Reference Manual

Original Instructions

Allen-Bradley

Minotaur Safety Relay (MSR) to Guardmaster Safety Relay (GSR) Conversion – Phase 2

Bulletin 440R

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

	**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	**ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Chapter 5

MSR18T Safety Relay

Chapter 6

MSR19E Safety Relay

Chapter 7

MSR30RT/RTP Safety Relay

Chapter 8

MSR38DP Safety Relay

MSR121RT Safety Relay

Chapter 9

MSR122E Safety Relay

Chapter 10

MSR144 Safety Relay

Chapter 11

MSR200 Safety Relay

Chapter 12

Notes:

A number of older Allen-Bradley Guardmaster® safety relays will be obsoleted and no longer be available for sale soon. This publication suggests examples for how to convert these existing safety relay applications to safety relays with the latest technologies.

The products that are described in this publication can be used in various ways. Therefore, designers must verify that all steps have been taken to assure that each application and use of this control equipment meets all performance and safety requirements. Designers must consider applicable laws, regulations, codes, and standards.

The wiring diagrams in this publication are intended as examples. Since many variables and requirements are associated with any particular installation, Rockwell Automation does not assume responsibility or liability for actual use based on these examples.

This publication is intended for machine safeguarding system designers who have been adequately trained in the design and use of safeguarding systems and risk assessments.

Summary of Changes

This manual contains the following new and updated information:

- Added chapter: MSR144 Safety Relay on page 59.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Guardmaster EtherNet/IP Network Interface User Manual, 440R-UM009	Provides detailed information to install, wire, configure, troubleshoot, and use the EtherNet/IP module.
Guardmaster Safety Relays (GSR) User Manual, 440R-UM013	Provides detailed information to install, wire, configure, troubleshoot, and use GSR relays.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation® industrial system.
Product Certifications website, http://www.rockwellautomation.com/global/certification/overview.page	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/global/literature-library/overview.page. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Notes:

Introduction

The next generation Guardmaster safety relay (GSR) family is a high-quality replacement for most of the Minotaur safety relay (MSR) family.

The consistent 22.5 mm (0.9 in.) wide housing design and configurable functions for reset and logic of GSR modules let you consolidate various functions of MSR modules with fewer relays. These features help you reduce your stocking requirements.

The MSR family of safety relays typically offers one dedicated safety function, for each safety circuit and actuator. MSR solutions have less connectivity to each other than GSR modules.

The GSR family of safety relays offers configurable safety functions and consolidated safety circuits, which result in fewer units, less space, and less cost. Due to the unique capability to cascade single-wire safety (SWS), logic combinations and zones are constructed quickly.

A replacement with GSR modules is meant to be more than just a swap out.

New Machinery Directives have changed machine designs over the years. These changes have harmonized standards and demands of safety solutions that contribute to productivity and flexibility.

The following chapters offer detailed information to help with your conversion from the legacy MSR family to a smarter and cost-effective machine design in compliance with the latest requirements of Machinery Directive and harmonized standards.

For further assistance in replacing those devices contact Technical Support, your local Allen-Bradley distributor, or Rockwell Automation sales office.

GSR Benefits

The GSR family of safety relays provides the following benefits:

- One or two (dual-channel) inputs
- Single wire safety (SWS) expansion
- Narrow package (less panel space)
- Configurable operation
- Cat 4 PLe and SIL3 rating on most models
- RoHS compliance

Conversion Concerns

It is widely recognized that product obsolescence is a part of the industrial business cycle. This publication provides cost-effective recommendations for converting your MSR family of safety relays to the state-of-the-art GSR family, and considers the following major concerns.

Panel Space

Many control panel designers leave space in their panels for future expansion and improvements. If that extra panel space gets used, then panel space can become tight. With panel space in mind, the recommended conversion is intended to maintain, or even reduce, panel space.

Wiring Terminal Location

A wire that is moved from the top of the old device to the bottom of the new device in a control panel cannot be taken lightly. Each of the recommended conversions shows the terminal locations of the old and new devices, so you can plan the conversion appropriately.

Wiring Change

Example schematics that compare the older and recommended newer devices are provided for each of the applications that the older device can provide.

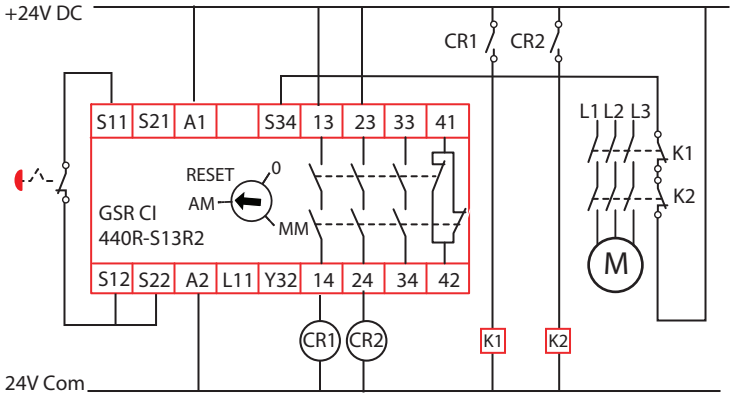
Response Time

This is the time that is required to perform the safety function. For each conversion, the comparable response time is provided. An increase in the response time requires you to adjust the safety distance. This increase is not as much of an issue when a safety gate must be opened manually. However, this additional response time is likely to be an issue when presence-sensing devices like light curtains and safety mats are used.

Output Load Capability

Every safety relay has limitations on the amount of current the relay can switch or carry. When the load exceeds the rating of the safety relay, interposing relays can be used as shown in Figure 1.

Figure 1 - Output Load Capability Using Interposing Relays



CR1 and CR2 consist of: 700-HPSXZ24 (relay)
700-HN123 (base)
700-AD1LR (diode & LED)
700-HN119 (retainer)

Notes:

CU2 Control Unit

Figure 2 - CU2 Control Unit

We recommend replacing the CU2 control unit with a GLP safety relay.

Both the CU2 control unit and GLP safety relay use two proximity sensors to sense the motion of the hazard. The CU2 control unit uses one proximity sensor with an NPN output and the second proximity sensor with a PNP output. The GLP safety relay requires PNP outputs for both proximity sensors.

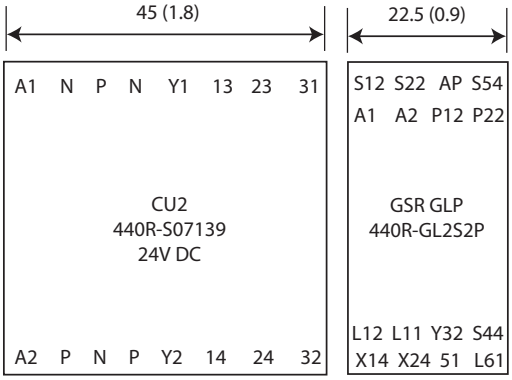
The GLP safety relay has a multi-position switch that lets you configure the GLP safety relay functionality. Switch positions 5, 6, 7, and 8 reflect the functionality of the CU2 control unit. Additional functionalities (Cat 1 stop, Safe limited speed, single wire safety expansion, unlock request, reset, and lock request) are achieved with logic settings 1, 2, 3, and 4.

The CU2 control unit offers automatic/manual reset with the Y1/Y2 terminals. When the GLP safety relay is configured for logic settings 5, 6, 7, or 8, the GLP safety relay ignores the S44 reset input and operates in automatic mode.

Terminal Location and Panel Space

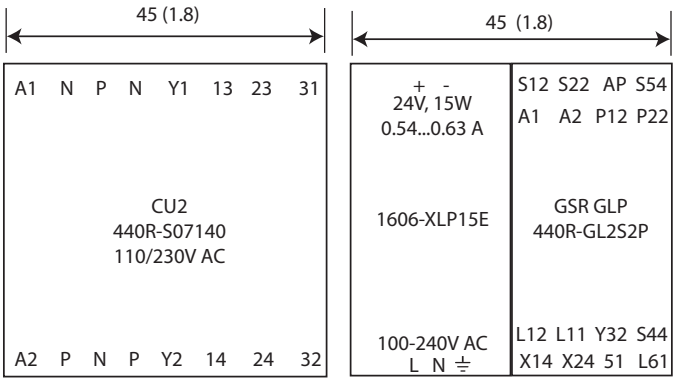
The CU2 control unit is 45 mm (1.8 in.) wide and has one row of terminals at the top and bottom. The GLP safety relay is only 22.5 mm (0.9 in.) wide and has two rows of terminals at the top and bottom.

Figure 3 - DC Powered Terminals and Panel Space [mm (in.)]



The CU2 control unit can also be ordered with a 110/230V AC power supply. Since the GLP safety relay is DC powered, a power supply (catalog number 1606-XLP15E) must be used to convert the AC supply to 24V DC. This configuration occupies the same amount of space as one CU2 control unit.

Figure 4 - AC Powered Terminals and Panel Space [mm (in.)]

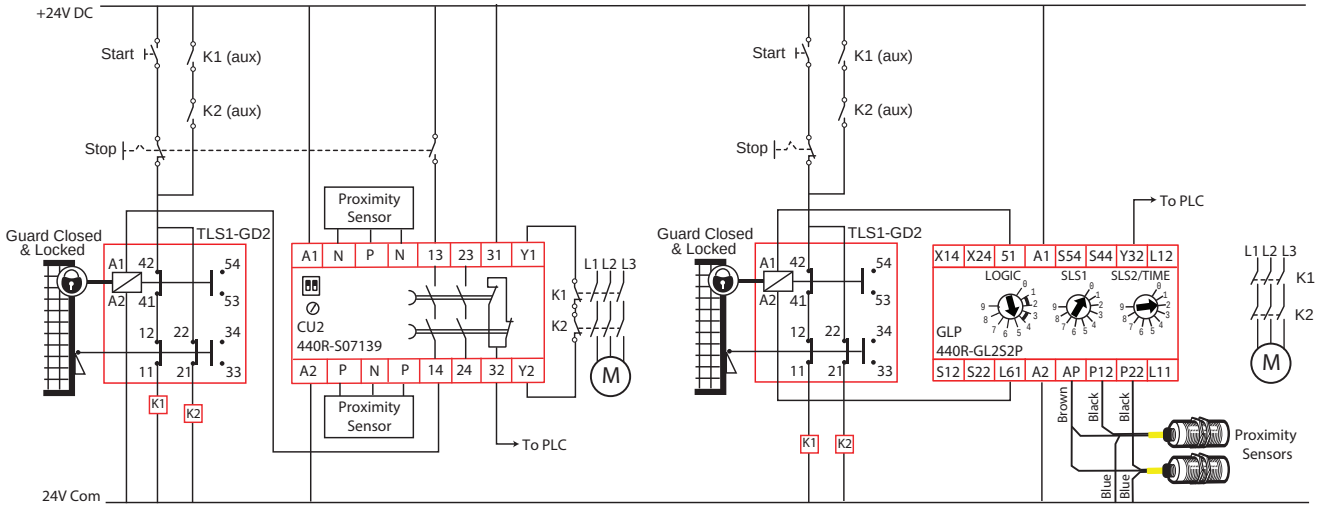


Wiring Schematics

The following schematics compare the wiring of your existing MSR module to the recommended newer devices for each application that the existing device provides.

DC Powered

Figure 5 - DC Powered Schematic



AC Powered

Figure 6 - AC Powered Schematic

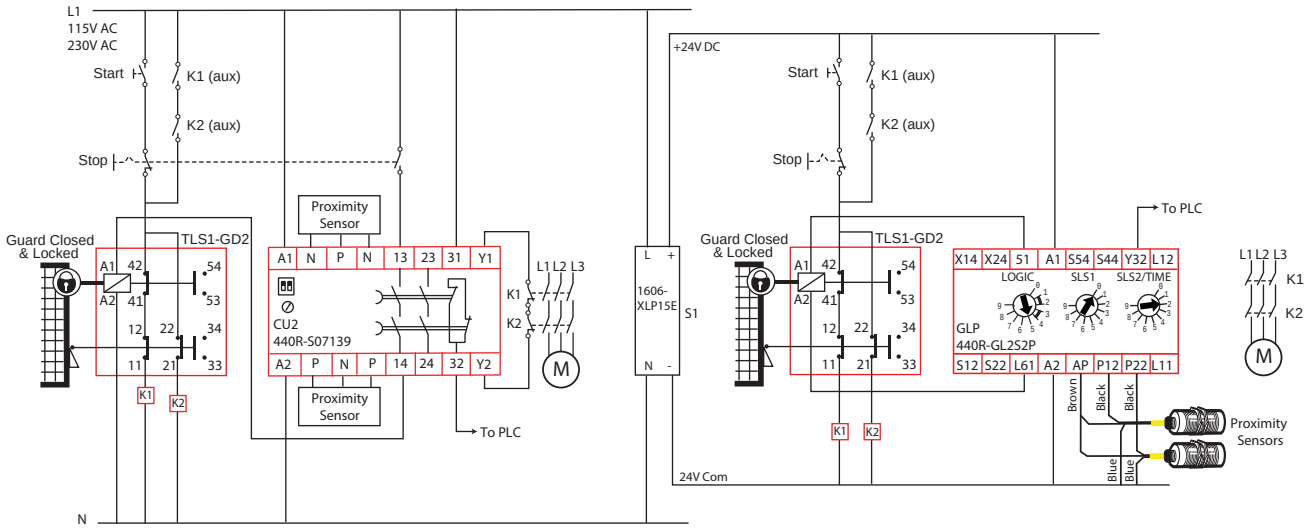
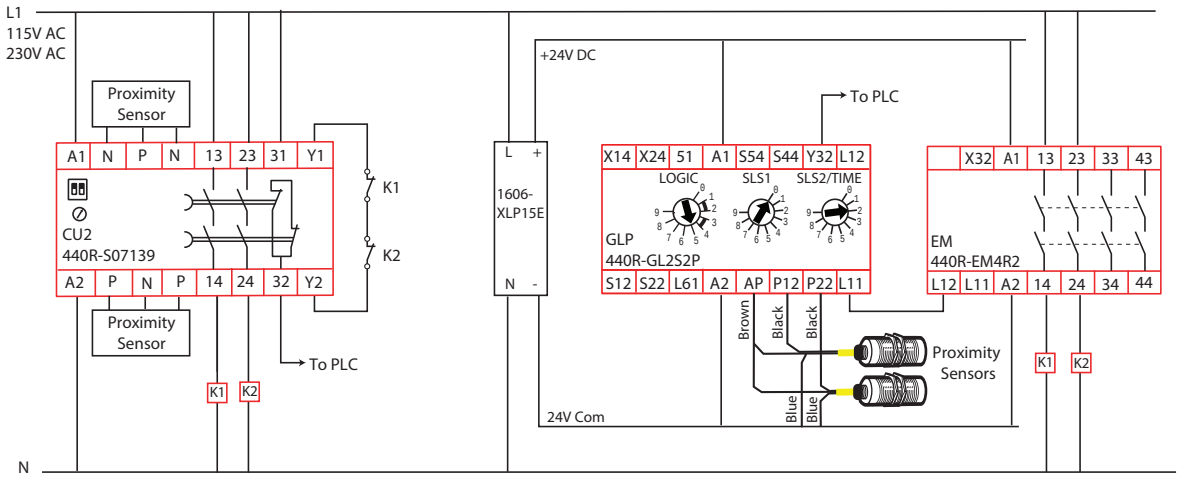


Figure 7 - AC Powered Loads Schematic



Output Load Capability

The CU2 control unit has a higher current capability than the GLP safety relay, as shown in Table 1. See Output Load Capability (page 11) for a wiring example of using interposing relays for applications where the load exceeds the GLP capability or the EM safety relay can be used for easy expansion.

Table 1 - Current Capability

Load Type	CU2	GLP	EM
AC Inductive	B300, AC-15 5 A/120,250V	—	B300 AC-15 1.5 A / 250V AC
DC	DC-13 3 A/24V DC	0.5 A/24V DC	DC13 2 A/24V DC (0.1 Hz)
Thermal (non-switching)	4 A	0.5 A	1 x 6 A

Notes:

MSR6R/T Safety Relay

Figure 8 - MSR6R/T Safety Relay

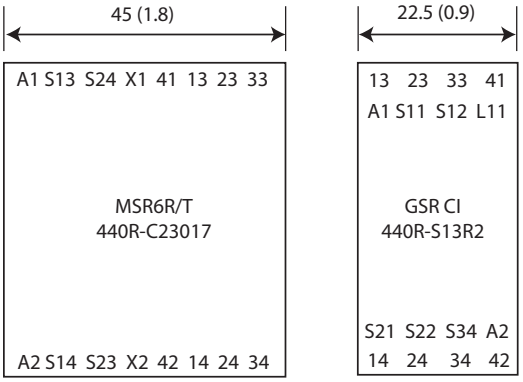
We recommend replacing the MSR6R/T safety relay with a CI safety relay.

The CI safety relay has one switch to configure the reset as automatic or monitored manual. Wiring determines whether operation is single- or dual-channel.

Terminal Locations and Panel Space

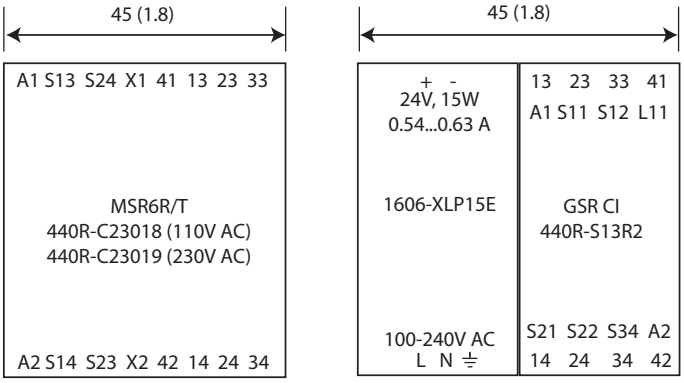
The MSR6R/T safety relay is 45 mm (1.8 in.) wide and has one row of terminals at the top and bottom. The CI safety relay is 22.5 mm (0.9 in.) wide and has two rows of terminals at the top and bottom.

Figure 9 - DC Powered Terminals and Panel Space [mm (in.)]



The MSR6R/T safety relay also has the option for a 115V AC and 230V AC power supply connection. Since the CI safety relay is DC powered, a power supply (catalog number 1606-XLP15E) must be used to convert the AC supply to 24V DC. This configuration occupies the same amount of space as one MSR6R/T safety relay.

Figure 10 - AC Powered Terminals and Panel Space [mm (in.)]



Wiring Schematics

The power, safety inputs, and outputs of the two safety relays are similar while the reset/monitoring circuit is slightly different. The following schematics compare the typical ways an MSR6R/T safety relay can be applied and the CI safety relay equivalent.

DC Powered, Single Channel

Safety standards require that closing interlocks or releasing E-stops must not initiate hazards. Therefore, a start-stop circuit is included.

Figure 11 - DC Powered, Single Channel, Auto Reset Schematic

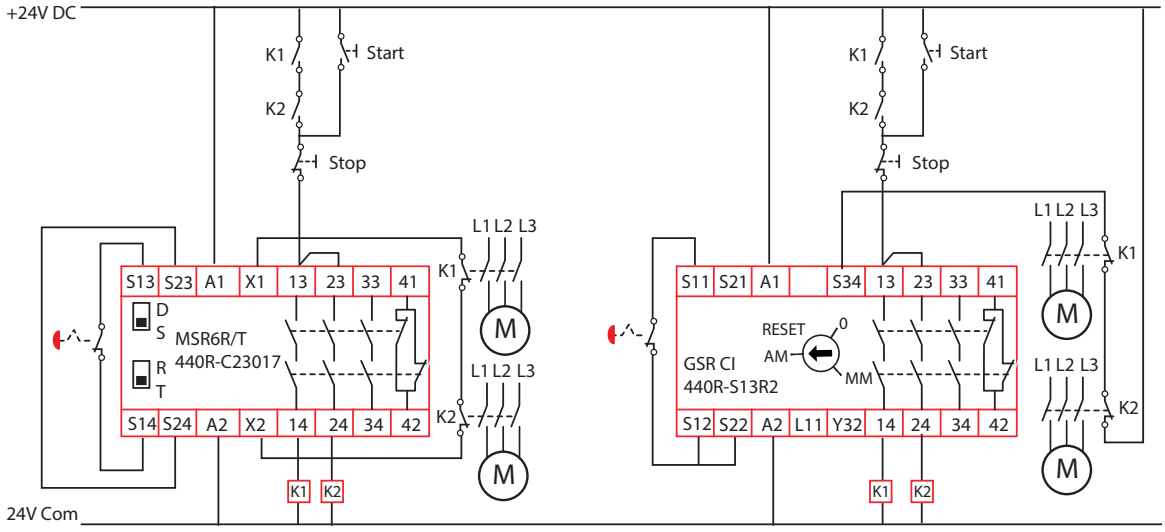
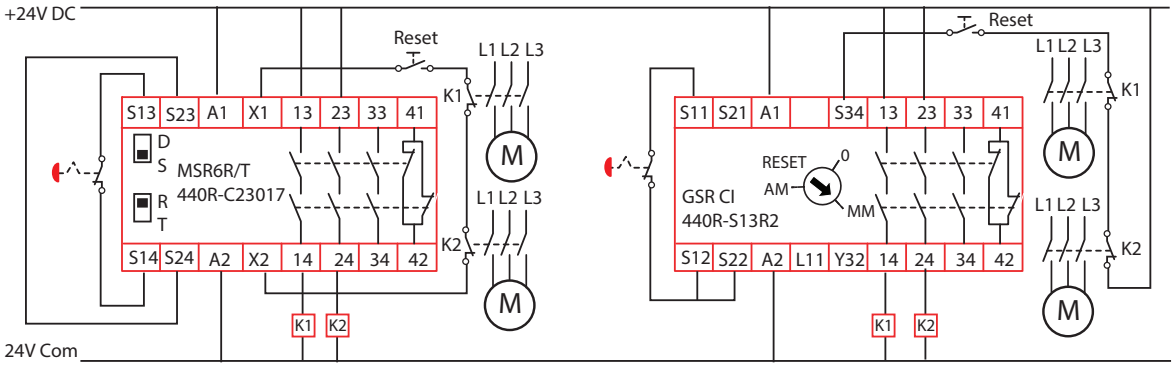


Figure 12 - DC Powered, Single Channel, Monitored Reset Schematic



DC Powered, Dual Channel

Figure 13 - DC Powered, Dual Channel, Auto Reset Schematic

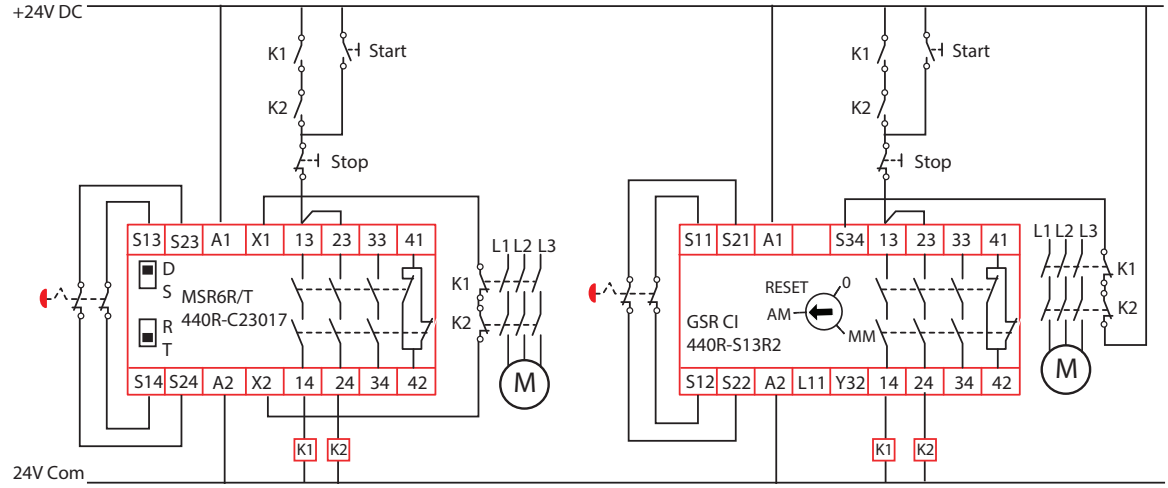
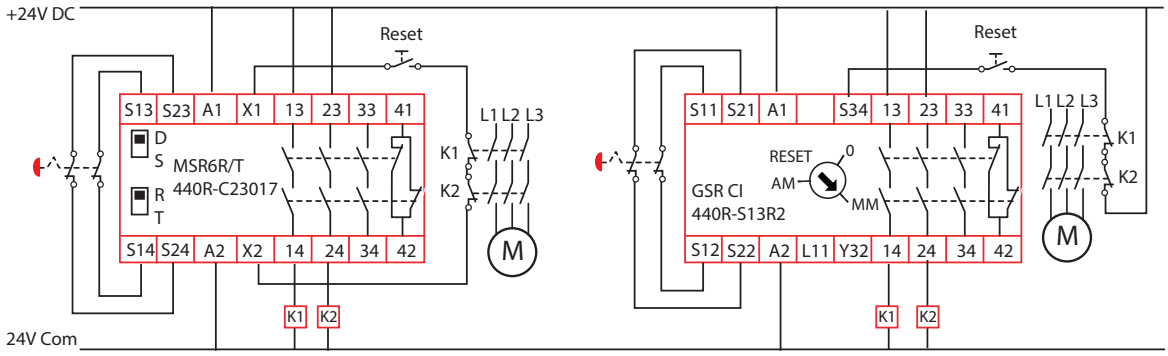


Figure 14 - DC Powered, Dual Channel, Monitored Reset Schematic

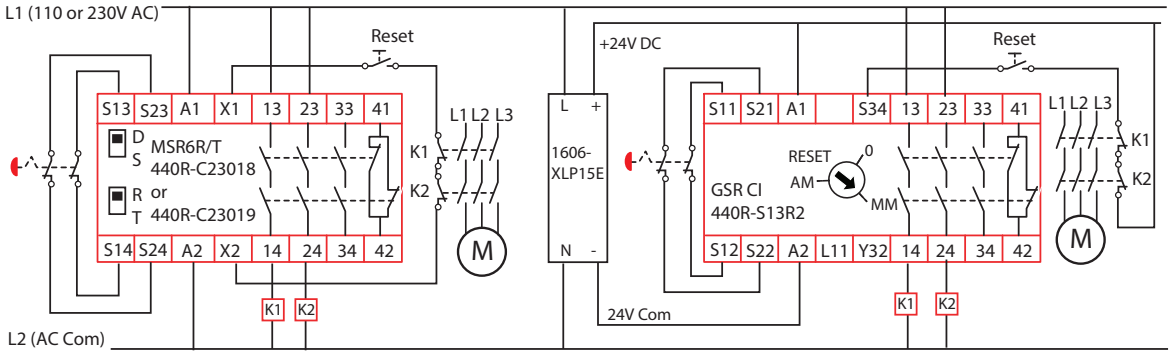


AC Powered

A small 1606 power supply converts 100/240V AC to 24V DC to power the CI safety relay. The outputs of the CI safety relay can switch up to 240V AC loads.

The MSR6R/T safety relay has an internal switch that sets the power to either 115V AC or 230V AC.

Figure 15 - AC Powered Schematic



Response Time

The CI safety relay has a faster response time, therefore the safety distance is shorter than the MSR6R/T safety relay. You do not need to adjust the safety distance.

Table 2 - Response Time

Safety Relay	Response Time [ms]
MSR6R/T	50
CI	35

Output Load Capability

The MSR6R/T safety relay has a higher current capability than the CI safety relay, as shown in Table 3. See Output Load Capability (page 11) for a wiring example of using interposing relays for applications where the load exceeds the CI safety relay capability.

Table 3 - Current Capability

Load Type	MSR6R/T	CI
AC Inductive	B300, AC-15 4 A	C300, AC-15 1.5 A
DC	P300, DC-13 3A/24V DC	2 A/24V DC
Thermal (non-switching)	4 A	2 A

MSR17T Safety Relay

Figure 16 - MSR17T Safety Relay

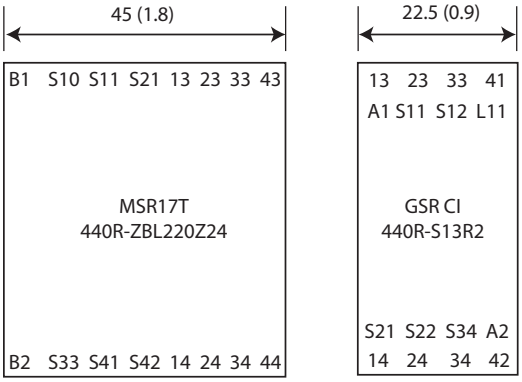
We recommend replacing the MSR17T safety relay with a CI safety relay.

The MSR17T safety relay is only available with a 24V DC power supply.

Terminal Locations and Panel Space

The MSR17T safety relay is 45 mm (1.8 in.) wide and has one row of terminals at the top and bottom. The CI safety relay is 22.5 mm (0.9 in.) wide and has two rows of terminals at the top and bottom.

Figure 17 - Terminals and Panel Space [mm (in.)]



Wiring Schematics

The following schematics compare the wiring of your existing MSR module to the recommended newer devices for each application that the existing device provides.

DC Powered, Single Channel

Safety standards require that interlock closure or release of E-stops must not initiate hazards. Therefore, a start-stop circuit is included.

Figure 18 - DC Powered, Single Channel, Auto Reset

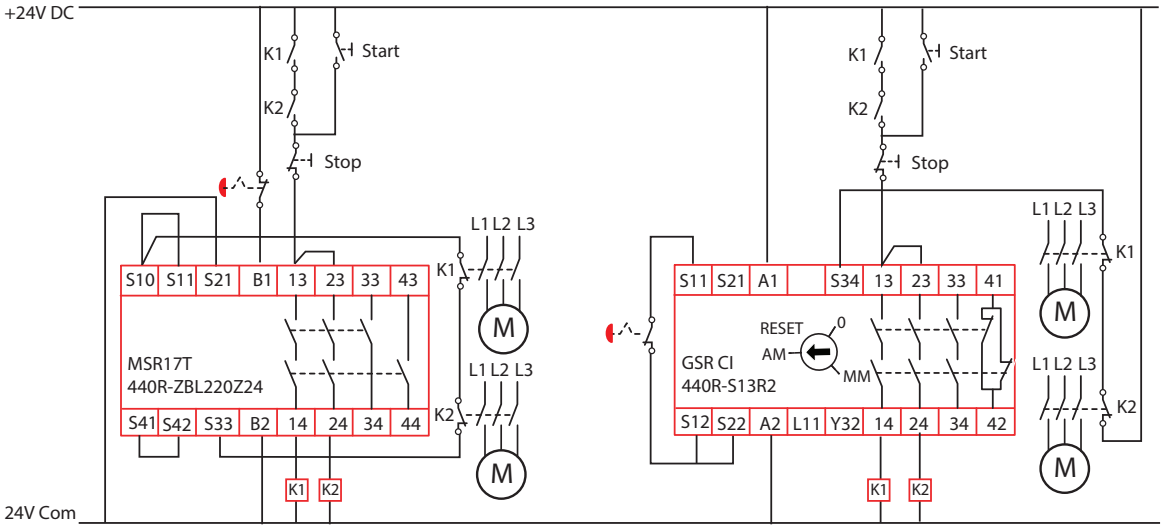
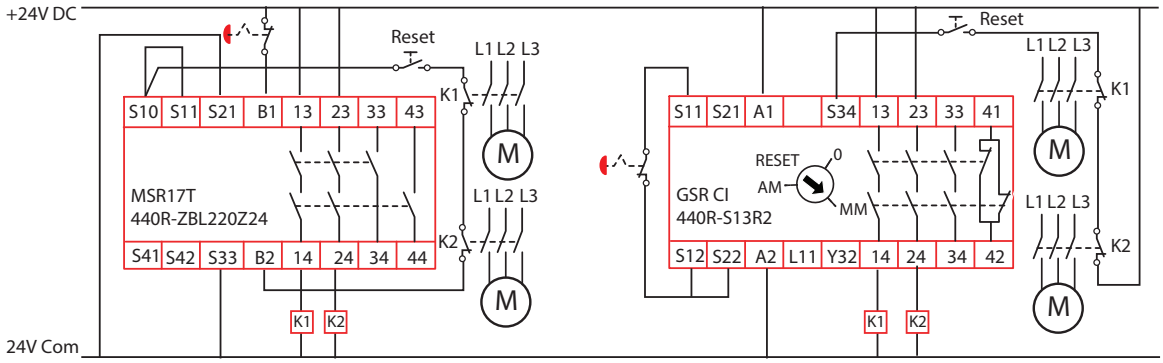


Figure 19 - DC Powered, Single Channel, Monitored Reset



DC Powered, Dual Channel

Figure 20 - DC Powered, Dual Channel, Auto Reset

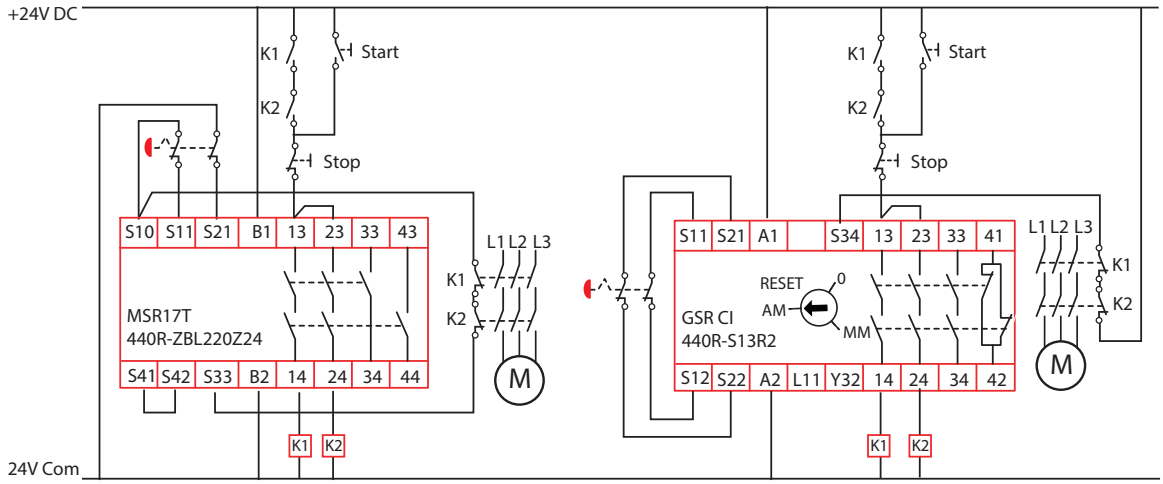
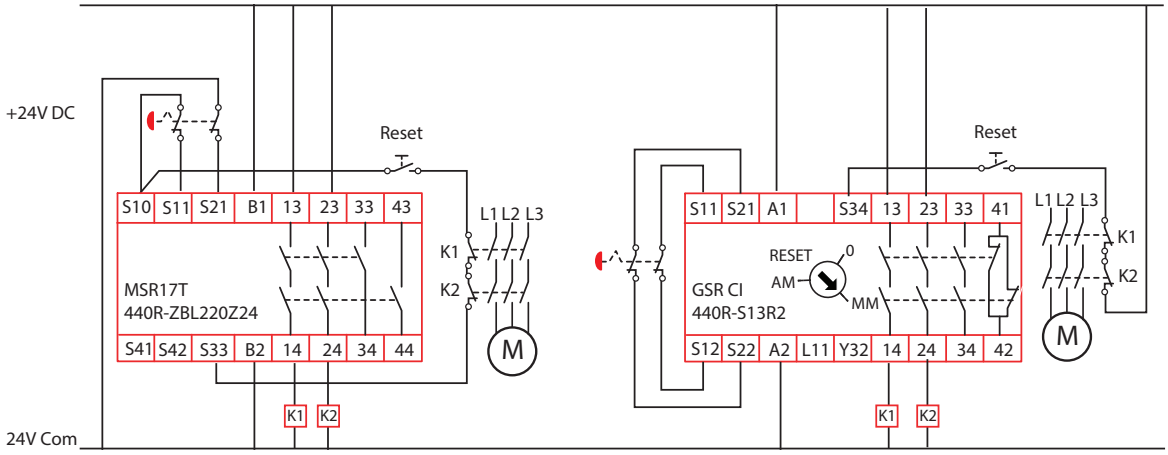


Figure 21 - DC Powered, Dual Channel, Monitored Reset



Response Time

ATTENTION: The response time of the MSR17T safety relay is faster than the CI safety relay, so the safety distance must be examined closely and adjusted if necessary.

Table 4 - Response Time

Safety Relay	Response Time [ms]
MSR17T	13
CI	35

Output Load Capability

The CI safety relay has the same DC current rating and a higher AC current capability than the MSR17T safety relay as shown in Table 5.

Table 5 - Current Capability

Load Type	MSR17T	CI
AC Inductive	BC300, AC-15 0.75 A	C300, AC-15 1.5 A
DC	P300, DC-13 2A/24V DC	DC-13 2A/24V DC
Thermal (non-switching)	—	2 A

MSR18T Safety Relay

Figure 22 - MSR18T Safety Relay

The MSR18T safety relay accommodates four different input functions. Two functions can be replaced by the GSR relay family. The other two functions must be replaced with other MSR relays.

Table 6 - MSR18T Safety Relay Replacement

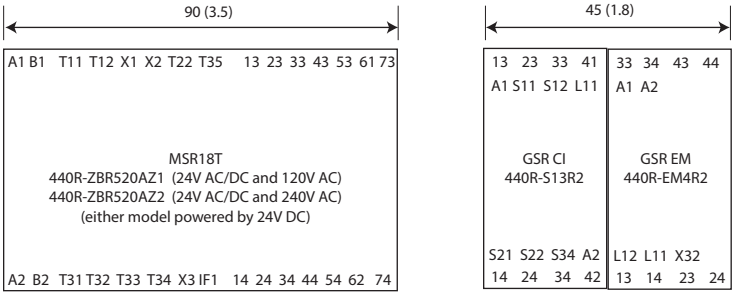
Function	Recommended Replacement
1 N.C.	CI and EM safety relays
2 N.C.	CI and EM safety relays
1 N.O. and 1 N.C.	MSR9 safety relay and up to two MSR132E expansion relays
Two-hand Control	MSR125 safety relay and up to two MSR132E expansion relays

The MSR18T safety relay is available with a 24V DC/120V AC or a 24V DC/240V AC supply input. If your application is AC powered, a power supply (catalog number 1606-XLP15E) must be used to convert the AC supply to 24V DC for the recommended GSR relays.

Terminal Locations and Panel Space

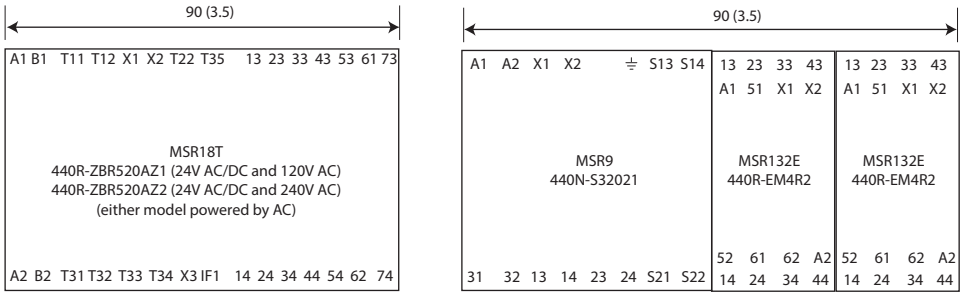
The MSR18T safety relay is 90 mm (3.5 in.) wide and has one row of terminals at the top and bottom. The CI and EM safety relays are each 22.5 mm (0.9 in.) wide and have two rows of terminals at the top and bottom.

Figure 23 - DC Powered Terminals and Panel Space [mm (in.)]



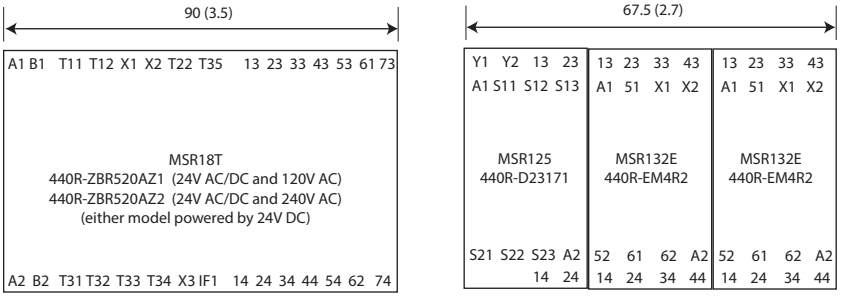
For applications where the MSR18T safety relay is configured for 1 N.C. and 1 N.O. with automatic reset, an MSR9 safety relay with MSR132 expansion relays is the recommended replacement.

Figure 24 - 1 N.C. and 1 N.O. DC Powered Terminals and Panel Space [mm (in.)]



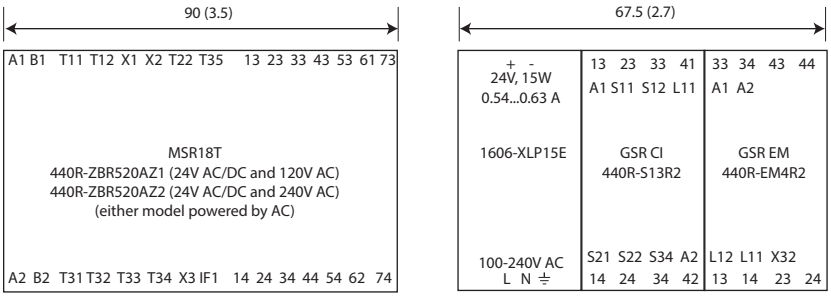
For two-hand control applications, the MSR125 safety relay is the recommended replacement for the MSR18T safety relay. If additional outputs are needed, the MSR125 safety relay can be expanded with the MSR132E expansion relay.

Figure 25 - Two-hand DC Powered Control Terminals and Panel Space [mm (in.)]



For applications where the MSR18T safety relay power is 120V or 240V AC, a 24V DC power supply (catalog number 1606-XLP15E) must be used to power the newer safety relays.

Figure 26 - AC Powered Terminals and Panel Space [mm (in.)]

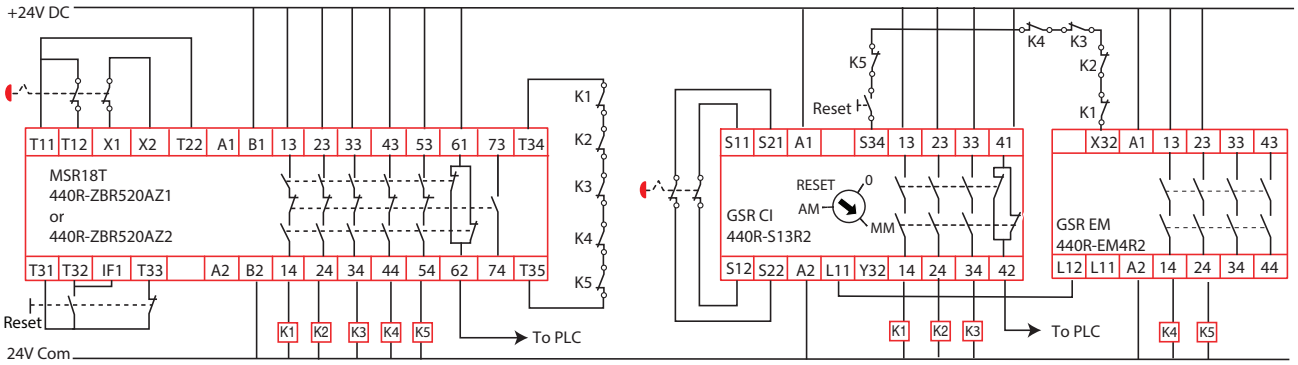


Wiring Schematics

The power, safety inputs, and safety outputs of the MSR18T and CI safety relays are similar. The reset/monitoring circuit is slightly different. The following schematics show comparisons of the four ways an MSR18RT safety relay can be applied and the CI safety relay equivalent.

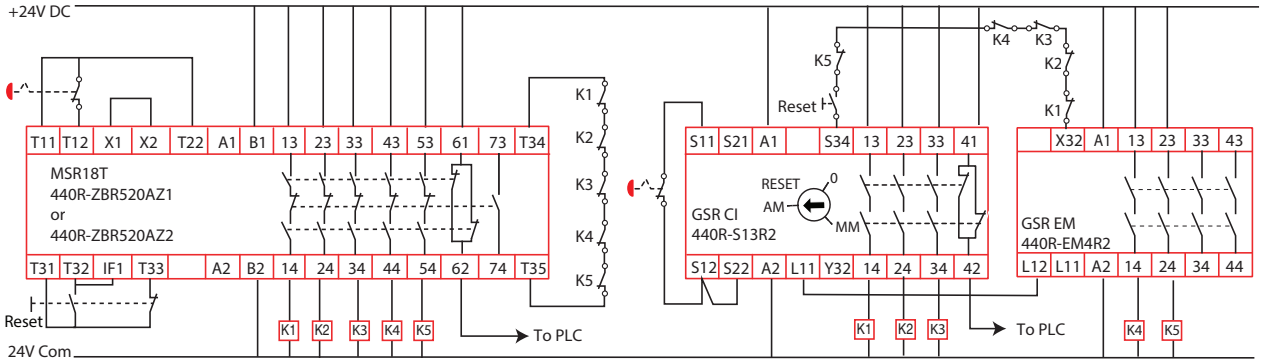
Dual Channel

Figure 27 - Dual Channel, Manual Reset Schematic



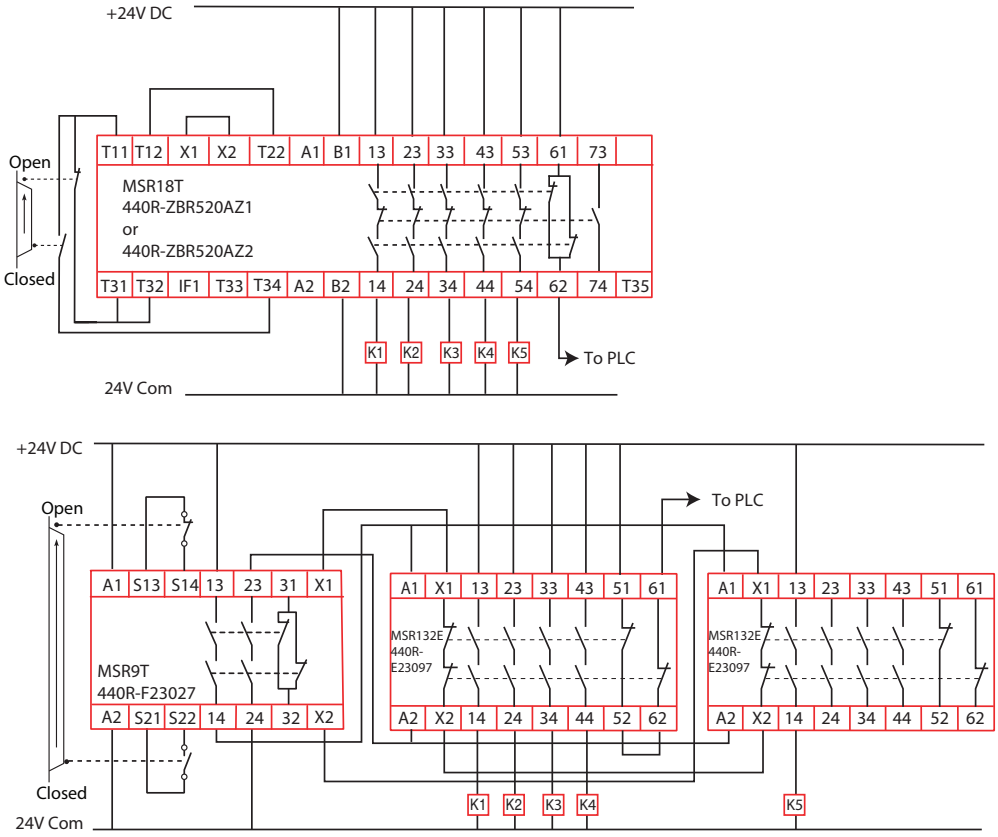
Single Channel

Figure 28 - Single Channel, Manual Reset Schematic



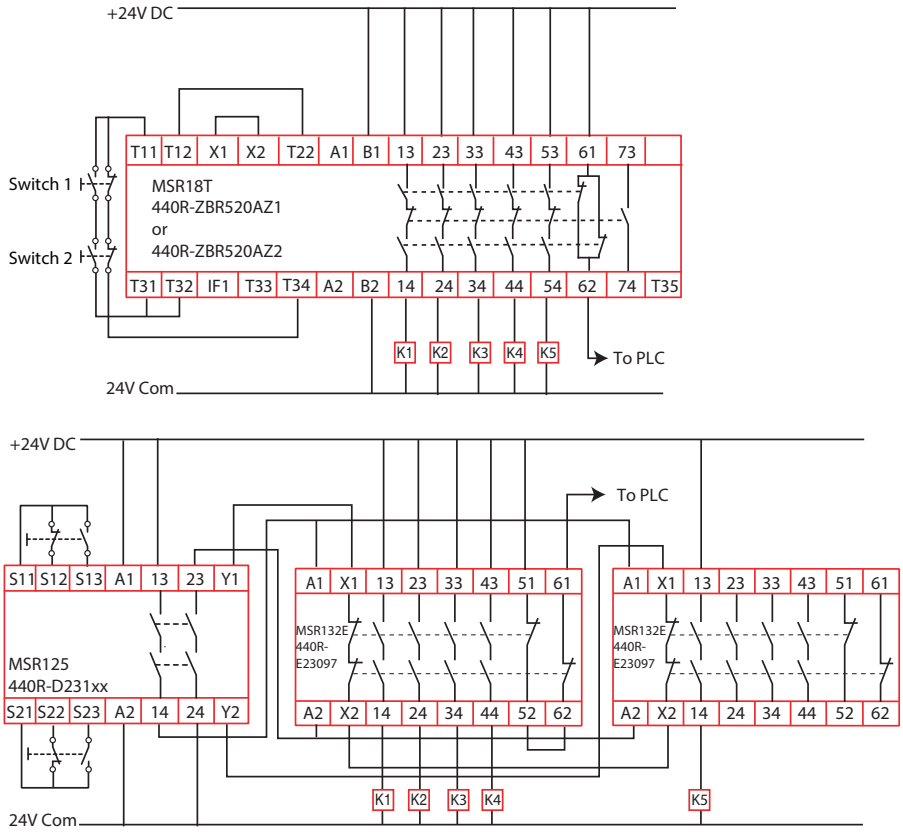
1 N.C. and 1 N.O.

Figure 29 - 1 N.C. and 1 N.O., Automatic Reset Schematic



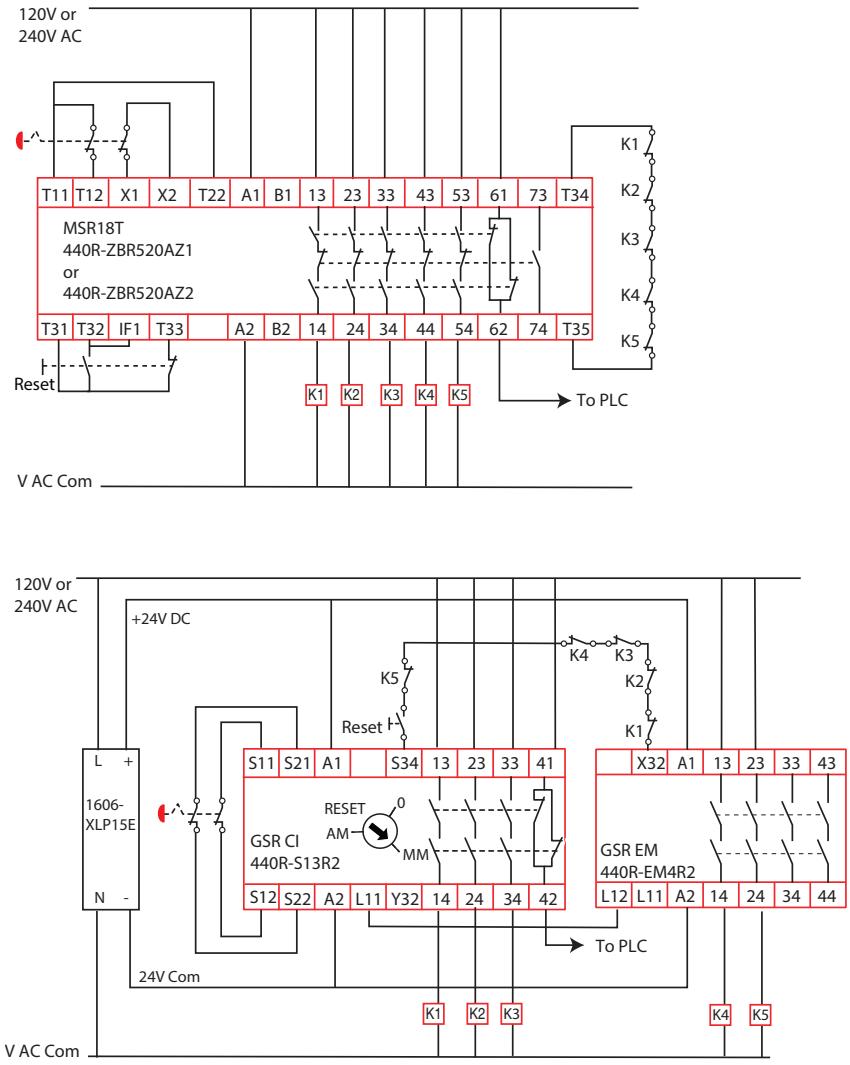
Two-hand Control

Figure 30 - Two-hand Control Schematic



AC Powered

Figure 31 - AC Powered Schematic



Response Time

ATTENTION: The response time of the MSR18T safety relay is faster than each of the replacements, so the safety distance must be examined closely and adjusted if necessary

Table 7 - Response Time

Safety Relay	Response Time [ms]
MSR18T	20
CI	35
EM	35
MSR9T	60
MSR132E	50
MSR125H	20

Output Load Capability

Table 8 compares the output load capability of the MSR18T to the replacement relays. See Output Load Capability (page 11) for a wiring example of using interposing relays for applications where the load exceeds the capability of the replacements.

Table 8 - Current Capability

Load Type	MSR18T	CI	EM	MSR9	MSR132	MSR125
AC Inductive	C300, AC-15 0.75 A/250V AC 1.5 A/120V AC	C300, AC-15 1.5 A/250V AC	2 x B300, AC-15 4 A/250V AC	A300, AC-15 3 A/250V AC	AC-15 6 A/250V AC 6 A/120V AC	AC-15 6 A/250V AC 6 A/120V AC
DC	Q300, DC-13 2 A/24V DC	DC-13 2 A/24V DC	P300, DC-13 2 A/24V DC	P300, DC-13 3 A/24V DC	DC-13 3 A/24V DC	DC-13 3 A/24V DC
Thermal (non-switching)	1 x 8 A, 2 x 7 A, 3 x 5.5 A, 4 x 5 A, 5 x 4.5 A	1 x 6 A	2 A	2 A	2 A	2 A

Notes:

MSR19E Safety Relay

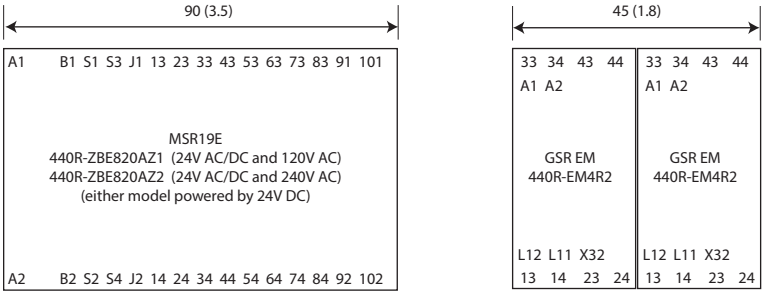
Figure 32 - MSR19E Safety Relay

We recommend replacing the MSR19E safety relay with two EM safety relays. The MSR19E safety relay has two input channels. When driven by a host safety relay, the host safety relay must devote two safety outputs to drive the MSR19E safety relay. With the GSR safety relays, the Single Wire Safety (SWS) output lets the host safety relay communicate with the EM safety relay over one wire and saves the safety outputs of the host for other uses.

Terminal Locations and Panel Space

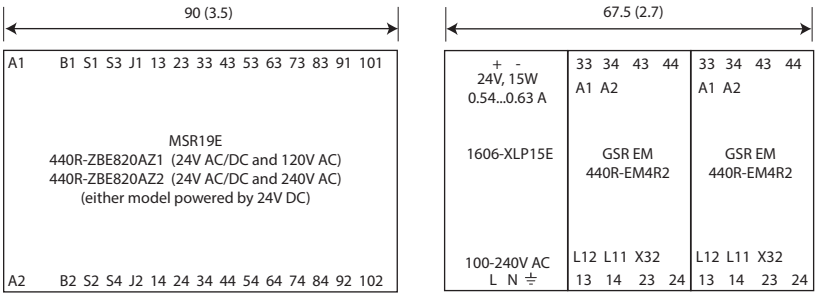
The MSR19E safety relay is 90 mm (3.5 in.) wide and has one row of terminals at the top and bottom. The EM safety relay is 22.5 mm (0.9 in.) wide and has two rows of terminals at the top and bottom. Two EM safety relays use half of the panel space as one MSR19E safety relay.

Figure 33 - DC Powered Terminals and Panel Space [mm (in.)]



Each MSR19E safety relay also has option for AC power: 120V or 240V AC. Since the EM safety relay is DC powered, a power supply (catalog number 1606-XLP15E) must be used to convert the AC supply to 24V DC. This configuration occupies less panel space than one MSR19E safety relay.

Figure 34 - AC Powered Terminals and Panel Space [mm (in.)]

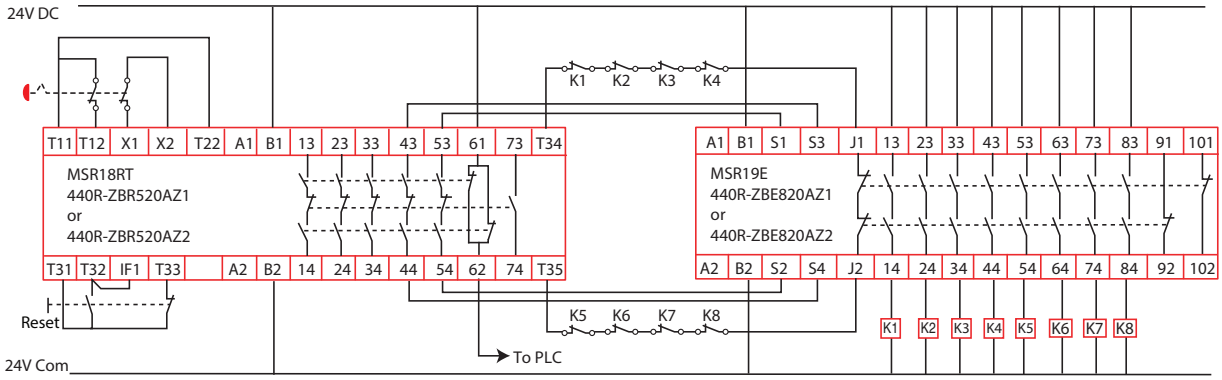


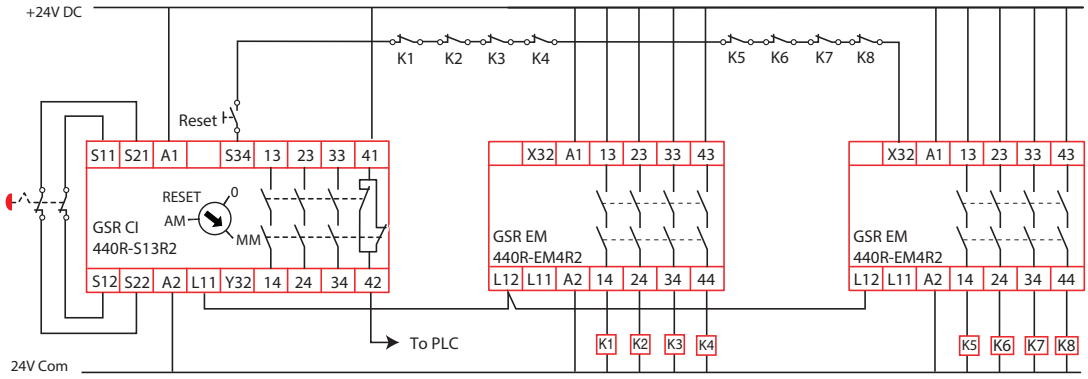
Wiring Schematics

The following schematics compare the wiring of your existing MSR module to the recommended newer devices for each application that the existing device provides.

DC Powered

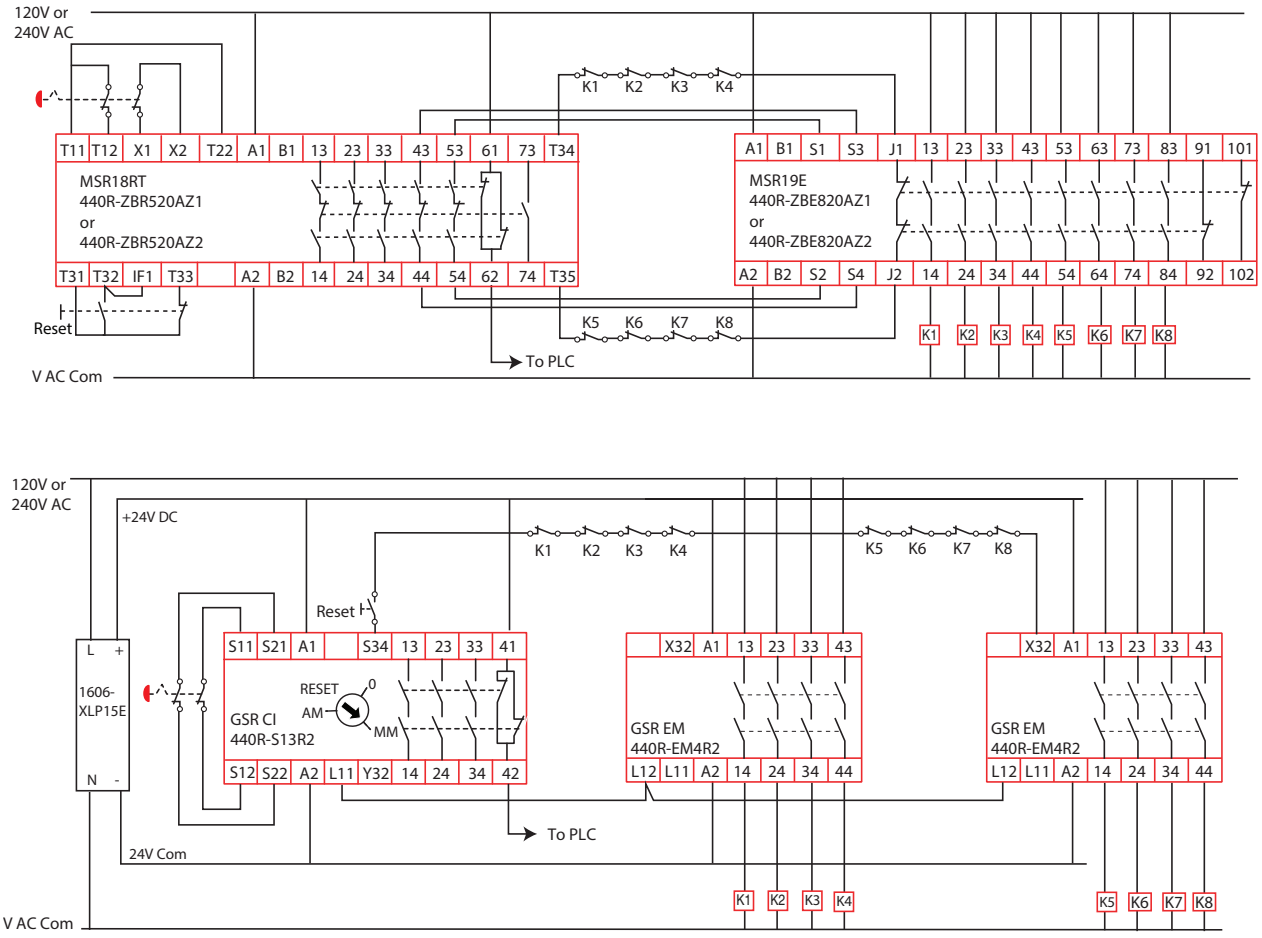
Figure 35 - DC Powered Schematic





AC Powered

Figure 36 - AC Powered Schematic



Response Time

The two EM safety relays must have the SWS inputs (terminals L12) connected in parallel to activate all outputs simultaneously.

ATTENTION: The response time of the MSR19E safety relay is faster than the EM safety relay, so the safety distance must be examined closely and adjusted if necessary.

Table 9 - Response Time

Safety Relay	Response Time [ms]
MSR19E	20
EM	35

Output Load Capability

The MSR19E safety relay has a higher current capability than the EM safety relay as shown in Table 10. See Output Load Capability (page 11) for a wiring example of using interposing relays for applications where the load exceeds the EM safety relay capabilities.

Table 10 - Current Capability

Load Type	MSR19E	EM
AC Inductive	C300, AC-15 0.75 A/250V AC 1.5 A/120V AC	2 x B300, AC-15 1.5 A/250V AC
DC	Q300, DC-13 2 A/24V DC	DC-13 2 A/24V DC
Thermal (non-switching)	1x8 A, 2x7 A, 4x6 A, 6x5 A, 8x4.5 A	1x6 A

MSR30RT/RTP Safety Relay

Figure 37 - MSR30RT/RTP Safety Relay

We recommend replacing the MSR30RT/RTP safety relay with a DIS safety relay. The MSR30 safety relay is only available with 24V DC power and can be wired for either single- or dual-channel inputs. It can also be wired for automatic or monitored reset. It has two normally open solid-state outputs and one normally closed solid-state output.

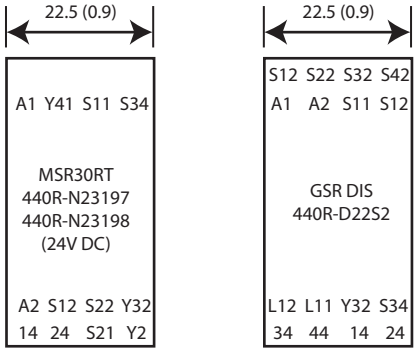
The DIS safety relay has one multi-position rotary switch to configure the reset as automatic or monitored manual and the logic applied to the two inputs. The wiring of the relay determines single- or dual-channel inputs.

The MSR30 safety relay has a feature called Startup Test. The wiring of the relay configures Startup Test. Upon initial power-up, the input device must be cycled once to energize the safety outputs. The DIS safety relay does not support this feature.

Terminal Locations and Panel Space

The MSR30 safety relay and DIS safety relay are both 22.5 mm (0.9 in.) wide and have two rows of terminals at the top and bottom.

Figure 38 - Terminals and Panel Space [mm (in.)]

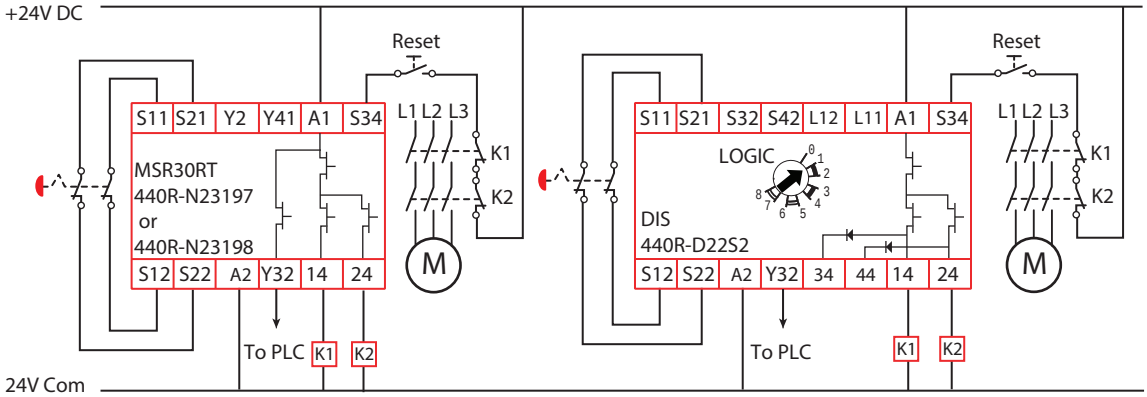


Wiring Schematics

The following schematics compare the wiring of your existing MSR module to the recommended newer devices for each application that the existing device provides.

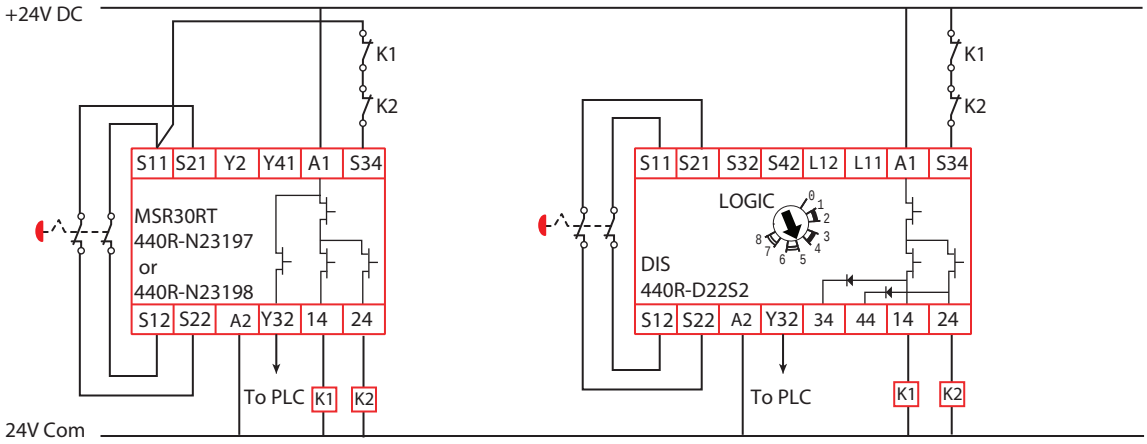
Dual Channel

Figure 39 - Dual Channel, Monitored Reset Schematic



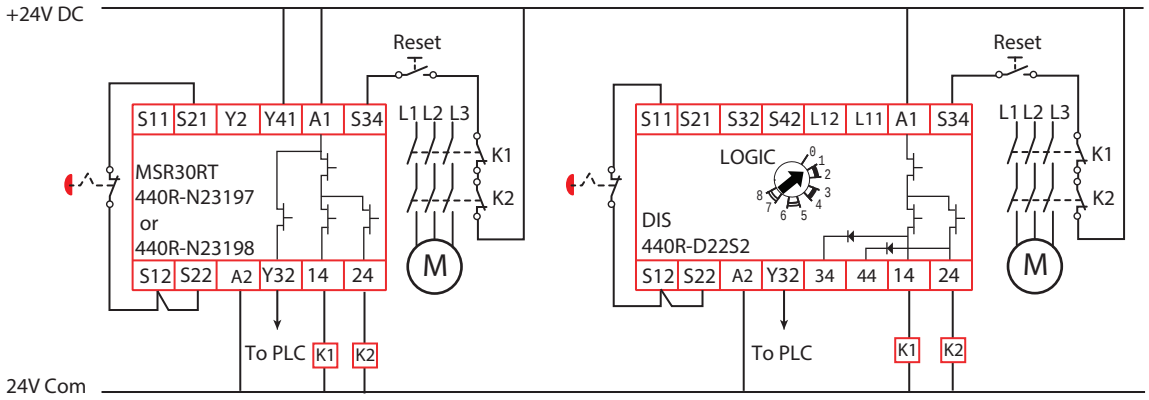
ATTENTION: In Figure 40, closing the safety inputs automatically energizes the safety outputs. You must design the safety system such that an additional manual action is required to initiate the hazard.

Figure 40 - Dual Channel, Automatic Reset Schematic



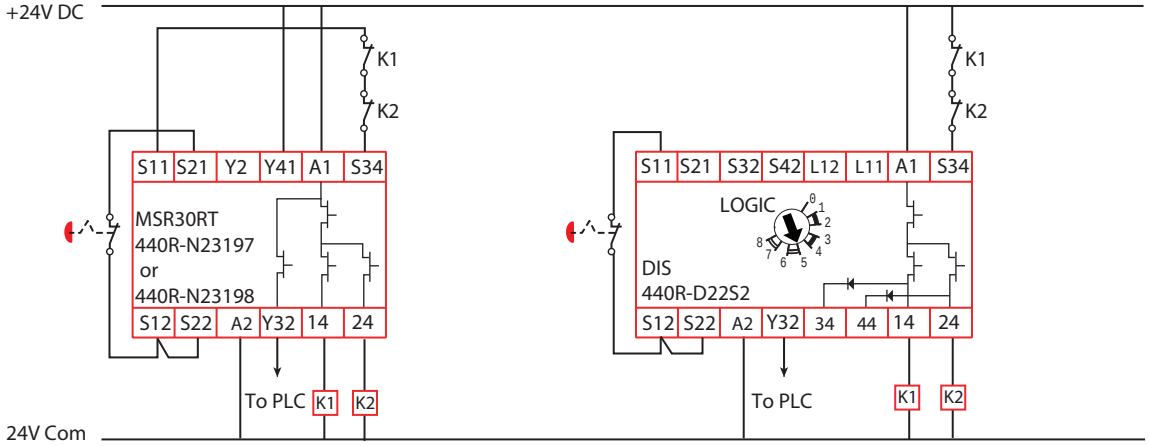
Single Channel

Figure 41 - Single Channel, Monitored Reset Schematic



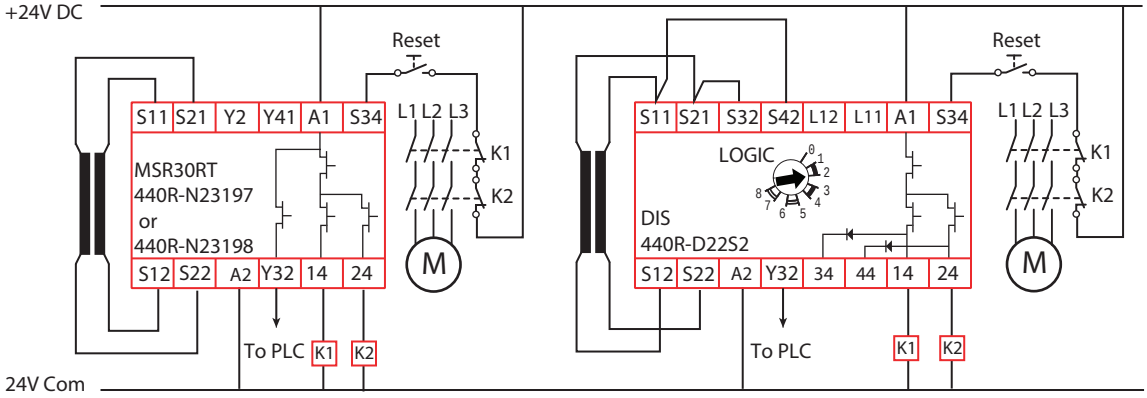
ATTENTION: In Figure 42, closing the safety inputs automatically energizes the safety outputs. You must design the safety system such that an additional manual action is required to initiate the hazard.

Figure 42 - Single Channel, Automatic Reset Schematic



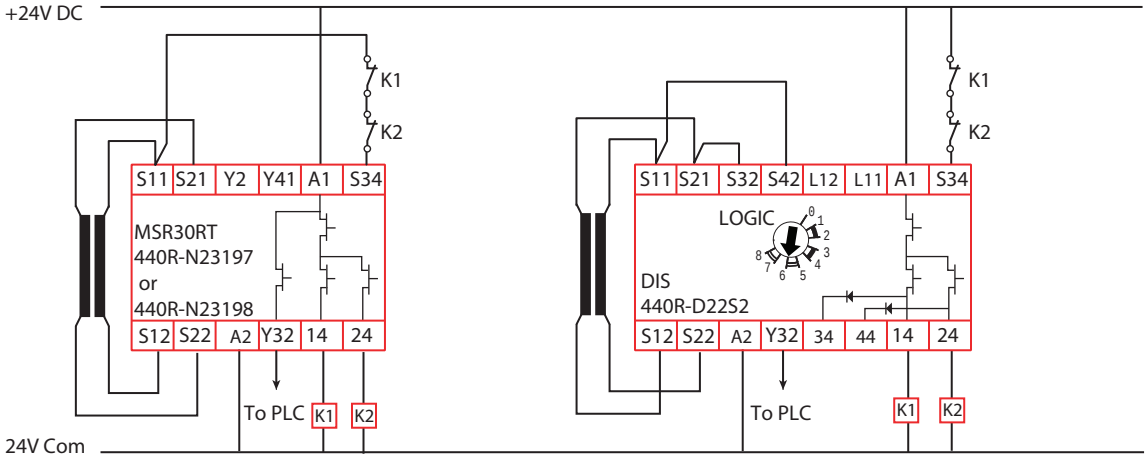
Safety Mat

Figure 43 - Safety Mat, Monitored Reset Schematic



ATTENTION: In Figure 44, stepping off the safety mat automatically energizes the safety outputs. You must design the safety system such that an additional manual action is required to initiate the hazard.

Figure 44 - Safety Mat, Automatic Reset Schematic



Response Time

ATTENTION: The response time of the MSR30RT/RTP safety relay is faster than the DIS safety relay, so the safety distance must be examined closely and adjusted if necessary.

Table 11 - Response Time

Safety Relay	Response Time [ms]
MSR30RT/RTP	15
DIS	25 (mechanical switches) 30 (safety mats)

Output Load Capability

The MSR30RT/RTP safety relay has a higher current capability than the DIS safety relay as shown in Table 12. See Output Load Capability (page 11) for a wiring example of using interposing relays for applications where the load exceeds the GSR capability.

Table 12 - Current Capability

Load Type	MSR30RT/RTP	DIS
DC	2 A/24V DC	14, 24: 1.5 A/24V DC

Notes:

MSR38DP Safety Relay

Figure 45 - MSR38DP Safety Relay

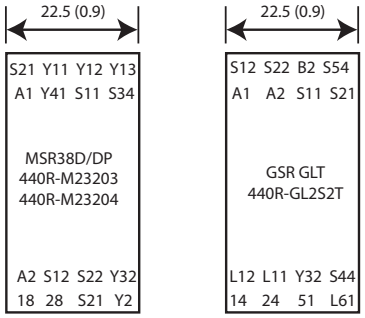
We recommend replacing the MSR38D safety relay with the GLT safety relay for most applications. The MSR38D safety relay has two delayed safety outputs and one immediate auxiliary output. The inputs accommodate applications that require dual-channel, single-channel mechanical devices or safety mats.

When safety mats are used with the MSR38D safety relay, we recommend replacing with SI and EMD safety relays.

Terminal Locations and Panel Space

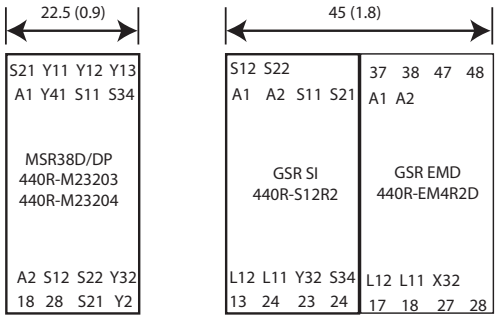
The MSR38D and GLT safety relays are both 22.5 mm (0.9 in.) wide and have two rows of terminals at the top and bottom. The terminal locations are different.

Figure 46 - Terminals and Panel Space [mm (in.)]



For safety mat applications, the combination of an SI and EMD safety relay uses 45 mm (1.8 in.) of panel space as compared to the 22.5 mm (0.9 in.) use by the MSR38D safety relay.

Figure 47 - Terminals and Panel Space [mm (in.)]

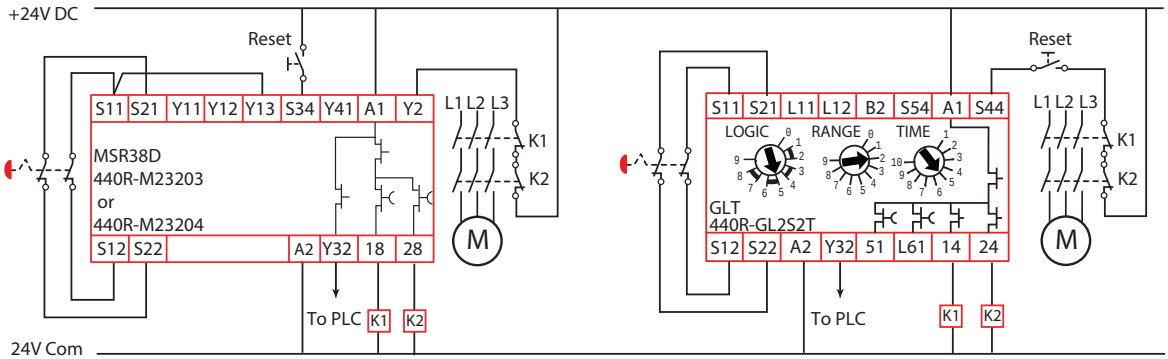


Wiring Schematics

The following schematics compare the wiring of your existing MSR module to the recommended newer devices for each application that the existing device provides.

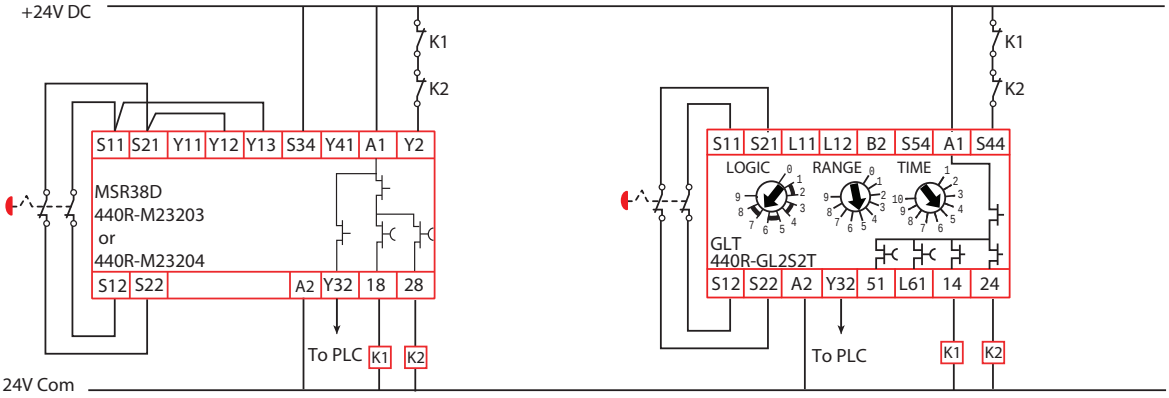
Dual Channel

Figure 48 - Dual Channel Input, Monitored Reset, 1.5 s Off-delay Schematic



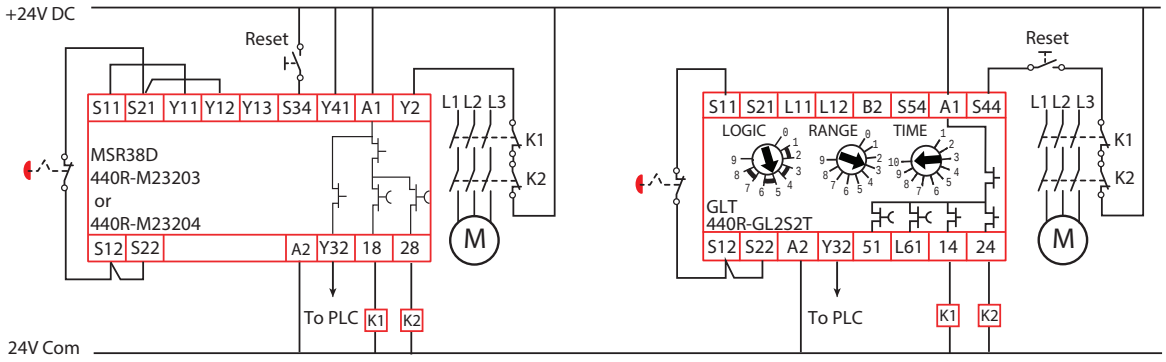
ATTENTION: In Figure 49, closing the safety inputs automatically energizes the safety outputs. You must design the safety system such that an additional manual action is required to initiate the hazard.

Figure 49 - Dual Channel Input, Automatic Reset, 15 s Off-delay Schematic



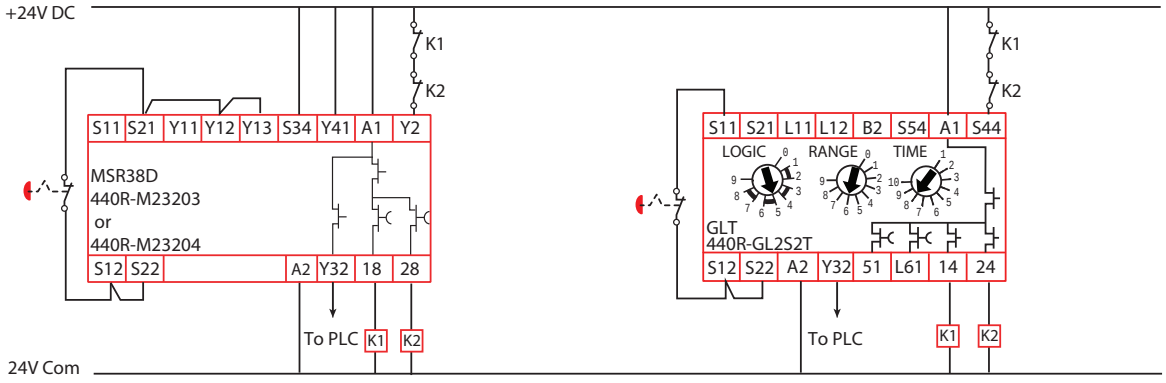
Single Channel

Figure 50 - Single Channel Input, Monitored Reset, 5 s Off-delay Schematic



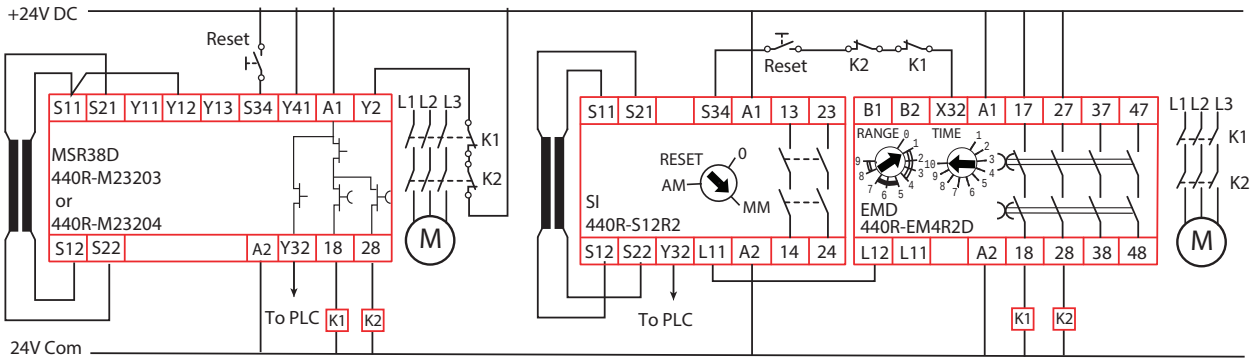
ATTENTION: In Figure 51, closing the safety inputs automatically energizes the safety outputs. You must design the safety system such that an additional manual action is required to initiate the hazard.

Figure 51 - Single Channel Input, Automatic Reset, 50 s Off-delay Schematic



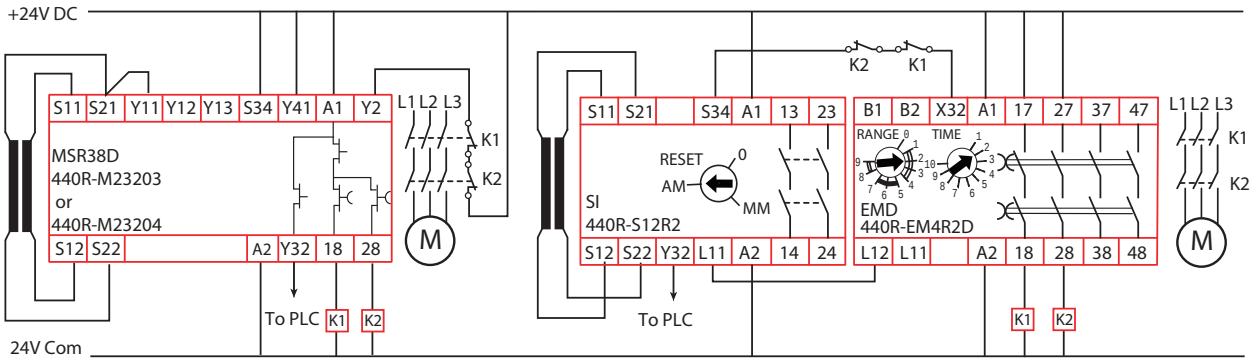
Safety Mat

Figure 52 - Safety Mat Input, Monitored Reset, 1 s Off-delay Schematic



ATTENTION: In Figure 53, stepping off the safety mat automatically energizes the safety outputs. You must design the safety system such that an additional manual action is required to initiate the hazard.

Figure 53 - Safety Mat Input, Automatic Reset, 2 s Off-delay Schematic



Response Time

ATTENTION: The response time of the MSR38D safety relay is faster than the GLT, SI, and EMD safety relays, so the safety distance must be examined closely and adjusted if necessary.

Table 13 - Response Time

Safety Relay	Response Time [ms]
MSR38D	15 + delayed time
GLT	55 + delayed time
SI	45
EMD	35 + delayed time

Output Load Capability

The MSR38D safety relay has a higher current capability than the GLT safety relay as shown in Table 14. See Output Load Capability (page 11) for a wiring example of using interposing relays for applications where the load exceeds the GSR capability.

Table 14 - Current Capability

Load Type	MSR38D	GLT	EMD
DC	2 A/24V DC	0.3 A/24V DC	2 A/24V DC

Notes:

MSR121RT Safety Relay

Figure 54 - MSR121RT Safety Relay

We recommend replacing the MSR121RT safety relay with the GSR CI safety relay. The MSR121RT safety relay can be wired for automatic or monitored reset. The CI safety relay is configured for automatic or monitored reset by a rotary switch on its front face.

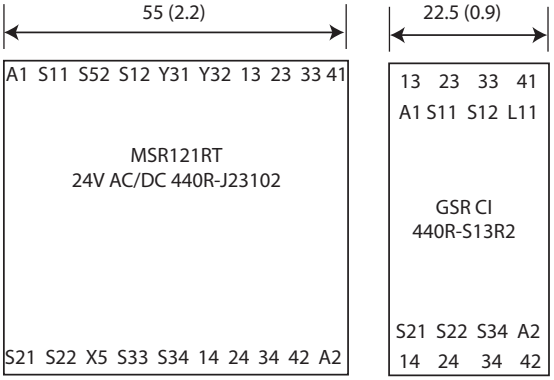
The MSR121RT safety relay is in models supplied by 24V AC/DC, 115V AC, or 230V AC power. For the DC power units, a power supply (catalog number 1606-X15E) must be used to convert the power to 24V DC.

The CI safety relay has one switch to configure the reset as automatic or monitored manual. The wiring of the relay determines dual-channel operation.

Terminal Locations and Panel Space

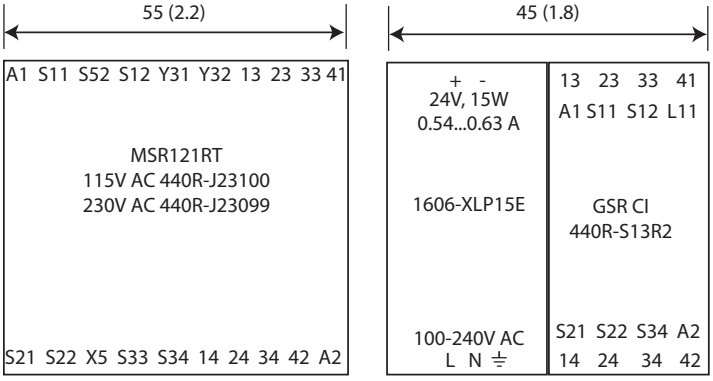
The MSR121RT safety relay is 55 mm (2.2 in.) wide with one row of terminals at the top and bottom. The CI safety relay is 22.5 mm (0.9 in.) wide with two rows of terminals at the top and bottom.

Figure 55 - DC Powered Terminals and Panel Space [mm (in.)]



For the AC powered applications, a power supply (catalog number 1606-XLP15E) must be used to convert the AC supply to 24V DC for the CI safety relay. The combination of power supply and CI safety relay uses 45 mm (1.8 in.) of panel space, which is less than one MSR121RT safety relay.

Figure 56 - AC Powered Terminals and Panel Space [mm (in.)]



Wiring Schematics

The following schematics compare the wiring of your existing MSR module to the recommended newer devices for each application that the existing device provides.

Dual Channel

Figure 57 - Dual Channel Input, Monitored Reset, DC Powered Schematic

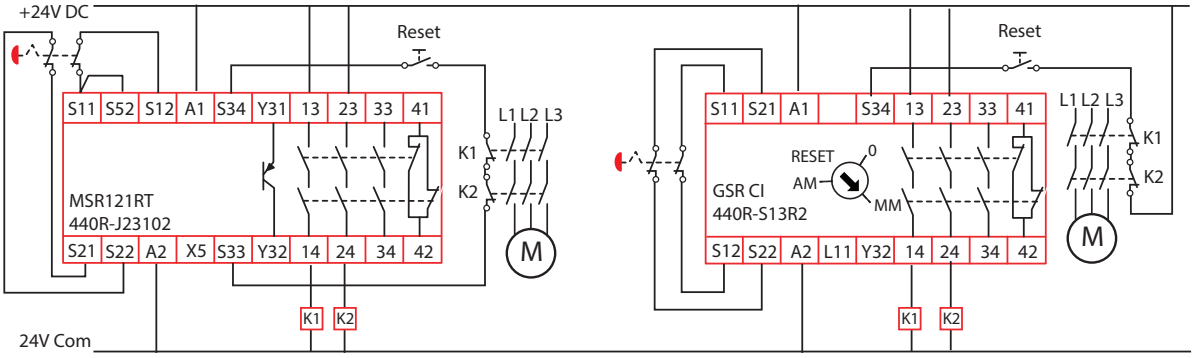
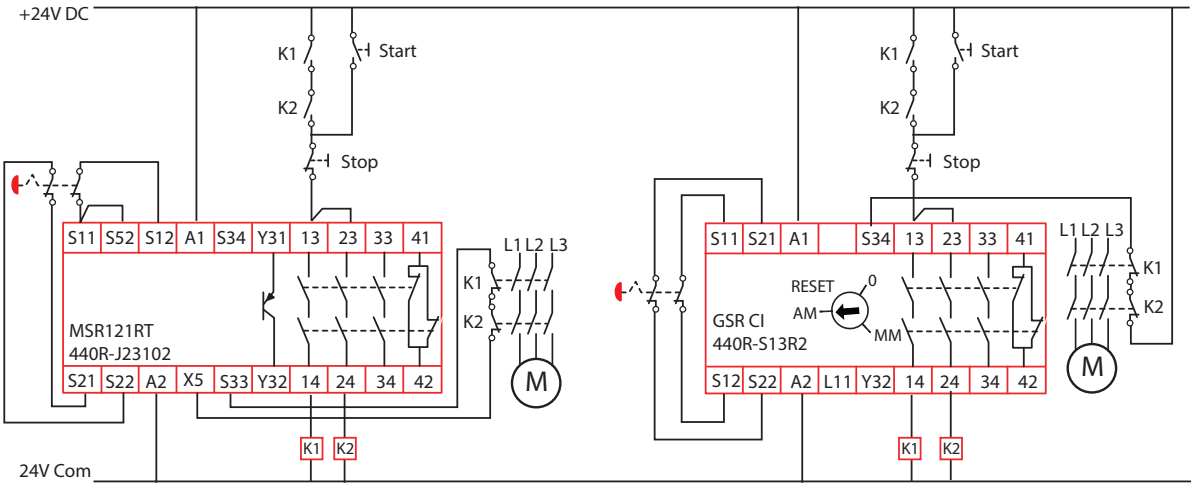


Figure 58 - Dual Channel Input, Automatic Reset, DC Powered Schematic



Single Channel

Figure 59 - Single Channel Input, Monitored Reset, DC Powered Schematic

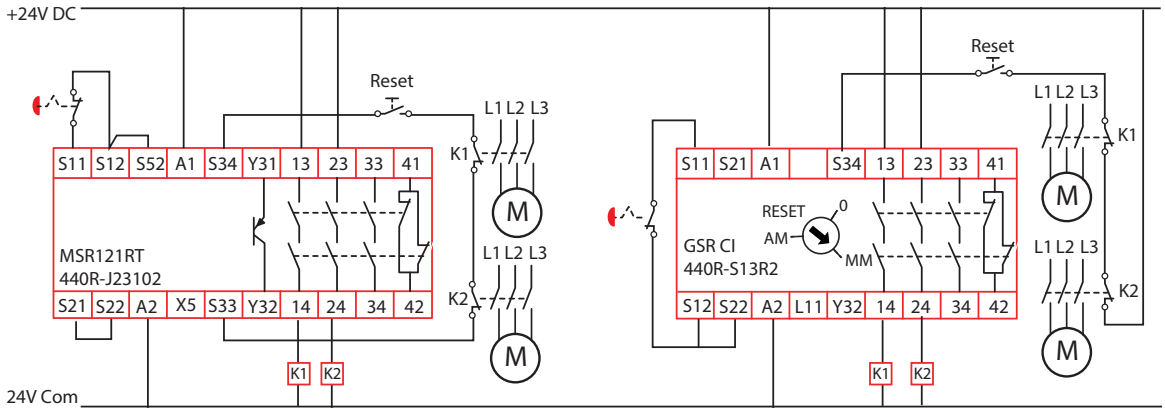
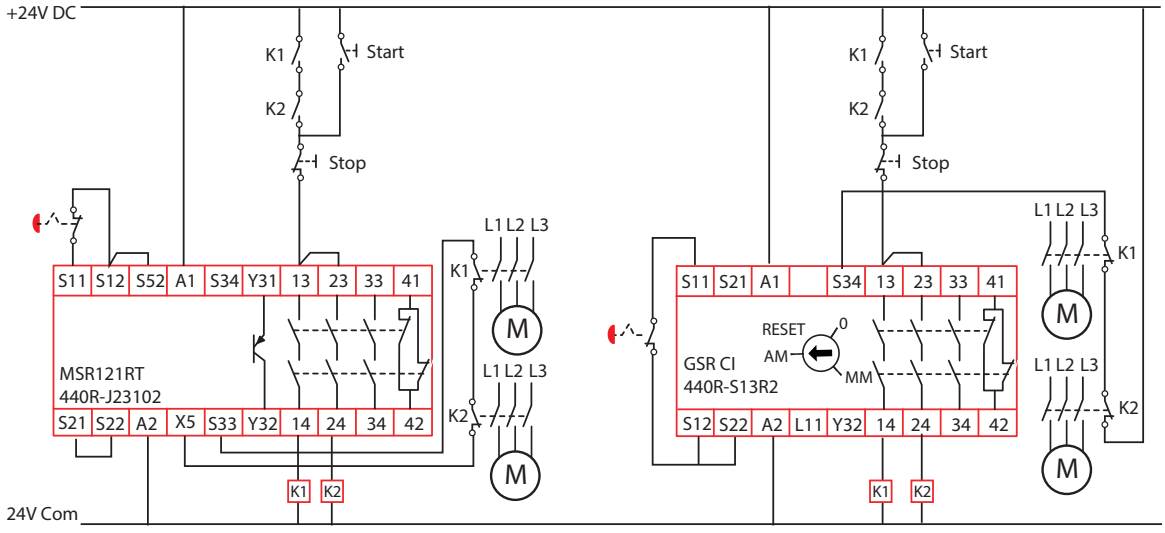


Figure 60 - Single Channel Input, Automatic Reset, DC Powered Schematic



OSSD Input

Figure 61 - OSSD Input, Monitored Reset, DC Powered Schematic

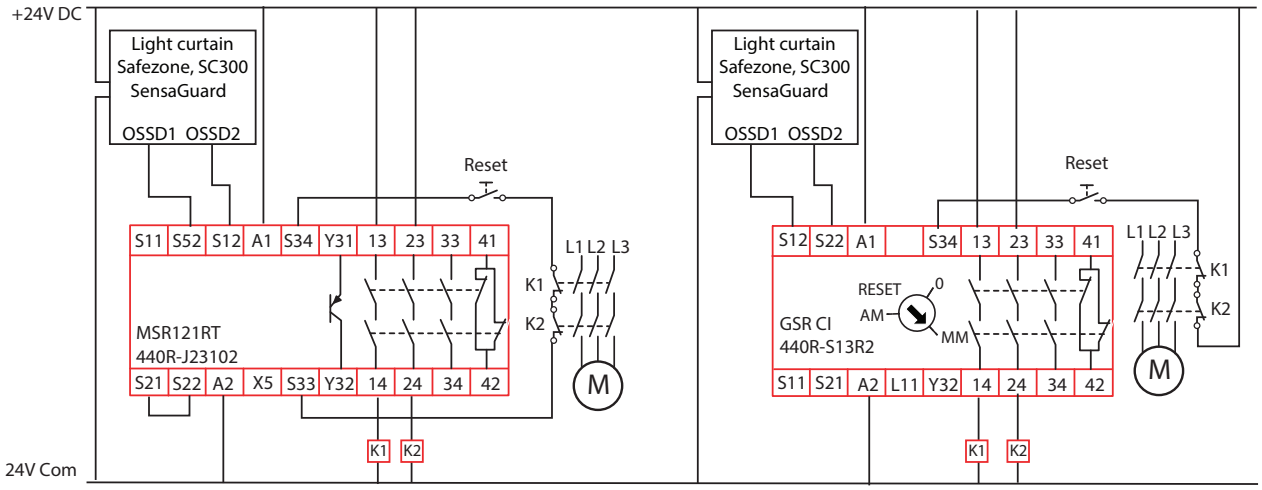
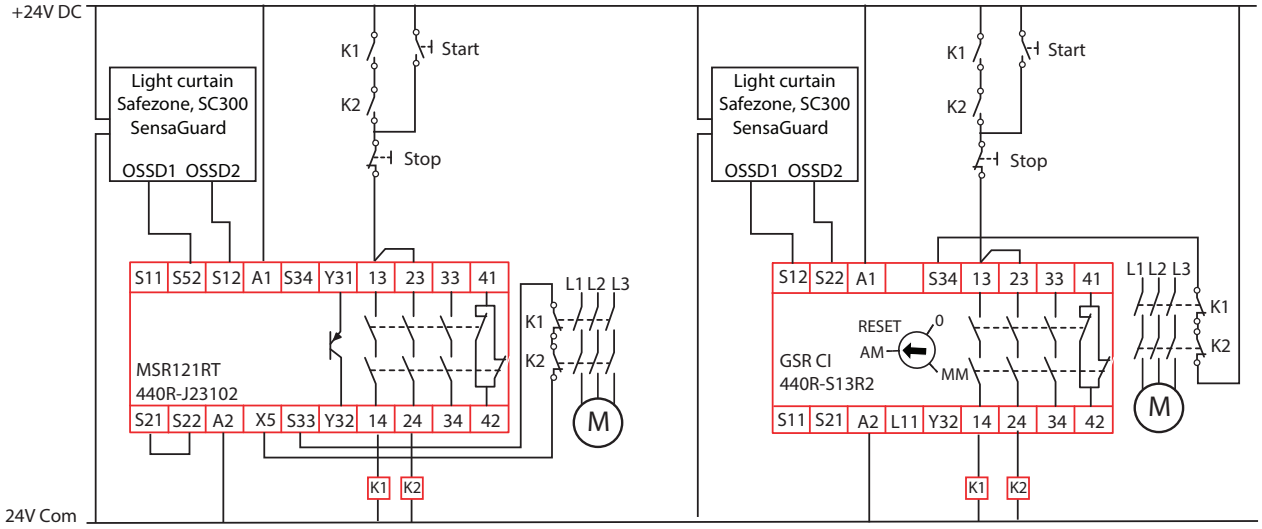


Figure 62 - OSSD Input, Automatic Reset, DC Powered Schematic



Safety Mat

Figure 63 - Safety Mat Input, Monitored Reset, DC Powered Schematic

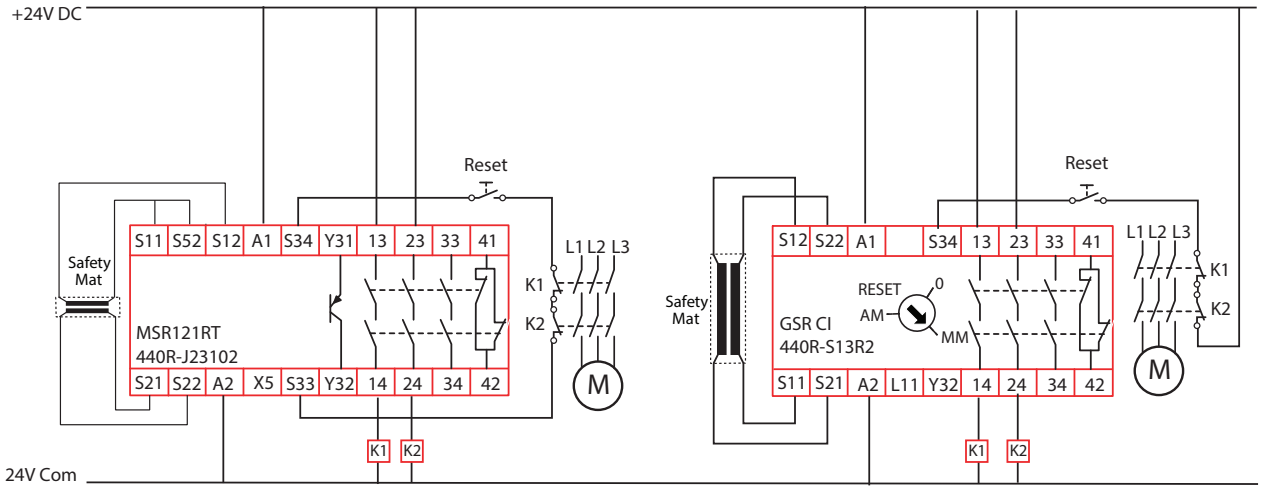
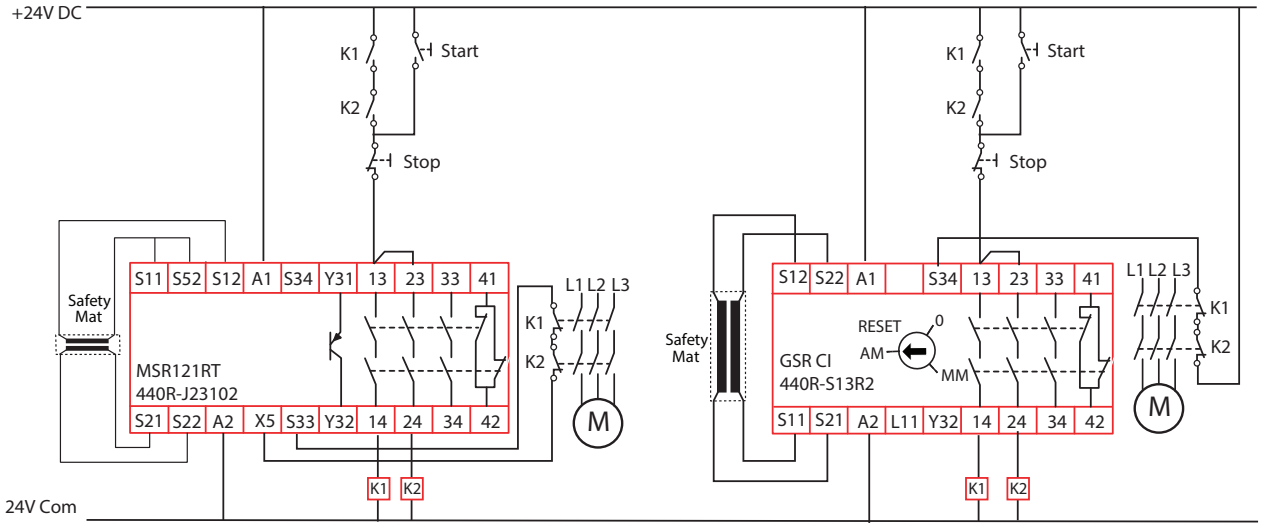
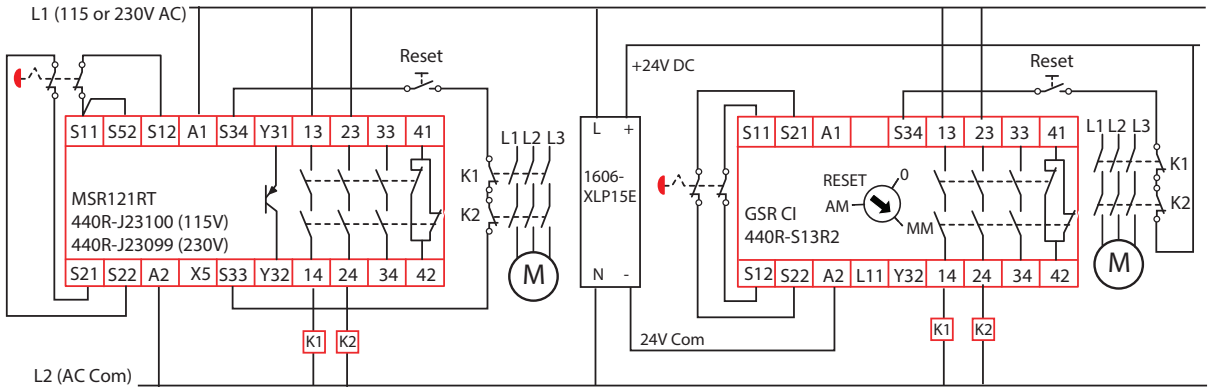


Figure 64 - Safety Mat Input, Automatic Reset, DC Powered Schematic



AC Powered

Figure 65 - Dual Channel Input, Monitored Reset, AC Powered Schematic



Response Time

ATTENTION: The response time of the MSR121RT safety relay is faster than the CI safety relay, so the safety distance must be examined closely and adjusted if necessary.

Table 15 - Response Time

Safety Relay	Response Time [ms]
MSR121RT	15 (24V AC/DC) 20 (24, 115, and 230V AC)
CI	35 (mechanical and OSSD inputs) 45 (safety mat inputs)

Output Load Capability

The MSR121RT safety relay has a higher current capability than the CI safety relay as shown in Table 16. See Output Load Capability (page 11) for a wiring example of using interposing relays for applications where the load exceeds the GSR capability.

Table 16 - Current Capability

Load Type	MSR121RT	CI
AC Inductive	B300, AC-15 6 A/250V AC	C300, AC-15 1.5 A
DC	R300, DC-13 6 A/240V DC	2 A at 24V DC
Thermal (non-switching)	6 A	2 A

MSR122E Safety Relay

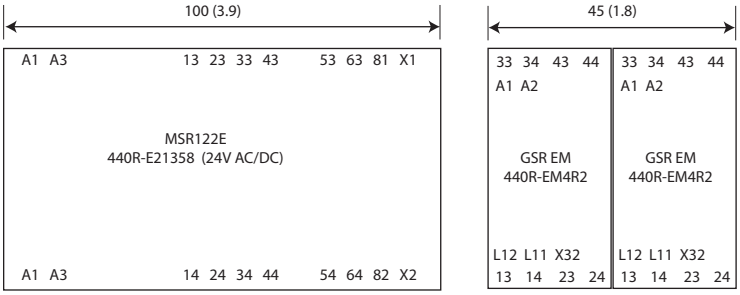
Figure 66 - MSR122E Safety Relay

We recommend replacing the MSR122E safety relay with two EM safety relays. The MSR122E safety relay has two input channels. When driven by a host safety relay, the host relay must devote two safety outputs to drive the MSR122E safety relay. With the EM safety relays, the Single Wire Safety (SWS) output lets the host relay communicate with the EM safety relay over one wire and saves the safety outputs of the host for other uses.

Terminal Locations and Panel Space

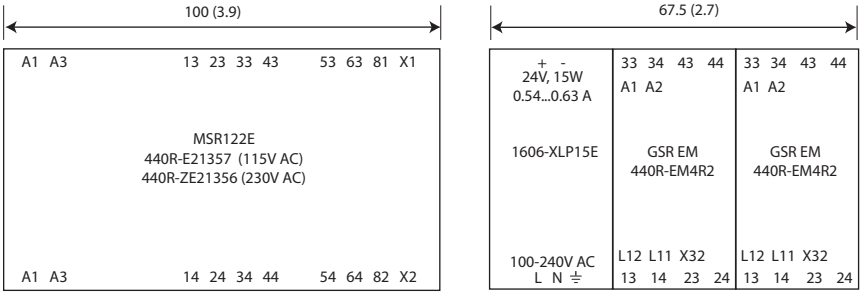
The MSR122E safety relay is 100 mm (3.9 in.) wide with one row of terminals at the top and bottom. The EM safety relay is 22.5 mm (0.9 in.) wide with two rows of terminals at the top and bottom. Two EM safety relays occupy 45 mm (1.8 in.) of panel space, which is half the panel space as one MSR122E safety relay.

Figure 67 - DC Powered Terminals and Panel Space [mm (in.)]



For applications where the MSR122E safety relay power supply is 110V AC, a power supply (catalog number 1606-XLP15E) must be used to convert the AC supply to 24V DC. With the additional power supply, the panel space by the replacement design still occupies less space than one MSR122E safety relay.

Figure 68 - AC Powered Terminals and Panel Space [mm (in.)]

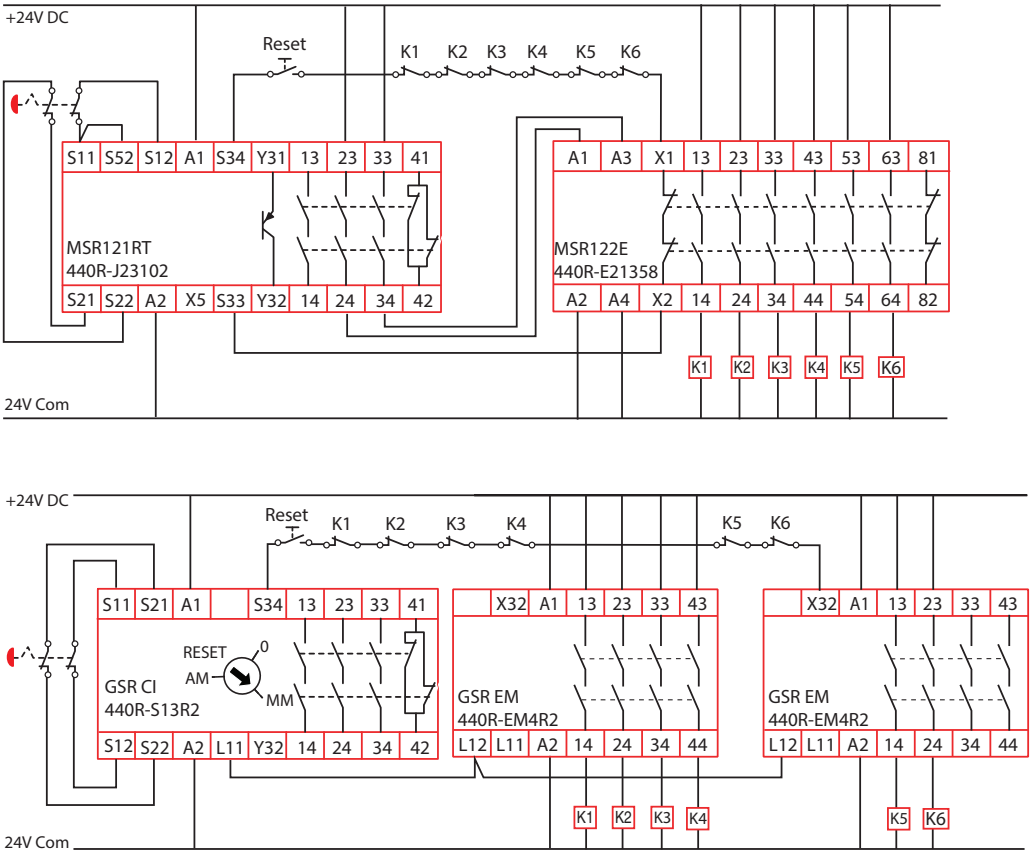


Wiring Schematics

The following schematics compare the wiring of your existing MSR module to the recommended newer devices for each application that the existing device provides.

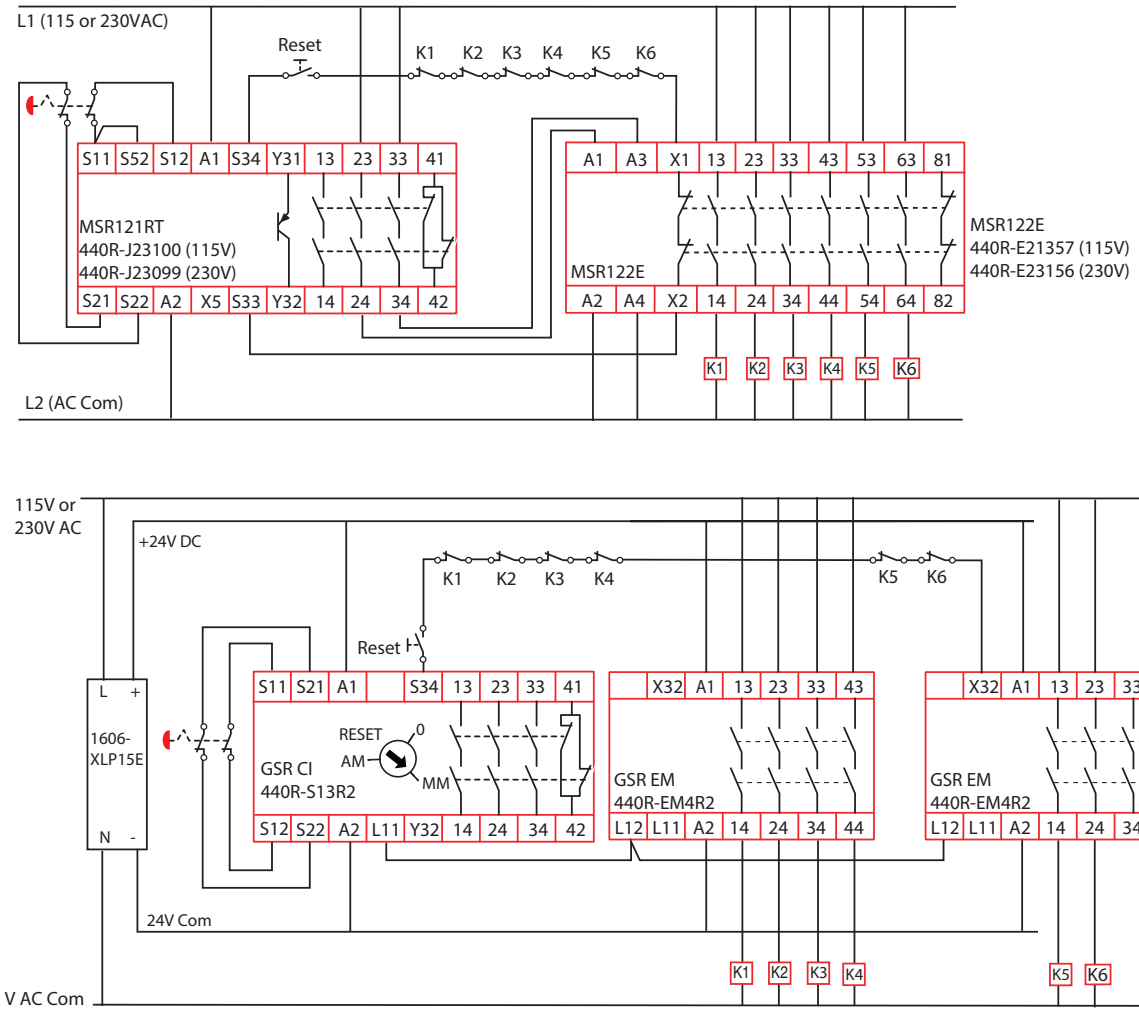
DC Powered

Figure 69 - 24V DC Powered Schematic



AC Powered

Figure 70 - 115V/230V AC Powered Schematic



Response Time

ATTENTION: The response time of the MSR122E safety relay is faster than the EM safety relays, so the safety distance must be examined closely and adjusted if necessary.

Table 17 - Response Time

Safety Relay	Response Time [ms]
MSR122E	30
EM	35

Output Load Capability

The outputs of the EM safety relay may require interposing relays, depending in the load the MSR122E safety relay switches. See Output Load Capability (page 11) for a wiring example of using interposing relays for applications where the load exceeds the EM safety relay capability.

Table 18 - Current Capability

Load Type	MSR122E	EM
AC Inductive	B300, AC-15 4 A/250V AC	B300, AC-15 1.5 A/250V AC
DC	DC-13 2 A/24V DC	DC-13 2 A/24V DC (0.1 Hz)

MSR144 Safety Relay

Figure 71 - MSR144 Safety Relay

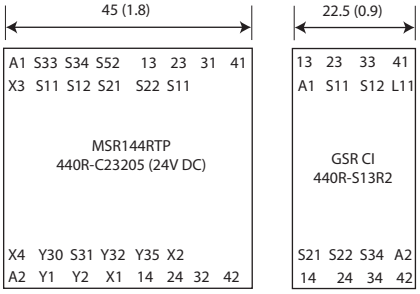
We recommend replacing the MSR1244 safety relay with a CI safety relay. If the application does not use the normally closed outputs of the MSR144, an SI safety relay can replace the MSR144 safety relay.

The outputs of the MSR144 safety relay can be expanded with MSR230 safety relay immediate operating outputs and the MSR238 safety relay delayed operating output modules. GSR modules use the EM and EMD safety relays to expand its outputs.

Terminal Locations and Panel Space

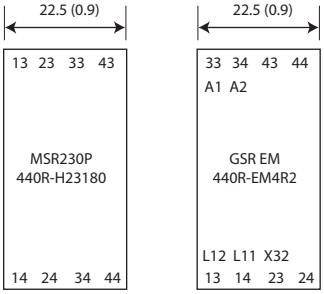
The MSR144 safety relay is 45 mm (1.8 in.) wide while the CI safety relay is only 22.5 mm (0.9 in.) wide.

Figure 72 - DC Powered Terminals and Panel Space [mm (in.)]



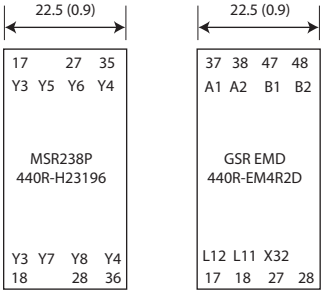
The MSR230P safety relay expands outputs with four immediately operating outputs. The EM safety relay is the equivalent immediately operating outputs in the GSR family. Both modules are 22.5 mm (0.9 in.) wide.

Figure 73 - Expansion Module Terminals and Panel Space [mm (in.)]



The MSR238P safety relay has two delayed outputs. You can replace this module with the EMD safety relay. Both modules are 22.5 mm (0.9 in.) wide.

Figure 74 - Expansion Module with Delay Terminals and Panel Space [mm (in.)]



Wiring Schematics

The following schematics compare the wiring of your existing MSR module to the recommended newer devices for each application that the existing device provides.

Dual Channel

Figure 75 - Dual Channel, Monitored Reset Schematic, DC Powered

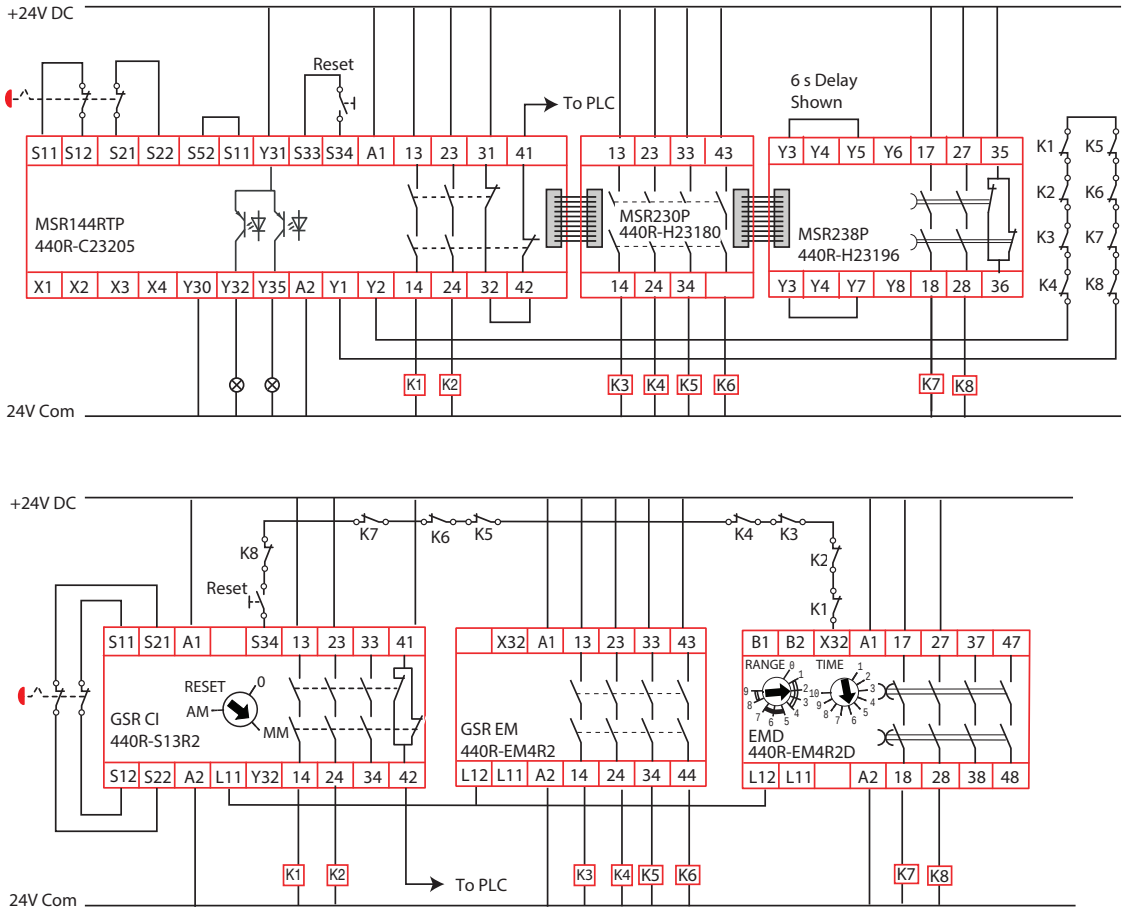
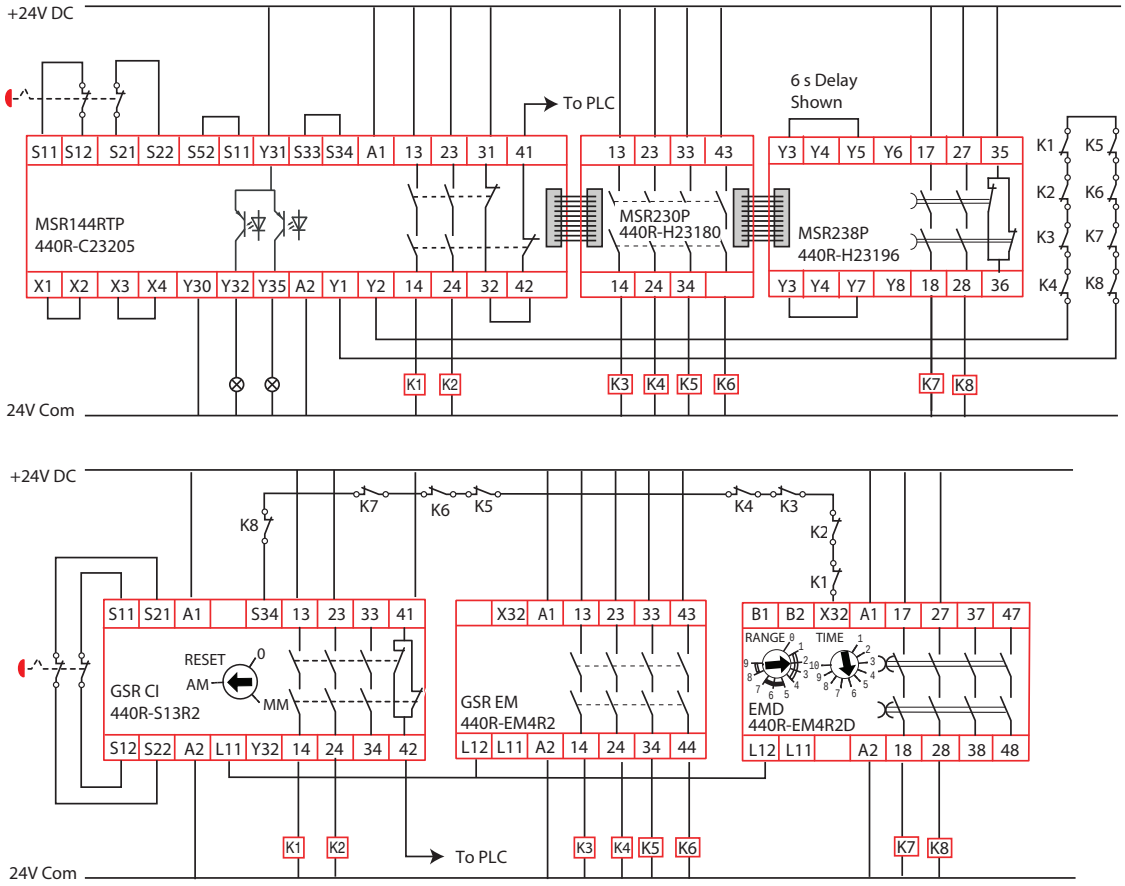
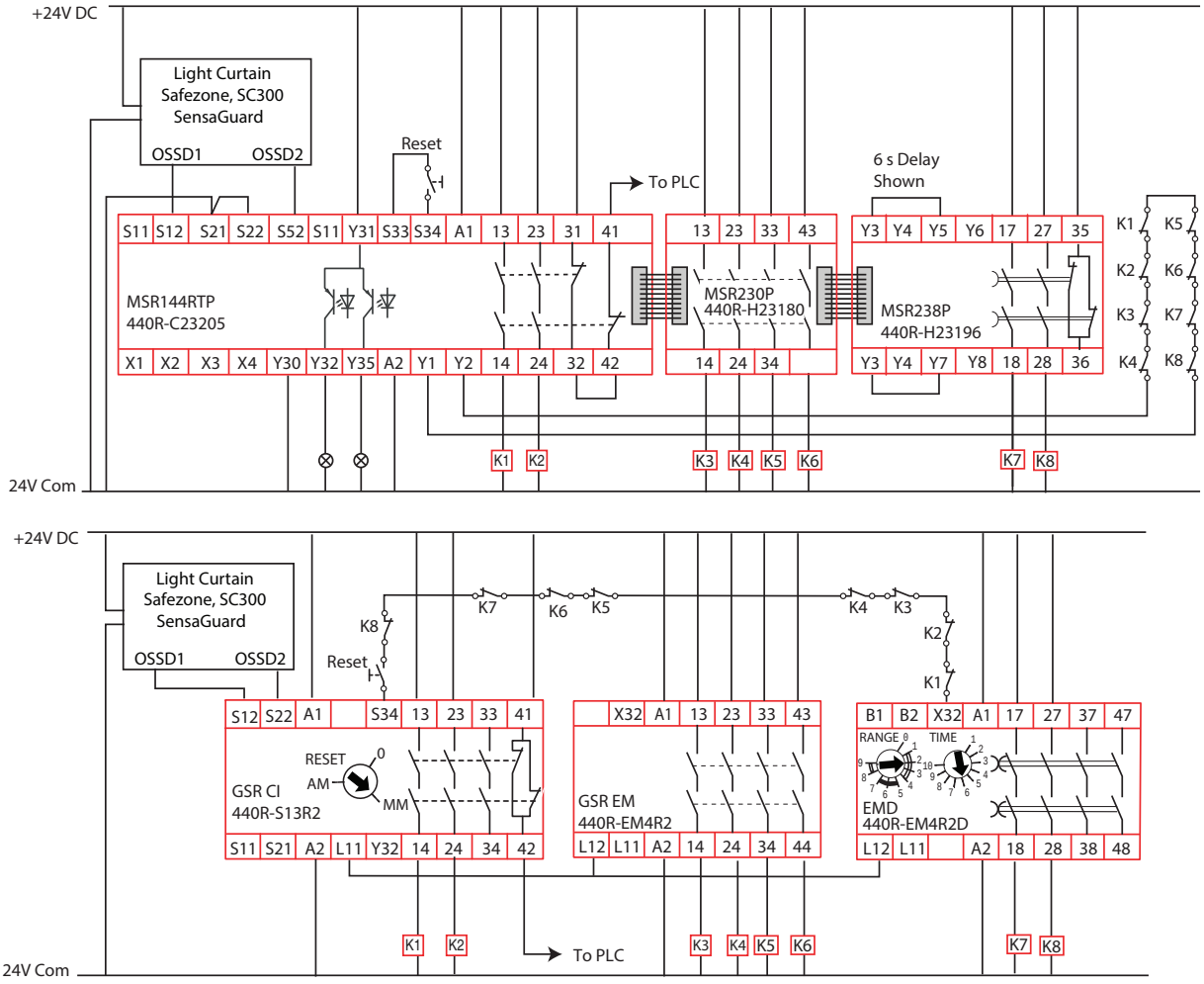


Figure 76 - Dual Channel, Automatic Reset Schematic, DC Powered



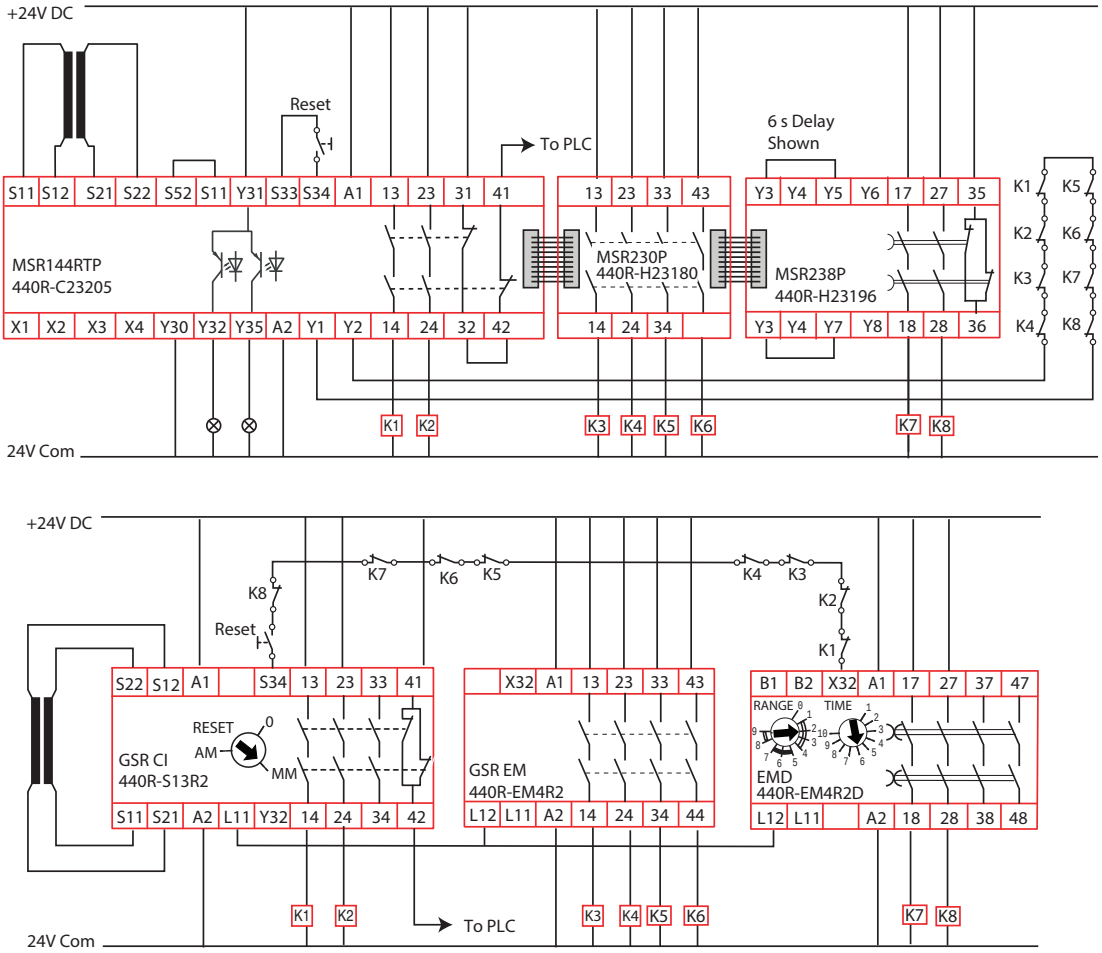
Light Curtain

Figure 77 - Light Curtain, Monitored Reset Schematic, DC Powered



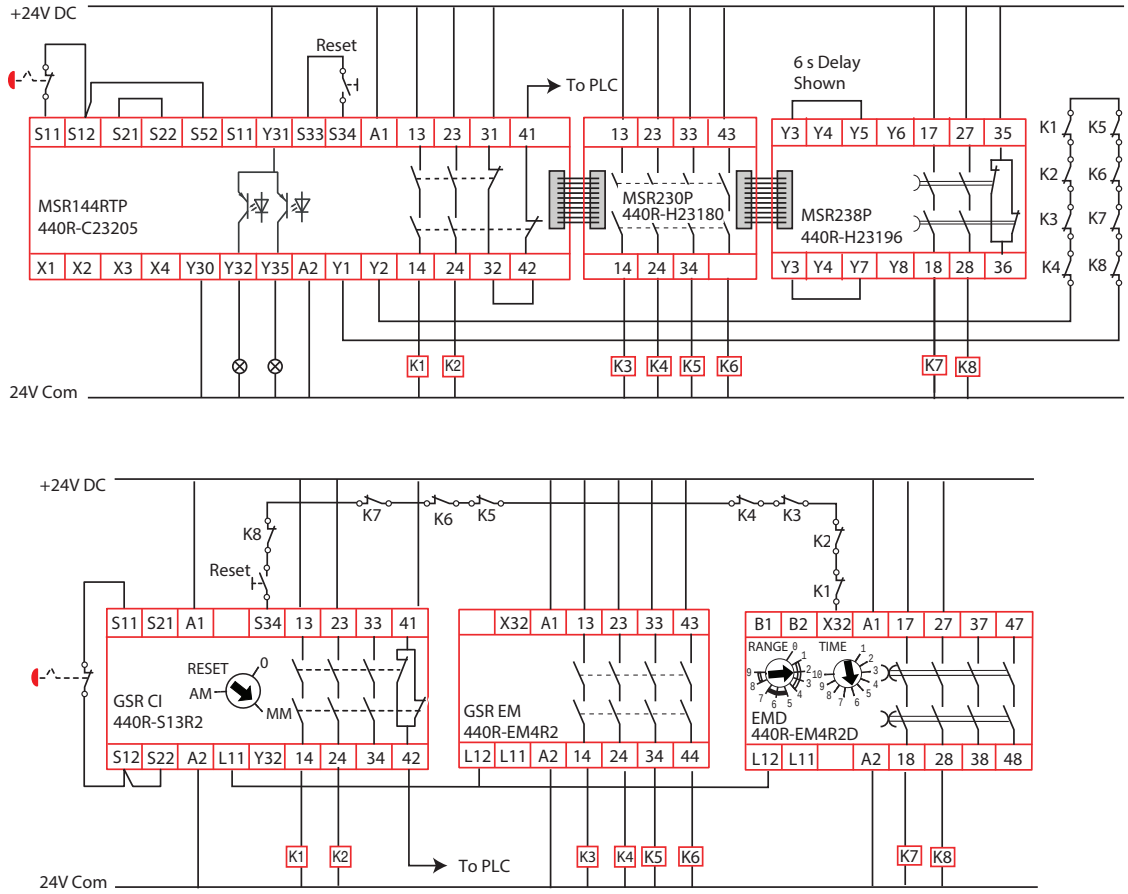
Safety Mat

Figure 78 - Safety Mat, Monitored Reset Schematic, DC Powered



Single Channel

Figure 79 - Single Channel, Monitored Reset Schematic, DC Powered



Response Time

ATTENTION: You must evaluate the response time of your existing system and compare it to the new system. Based on the difference, you can adjust the safety distance.

Table 19 - Response Time

Safety Relay	Response Time [ms]
MSR144RTP	15
MSR230P	—
MSR238P	Delay determined by wiring jumpers
CI safety output	35 (45 for safety mats)
CI SWS output	25 (35 for safety mats)
EM	35 (40 for safety mats)
EMD	35 + delay determined by switch setting

Output Load Capability

The following tables compare the output switching capabilities of the MSR144RTP to the suggested replacements. In some cases, an interposing relay is required. See Output Load Capability (page 11) for a wiring example of using interposing relays.

Table 20 - Current Capability (MSR144/CI)

Load Type	MSR144RTP	CI
AC Inductive	B300, AC-15 5 A/250V AC	C300, AC-15 3 A/250V AC
DC	DC-13 3 A/24V DC	DC-13 4 A/24V DC
Thermal (non-switching)	1 x 6 A or 2 x 5 A	4 A on 1 circuit

Table 21 - Current Capability (MSR230P/EM)

Load Type	MSR230P	EM
AC Inductive	B300, AC-15 6 A/250V AC	B300, AC-15 1.5 A/250V AC
DC	DC-13 3 A/24V DC	DC-13 2 A/24V DC
Thermal (non-switching)	2 x 6 A, 3 x 5 A, or 4 x 4 A	6 A on 1 circuit

Table 22 - Current Capability (MSR238DP/EMD)

Load Type	MSR238DP	EMD
AC Inductive	B300, AC-15 3 A/250V AC	B300, AC-15 1.5 A/250V AC
DC	DC-13 2.5 A/24V DC	DC-13 2 A/24V DC
Thermal (non-switching)	1 x 6 A, 2 x 4 A	6 A on 1 circuit

Notes:

MSR200 Safety Relay

Figure 80 - MSR200 Safety Relay

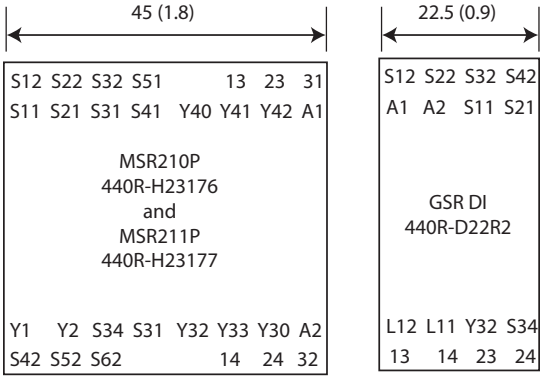
We recommend replacing the MSR200 safety relay with a DI safety relay. When output expansion is needed, use an EM and EMD safety relay.

The MSR200 safety relay also has a communication module (MSR240P). The module generates messages that meet the requirements for RS-232 and RS-485. There is no direct replacement for both. The recommended alternative is to use the EtherNet/IP™ module (catalog number 440R-ENETR).

Terminal Locations and Panel Space

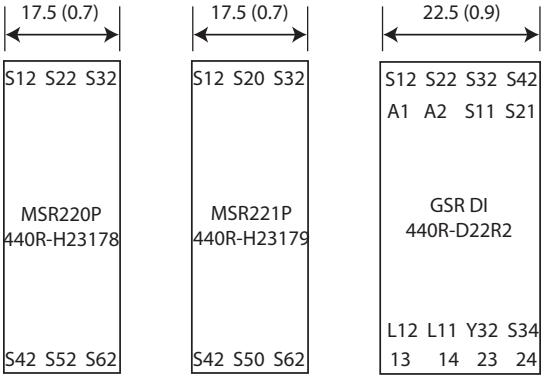
The MSR210P and MSR211P safety relays have identical terminal locations. The MSR210 safety relay is designed for mechanically operated safety devices; the MSR211 safety relay is designed for safety devices with OSSD outputs. We recommend replacing these safety relays with a DI safety relay.

Figure 81 - MSR210P Terminals and Panel Space [mm (in.)]



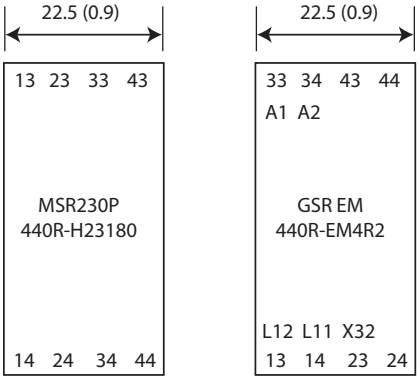
The MSR200 relay family is able to add additional input modules: one is the MSR220P safety relay and the other is the MSR221P safety relay. We recommend replacing these safety relays with a DI safety relay.

Figure 82 - MSR220P and MSR221P Terminals and Panel Space [mm (in.)]



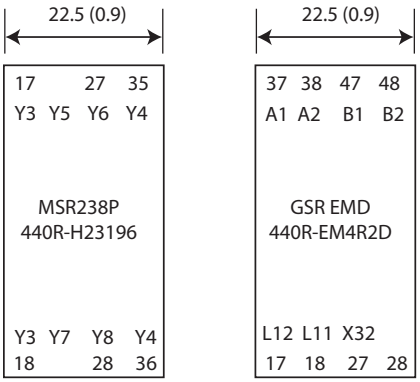
The MSR200 relay family can also expand output modules. The MSR230P safety relay has immediate outputs. We recommend replacing this safety relay with an EM safety relay.

Figure 83 - MSR230P Terminals and Panel Space [mm (in.)]



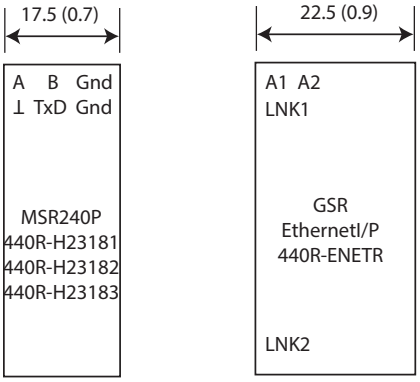
The MSR238P safety relay has delayed outputs. We recommend replacing this safety relay with an EMD safety relay.

Figure 84 - MSR238P Terminals and Panel Space [mm (in.)]



The MSR240 safety relay also has communications options. Relay status is communicated using an RS-232 or RS-485 output module. There is no direct replacement, however we recommend replacing this safety relay with an EtherNet/IP module (catalog number 440R-ENETR).

Figure 85 - MSR240P Terminals and Panel Space [mm (in.)]



Wiring Schematics

The following schematics compare the wiring of your existing MSR module to the recommended newer devices for each application that the existing device provides.

Dual Channel

Safety standards require that interlock closure or release of E-stops must not initiate hazards.

Figure 86 - MSR210, Dual Chanel, Monitored Reset, DC Powered Schematic

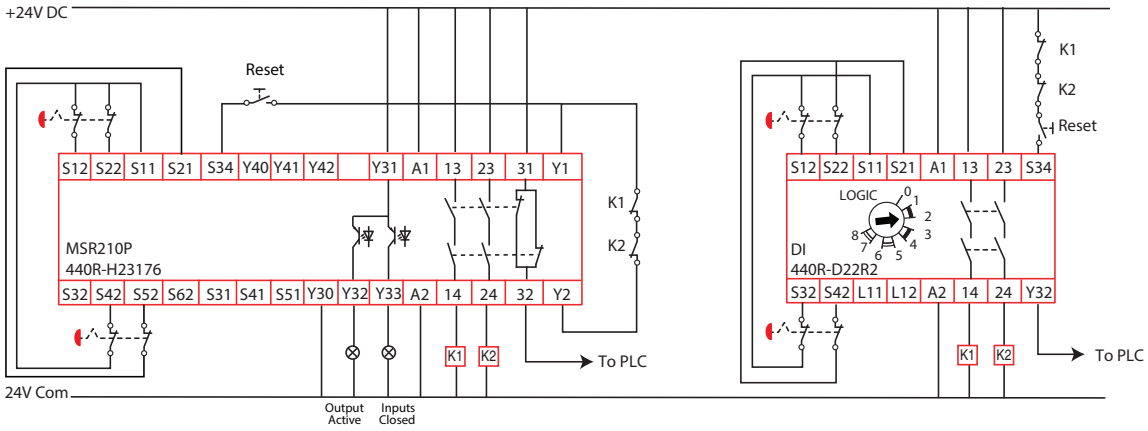
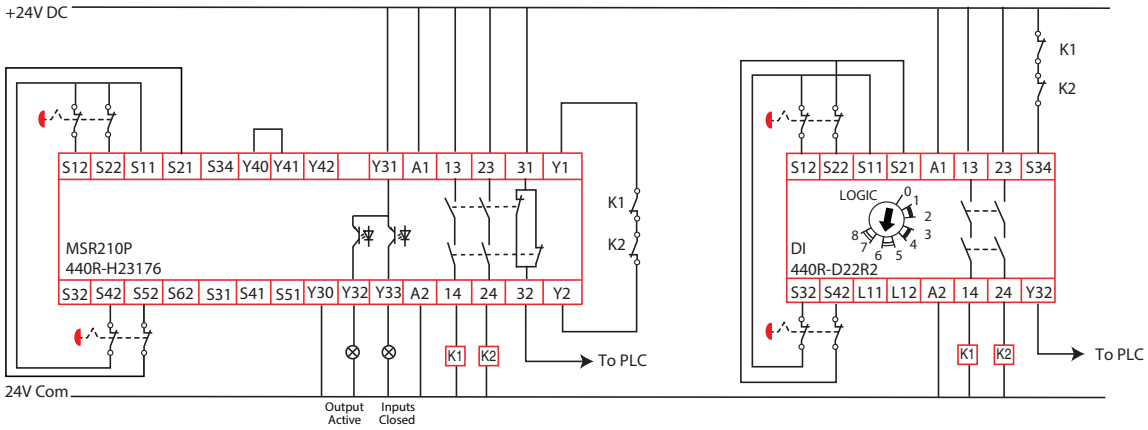


Figure 87 - MSR210, Dual Chanel, Automatic Reset, DC Powered Schematic



Single Channel

Figure 88 - MSR210, Single Chanel, Monitored Reset, DC Powered Schematic

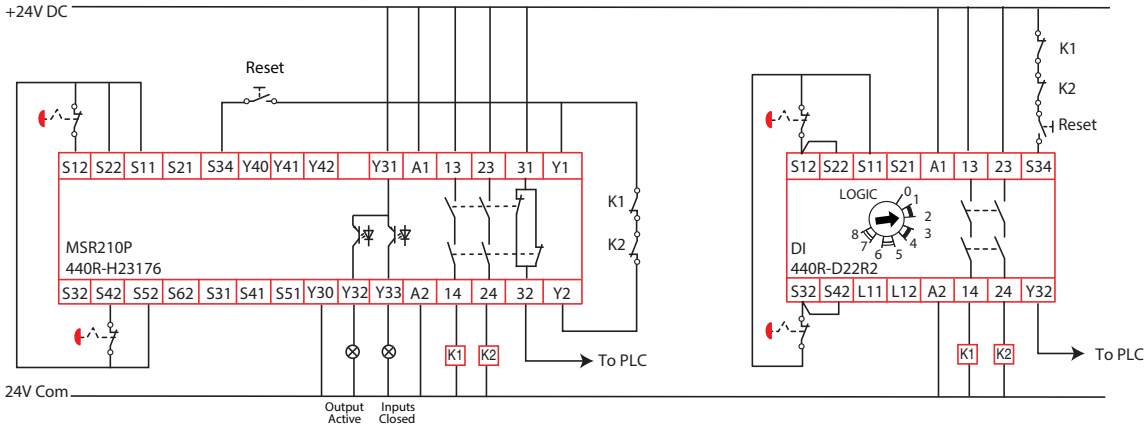
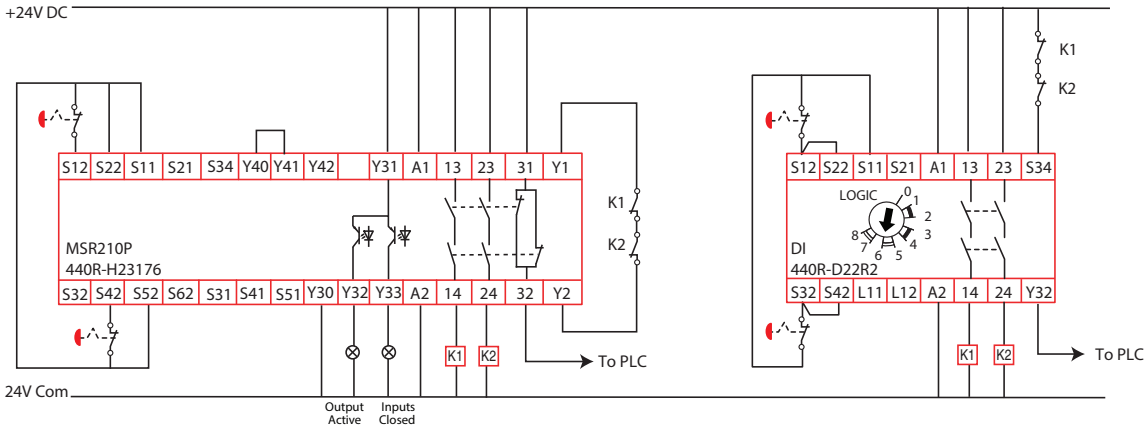
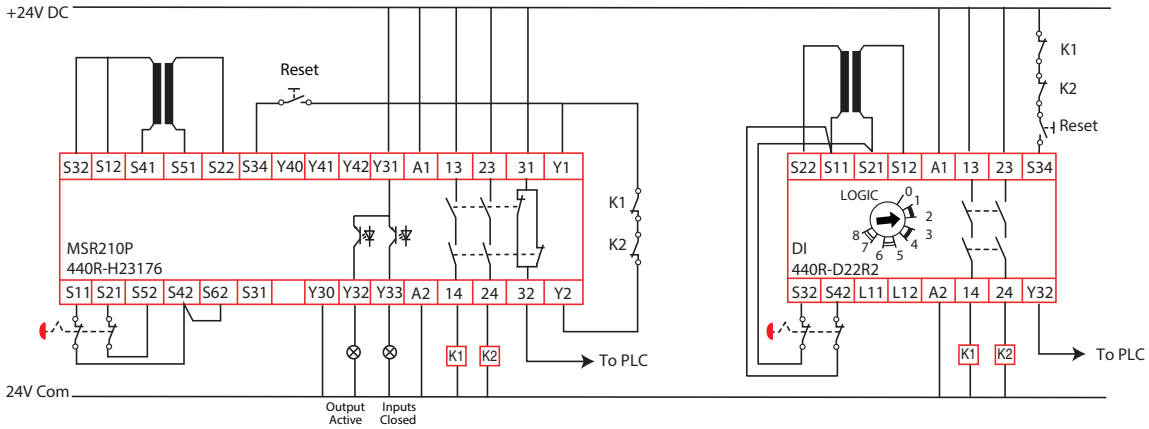


Figure 89 - MSR210, Single Chanel, Automatic Reset, DC Powered Schematic



Safety Mat

Figure 90 - MSR210, Safety Mat, Monitored Reset, DC Powered Schematic



OSSD Inputs

Figure 91 - MSR211, OSSD Inputs, Monitored Reset, DC Powered Schematic

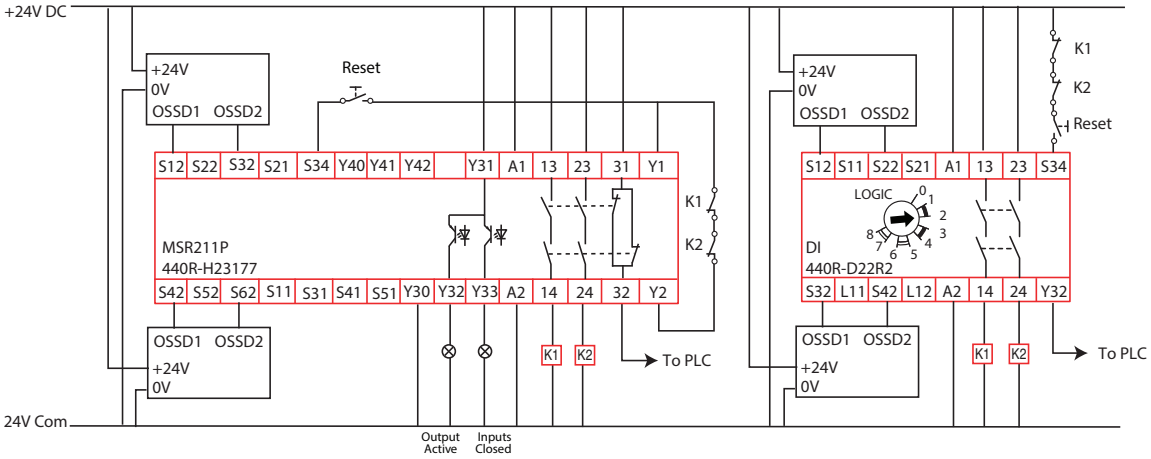
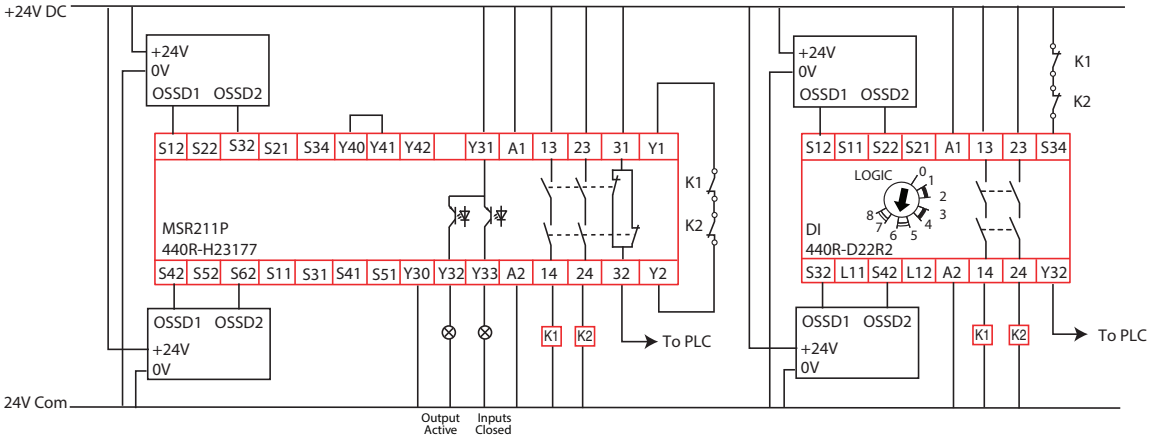


Figure 92 - MSR211, OSSD Inputs, Automatic Reset, DC Powered Schematic



Input Expansion

Figure 93 - MSR220 Input Expansion Schematic

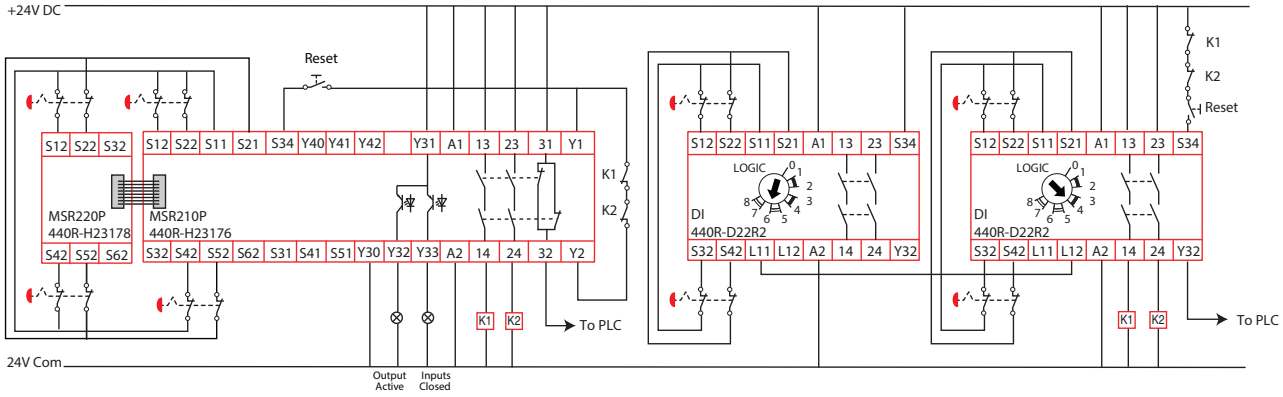
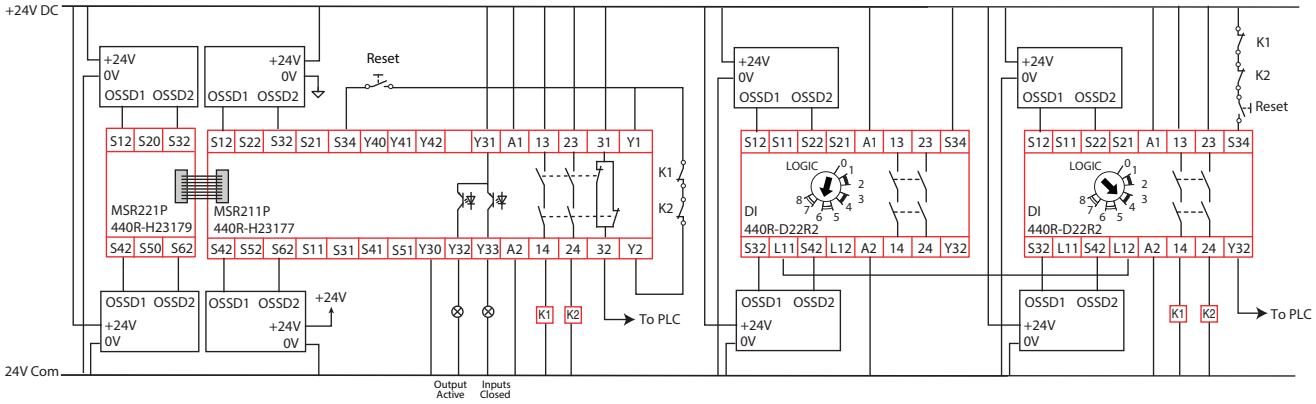


Figure 94 - MSR221 Input Expansion Schematic



Output Expansion

Figure 95 - MSR230 Output Expansion Schematic

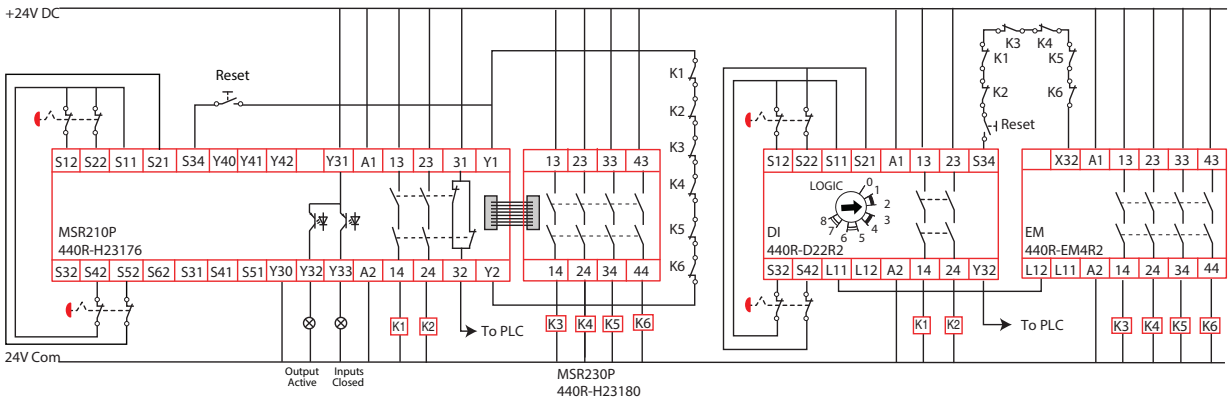
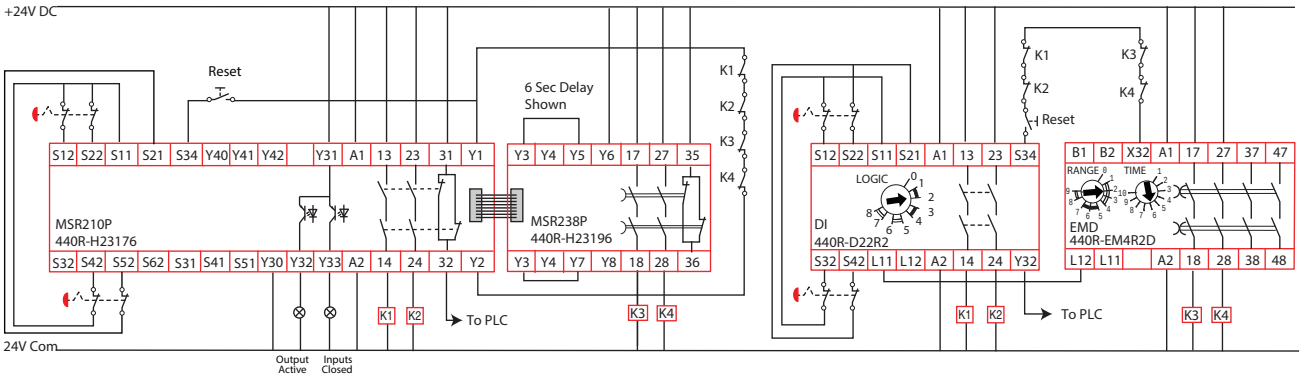
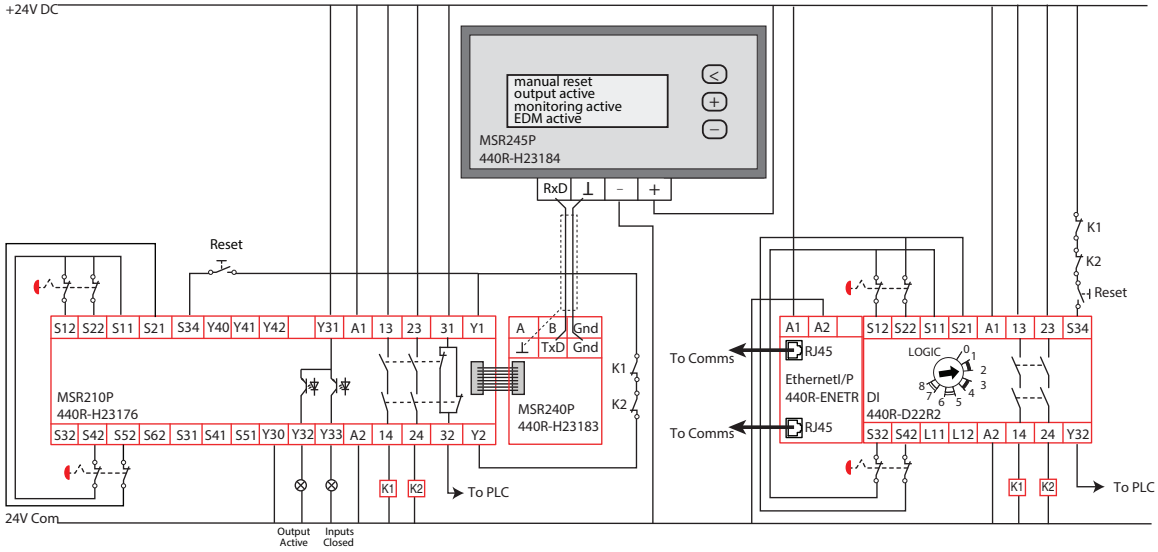


Figure 96 - MSR238 Output Delayed Expansion Schematic



Communication

Figure 97 - MSR240 Communication Schematic



Response Time

ATTENTION: You must evaluate the response time of your existing system and compare it to the new system. Based on the difference, you may have to adjust the safety distance.

Table 23 - Response Time

Safety Relay	Response Time [ms]
MSR210P, MSR211P	32 34 + 6 ms per module (with input expansion modules)
MSR230P	—
MSR238P	Delay determined by wiring jumpers
DI	25 (single wire safety output)
EM	35 (40 for mats)
EMD	35 + delay determined by switch settings

Output Load Capability

The following tables compare the output switching capabilities of the MSR200 safety relay family to the suggested replacements. In some cases, an interposing relay may be required. See Output Load Capability (page 11) for a wiring example of using interposing relays.

Table 24 - MSR210P and MSR211P/DI Current Capability

Load Type	MSR210P and MSR211P	DI
AC Inductive	B300, AC-15 3 A/250V AC	C300, AC-15 3 A/250V AC
DC	DC-13 2.5 A/24V DC	DC-13 4 A/24V DC
Thermal (non-switching)	1 x 6 A or 2 x 4 A	4 A on 1 circuit

Table 25 - MSR230P/EM Current Capability

Load Type	MSR230P	EM
AC Inductive	B300, AC-15 6 A/250V AC	B300, AC-15 1.5 A/250V AC
DC	DC-13 3 A/24V DC	DC-13 2 A/24V DC
Thermal (non-switching)	2 x 6 A, 3 x 5 A, or 4 x 4 A	6 A on 1 circuit

Table 26 - MSR238DP/EMD Current Capability

Load Type	MSR238DP	EMD
AC Inductive	B300, AC-15 3 A/250V AC	B300, AC-15 1.5 A/250V AC
DC	DC-13 2.5 A/24V DC	DC-13 2 A/24V DC
Thermal (non-switching)	1 x 6 A, 2 x 4 A	6 A on 1 circuit

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Direct Dial Codes	Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer.	http://www.rockwellautomation.com/global/support/direct-dial.page
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Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	http://www.rockwellautomation.com/global/support/pcdc.page

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