QuadSafe RM-4

Installation and Operating Manual

- Original Instructions

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RM4 for Light Curtains

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1 IMPORTANT SAFETY WARNINGS

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⚠ ***WARNING! Read and understand this section prior to installing the QuadSafe RM-4 system.***

1.1. SAFETY WARNINGS

The QuadSafe RM-4 module is a "*Type 4*" safety device. It is designed to work with safety devices to guard personnel working around moving machinery.

Whether a specific machine application and QuadSafe RM-4 installation complies with safety regulations depends on several items, including the proper application, installation, maintenance and operation of the QuadSafe RM-4. 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 QuadSafe RM-4 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)

To use a QuadSafe RM-4 module, the following requirements must be met:

— The guarded machine must be able to stop anywhere in its cycle. Do not use an QuadSafe RM-4 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 safety devices. Do not use the QuadSafe RM-4 module and safety devices 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 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 QuadSafe RM-4 module and safety device 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 QuadSafe RM-4 and safety device system.

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

— Follow all procedures in this manual for proper operation of the QuadSafe RM-4.

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.

⚠ ***WARNING! Despite inherent safe design measures, safeguarding and complementary protective measures adopted by the user, residual risk may remain in any installation. Potential risks are strictly under the control of the end user and may include severd injury or death.***

2 DESCRIPTION OF QUADSAFE RM-4 2

2.1. DESCRIPTION

The QuadSafe RM-4 provides protection for machines with more than one opening to guard. It produces a single pair of OSSD (OSSD A, OSSD B) safety outputs by receiving safety and auxiliary outputs from up to four STI 4600 family of light curtains. The QuadSafe RM-4 is enclosed in a 3"W X 5.8"L X 4.3"H DIN box with two rows of removable terminal blocks. The mode and configuration DIP switches are located inside the box. For DIP switch settings, see *Section 4.3.* on page 13.

The QuadSafe RM-4 module works with up to four independent safety sensing devices identified as safety device 1, safety device 2, safety device 3, and safety device 4. Each safety sensing device (light curtain) has two solid-state, current sourcing type OSSD outputs identified as OSSD 1 and OSSD 2. The OSSD signals conform to 24 VDC indicating Machine Run and 0 VDC indicating Machine Stop. The QuadSafe RM-4 is primarily intended to work with the 4600 family of light curtains, but it can operate with other safety devices that test its OSSD output, including the following other OMRON STI products: the MC4700 Light Curtain and the BeamSafe II solid state unit (BS2RC24).

For the QuadSafe RM-4 to act as the primary safety device, the safety devices used with the QuadSafe RM-4 module must be configured in the Automatic Start mode and have their MPCE function disabled. The QuadSafe RM-4 also provides connection for the safety device power, auxiliary, and start signals.

2.2. RESPONSE TIME

The response time is less than 1 msec. The response time is measured from the time when any safety device transitions to the MACHINE STOP state to the time that the QuadSafe RM-4 OSSDs are in the OFF state. The QuadSafe RM-4 controls it's OSSDs according to the state of the safety device OSSD inputs. The QuadSafe RM-4 outputs are only active when all the selected safety device OSSD inputs are active.

3 QUADSAFE RM-4 TOP LABEL AND INDICATORS

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3.1. QUADSAFE RM-4 DIN CONTROLLER LABEL

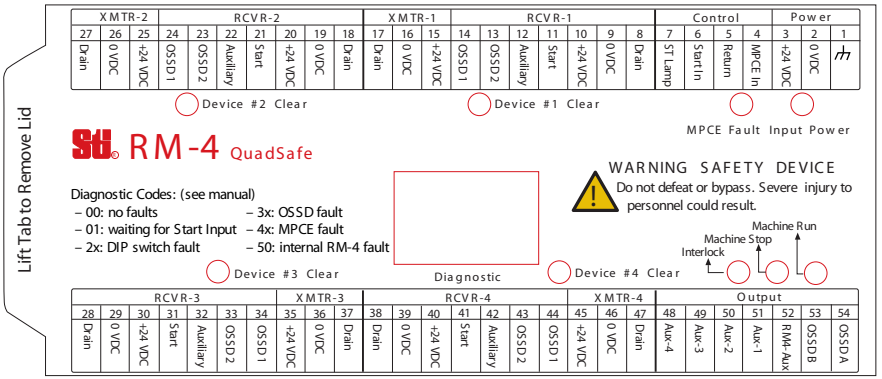

Figure 3-1 QuadSafe RM-4 Top Label

4 OPERATING AND WIRING INSTRUCTIONS

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4.1. CONFIGURATION OF 4600 LIGHT CURTAINS

Configure each 4600 light curtain as follows:

- Set DIP switches A and B:

— Positions 1 and 2 to ON (Automatic Start)

— Position 3 to ON (MPCE inactive)

— Positions 4, 5, and 6 as required (Exact Channel Select and Floating Blanking)

- Connect each light curtain MPCE wire (pink) to the ground (0 VDC)
- Connect the conductors of the 4600 transmitter and receiver cables to a 10-position terminal block as described in 4.2.*Wiring Connections*.

4.2. WIRING CONNECTIONS

4.2.1 REMOVABLE TERMINAL BLOCKS ARE DIVIDED AS FOLLOWS:

- Each light curtain receiver and transmitter is connected to a 10 position terminal block.
- Power supply inputs, control input & lamp out are connected to a 7 position block.
- Outputs are connected to a 7-position terminal block.

4.2.2 THE LIGHT CURTAINS MUST BE CONNECTED TO THE QUADSAFE RM-4 USING SPECIFIC TERMINALS:

- one light curtain - connect to RCVR-1 terminals
- two light curtains – connect to RCVR-1 and RCVR-2 terminals
- three light curtains – connect to RCVR-1, RCVR-2, and RCVR-3 terminals

4.2.3 *THE CONNECTIONS TO THE QUADSAFE RM-4 TERMINAL BLOCKS ARE SPECIFIED IN THE TABLE BELOW:*

Table 4-1 Function Pin Assignment

PIN #	FUNCTION	ASSIGNMENT	PIN #	FUNCTION	ASSIGNMENT
1	Power Supply Input	PE	54	Outputs	OSSD A
2		0 VDC	53		OSSD B
3		+24 VDC	52		RM4-AUX
4	Control Input	MPCE In	51		Aux-1
5		Return	50		Aux-2
6		Start In	49		Aux-3
7	Lamp Out	Start Lamp Out	48		Aux-4
8	RCVR-1	Drain	47	XMTR-4	Drain
9		0 VDC	46		0 VDC
10		+24 VDC	45		+24 VDC
11		Start	44	RCVR-4	OSSD 1
12		Auxiliary	43		OSSD 2
13		OSSD 2	42		Auxiliary
14		OSSD 1	41		Start
15	XMTR-1	+24 VDC	40		+24 VDC
16		0 VDC	39		0 VDC
17		Drain	38		Drain
18	RCVR-2	Drain	37	XMTR-3	Drain
19		0 VDC	36		0 VDC
20		+24 VDC	35		+24 VDC
21		Start	34	RCVR-3	OSSD 1
22		Auxiliary	33		OSSD 2
23		OSSD 2	32		Auxilliary
24		OSSD 1	31		Start
25	XMTR-2	+24 VDC	30		+24 VDC
26		0 VDC	29		0 VDC
27		Drain	28		Drain

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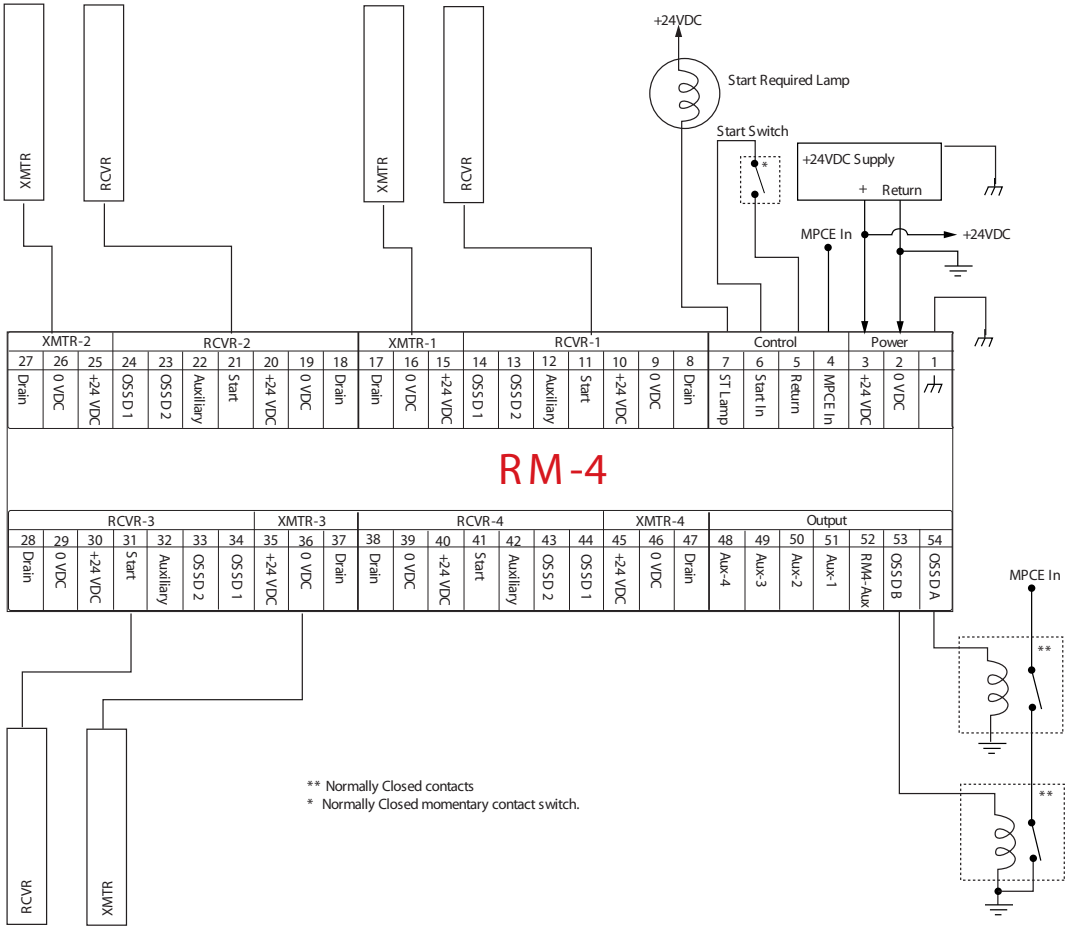

Figure 4-1 Connecting the RM-4 to Three Light Curtains

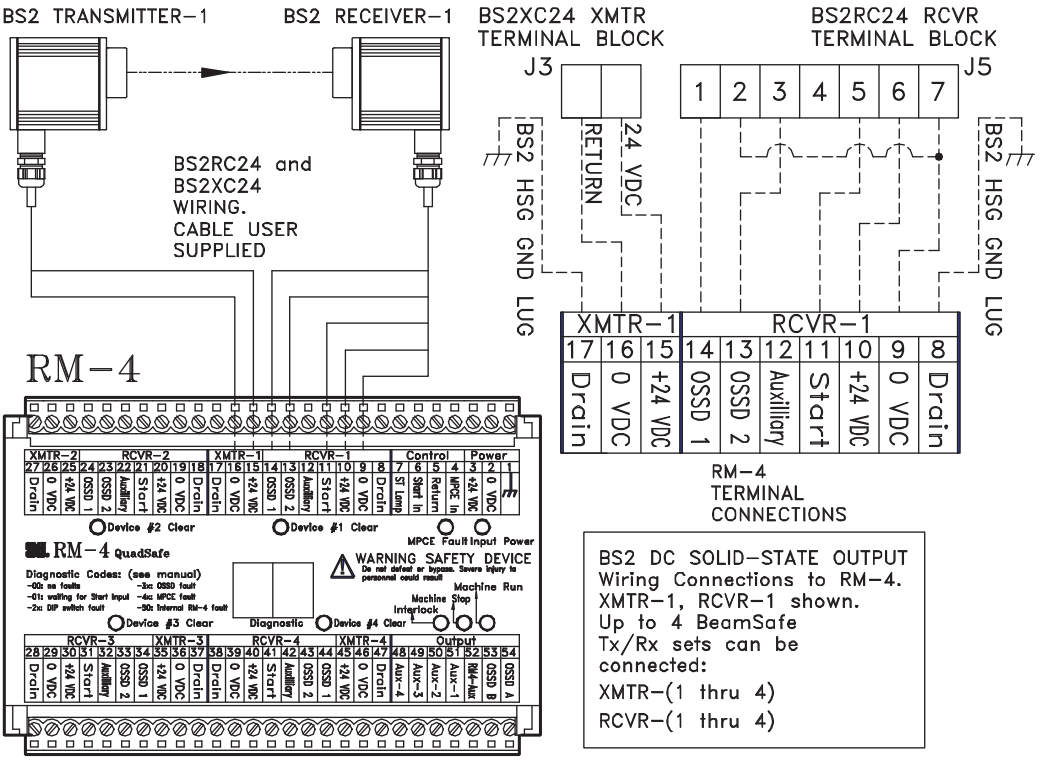

Figure 4-2 Connecting the RM-4 to BeamSafe

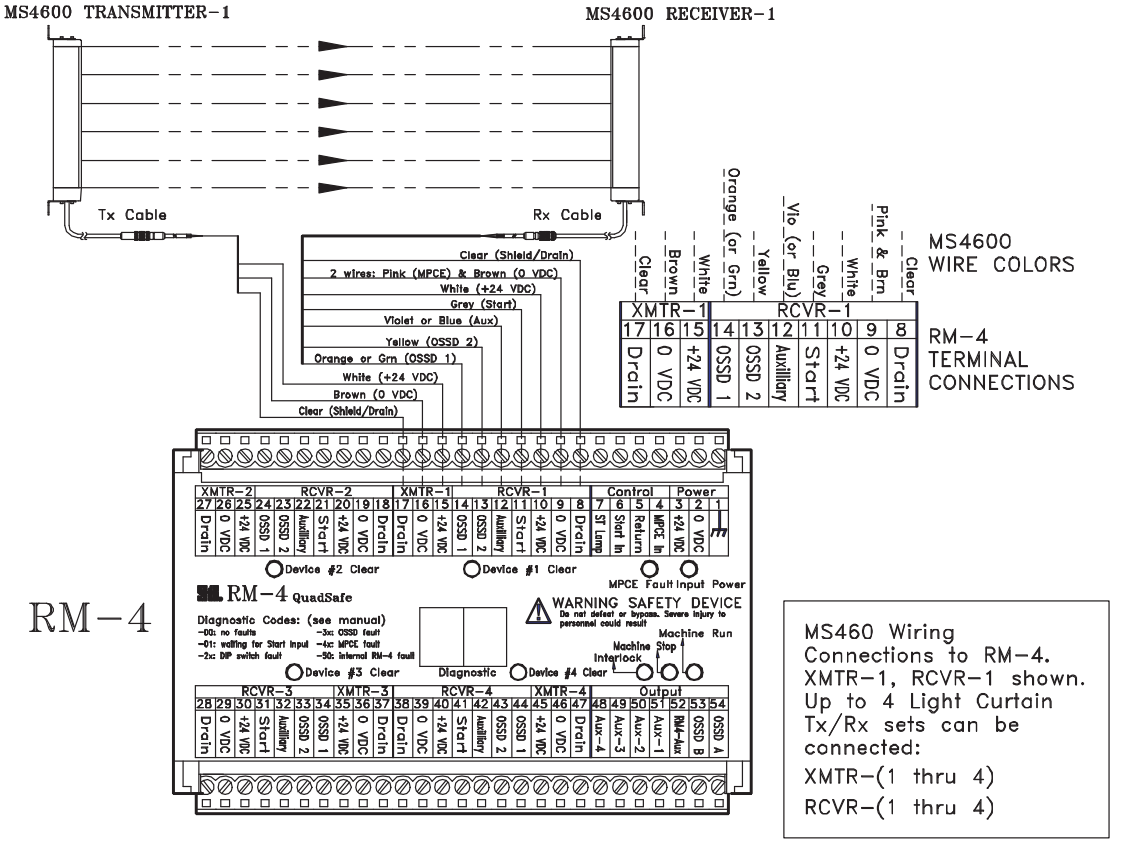

Figure 4-3 Connecting RM-4 to MS4600 Series Light Curtain

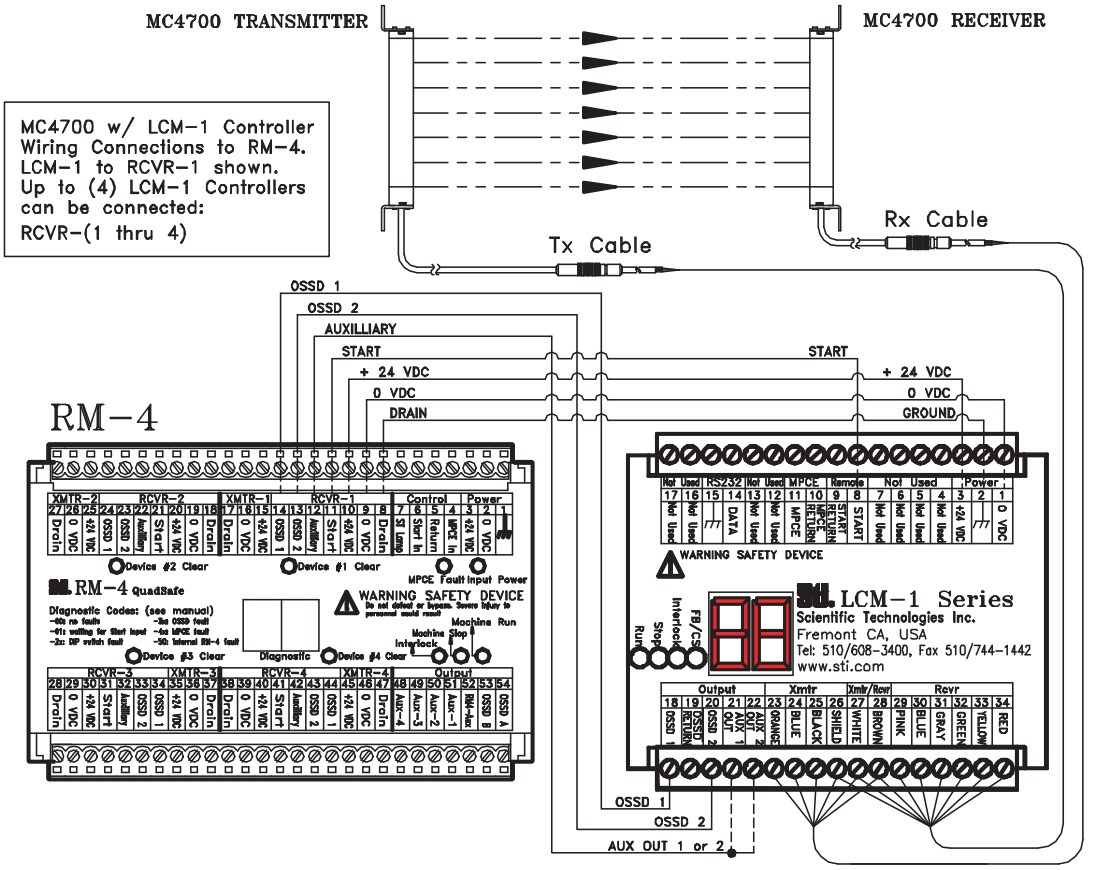

Figure 4-4 Connecting to MC4700 Series Light Curtain with LCM-1 Controler.

4.3. SETTING QUADSAFE RM-4 CONFIGURATION SWITCHES

The following table defines the setting of the redundant 7-position DIP switches (labeled SWA and SWB) used on the QuadSafe RM-4 module to select from the configuration options.

4.3.1 ACCESS TO CONFIGURATION SWITCHES

Switches to configure the QuadSafe RM-4 system operating features are located inside the controller. Access is gained by lifting the controller cover tab provided on the label.

⚠ ***WARNING! Isolate power before removing controller cover.***

4.3.2 FIELD CONFIGURATION SWITCH SETTINGS

Function SelectionDescription

Switch	Function Selection	Description
1 2	Operating Mode	Automatic: 1=Closed, 2=Closed Start Interlock:: 1=Closed, 2=Open Invalid:1=Open, 2=Closed Start/Restart Interlock:1 =Open,2=Open
3	MPCE Monitoring	Enabled = Open Disabled = Closed
4 5	Number of Light Curtains	One device: 4 = Closed, 5 = Closed Two devices: 4 = Closed, 5 = Open Three devices: 4 =Open, 5 = Closed Four devicess: 4 = Open, 5 = Open
6	QuadSafe RM-4 Auxiliary Output Mode	Follow OSSD indication =Closed Fault Indication =Open
7	QuadSafe RM-4 Auxiliary Output Type	Current Source (PNP) = Closed Current Sink (NPN) = Open

4.4. GENERAL CONSIDERATIONS

4.4.1 INPUT POWER REQUIREMENTS/CONNECTIONS

The QuadSafe RM-4 system operates directly from 24 VDC ±10%. Power to the QuadSafe system must come from a dedicated power supply which must meet the requirements of IEC 60204-1 and IEC 61496-1, OMRON STI part number 42992 or equivalent.

4.4.2 START REQUIRED LAMP

When connected, the Start Required Lamp indicates when the QuadSafe RM-4 module is waiting for a signal from the start switch. The Start Required Lamp is an option and is not required for operation of the QuadSafe RM-4.

4.4.3 SYSTEM COMMON RETURN

The QuadSafe RM-4 power input return must be connected to the overall system component returns. At the installation site, the power return of the QuadSafe RM-4 Start switch, MPCE monitor, Start Required lamp, OSSD loads and Aux loads must all be connected in common for proper system operation.

4.4.4 MPCE MONITORING SET TO DISABLED

When MPCE monitoring is set to the inactive position, the MPCE In terminal block, contact 4, must be connected to the system common return.

5 SYSTEM OPERATION

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The QuadSafe RM-4 module receives ouputs from up to four safety devices and produces a single pair of OSSD outputs. The system consists of a DIN box with two rows of removable terminal blocks, and is wired to up to four safety devices.

5.1. OPERATING STATES

The Output Signal Switching Devices (OSSD A and OSSD B) are QuadSafe RM-4 components that connect to the machine control system. When a safety device detection zone is interrupted, the QuadSafe RM-4 OSSD responds by going to the off state.

The operating condition of an QuadSafe RM-4 safety device system is described in terms of states. The following operating states exist for the QuadSafe RM-4 module.

5.1.1 MACHINE RUN

The green MACHINE RUN indicator is lit, the OSSD outputs are on, and the AUXILIARY output responds in a manner consistent with its set operating mode. The protected machine is allowed to operate. Pressing and releasing the START button has no effect.

5.1.2 MACHINE STOP

The red MACHINE STOP indicator is lit, the OSSD outputs are off, and the AUXILIARY output is off. The protected machine is not allowed to operate. Pressing and releasing the START button has no effect.

5.1.3 INTERLOCK

The yellow INTERLOCK indicator is lit, and the Start Required Lamp output is on. The AUXILIARY output is off. The INTERLOCK state does not allow the protected machine to operate until the START button is pressed and released.

5.1.4 LOCKOUT (FAULT)

The yellow INTERLOCK indicator is blinking, and the Start Required lamp is blinking. The AUXILIARY output responds in a manner consistent with its set operating mode. This state does not allow the protected machine to operate until the fault is removed and the START button is pressed and released or power is cycled.

Table 5-1 QuadSafe RM-4 operating states and corresponding outputs

Output	Machine Run	Machine Stop	Interlock	Lockout
Green LED: Machine Run	On	Off	Off	Off
Red LED: Machine Stop	Off	On	On	On
Yellow LED: Interlock	Off	Off	On	Blinking
Start Required Lamp Output	Off	Off	On	Blinking
OSSD A Output	On	Off	Off	Off
OSSD B Output	On	Off	Off	Off
QuadSafe RM-4 Auxiliary Output:				
– Follow OSSD Indication Mode	On	Off	Off	Off
– Fault Indication Mode	Off	Off	Off	On

6 CABLE LENGTHS

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6.1. INPUT SIGNAL CABLE LENGTHS

— Safety Device OSSD inputs: Use 20 AWG shielded wire with cable capacitance < 100 pF/ft., max length 60m (198 ft)

— MPCE Monitor input: Use 22 AWG unshielded wire, max length 10m (33 ft)

— Start input: Use 22 AWG unshielded wire, max length 60m (198 ft)

6.2. OUTPUT SIGNAL CABLE LENGTHS

— OSSD A and OSSD B outputs and return: Use 20 AWG unshielded wire with cable capacitance < 100 pF/ft., max length 10m (33 ft)

— QuadSafe RM-4 Auxiliary outputs (PNP Out and NPN Out): Use 20 AWG unshielded wire, max length 10m (33 ft)

— Start Required lamp output: Use 20 AWG unshielded wire, max length 60m (198 ft)

7 SAFETY DISTANCE

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⚠ ***WARNING! Never install a QuadSafe RM-4 safety device system without regard to the safety distance. If the safety devices connected to the QuadSafe RM-4 system are mounted too close to the point of operation hazard, the machine may not stop in time to prevent an operator injury.***

A safety device 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 the user's manual for the 4600, 4700 or BeamSafe safety device for safe mounting distance formulas.

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8 DIAGNOSTIC DISPLAY

The controller contains a two-digit diagnostic display, which presents numeric codes indicating both normal operation and system fault status. .

8.1. OPERATIONAL CODES

The operational codes are described in the table below

Code Displayed	System Status
00	Normal operation
01	Waiting for start input
88	Start operation power-up indication

8.2. DIP SWITCH FAULT CODES

The DIP switch fault codes are described in the table below.

Code Displayed	Fault Indicated
21	Wrong operation mode selection
22	Changed during operation
23	DIP switch settings not redundant
24	DIP switch hardware fault
25	Start switch did not toggle
27	More safety devices present than selected

8.3. OSSD CODES

The OSSD fault codes are described in the table below.

Code Displayed	Fault Indicated
31	OSSD outputs shorted together
32	OSSD A shorted to power
33	OSSD B shorted to power
34	OSSD A shorted to ground
35	OSSD B shorted to ground

8.4. MPCE CODES

The MPCE fault codes are described in the table below.

Code Displayed	Fault Indicated
41	Wrong before activation
42	Wrong before activation
43	Wrong on power on

8.5. INTERNAL QUADSAFE RM-4 FAULT CODE

The Internal Fault codes are described in the table below.

Code Displayed	Internal Fault
50	Consult OMRON STI

9 QUADSAFE RM-4 SPECIFICATIONS

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9.1. SPECIFICATIONS

Safety Output:	Two PNP outputs each sourcing 625 mA @ 24 VDC
Auxiliary (non-safety) Output	– NPN output sinking 100 mA @ 24 VDC. – PNP sourcing 500 mA @ 24 VDC.
MPCE Monitor	50mA @ 24 VDC (QuadSafe RM-4 sourcing current)
Max. Response Time	<1 millisecond
Power Input	24 VDC± 10% – Power for QuadSafe RM-4 only: 3 Watts – Power for QuadSafe RM-4 supplying four maximum length 4600 series safety light curtains and max. loads on outputs: 120 Watts (See Table 9-1*Power Supply Requirement* for more details)
Start Input	Start switch is a N/C SPST momentary contact switch providing contact closure to the QuadSafe RM-4 power return. – Current through switch with 1 light curtain connected to QuadSafe RM-4: 18mA @ 24 VDC – Current through switch with 4 light curtains connected to QuadSafe RM-4: 40mA @ 24VDC
Start Required Lamp Output	Current Sinking(NPN) output 500 mA max @ 24VDC
Temperature	0 to 55 degrees C (32 to 131° F)
Relative Humidity	95% maximum, non-condensing
Enclosure Rating	Controller: IP20
Indicator Lights	Machine Run, Machine Stop, Interlock/Fault two-digit diagnostic display, MPCE Fault, and light curtain OSSD clear LEDs.
Approvals	CE, TUV, UL
Conformities	ESPE Type 4 (IEC61496 -1/ -2) Category 4 / PL e (EN ISO 13849-1) SIL 3 / SIL3 CL3 (IEC 61508 / EN 62061) when used with an OMRON STI SIL3 product.
Safety Related Parameters	PFH = 6.83 E-10 1/h Proof Test Interval = 10 years MTTFd = 100 years.

Specifications subject to change without notice.

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Table 9-1 Power Supply Requirement

Total System Components	Power Supply Requirements				
	50 watts	75 watts	100 watts	125 watts	150 watts
RM4/4 MS4600/ 2 Relays					X
RM4/3 MS4600/ 2 Relays				X	
RM4/2 MS4600/ 2 Relays			X		
RM4/1 MS4600/ 2 Relays		X			
RM4/1 MS4600/ 2 PLC Inputs	X				

9.2. MECHANICAL DRAWING

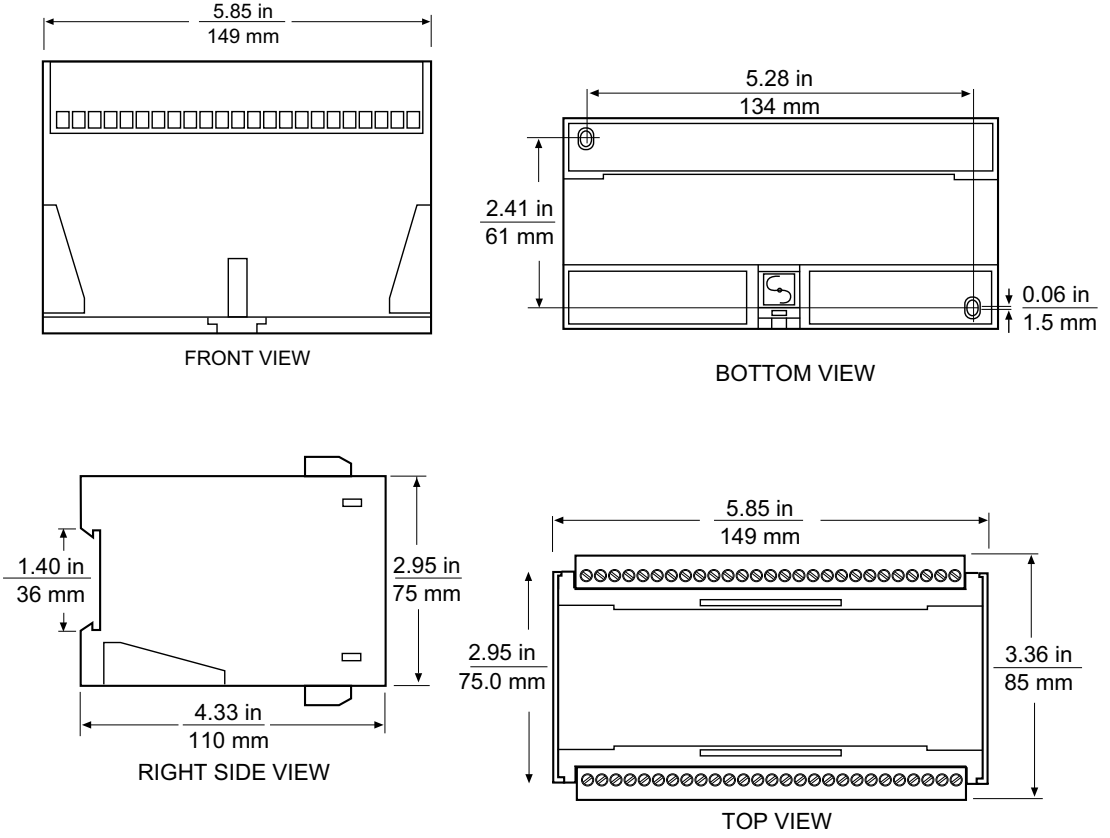

Figure 9-1 RM-4 Dimensional Drawing

10 WARRANTY

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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.

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10.1. 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.

10.2. TRADEMARKS

QuadSafe™ is a trademark of OMRON Scientific Technologies, Inc.

10.3. 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.

10.4. 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.

10.5. 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.

11 GLOSSARY

11

Detection Zone	The zone within which a specified test piece will be detected by the safety light curtain
MPCE	The electrically powered element that directly controls the normal operation of a machine in such a way that it is the last (in time) to function when machine operation is to be initiated or arrested.
OFF State	The state in which the output circuit is interrupted and does not permit current to flow.
ON State	The state in which the output circuit is complete and permits the flow of current.
Output Signal Switching Device (OSSD)	The component of the safety light curtain connected to the machine control system which, when the light curtain detection zone is interrupted, responds by going to the off state.

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).

Combination Resource Module RM-4

(The RM-4 is used in combination with OSTI type-4 electro-sensitive protection equipment such as MS/OF4600 & 4700 Series light curtains. Provides centralized connections for safety outputs from up to **four** safety devices and produces a single pair of safety outputs)

The RM-4 Series products has been type-examined per

EC Type-Examination Certificate,
Registration No.: 01/205/5103/11,

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.

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11. Shipping; Delivery. Unless otherwise expressly agreed in writing by Omron:
    a. Shipments shall be by a carrier selected by Omron; Omron will not drop ship except in "break down" situations.
    b. Such carrier shall act as the agent of Buyer and delivery to such carrier shall constitute delivery to Buyer;
    c. All sales and shipments of Products shall be FOB shipping point (unless otherwise stated in writing by Omron), at which point title and risk of loss shall pass from Omron to Buyer; provided that Omron shall retain a security interest in the Products until the full purchase price is paid;
    d. Delivery and shipping dates are estimates only; and
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