must be connected to the enclosure or chassis ground of the installation site. Protection devices internal to the RM-3 that provide immunity from electrical interference connect to this earth ground terminal.

4.3. INSTALLATION WIRING EXAMPLE

RM-3 Mute Module with two sensing channels connected and the RM-3 safety outputs (OSSD) connected to a RM-X Relay module. The Normally Open (NO) contacts of the RM-X connect to the machine primary control elements.

Notes:

- The Start switch must be located in an area that allows complete visibility of the guarded area. The operator must ensure that the protection zone is clear before press & release of Start.
- Mute sensors S1A, S1C, S2A & S2C must have 'Dark-On' PNP type outputs, nominal 24 VDC when Ok to mute and nominal 0 VDC when no mute. Mute sensors S1B, S1D, S2B & S2D must have 'Light-On' PNP type outputs, nominal 0 VDC when Ok to mute and nominal 24 VDC when no mute.

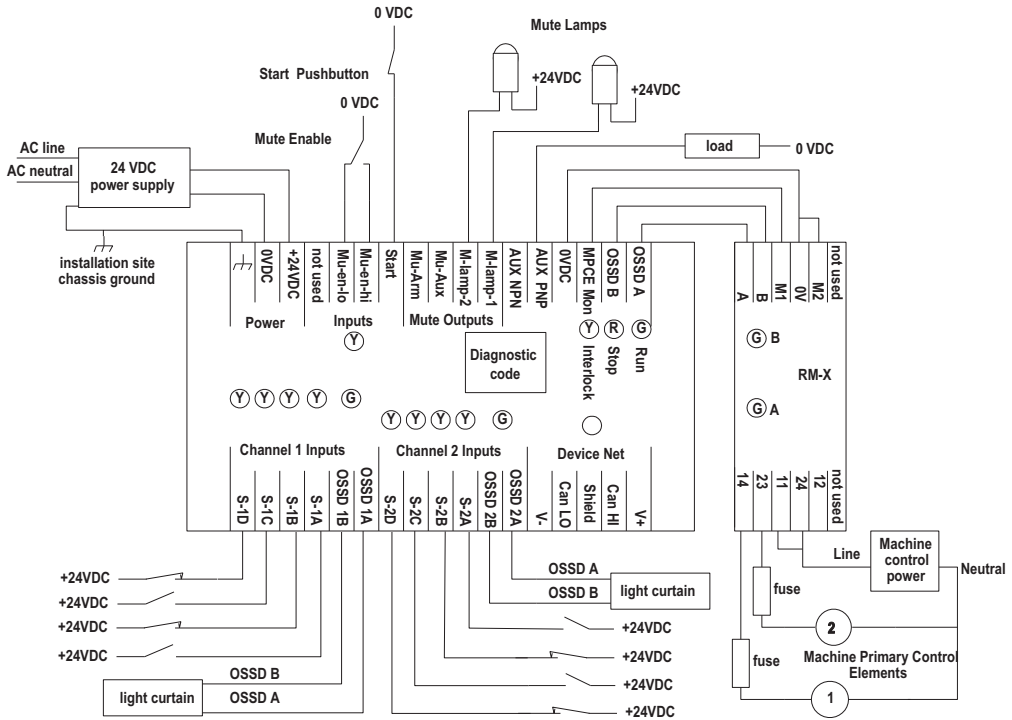


Figure 4-1 Installation Wiring Example

4.4. RM-3 VISIBLE INDICATORS

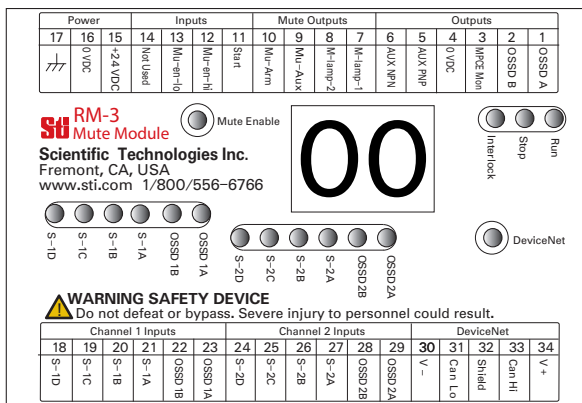


Figure 4-2 RM-3 Top Label and Indicators

RM3 Status	Color	State	Description
Mute Enable	Yellow	ON	External mute enable switch is set to ON
Interlock	Yellow	ON	Interlock State, waiting Start signal
	Yellow	FLASH	Lockout State (Internal or External Fault Detected)
Machine Stop	Red	ON	RM-3 OSSD Safety outputs are OFF
Machine Run	Green	ON	RM-3 OSSD Safety Outputs are ON
Channel 1 & 2 Status			
OSSD A/B	Green	ON	Both OSSD Inputs from Safety Device are On.
S-A	Yellow	ON	Muting Sensor S1-A is blocked (activated)
S-B	Yellow	ON	Muting Sensor S1-B is blocked (activated)
S-C	Yellow	ON	Muting Sensor S1-C is blocked (activated)
S-D	Yellow	ON	Muting Sensor S1-D is blocked (activated)

DeviceNet is Bicolor green/red LED that indicates the RM-3 DeviceNet node status.

Diagnostic Display two digit numeric display that provides diagnostic codes.



4.5. OPERATING STATES AND CORRESPONDING OUTPUTS

Table 4-1 RM-3 Operating States and Corresponding Outputs

Output		Muting	Bypass Allowed	Machine Run	Machine Stop	Interlock	Lockout (Fault)
Machine Run, Green LED		ON	OFF	ON	OFF	OFF	OFF
Machine Stop, Red LED		OFF	ON	OFF	ON	ON	ON
Interlock or Fault, Yellow LED		OFF	OFF	OFF	OFF	ON	BLINKING
OSSD A OUTPUT		ON	OFF	ON	OFF	OFF	OFF
OSSD B OUTPUT		ON	OFF	ON	OFF	OFF	OFF
AUXILIARY OUTPUTS	Follow OSSD	ON	OFF	ON	OFF	OFF	OFF
	Alarm Mode	OFF	OFF	OFF	OFF	OFF	ON
MUTE-LAMP 1 OUTPUT		ON when Ch#1 is being muted	BLINKING when Ch #1 causes Bypass	OFF	OFF	OFF	OFF
MUTE-LAMP 2 OUTPUT		ON when Ch#2 is being muted	BLINKING when Ch #2 causes Bypass	OFF	OFF	OFF	OFF
MUTE-AUX OUTPUT		ON	BLINKING	OFF	OFF	OFF	OFF
MUTE-ARMED OUTPUT		ON	ON	X	X	X	X

X = This output is dependent on Mute Enable input signal.

4.6. MAXIMUM CABLE LENGTHS

The following table lists the recommended maximum lengths for the RM-3 input & output signals. Unshielded cables and wires may be used for all connections.

Table 4-2 RM-3 Input & Output Signal Cable Length

Signal Names	Cable or Wire	Specified max. length
Safety outputs A & B	20 AWG wire with cable capacitance < 100 pF/ft.	300 mA load: 70 meter (230 ft.) 625 mA load: 35 meter (115 ft.)
Aux PNP and Mute Lamps 1 & 2 outputs	18 AWG wire	50 meter (164 ft.)
Aux NPN, Mute Aux and Mute Armed outputs	22 AWG wire	100 meter (330 ft.)
Light curtain safety inputs	20 AWG wire with cable capacitance < 100 pF/ft.	100 meter (330 ft.)
Mute sensor inputs	22 AWG wire	100 meter (330 ft.)
Start input	22 AWG wire	100 meter (330 ft.)
MPCE Monitor input	22 AWG wire	100 meter (330 ft.)

4.7. RM-3 CONFIGURATION

The RM-3 is configured for the various operating modes through the use of two banks of eight-position DIP switches and a single two-position DIP switch. The DIP switches are accessible by removing the front cover. The redundant DIP switches must be set exactly the same.

Table 4-3 Eight-Position Redundant DIP Switch Settings

Switch	Function Selection	Description
1 & 2	Start Mode	Automatic Start: 1 = On, 2 = On Start Interlock: 1 = On, 2 = Off Invalid Setting: 1 = Off, 2 = On Start/Restart Interlock: 1 = Off, 2 = Off
3	MPCE Monitoring	Enabled = Off, Disabled = On
4	Bypass Allowed	Enabled = On, Disabled = Off
5	Number of Light Curtains	1 Light Curtain System = On 2 Light Curtain System = Off
6 & 7	Number of Mute Sensors	2 Sensor System: 6 = On, 7 = Off 3 Sensor System: 6 = Off, 7 = On 4 Sensor System: 6 = Off, 7 = Off Dual X 4 Sensor System: 6 = On, 7 = On
8	Muting Time Limit	No time limit = On 2 minute time limit = Off

Table 4-4 Two-position DIP switch Settings

Switch	Function Selection	Description
1	Auxiliary Output Mode	Follow OSSD output = On Alarm mode = Off
2	Start switch type	Normally Closed switch = On Normally Open switch = Off

5 TROUBLESHOOTING

5.1. SYSTEM DIAGNOSTIC CODES

5.1.1 NORMAL OPERATION

88	PowerUp Indication
00	Normal operation, No Faults
01	In the Interlock state and waiting for Start input.
02	Operating in Muting state.
03	In Bypass Allowed state & waiting for Start input.

5.1.2 DIP SWITCH FAULTS

21	Invalid Mode Selection setting.
22	Switch Setting Changed During Operation.
23	DIP Switch Settings Not Identical.
27	Invalid selection for the number of safety inputs connected.
28	Invalid selection for the number of mute sensors connected.

5.1.3 SAFETY OUTPUT (OSSD) FAULTS

31	Safety outputs A & B shorted together.
32	Safety output A shorted to Power.
33	Safety output B shorted to Power.
34	Safety output A shorted to Ground.
35	Safety output B shorted to Ground.

5.1.4 MPCE FAULTS

41	MPCE monitoring signal was in the Wrong state Before entering the Machine Run state.
42	MPCE monitoring signal was in the Wrong state After entering the Machine Run state.
43	MPCE monitoring signal was in the Wrong state during power up of RM-3.

5.1.5 INTERNAL CONTROLLER FAULTS

50	Detected Fault of RM-3 internal circuits.
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5.2. MUTE OPERATION DIAGNOSTIC CODES

5.2.1 MUTE ERRORS (NOT FAULTS)

61	Incorrect activation sequence of Channel 1 mute sensors did not allow Muting.
62	Incorrect activation sequence of Channel 2 mute sensors did not allow Muting.
63	The activation time period between the mute sensor pairs (S1A & S1B or S1C & S1D) of Channel 1 exceeded 3 seconds, concurrency error.
64	The activation time period between the mute sensor pairs (S2A & S2B or S2C & S2D) of Channel 2 exceeded 3 seconds, concurrency error.
65	The 2 minute time limit of being in the Muting state was exceeded, mute was initiated by the sensors of Channel 1.
66	The 2 minute time limit of being in the Muting state was exceeded, mute was initiated by the sensors of Channel 2.
67	The lamp connected to Mute Lamp 1 output is open circuit, this error will not allow muting to occur.
68	The lamp connected to Mute Lamp 2 output is open circuit, this error will not allow muting to occur.

5.2.2 SAFETY INPUT DEVICES, LIGHT CURTAIN OSSD INPUT SIGNALS, ERRORS

71	The On state or Off state switching time between Light Curtain 1 OSSD inputs 1A & 1B exceeded 300 msec, concurrency error.
72	The On state or Off state switching time between Light Curtain 2 OSSD input 2A & 2B exceeded 300 msec, concurrency error.

6 TEST PROCEDURE

6

The following test procedure **MUST** be performed by qualified personnel:

1. Following system installation.
2. In accordance with the employer's regular inspection program.
3. Immediately following any maintenance, adjustment or other modification to any system component.

Testing ensures that the safety devices and associated machine control system work together to properly stop the guarded machine. Failure to perform these procedures could result in serious injury.

NOTE! It is the user's responsibility to ensure that the installation conforms to all federal, state, local and company regulations pertaining to safe operation of the equipment.

6.1. INSTALLATION CHECKOUT

1. Disable the guarded machine.
2. Visually inspect the machine to ensure that access to the danger point is only through the area (s) protected by the safety light curtain(s).

3. Verify that the mounting distance of the safety light curtain(s) is equal to or greater than the minimum safety distance required according to the ANSI Minimum Safe Distance calculation.
4. Check the overall system for damage, security of electrical cabling and wiring, or other hazards.

If any of the above requirements are not met, immediately lock out the machine and initiate the necessary corrective action.

6.2. NORMAL OPERATION WITH MUTING DISABLED

1. Disable the guarded machine. Apply power to the RM-3 system.
2. Ensure the Muting Enable switch is in the OFF (disabled) position.
3. Using the proper size test object for each light curtain, test the protected area of the light curtain. Test the area by moving completely through the field, top to bottom, ensuring that all the areas between transmitter and receiver are completely tested. The light curtain should remain blocked at any point with the test object present in the sensing field.
4. Enable the machine and initiate a start. Interrupt the sensing zone with the correct test object and verify the machine stops immediately. Never attempt to insert the test object directly into the danger area! If the machine fails to stop, discontinue the testing and lock out the machine. Investigate and correct prior to re-testing.
5. With the test object present in the field, verify the machine cannot start.
6. Repeat tests for all safety light curtains installed.

6.3. MUTE OPERATION (MUTING ENABLED)

1. Complete testing requirements in sections 6.1 and 6.2
2. Disable the guarded machine and apply power to the system.
3. Set the Muting Enable Switch to the ON position.

4. Mute the system by blocking the correct sensors at the proper intervals (<3 seconds between sensors) and logical order. (Refer to the appropriate system timing diagram) Verify that the associated mute inputs on RM-3 are ON. Verify the external Mute active light(s) are ON and the RM-3 OSSD outputs are in the RUN mode, RM-3 Display indicates 02 (mute active)
5. Interrupt the safety light curtain (SLC) with the correct test object. Verify that the SLC outputs switch OFF (Red or blocked). OSSD inputs for that SLC are OFF, RM-3 outputs remain ON. RM-3 Display indicates 02 (mute active)
6. With the test object present in the light curtain sensing field, verify the machine is “run capable”. Remove the test object for further tests.
7. If the Mute Time Limit is enabled, maintain the mute state for 2 minutes. After 2 minutes the RM-3 OSSD outputs will switch from RUN to STOP. The external Mute Active light will flash at a 1-2 Hz rate and the display will indicate 03 (Bypass Allowed). Press the Start switch and verify the RM-3 outputs return to the RUN state and external Mute Active lamp is ON. RM-3 Display indicates 02. Bypass is allowed until either the muting sensors clear or light curtain clears or 10 minutes has expired.
8. Reset system to Normal (non-mute) Operation.
9. If a one way or directional system is used, test operation to verify mute is activated only when the correct sequence and intervals are applied.
10. Repeat test procedure(s) for 2nd muting channel (if installed).

7 GLOSSARY

Automatic Start

Upon completion of power-up, the RM-3 will enter the MACHINE RUN state as soon as all of the selected light curtain OSSD inputs are in the ON state. STI has traditionally referred to this as the Normal mode.

Bypass-Allowed

Allows supervisor personnel to momentarily override the Machine Stop operation of the RM-3. This function is used during instances where processing sequence operations did not allow a transition to the Muting state and the RM-3 entered the Machine Stop state. When in the Bypass-Allowed state, a press-and-release of the Start button allows the RM-3 to transition to the Muting state for only one cycle or a maximum duration of 10 minutes.

Dark-On

A photo-electric sensor term that means the sensor output will be active when the sensor detects an object.

Interlock

For the RM-3 to enter this state the unit must be set to either the Start Interlock or Start/Restart Interlock mode. In this state the yellow Interlock LED is on and the red Machine Stop LED is on.

Light-On

A photo-electric sensor term that means the sensor output will be active when it receives the sensed light source.

Lockout (Fault)

When the RM-3 detects a fault, it transitions to this state. The Safety outputs will be held to the off state and the RM-3 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 RM-3 power or by a Start signal transition.

Machine Run

When the RM-3 is in this state the two Safety outputs 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 RM-3 is in this state the two Safety outputs are both inactive. In this state the Green Machine Run LED is off, the Red Machine Stop LED is on and the Yellow Interlock LED is off.

MPCE (Machine Primary Control Element) Monitoring

The RM-3 monitors the state of the MPCE signal produced by the guarded machine to insure that it is in the correct state with respect to “Machine Run” and “Machine Stop.”

Muting

The mute sensors have been properly activated for the RM-3 to keep the Safety outputs active when the light curtain detection zone is interrupted.

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.

Response Time

The maximum amount of time required for the RM-3 to recognize a light curtain detection zone interruption and to set its Safety outputs to the Off state.

Safety Output (Output signal switching device (OSSD))

The component of the RM-3 connected to the control system of the guarded machine.

Start Interlock

Upon completion of power-up, the RM-3 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 RM-3 will operate in the Automatic Start mode. STI has traditionally referred to this as the Power-up Inhibit.

Start/Restart Interlock

The RM-3 will go into the Interlock state upon completion of power-up and after all light curtain detection zone interruptions which cause a transition to the Machine Stop state. A Start signal transition must occur before returning to Machine Run following any transition to Machine Stop. STI has traditionally referred to this as Guard mode.

8 DEVICENET OPERATING INSTRUCTIONS

8

▲ ***WARNING! DeviceNet is not a safety-rated communications bus system and is only used to provide status information. Never use information provided by DeviceNet to perform safety control of a machine. Serious injury may result to personnel.***

8.1. INTRODUCTION

The RM-3 Mute modules are available with DeviceNet communication. DeviceNet will allow communication of non-safety, monitoring and diagnostic information across the DeviceNet communication bus. DeviceNet equipped RM-3 Mute modules are used with standard light curtain systems to create a DeviceNet ready system.



8.2. FEATURES

- Connects to DeviceNet network using 5-pin terminal screw connectors
- The following information is available for DeviceNet communications

8.2.1 SYSTEM IDENTIFICATIONS

Manufacturer, Product Name, Product Serial Number

8.2.2 SYSTEM STATUS

- Safety Output Status
- Light Curtain Detection Status
- Mute Sensor Status
- Machine Status
- Error/Fault Status

8.2.3 SYSTEM SETTINGS

- Operating Mode, Automatic Start/ Start Interlock/ Start-Restart Interlock
- MPCE Monitoring, Enable/Disabled
- Auxiliary Mode, Fault/Follow OSSDs
- Mute Enable, Enabled/Disabled
- Bypass Permitted, Enabled/Disabled
- Number of Light Curtains, 1/2
- Number of Sensors, 2/3 or 4



8.3. DEVICENET DIAGNOSTIC INFORMATION

8.3.4 RM-3 MUTE MODULE DIAGNOSTIC INFORMATION SENT IN RESPONSE TO EXPLICIT MESSAGING.

Table 8-1 RM-3 Response to Explicit Messaging

Message	Class	Instance	Attribute	Date Type	# Bytes	Data
Operating Mode	100	1	1	8, unsigned integer	1	0 = no data 1 = Automatic Start 2 = Start Interlock 3 = Start/Restart Interlock
Machine Status	100	1	2	8, unsigned integer	1	0 = no data 1 = Run 2 = Stop 3 = Interlock 4 = Bypass Allowed 5 = Bypass 6 = Muting 7 = Fault
Detection Zone 1 OSSD 1A & 1B	100	1	3	8, unsigned integer	1	0 = no data 1 = Clear 2 = Zone Interruption
Detection Zone 2 OSSD 2A & 2B	100	1	4	8, unsigned integer	1	0 = no data 1 = Clear 2 = Zone Interruption
OSSD Relays	100	1	5	8, unsigned integer	1	0 = no data 1 = De-energized 2 = Energized
MPCE Monitoring	100	1	6	8, unsigned integer	1	0 = no data 1 = Enabled 2 = Disabled
Bypass Permit	100	1	7	8, unsigned integer	1	0 = no data 1 = Enabled 2 = Disabled
Number of Light Curtains Selected	100	1	8	8, unsigned integer	1	0 = no data 1 = Light Curtain 2 = Light Curtains



Message	Class	Instance	Attribute	Date Type	# Bytes	Data
Number of Sensors Selected	100	1	9	8, unsigned integer	1	0 = no data 1 = 2 Sensors 2 = 3 Sensors 3 = 4 Sensors
Muting Time Limit	100	1	10	8, unsigned integer	1	0 = no data 1 = 2 Minutes 2 = Unlimited
Auxiliary Mode	100	1	11	8, unsigned integer	1	0 = no data 1 = Fault Mode 2 = Follow Sods
Sensor 1A	100	1	12	8, unsigned integer	1	0 = no data 1 = Clear 2 = Blocked
Sensor 1B	100	1	13	8, unsigned integer	1	0 = no data 1 = Clear 2 = Blocked
Sensor 1C	100	1	14	8, unsigned integer	1	0 = no data 1 = Clear 2 = Blocked
Sensor 1D	100	1	15	8, unsigned integer	1	0 = no data 1 = Clear 2 = Blocked
Sensor 2A	100	1	16	8, unsigned integer	1	0 = no data 1 = Clear 2 = Blocked
Sensor 2B	100	1	31	8, unsigned integer	1	0 = no data 1 = Clear 2 = Blocked
Sensor 2C	100	1	32	8, unsigned integer	1	0 = no data 1 = Clear 2 = Blocked
Sensor 2D	100	1	33	8, unsigned integer	1	0 = no data 1 = Clear 2 = Blocked



Message	Class	Instance	Attribute	Date Type	# Bytes	Data
Error Code	100	1	25	8, unsigned integer	1	0 = no Errors
Serial Number	100	1	6	9, 32-bit unsigned integer	4	Serial Number
Software Version	100	1	34	8, unsigned integer	1	Software version
Mute Enable	100	1	43	8, unsigned integer	1	0 = no data 1 = Enabled 2 = Disabled

8.3.5 RM-3 MUTE MODULE STATUS INFORMATION SENT IN RESPONSE TO A POLL COMMAND. CLASS 4, INSTANCE 1, ATTRIBUTE 3

Table 8-2 RM-3 Response to Poll command

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	0	Controller Fault		Muting	Detection Zone 1	Detection Zone 2	Machine Stop	Machine Run	Interlock

8.3.6 RM-3 MUTE MODULE STATUS INFORMATION SENT IN RESPONSE TO BIT STROBE COMMAND.

Table 8-3 RM-3 Response to Bit Strobe command

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
2	0	Controller Fault		Muting	Detection Zone 1	Detection Zone 2	Machine Stop	Machine Run	Interlock
	1			Mute Time-out Enable	MPCE Monitor Enable	Restart Interlock Mode	Start Interlock Mode	Automatic Start Mode	
	2								
	3								
	4	Diagnostic Codes							
	5	Number of Light Curtains							
	6	Number is Muting Sensors per Channel							
	7	Reserved for future use							

8.3.7 RM-3 MUTE MODULE STATUS INFORMATION IN RESPONSE TO A CHANGE OF STATE.

A Change of State message is sent when any of the signals in Byte 0 changes. Class 4, Instance 3, Attribute 3

Table 8-4 RM-3 Response to Change of State

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
3	0	Controller Fault		Muting	Detection Zone 1	Detection Zone 2	Machine Stop	Machine Run	Interlock

8.4. DEVICENET CONNECTIONS

Connections for DeviceNet communications are made at the RM-3 module. Pin assignments for the five-pin DeviceNet connector are shown in *DeviceNet 5-Pin Terminal Screw Connector* on page 51. Pin assignments for the standard RM-3 system functions are presented in Table 4.

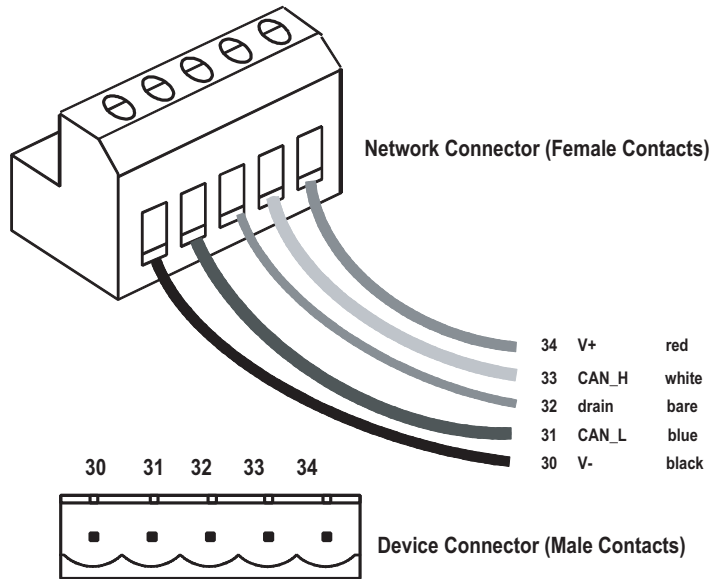


Figure 8-1 DeviceNet 5-Pin Terminal Screw Connector

9 MUTE ACCESSORIES

Mute Accessories		
	STI Part No.	Manufacturer's Part No. (1)
Mute Enable Keyswitch	51169	EAO Switch 61-221.50D
Mute Enable Keyswitch Contact Block	51173	EAO Switch 61-849.022
Mute Lamp Kit	43987-0010	–
– Mute Indicator Lamp, bulb, 24 VDC	37095	IDI-24PSB
– Replacement Indicator Lens, White	90684	IDI-2814
– Mute Indicator Lamp Socket	90685	IDI-2803
(1) Note: The Mute Enable Keyswitch and Mute Indicator may be substitute with equivalent items from other manufacturers.		

10 WARRANTY

10

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 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.

10.1. 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.

10.2. RETURNS

To return a product to Omron STI, please contact our Customer Service Department and request a Returned Goods Authorization number (RGA). Goods returned for credit are subject to final review by Omron STI and are subject to restocking charges as determined by Omron STI.

10.3. 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.



APPENDIX A - DECLARATION OF CONFORMITY INFORMATION

OMRON SCIENTIFIC TECHNOLOGIES INCORPORATED

OMRON Scientific Technologies Incorporated (at 6550 Dumbarton Circle, Fremont, CA 94555-3605, U.S.A.), hereby declares that the following series manufactured products listed below conform with the relevant Essential Health and Safety Requirements (EHSRs) of the European **Machinery Directive** (2006/42/EC), with the relevant requirements of the **Low Voltage Directive** (2006/95/EC), and with the essential protection requirements of the **Electromagnetic Compatibility (EMC) Directive** (2004/108/EC).

RM-3 (Mute Module)

(The RM-3 is used in combination with OSTI type-4 electro-sensitive protection equipment such as MS/OF4600 & 4700 Series light curtains)

The RM-3 Series products has been type-examined per

EC Type-Examination Certificate,
Registration No.: 01/205/5102/11

issued by notified body TUV Rheinland Industrie Service GmbH, Alboinstr. 56, 12103 Berlin/Germany, Certification Body for Machinery (NB No. 0035).

The following Standards were used to form the basis for the requirements and tests:

EN 61496-1:2004 + A1:2008 - Safety of machinery – Electro Sensitive Protective Equipment, Part 1: General requirements and tests.

EN ISO 13849-1:2008 - Safety of machinery – Safety-related parts of control systems, Part 1: General principle for design.

EN 60204-1:2006: Safety of machinery – Electrical equipment of machines, Part 1: General requirements.

EN 50178:1997: Electronic equipment for use in power installations.

IEC 61508, Parts 1 – 7:1998 – 2000 - Functional Safety Of Electrical/Electronic/Programmable electronic Safety-Related Systems.

EN 62061:2005 – Safety of machinery. Functional safety of safety-related electrical, electronic and programmable electronic control systems.

Martin D. Krikorian
Quality Director
Scientific Technologies, Inc.
Fremont, CA, USA

Documentation Manager of the EU Office
OMRON Scientific Technologies, Inc.
Am Grarock 8
D-33154 Salzkotten, Germany

OMRON AUTOMATION AND SAFETY • THE AMERICAS HEADQUARTERS • Chicago, IL USA • 847.843.7900 • 800.556.6766 • www.omron247.com

OMRON CANADA, INC. • HEAD OFFICE

Toronto, ON, Canada • 416.286.6465 • 866.986.6766 • www.omron247.com

OMRON ELECTRONICS DE MEXICO • HEAD OFFICE

México DF • 52.55.59.01.43.00 • 01-800-226-6766 • mela@omron.com

OMRON ELECTRONICS DE MEXICO • SALES OFFICE

Apodaca, N.L. • 52.81.11.56.99.20 • 01-800-226-6766 • mela@omron.com

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São Paulo, SP, Brasil • 55.11.2101.6300 • www.omron.com.br

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