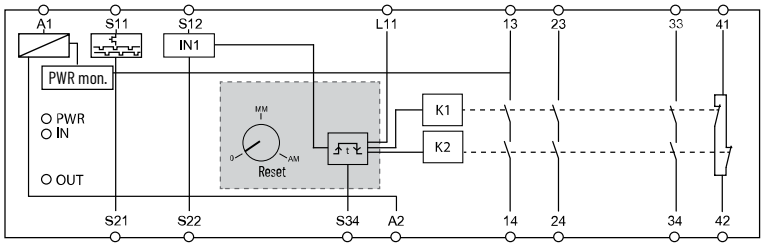
Internal Circuit Block Diagrams

The figures in this chapter show the internal circuit block diagrams of each safety relay.

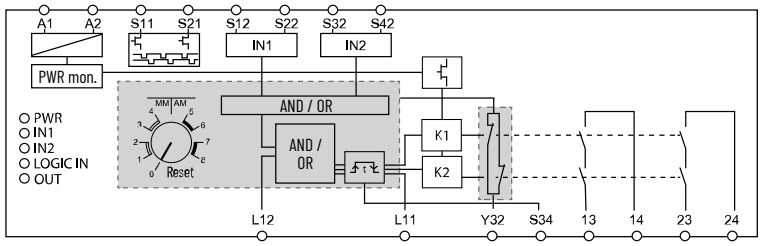
CI Safety Relay (Cat. No. 440R-S13R2)

Figure 37 - CI Safety Relay Circuit Diagram



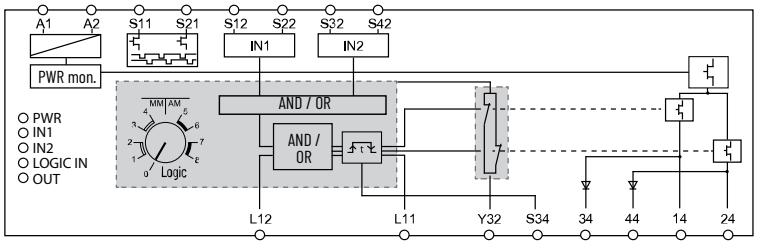
DI Safety Relay (Cat. No. 440R-D22R2)

Figure 38 - DI Safety Relay Circuit Diagram



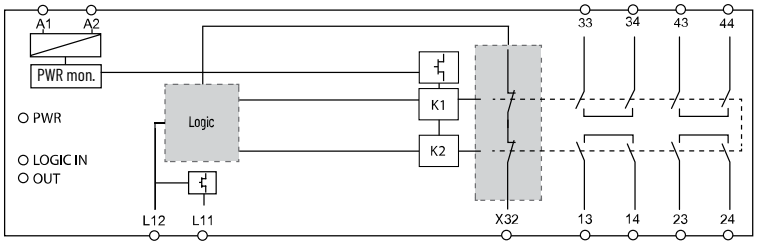
DIS Safety Relay (Cat. No. 440R-D22S2)

Figure 39 - DIS Safety Relay Circuit Diagram



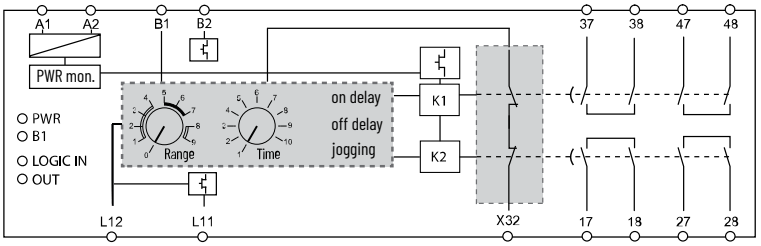
EM Safety Relay (Cat. No. 440R-EM4R2)

Figure 40 - EM Safety Relay Circuit Diagram



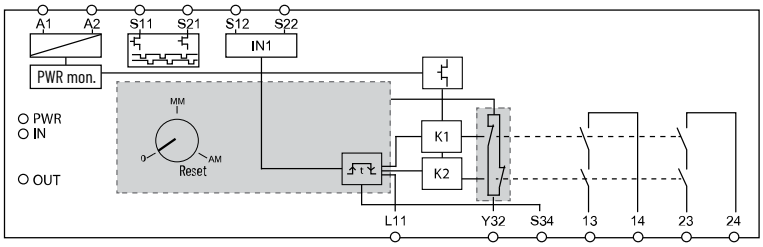
EMD Safety Relay (Cat. No. 440R-EM4R2D)

Figure 41 - EMD Safety Relay Circuit Diagram



SI Safety Relay (Cat. No. 440R-S12R2)

Figure 42 - SI Safety Relay Circuit Diagram



Application and Wiring Examples

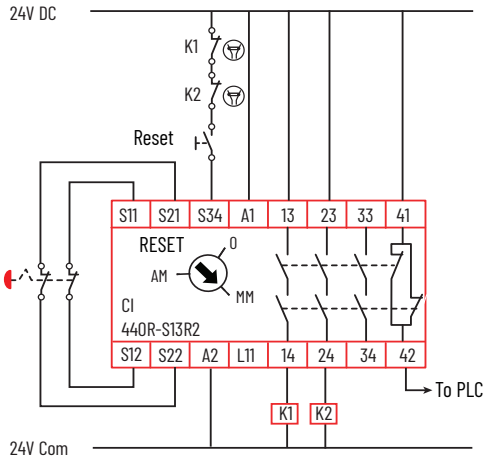
The application and wiring examples in this chapter show you how to put the inputs and outputs together to create an operating safety system. These circuit diagrams are examples; many features are interchangeable between safety relays.

Publication SAFETY-WD001 provides additional application and wiring diagrams.

CI Safety Relay (Cat. No. 440R-S13R2)

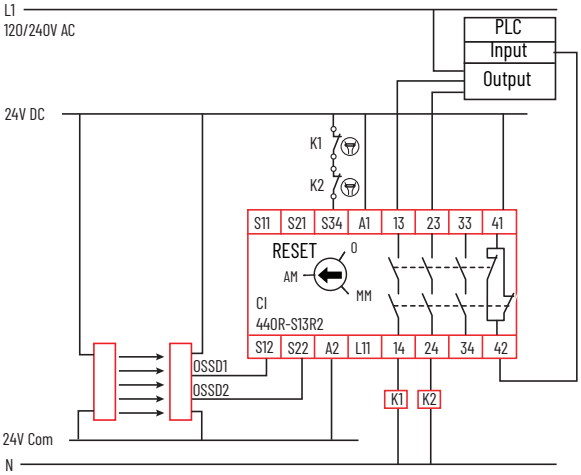
In the following image, the CI safety relay is monitoring a device (an E-stop push button) with mechanically operated contacts. The CI safety relay is configured for monitored manual (MM) reset. The output turns on if the E-stop is released and the Reset push button is pressed and released between 0.25...3 seconds. The CI safety relay monitors the status of the two output contactors, K1 and K2. If either fails to close their N.C. contacts, the CI safety relay does not reset. An auxiliary signal, terminals 41/42, is sent to the PLC when the E-stop is pressed.

Figure 43 - Mechanical Contacts with Monitored Manual Reset



The following image shows a CI safety relay monitoring a safety light curtain with two OSSD outputs. The CI safety relay is set to automatic/manual reset (AM). The auxiliary signal (terminals 41/41) informs the PLC that the safety system is off or on. The CI safety relay outputs connect to AC voltage loads. When the CI safety relay is on, the PLC can then turn on the K1 and K2 contactors.

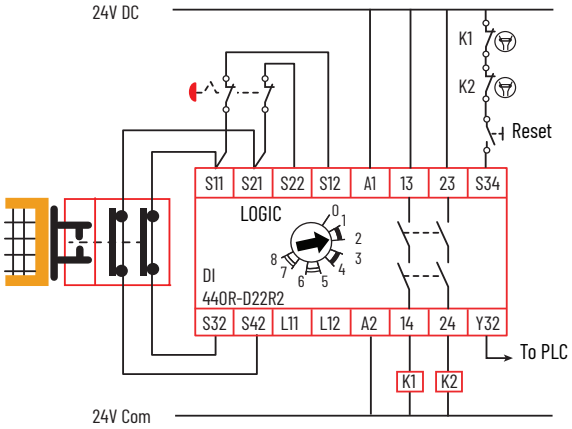
Figure 44 - With Device Using OSSD Outputs, Automatic Reset, AC Load Voltage



DI Safety Relay (Cat. No. 440R-D22R2)

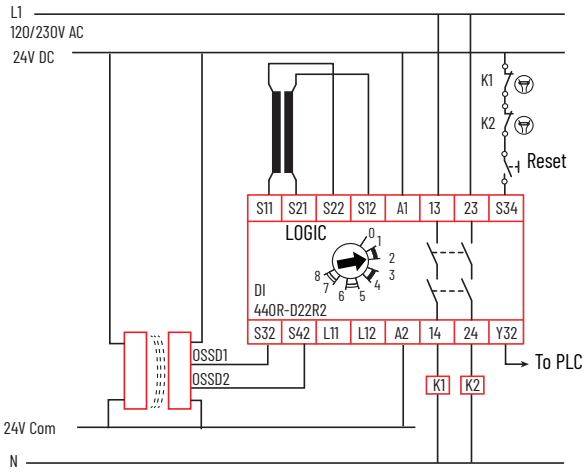
The DI safety relay in the following image monitors two devices having mechanical contacts and is set for monitored manual reset. With the two devices closed, the operator presses the Reset button to energize contactors K1 and K2. The DI safety relay verifies that contactors K1 and K2 are off by monitoring the mechanically linked normally closed contacts in the reset circuit. When the DI safety relay is off, the auxiliary signal at terminal Y32 turns on and reports the status to a PLC.

Figure 45 - With Two Devices with Mechanical Contacts and Monitored Manual Reset



In the following image, a DI safety relay monitors a safety mat and non-contact interlock with OSSD outputs. Make note of the specific wiring for the safety mat. Also, during configuration and for each power-up, the safety mat must be clear and the interlock closed. The DI safety relay must be configured for AND logic for the two inputs. The DI safety relay logic setting is 6: (IN1 AND IN2) OR L12 with automatic reset. The DI safety relay verifies that contactors K1 and K2 are off by monitoring the mechanically linked normally closed contacts in the S34 circuit. When the DI safety relay is off, the auxiliary signal at terminal Y32 turns on and reports the status to a PLC. Per ISO 13856-1, safety mat applications require a manual reset function. For fault detection purposes, all GSR safety relays used for safety mat control must be configured for monitored manual reset.

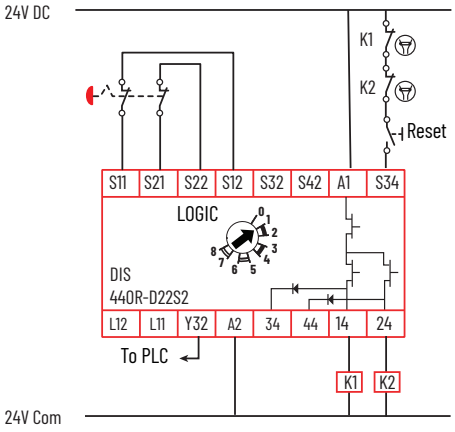
Figure 46 - With a Safety Mat and Device with OSSD Outputs, Monitored Manual Reset, AC Loads



DIS Safety Relay (Cat. No. 440R-D22S2)

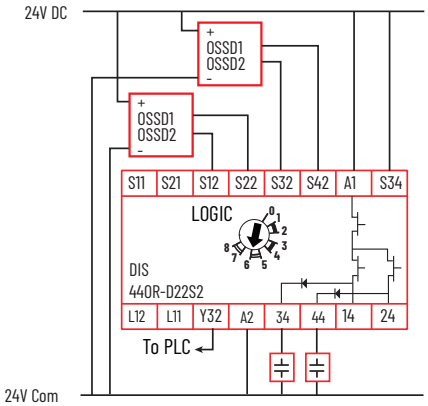
The following image shows the DIS safety relay with only one device. The DIS and DI safety relays can monitor one device by configuring the safety relay for OR logic. The DIS safety relay logic setting is 1: (IN1 OR IN2) OR L12 with monitored manual reset. The second input (terminals S32 and S42) requires no connection. With solid-state outputs, the contactors K1 and K2 must be 24V DC powered coils. The DIS safety relay verifies that contactors K1 and K2 are off by monitoring the mechanically linked normally closed contacts in the S34 circuit. When the DIS safety relay is off, the auxiliary signal at terminal Y32 turns on and reports the status to a PLC.

Figure 47 - Single Input, Monitored Reset



The DIS safety relay monitors two devices with OSSD outputs in the following image. The DIS safety relay logic setting is 6: (IN1 AND IN2) OR L12 with automatic reset. The output terminals 34 and 44 are designed to tolerate higher capacitance loads (but lower resistive load) as compared to terminals 14 and 24.

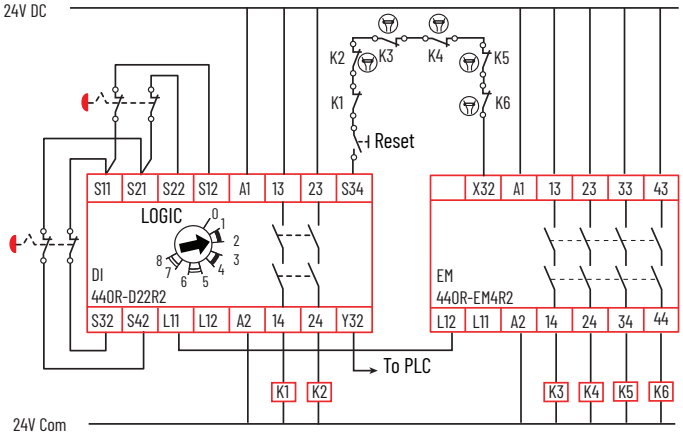
Figure 48 - High Capacitive Load



EM Safety Relay (Cat. No. 440R-EM4R2)

The EM safety relay in the following image expands the number of outputs of the DI safety relay. The single wire safety signal from terminal L11 to L12 instructs the EM safety relay to turn on and off. The EM safety relay outputs mimic the DI safety relay outputs. The DI safety relay monitors contactors K1...K6 and the status of the EM safety relay by sourcing the reset signal from the X32 terminal on the EM safety relay.

Figure 49 - Expansion of Immediate Safety Outputs

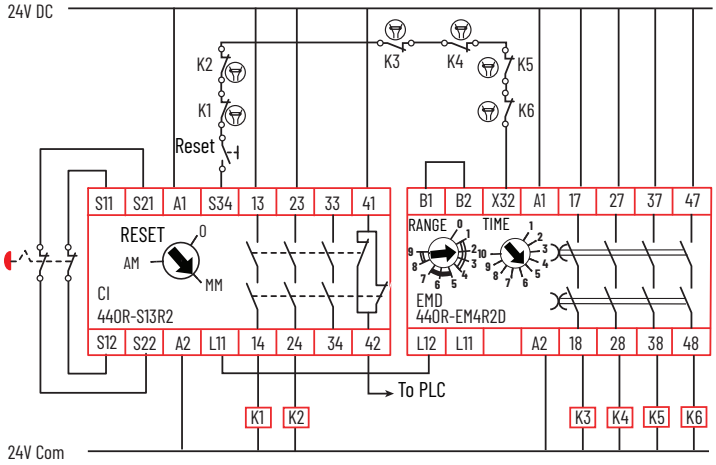


EMD Safety Relay (Cat. No. 440R-EM4R2D)

The EMD safety relay in the following image is configured for a 5 second off-delay. The single wire safety signal from terminals L11 to L12 instructs the EMD safety relay to turn on and off. When the E-stop is pressed, the CI safety relay turns off immediately and the EMD safety relay turns off 5 seconds later. The CI safety relay monitors contactors K1...K6 and the status of the EMD safety relay by sourcing the reset signal from the X32 terminal on the EMD safety relay.

In this example, the jumper from B1 to B2 makes the EMD safety relay retriggerable. If the E-stop is released and the reset is pressed within the 5 second delay time, the outputs of the EMD safety relay do not turn off because the internal timer is retriggered.

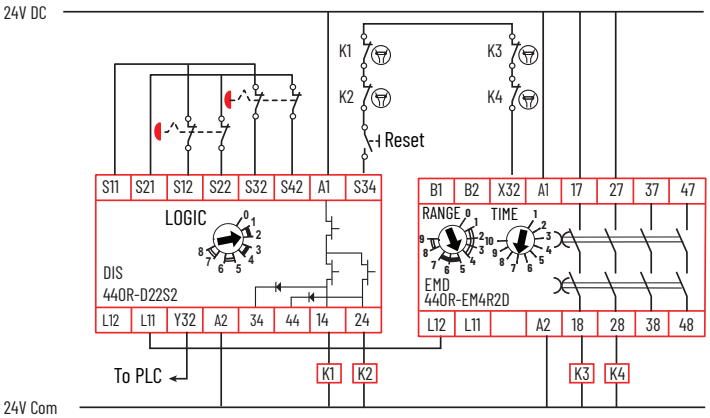
Figure 50 - EMD Safety Relay - Off Delay



The following image shows the EMD safety relay that is configured for a 2.1 second on-delay. The single wire safety signal from terminals L11 to L12 instructs the EMD safety relay to turn on and off. When the Reset button is pressed, the DIS safety relay outputs turn on immediately. After a 2.1 second delay, the EMD safety relay outputs turn on.

The DIS safety relay monitors contactors K1...K4 and the status of the EMD safety relay by sourcing the reset signal from the X32 terminal on the EMD safety relay.

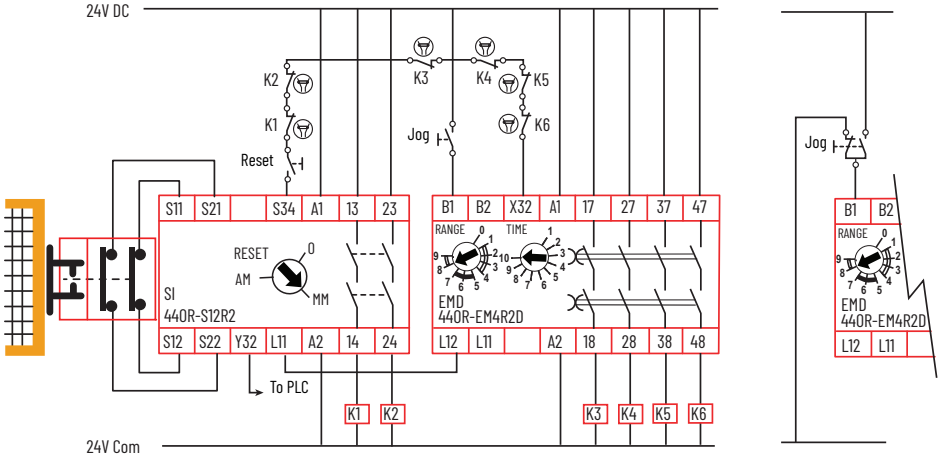
Figure 51 - EMD Safety Relay - On Delay



The EMD safety relay in the following image is configured for a maximum of a 100 second jog. The single wire safety signal from terminals L11 to L12 enables the EMD safety relay when the safety gate is closed and the SI safety relay is reset. When enabled, press and hold closed the Jog switch to turn on the EMD safety relay outputs. If the Jog button is released before the 100 second time, the EMD safety relay outputs turn off. If the Jog button is held longer than 100 seconds, the EMD safety relay outputs only turn on for 100 seconds.

For most applications, the jog switch can be connected directly to 24V through a normally open switch or contact. A Form C contact can be used for improved noise immunity; connect the normally closed contact to 0V.

Figure 52 - EMD Safety Relay - Jog



SI Safety Relay (Cat. No. 440R-S12R2)

The SI safety relay monitors a gate interlock with mechanical contacts in the following image. The SI safety relay is configured for automatic reset. When the gate is closed, the SI safety relay outputs turn on if contactors K1 and K2 are already off. Press the Start button to turn on contactors K1 and K2.

Figure 53 - SI Safety Relay Example