



Minotaur Safety Relay (MSR) to Guardmaster Safety Relay (GSR) Conversion (Phases 1...4)

Bulletin Number 440R



Allen-Bradley

by ROCKWELL AUTOMATION

Guardmaster®

Reference Manual

Original Instructions

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.

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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.

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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).

The following icon may appear in the text of this document.



Identifies information that is useful and can help to make a process easier to do or easier to understand.

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A number of older Allen-Bradley Guardmaster® safety relays are discontinued and no longer available for sale. 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, you must verify 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. Because many variables and requirements are associated with any particular installation, Rockwell Automation does not assume responsibility or liability for actual use that is based on these examples.

IMPORTANT The following MSR safety relays will continue to be offered for the foreseeable future.

MSR Family	Cat. No.	MSR Family	Cat. No.	MSR Family	Cat. No.	MSR Family	Cat. No.
MSR22LM	440R-P23071	MSR126	440R-N23112	MSR131	440R-C23136	MSR138	440R-M23080
MSR41	440R-P221AGS		440R-N23113		440R-C23137		440R-M23081
MSR42	440R-P226AGS-NNR		440R-N23114		440R-C23139		440R-M23082
	445L-104794-Bx		440R-N23115		440R-C23139S		440R-M23084
MSR45	440R-P4NANS		440R-N23116	MSR132	440R-E23098		440R-M23085
	445L-1x		440R-N23117		440R-E23097		440R-M23086
MSR5T	440R-B23020		440R-N23118		440R-E23159		440R-M23088
MSR55	440R-S3501x		440R-N23119		440R-E23160		440R-M23089
MSR117	440R-B23211		440R-N23120		440R-E23161		440R-M23090
MSR124	440R-G23107		440R-N23121		440R-E23162		440R-M23092
	440R-G23108		440R-N23122		440R-E23191		440R-M23140
	440R-G23110		440R-N23123		440R-E23192		440R-M23141
MSR125	440R-D23163	MSR127	440R-N23126		440R-E23193		440R-M23143
	440R-D23164		440R-N23124		440R-E23194		440R-M23143S
	440R-D23166		440R-N23125		440R-E23195		440R-M23144
	440R-D23168		440R-N23127				440R-M23145
	440R-D23169		440R-N23129				440R-M23147
	440R-D23170		440R-N23128				440R-M23147S
	440R-D23171		440R-N23132				440R-M23148
			440R-N23132S			MSR142	440R-M23149
			440R-N23130				440R-M23151
			440R-N23131				440R-G23214
			440R-N23133				440R-G23215
			440R-N23134				440R-G23216
			440R-N23135				
			440R-N23135S				
			440R-N23213				

Who Should Use this Manual

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

This manual provides guidance on the differences between the features of the safety relays to help you select an appropriate solution for your application. You must perform a risk assessment of your converted design to confirm it meets your safeguarding requirements.

Additional Resources

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

Resource	Description
Guardmaster EtherNet/IP Network Interface User Manual, publication 440R-UM009	Provides detailed information to install, wire, configure, troubleshoot, and use the EtherNet/IP™ module.
Guardmaster Safety Relays User Manual, publication 440R-UM013	Provides detailed information to install, wire, configure, troubleshoot, and use Guardmaster safety relays.
Minotaur Safety Relay User Manual, publication 440R-UM014	Provides detailed information to install, wire, configure, troubleshoot, and use the Minotaur™ MSR55P safety relay.
Guardmaster Configurable Safety Relay, Publication 440C-UM001	Provides detailed information to install, wire, configure, troubleshoot, and use the Guardmaster configurable safety relay.
System Design for the Control of Electrical Noise Reference Manual, publication GMC-RM001	Provides a thorough review of the installation and grounding of noisy components and what can be done to minimize their potential to inject noise into the system.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation® industrial system.
Product Certifications website, rok.auto/certifications	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at [rok.auto/literature](#).

Introduction

Product Overview

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

The narrow housing design of 22.5 mm (0.88 in.) and configurable reset and logic functions, GSR safety relays can consolidate various functions of MSR safety relays with fewer models.

The MSR product line of safety relay modules typically offers one dedicated safety function for one safety circuit and actuator. MSR safety relays have less connectivity to each other than GSR safety relays. To add a second or third safety circuit requires more safety relay modules and safety contacts for cascading to maintain PLd or PLe safety ratings according to EN ISO 13849-1, respectively, SIL 2 or SIL 3 according to IEC 62061.

The GSR safety relay offers configurable safety functions and consolidates safety circuits, which result in fewer units, less space, and fewer costs. Due to the unique SWS cascading capability, logic combinations and zones can be constructed quickly.

Replacement with a GSR safety relay is more than a one-by-one swap out.

New Machinery Directives, changes of harmonized standards, and demands of safety solutions drove past designs of machines and contributed to productivity and flexibility.

This publication offers detailed assistance in the conversion of legacy MSR safety relay solutions to a smarter, cost-effective design of machines. Compliance with the latest requirements of Machinery Directive and harmonized standards have also been addressed.

For further assistance in replacing those devices contact [Rockwell Automation 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 SIL 3 rating on most models
- RoHS compliance

Conversion Concerns

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. Panel space can become tight as the extra space is used. With panel space in mind, the recommended conversion is intended to maintain, or even reduce, panel space.

Wiring Terminal Location

The need to move a wire 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 previous and new devices, so you can plan the conversion appropriately.

Wiring Change

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

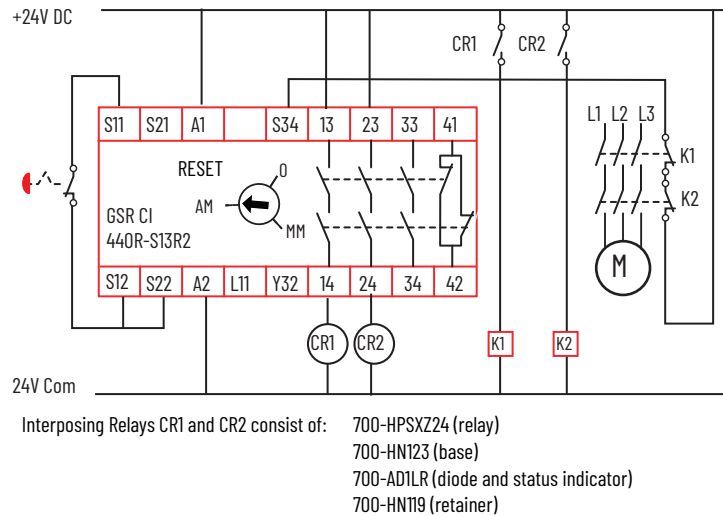
Response Time

Response time 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, you can use relays that interpose, as shown in [Figure 1](#).

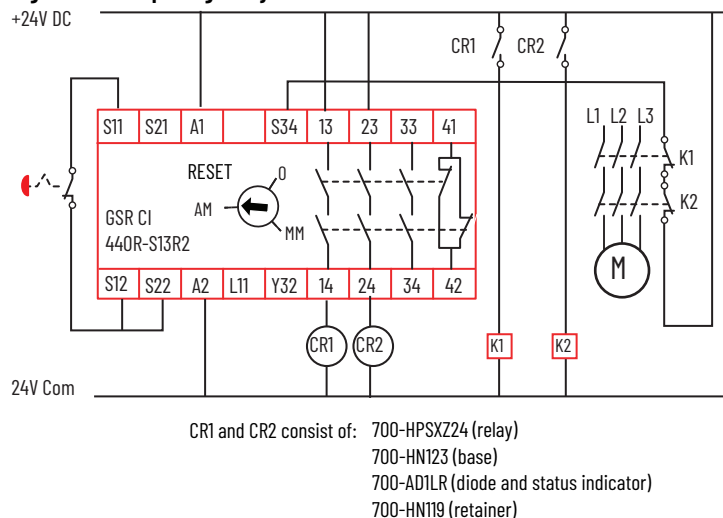
Figure 1 - Output Load Capability Using Interposing Relays



Interposing Relays

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 [Figure 2](#).

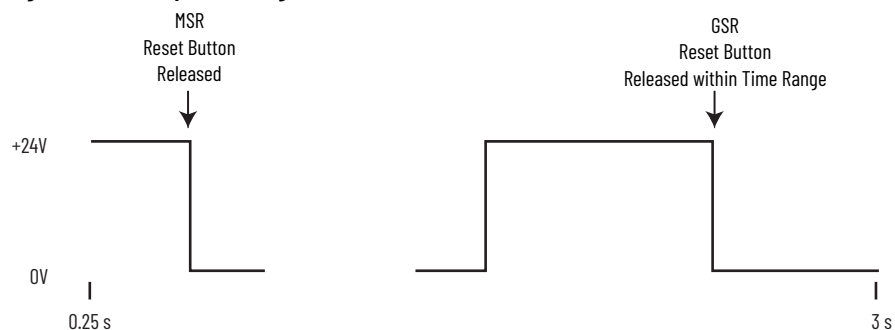
Figure 2 - Interposing Relays



Monitored Reset Operation

The reset operation of the GSR relays is slightly different from the operation of the MSR relays. The reset operation of the MSR relays occurs on the trailing edge of the signal; for example, when the reset button is released. The reset on the GSR relays must see that the reset signal is released within the range of 0.25...3 seconds.

Figure 3 - Reset Operation Signal



Phase 1 (April 2015)

MSR8T Safety Relay



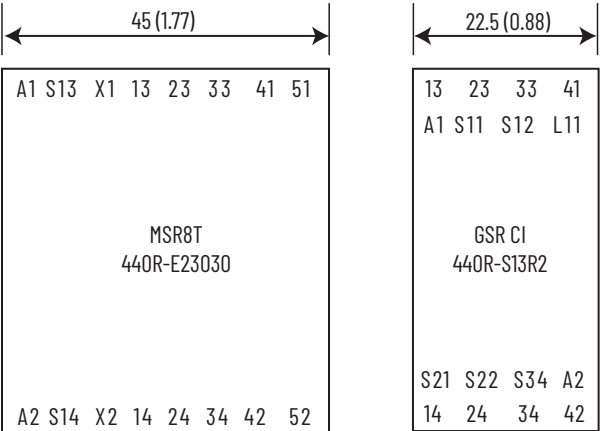
The preferred migration for the MSR8T safety relay is to the GSR CI safety relay.

The GSR CI safety relay has a switch to configure the reset to automatic or monitored manual. The wiring determines the single or dual-channel operation.

Terminal Locations and Panel Space

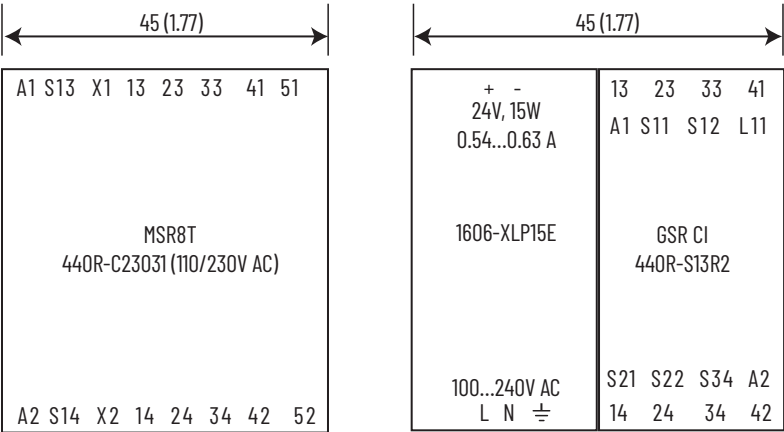
The MSR8T safety relay has a row of terminals at the top and bottom. The width is 45 mm (1.77 in.). The GSR CI safety relay has two rows of terminals at the top and bottom, with a smaller 22.5 mm (0.88 in.) width.

Figure 4 - DC Powered [mm (in.)]



The MSR8T safety relay has an option for 115V AC and 230V AC. Since the GSR CI safety relay is powered by 24V DC, catalog number 1606-XLP15E, can be used to convert the AC supply to 24V DC, while still occupying the same amount of space.

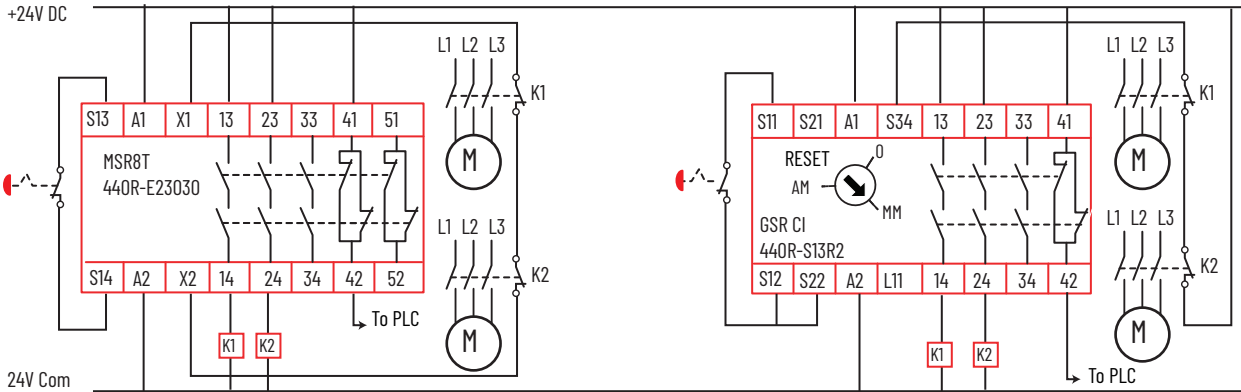
Figure 5 - AC Powered [mm (in.)]



The power, safety inputs, and outputs are similar. The reset/monitoring circuit is slightly different. [Figure 6...](#)[Figure 8 on page 15](#) show comparisons of the typical ways a MSR8T safety relay can be applied and the GSR CI safety relay equivalent.

Example Wiring Schematics

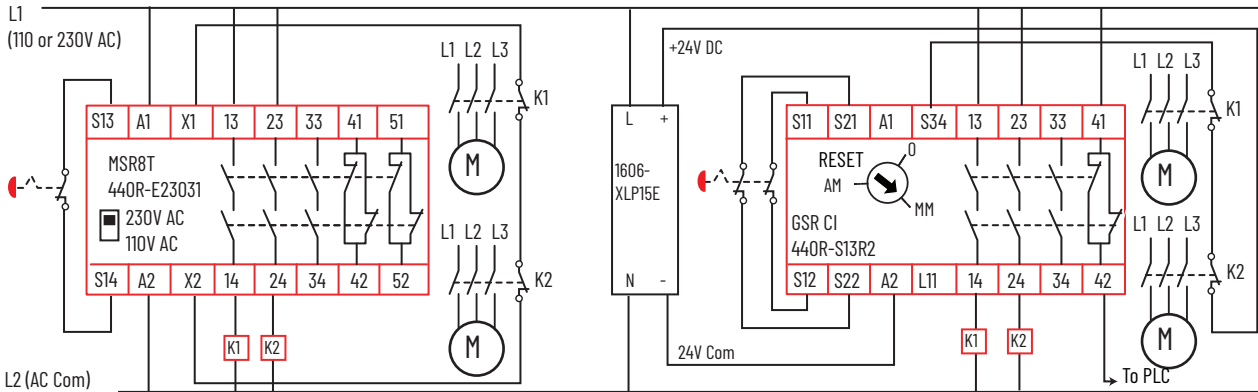
Figure 6 - DC Powered



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

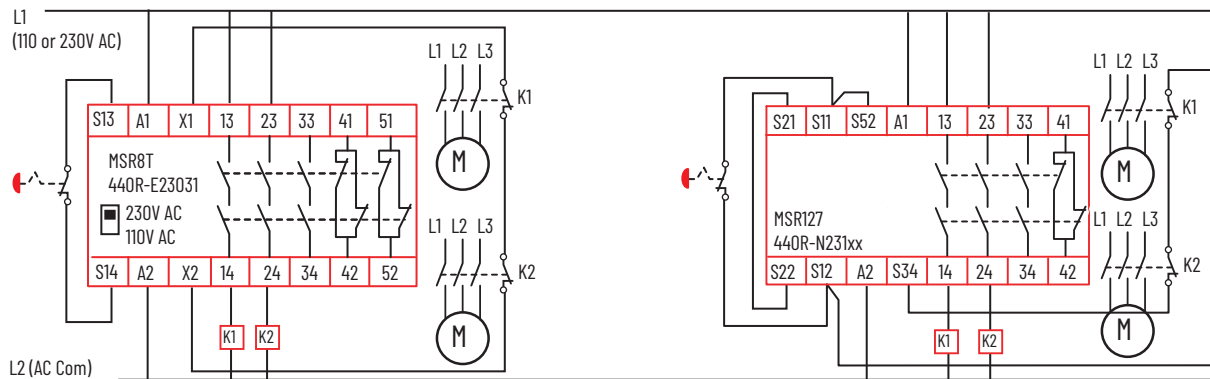
The MSR8T safety relay has an internal switch that sets the power to either 115V or 230V AC.

Figure 7 - AC Powered



As an alternative, an equivalent MSR127 safety relay can replace the AC powered MSR8 safety relay. Select the appropriate MSR127 safety relay.

Figure 8 - AC Powered Alternative



Response Time

Table 1 - Response Time

Safety Relay	Response Time [ms]
MSR8T	90
GSR CI	35

Since the GSR CI safety relay has a faster response time, the safety distance for the GSR CI safety relay is shorter than the MSR8T safety relay. No further action is required.

Output Load Capability

The MSR8T safety relay has a higher current capability than the GSR CI safety relay, see [Table 2](#). See [Interposing Relays on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR CI safety relay capability.

Table 2 - Current Capability

Load Type	MSR8T	GSR CI
AC Inductive	B300, AC-15 4 A	C300, AC-15 1.5 A
DC	P300, DC-13 3 A at 24V DC	2 A at 24V DC
Thermal (non-switching)	4 A	2 A

MSR10RD Safety Relay



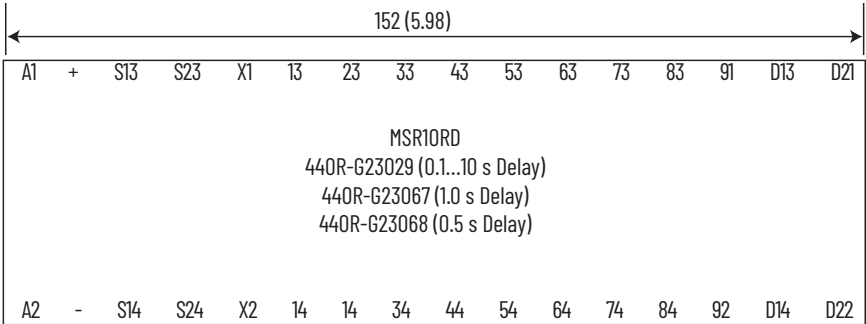
The MSR10RD safety relay has eight immediate safety outputs and one delayed safety output, plus an immediate auxiliary output and a delayed auxiliary output. The preferred migration for the MSR10RDT safety is to the GSR CI safety relay with two EM expansion relays and one EMD expansion relay.

The MSR10RD safety relay has an option for 24V DC, 115V AC, and 230V AC. For AC powered applications, a catalog number 1606 power supply can be used to provide 14V to the GSR safety relays.

Terminal Locations and Panel Space

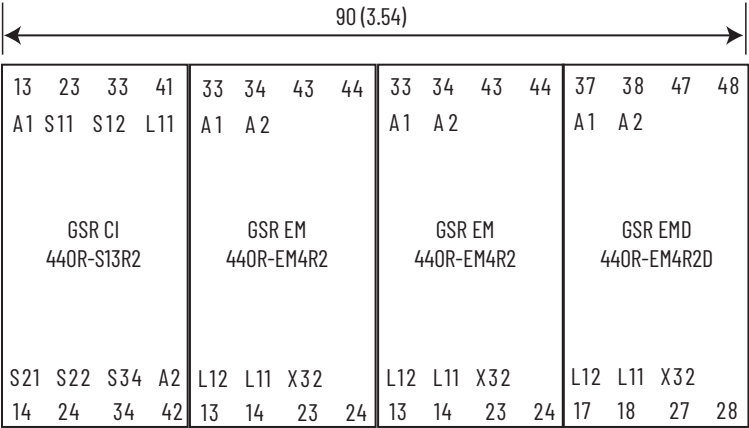
The MSR10RD safety relay has a row of terminals at the top and bottom. Its width is 152 mm (5.98 in.).

Figure 9 - DC Powered [mm (in.)]



For 24V DC powered applications, a GSR CI safety relay, two EM expansion relays, and one EMD expansion relay are needed; these occupy only 90 mm (3.54 in.) of panel space.

Figure 10 - AC Powered [mm (in.)]



For applications powered by 115V AC or 230V AC, the 1606-XLP15E power supply can be used to convert the AC supply to 24V DC, while still occupying less than the amount of panel space required by the MSR10RD safety relay.

Figure 11 - DC Powered [mm (in.)]

112.5 (4.43)																			
+ - 24V, 15W 0.54...0.63 A	13	23	33	41	33	34	43	44	33	34	43	44	37	38	47	48			
	A1	S11	S12	L11	A1	A2			A1	A2			A1	A2					
1606-XLP15E	GSR CI 440R-S13R2				GSR EM 440R-EM4R2				GSR EM 440R-EM4R2				GSR EMD 440R-EM4R2D						
100...240V AC L N \perp	S21	S22	S34	A2	L12	L11	X32		L12	L11	X32		L12	L11	X32				
	14	24	34	42	13	14	23	24	13	14	23	24	17	18	27	28			

Example Wiring Schematics

Figure 12 - DC Powered

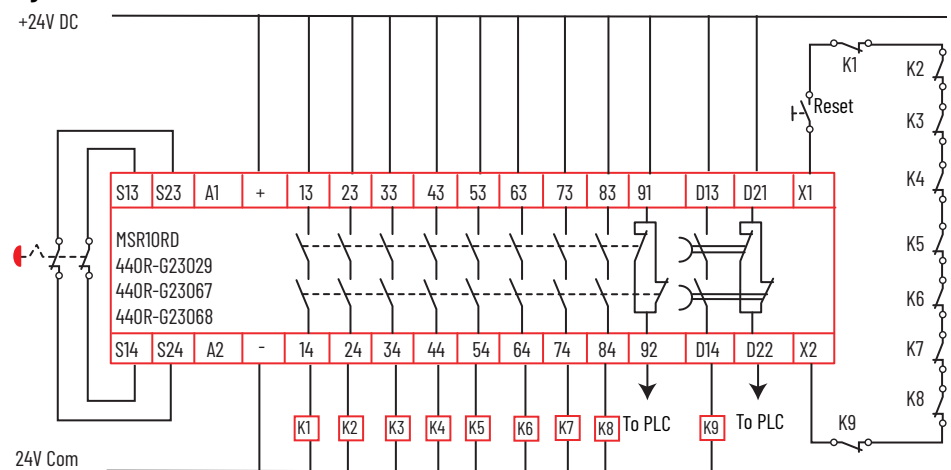
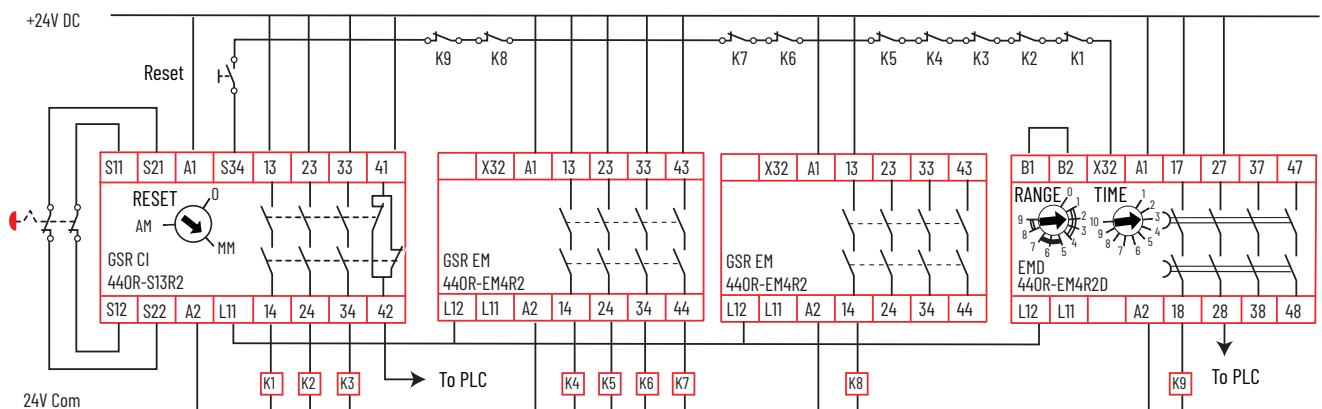
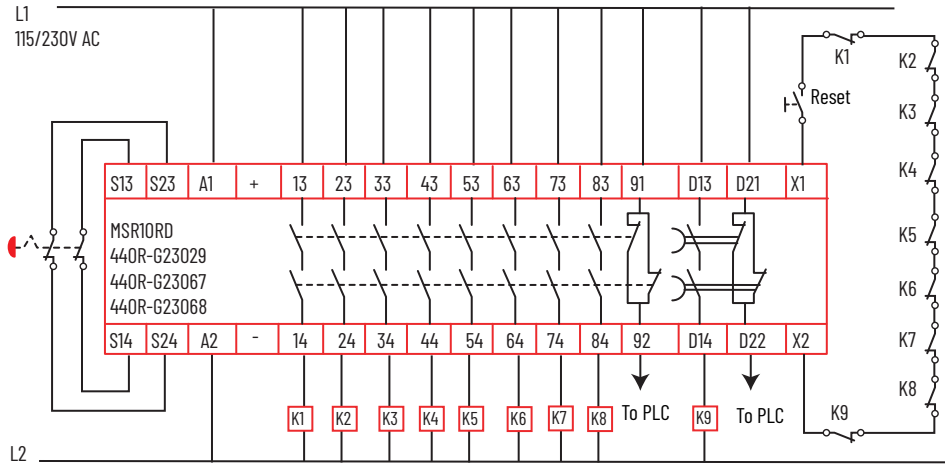


Figure 13 - GSR Equivalent Circuit



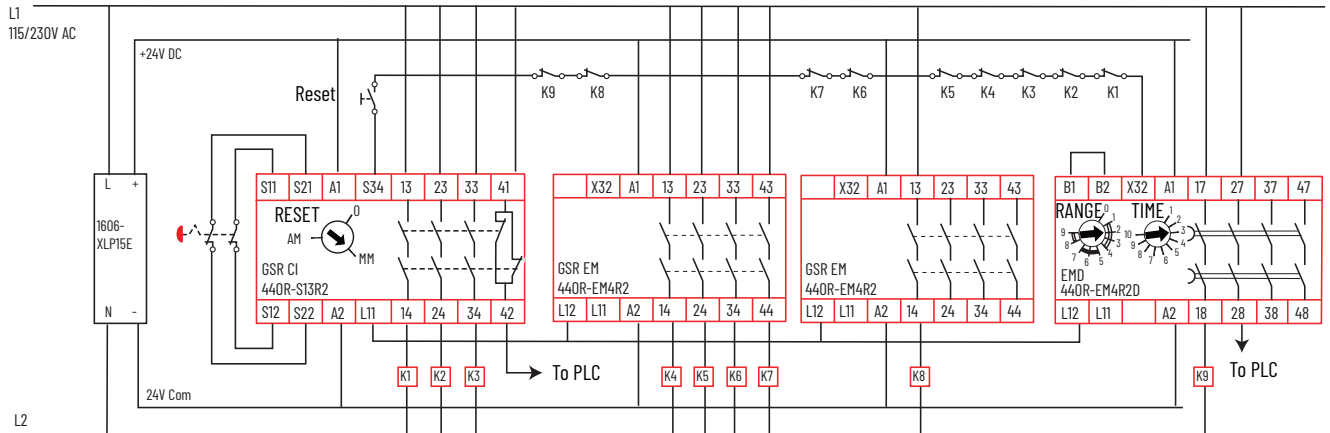
The MSR10RD safety relay has an internal switch that sets the power to either 115V or 230V AC.

Figure 14 - AC Powered



The GSR safety relay solution requires a power supply. The 1606-XLP15E power supply provides 15 W, enough to power the four GSR safety relays. Each GSR safety relay consumes a maximum 3.5 W.

Figure 15 - GSR Safety Relay



Response Time

Table 3 - Response Time

Safety Relay	Response Time [ms]
MSR10RD	50
GSR CI	35
EM	70 (35 from the GSR CI + 35 from the safety wire input)
EMD	70 (35 from the GSR CI + 35 from the safety wire input)

Since the GSR CI safety relay has a faster response time, the safety distance for the GSR CI safety relay is shorter than the MSR10RD safety relay. The response time of the loads that are connected to the EM and EMD expansion relays are longer and must be evaluated for adequate safety distance.



ATTENTION: Since the MSR10RD safety relay is faster than the EM and EMD expansion relays, the safety distance must be examined closely and adjusted if necessary.

Output Load Capability

The MSR10RD safety relay has a higher current capability than the GSR CI safety relay, EM, and EMD expansion relays as shown in [Table 4](#). See [Interposing Relays on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR safety relay capability.

Table 4 - Current Capability

Load Type	MSR10RD	GSR CI	EM	EMD
AC Inductive	B300, AC-15 4 A	C300, AC-15 1.5 A	B300, AC-15 1.5 A/250V AC	B300, AC-15 1.5 A/250V AC
DC	P300, DC-13 3 A at 24V DC	DC-13 2 A at 24V DC	DC-13 2 A at 24V DC	DC-13 2 A at 24V DC
Thermal (non-switching)	4 A	2 A	6 A on 1 circuit	6 A on 1 circuit

MSR11R Safety Relay



The preferred migration for the MSR11R safety relay is to the GSR CI relay. The MSR11R safety relay is only available with one dual-channel and monitored manual reset.

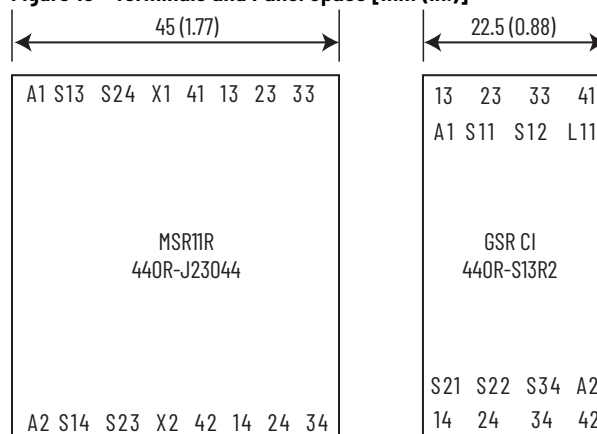
Currently, only the 24V version is available. The 110V AC and 230V AC versions were obsoleted earlier.

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

Terminal Locations and Panel Space

The MSR11R safety relay has a row of terminals at the top and bottom. Its width is 45 mm (1.77 in.). The GSR CI safety relay has two rows of terminals at the top and bottom, allowing a smaller 22.5 mm (0.88 in.) width.

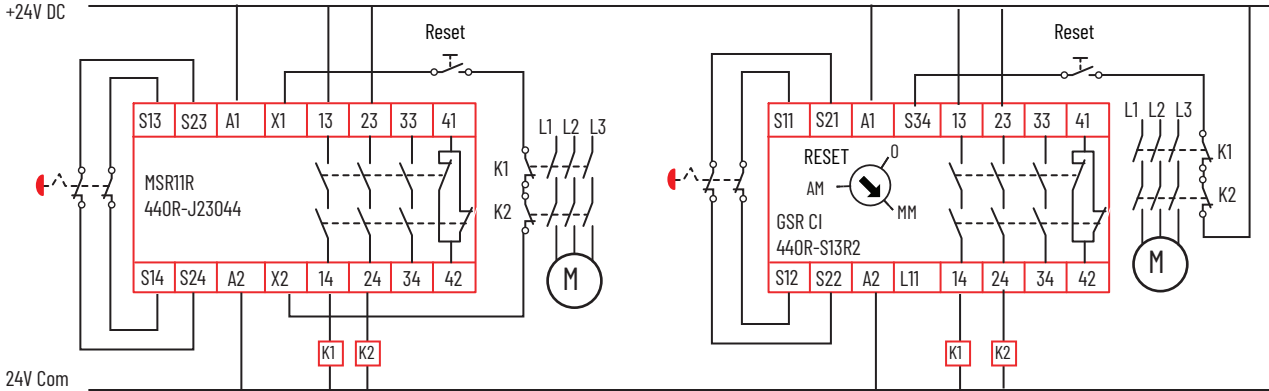
Figure 16 - Terminals and Panel Space [mm (in.)]



The power, safety inputs, and outputs are similar. The reset/monitoring circuit is slightly different. The schematics below show comparisons of the four different ways an MSR11R safety relay can be applied and the GSR CI safety relay equivalent.

Example Wiring Schematic

Figure 17 - DC Powered



Response Time

Table 5 - Response Time

Safety Relay	Response Time [ms]
MSR11R	50
GSR CI	35

Since the GSR CI safety relay has a faster response time, the safety distance for the GSR CI safety relay is shorter than the MR11R safety relay. No further action is required.

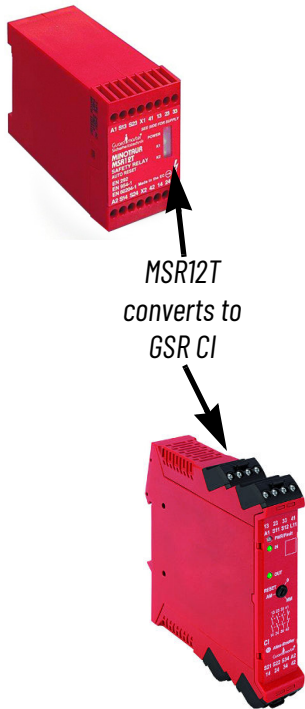
Output Load Capability

The MSR11R safety relay has a higher current capability than the GSR CI safety relay, see [Table 6](#). See [Interposing Relays on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR CI safety relay capability.

Table 6 - Current Capability

Load Type	MSR11R	GSR CI
AC Inductive	B300, AC-15 4 A	C300, AC-15 1.5 A
DC	P300, DC-13 3 A at 24V DC	2 A at 24V DC
Thermal (non-switching)	4 A	2 A

MSR12T Safety Relay



The preferred migration for the MSR12T safety relay is to the GSR CI safety relay. The MSR12T safety relay is only available with one dual-channel and automatic reset.

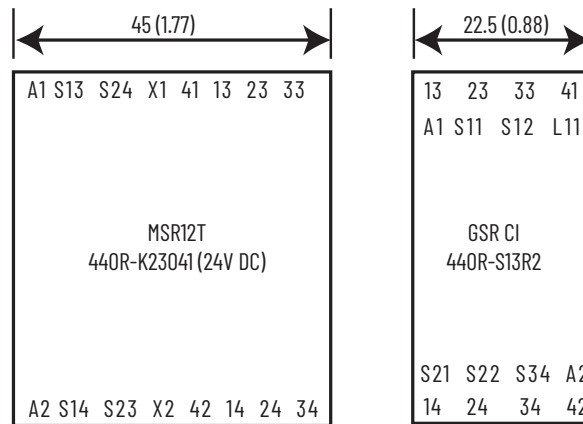
Currently, only the 24V DC and 110V AC versions are available. The 230V AC version is obsolete.

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

Terminal Locations and Panel Space

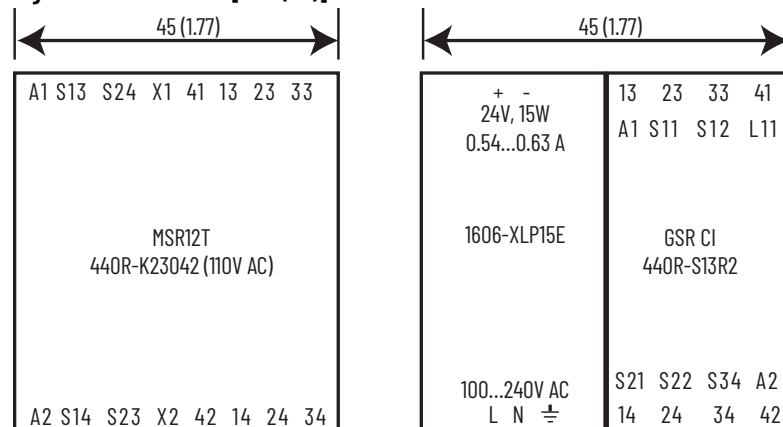
The MSR12T safety relay has a row of terminals at the top and bottom. Its width is 45 mm (1.77 in.). The GSR CI safety relay has two rows of terminals at the top and bottom, allowing a smaller 22.5 mm (0.88 in.) width.

Figure 18 - DC Powered [mm (in.)]



The MSR12T safety relay also has an option for 110V AC. Since the GSR CI safety relay is powered by 24V DC, the 1606-XLP15E power supply can be used to convert the AC supply to 24V DC, while still occupying the same amount of space.

Figure 19 - AC Powered [mm (in.)]



Example Wiring Schematics

Figure 20 - DC Powered

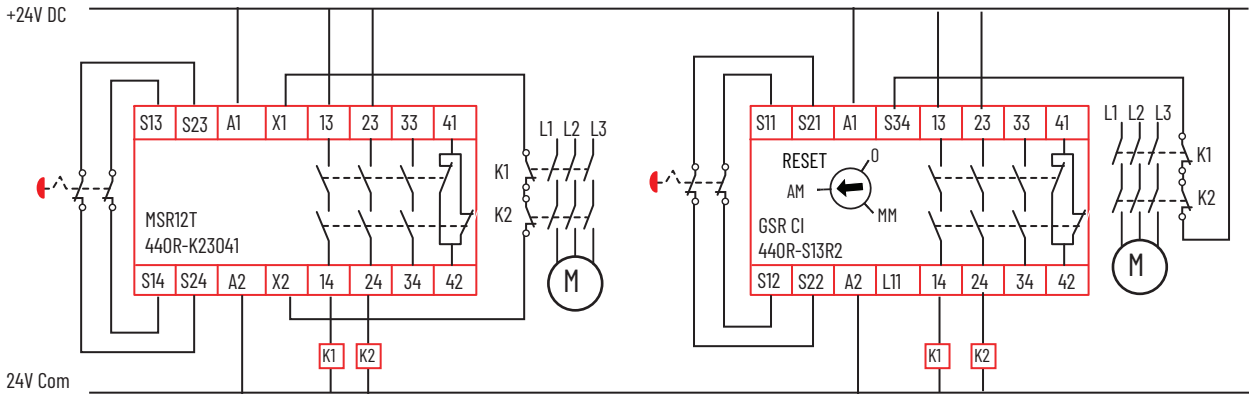
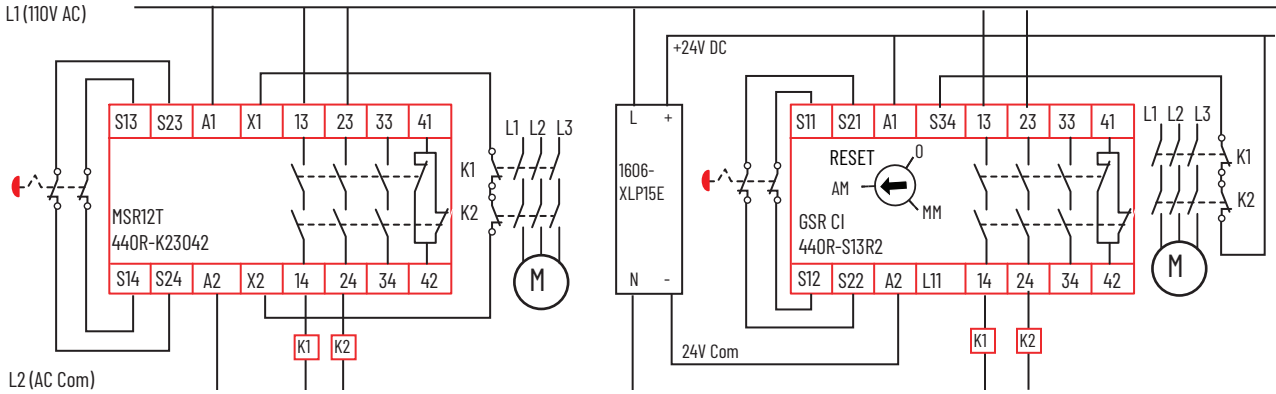
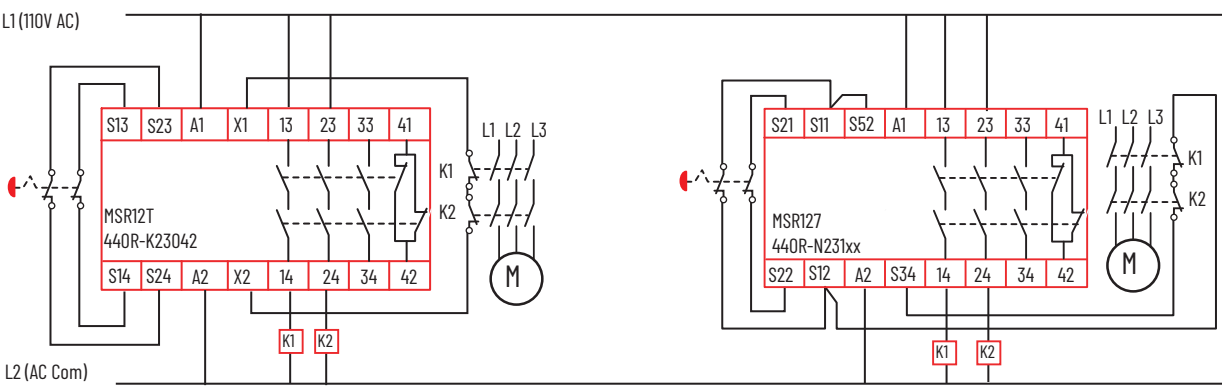


Figure 21 - AC Powered



As an alternative, an equivalent MSR127 safety relay can replace the AC powered MSR12 safety relay. Select the appropriate MSR127 safety relay.

Figure 22 - AC Powered



Response Time

Table 7 - Response Time

Safety Relay	Response Time [ms]
MSR12T	50
GSR CI	35

Since the GSR CI safety relay has a faster response time, the safety distance for the GSR CI safety relay is shorter than the MR12T. No further action is required.

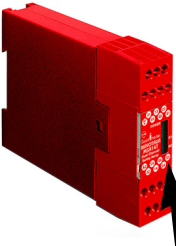
Output Load Capability

The MSR12T safety relay has a higher current capability than the GSR CI safety relay, see [Table 8](#). See [Interposing Relays on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR CI safety relay capability.

Table 8 - Current Capability

Load Type	MSR12T	GSR CI
AC Inductive	B300, AC-15 4 A at 250V AC	C300, AC-15 1.5 A
DC	N300, DC-13 3 A at 30V DC	2 A at 24V DC
Thermal (non-switching)	4 A	2 A

MSR14T Safety Relay



MSR14T
converts to
GSR CI



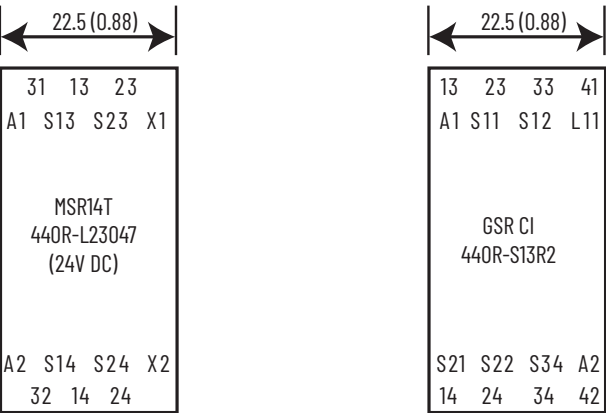
The preferred migration for the MSR14T safety relay is to the GSR CI safety relay. The MSR14T safety relay is only available with 24V DC power, one dual-channel input, and automatic reset. It has two normally open (N.O) outputs and one normally closed (N.C.) output.

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

Terminal Locations and Panel Space

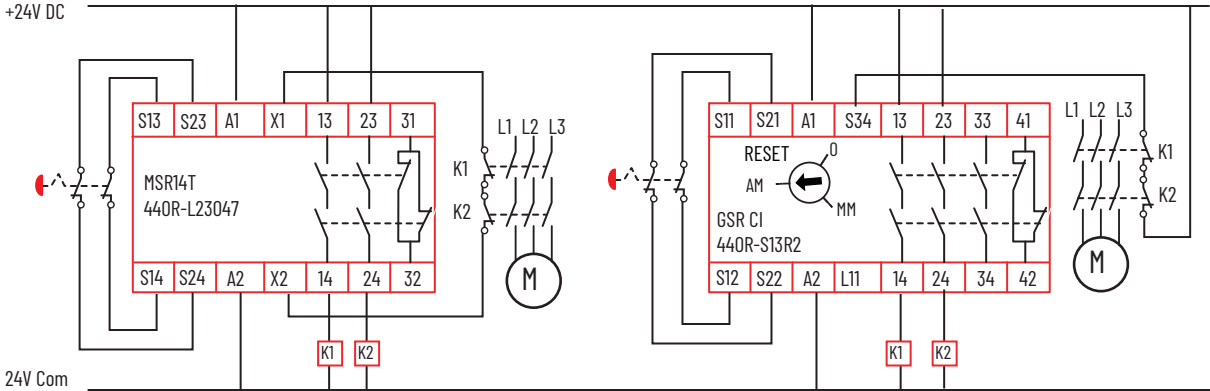
The MSR14T safety relay has a 22.5 mm (0.88 in.) wide body, with two rows of terminals at the top and bottom. The GSR CI safety relay also has two rows of terminals at the top and bottom in a 22.5 mm (0.88 in.) width.

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



Example Wiring Schematic

Figure 24 - DC Powered



Response Time

Table 9 - Response Time

Safety Relay	Response Time [ms]
MSR14T	90
GSR CI	35

Since the GSR CI safety relay has a faster response time, the safety distance for the GSR CI safety relay is shorter than the MR12T safety relay. No further action is required.

Output Load Capability

The MSR14T has a higher current capability than the GSR CI safety relay, see [Table 10](#). See [Interposing Relays on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR CI safety relay capability.

Table 10 - Current Capability

Load Type	MSR14T	GSR CI
AC Inductive	B300, AC-15 4 A at 250V AC	C300, AC-15 1.5 A
DC	N300, DC-13 2 A at 30V DC	2 A at 24V DC
Thermal (non-switching)	4 A	2 A

MSR15D Safety Relay



MSR15D
converts to
GSR CI



plus the EMD expansion relay



The MSR15D is a safety relay with two immediate safety outputs and one off-delayed safety output. There are two models, which have different delay time ranges. The preferred migration for the MSR15D safety relay is to the GSR CI safety relay with the EMD expansion relay. The MSR15D safety relay is only available with 24V DC power, one dual-channel input, and automatic reset.

The GSR CI safety relay has one switch to configure the reset to automatic or monitored manual. The EMD expansion relay has two rotary switches that can accommodate the delay ranges of both MSR15D safety relay models.

Terminal Locations and Panel Space

The MSR15D safety relay has a 45 mm (1.77 in.) wide body, with a row of terminals at the top and bottom. The combination the GSR CI safety relay and EMD expansion relay also occupy 45 mm (1.77 in.) of panel space. They each have two rows of terminals at the top and bottom.

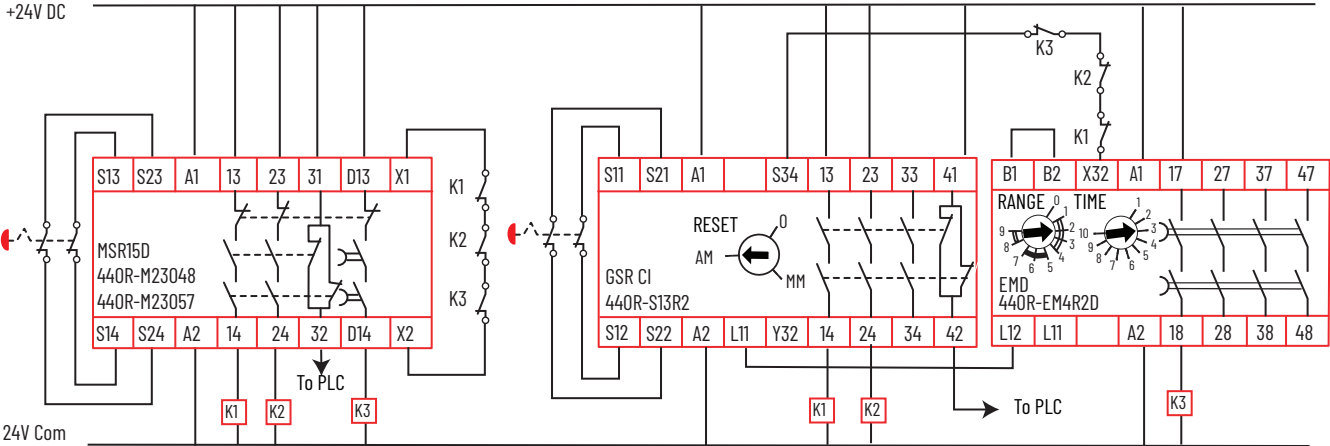
Figure 25 - Terminals and Panel Space [mm (in.)]

45 (1.77)								45 (1.77)							
A1	S13	S23	X1	31	13	23	47	13	23	33	41	37	38	47	48
MSR15DT 440R-M23048 (0.1...10 s) 440R-M23057 (1...35 s)								GSR CI 440R-S13R2				GSR EMD 440R-EM4R2D			
A2	S1	S24	X2	32	14	24	48	S21	S22	S34	A2	L12	L11	X32	
								14	24	34	42	17	18	27	28

For off-delay operation, the Range switch on the EMD expansion relay must be set to values 1, 2, 3 or 4. Use a jumper between B1 and B2 if a retriggerable operation is desired.

Example Wiring Schematic

Figure 26 - DC Powered



Response Time

Table 11 - Response Time

Safety Relay	Response Time [ms]
MSR15D	90 (Immediate Outputs), 0.1...35 s (delayed output)
GSR CI	35 (Immediate Outputs), 0.1...35 s (delayed output)

Since the GSR CI safety relay has a faster response time, the safety distance for the GSR CI safety relay is shorter than the MR15Dsafety relay. No further action is required.

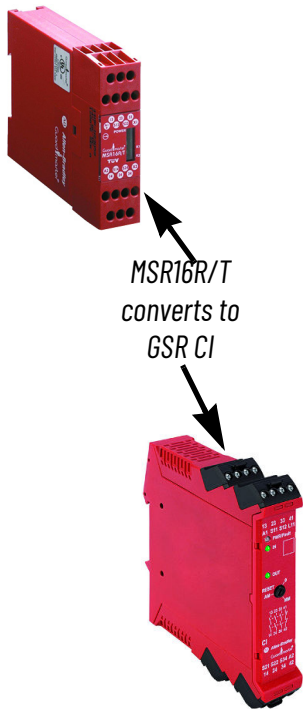
Output Load Capability

The MSR15D safety relay has a higher current capability than the GSR CI safety relay, as shown in [Table 12](#). See [Interposing Relays on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR CI safety relay capability.

Table 12 - Current Capability

Load Type	MSR15T	GSR CI	EMD
AC Inductive	B300, AC-15 4 A at 250V AC	C300, AC-15 1.5 A	B300, AC-15 1.5 A, 250V AC
DC	N300, DC-13 3 A at 30V DC	2 A at 24V DC	DC-13 2 A at 24V DC
Thermal (non-switching)	4 A	2 A	6 A on 1 circuit

MSR16R/T Safety Relay



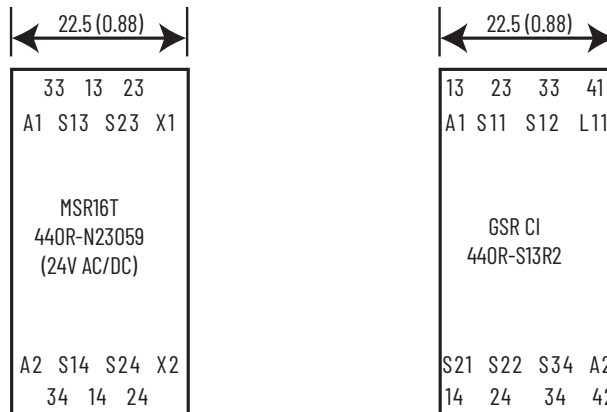
The preferred migration for the MSR16R/T safety relay is to the GSR CI safety relay. The MSR16T safety relay is only available with 24V AC/DC power, one dual-channel input. By setting an internal switch, the MSR16R/T safety relay can be set for monitored manual or automatic reset. It has three N.O. outputs.

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

Terminal Locations and Panel Space

The MSR16R/T safety relay has a 22.5 mm (0.88 in.) wide body, with two rows of terminals at the top and bottom. The GSR CI safety relay is similar in that it also two rows of terminals at the top and bottom in a 22.5 mm (0.88 in.) width.

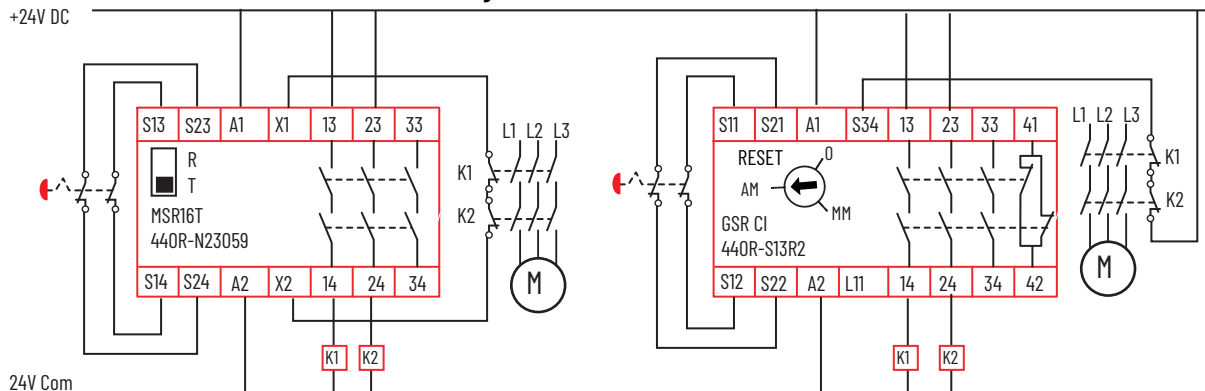
Figure 27 - Terminals and Panel Space [mm (in.)]



Inside the MSR16R/T safety relay cover, set the internal switch to T. On the GSR CI safety relay, configure the rotary switch on its front face to AM.

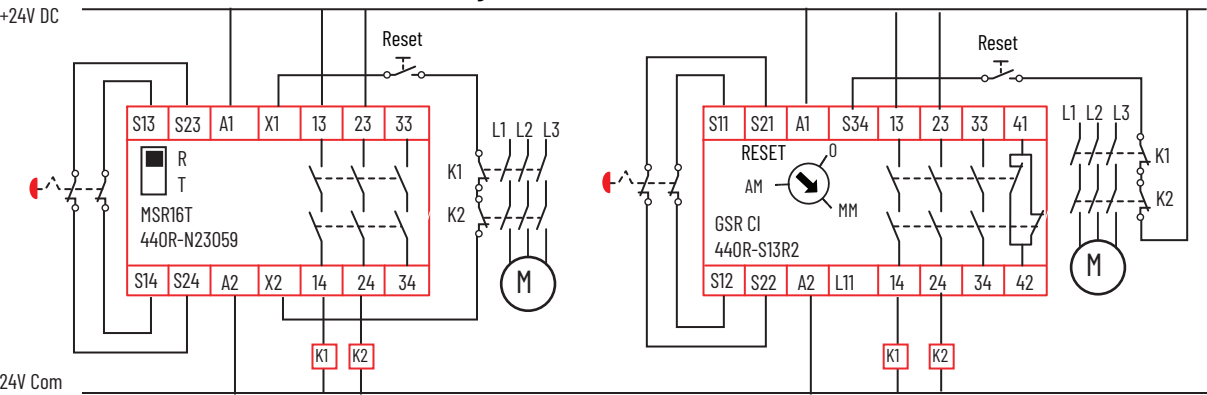
Example Wiring Schematics

Figure 28 - Automatic Reset



Inside the MSR16R/T safety relay cover, set the internal switch to R. On the GSR CI safety relay, configure the rotary switch on its front face to MM.

Figure 29 - Monitored Reset



Response Time

Table 13 - Response Time

Safety Relay	Response Time [ms]
MSR16R/T	90
GSR CI	35

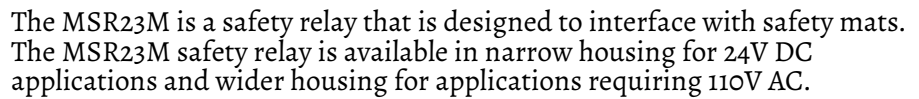
Since the GSR CI safety relay has a faster response time, the safety distance for the GSR CI safety relay is shorter than the MR16T safety relay. No further action is required.

Output Load Capability

The MSR16R/T safety relay has a higher current capability than the GSR CI safety relay, see [Table 14](#). See [Interposing Relays on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR CI safety relay capability.

Table 14 - Current Capability

Load Type	MSR16R/T	GSR CI
AC Inductive	A300, AC-15 6 A at 250V AC	C300, AC-15 1.5 A
DC	N300, DC-13 6 A at 30V DC	2 A at 24V DC
Thermal (non-switching)	6 A	2 A



The recommended conversion is to a GSR CI safety relay for the DC powered unit and a GSR CI safety relay with a catalog number 1606 power supply for the MSR23M safety relay, which is powered at 110V AC.

Terminal Locations and Panel Space

Diagram showing two 4x4 matrices with dimensions 22.5 (0.88) indicated above them.

Left Matrix:

A1	S33	S34	
13	23	24	31
MSR23M 440R-P23073 (24V DC)			
14	S11	S12	32
S21	S22	A2	

Right Matrix:

13	23	33	41
A1	S11	S12	L11
GSR CI 440R-S13R2			
S21	S22	S34	A2
14	24	34	42

Figure 31 - AC Powered [mm (in.)]

45 (1.77)

A1 S33 S34
13 23 24 31

MSR23M
440R-P23074 (110V AC)

1606-XLP15E

GSR CI
440R-S13R2

100...240V AC
L N \perp

A2 S21 S22 32
S21 S22

13 23 33 41
A1 S11 S12 L11

S21 S22 S34 A2
14 24 34 42

Example Wiring Schematics

Figure 32 - 24V DC with Automatic Reset

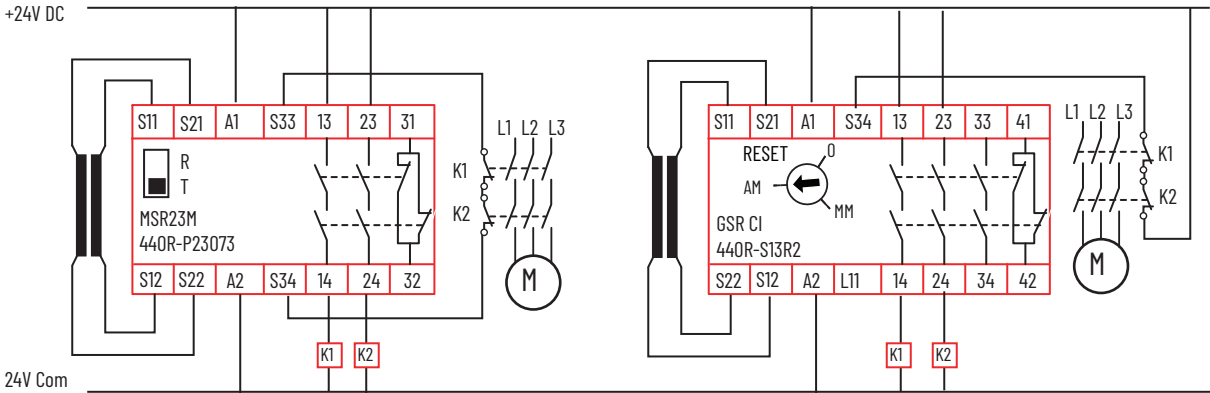
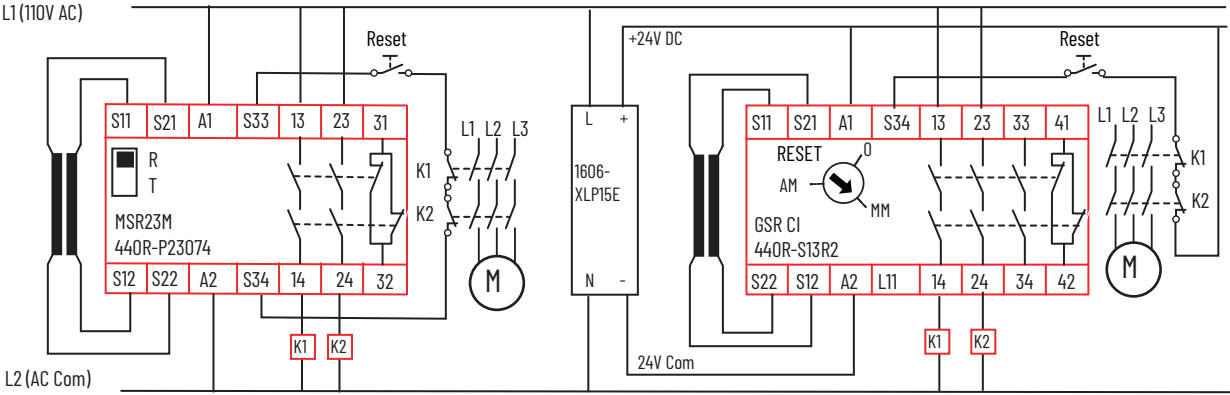


Figure 33 - 110V AC with Monitored Reset



Response Time



ATTENTION: Since the MSR23M safety relay is faster than the GSR CI safety relay, the safety distance must be examined closely and adjusted if necessary.

Table 15 - Response Time

Safety Relay	Response Time [ms]
MSR23M	15
GSR CI	35

Output Load Capability

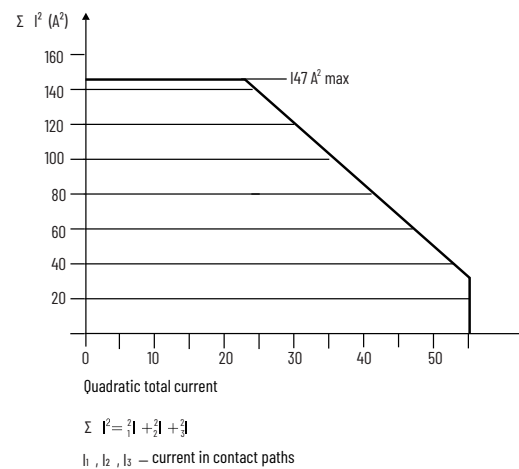
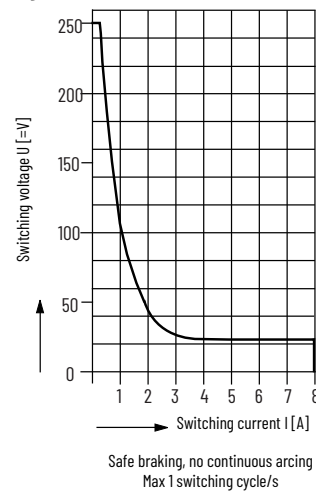
The outputs of the GSR CI safety relay can require interposing relays, depending on the load being switched by the MSR23M safety relay. See [Interposing Relays on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR CI safety relay capability.

Table 16 - Current Capability

Load Type	MSR16R/T	GSR CI
AC Inductive	B300, AC-15 3 A	C300, AC-15 1.5 A
DC	P300, DC-13 2.5 A at 24V DC	2 A at 24V DC
Thermal (non-switching)	1 circuit at 8 A 2 circuits at 7 A See Figure 34	2 A

The current through the contacts in the MSR23M safety relay must be adjusted to its current limit curves:

Figure 34 - Current Limit Curves



Arc Limit Curve Under Resistive Load

Quadratic Total Current Limit Curve

MSR123RT Safety Relay

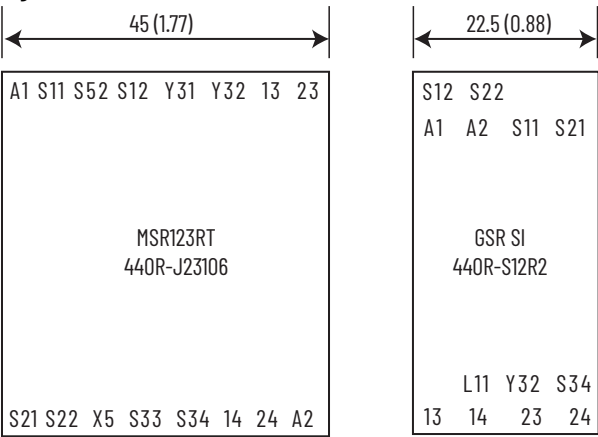


The MSR123RT safety relay has the following key design characteristics:

- Single or dual-channel inputs
- Accommodates mechanical and OSSD (light curtain) inputs
- Two electromechanical safety outputs
- One solid-state auxiliary output
- Reset can operate automatically or monitored manual

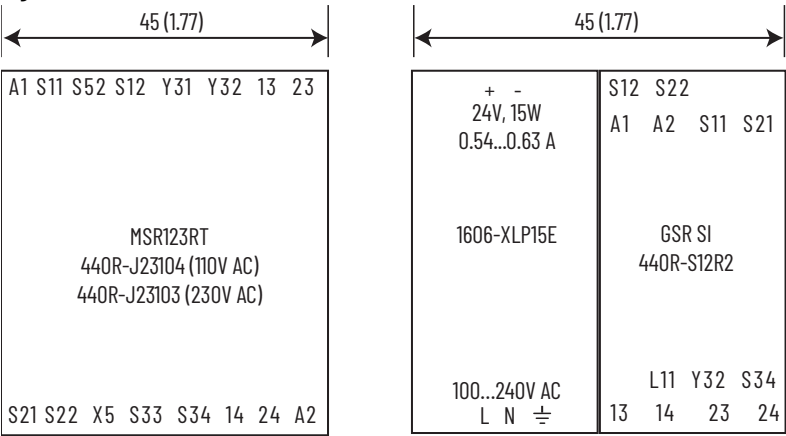
The recommended conversion is to a GSR SI safety relay.

Figure 35 - DC Powered [mm (in.)]



For those applications where the MSR123RT safety relay is powered by 115V AC or 230V AC, a 1606-XLP15E power supply can be used. With the additional power supply, the panel space by the replacement design occupies a smaller space than one MSR123RT safety relay.

Figure 36 - AC Powered [mm (in.)]



Example Wiring Schematics

Figure 37 - 24V DC, Mechanical Contacts, Monitored Reset

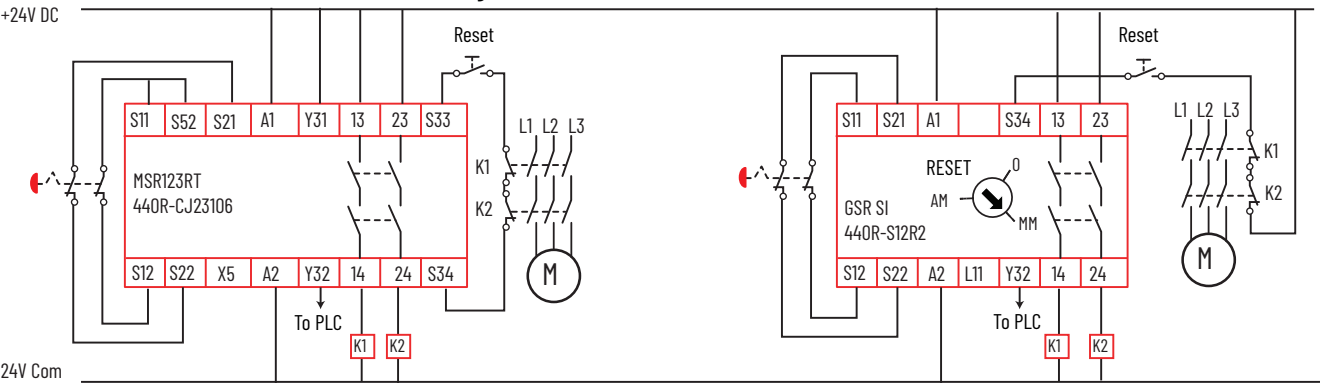


Figure 38 - DC Powered, Dual-channel, Automatic Reset

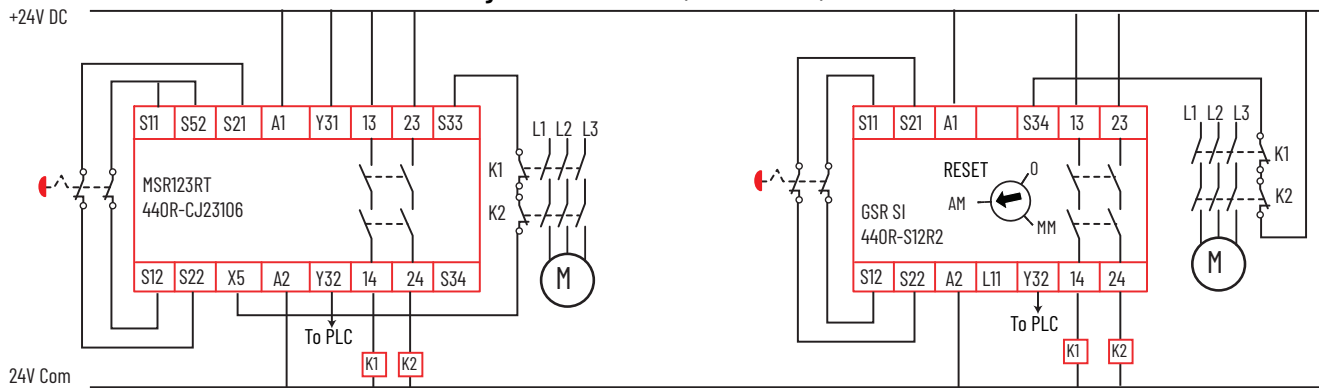


Figure 39 - Single-channel, Monitored Reset

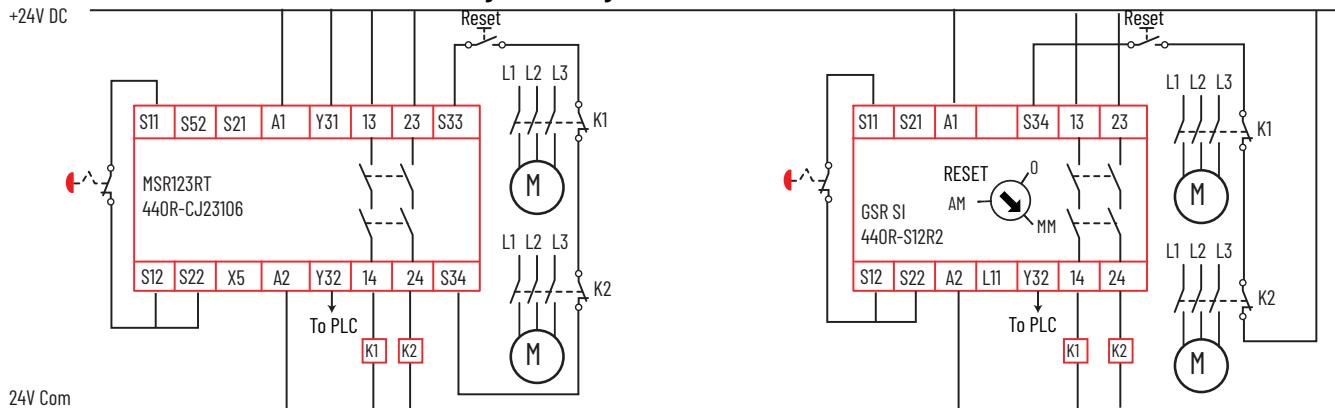


Figure 40 - Single-channel, Automatic Reset

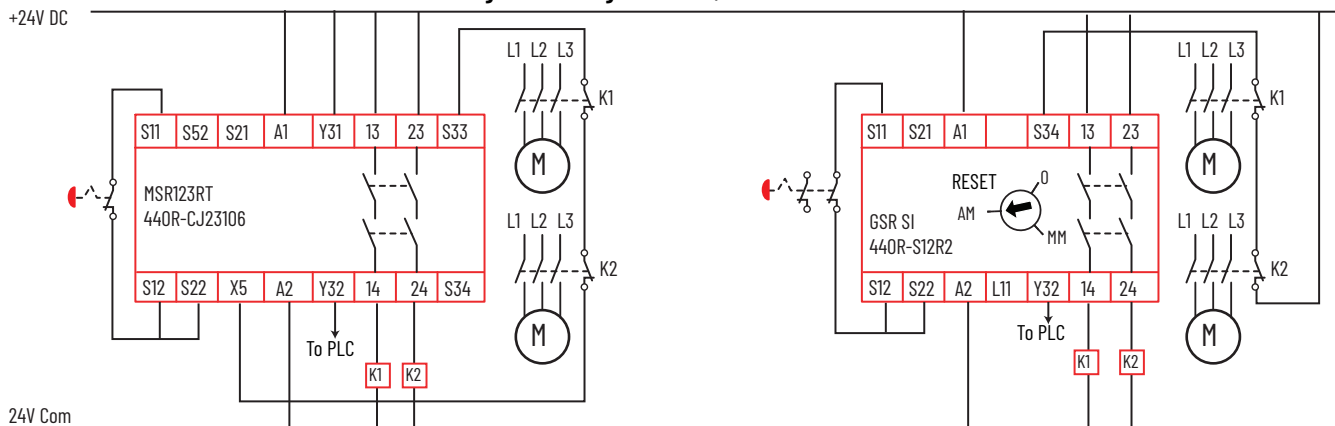
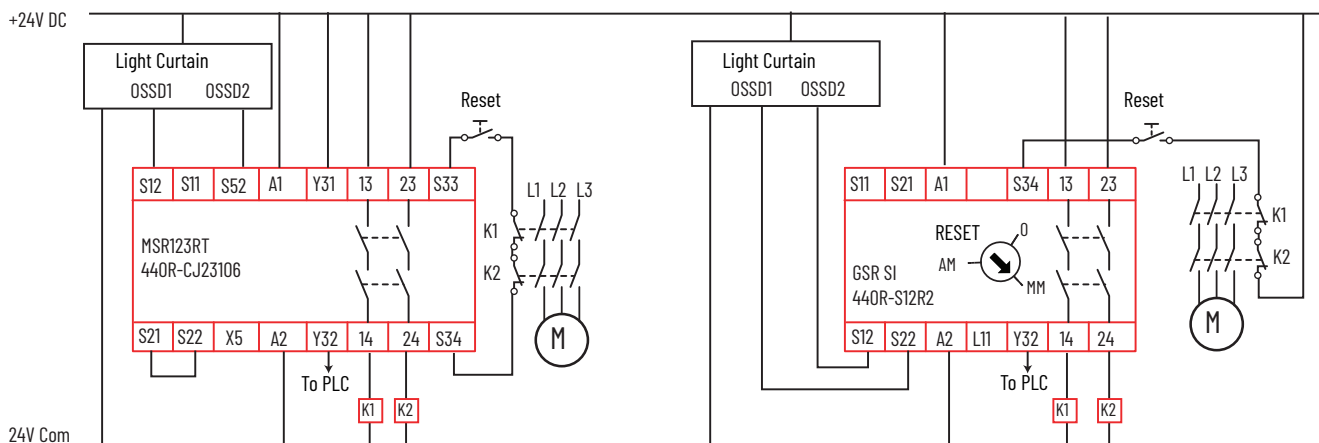
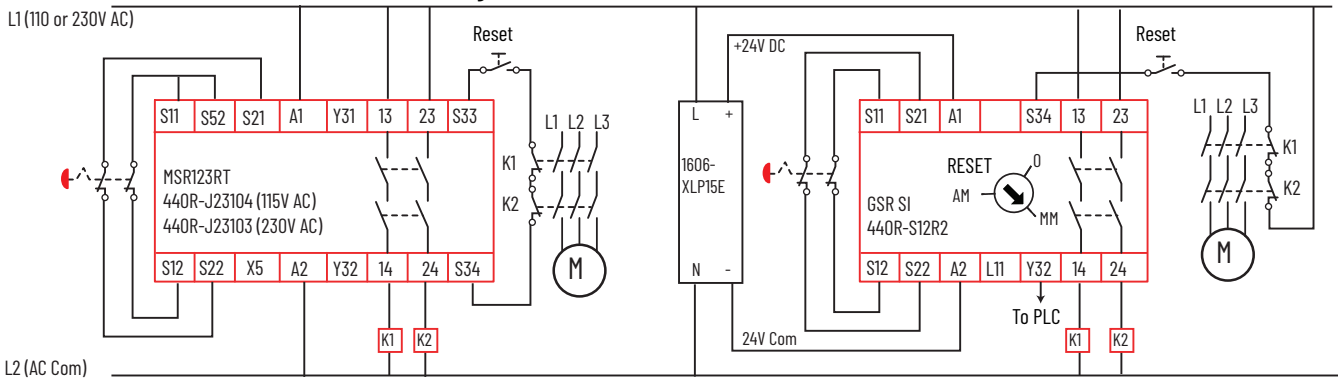


Figure 41 - Light Curtain, Monitored Reset



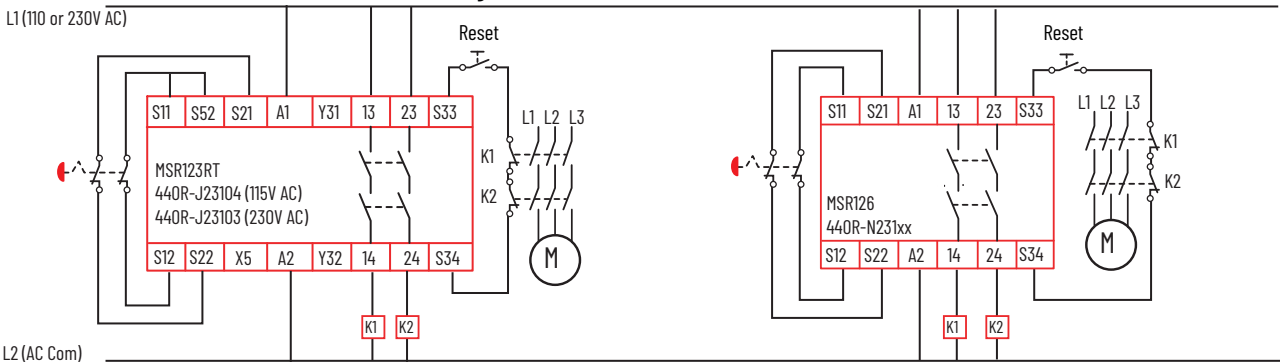
A 1606-XLP15E power supply can be used to provide the 24V DC to power the GSR SI safety relay.

Figure 42 - AC Powered, Monitored Reset




As an alternative, an equivalent MSR126 safety relay can replace the AC powered MSR123 safety relay. Select the appropriate MSR126 safety relay. The MSR126 safety relay does not have an auxiliary output.

Figure 43 - AC Powered Alternative



Response Time

The safety outputs of the GSR CI safety relay has a 35 ms response time, whereas the single wire safety output of the GSR CI safety relay is 25 ms.



ATTENTION: Since the MSR123RT safety relay is faster than the GSR SI safety relay, the safety distance must be examined closely and adjusted if necessary.

Table 17 - Response Time

Safety Relay	Response Time [ms]
MSR123RT	15
GSR SI	35

Output Load Capability

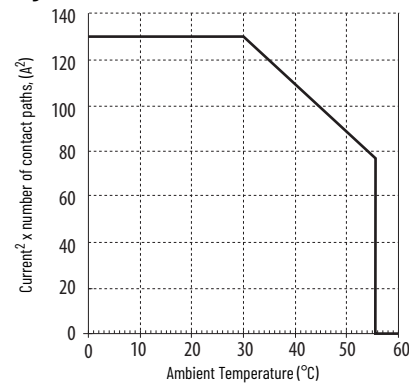
The outputs of the GSR SI safety relay can require interposing relays, depending on the load being switched by the MSR123RT safety relay. See [Interposing Relays on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR SI capability.

Table 18 - Current Capability

Load Type	MSR123RT	GSR SI
AC Inductive	A300, AC-15 6 A	C300, AC-15 1.5 A
DC	N300, DC-13 3 A at 24V DC	2 A at 24V DC
Thermal (non-switching)	10 A (max in one circuit) See Figure 44	2 A

The current through the contacts in the MSR123RT safety relay must be adjusted to its current limit curve.

Figure 44 - Current Limit Curve



MSR178DP Safety Relay



The preferred migration for the MSR178DP safety relay is to the GSR SI safety relay and EMD expansion relay combination. This migration covers most of the applications.

The MSR178DP safety relay is available with 24V DC, 115V AC and 230V AC all included in the same catalog number. A catalog number 1606 power supply converts the AC supply to DC.

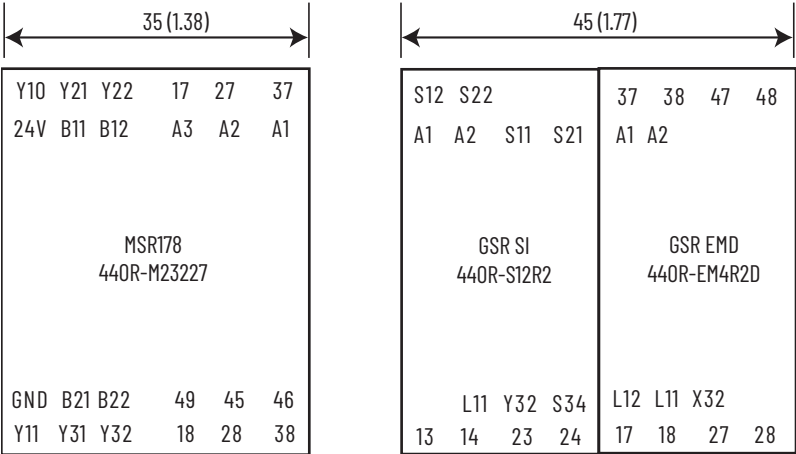
The MSR178DP safety relay function can also be initiated with a two-hand control requirement. An MSR125HP safety relay provides the replacement two-hand operation.

Use a combination of jumpers and an analog potentiometer to set the MSR178 safety relay timing range of 0.1 seconds to 30 minutes. The EMD expansion relay can also be set between 0.1 seconds and 30 minutes, by setting two multi-position switches.

Terminal Locations and Panel Space

The MSR178DP safety relay has a 35 mm (1.38 in.) wide body, with two rows of terminals at the top and bottom. The GSR CI safety relay and EMD expansion relay are similar in that they also two rows of terminals at the top and bottom in a 22.5 mm (0.88 in.) width.

Figure 45 - DC Powered [mm (in.)]



For AC operation, the 1606-XLP15E power supply can be used to supply 24V to the GSR SI and MSR125 safety relays and the EMD expansion relay. The MSR125HP safety relay is also available in 115V AC or 230V AC. In the worst case scenario, the panel space that is required to replace the MSR178DP safety relay is 90 mm (3.54 in.).

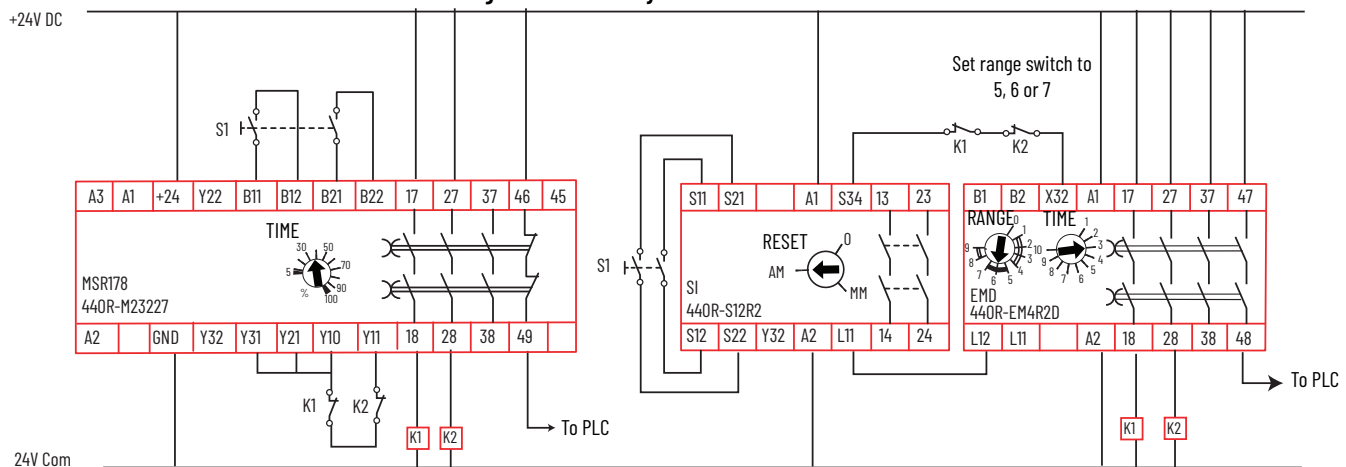
Figure 46 - AC Powered with GSR SI [mm (in.)]

90 (3.54)															
+ - 24V, 15W 0.54...0.63 A 1606-XLP15E 100...240V AC L N \perp	Y1	Y2	13	23	S12	S22	37	38	47	48					
	A1	S11	S12	S13	A1	A2	S11	S21	A1	A2					
	MSR125HP 440R-D23171				GSR SI 440R-S12R2				GSR EMD 440R-EM4R2D						
	S21	S22	S23	A2	L11	Y32	S34	L12	L11	X32					
			14	24	13	14	23	24	17	18	27	28			

Figure 47 - AC Powered with GSR CI [mm (in.)]

90 (3.54)															
+ - 24V, 15W 0.54...0.63 A 1606-XLP15E 100...240V AC L N $\frac{\perp}{\equiv}$	Y1	Y2	13	23	13	23	33	41	37	38	47	48			
	A1	S11	S12	S13	A1	S11	S12	L11	A1	A2					
	MSR125HP 440R-D23171				GSR CI 440R-S13R2				GSR EMD 440R-EM4R2D						
	S21	S22	S23	A2	S21	S22	S34	A2	L12	L11	X32				
			14	24	14	24	34	42	17	18	27	28			

Example Wiring Schematics

Figure 48 - On-delay

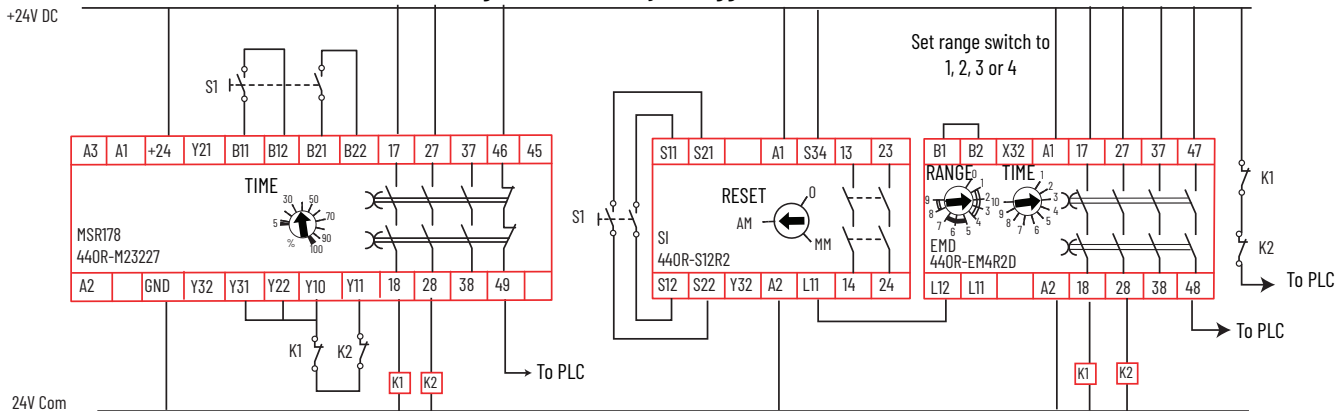
Shown in [Figure 48](#), when you press and hold the GSR S1 safety relay, the status indicators on both examples flash to indicate that the timing has started. On the MSR178 safety relay, the CH1 IN and CH2 IN status indicators flashes. On the EMD expansion relay, the Logic IN status indicator flashes.

After the time expires, the outputs turn on.

When you release switch S1, the outputs turn off immediately.

If you release GSR S1 safety relay in the middle of the timing cycle, and then reapply the GSR S1 safety relay, the timer starts from zero.

Figure 49 - Off-delay, Retriggerable



Shown in [Figure 49](#), the MSR178 safety relay off-delay is retriggerable. To achieve similar result, the EMD expansion relay requires a jumper from B1 to B2.

When you press GSR S1 safety relay, K1 and K2 turn on immediately. You can release the GSR S1 safety relay immediately; it does not need to be held closed.

Both systems have a status indicator that flashes to indicate that the timing cycle is in process. On the MSR178 safety relay, it is the CH1 IN and CH2 IN status indicators. On the EMD expansion relay, it is the Logic IN status indicator.

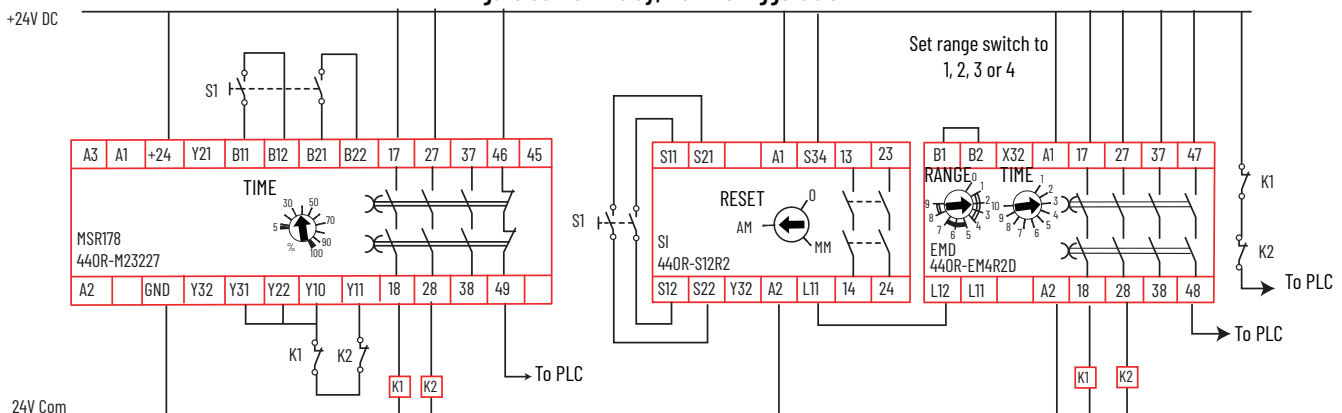
After the time expires, the outputs turn off (and all four status indicators turn off).

If you repress the GSR S1 safety relay during the timing cycle, K1 and K2 remain on, the timing cycle is retriggered and starts again from zero.

If you have used the auxiliary signal to the Programmable Logic Controller (PLC), you can use one of the N.O. contacts of the EMD expansion relay and reverse the logic in the PLC.

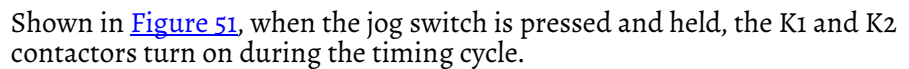
The PLC monitors K1 and K2 (N.C.) to achieve the same retriggerable performance as the MSR178 safety relay.

Figure 50 - Off Delay, Non-Retriggerable



When you press the GSR SI safety relay switch, the K1 and K2 contactors turn ON immediately.

Figure 51 - Single Shot Jog

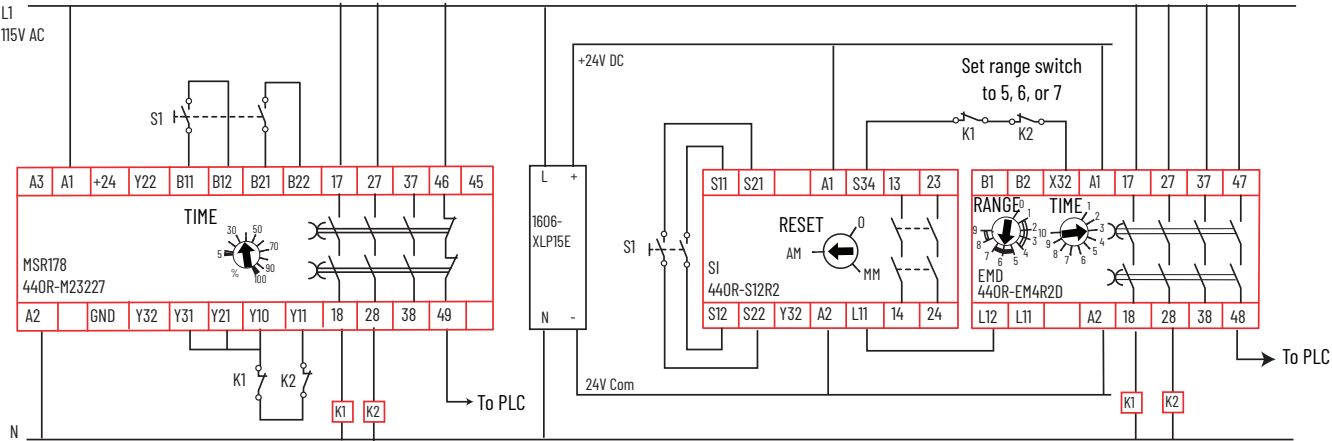


If you have use of the MSR178 safety relay auxiliary signal to the PLC, you can use one of the N.O. contacts of the EMD expansion relay and reverse the logic in the PLC.

Shown in [Figure 52](#), the MSR178 safety relay can generate a shot output with a two hand control operation. Switches S1 and S2 must be actuated within 0.5 s of each other and the K1 and K2 outputs turn on for the specified duration.

To accomplish the combination of features, a two-hand control must be used and the GSR SI safety relay and EMD expansion relay. The MSR125 safety relay is recommended, but it requires that S1 and S2 to be converted to N.O., N.C. switches.

Figure 53 - On-delay, AC Powered



Shown in [Figure 53](#), a 1606-XLP15E power supply can be used in applications where the MSR178 safety relay is powered by either 115V AC or 230V AC.

Response Time



ATTENTION: Since the MSR178DP safety relay has a faster response time than all combinations of GSR SI and MSR125 safety relays, and EMD expansion relay, the safety distance must be examined closely and adjusted if necessary.

Table 19 - Response Time

Safety Relay	Response Time [ms]
MSR178DP	20
GSR SI	25 (single wire safety output)
EMD	35
MSR125	20

Output Load Capability

The MSR178DP safety relay has a higher current capability than the GSR CI safety relay, as shown in [Table 20](#). See [Interposing Relays on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR CI safety relay capability.

Table 20 - Current Capability

Load Type	MSR123RT	GSR CI
AC Inductive	B300, AC-15 6 A at 250V AC	B300, AC-15 1.5 A
DC	DC-13 3 A at 30V DC	DC-13 2 A at 24V DC
Thermal (non-switching)	4 A	6 A on 1 circuit



The preferred migration for the CU1 safety relay is to the GSR SI safety relay and EMD expansion relay combination.

The CU1 safety relay is available with 24V DC, 115V AC and 230V AC all included in the same catalog number. A catalog number 1606 power supply is required to convert the AC supply to DC.

The CU1 safety relay on-delay can be adjusted from 0.1 seconds to 40 minutes. The EMD expansion relay can be adjusted from 0.1 seconds to 30 minutes. For applications that require longer than 30 minutes, use the Single Wire Safety signal to cascade two EMD expansion relays.

The CU1 safety relay has a Remote Indication accessory. This device contains two status indicators—red to indicate that the timing cycle is in process and green to indicate that the output is on (the timing cycle is completed).

Terminal Locations and Panel Space

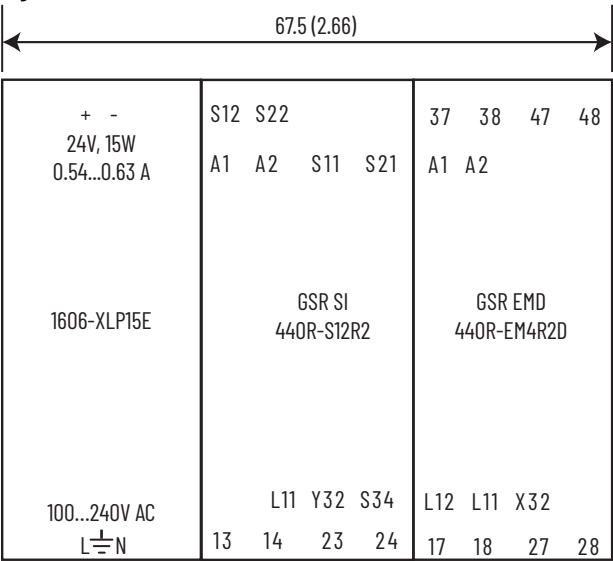
The CU1 safety relay has a 45 mm (1.77 in.) wide body, with one row of terminals at the top and bottom. The combination of the GSR SI safety relay and EMD expansion relay also occupies 45 mm (1.77 in.) of panel space.

Figure 54 - AC Powered [mm (in.)]

45 (1.77)							45 (1.77)							
A1	+	R1	*	13	23	31	S12	S22			37	38	47	48
							A1	A2	S11	S21	A1	A2		
CU1 440R-T07M4							GSR SI 440R-S12R2				GSR EMD 440R-EM4R2D			
							L11 Y32 S34				L12 L11 X32			
A2	-	R2	R3	14	24	32	13	14	23	24	17	18	27	28

For those applications powered by AC, a 1606-XPL15E power supply can be used to provide the 24V DC for the GSR CI safety relay and EMD expansion relay. This configuration increases the panel space by 22.5 mm (0.88 in.) to a total of 67.5 mm (2.66 in.).

Figure 55 - AC Powered [mm (in.)]

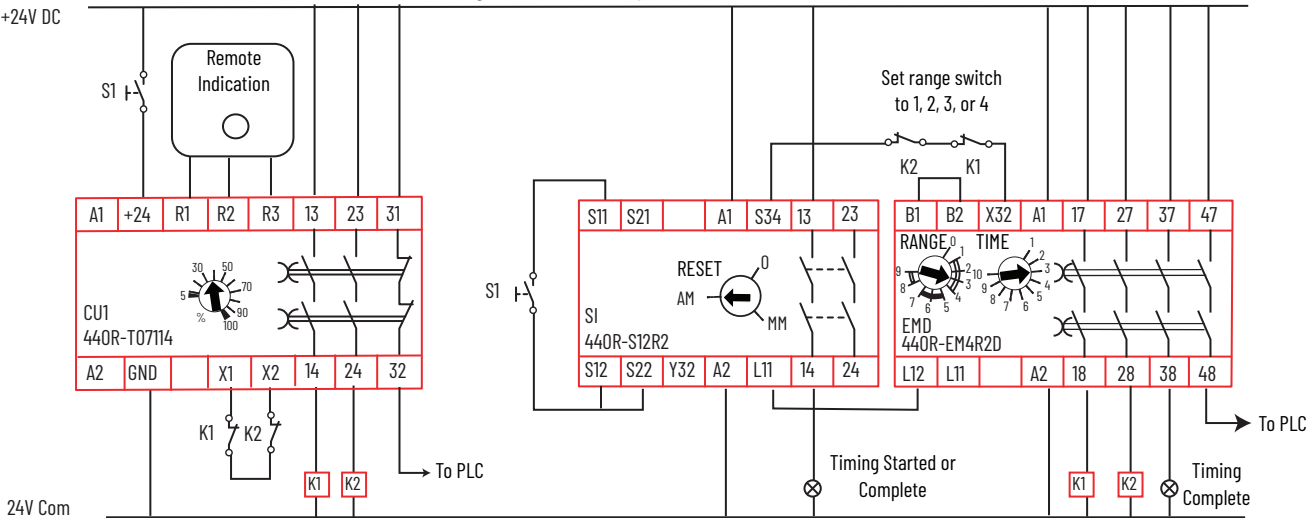


Example Wiring Schematics

Timing begins when switch S1 is pressed, provided the reset loop X1-X2 on the CU1 safety relay is made. Switch S1 must be maintained closed for the full duration of the timing cycle.

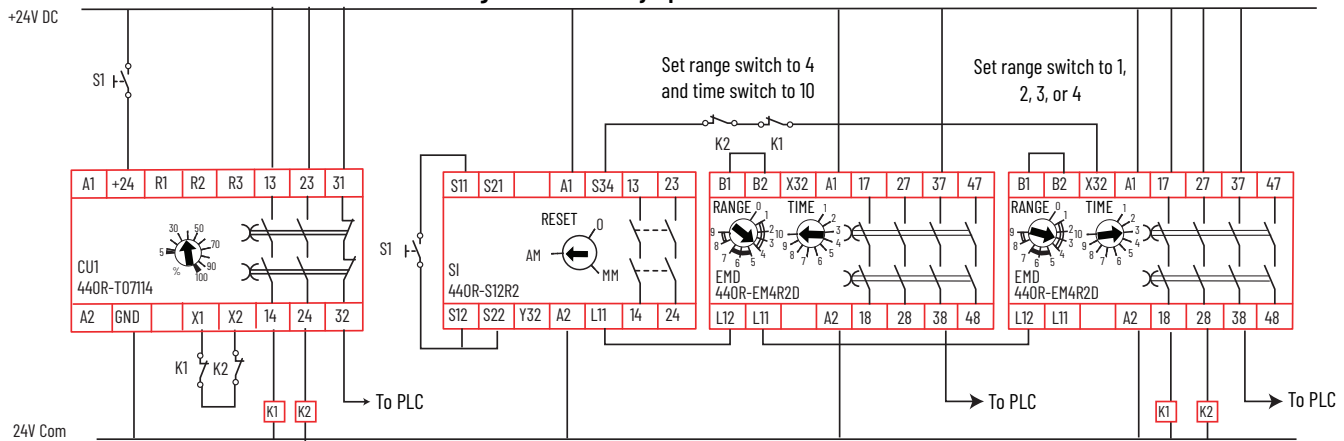
The Remote Indication unit can be replaced with two status indicators.

Figure 56 - On-delay Up to 30 Minutes



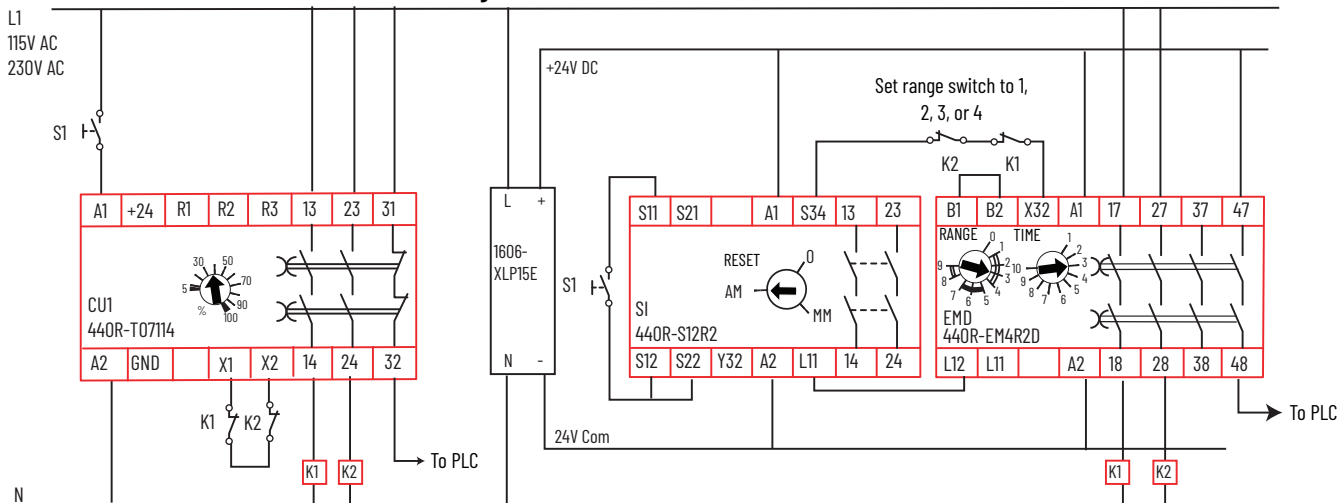
For applications where the timing cycle is greater than 30 minutes and less than 60 minutes, two EMD expansion relays must be used. The Single Wire Safety signal is cascaded (L11 to L12 and then again from L11 to L12). Set the Range switch to 4 and the Time switch to 10, on the first EMD expansion relay to achieve a 30 minute delay. At the end of its cycle, it signals the second EMD expansion relay to start its timing cycle. Set the Range and Time of the second EMD expansion relay to achieve the desired extra time (up to a total of 60 minutes).

Figure 57 - On-delay Up to 60 Minutes



For AC powered applications, a 1606-XLP15E power supply is recommended to provide the 24V DC supply to the GSR CI safety relay and EMD expansion relays.

Figure 58 - AC Powered



Response Time

Table 21 - Response Time

Safety Relay	Response Time [ms]
CU1	Set by the timer selection
EMD	Set by the timer selection

For most applications, no further action is required, as the timings can be made equivalent.

Output Load Capability

The CU1 safety relay has a higher current capability than the GSR CI safety relay, as shown in [Table 22](#). See [Interposing Relays on page 11](#) or a wiring example of using interposing relays for applications where the load exceeds the GSR CI safety relay capability.

Table 22 - Current Capability

Load Type	CU1	GSR CI
AC Inductive	B300, AC-15 4 A at 250V AC	C300, AC-15 1.5 A
DC	N300, DC-13 2 A at 30V DC	2 A at 24V DC
Thermal (non-switching)	4 A	2 A

Phase 2 (June 2016)

CU2 Control Unit



We recommend that you replace the CU2 control unit with a GLP safety relay.

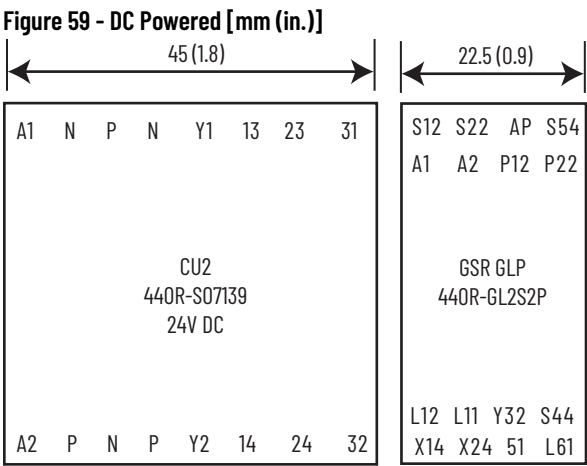
Both the CU2 control unit and the GLP safety relay use two proximity sensors to sense the motion of the hazard. The CU2 control unit uses one proximity sensor with an NPN output and the second proximity sensor with a PNP output. The GLP safety relay requires PNP outputs for both proximity sensors.

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, Safely-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.

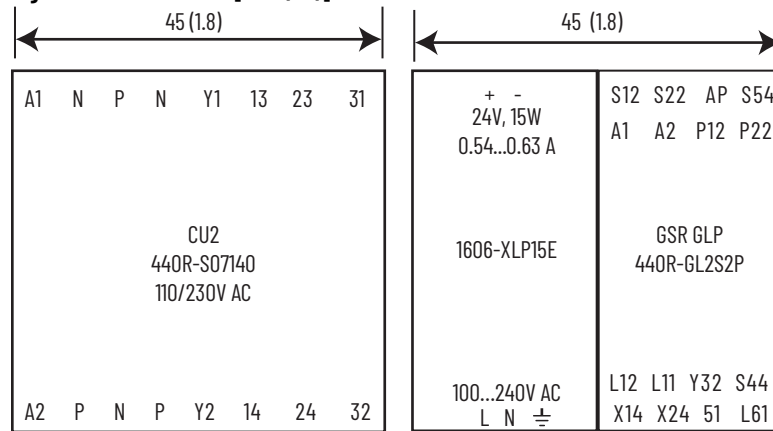
Terminal Location and Panel Space

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.



The CU2 control unit can also be ordered with a 110/230V AC power supply. Since the GLP safety relay is DC powered, a 1606-XLP15E power supply 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 60 - AC Powered [mm (in.)]



Example Wiring Schematics

The following schematics compare the wiring of your existing MSR safety relay module to the recommended newer devices for each application.

Figure 61 - DC Powered

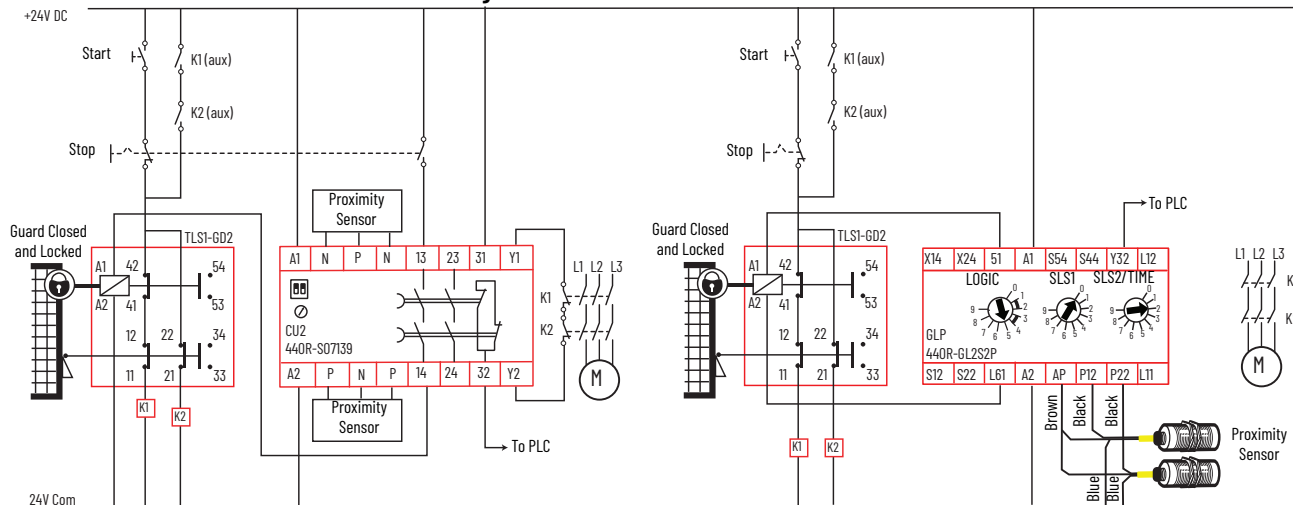


Figure 62 - AC Powered

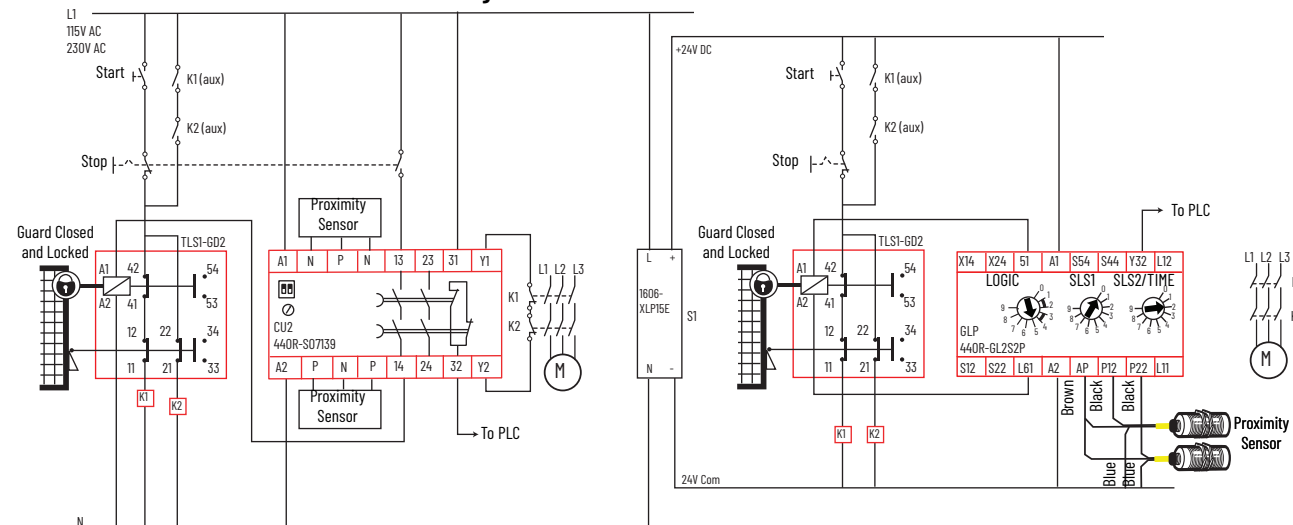
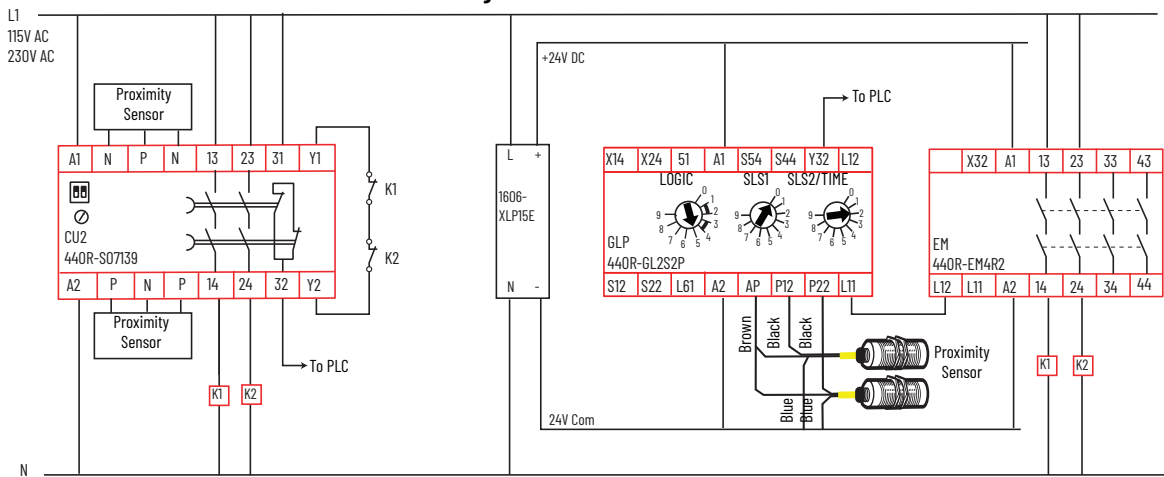


Figure 63 - AC Powered Loads



Output Load Capability

The CU2 control unit has a higher current capability than the GLP safety relay, as shown in [Table 23](#). See [Output Load Capability on 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 23 - 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

MSR6R/T Safety Relay



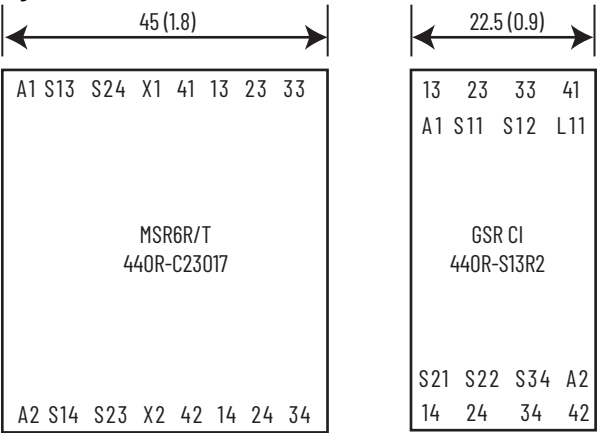
We recommend replacing the MSR6R/T safety relay with a GSR CI safety relay.

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

Terminal Locations and Panel Space

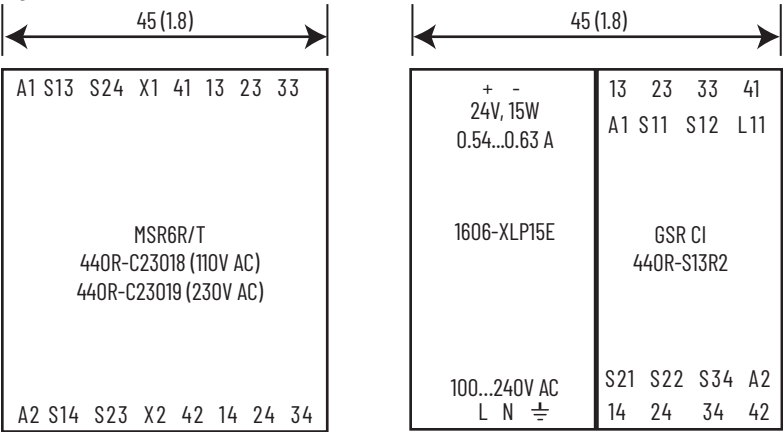
The MSR6R/T safety relay is 45 mm (1.8 in.) wide and has one row of terminals at the top and bottom. The GSR CI safety relay is 22.5 mm (0.9 in.) wide and has two rows of terminals at the top and bottom.

Figure 64 - DC Powered [mm (in.)]



The MSR6R/T safety relay also has the option for a 115V AC and 230V AC power supply connection. Since the GSR CI safety relay is DC powered, a 1606-XLP15E power supply 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.

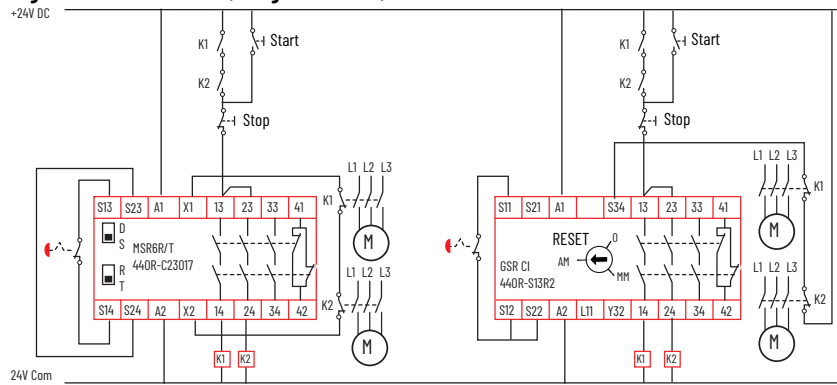
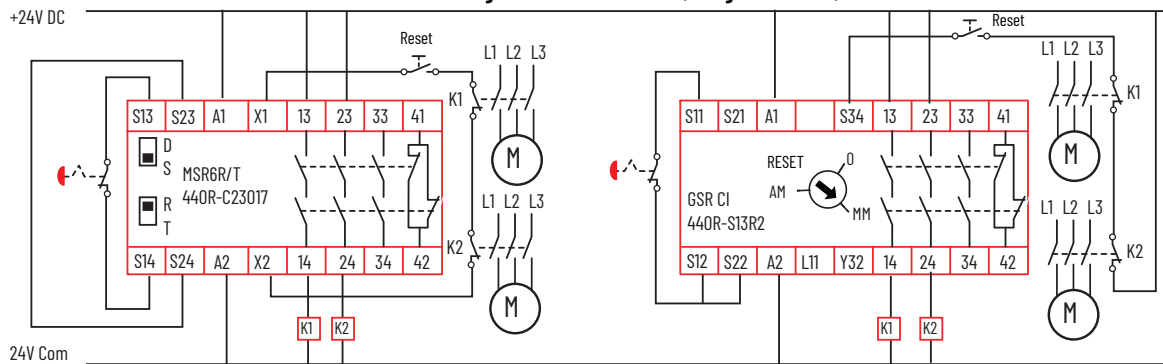
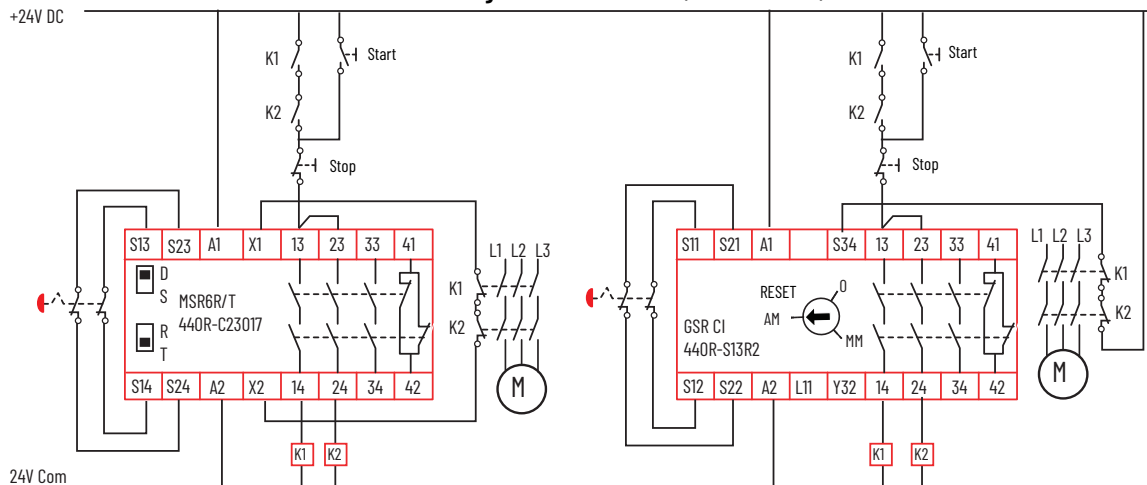
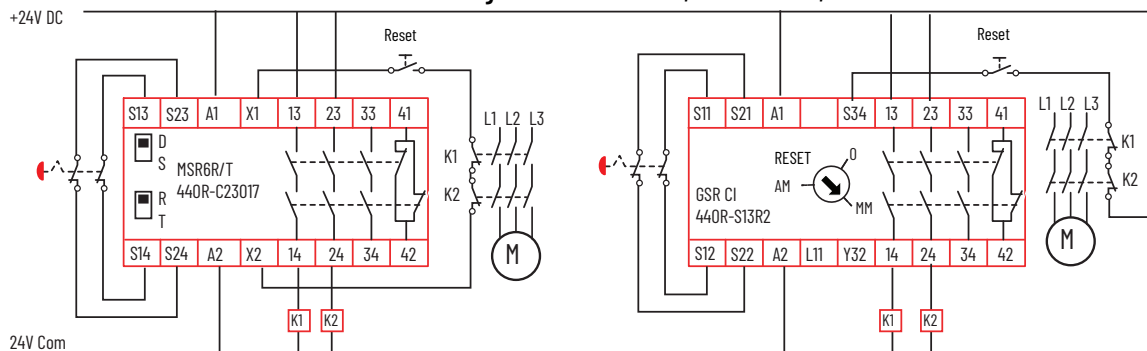
Figure 65 - AC Powered [mm (in.)]



Example 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 GSR CI safety relay equivalent.

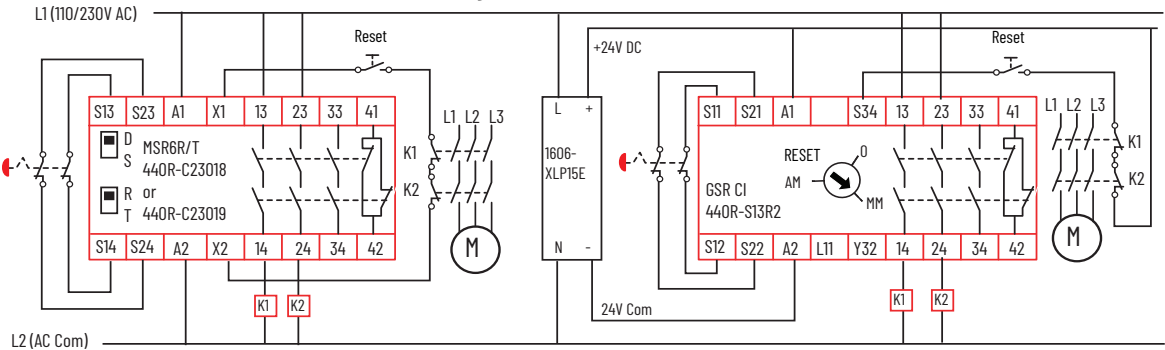
Safety standards require that interlock closure or release of E-stops must not initiate hazards. Therefore, a start-stop circuit is included.

Figure 66 - DC Powered, Single-channel, Auto Reset**Figure 67 - DC Powered, Single-channel, Monitored Reset****Figure 68 - DC Powered, Dual-channel, Auto Reset****Figure 69 - DC Powered, Dual-channel, Monitored Reset**

A catalog number 1606 power supply converts 100/240V AC to 24V DC to power the GSR CI safety relay. The outputs of the GSR 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 70 - AC Powered



Response Time

The GSR 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 24 - Response Time

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

Output Load Capability

The MSR6R/T safety relay has a higher current capability than the GSR CI safety relay, as shown in [Table 25 on page 50](#). See [Output Load Capability on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR CI safety relay capability.

Table 25 - Current Capability

Load Type	MSR6R/T	GSR 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

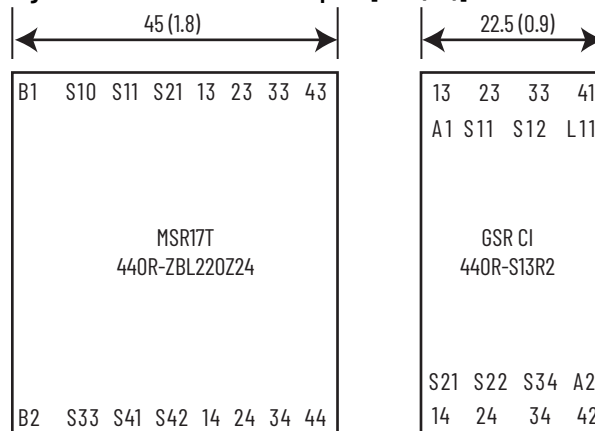


We recommend replacing the MSR17T safety relay with a GSR CI safety relay. The MSR17T safety relay is only available with a 24V DC power supply.

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 GSR CI safety relay is 22.5 mm (0.9 in.) wide and has two rows of terminals at the top and bottom.

Figure 71 - Terminals and Panel Space [mm (in.)]



Example Wiring Schematics

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

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

Figure 72 - DC Powered, Single-channel, Auto Reset

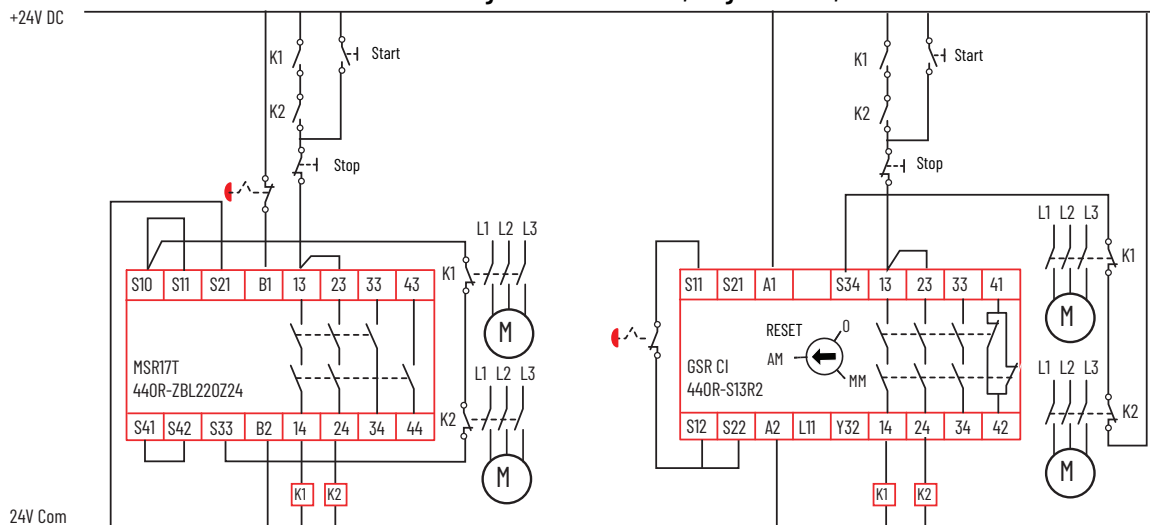


Figure 73 - DC Powered, Single-channel, Monitored Reset

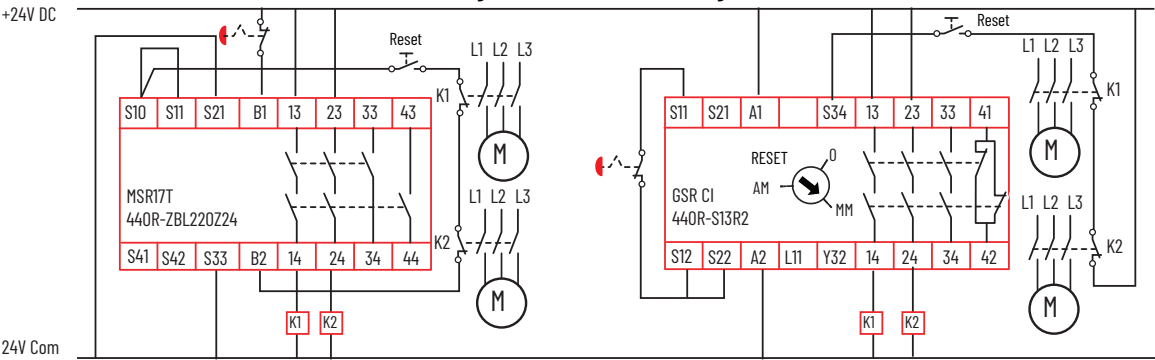


Figure 74 - DC Powered, Dual-channel, Auto Reset

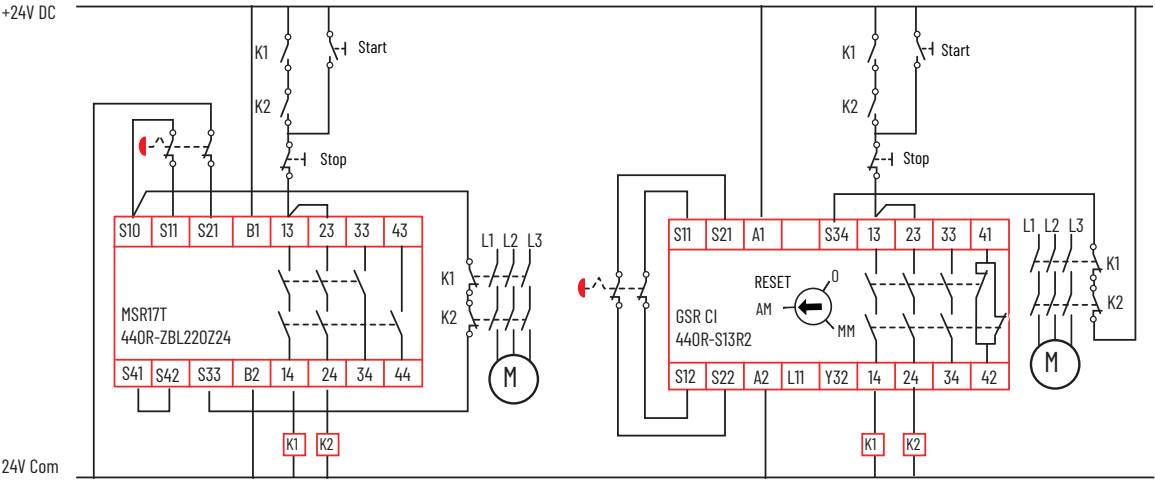
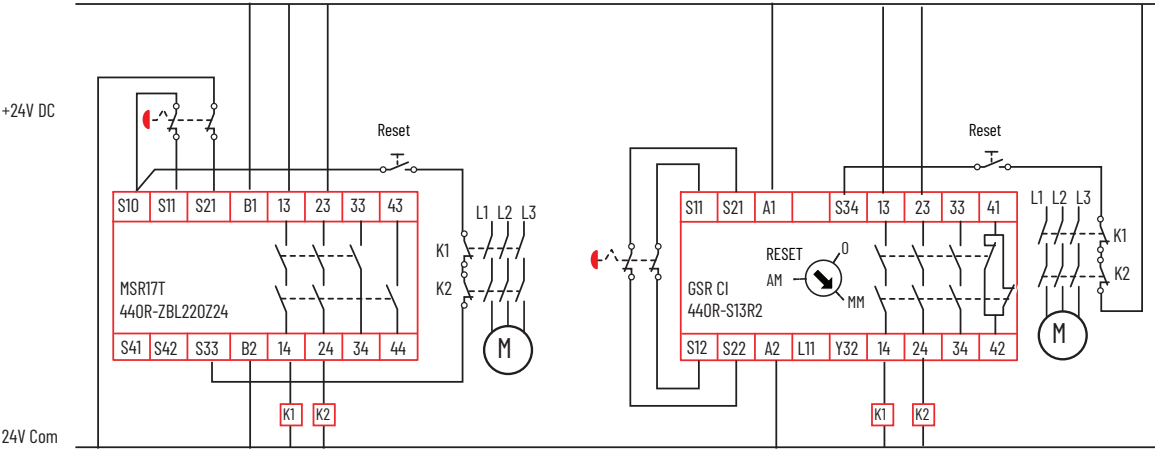


Figure 75 - DC Powered, Dual-channel, Monitored Reset



Response Time



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

Table 26 - Response Time

Safety Relay	Response Time [ms]
MSR17T	13
GSR CI	35

Output Load Capability

The GSR CI safety relay has the same DC current rating and a higher AC current capability than the MSR17T safety relay as shown in [Table 27](#).

Table 27 - Current Capability

Load Type	MSR17	GSR CI
AC Inductive	B300, AC-15 0.75 A	C300, AC-15 1.5 A
DC	P300, DC-13 2 A/24V DC	DC-13 2 A/24V DC
Thermal (non-switching)	-	2 A

MSR18T Safety Relay



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

Table 28 - MSR18T Safety Relay Replacement

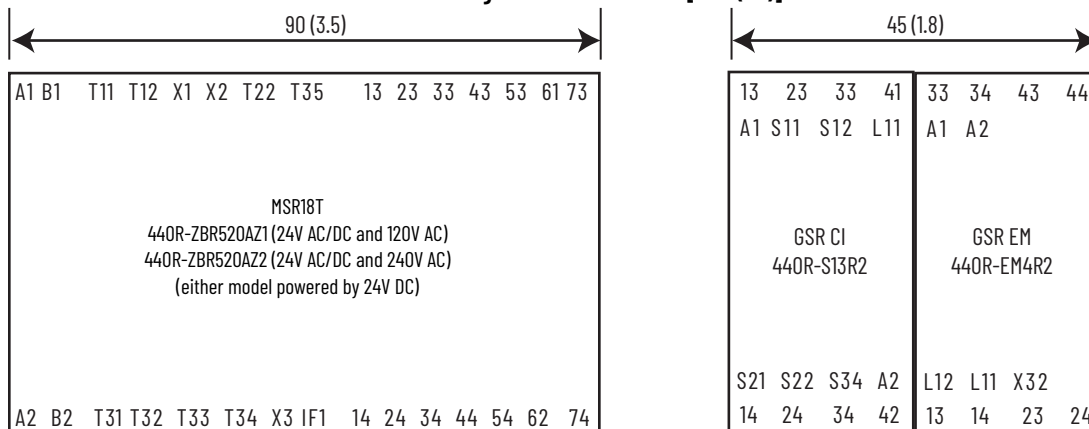
Function	Recommended Replacement
1 N.C.	GSR CI and EM safety relays
2 N.C.	GSR CI and EM safety relays
1 N.O. and 1 N.C.	MSR9 safety relay and up to two MSR132E expansion relays
Two-hand control	MSR125 safety relay and up to two MSR132E expansion relays

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 1606-XLP15E power supply must be used to convert the AC supply to 24V DC for the recommended GSR relays.

Terminal Locations and Panel Space

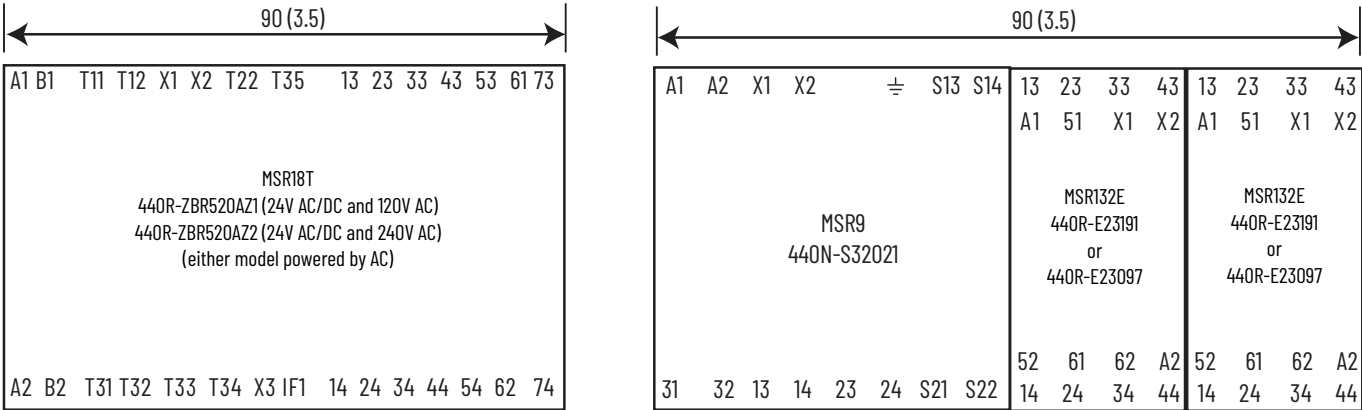
The MSR18T safety relay is 90 mm (3.5 in.) wide and has one row of terminals at the top and bottom. The GSR CI and EM safety relays are each 22.5 mm (0.9 in.) wide and have two rows of terminals at the top and bottom.

Figure 76 - DC Powered [mm (in.)]



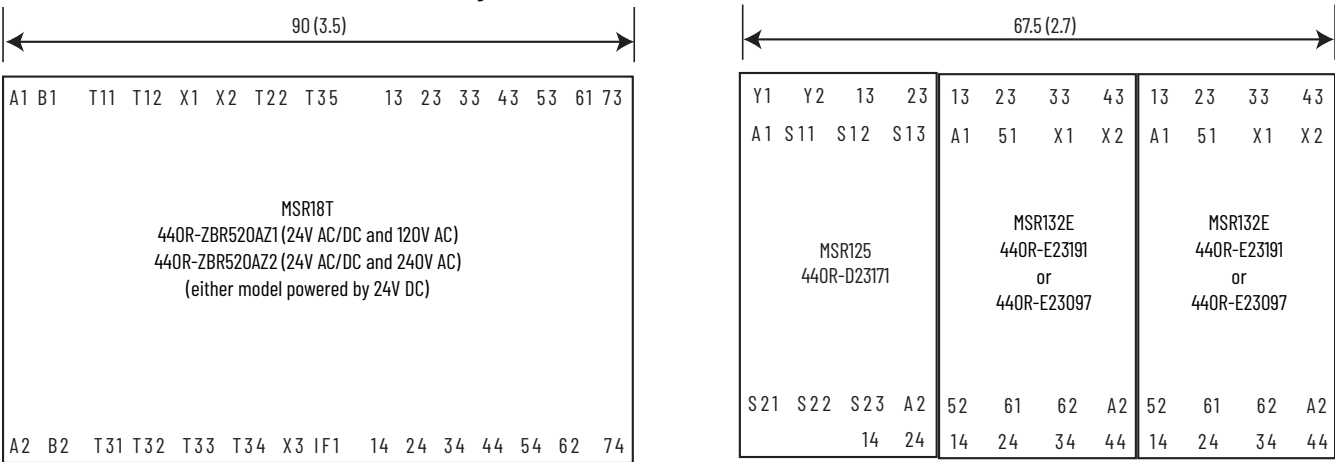
For applications where the MSR18T safety relay is configured for 1 N.C. and 1 N.O. with automatic reset, an MSR9 safety relay with MSR132 expansion relays is the recommended replacement.

Figure 77 - 1 N.C. and 1 N.O. DC Powered [mm (in.)]



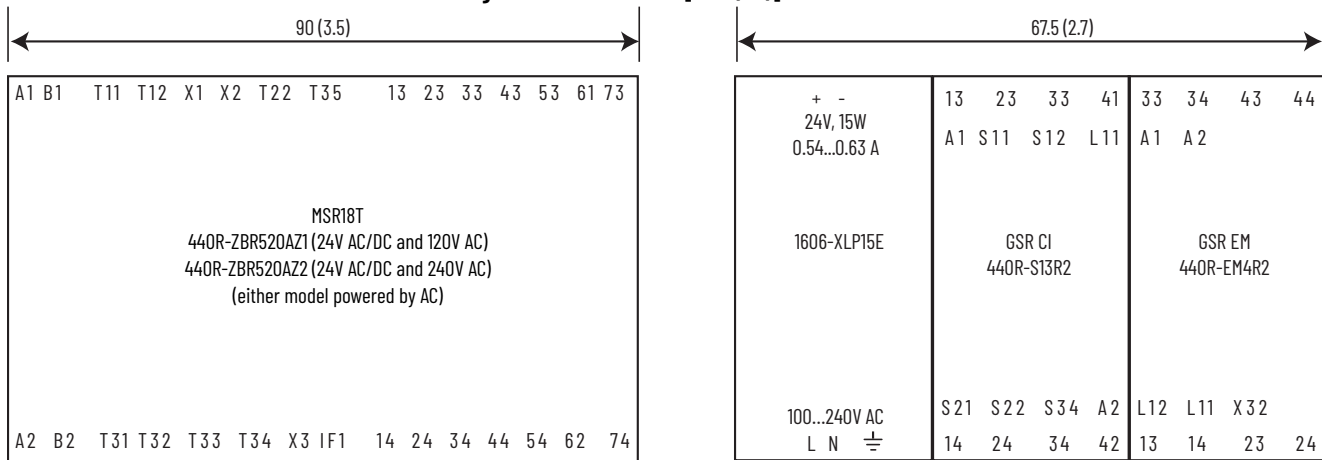
For two-hand control applications, we recommend the MSR125 safety relay as the replacement for the MSR18T safety relay. If additional outputs are needed, you can expand the MSR125 safety relay with the MSR132E expansion relay.

Figure 78 - Two-hand DC Powered [mm (in.)]



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

Figure 79 - AC Powered [mm (in.)]



Example Wiring Schematics

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

Figure 80 - Dual-channel, Manual Reset

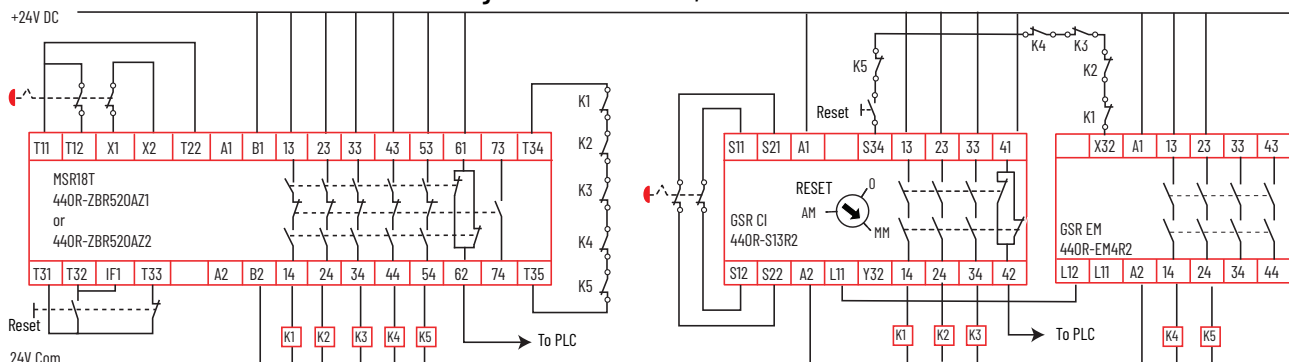


Figure 81 - Single-channel, Manual Reset

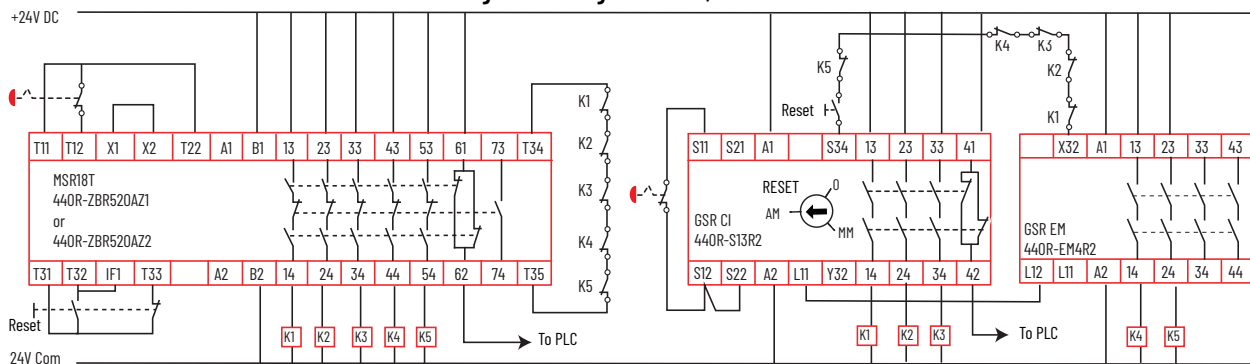


Figure 82 - 1 N.C. and 1 N.O., Automatic Reset

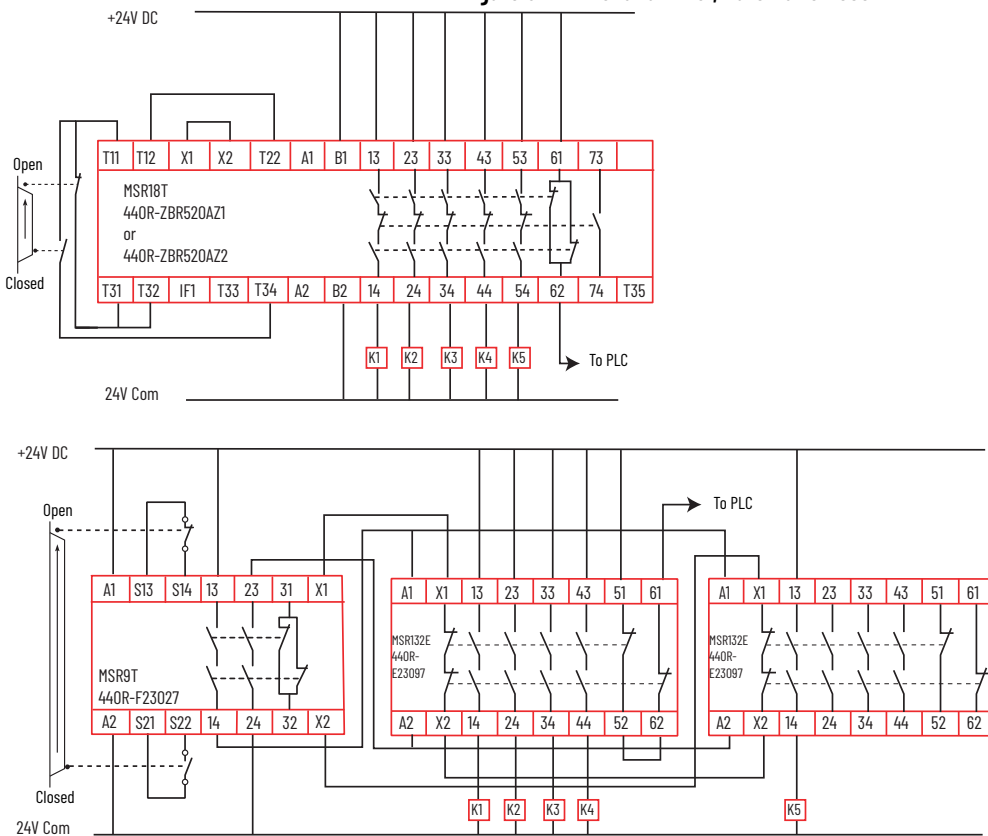


Figure 83 - Two-hand Control

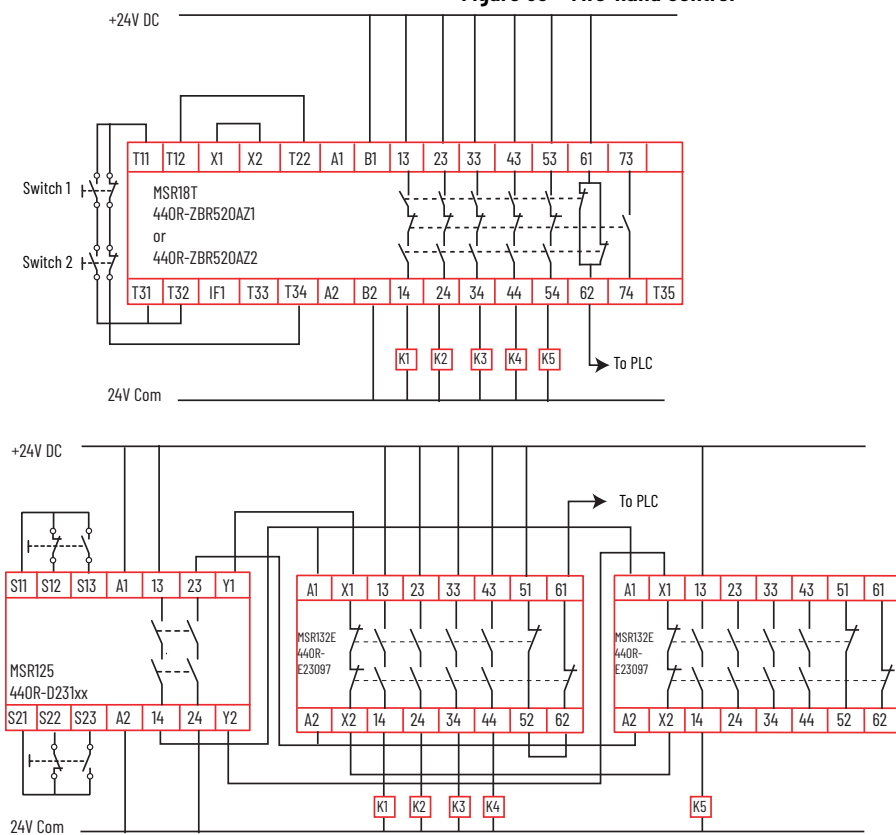
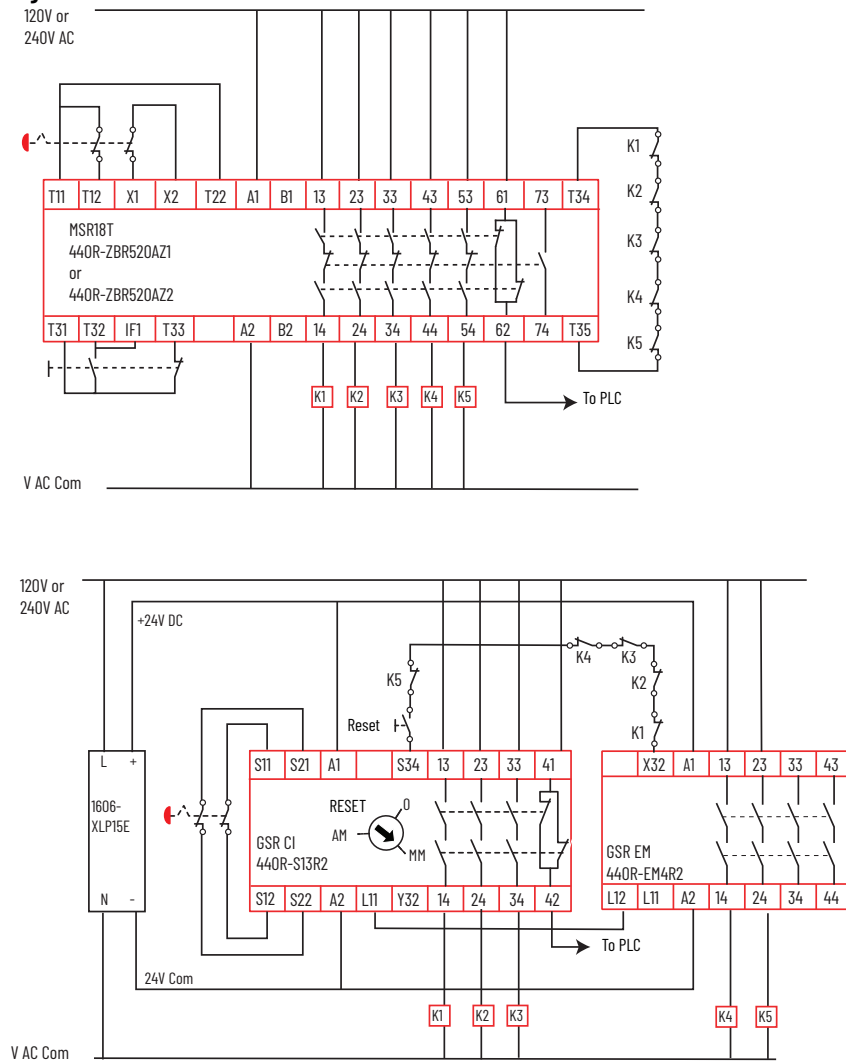


Figure 84 - AC Powered

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 29 - Response Time

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

Output Load Capability

[Table 30](#) compares the output load capability of the MSR18T safety relay to the replacement safety relays. See [Output Load Capability on page 11](#) for a wiring example of that uses interposing relays for applications where the load exceeds the capability of the replacements.

Table 30 - Current Capability

Load Type	MSR18T	GSR 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

MSR19E Safety Relay

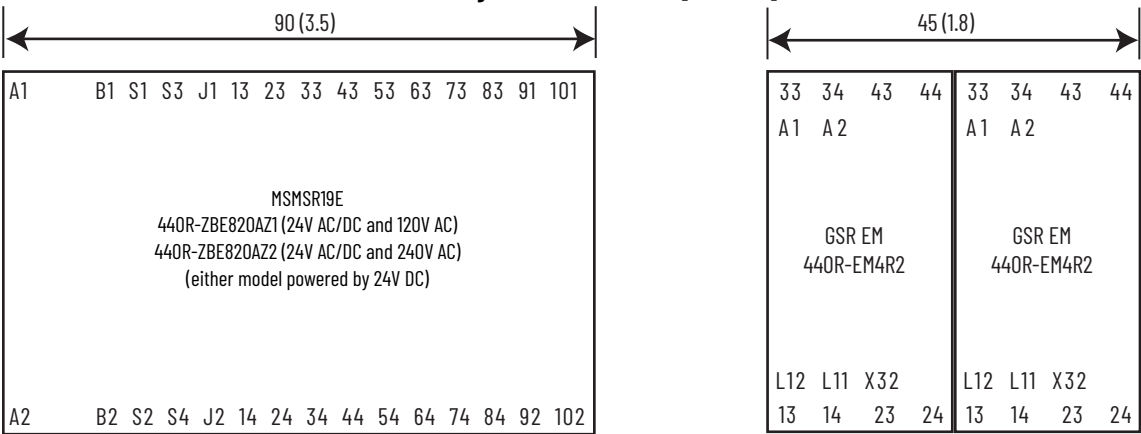


We recommend replacing the MSR19E safety relay with two EM safety relays. The MSR19E safety relay has two input channels. When driven by a host safety relay, the host safety relay must devote two safety outputs to drive the MSR19E safety relay. With the GSR safety relays, the Single Wire Safety (SWS) 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

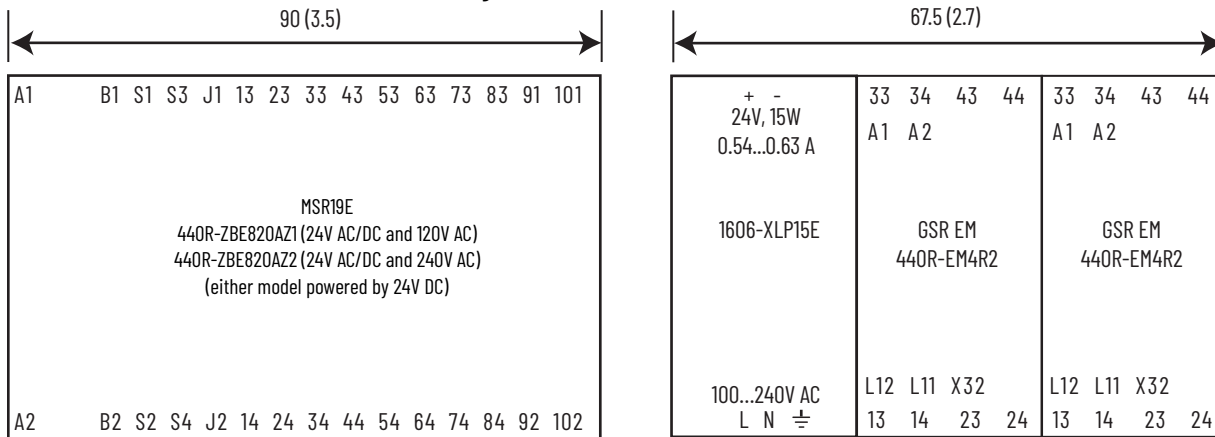
The MSR19E safety relay is 90 mm (3.5 in.) wide and has one row of terminals at the top and bottom. The EM safety relay is 22.5 mm (0.9 in.) wide and has two rows of terminals at the top and bottom. Two EM safety relays use half of the panel space as one MSR19E safety relay.

Figure 85 - DC Powered [mm (in.)]



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

Figure 86 - AC Powered [mm (in.)]



Example Wiring Schematics

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

Figure 87 - DC Powered

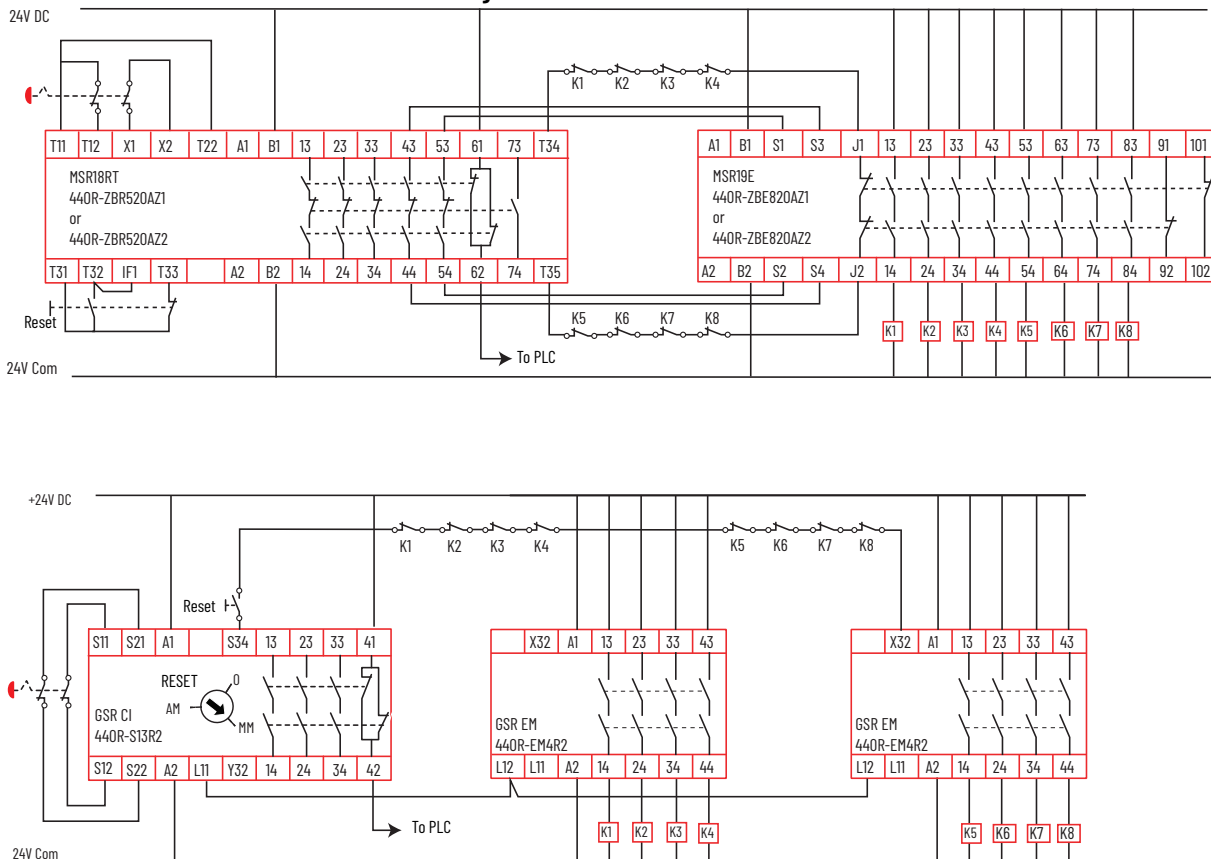
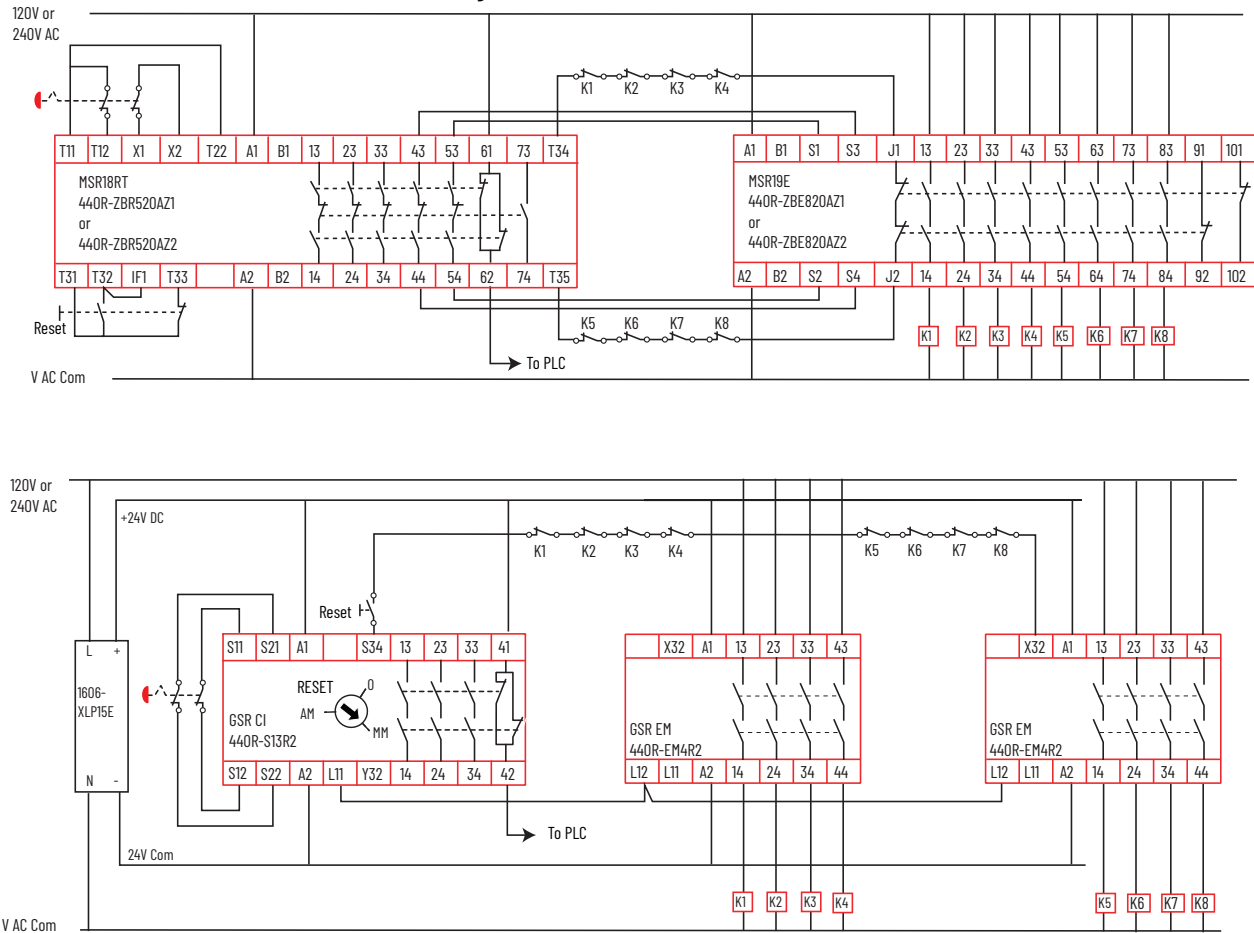



Figure 88 - AC Powered



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 31 - 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 32 on page 61](#). See [Output Load Capability on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the EM safety relay capabilities.

Table 32 - 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)	1 x 8 A, 2 x 7 A, 4 x 6 A, 6 x 5 A, 8 x 4.5 A	1x6 A

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. The MSR30 safety relay can also be wired for automatic or monitored reset. It has two normally open (N.O) solid-state outputs and one normally closed (N.C.) solid-state output.

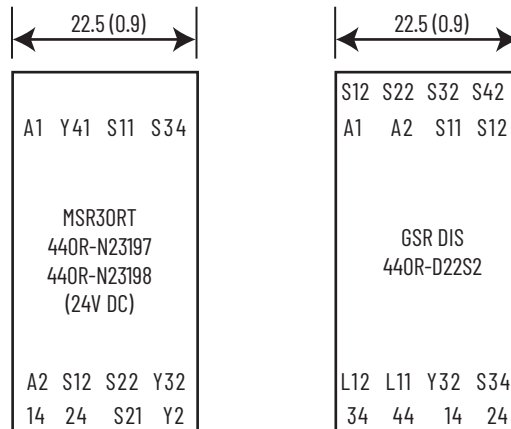
The DIS safety relay has one multi-position rotary switch to configure the reset as automatic or monitored manual and the logic that is applied to the two inputs. The wiring of the relay determines single or dual-channel inputs.

The MSR30 safety relay has a feature that is 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.

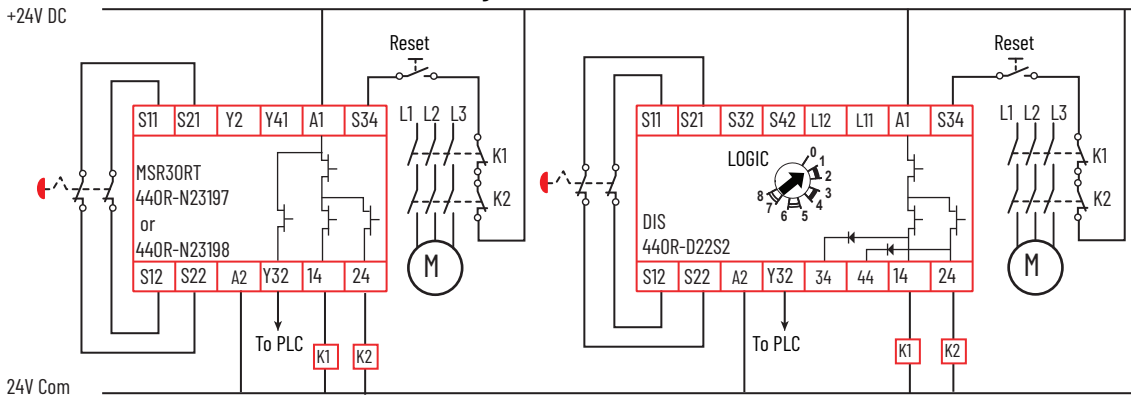
Figure 89 - Terminals and Panel Space [mm (in.)]



Example Wiring Schematics

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

Figure 90 - Dual-channel, Monitored Reset



ATTENTION: In [Figure 91](#), when the safety inputs close the safety outputs energize automatically. You must design the safety system such that an additional manual action is required to initiate the hazard.

Figure 91 - Dual-channel, Automatic Reset

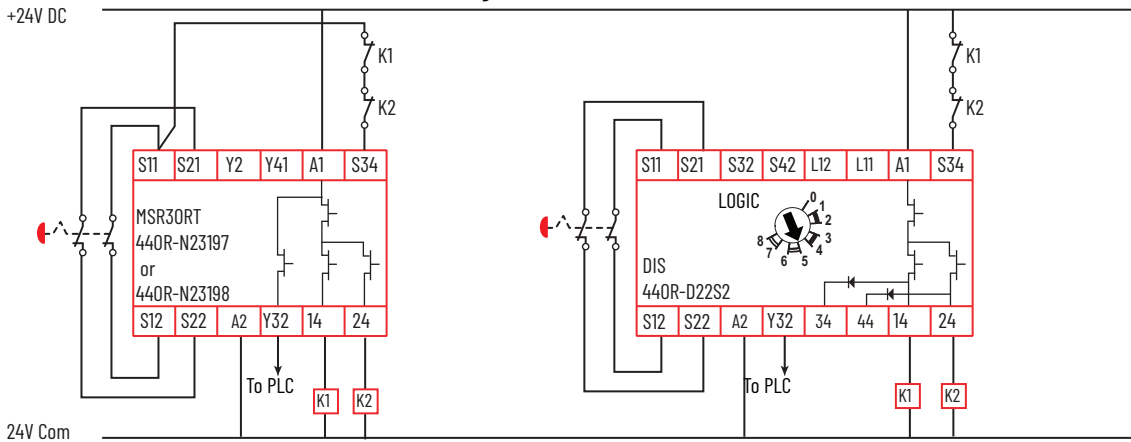
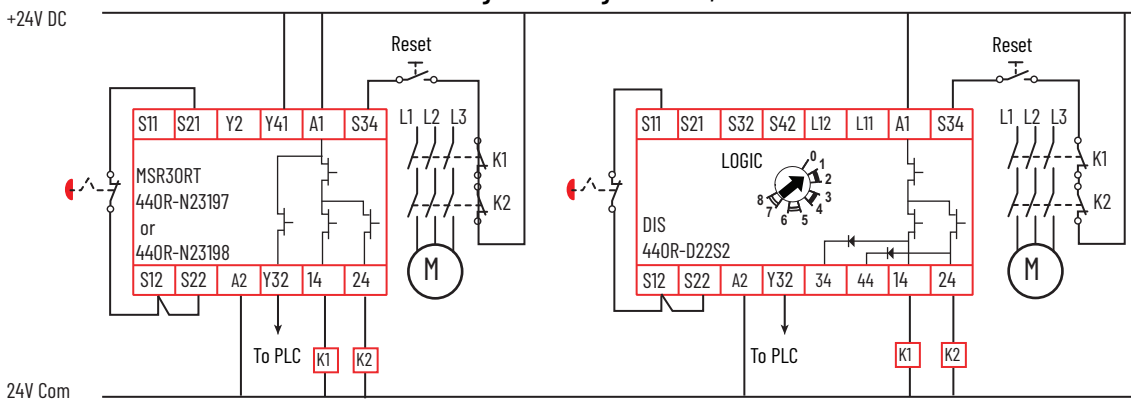


Figure 92 - Single-channel, Monitored Reset



ATTENTION: In [Figure 93 on page 63](#), when the safety inputs close the safety outputs energize automatically. You must design the safety system such that an additional manual action is required to initiate the hazard.

Figure 93 - Single-channel, Automatic Reset

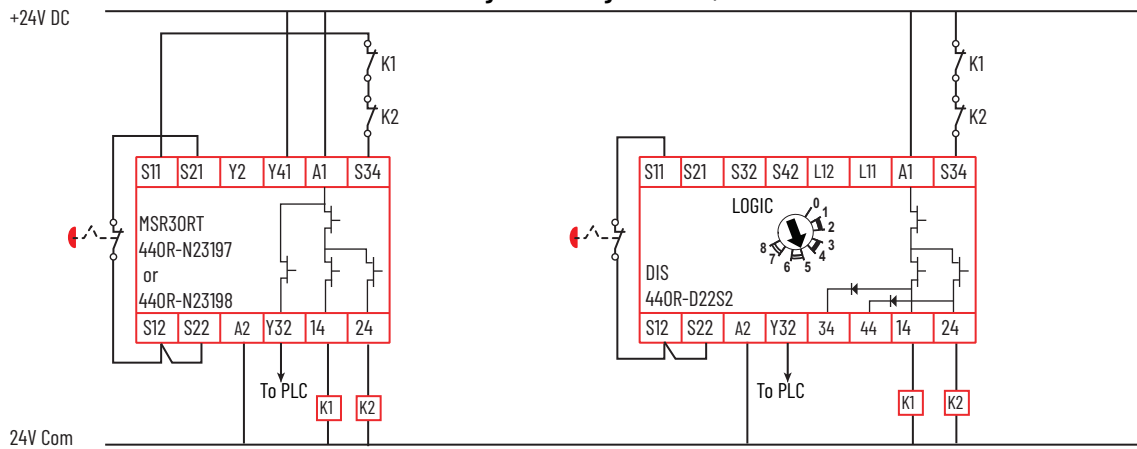
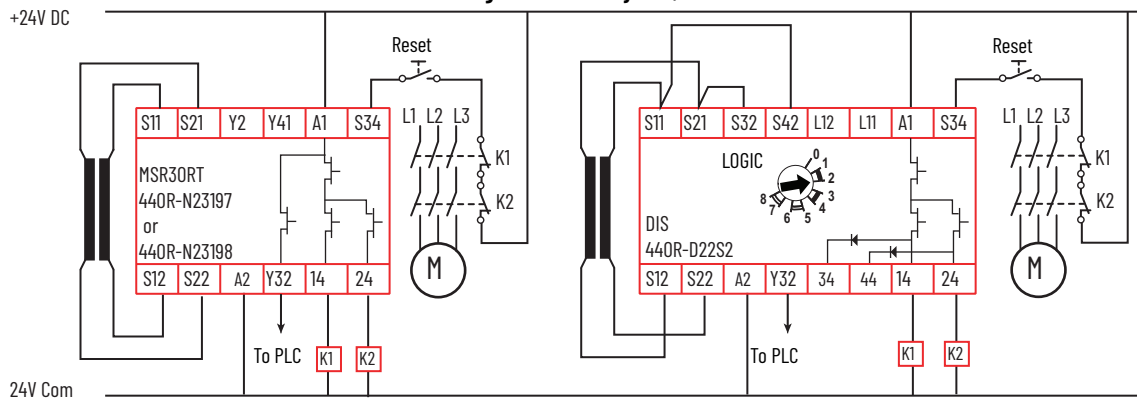
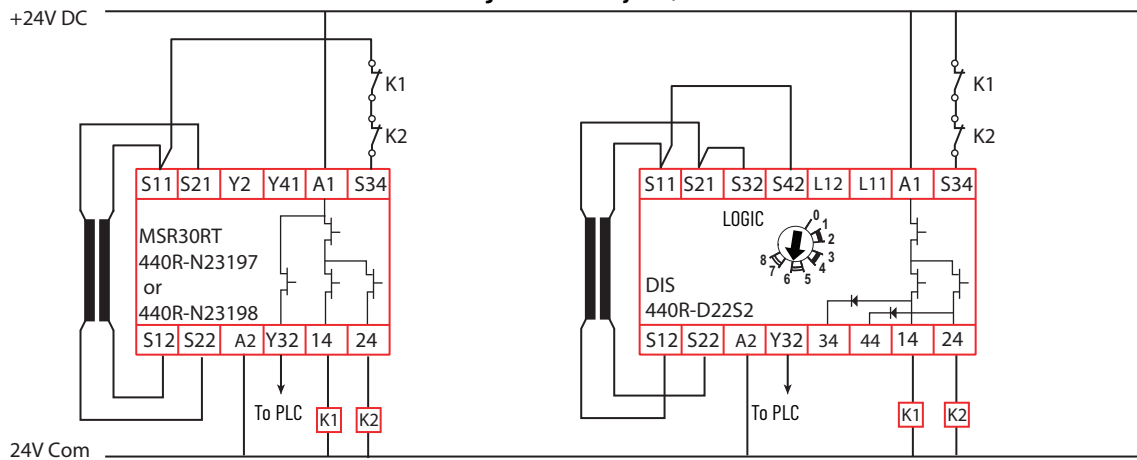


Figure 94 - Safety Mat, Monitored Reset




ATTENTION: In [Figure 95](#), when you step off the safety mat the safety outputs energize automatically. You must design the safety system such that an additional manual action is required to initiate the hazard.

Figure 95 - Safety Mat, Automatic Reset



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 33 - 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 34](#). See [Output Load Capability on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR capability.

Table 34 - Current Capability

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

MSR38DP Safety Relay

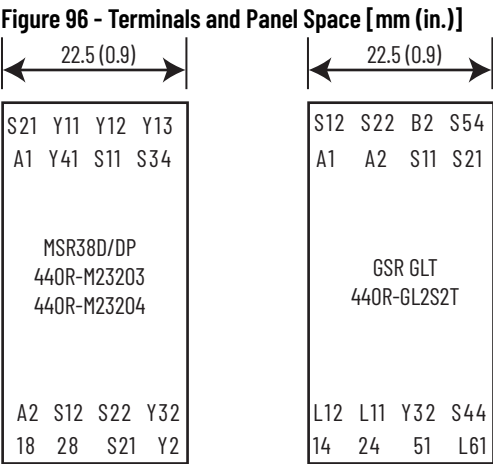


We recommend replacing the MSR38D safety relay with the GLT safety relay for most applications. The MSR38D safety relay has two delayed safety outputs and one immediate auxiliary output. The inputs accommodate applications that require dual-channel, single-channel mechanical devices or safety mats.

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

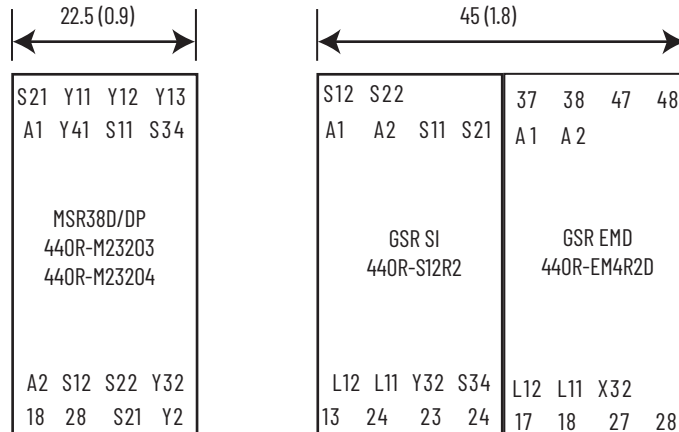
Terminal Locations and Panel Space

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.



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.

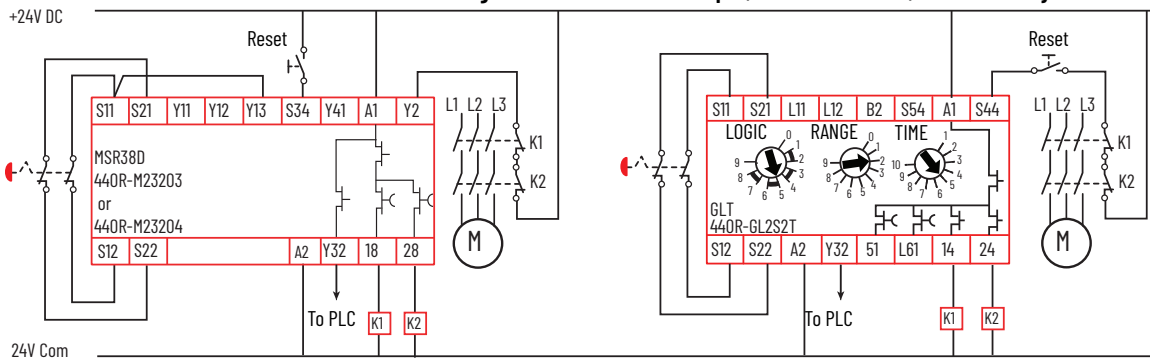
Figure 97 - Safety Mat Applications [mm (in.)]



Example Wiring Schematics

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

Figure 98 - Dual-channel Input, Monitored Reset, 1.5 s Off-delay



ATTENTION: In [Figure 99](#), when the safety inputs close the safety outputs energize automatically. You must design the safety system such that an additional manual action is required to initiate the hazard.

Figure 99 - Dual-channel Input, Automatic Reset, 15 s Off-delay

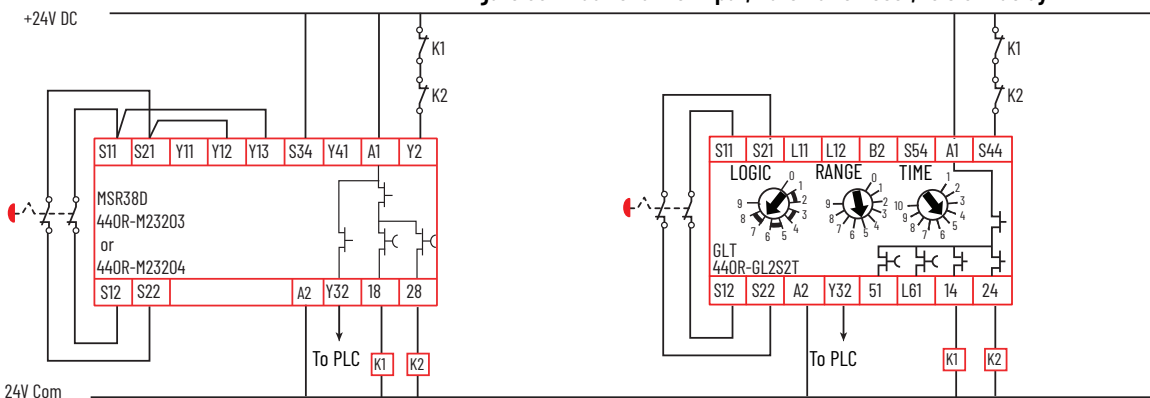
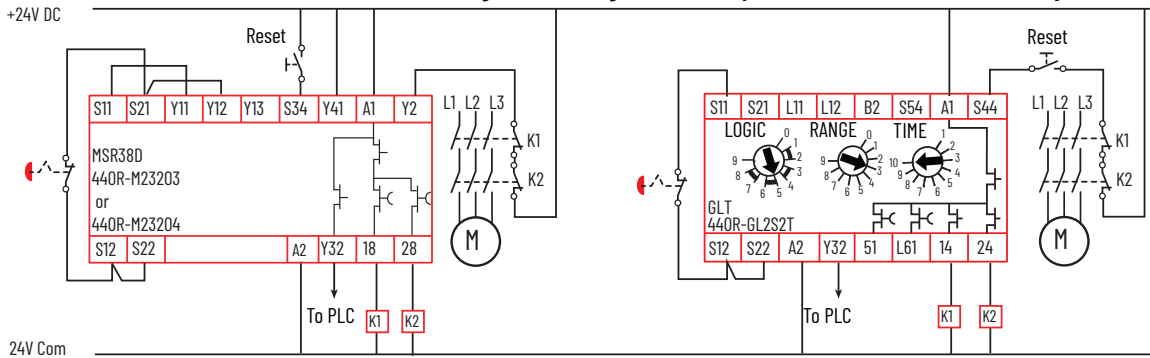


Figure 100 - Single-channel Input, Monitored Reset, 5 s Off-delay



ATTENTION: In [Figure 101](#), when the safety inputs close the safety outputs energize automatically. You must design the safety system such that an additional manual action is required to initiate the hazard.

Figure 101 - Single-channel Input, Automatic Reset, 50 s Off-delay

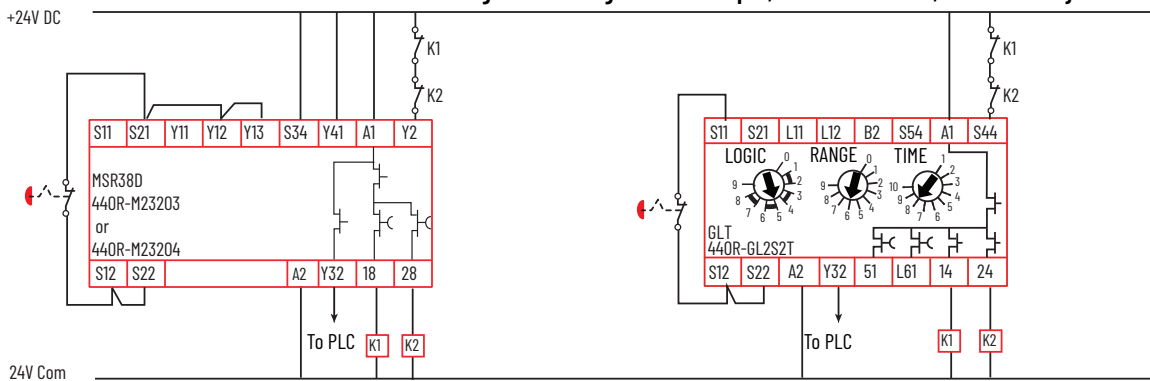
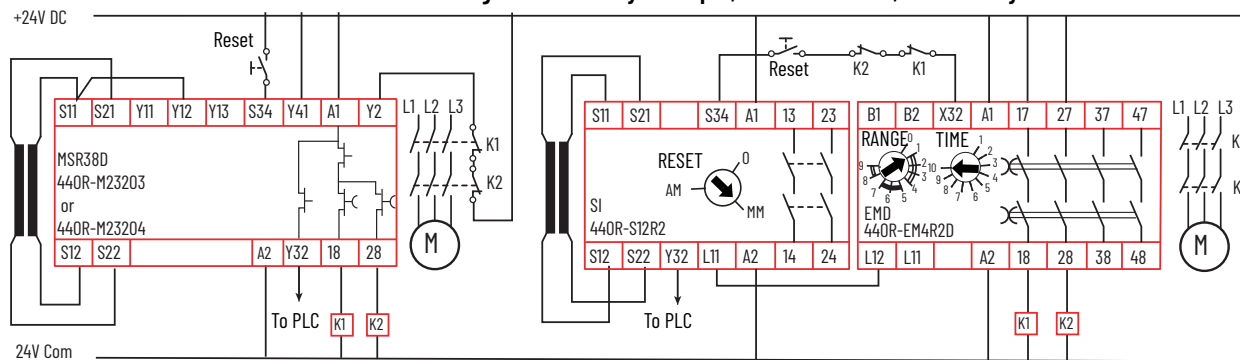
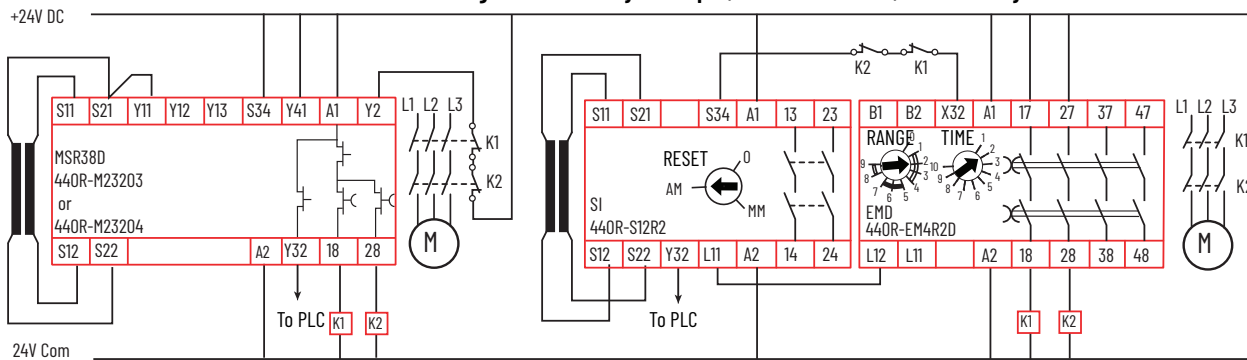


Figure 102 - Safety Mat Input, Monitored Reset, 1 s Off-delay



ATTENTION: In [Figure 103 on page 67](#), when you step off the safety mat the safety outputs energize automatically. You must design the safety system such that an additional manual action is required to initiate the hazard.

Figure 103 - Safety Mat Input, Automatic Reset, 2 s Off-delay



Response Time



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

Table 35 - Response Time

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

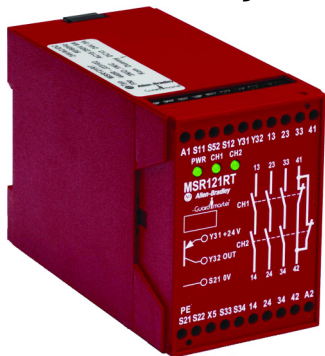
Output Load Capability

The MSR38D safety relay has a higher current capability than the GLT safety relay as shown in [Table 36](#). See [Output Load Capability on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR capability.

Table 36 - Current Capability

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

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 GSR CI safety relay is configured for automatic or monitored reset by a rotary switch on its front face.

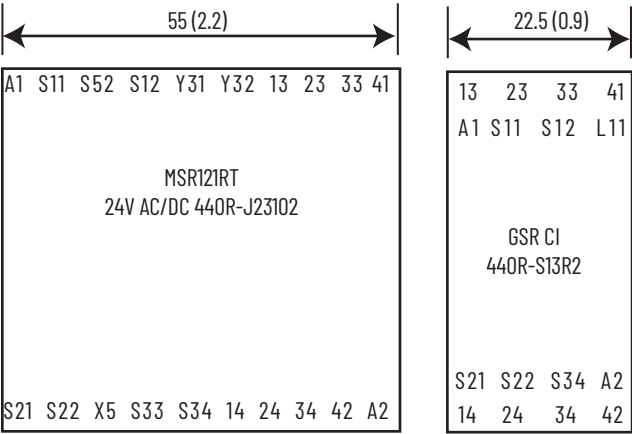
The MSR121RT safety relay is in models that are supplied by 24V AC/DC, 115V AC, or 230V AC power. For the DC power units, a 1606-X15E power supply must be used to convert the power to 24V DC.

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

Terminal Locations and Panel Space

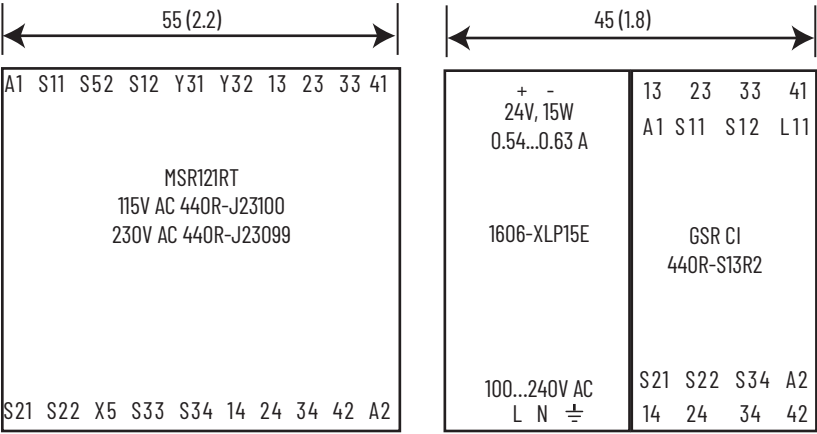
The MSR121RT safety relay is 55 mm (2.2 in.) wide with one row of terminals at the top and bottom. The GSR CI safety relay is 22.5 mm (0.9 in.) wide with two rows of terminals at the top and bottom.

Figure 104 - DC Powered [mm (in.)]



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

Figure 105 - AC Powered [mm (in.)]



Example Wiring Schematics

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

Figure 106 - Dual-channel Input, Monitored Reset, DC Powered

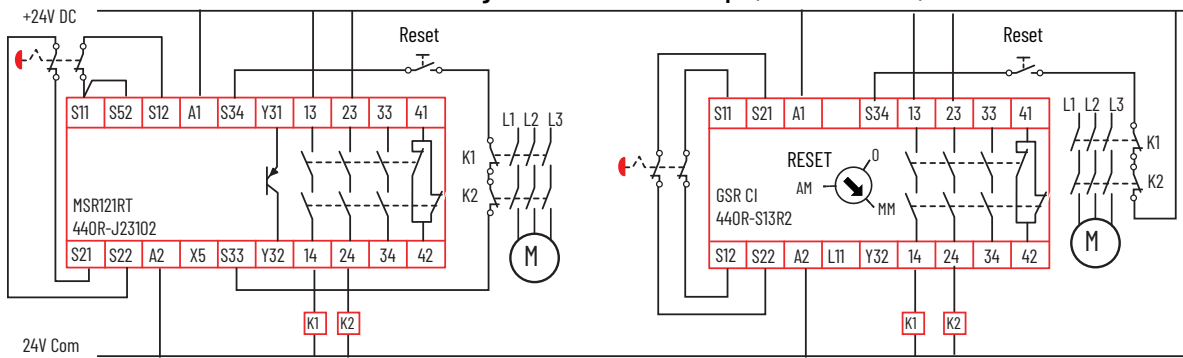


Figure 107 - Dual-channel Input, Automatic Reset, DC Powered

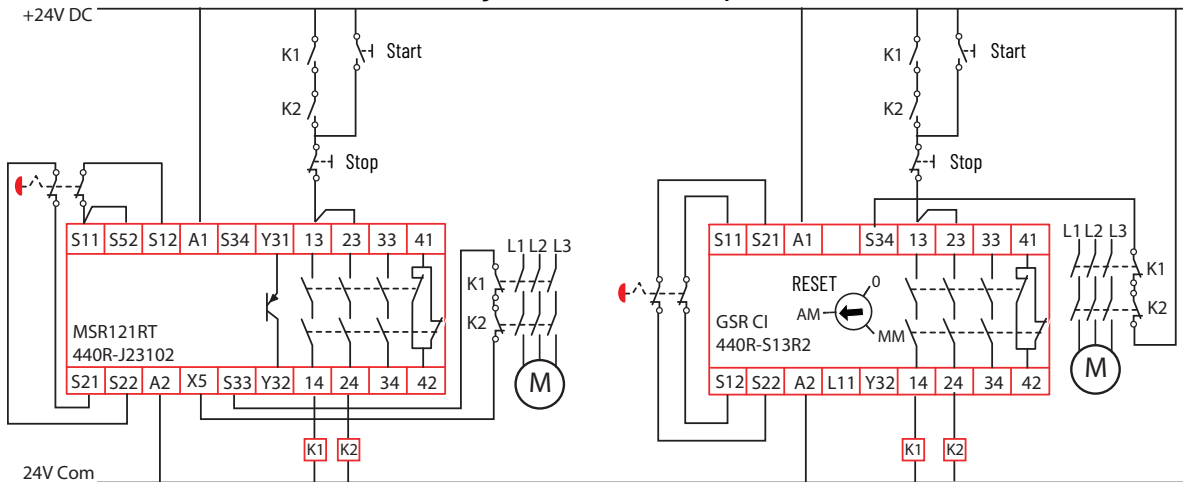


Figure 108 - Single-channel Input, Monitored Reset, DC Powered

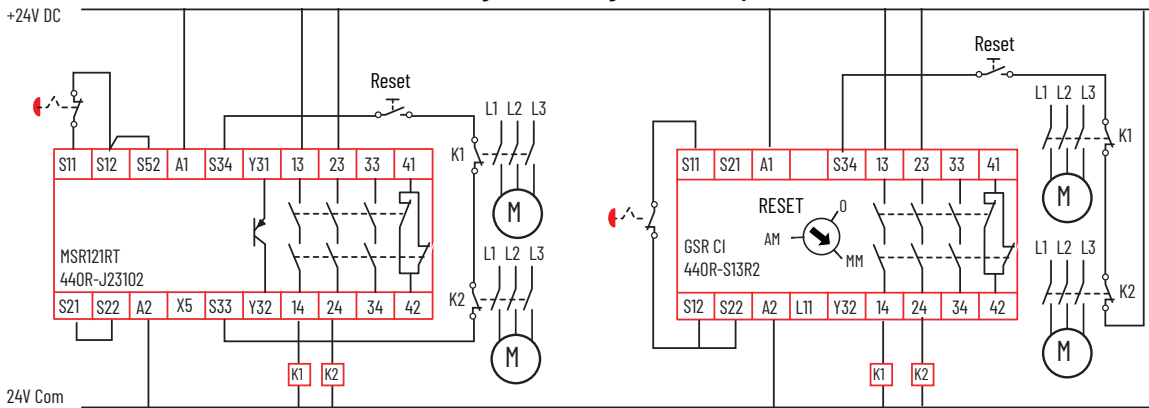


Figure 109 - Single-channel Input, Automatic Reset, DC Powered

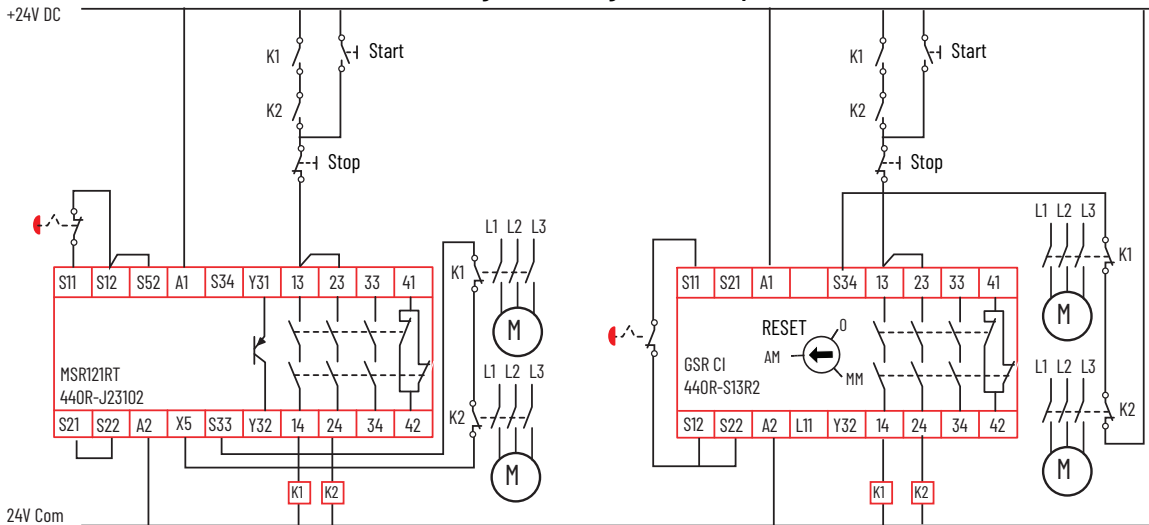


Figure 110 - OSSD Input, Monitored Reset, DC Powered

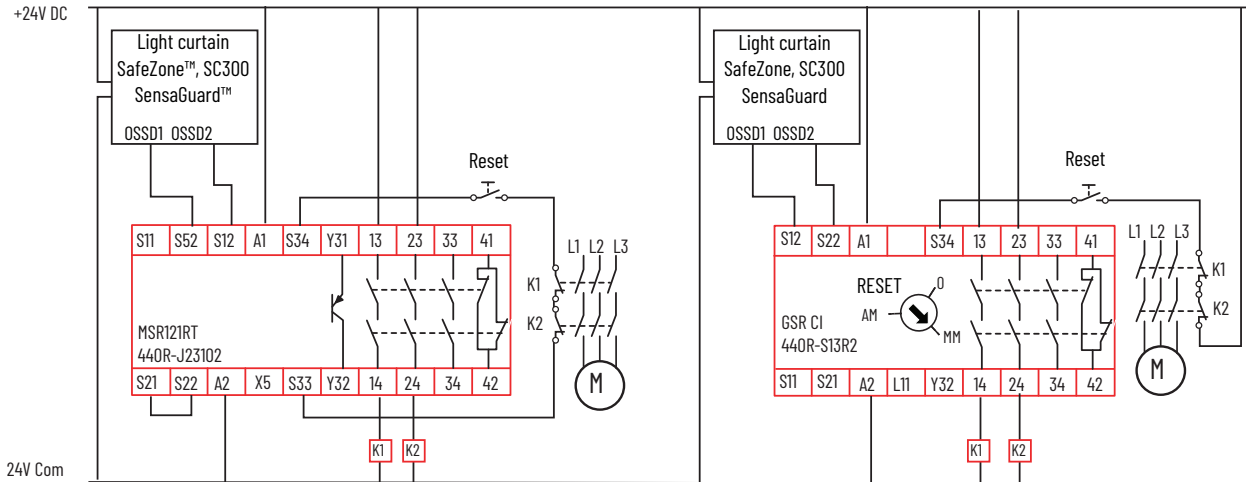


Figure 111 - OSSD Input, Automatic Reset, DC Powered

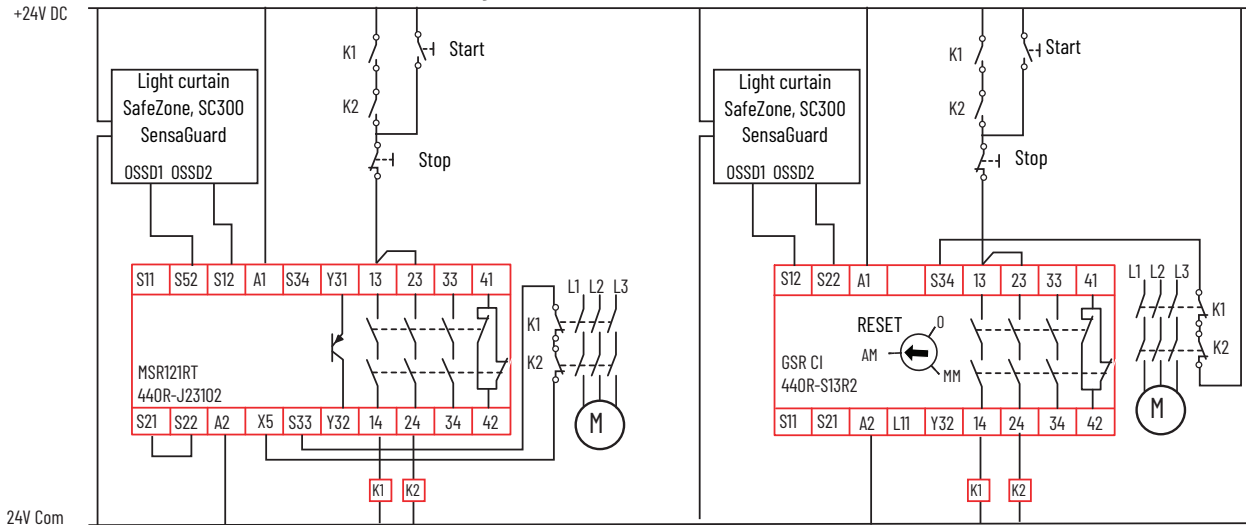


Figure 112 - Safety Mat Input, Monitored Reset, DC Powered

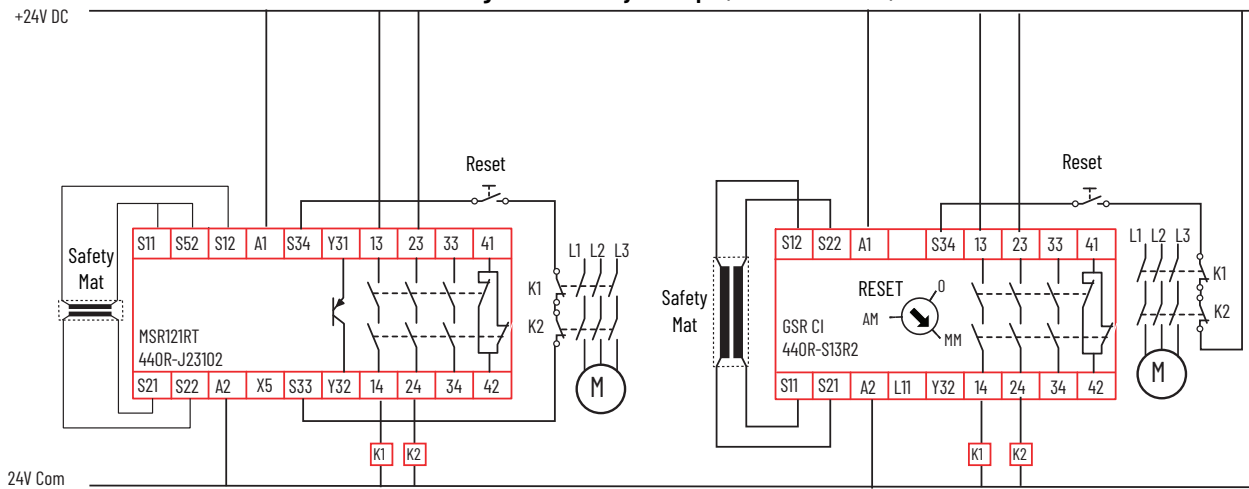


Figure 113 - Safety Mat Input, Automatic Reset, DC Powered

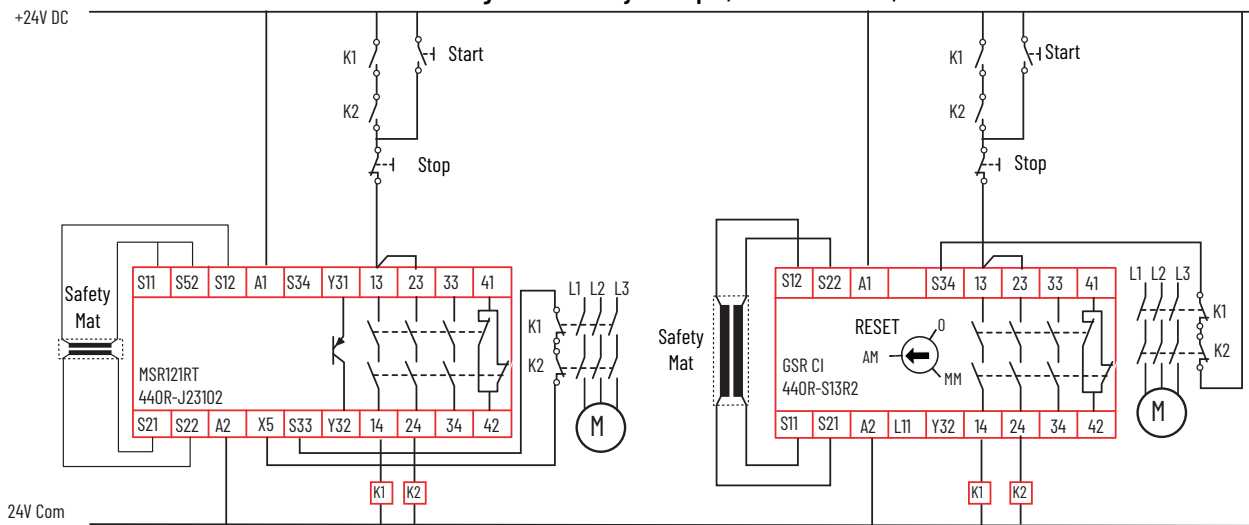
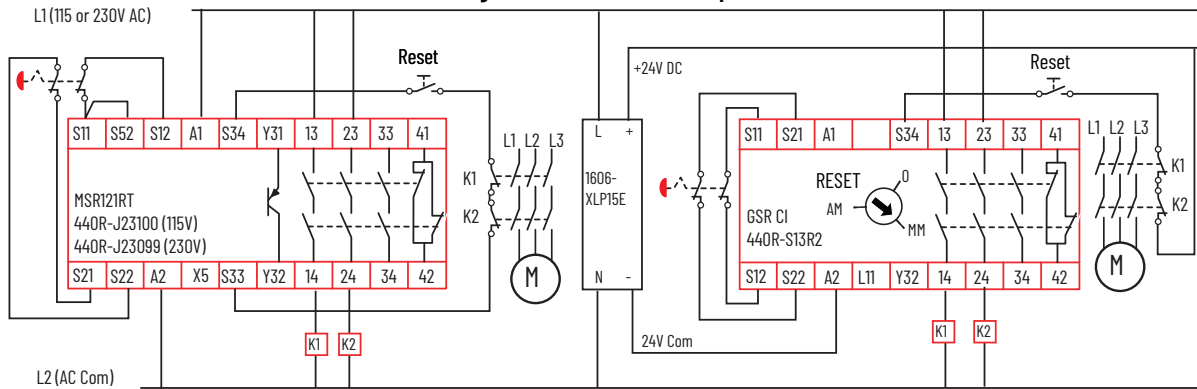



Figure 114 - Dual-channel Input, Monitored Reset, AC Powered



Response Time



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

Table 37 - Response Time

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

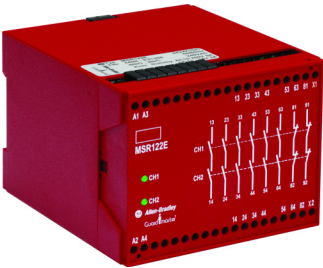
Output Load Capability

The MSR121RT safety relay has a higher current capability than the GSR CI safety relay as shown in [Table 38](#). See [Output Load Capability on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR capability.

Table 38 - Current Capability

Load Type	MSR121RT	GSR 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

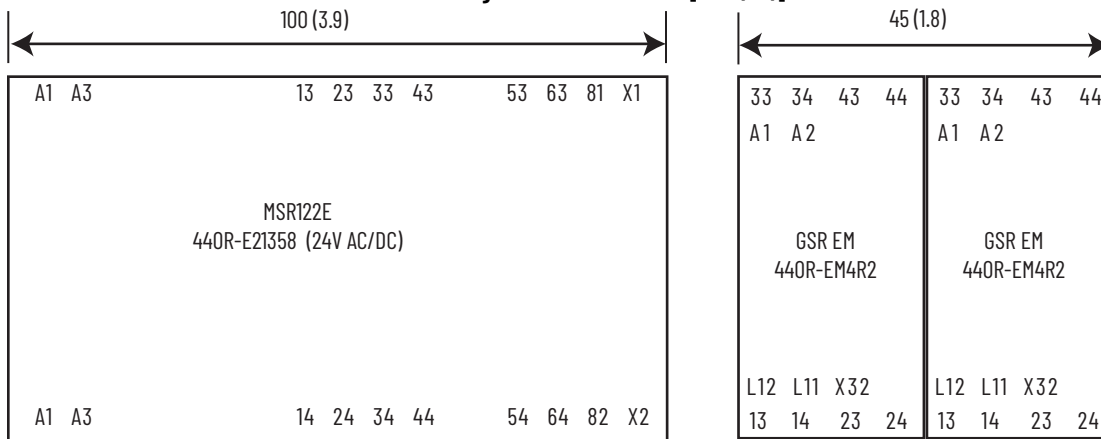
MSR122E Safety Relay



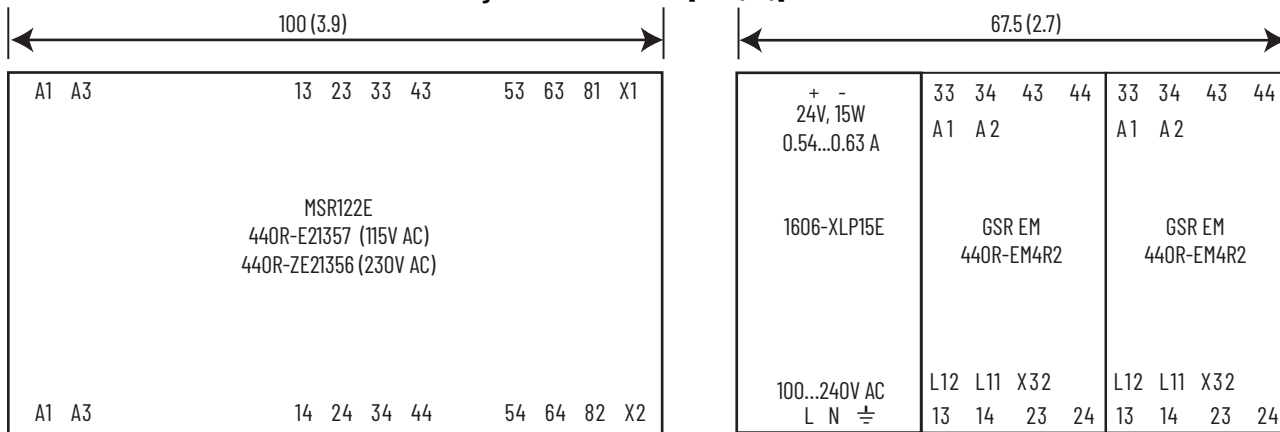
We recommend replacing the MSR122E safety relay with two EM safety relays. The MSR122E safety relay has two input channels. When driven by a host safety relay, the host relay must devote two safety outputs to drive the MSR122E safety relay. With the EM safety relays, the Single Wire Safety (SWS) output 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 115 - DC Powered [mm (in.)]

For applications where the MSR122E safety relay power supply is 110V AC, a 1606-XLP15E power supply 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 116 - AC Powered [mm (in.)]

Example Wiring Schematics

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

Figure 117 - 24V DC Powered

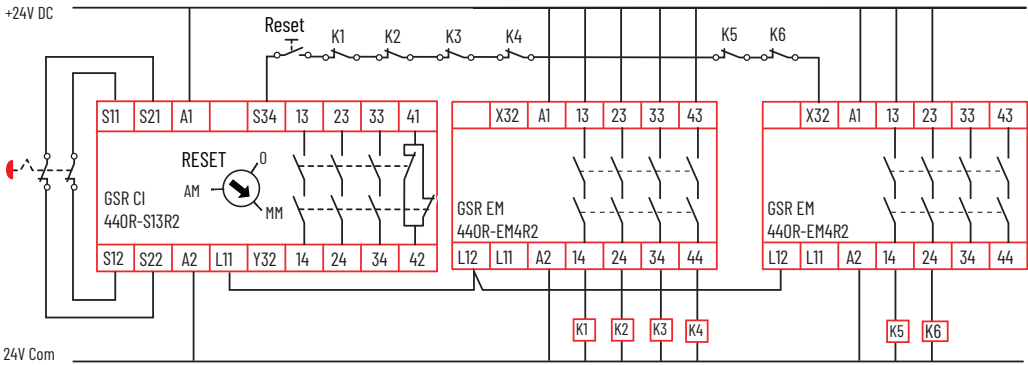
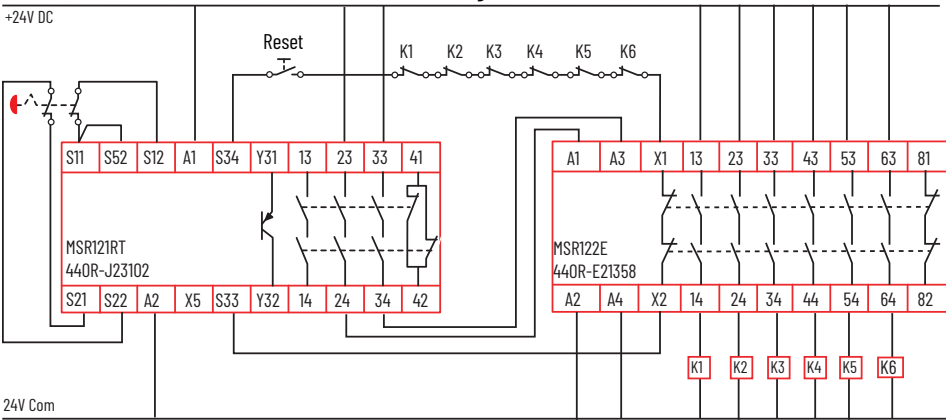
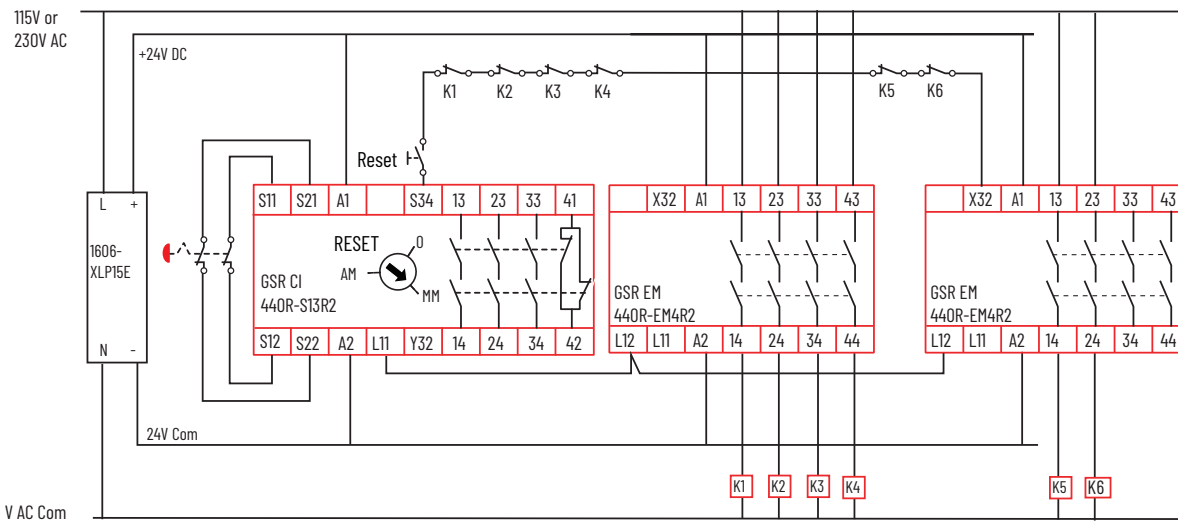
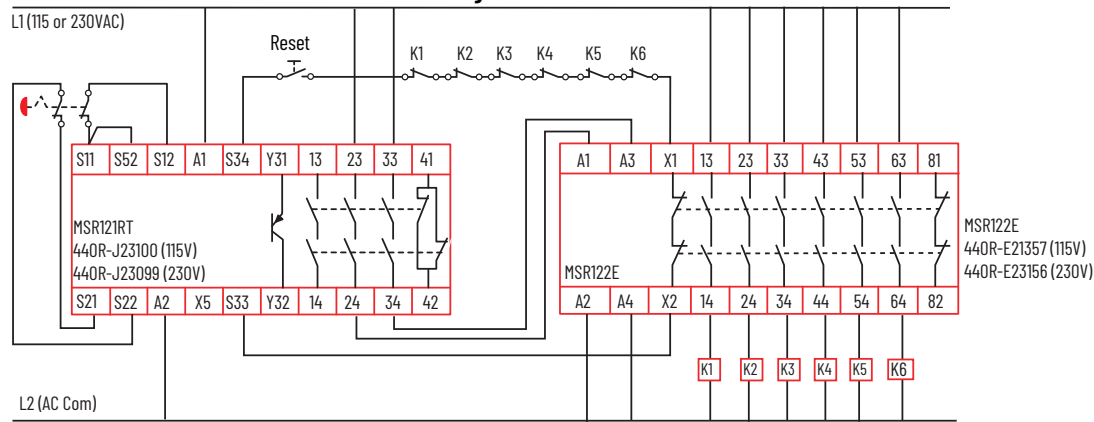


Figure 118 - 115V/230V AC Powered



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 39 - Response Time

Safety Relay	Response Time [ms]
MSR122E	30
EM	35

Output Load Capability

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

Table 40 - 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



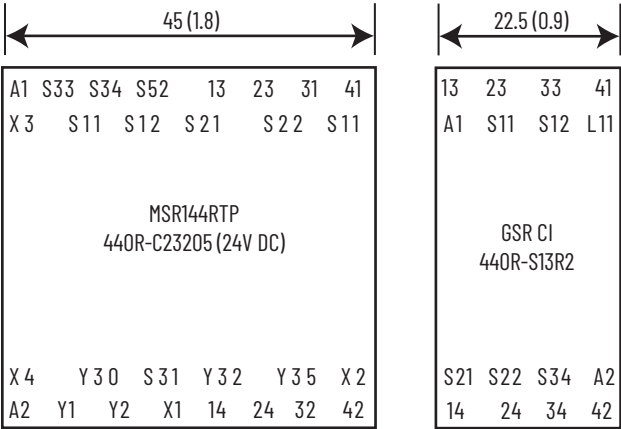
We recommend replacing the MSR1244 safety relay with a GSR CI safety relay. If the application does not use the N.C. outputs of the MSR144 safety relay, an SI safety relay can replace the MSR144 safety relay.

The outputs of the MSR144 safety relay can be expanded with the 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.

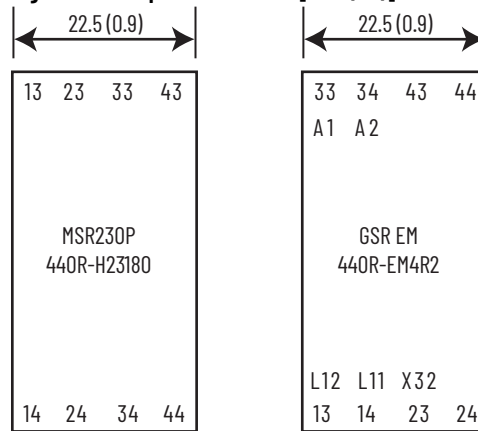
Terminal Locations and Panel Space

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

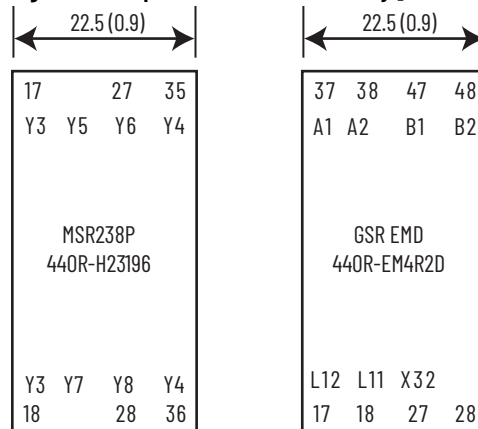
Figure 119 - DC Powered [mm (in.)]



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 120 - Expansion Module [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 121 - Expansion Module with Delay [mm (in.)]

Example Wiring Schematics

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

Figure 122 - Dual-channel, Monitored Reset Schematic, DC Powered

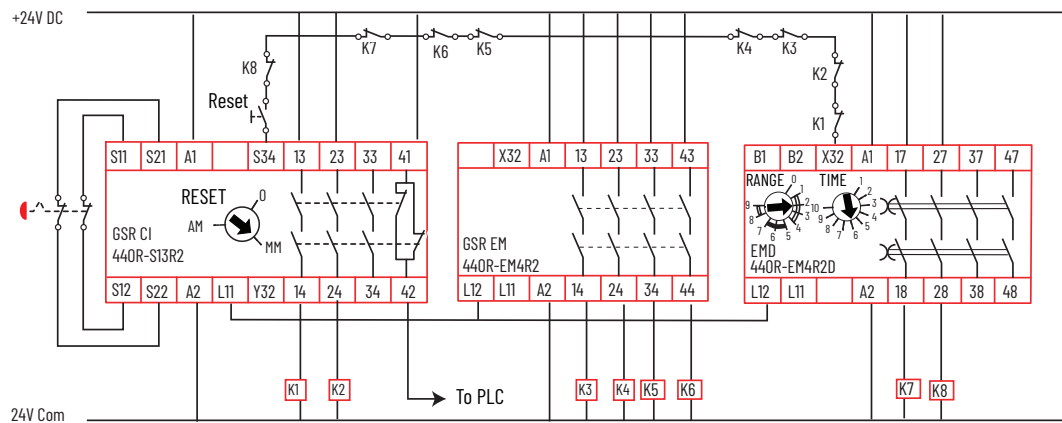
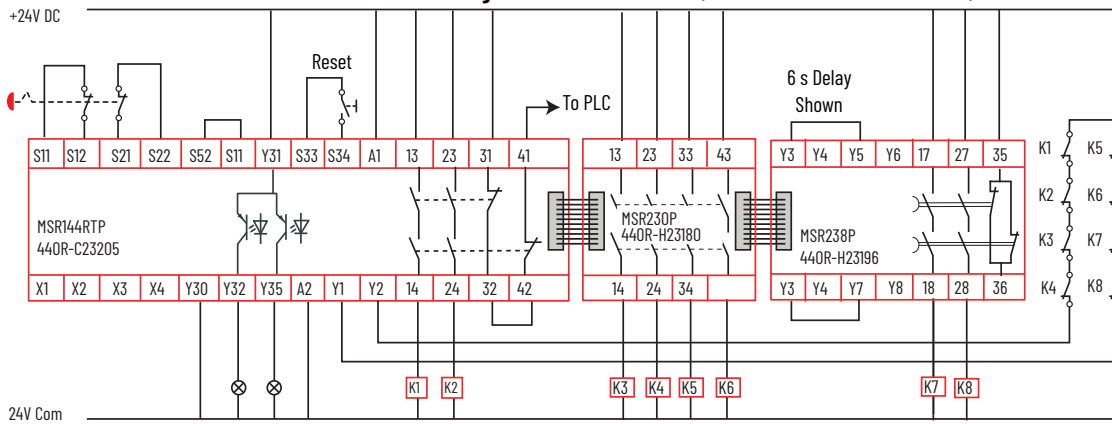


Figure 123 - Dual-channel, Automatic Reset Schematic, DC Powered

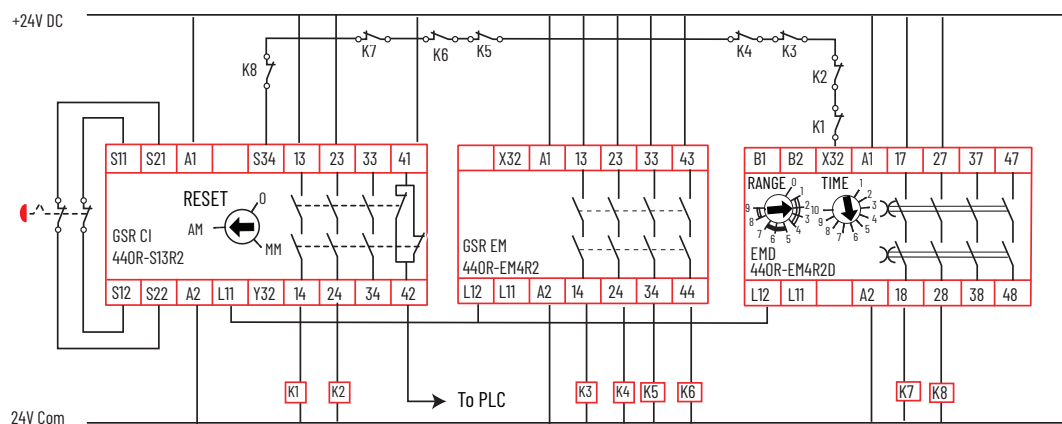
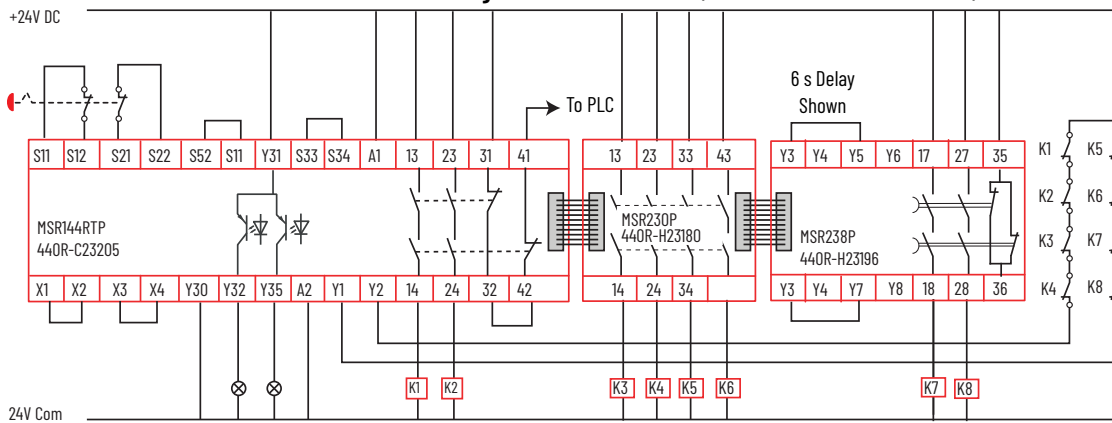


Figure 124 - Light Curtain, Monitored Reset Schematic, DC Powered

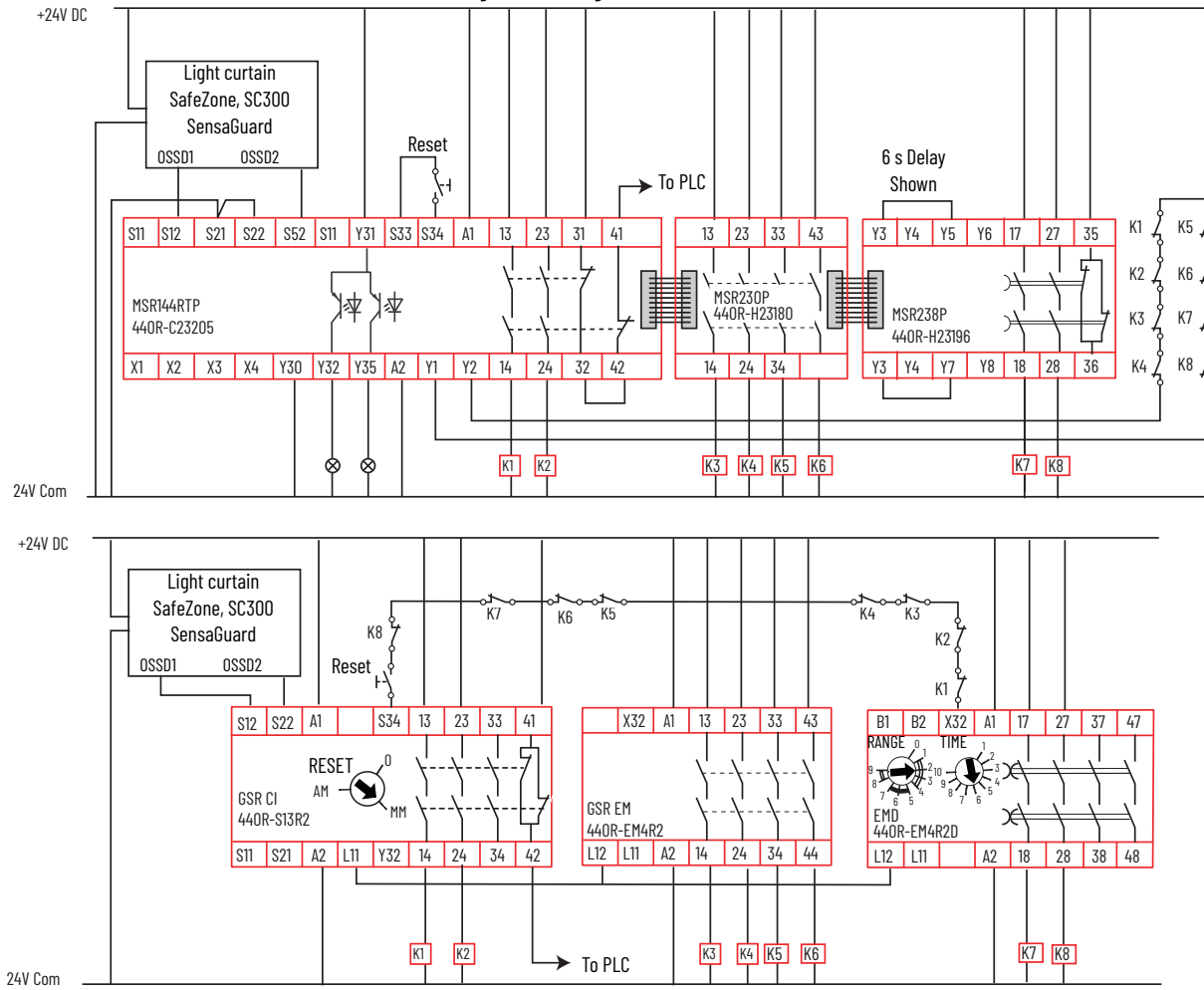


Figure 125 - Safety Mat, Monitored Reset Schematic, DC Powered

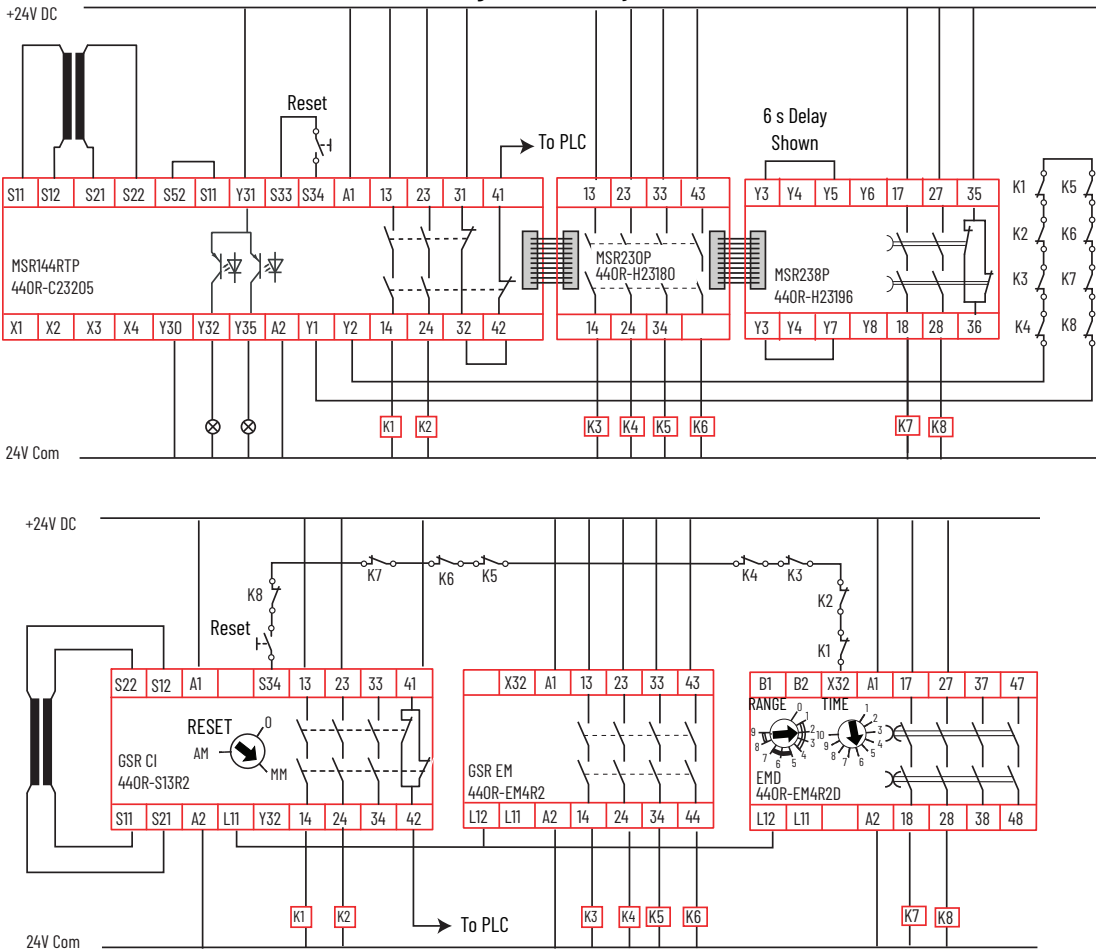
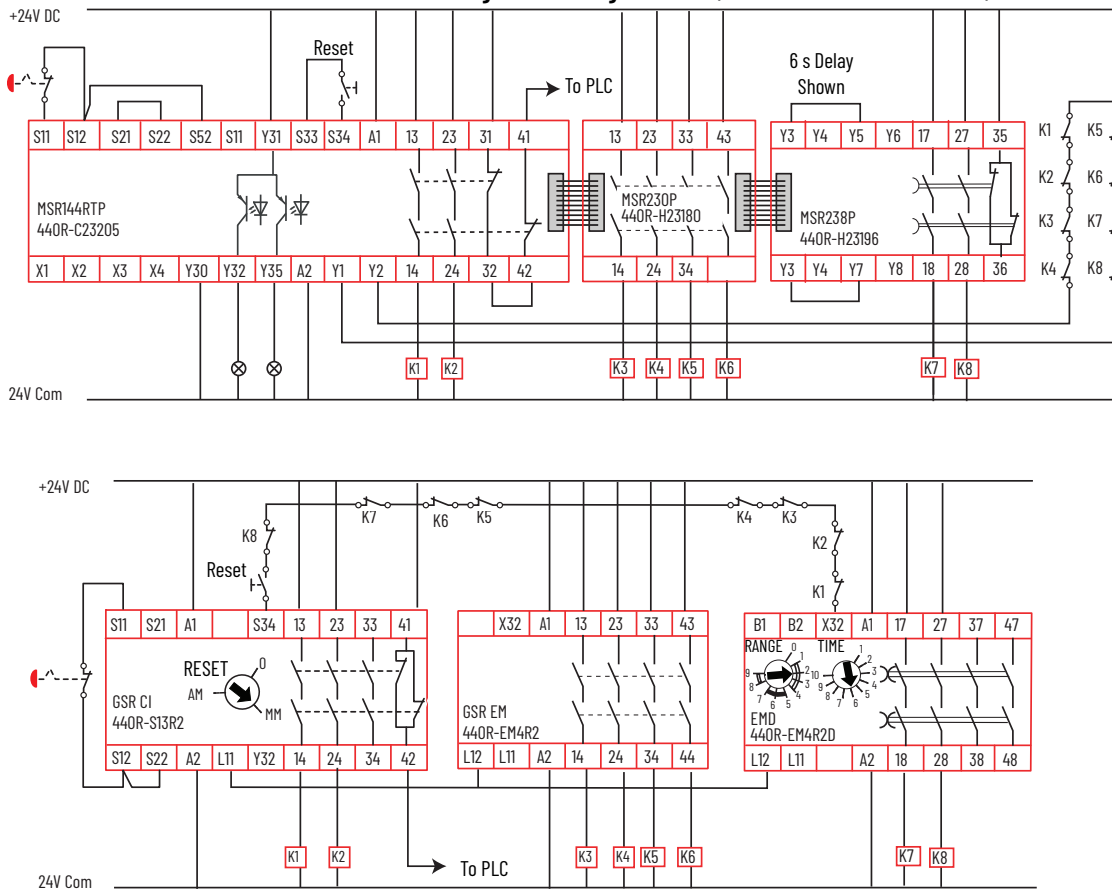


Figure 126 - Single-channel, Monitored Reset Schematic, DC Powered



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 41 - Response Time

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

Output Load Capability

[Table 42](#)...[Table 44](#) compare the output switching capabilities of the MSR144RTP safety relay to the suggested replacements. In some cases, an interposing relay is required. See [Output Load Capability on page 11](#) for a wiring example of using interposing relays.

Table 42 - Current Capability (MSR144)

Load Type	MSR144RTP	GSR 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 43 - Current Capability (MSR230P)

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 44 - Current Capability (MSR238DP)

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

MSR200 Safety Relay

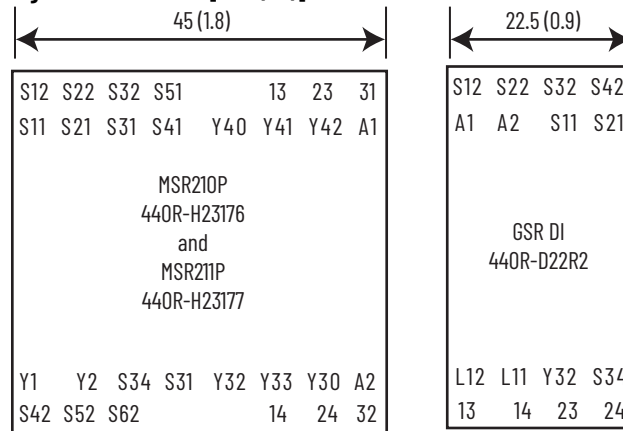


We recommend replacing the MSR200 safety relay with a DI safety relay. When output expansion is needed, use an EM and EMD safety relay.

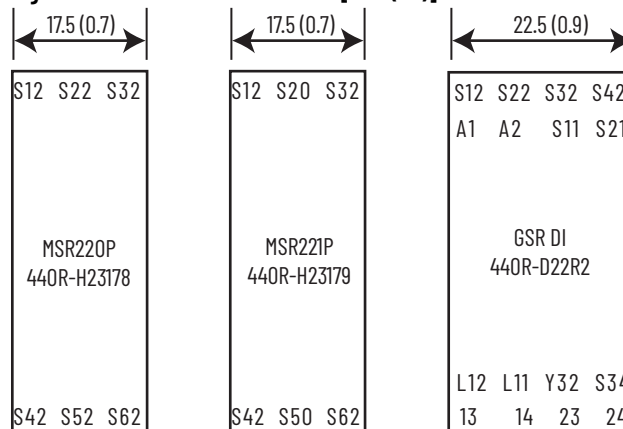
The MSR200 safety relay also has a communication module (catalog number MSR240P). The module generates messages that meet the requirements for RS-232 and RS-485. There is no direct replacement for both. The recommended alternative is to use the EtherNet/IP™ module (catalog number 440R-ENETR).

Terminal Locations and Panel Space

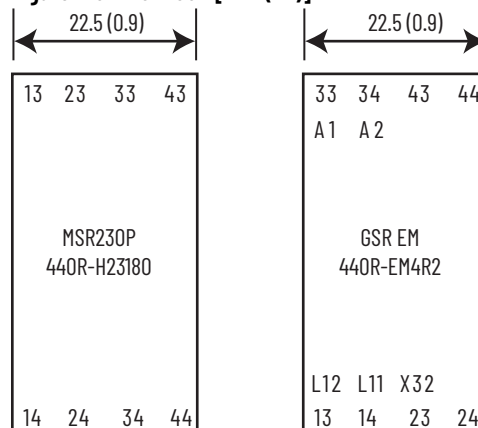
The MSR210P and MSR211P safety relays have identical terminal locations. The MSR210 safety relay is designed for mechanically operated safety devices; the MSR211 safety relay is designed for safety devices with OSSD outputs. We recommend replacing these safety relays with a DI safety relay.

Figure 127 - MSR210P [mm (in.)]

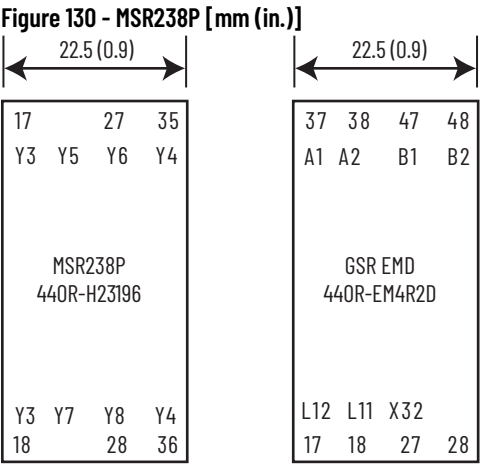
The MSR200 safety relay family is able to add additional input modules: one is the MSR220P safety relay and the other is the MSR221P safety relay. We recommend replacing these safety relays with a DI safety relay.

Figure 128 - MSR220P and MSR221P [mm (in.)]

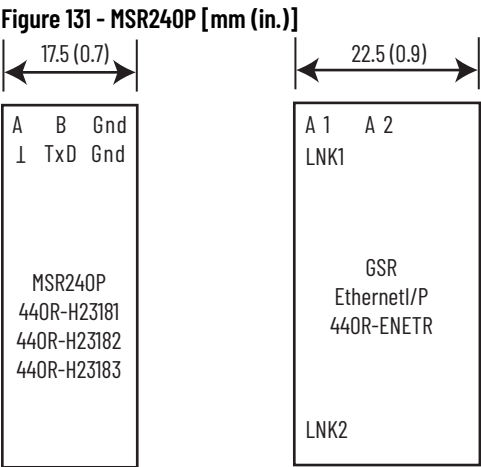
The MSR200 safety relay family can also expand output modules. The MSR230P safety relay has Immediate Outputs. We recommend replacing this safety relay with an EM safety relay.

Figure 129 - MSR230P [mm (in.)]

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



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).



Example Wiring Schematics

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

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

Figure 132 - MSR210, Dual-channel, Monitored Reset, DC Powered

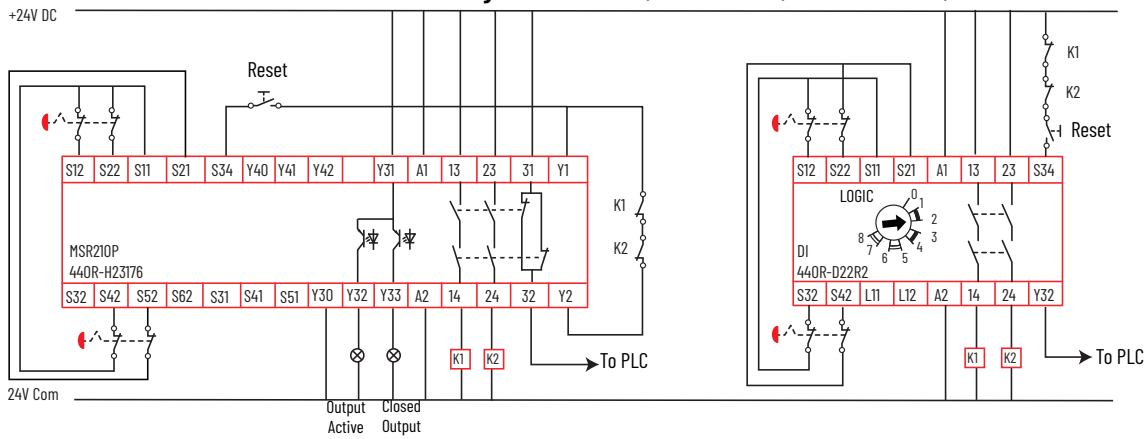


Figure 133 - MSR210, Dual-channel, Automatic Reset, DC Powered

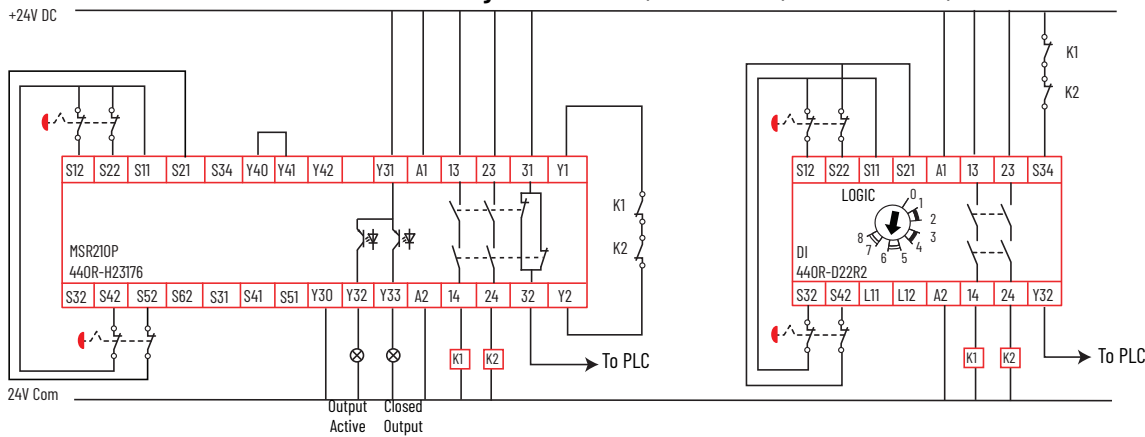


Figure 134 - MSR210, Single-channel, Monitored Reset, DC Powered

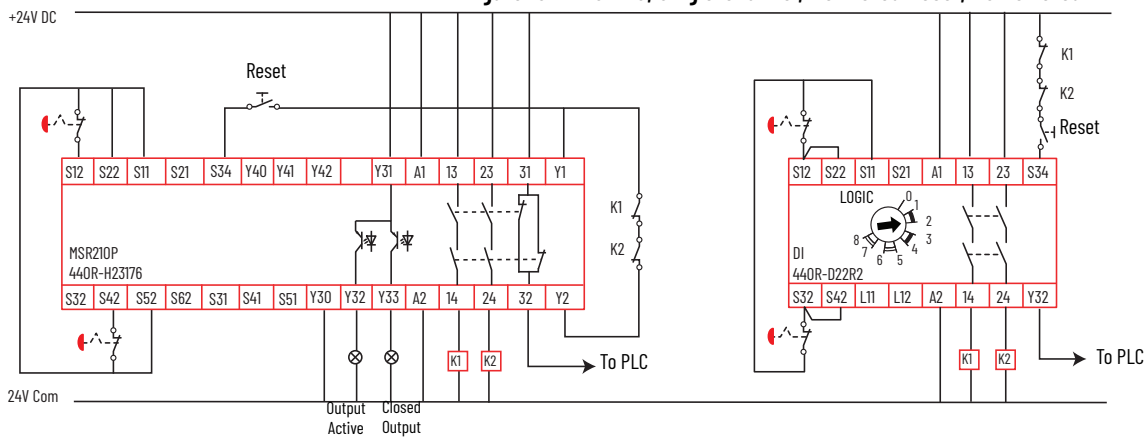


Figure 135 - MSR210, Single-channel, Automatic Reset, DC Powered

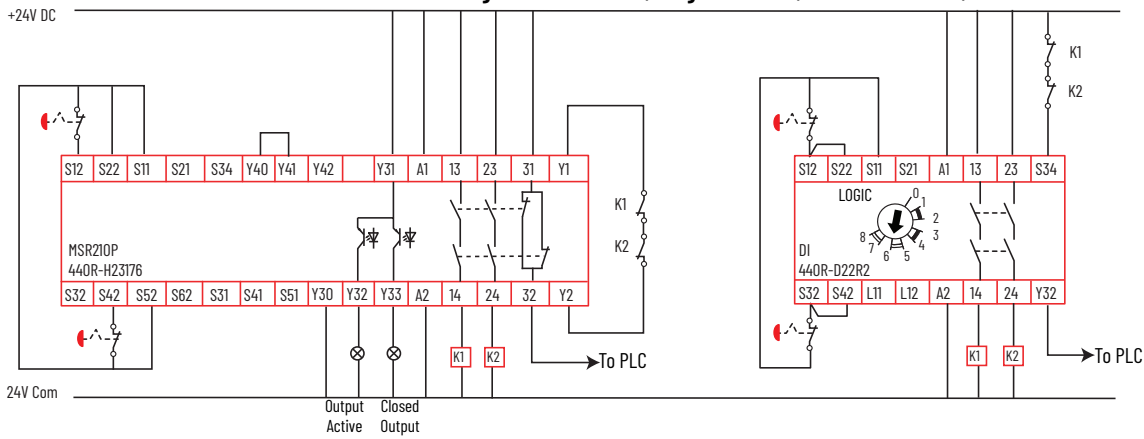


Figure 136 - MSR210, Safety Mat, Monitored Reset, DC Powered

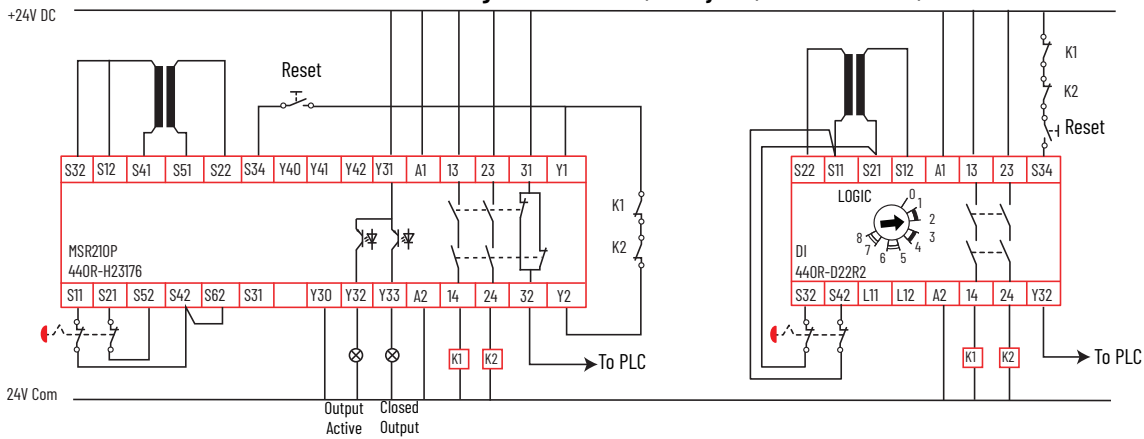


Figure 137 - MSR211, OSSD Inputs, Monitored Reset, DC Powered

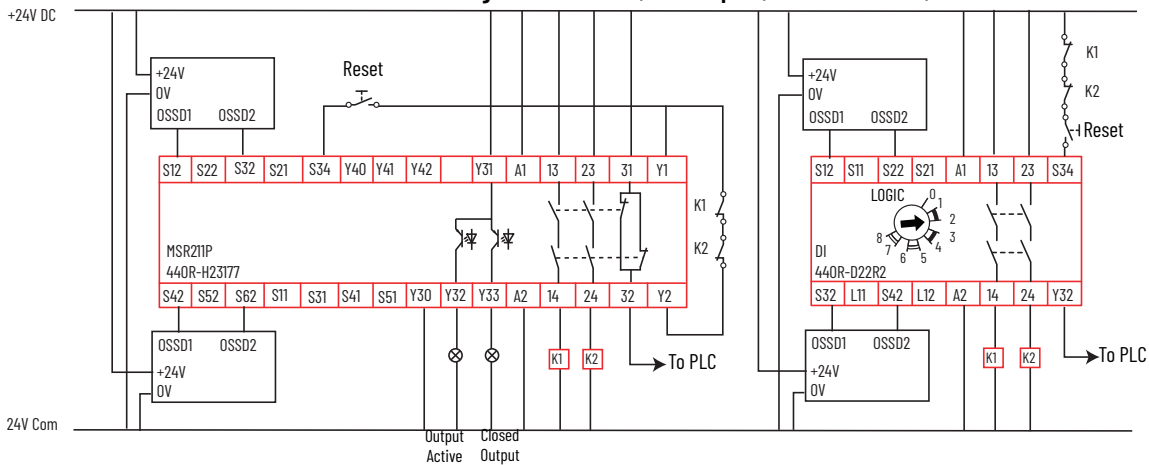


Figure 138 - MSR211, OSSD Inputs, Automatic Reset, DC Powered

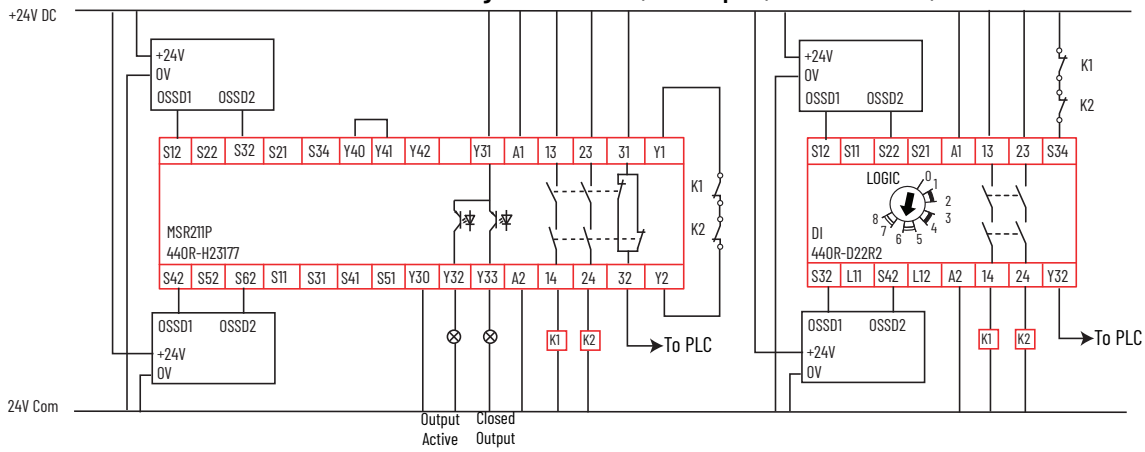


Figure 139 - MSR220 Input Expansion

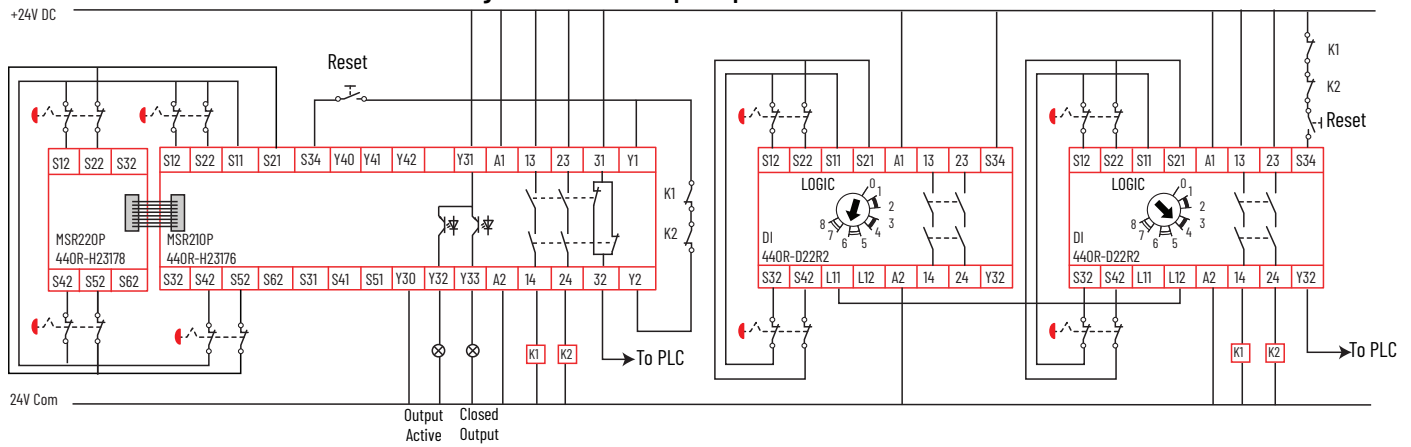


Figure 140 - MSR221 Input Expansion

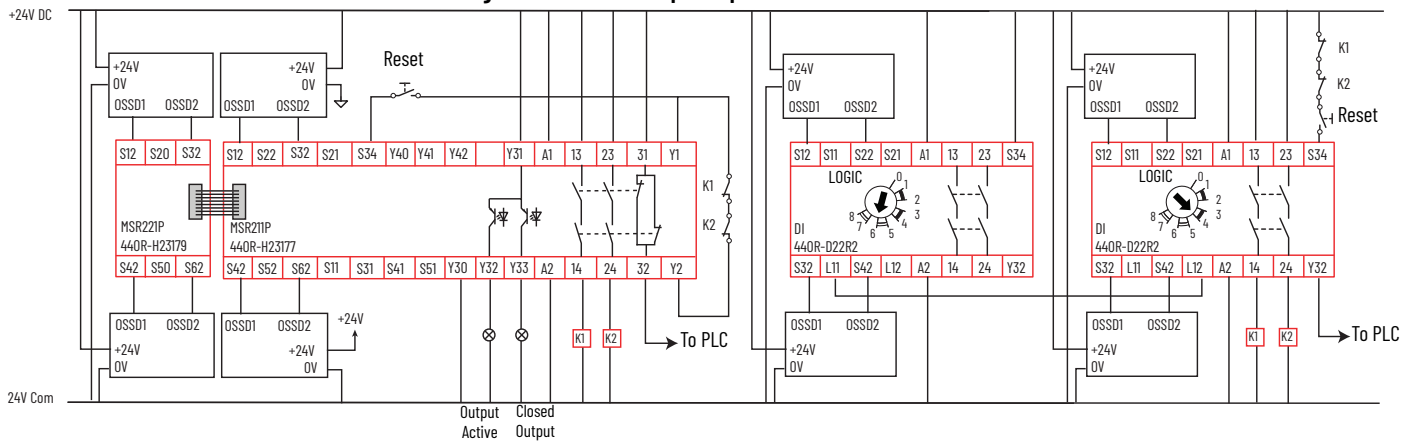


Figure 141 - MSR230 Output Expansion

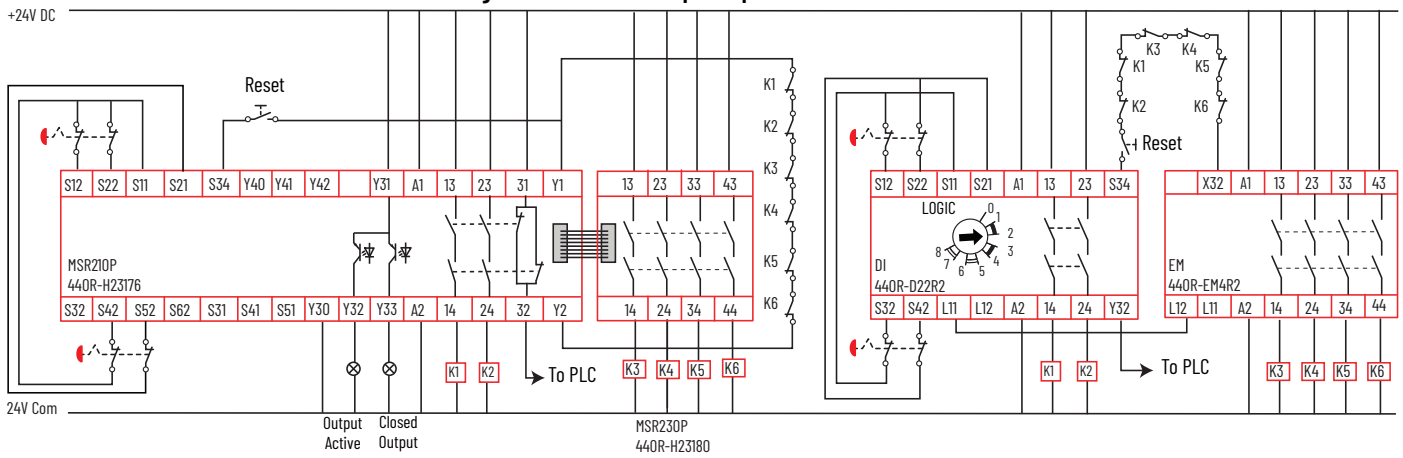


Figure 142 - MSR238 Output Delayed Expansion

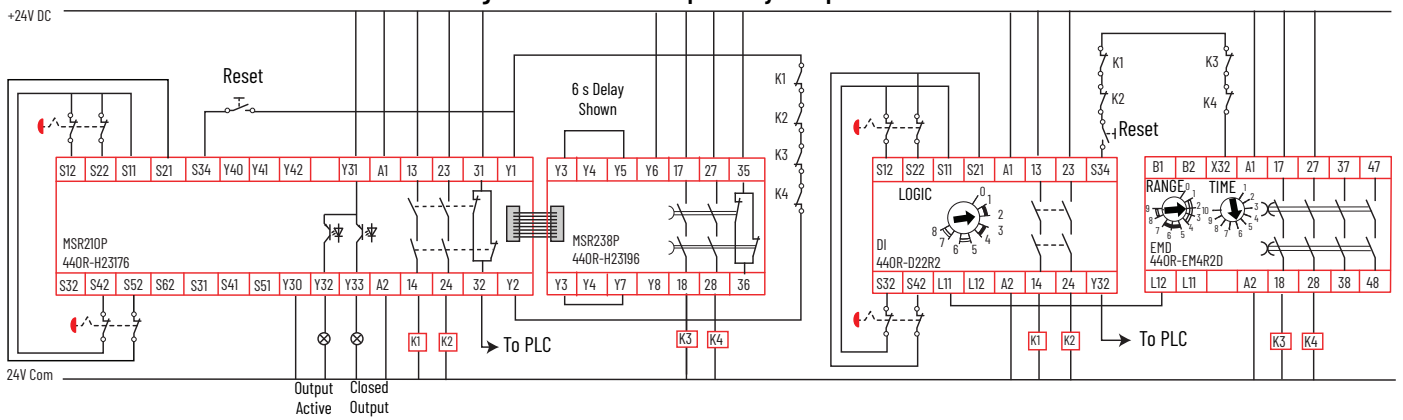
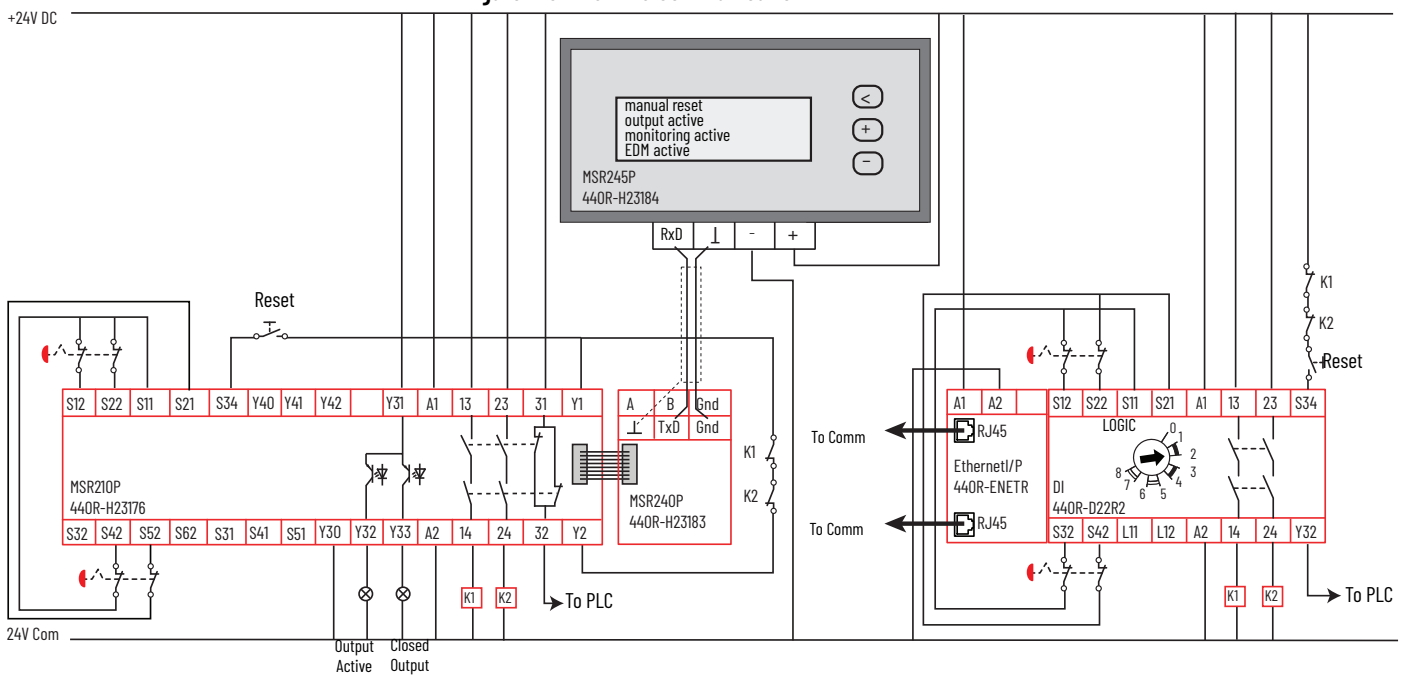


Figure 143 - MSR240 Communication



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 45 - 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

[Table 46...](#)[Table 48](#) compare the output switching capabilities of the MSR200 safety relay family to the suggested replacements. In some cases, an interposing relay can be required. See [Output Load Capability on page 11](#) for a wiring example of using interposing relays.

Table 46 - Current Capability (MSR210P and MSR211P)

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 47 - Current Capability (MSR230P)

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 48 - Current Capability (MSR238DP)

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:

Phase 3 (July 2018)

CU2 Control Unit



We recommend replacing the CU2 control unit with a GLP (Series A 205 or later) safety relay.

Both the CU2 control unit and the 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, Safely-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.

Table 49 shows the recommended conversions. With 110/230V AC supply voltages, many other catalog number 1606 power supplies can be used. If voltage-free contacts are needed, the single wire safety signal from the GLP safety relay can drive the EM safety relay.

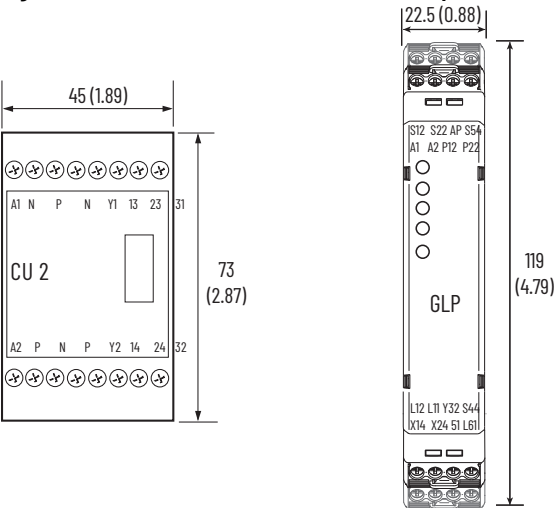
Table 49 - Conversion Table

Supply Voltage	CU2 Cat. No.	GLP Cat. No.	EM Cat. No.
24V AC/DC	440R-S07139	440R-GL2S2P	440R-EM4R2
110/230V AC	440R-S07140	440R-GL2S2P with 1606-XLP15E	

Terminal Location and Panel Space

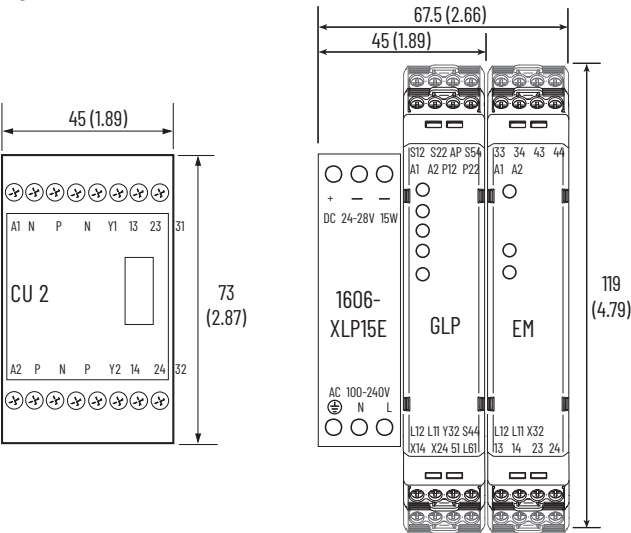
The CU2 control unit is 45 mm (1.8 in.) wide and has one row of terminals at the top and bottom. The GLP safety relay is 22.5 mm (0.9 in.) wide and has two rows of terminals at the top and bottom.

Figure 144 - DC Powered Terminals and Panel Space [mm (in.)]



The CU2 control unit can also be ordered with a 110/230V AC power supply. Because 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 145 - AC Powered Terminals and Panel Space [mm (in.)]



Example Wiring Schematics

[Figure 146...](#)[Figure 148 on page 93](#) compare the wiring of your existing MSR safety relay module to the recommended newer devices for each application that the existing device provides.

Figure 146 - DC Powered

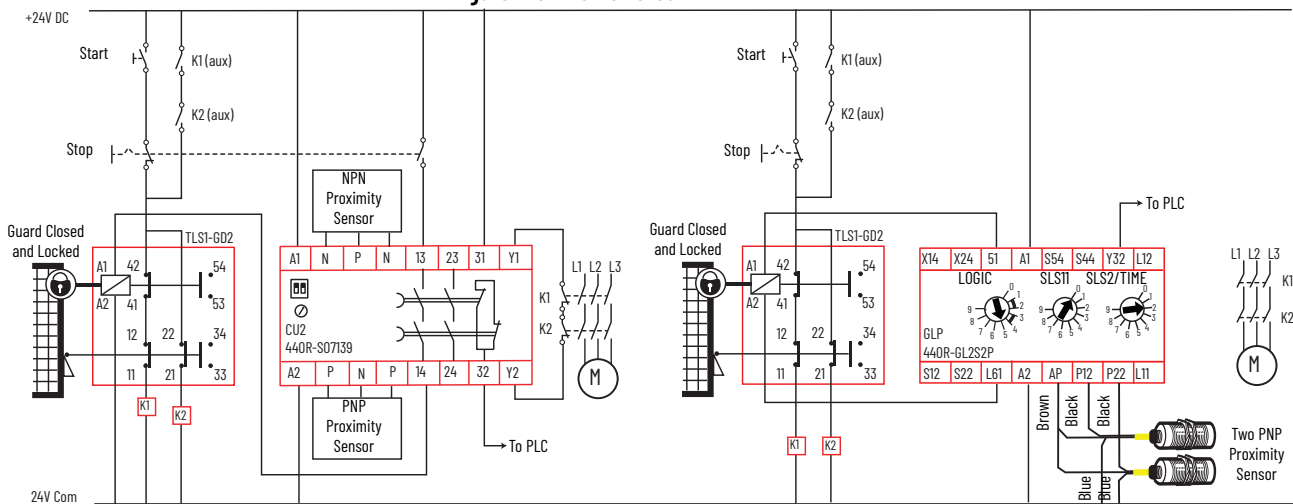


Figure 147 - AC Powered

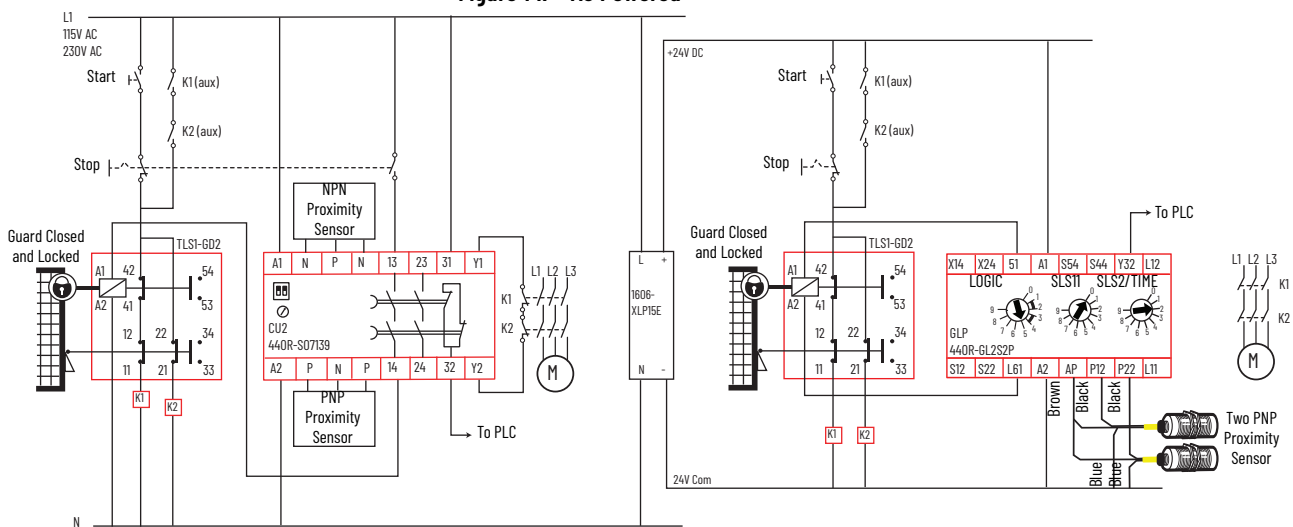
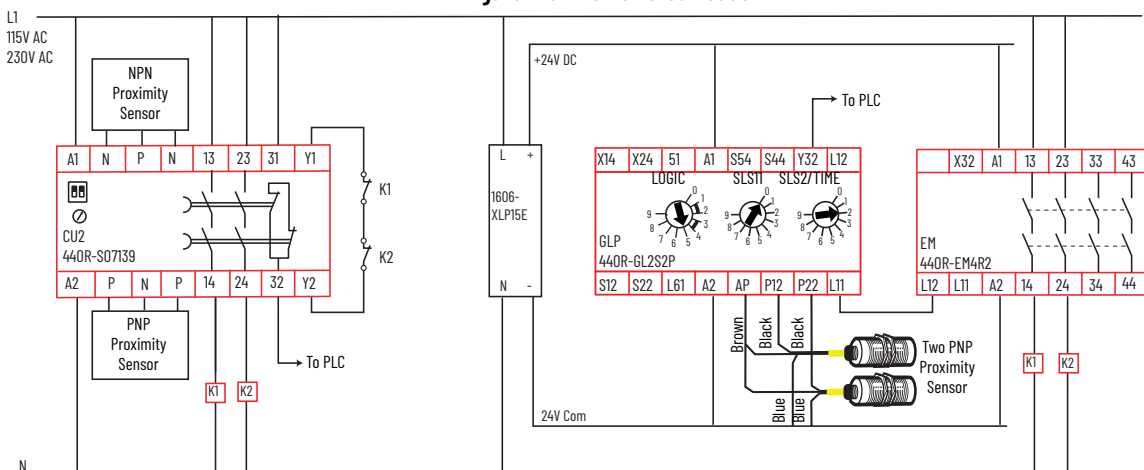


Figure 148 - AC Powered Loads



Output Load Capability

The CU2 control unit has voltage-free output contacts, while the GLP safety relay has solid-state outputs. The GLP safety relay can easily expand its output capability with the single wire safety connection to an EM expansion relay, which has voltage-free contacts. Use an interposing relay if additional current capability is needed. [Table 50](#) shows the current capability of the three relays.

Table 50 - 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

MSR7R and MSR7C Safety Relays



We recommend replacing both the MSR7R and MSR7C safety relays with the MSR125H/HP safety relay. The replacement catalog numbers are shown in [Table 51](#). The MSR125H/HP safety relay is one of the MSR safety relays that remain available for five or more years.

The MSR7R and MSR7C safety relays are logic units for monitoring and interfacing two-hand control devices with a safety-related circuit. The MSR7R safety relay is for use with mechanical switches and 800Z Zero-Force Touch Buttons™. The MSR7C safety relay is for use with electronic-sensing (for example, capacitive or photoelectric) palm buttons because the MSR7C safety relay does not turn on its output if a power interruption occurs while hands are on the buttons.

Table 51 - Conversion Table

Type	Supply Voltage	MSR7 Cat. No.	MSR125 Cat. No.	
			Fixed Terminals	Removable Terminals
MSR7R	24V DC	440R-D23021	440R-D23166	440R-D23171
	24V AC		440R-D23165	440R-D23171 or 440R-D23170
	110/115V AC	440R-D23022	440R-D23164	440R-D23169
	230V AC	440R-D23023	440R-D23163	440R-D23168
MSR7C	24V DC	440R-D23024	440R-D23166	440R-D23171
	24V AC		440R-D23165	440R-D23171 or 440R-D23170
	110/115V AC	440R-D23025	440R-D23164	440R-D23169
	230V AC	440R-D23026	440R-D23163	440R-D23168



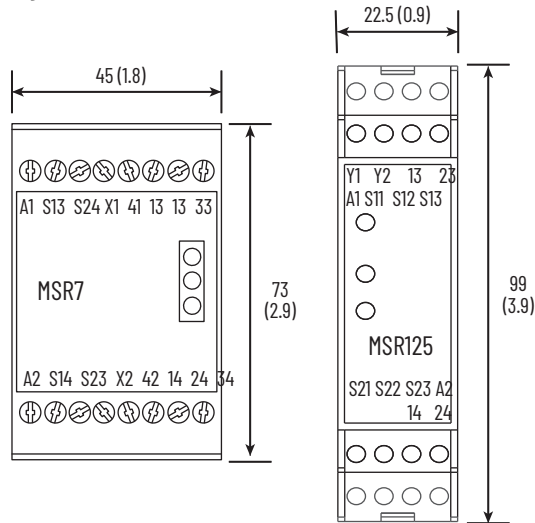
ATTENTION: A risk assessment must be performed when converting a MSR7C safety relay to an MSR125 safety relay. The risk assessment must include an evaluation of a hands-on-the-buttons during a power interruption.

Terminal Location and Panel Space

The MSR7 safety relay is 45 mm (1.8 in.) wide and has one row of terminals at the top and bottom. The MSR125 safety relay is 22.5 mm (0.9 in.) wide with two rows of terminals on the top and bottom.

The MSR125 safety relay is available with either fixed or removable terminals; the MSR7 safety relay only has fixed terminals.

Figure 149 - Terminals and Panel Space [mm (in.)]



Example Wiring Schematics

The MSR7 and MSR125 safety relays are available in the following power supplies:

- 24V AC
- 24V DC
- 110V AC
- 230V AC

The wiring schematics are the same for each voltage supply.

Figure 150 - MSR7R Safety Relay

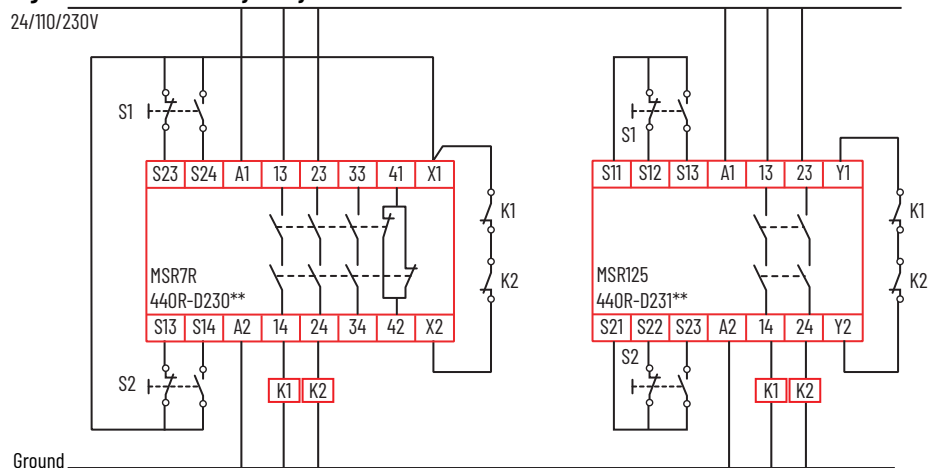
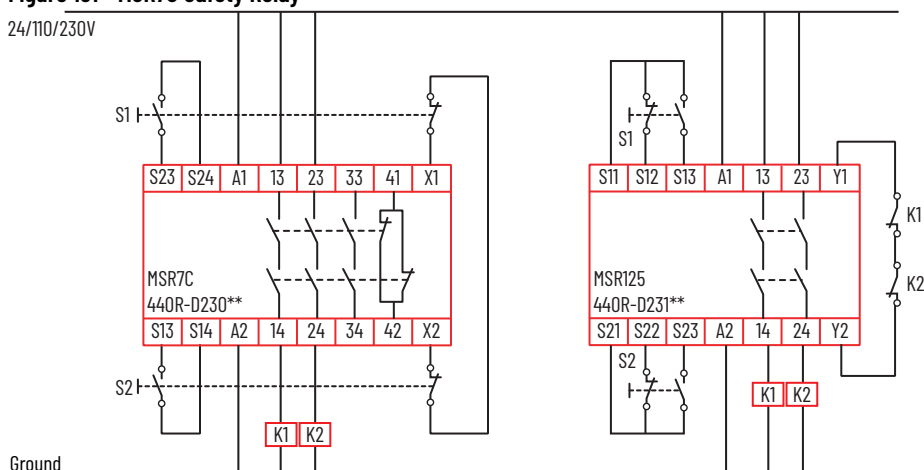
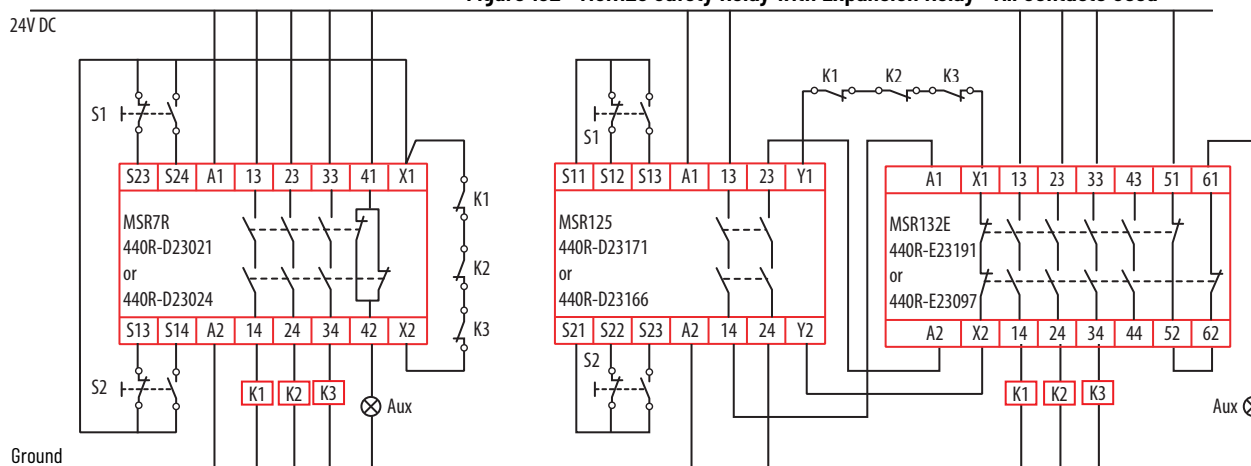


Figure 151 - MSR7C Safety Relay

24/110/230V

**Figure 152 - MSR125 Safety Relay with Expansion Relay - All Contacts Used**

24V DC



Maximum Input Impedance

The MSR7 safety relay can tolerate up to 500 Ω of resistance on its input circuits. The MSR125 safety relay is limited to 40 Ω . This difference is not likely to be an issue as the typical cable resistance of 18 AWG (0.75 mm²) wire is 20.95 Ω /1000 meters (6.4 Ω /1000 feet).

Response Time

Response time applies when at least one hand is removed from the two-hand controls and the operator reaches towards the hazard.

If the MSR132 expansion relay is not used, the response time of the MSR125 safety relay is faster than the MSR7 safety relay, and the distance from the two-hand controls to the hazard can remain unchanged.

If the MSR132 expansion relay is used, the response time of the relay is 20 ms longer; the safety distance must be recalculated and the two-hand controls must be moved further away from the hazard. When you use the standard speed constant of 1600 mm/sec (63 in./sec), the additional 20 ms requires an additional 32 mm (1.25 in.) of spacing from the hazard.

Table 52 - Response Time

Safety Relay	Response Time [ms]
MSR7	50
MSR125	20
MSR132	50

Output Load Capability

The MSR125 safety relay has a higher current capability than the MSR7 safety relay.

Table 53 - Current Capability

Load Type	MSR7	MSR125	MSR132
AC Inductive	BC300, AC-15 4 A	B300, AC-15 6 A	AC-15 6 A
DC	P300, DC-13 2 A/24V DC	P300, DC-13 3 A/24V DC	DC-13 3 A/24V DC
Thermal (non-switching)	4 A	1 x 6 A 2 x 4 A	2 x 6 A 4 x 4 A

MSR9T Safety Relay



We recommend replacing the MSR9T safety relay with a Sipha™ 2 controller. The replacement catalog numbers are shown in [Table 54](#).

The MSR9T safety relay was used in older applications, where the input device employed the diversity concept of one normally closed (N.C) contact and one normally open (N.O.) contact. The Sipha 2 controller employs the same diversity approach and can easily be applied to contact-type switches and the Sipha controller non-contact switches.

These controllers are similar in the type of inputs and the number of outputs.

Table 54 - Conversion Table

Supply Voltage	MSR9T Cat. No.	Sipha 2 Cat. No.
24V AC/DC ⁽¹⁾	440R-F23027	440N-S32021
110/230V AC	440R-F23028	

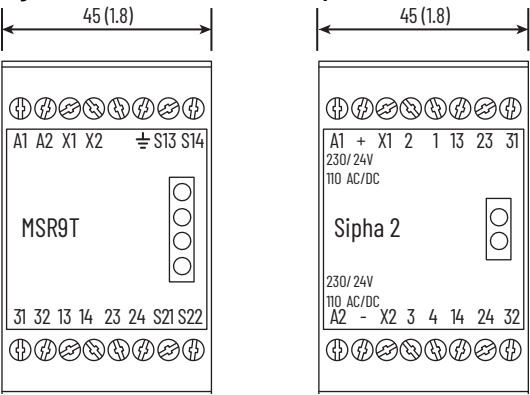
(1) For 24V, the Sipha 2 controller can only operate at 24V DC. When the MSR9T safety relay is powered by 115/230V AC, you must provide an AC/DC converter.

Terminal Location and Panel Space

The MSR9T safety relay and Sipha 2 controller are both 45 mm (1.8 in.) wide and have one row of terminals at the top and bottom.

There is a significant difference in the location of the terminals for the power, inputs, outputs, and monitoring. Numerous wires must be moved from the top of the relay to the bottom and vice versa.

Figure 153 - Terminals and Panel Space [mm (in.)]

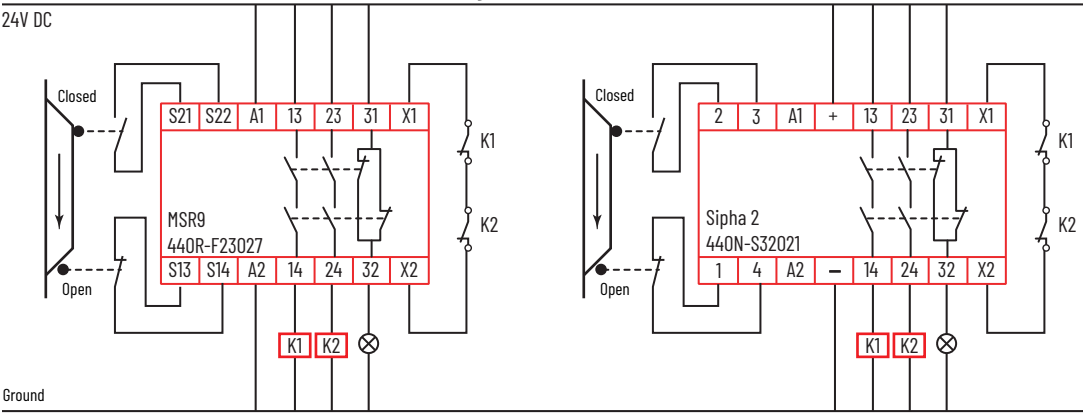


Example Wiring Schematics

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

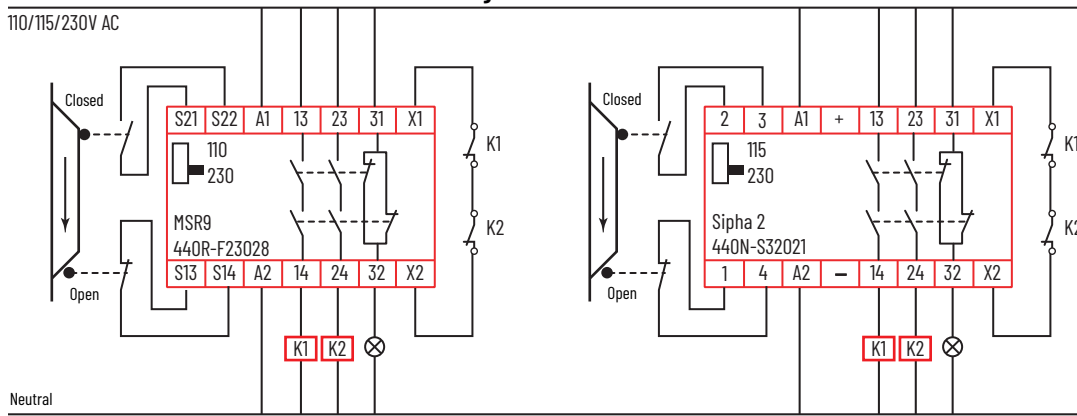
When powered by 24V AC/DC, the power supply connections are made to + and – terminals of the Sipha controller; the A1 and A2 terminals must have no connections.

Figure 154 - 24V AC/DC Powered



An internal, user-selectable switch is used to set the input voltage of both the MSR9 safety relay and the Sipha 2 controller. Remove the front cover and set the switch to either 110/115V or 230V AC. [Figure 155 on page 99](#) shows the conversion schematics; in this case, the power to the relay is connected to A1 and A2.

Figure 155 - 110/115/230V AC Powered



Maximum Input Impedance

The MSR9T safety relay tolerates up to 500 Ω of resistance on its input circuits. The Sipa 2 controller tolerates 200 Ω on terminals 1...4 and 150 Ω on terminals 2...3. This difference is not likely to be an issue as the typical cable resistance of 18 AWG (0.75 mm²) wire is 20.95 Ω /1000 meters (6.4 Ω /1000 feet).

Input Simultaneity

Input simultaneity is a measure of the difference in time between the change in state of the two channels to enable the relay to energize its outputs.

The MSR9T safety relay is specified to have input simultaneity of 500 ms; the dual-inputs must change state with 500 ms of each other. The Sipa 2 controller has historically been specified with a minimum approach speed of 17 mm/s (0.67 in./s).

The following describes how a Sipa 2 controller works:

- If the N.O. contact opens first, then the N.C. contact can close at any time afterwards.
- If the N.C. contact closes first, then the N.O. contact must open within 1.4 seconds.

Response Time

Because the response time of the Sipa 2 controller is faster than the MSR9T safety relay, the safety distance calculation does not require recalculation.

Table 55 - Response Time

Safety Relay	Response Time [ms]
MSR9T	50
Sipa 2	40

Output Load Capability

[Table 56](#) compares the output load capability of the MSR9T safety relay to the replacement relays. See [Output Load Capability on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the capability of the replacements.

Table 56 - Current Capability

Load Type	MSR9T	Sipha 2
AC Inductive	B300, AC-15 4 A/250V AC 4 A/120V AC	B300, AC-15 4 A/250V AC
DC	P300, DC-13 3 A/24V DC	P300, DC-15 2 A/24V DC
Thermal (non-switching)	4 A	—

MSR33 Safety Relay



We recommend replacing the MSR33 safety relay with a Sipha 2 controller.

The MSR33 safety relay is offered with either fixed or removable terminals. The Sipha 2 controller only has fixed terminals. The MSR33 safety relay has solid-state outputs, while the Sipha 2 controller has electromechanical outputs.

The MSR33 safety relay has a feature that is called Startup Test. The wiring configures the startup test. Upon initial power-up, the input device must be cycled once to energize the safety outputs. The Sipha 2 controller does not support this feature.

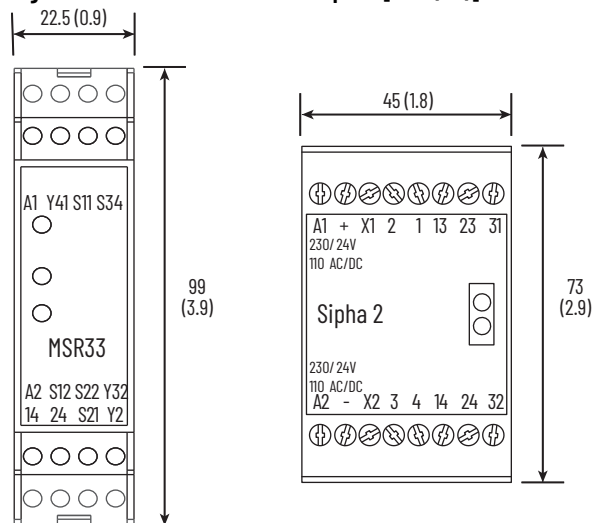
Table 57 - Conversion Table

Terminals	MSR33 Cat. No.	Sipha 2 Cat. No.
Fixed	440R-F23199	440N-S32021 (only fixed terminals)
Removable	440R-F23200	

Terminal Location and Panel Space

The Sipha 2 controller requires twice as much panel space as its width is 45 mm (1.8 in.), compared to the 22.5 mm (0.9 in.) for the MSR33 safety relay. The difference in relay height must be considered, but is not significant.

The terminal locations for the inputs, outputs, and monitoring circuits require movement of the wiring from the top to the bottom of the relay and vice versa.

Figure 156 - Terminals and Panel Space [mm (in.)]

Example Wiring Schematics

[Figure 157](#) and [Figure 158](#) on page 102 compare the wiring of your existing MSR safety relay module to the recommended newer devices for each application that the existing device provides.

In [Figure 157](#), the MSR33 safety relay has monitored reset, where the Reset button must be pressed and released. The reset action occurs when the button is released. With the Sipa 2 controller, the reset occurs when the button is pressed.

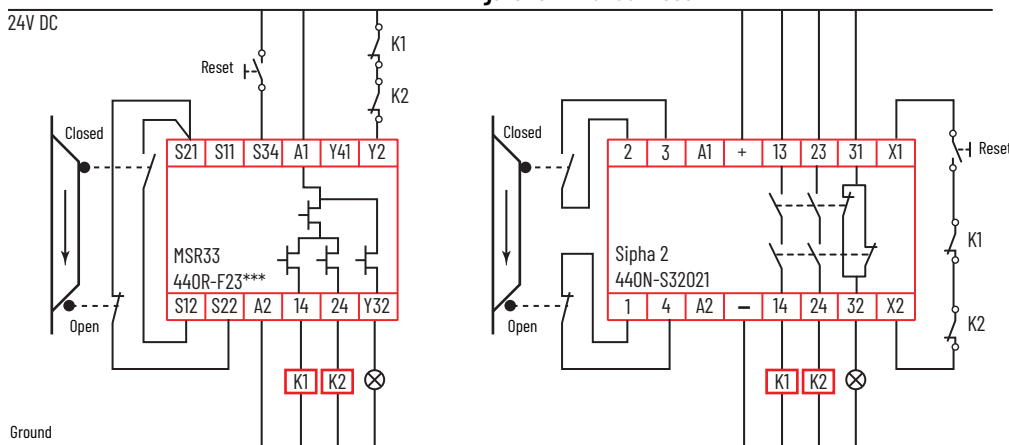
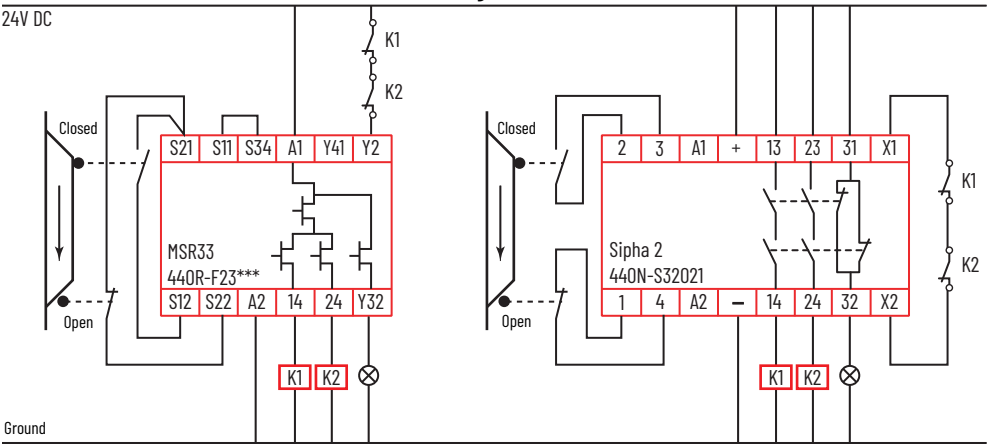
Figure 157 - Manual Reset

Figure 158 - Automatic Reset



The auxiliary output of the MSR33 safety relay is N.O. When the safety outputs are off, the auxiliary output is off.

The Sipa 2 controller auxiliary output is N.C. When the safety outputs are open (off), the auxiliary output is closed (on).

Input Simultaneity

Input simultaneity is a measure of the difference in time between the changes in state of the two channels to enable the relay to energize its outputs.

The MSR33 safety relay allows an infinite amount of time between the changes of state of the two inputs. The Sipa 2 controller has historically been specified with a minimum approach speed of 17 mm/s (0.67 in./s).

The following describes how a Sipa 2 controller works:

- If the N.O. contact opens first, then the N.C. contact can close at any time afterwards.
- If the N.C. contact closes first, then the N.O. contact must open with 1.4 seconds.

Response Time

ATTENTION: Because the response time of the MSR33 safety relay is 25 ms faster than the Sipa 2 controller, the safety distance must be examined closely and adjusted, if necessary.

Table 58 - Response Time

Safety Relay	Response Time [ms]
MSR33	15
Sipa 2	40

Output Load Capability

[Table 59](#) only compares DC loads because the MSR33 safety relay can only accommodate DC loads.

Table 59 - Current Capability

Load Type	MSR33	Sipha 2
DC	2 A/24V DC	2 A/24V DC

MSR35 Safety Relay



We recommend replacing the MSR35 safety relay with an MSR125 safety relay. The MSR125H/HP safety relay is one of the MSR safety relays that remain available for five or more years.

The MSR35H/HP safety relay is an electronic two-hand control relay that is offered with either fixed or removable terminals. It is only available with 24V DC power.

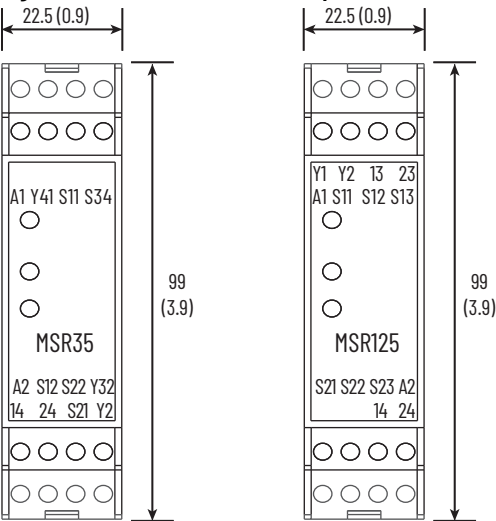
Table 60 - Conversion Table

Terminals	MSR35 Cat. No.	MSR125 Cat. No.
Fixed	440R-D23201	440R-D23171
Removable	440R-D23202	440R-D23166

Terminal Location and Panel Space

The MSR35RT safety relay has a 22.5 mm (0.9 in.) wide body, with two rows of terminals at the top and bottom. The MSR125 safety relay also has two rows of terminals at the top and bottom and is 22.5 mm (0.9 in.) wide.

Figure 159 - Terminals and Panel Space [mm (in.)]



Example Wiring Schematics

The output is a significant difference between the two relays. The MSR35 safety relay has solid-state outputs, while the MSR125 safety relay has voltage-free contacts.

Figure 160 - Category IIIC Per EN574

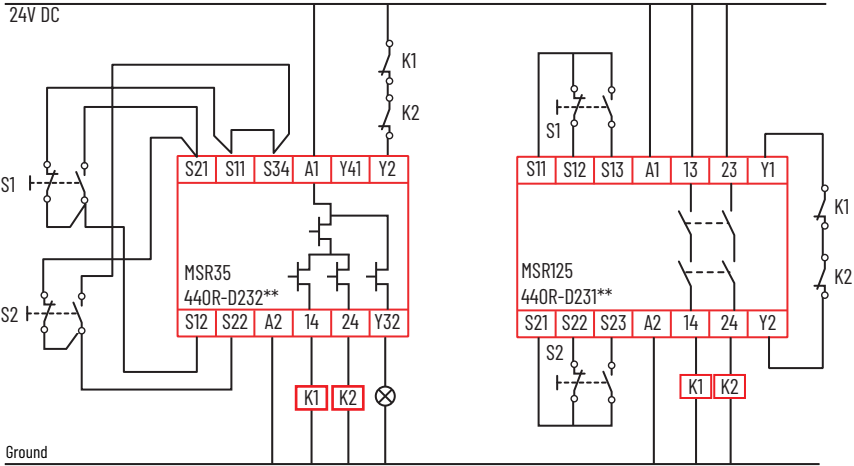
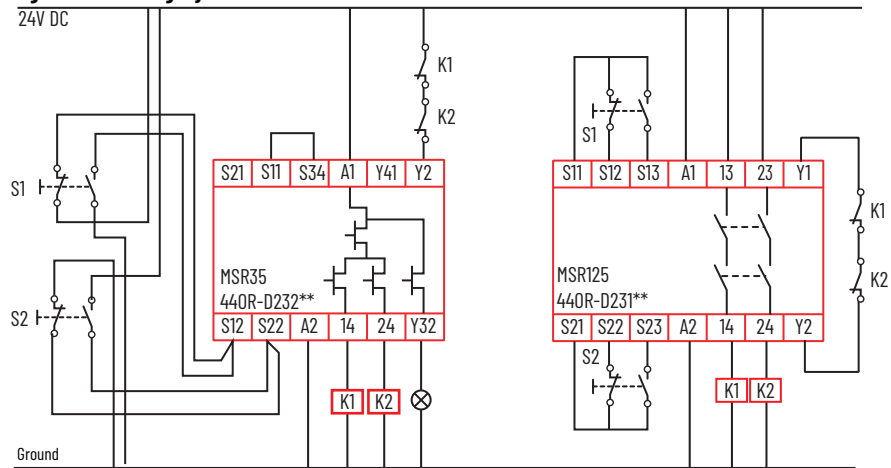


Figure 161 - Category IIIA Per EN574



Response Time



ATTENTION: Because the response time of the MSR35RT safety relay is faster than the MSR125 safety relay, the safety distance must be examined closely and adjusted if necessary.

Table 61 - Response Time

Safety Relay	Response Time [ms]
MSR35	15
MSR125	20

Output Load Capability

The MSR125 safety relay has a higher current capability than the MSR35H/HP safety relay, as shown in [Table 62 on page 105](#).

Table 62 - Current Capability

Load Type	MSR35	MSR125
DC	2 A/24V DC	3 A/24V DC

MSR121RT Safety Relay



We recommend replacing the MSR121RT safety relay with a GSR CI safety relay.

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

The MSR121RT safety relay is only available with a 24V AC/DC power supply.

Table 63 - Conversion Table

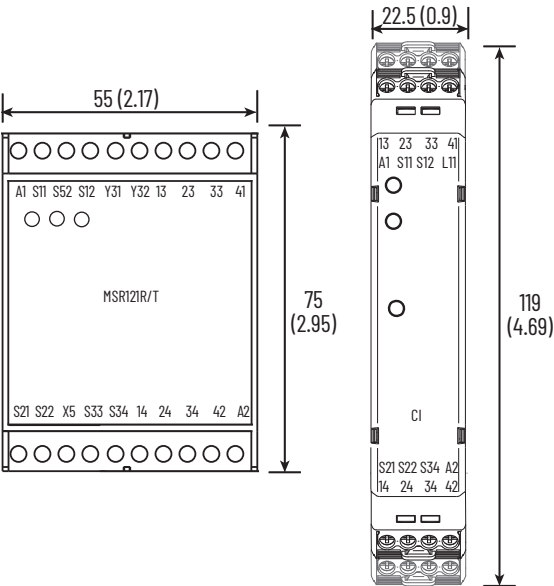
Supply Voltage	MSR121RT Cat. No.	GSR CI Cat. No.
24V AC/DC ⁽¹⁾	440R-J23102	440R-S13R2

⁽¹⁾ For 24V, the GSR CI safety relays can only operate at 24V DC. When the MSR121RT safety relay is powered by 24V AC, you must provide an AC/DC converter.

Terminal Location and Panel Space

The MSR121RT safety relay has a 55 mm (2.17 in.) wide body, with one row of terminals at the top and one at the bottom. The GSR CI safety relay has a 22.5 mm (0.9 in.) wide body with two rows of terminals at the top and bottom.

Figure 162 - Terminals and Panel Space [mm (in.)]



Example Wiring Schematics

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

Figure 163 - Dual-channel Input Monitored Reset

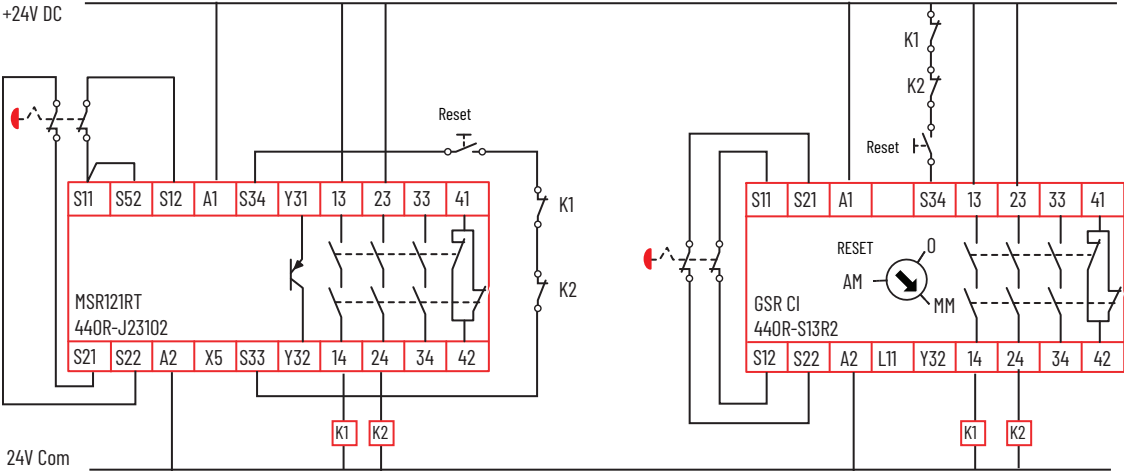


Figure 164 - Dual-channel Input Automatic Reset

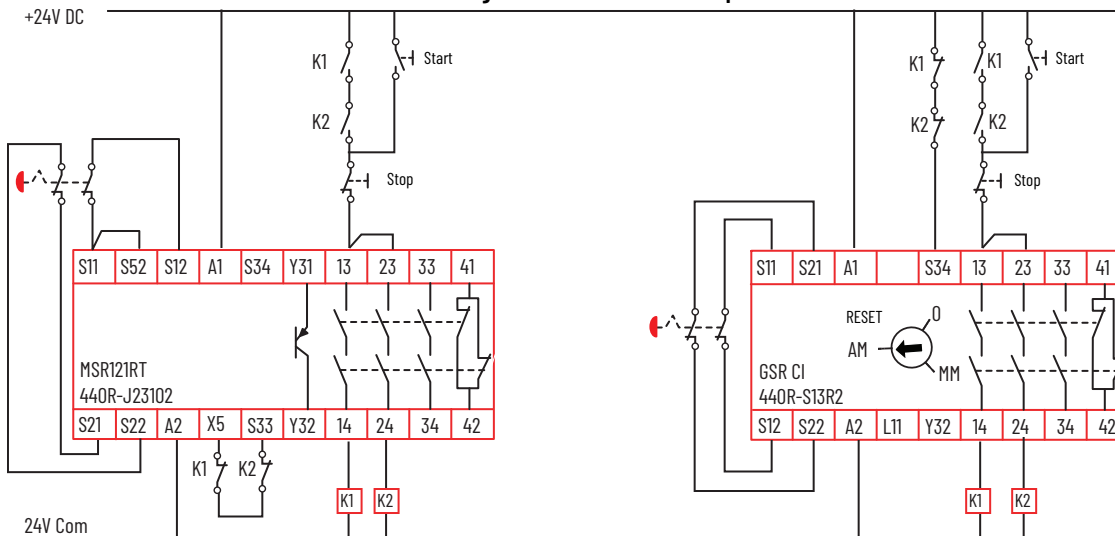


Figure 165 - Single-channel Input Monitored Reset

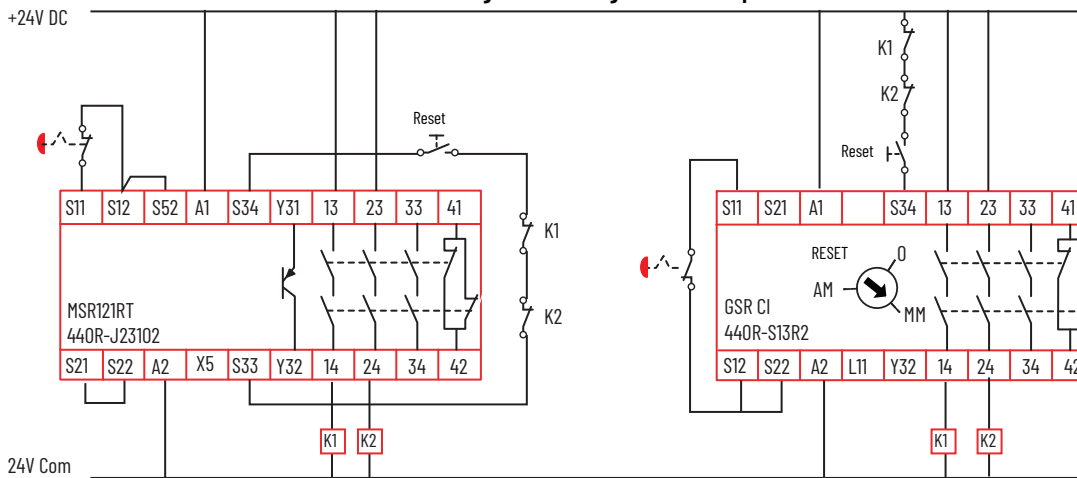


Figure 166 - Single-channel Input Automatic Reset

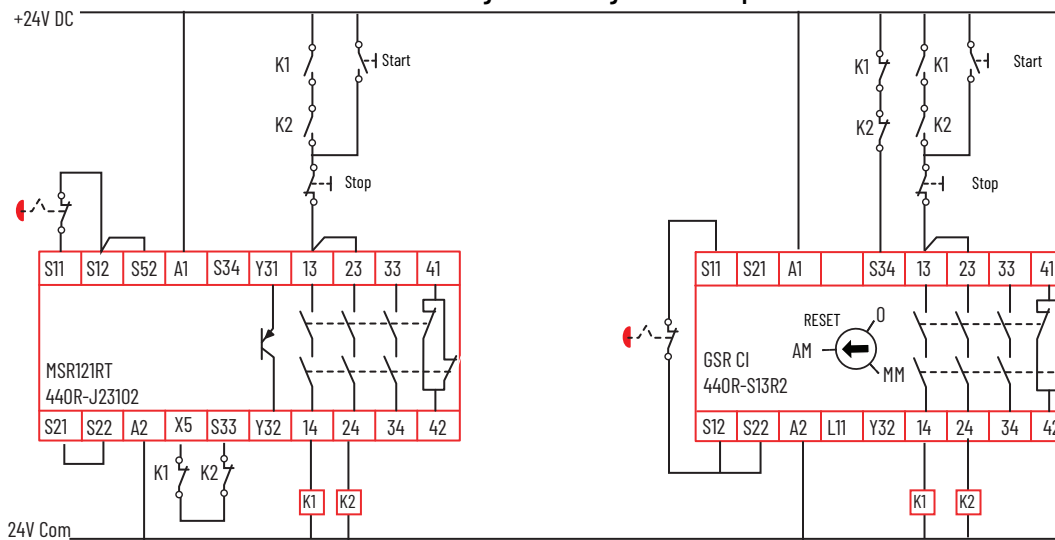


Figure 167 - OSSD Input Monitored Reset

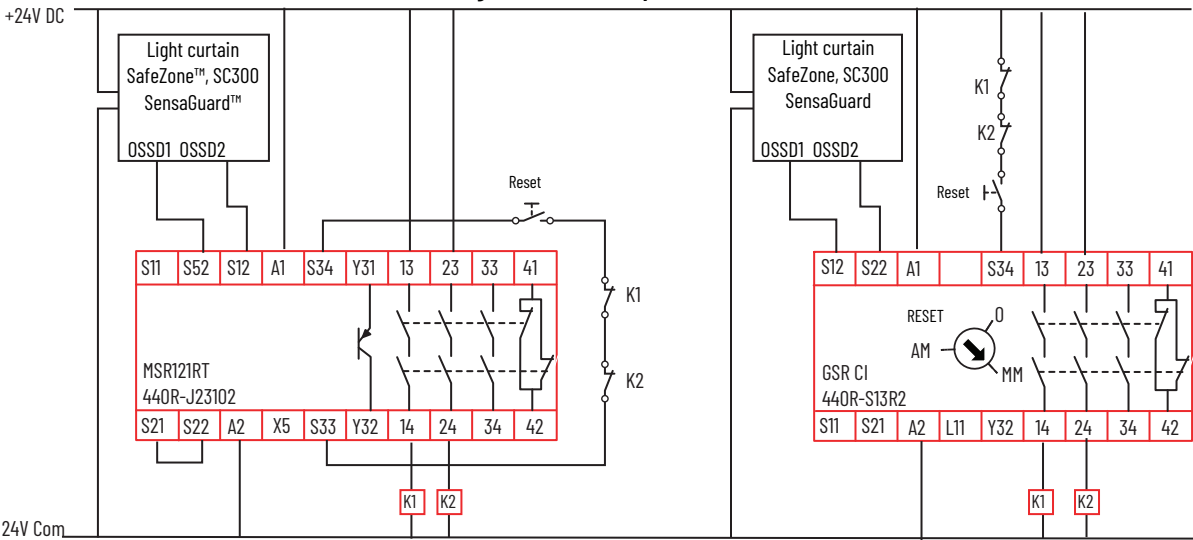


Figure 168 - OSSD Input Automatic Reset

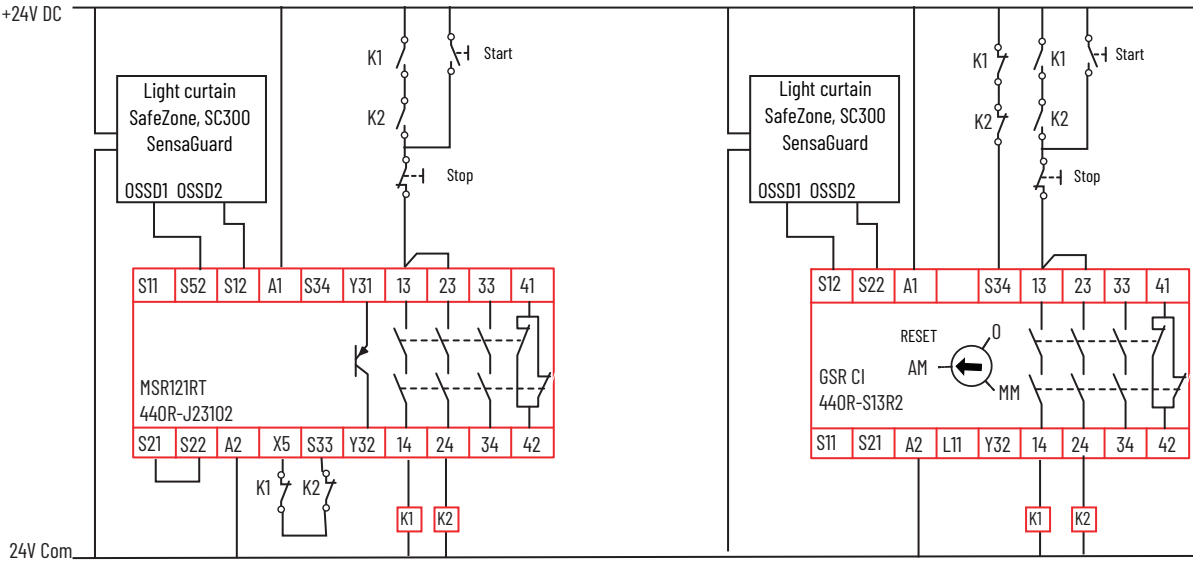


Figure 169 - Safety Mat Input Monitored Reset

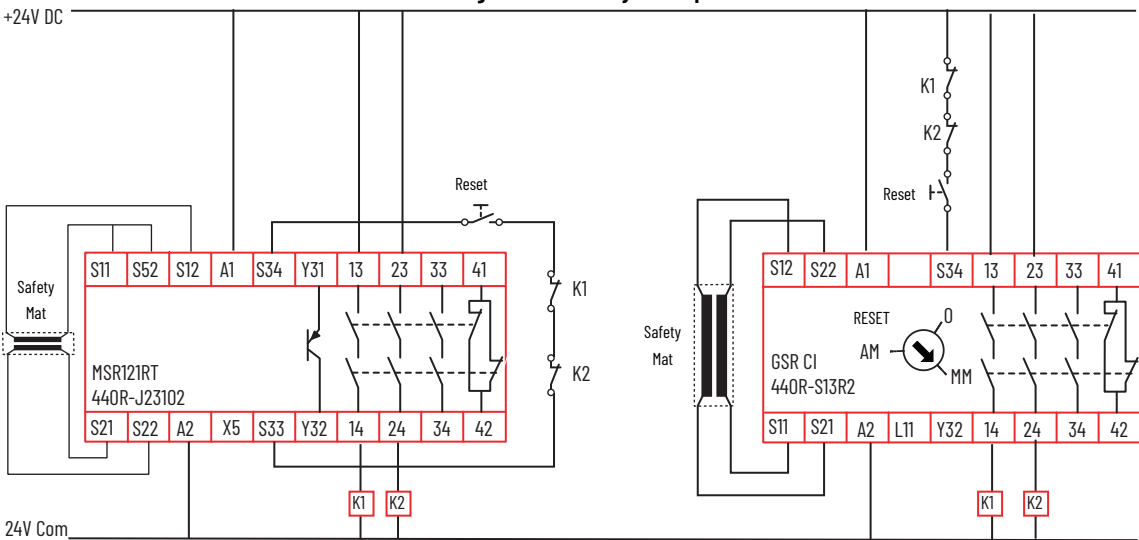
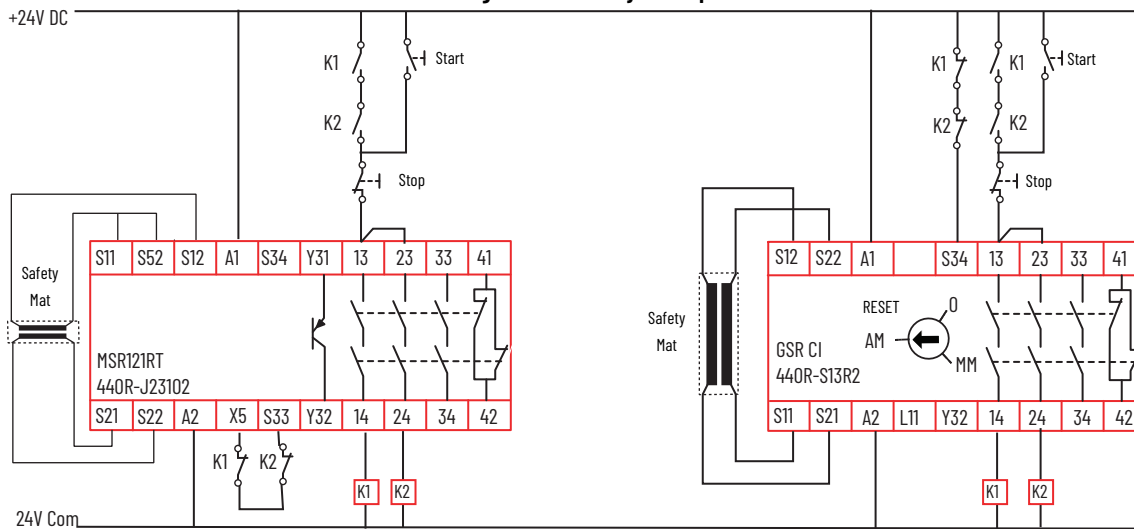


Figure 170 - Safety Mat Input Automatic Reset



Response Time



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

Table 64 - Response Time

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

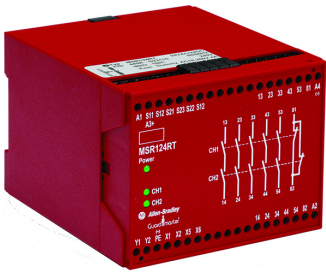
Output Load Capability

The MSR121RT safety relay has a higher current capability than the GSR CI safety relay, as shown in [Table 65](#). See [Output Load Capability on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the GSR CI safety relay capability.

Table 65 - Current Capability

Load Type	MSR121RT	GSR 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

MSR124RT Safety Relay



We recommend replacing the MSR124RT safety relay with a GSR CI and EM safety relay.

The MSR124RT safety relay has the following design characteristics:

- Single- or dual-channel inputs
- Can accommodate mechanical and OSSD (light curtain) inputs
- Five electromechanical safety outputs
- One solid-state auxiliary output
- Reset can operate automatically or monitored manual.

The MSR124RT safety relay is a safety monitoring relay that provides versatile inputs and monitoring capability with many safety outputs in a 100 mm (3.93 in.) package.

The MSR124RT safety relay can be connected as either a single or dual-channel safety gate or E-stop. It can also be connected to a light curtain that provides cross fault detection.

The wiring configuration determines the reset and output monitoring. Automatic/manual reset can use a jumper or can be used to check the operation of the contacts. Monitored manual requires the use of a manually operated N.O. momentary switch to activate the outputs.

The outputs include five N.O. safety rated outputs and one auxiliary output. The safety outputs have independent and redundant internal contacts to help verify the safety function. The auxiliary output is not safety rated and must only be used for indication purposes.

Table 66 - Conversion Table

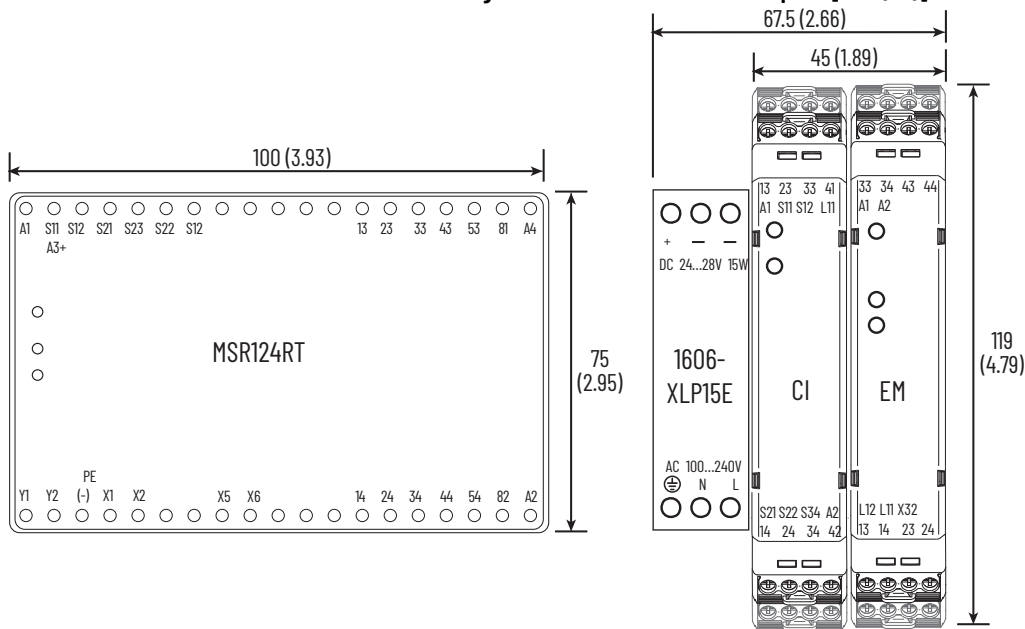
Supply Voltage	MSR124 Cat. No.	GSR CI Cat. No.	EM Cat. No.	Power Supply Cat. No.
24V AC/DC ⁽¹⁾	440R-G23110	440R-S13R2	440R-EM4R2	—
115V AC/ 24V DC	440R-G23108			1606-XLP15E
230V AC/24V DC	440R-G23107			

(1) For 24V, the GSR CI and EM safety relays can only operate at 24V DC. When the MSR124RT safety relay is powered by 24V AC, you must provide an AC/DC converter.

Terminal Location and Panel Space

For DC applications, the combination of the GSR CI and EM safety relays is smaller than the MSR124RT safety relay. For AC applications, a catalog number 1606-XLP15E power supply can be used; this combination still occupies less panel space than an MSR124RT safety relay.

Figure 171 - Terminals and Panel Space [mm (in.)]



Example Wiring Schematics

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

Figure 172 - Dual-channel Monitored Reset, DC Powered

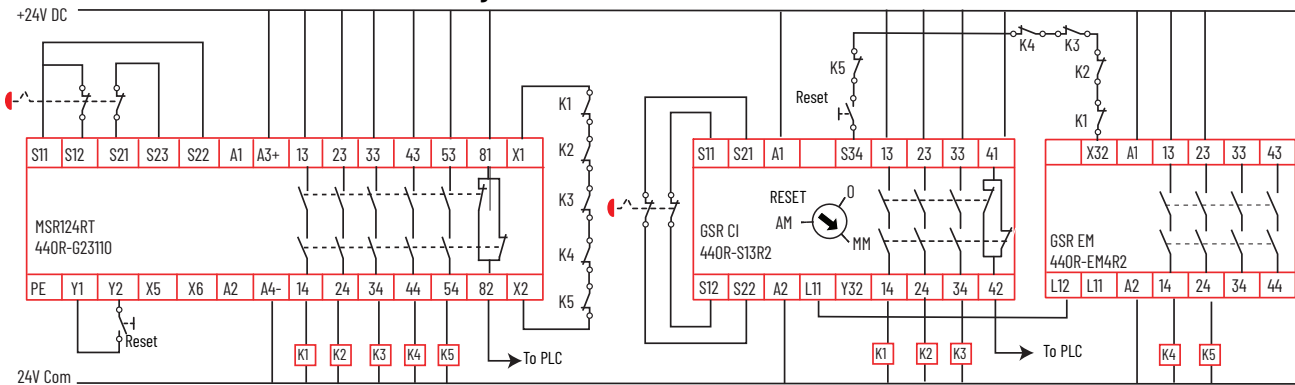
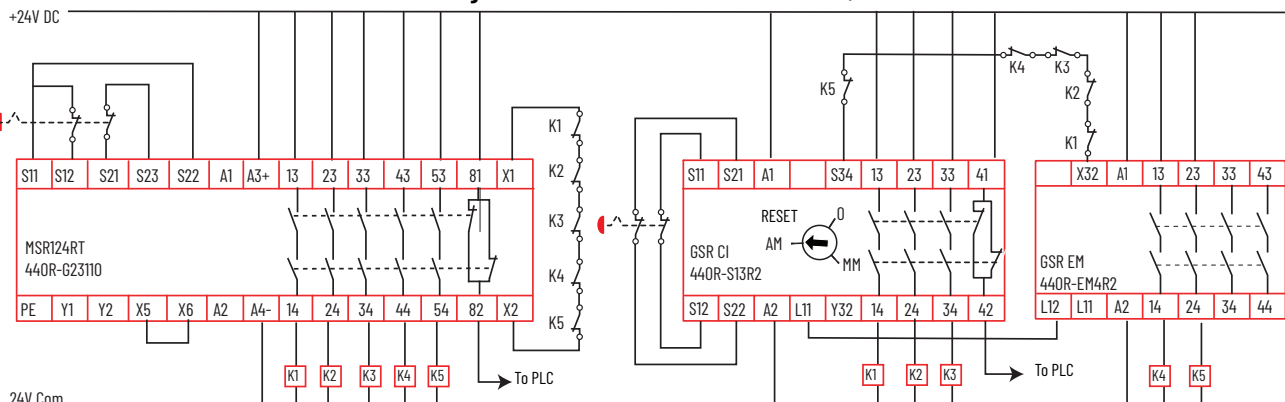
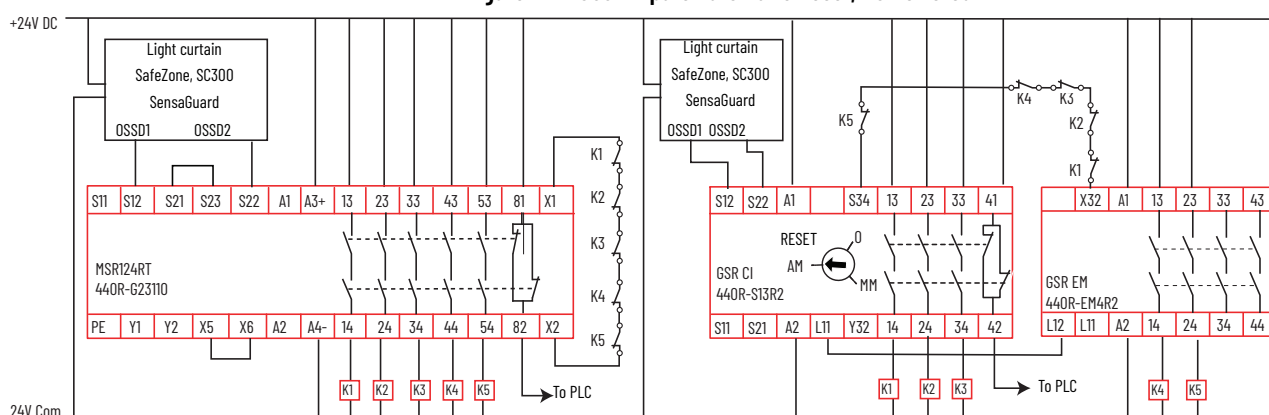
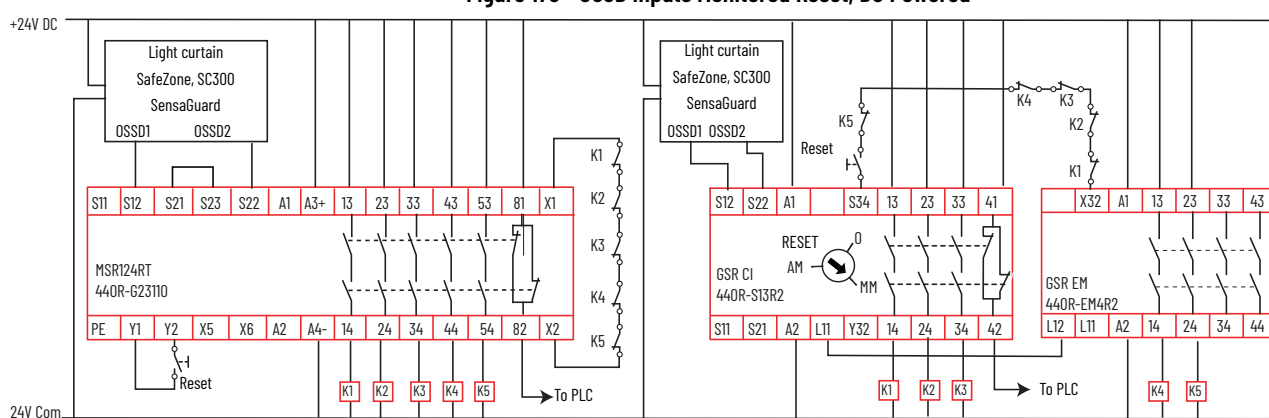
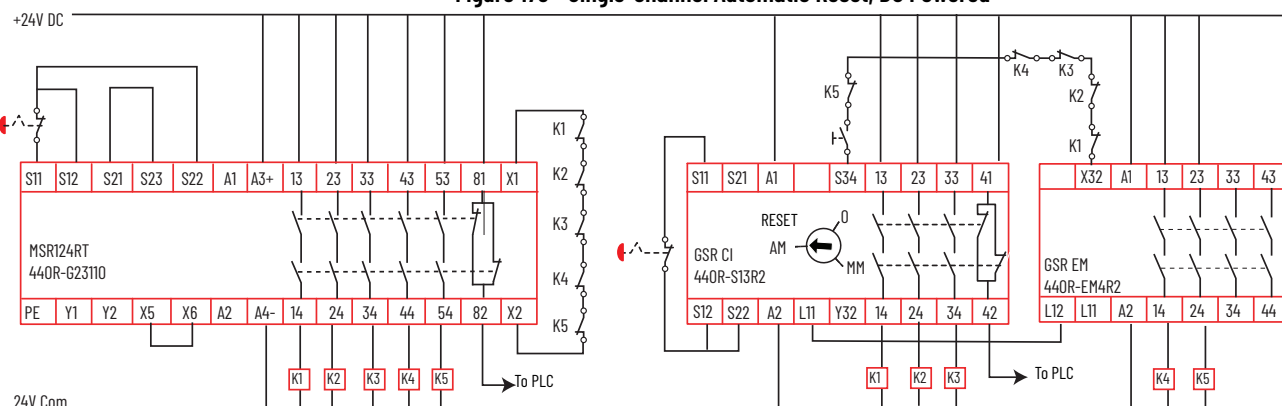
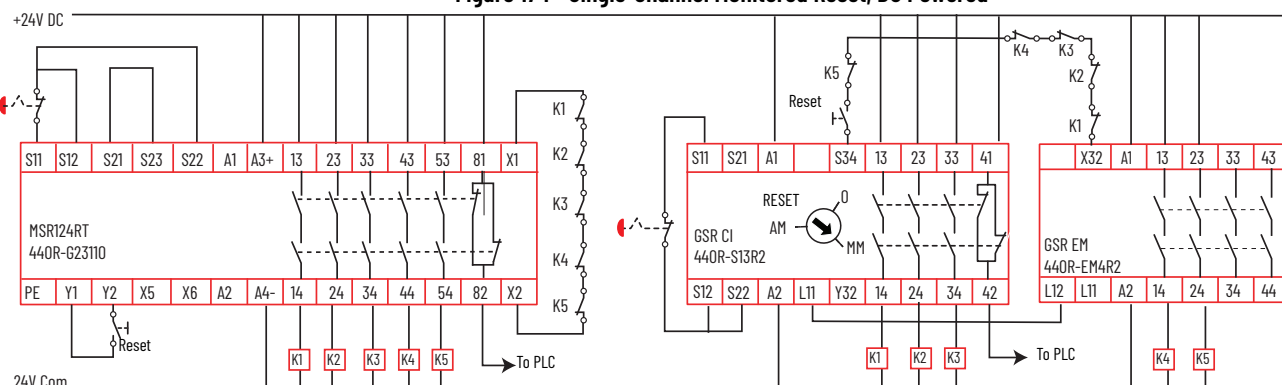


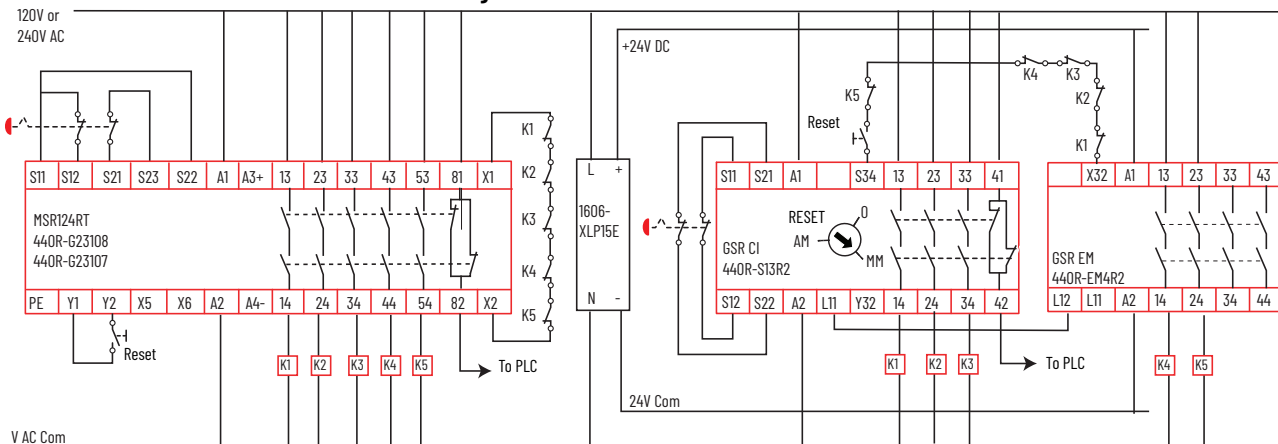
Figure 173 - Dual-channel Automatic Reset, DC Powered





A 1606-XLP15E power supply can be used to provide the 24V DC to power the GSR CI and EM safety relays.

Figure 178 - AC Powered



Response Time



ATTENTION: Because the MSR124RT safety relay is faster than the GSR CI and EM safety relays, the safety distance must be examined closely and adjusted if necessary.

Table 67 - Response Time

Safety Relay	Response Time [ms]
MSR124RT	20
GSR CI	35 for the inputs 25 for the SWS to the EM
EM	35

For example, the total response time of the EM safety relay is 25 + 35 = 60 ms.

Output Load Capability

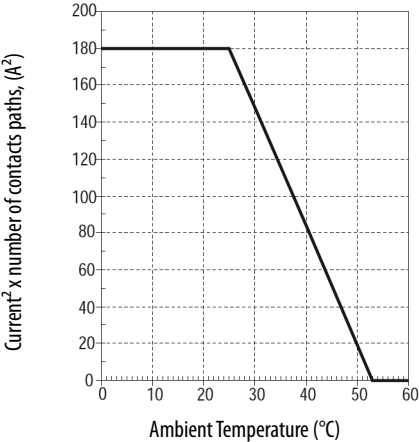
The outputs of the GSR CI safety relay can require interposing relays, depending in the load being switched by the MSR124RT safety relay. See [Output Load Capability on page 11](#) for a wiring example of using interposing relays for applications where the load exceeds the capability of the GSR CI or EM safety relay.

Table 68 - Current Capability

Load Type	MSR124RT	GSR CI	EM
AC Inductive	A300, AC-15 5 A/250V AC	C300, AC-15 1.5 A/250V AC	2 x B300, AC-15 4 A/250V AC
DC	N300, DC-13 4 A at 24V DC	DC-13 2 A/24V DC	P300, DC-13 2 A/24V DC
Thermal (non-switching)	10 A (max in one circuit) See current limit curve in Figure 179 .	1 x 6 A	2 A

The current through all contacts in the MSR124RT safety relay must be adjusted to its current limit curve, which is shown in [Figure 179](#).

Figure 179 - Current Limit Curve



Phase 4 (July 2021)

CU3 Control Unit



In late 2019, Rockwell Automation launched the MSR55P safety relay to provide additional features for monitoring the speed of a motor as the motor spins down to a stopped condition by sensing the back EMF of the motor. The MSR55P safety relay has been well accepted, and the CU3 control unit is now being obsoleted.

Feature Comparison

Table 69 compares the key feature differences between the CU3 control unit and the MSR55P safety relay. The MSR55P safety relay has several features that the CU3 control unit does not.

Table 69 - Key Feature Comparison

Feature	CU3	MSR55P
Panel space	45 mm (1.77 in.)	45 mm (1.77 in.)
Single-phase motor monitoring	Yes	Yes
Three-phase motor monitoring	No	Yes
Output monitoring	Yes	Yes
Fault output reporting	No	Yes
Monitors induction motors	Yes	Yes
Monitors servo motors	Not recommended	Yes
Adjustable threshold	Yes	Wider range
Delayed output capability	No	Yes
Safety rating	Cat 1	Cat4 PLe, SIL 3

Power Supply and Thresholds

The power supplies for the CU3 control unit and the MSR55P safety relay are similar, however, 24V AC cannot power the MSR55P safety relay. If the CU3 control unit is powered by 24V AC, you must provide an AC to DC converter to use the MSR55P safety relay.

Table 70 on page 116 lists the CU3 control unit catalog numbers, threshold voltage range, and typical applications. Table 71 on page 116 lists the MSR55P safety relay catalog numbers, threshold voltage range, and typical applications.

Table 70 - CU3 Catalog Options

Cat. No.	Supply Voltage	Standstill Monitoring Voltage Threshold	Typical Applications
440R-S35001	24V AC/DC	Up to 2.5V	Induction motors
440R-S35002	110V AC		
440R-S35002	230V AC		

Table 71 - MSR55P Catalog Options

Cat. No.	Supply Voltage	Standstill Monitoring Voltage Threshold	Typical Applications
440R-S35011	24V DC	20...400 mV	Induction motors
440R-S35012	115V AC		
440R-S35013	230V AC		
440R-S35014	24V DC	200 mV...4V	Servo (permanent magnet) motors
440R-S35015	115V AC		
440R-S35016	230V AC		

Threshold and Delay Settings

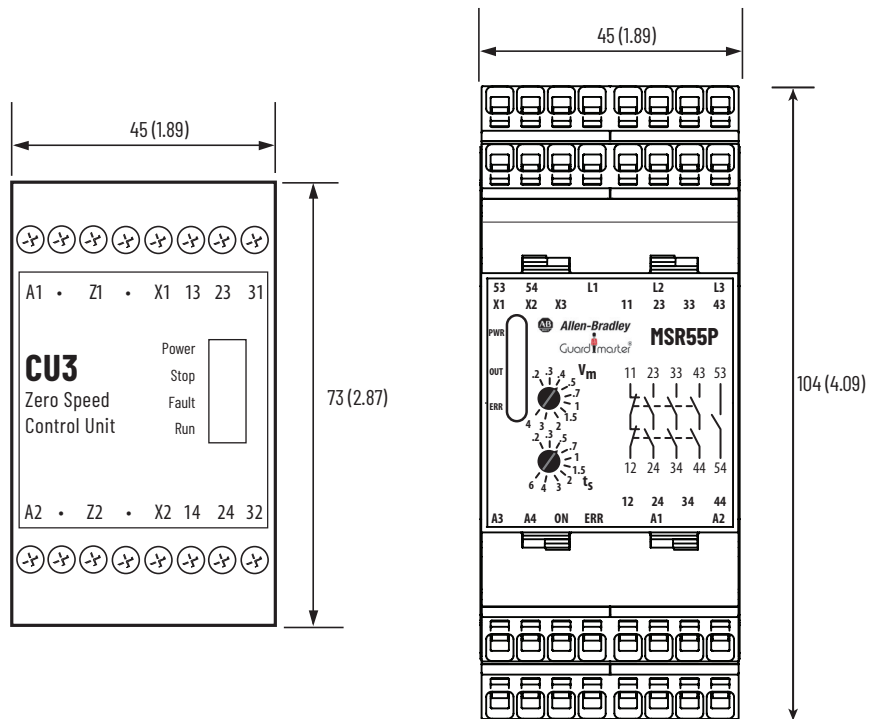
Both the CU3 control unit and the MSR55P safety relay have a potentiometer for adjusting the back EMF threshold setting. To access the threshold setting adjustment in the CU3 control unit, you must open the front cover. The MSR55P safety relay has the threshold setting adjustment on the front face.

In addition, the MSR55P safety relay has a second potentiometer on the front face. This potentiometer is for adjusting a delay time from when standstill is detected to when the outputs are energized. This feature provides additional assurance that the motor has achieved a steady state speed that is considered safe.

Terminal Locations and Panel Space

[Figure 180 on page 117](#) shows the relay sizes and terminal locations. The CU3 control unit has one row of terminals at the top and bottom. The MSR55P safety relay has two rows of terminals at the top and bottom to accommodate the features that the CU3 control unit does not have.

Both control units are 45 mm (1.77 in.) wide. The MSR55P safety relay is taller. To achieve optimal heat dissipation, 50 mm (2 in.) of spacing is recommended above and below each control unit.

Figure 180 - Terminals and Panel Space [mm (in.)]

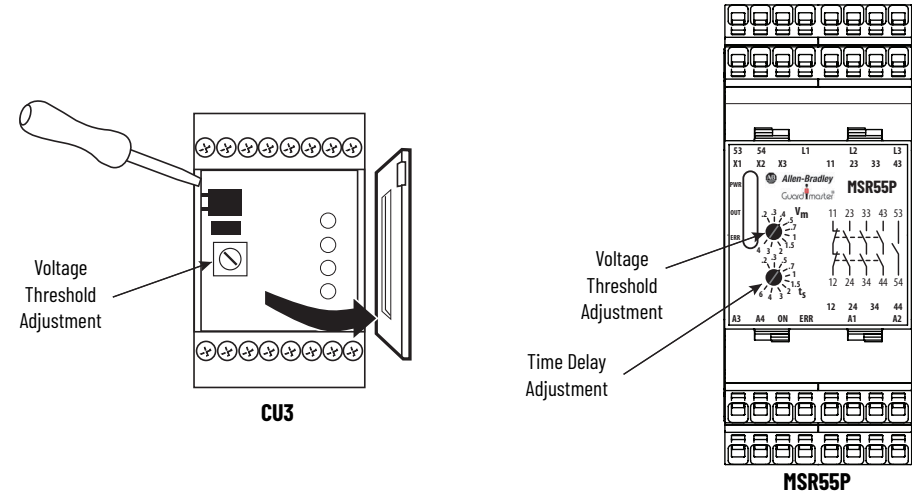
Threshold Settings

[Figure 181 on page 118](#) shows the adjustment locations.

To access the voltage threshold adjustment on the CU3 control unit, use a screwdriver to pop open the cover. Use a screwdriver to rotate the potentiometer to the desired setting.

The MSR55P safety relay potentiometers are on the front face. Use a screwdriver to adjust both the voltage threshold and the desired time delay so the motor can achieve a safe standstill motion.

Figure 181 - Threshold and Delay Settings



Example Wiring Schematics

Figure 182 and Figure 183 on page 119 show a direct comparison of schematics between the CU3 control unit and the MSR55P safety relay with Power to Release guard locking interlocks.

Figure 182 - TLS1-GD2 Guard Locking

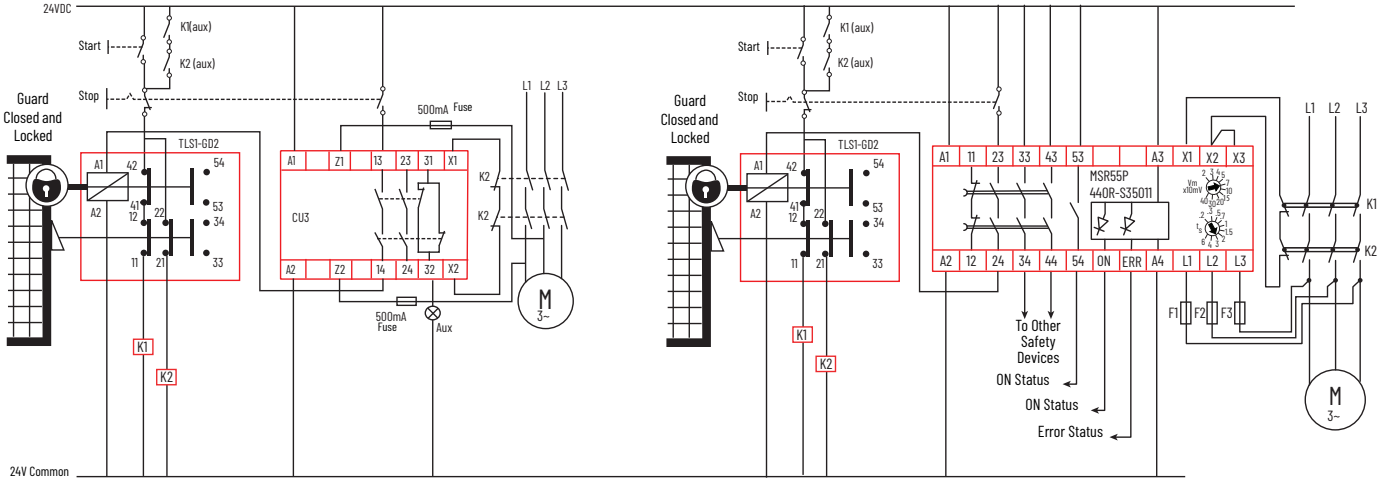
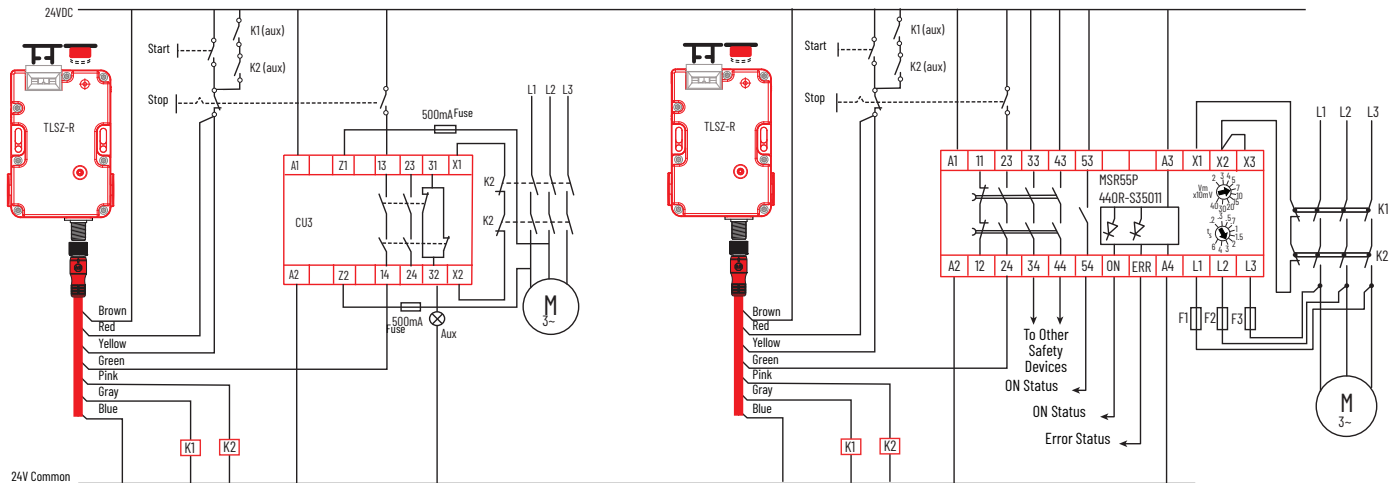


Figure 183 – TLSZ-R Guard Locking

Output Load Capability

The following table compares the output load capabilities of the CU3 control unit and MSR55P safety relay. The output switching capability of the two relays is similar. For AC loads, the MSR55P safety relay is derated when operating at higher ambient temperatures.

The MSR55P safety relay has a higher DC current rating than the CU3 control unit.

Load Description	CU3	MSR55P
AC-15 B300	5 A at 250V AC 5 A at 120V AC	5 A at 250V AC at 40 °C (104 °F) 2 A at 250V AC at 60 °C (140 °F)
DC	3 A at 24V DC	4 A at 24V DC

Feedback Monitoring

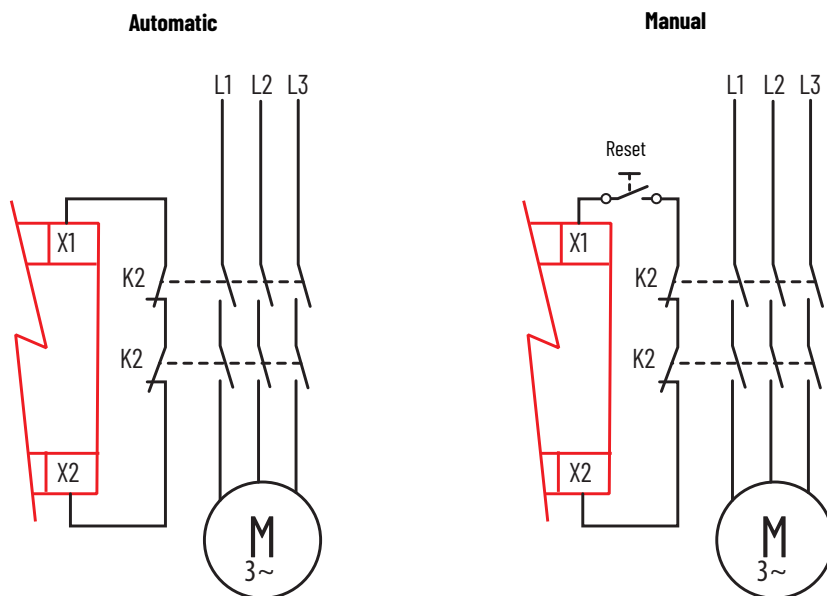
As shown in [Figure 184 on page 120](#), both the CU3 control unit and the MSR55P safety relay are able to monitor their respective output devices with automatic/manual monitoring on terminals X1 and X2.

Automatic monitoring is accomplished by connecting the monitored contacts in series to X1 and X2. Manual reset is accomplished by adding a momentary normally open (N.O.) push button in series with the monitored contacts.



Upon manual reset, the MSR55P displays a fault code 4.

Figure 184 - Automatic and Manual Reset



MSR300 Safety Relay



The best modernization for the MSR300 safety relay is to the GSR relays. This modernization can use many of the GSR relays due to the various relay configurations of the MSR300 safety relay.

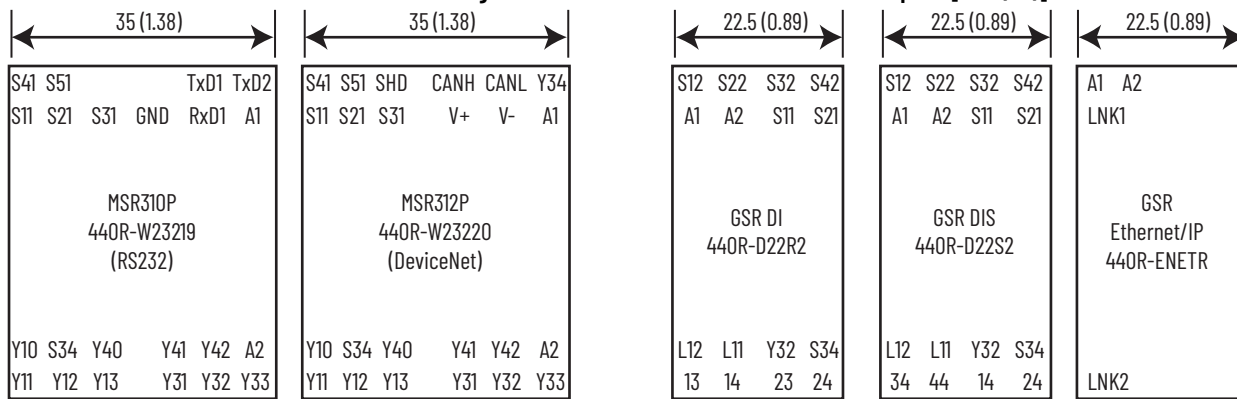
Alternatively, you can modernize the MSR300 safety relay to the CR30 safety relay. The CR30 safety relay requires a computer that runs Connected Components Workbench™ software to accomplish the configuration. The Connected Components Workbench software is a free download from Rockwell Automation.

Terminal Locations and Panel Space

Host Module

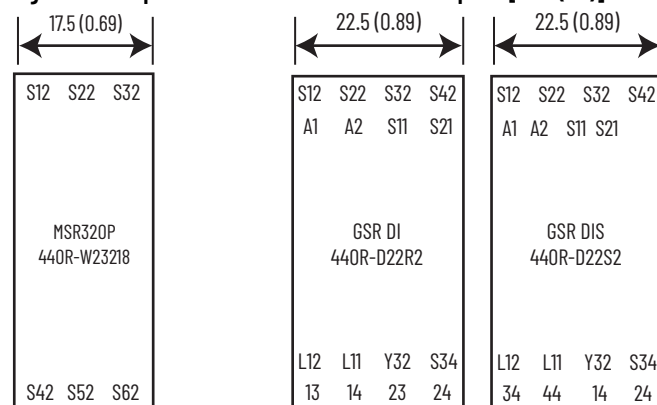
The host module for the MSR300 safety relay is either an MSR310P or an MSR312P host module. You can replace both of these modules with either a DI or DIS safety relay. The MSR3xx module has a 35 mm (1.38 in.) wide body as compared to the 22.5 mm (0.89 in.) for the GSR relays.

If communications are used in the application, you must convert from RS-232 or DeviceNet® to EtherNet/IP™ and add the GSR ENTER module.

Figure 185 - Host Module Terminals and Panel Space [mm (in.)]

Input Module

Each MSR300 safety relay system must have at least one MSR320P safety relay input module and can have up to 10 input modules. An equivalent GSR module is the DI or DIS safety relay. The MSR320P safety relay occupies slightly less panel space at 17.5 mm (0.69 in.) compared to 22.5 mm (0.89 in.) for the GSR relays.

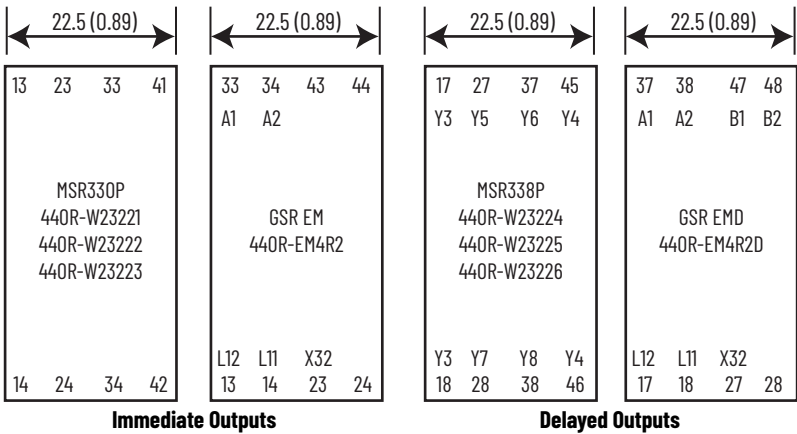
Figure 186 - Input Module Terminals and Panel Space [mm (in.)]

Output Module

Each MSR300 safety relay system must have at least one output module and can have up to six output modules. Equivalent modules in the GSR family are the EM safety relay for Immediate Outputs and the EDM safety relay for delayed outputs.

The significant difference is that the EM and EDM safety relays require power, ground and SWS connections, whereas the MSR330P and MSR338P safety relays get their power through the ribbon cable.

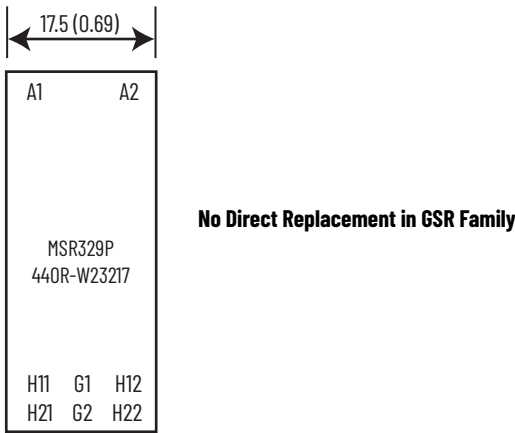
Figure 187 - Output Module Terminals and Panel Space [mm (in.)]



Muting Lamp Module

The MSR300 safety relay family has a separate MSR329 muting lamp module. The GSR family has no equivalent; the machine control system can provide a muting lamp function.

Figure 188 - Muting Lamp Module Terminals and Panel Space [mm (in.)]

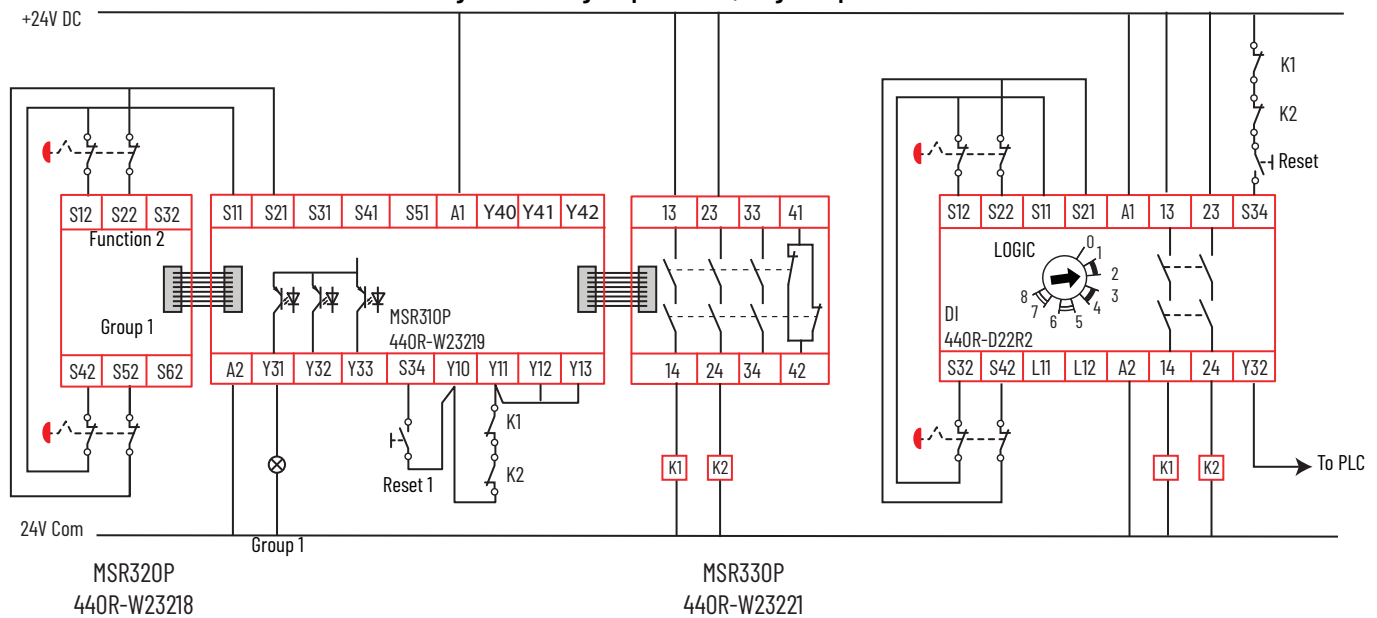


Example Wiring Schematics

Single Input Module, Single Output Module

At the basic level, the MSR300 safety relay system has one input module and one output module. You can replace the MSR300 safety relay system with one DI safety relay.

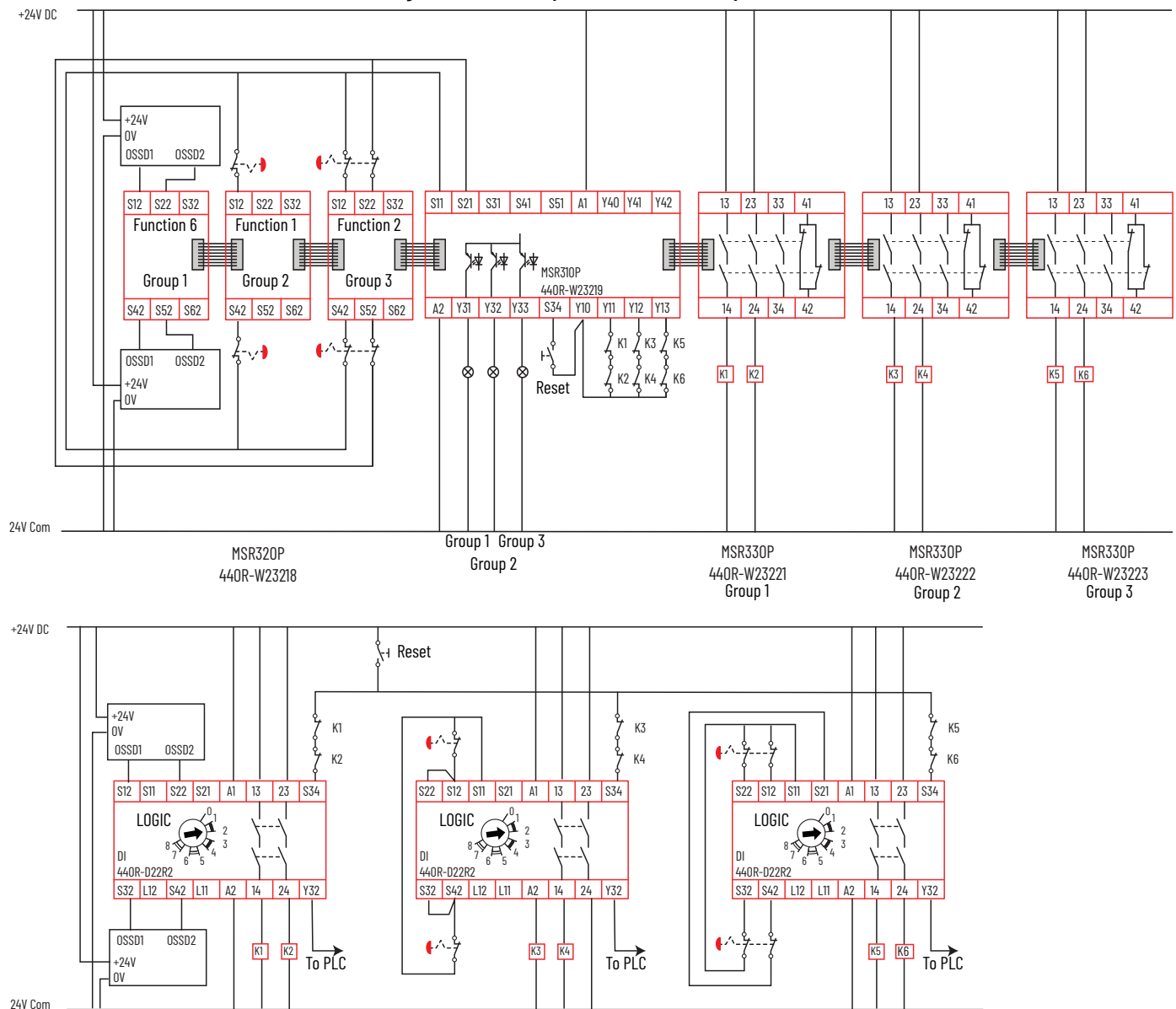
Figure 189 - Single Input Module, Single Output Module



Three Input Modules and Three Output Modules

[Figure 190](#) and [Figure 191 on page 125](#) show that the MSR300 safety relay has three input modules and three output modules. Each input module is set to another type of device (OSSD, single-channel, and dual-channel) and different output group (groups 1, 2, and 3). The equivalent GSR system is three DI safety relays. Both systems monitor the output contactors and one reset button resets the safety system.

Figure 190 - Three Input Modules/Three Output Modules

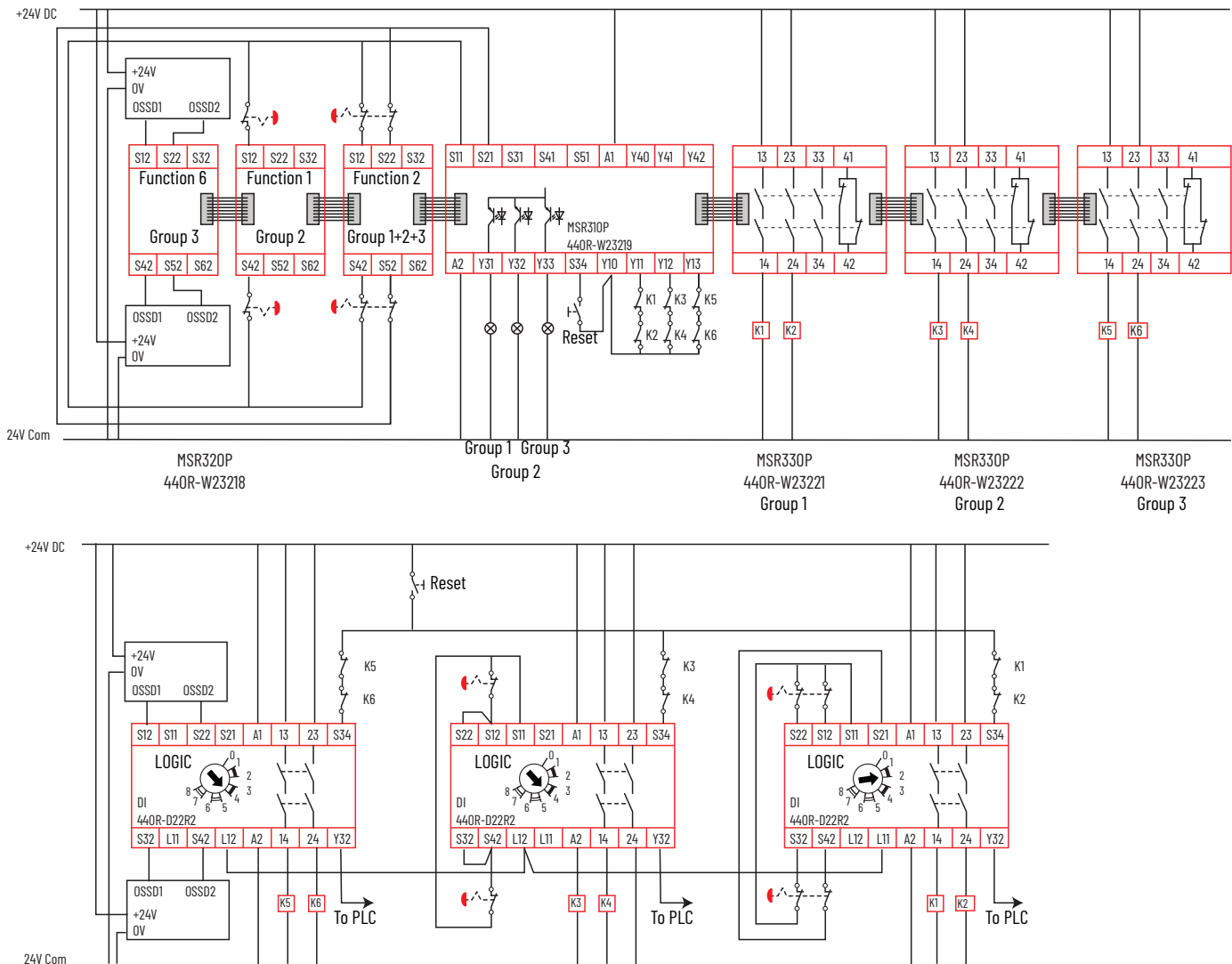


Two Zones, Global E-stop

In [Figure 191](#) and [Figure 193 on page 127](#), the MSR300 safety relay has a global E-stop that turns off outputs groups 1, 2, and 3. Group 2 and 3 inputs control their respective outputs.

The GSR relays can use the Single Wire Safety signals on terminals L11 and L12 to perform the same global E-stop function. For the GSR system, the reset button must be pressed twice: the first press turns on the DI safety relay with dual-channel E-stop, the second press turns on the other two DI safety relays.

Figure 191 - Two Zones, Global E-stop



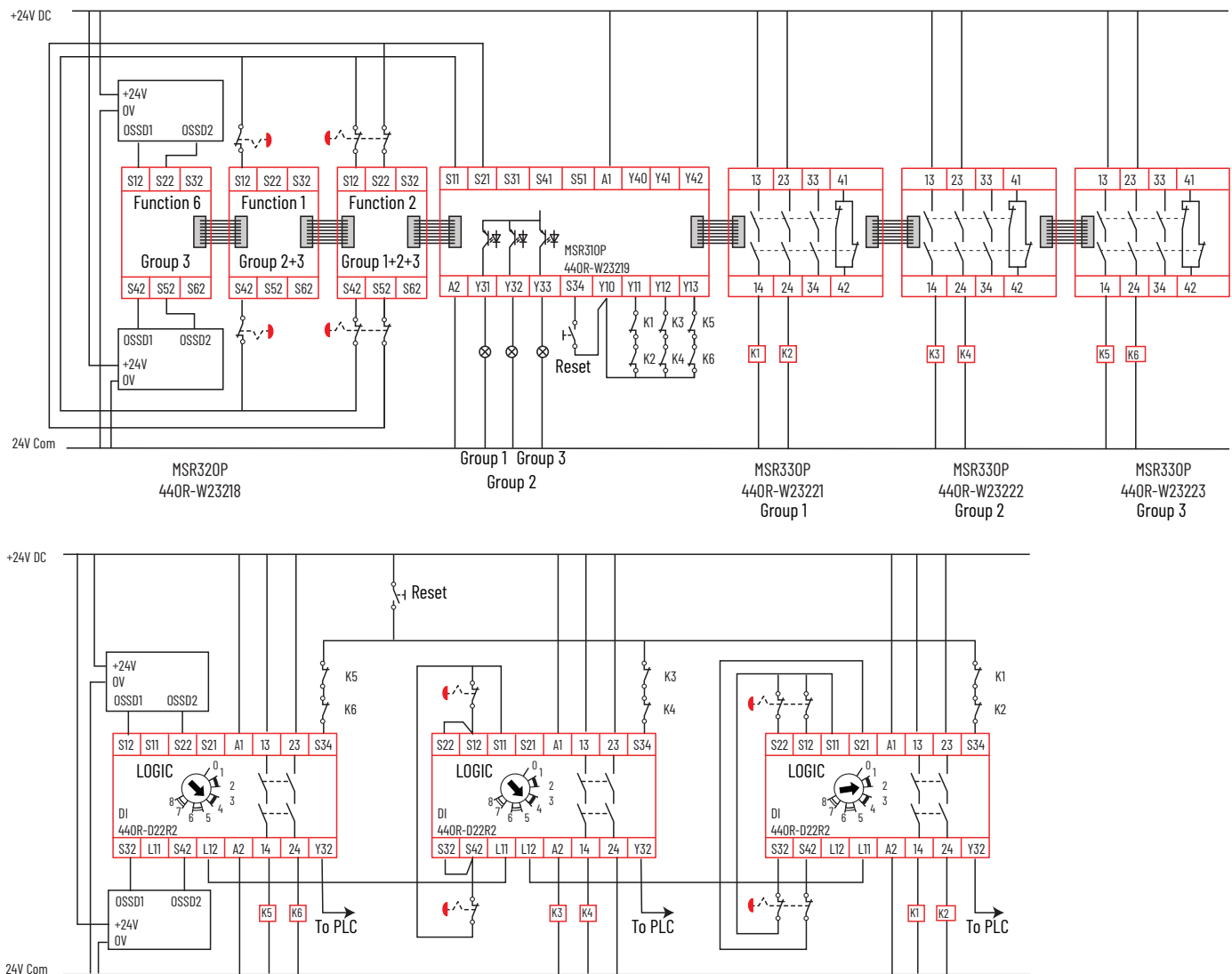
Global E-stop, Local E-stop

In [Figure 192](#) and [Figure 195 on page 128](#), the first MSR320P safety relay input module provides a global E-stop, which stops groups 1, 2 and 3. The middle MSR320P safety relay input modules stop groups 2 and 3. The third input module only stops the outputs in group 3. The GSR solution stops outputs with the Single Wire Safety connections on terminals L11 and L12.

For the GSR solution, you must press the reset button three times:

- First press turns on the DI safety relay with the dual-channel E-stops.
- Second press turns on the DI safety relay with the single-channel E-stop.
- Third press turns on the DI safety relay with the OSSD devices.

Figure 192 - Global E-stop, Local E-stop



Robot Zone (Function 8)

Shown in [Figure 193](#), if one of the MSR300 safety relay input modules is set to 8, the MSR300 safety relay treats the safety system as a two-zone robot cell. While the robot is present in one danger zone, the safeguard devices in the other zone are muted.

Safety rated limit switches with one N.O. and one N.C. contact detect the position of the robot. To convert the GSR solution, the limit switches must be changed to two N.C. plus one N.O. contacts.

When the group 8 robot In1 status indicator is red, the robot is in danger zone 1. If the group 1 E-stop is pressed or the light curtain is blocked, both group 1 and robot power turn off (group 2 hazards remain energized). If the group 2 E-stop is pressed or the light curtain is blocked, only the group 2 outputs turn off. After the E-stop is released and the light curtain is cleared, the reset must be pressed to turn the group 2 hazards outputs back on.

Figure 193 - Robot Zone (Function 8)

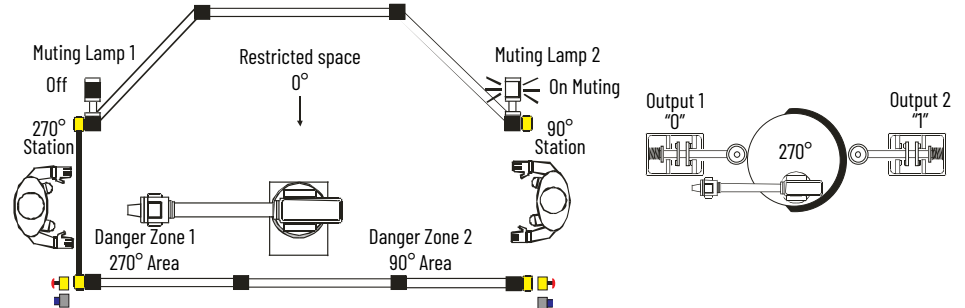
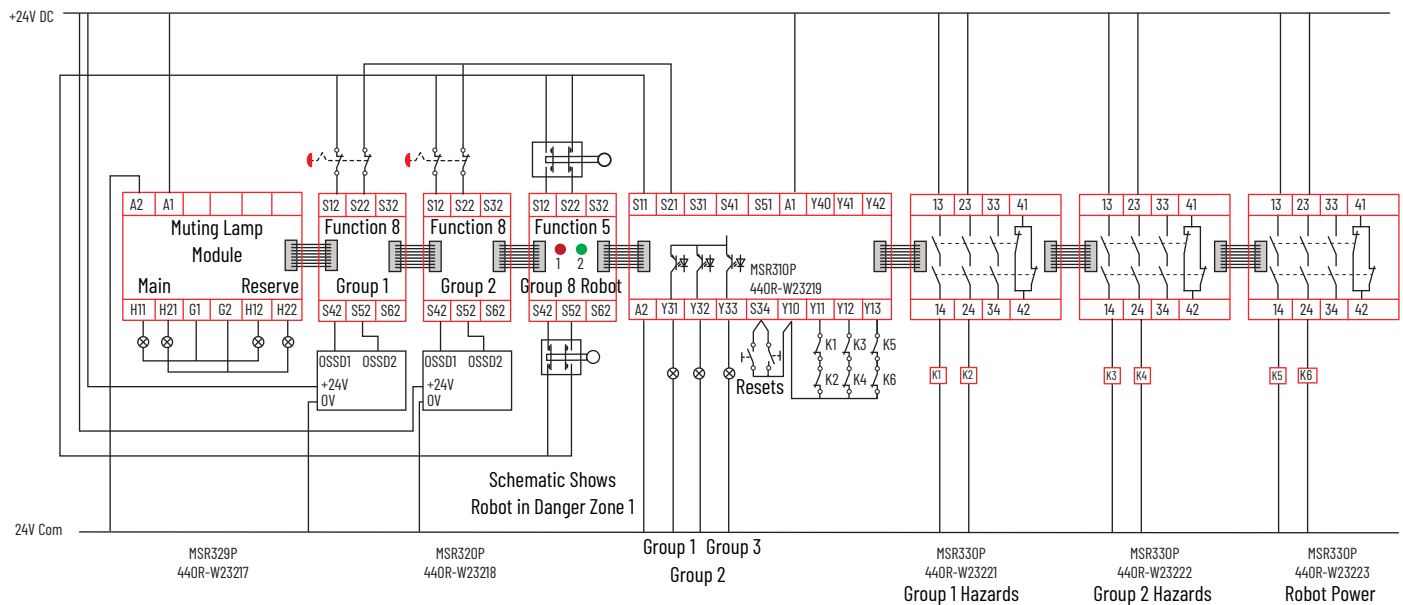


Figure 194 - Robot Zone (Function 8) Schematic



The CR30 safety relay with a 2080-IQ4OB4 plug-in module can replicate the robot zone function 8. [Figure 195](#) and [Figure 196 on page 129](#) show the robot in zone 1.

Figure 195 - CR30 Safety Relay with Plug-in

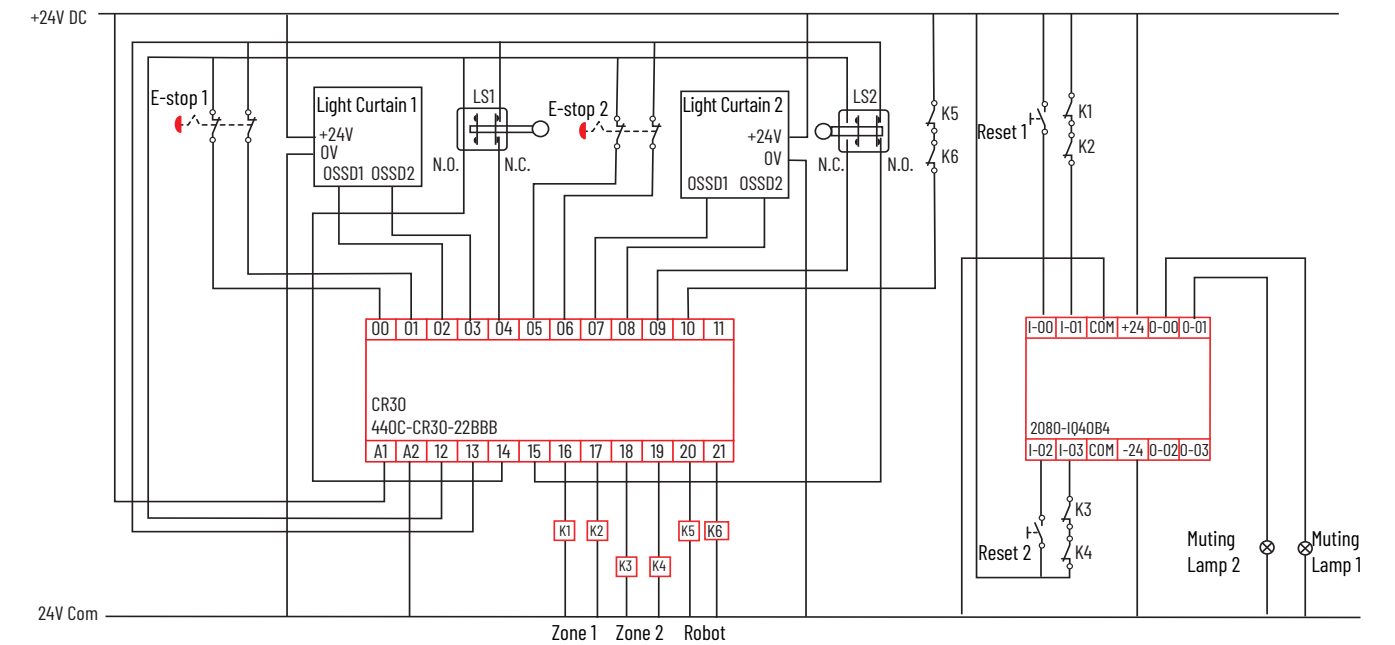


Figure 196 - Logic Diagram (1 of 2)

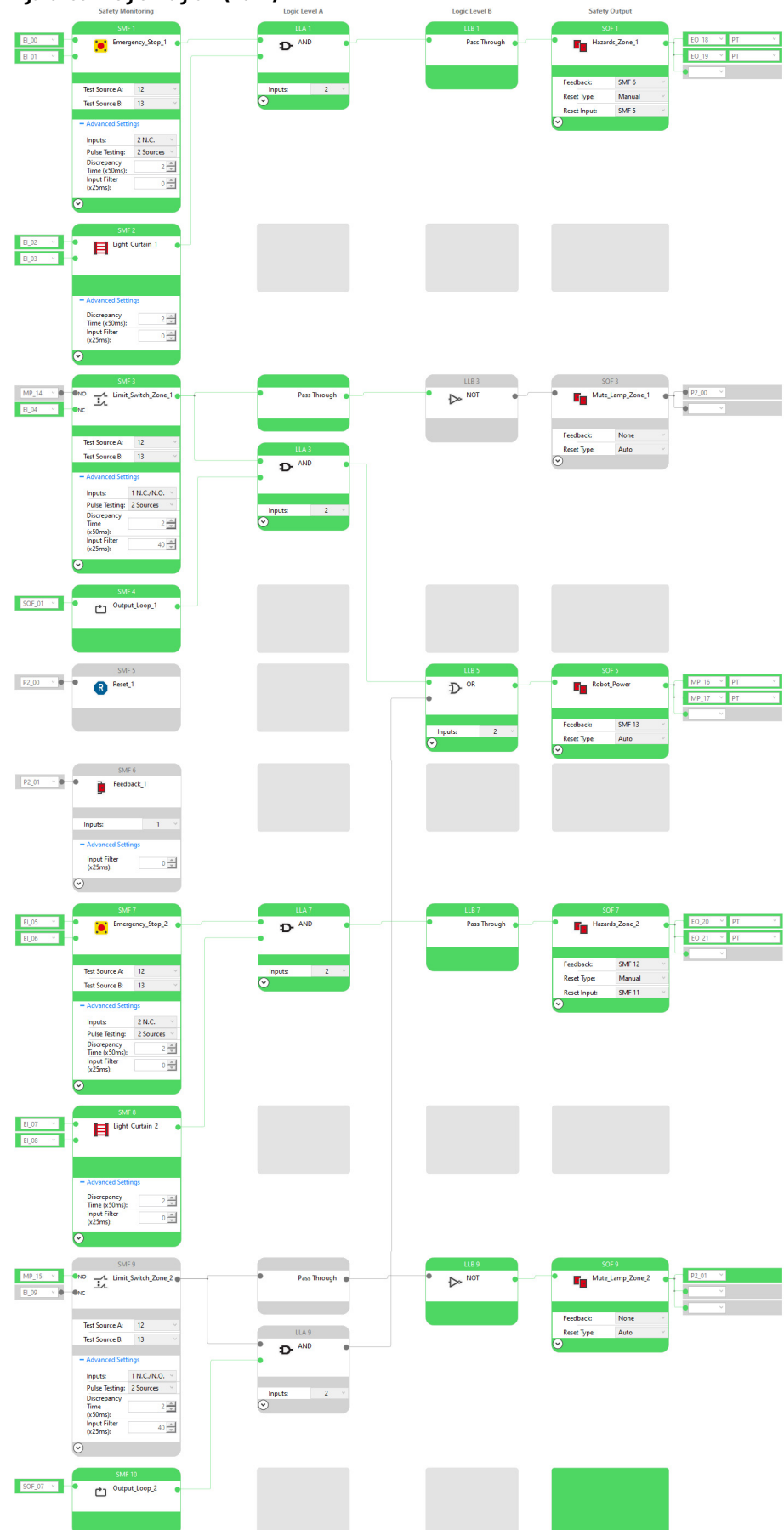
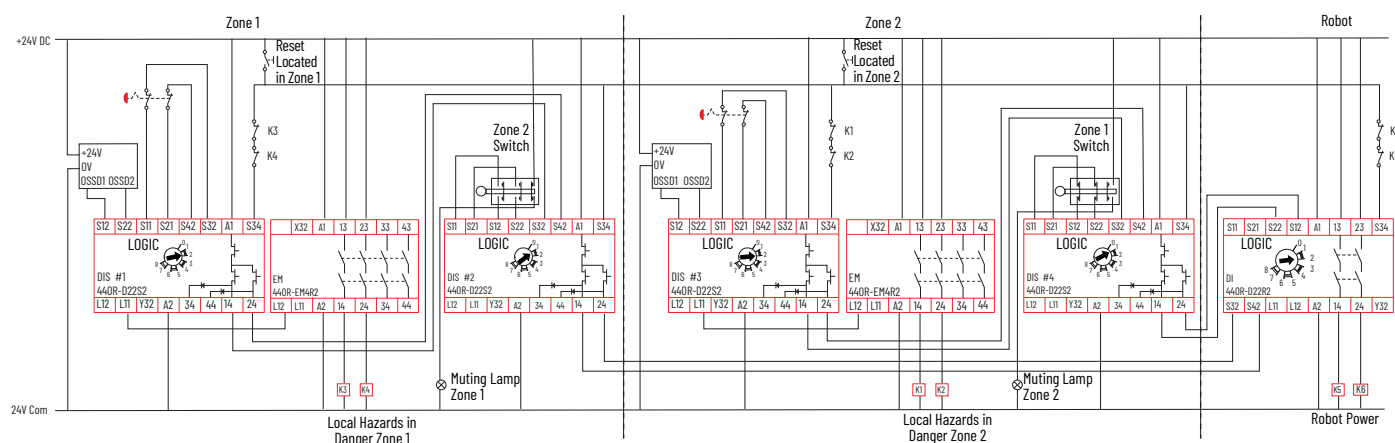


Figure 197 - Logic Diagram (2 of 2)



Figure 198 shows an equivalent circuit that uses the GSR relays. DIS safety relays are recommended as their solid-state outputs are pulse-tested. EM expansion relays provide voltage-free contacts to control the local hazards. The DI safety relay is suggested for robot power because it has electromechanical outputs.

Figure 198 - GSR Relays



Upon startup with the robot in zone 1, E-stops are released, and light curtains are clear; press reset once to energize the DIS safety relays 1, 3 and 4.

Press reset gain to energize the DIS safety relay 2.

Press reset once more to energize the DI safety relay (robot power).

While the robot is in zone 1, if the E-stop is pressed or the light curtain is blocked in zone 1, the hazards in zone 1 and the robot power are de-energized. Zone 2 hazards remain energized.

After the E-stop is released and the light curtain is cleared, press the reset button three times to energize the hazards in zone 1 and robot power.

While the robot is in zone 1, if the E-stop is pressed or the light curtain is blocked in zone 2, the loads are de-energized in zone 2. The hazards in zone 1 and robot power remain energized. After the E-stop is released and the light curtain is cleared, press the reset button once to energize the hazards in zone 2.

Robot Zone with Additional Safe Area (Function 9)

Shown in [Figure 199](#) and [Figure 200](#), function 9 of the MSR300 safety relay adds an additional safe area to the robot cell. When the robot is in the Additional Safe Area, both light curtains are muted.

Figure 199 - Robot Zone with Additional Safe Area (Function 9)

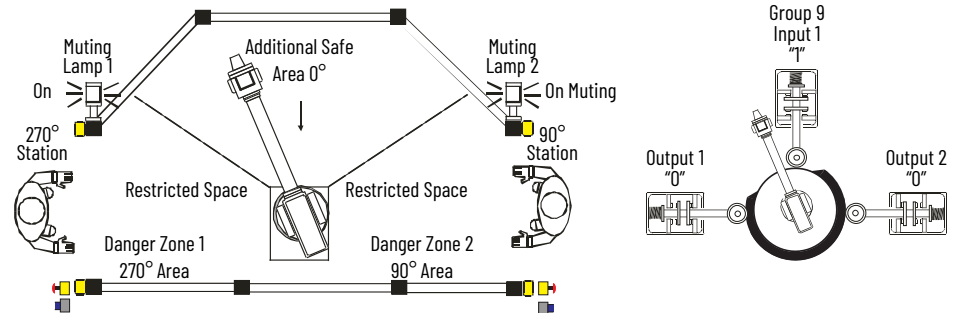
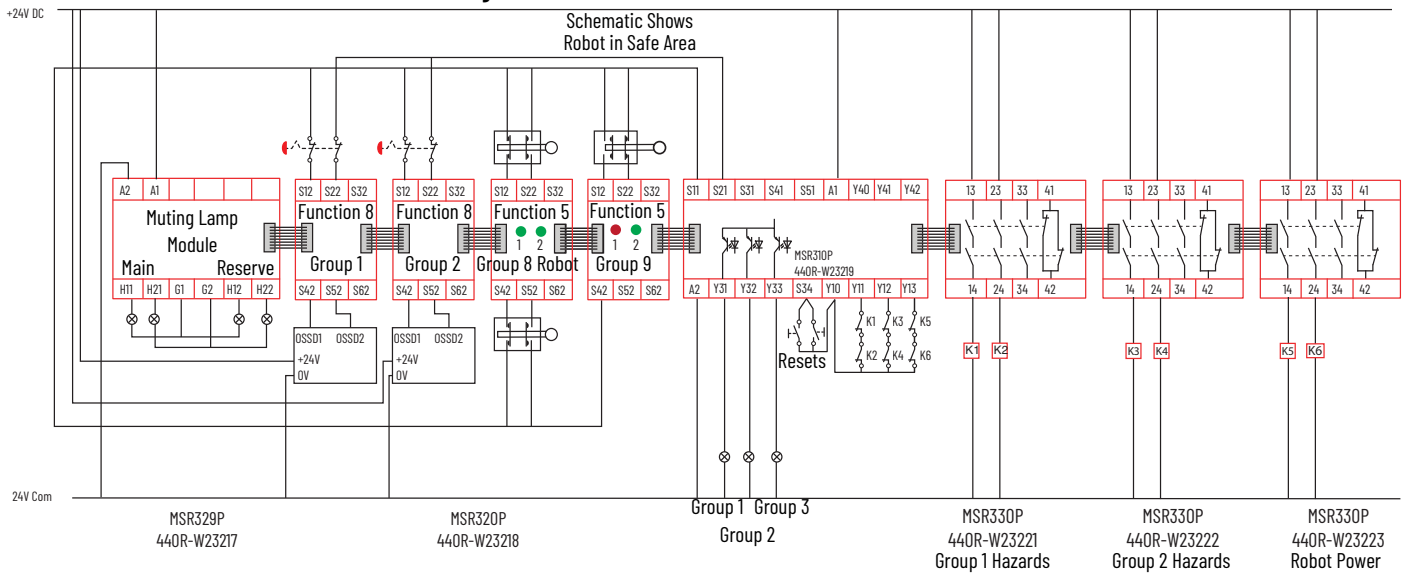


Figure 200 - Function 9 Schematic



Two CR30 safety relays, one with a 2080-IQ4OB4 plug-in module, can replicate the robot zone function 9. [Figure 201](#) ...[Figure 204 on page 134](#) show the robot in the safe area.

Figure 201 - CR30 Safety Relays with Plug-in

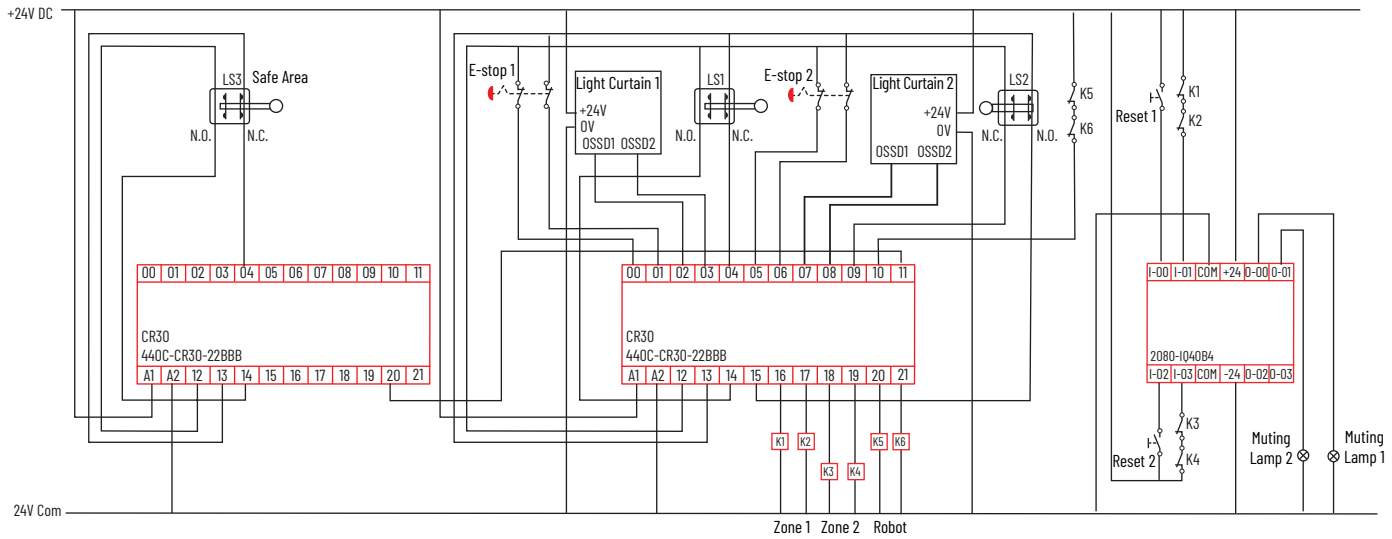


Figure 202 - Logic Diagram (1 of 3)

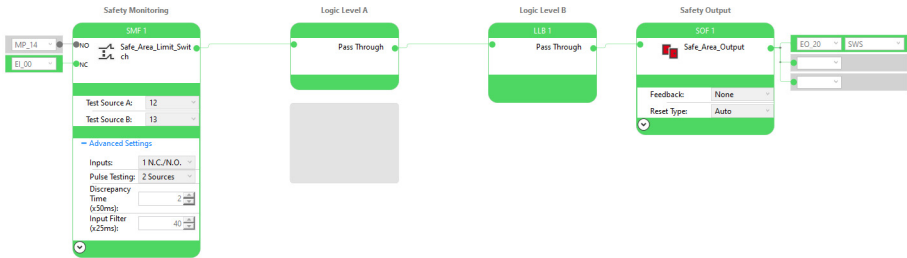


Figure 203 - Logic Diagram (2 of 3)

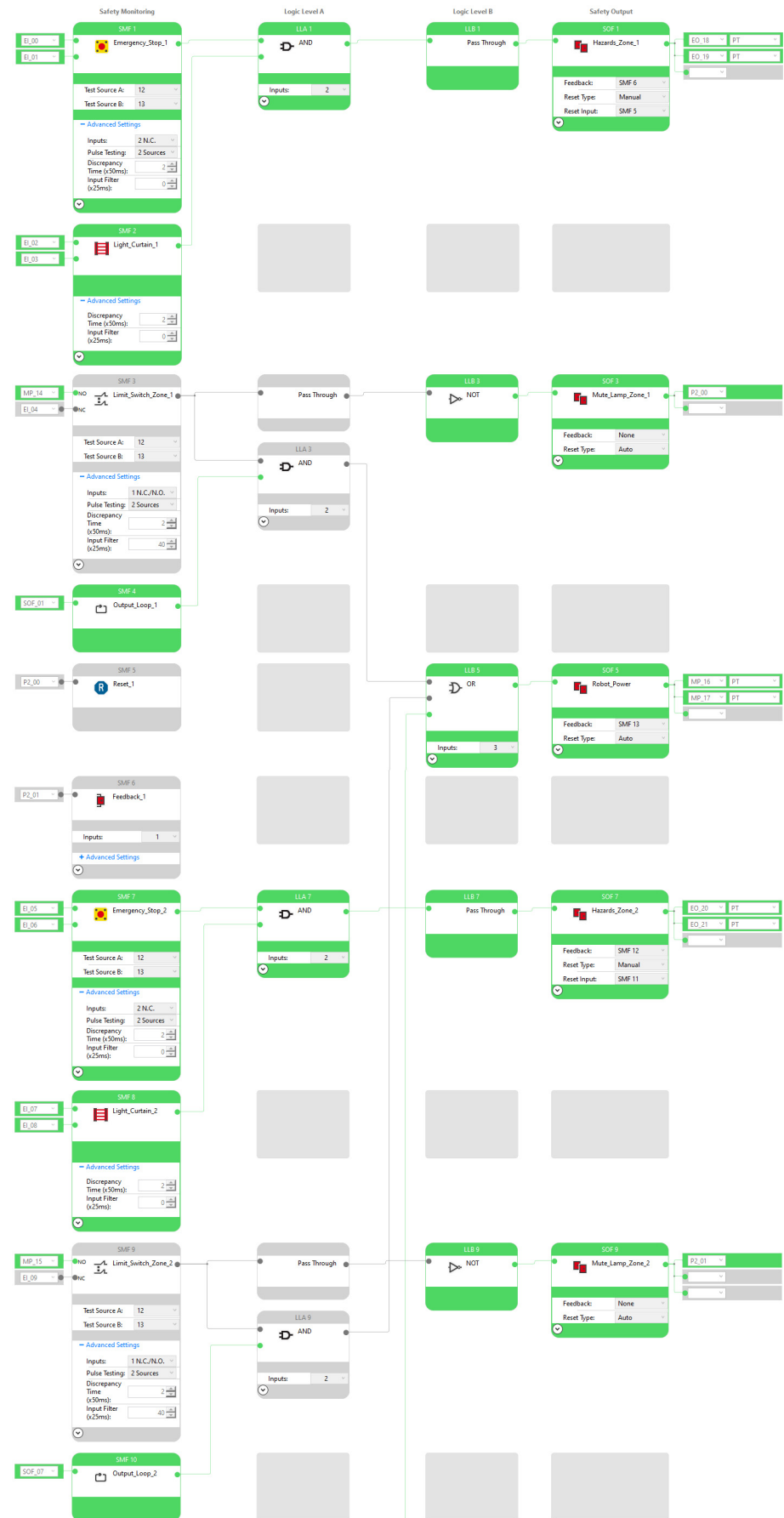
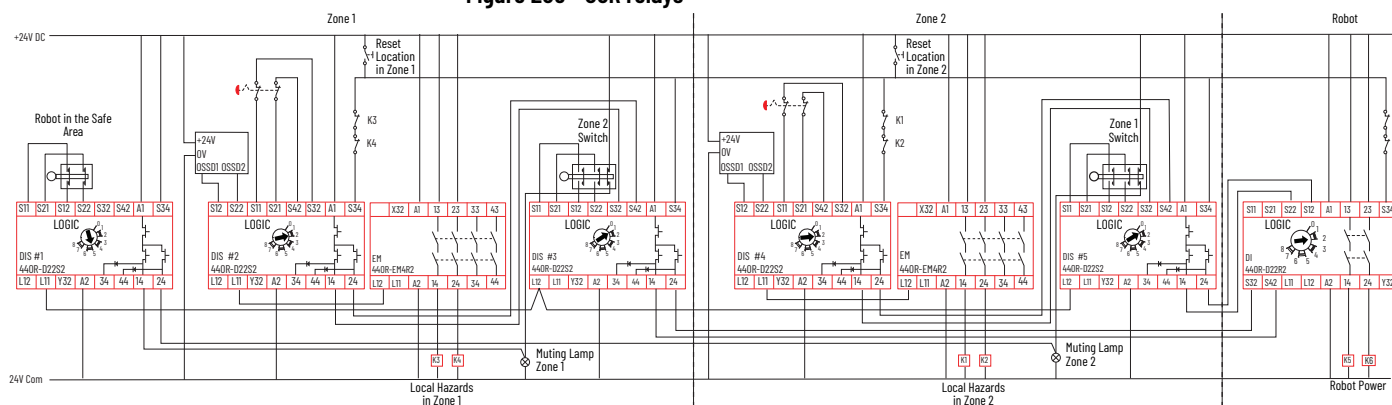


Figure 204 - Logic Diagram (3 of 3)



Figure 205 shows an equivalent circuit that uses the GSR relays. DIS safety relays are recommended as their solid-state outputs are pulse-tested. EM expansion relays provide voltage-free contacts to control the local hazards. The DI safety relay is suggested for robot power because it has electromechanical outputs.

Figure 205 - GSR relays



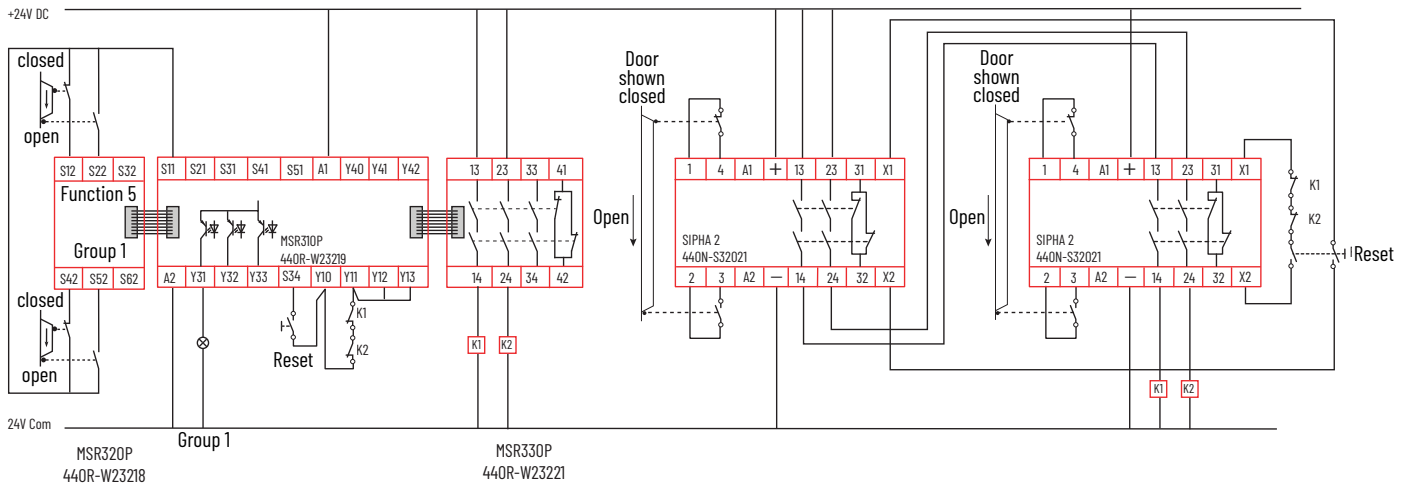
Upon power-up with the robot in the safe area, press the reset three times to energize the local hazards and robot power.

The E-stops and light curtains de-energize their respective local hazards, and the robot remains powered. Press the reset button once to re-energize the local hazards. The GSR solution cannot accommodate the muting lamps.

One N.C. and One N.O. Input

Shown in Figure 206 on page 135, the dual-channel input has a definite simultaneity when the input for the MSR300 safety relay is sourced from S11. When the dual-channel input is sourced from S21, the dual-channel inputs must change state within 3 seconds. The Sipa™ 2 controller supports the 3-second requirement.

Figure 206 - One N.C. and One N.O. Input

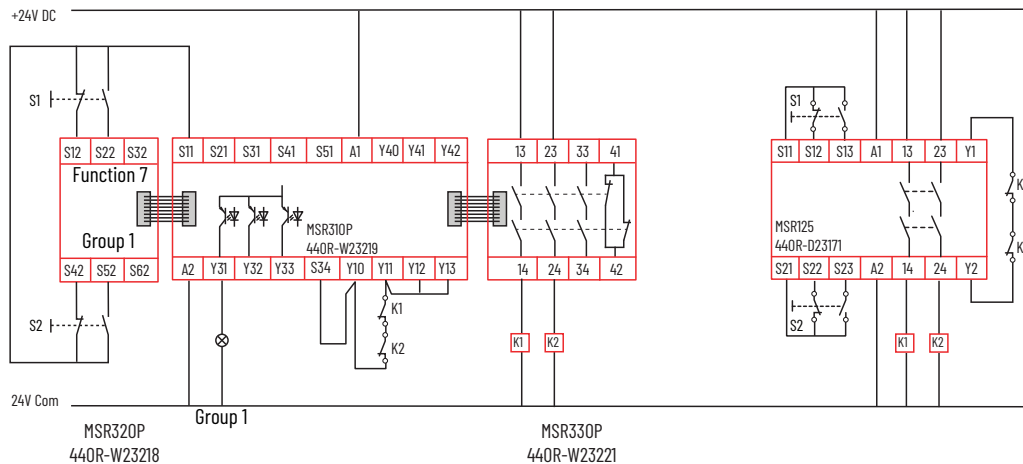


Two-hand Control Input

For simple applications, the MSR300 safety relay can be replaced with the MSR125 safety relay. A typical example is shown in [Figure 207](#).

For more complex applications, the CR30 can couple two-hand control with other safety-related functions. See publication [440C-UM001](#) for more details.

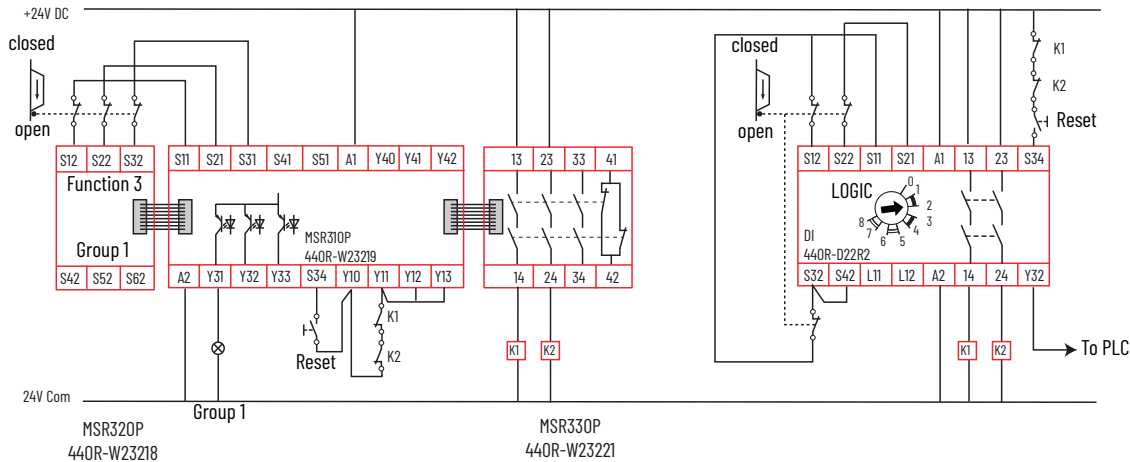
Figure 207 - Two-hand Control Input



Three-channel Input

Figure 208 shows the input wiring where no simultaneity is required.

Figure 208 - Three-channel Input



Muting with E-stop

Muting is accomplished with one safety monitor function. The muting function turns on the output with automatic reset and feedback monitoring. The E-stop turns off the outputs and requires a monitored manual reset. The E-stop turns off the outputs with the Output Loop block, which takes the E-stop output and logically ANDs it with the light curtain output.

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 must adjust the safety distance.

Table 72 - Response Time

Safety Relay	Response Time [ms]
MSR310P	26 + 6 per connected input
DIS	Inputs: 25 Mat operation: 30 SWS fault: 45
DI	Inputs: 35 Mat operation: 40 SWS fault: 45
EM	35 SWS output: 25
EMD	35 plus the timer selection SWS output: 25

Output Load Capability

The MSR300 safety relay has a higher current capability than the EM and EDM safety relays as shown in the following table. See

[Output Load Capability on page 11](#) for a wiring example of how to use relays that interpose for applications where the load exceeds the EM and the EDM safety relay capabilities.

Table 73 - Current Capability

Load Type	MSR330P	MSR338P	EM and EMD
AC Inductive	B300, AC-15 2x6 A or 3 x 5 A/250V AC	B300, AC-15 5 A/250V AC	B300, AC-15 1.5 A / 250V AC
DC	P300, DC-13 2x6 A or 3 x 5 A/24V DC	P300, DC-13 3A/30V DC	DC-13 2 A / 24V DC
Thermal (non-switching)	4 A	2 x 5 A, 3 x 4 A	6 A on 1 circuit

Notes:

B

benefit

GSR 10

C

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output load 11

catalog number

1606-XLP15E 91

1606-X15E 67

1606-XLP15E 13, 16, 18, 21, 29, 32, 34, 36, 40,
43, 48, 53, 54, 58, 68, 73, 92, 110,
113

1606-XPL15E 41

2080-I040B4 127, 132

440N-S32021 97, 100

440R-B23020 7

440R-B23211 7

440R-C23136 7

440R-C23137 7

440R-C23139 7

440R-C23139S 7

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440R-D23022 94

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440R-D23024 94

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440R-E23098 7

440R-E23159 7

440R-E23160 7

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440R-E23162 7

440R-E23191 7

440R-E23192 7

440R-E23193 7

440R-E23194 7

440R-E23195 7

440R-EM4R2 91, 110

440R-ENETR 82, 84

440R-F23027 97

440R-F23028 97

440R-F23199 100

440R-F23200 100

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440R-G23110 7, 110

440R-G23214 7

440R-G23215 7

440R-G23216 7

440R-GL2S2P 91

440R-J23102 105

440R-M23080 7

440R-M23081 7

440R-M23082 7

440R-M23084 7

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440R-M23089 7

440R-M23090 7

440R-M23092 7

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440R-M23143 7

440R-M23143S 7

440R-M23144 7

440R-M23145 7

440R-M23147 7

440R-M23147S 7

440R-M23148 7

440R-M23149 7

440R-M23151 7

440R-N23112 7

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440R-N23115 7

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440R-N23117 7

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440R-N23121 7

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440R-N23123 7

440R-N23124 7

440R-N23125 7

440R-N23126 7

440R-N23127 7

440R-N23128 7

440R-N23129 7

440R-N23130 7

440R-N23131 7

440R-N23132 7

440R-N23132S 7

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440R-N23134 7

440R-N23135 7

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MSR18T 53

MSR19E 58

MSR200 82

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MSR122E

safety relay 72

MSR123RT

safety relay 31

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MSR15D

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MSR16R/T

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 MSR19E 58
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MSR19E 59
MSR200 84
MSR23M 30
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Notes:

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