The CR30 as an Alternative to the Mat Manager

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Safety mat controllers detect a presence on a safety mat, as well as short- and open- circuits, turning off the safety outputs under any of those conditions. When interfaced properly, the machine or hazardous motion will receive a stop signal. For applications involving multiple safety mats, there are a range of control units available that monitor the status of the individual mats or areas of mats and that enable quick fault detection/repair and identification of actuated areas. This publication compares two mat controller options—the Allen-Bradley® Guardmaster® Mat Manager and the CR30 software-configurable safety relay—in terms of setup and performance.

In many instances, a CR30 (440C-CR30-22BBB) based Safety Mat system can provide an excellent alternative to a Mat Manager (440F-028XX) based Safety Mat system. This is especially true where the plug-in safety mat/IP65 enclosed control packaging of the 440F is not required or preferred.

In a typical application, stepping on any of several mats that are connected to the control system results in the control stopping a dangerous motion by removing power. Figures 1 and 2 are basic diagrams of two such systems:

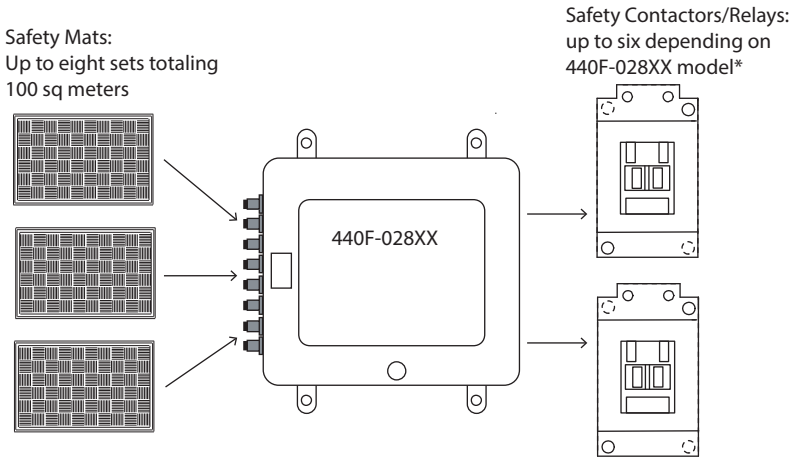
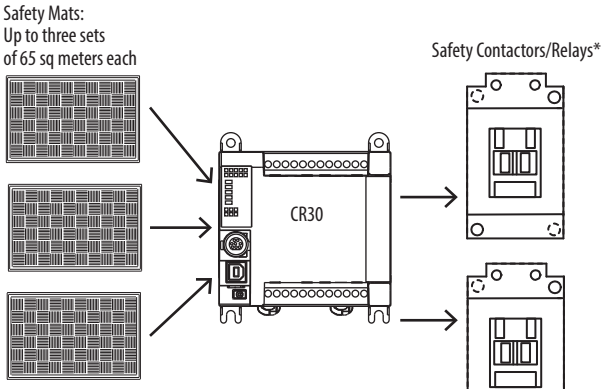


Figure 1 - 440F-028XX based system



* If more than two contactors are necessary, the CR30 can support up to 10 GSR EM Expansion Modules per each Single Wire Safety output (outputs 20 and 21). Each EM can drive up to four safety contactors. See the CR30 User Manual (440C-UM001_-EN-P) for detailed CR30 output specifications/capabilities.

Figure 2 - CR30 based system

An important consideration in any such safety function is the safety distance. In simplest terms, this is the minimum distance from the guarded hazard that a person must be detected in order for the hazard to cease before the person reaches it. This distance depends largely on how quickly the safety system responds to the approaching person.

In the case of the 440F-028XX system, the total response time is 80 ms. This is the sum of the response time of the 440F-028XX (35 ms) and the contactor drop out time. Assuming the contactor is a 100S or 700CF "EJ" electronic coil this drop out time is 45 ms (35 ms + 45 ms = 80 ms total).

The CR30 system is slower. The total response time for the CR30 system is 115 ms. This is the sum of the CR30/Safety Mat processing time (25 ms), the CR30 Logic processing time (45 ms), and the contactor drop out time (45 ms) (25 ms + 45 ms + 45 ms = 115 ms). The CR30 based system total response time is 35 ms longer.

Based on the approach speed (1600 mm/sec) used for safety distance calculations as prescribed by EN 13856 (Safety of machinery — Pressure-sensitive protective devices — Part 1: General principles for design and testing of pressure-sensitive mats and pressure-sensitive floors, the safety distance for the CR30 based system is 1600 X 0.35 = 56 mm or 2.25 inches greater than the 440F-028XX based system.

Another related difference is the maximum total safety mat area each control system can monitor. The 440F-028xx system can monitor a maximum of 100 square meters of safety mats. The CR30 system can monitor a maximum of three 65 square meters of safety mats or 195 square meters total.

Each system can provide multiple safety outputs. The 440F can provide a maximum of six safety outputs while the CR30, using the EM expansion module, can provide four safety outputs per EM and control a total of ten EMs.

Beyond this, the CR30 is a much more flexible system able to be easily configured for different applications, such as the integrating E-Stops. For instance, a single CR30 can be configured to provide two or three independent safety mat zones.

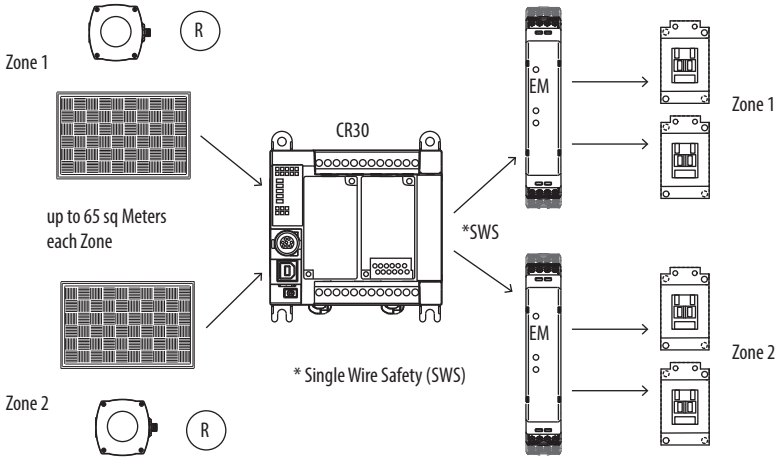


Figure 3 - Two independent zones (separate E-stops and resets)

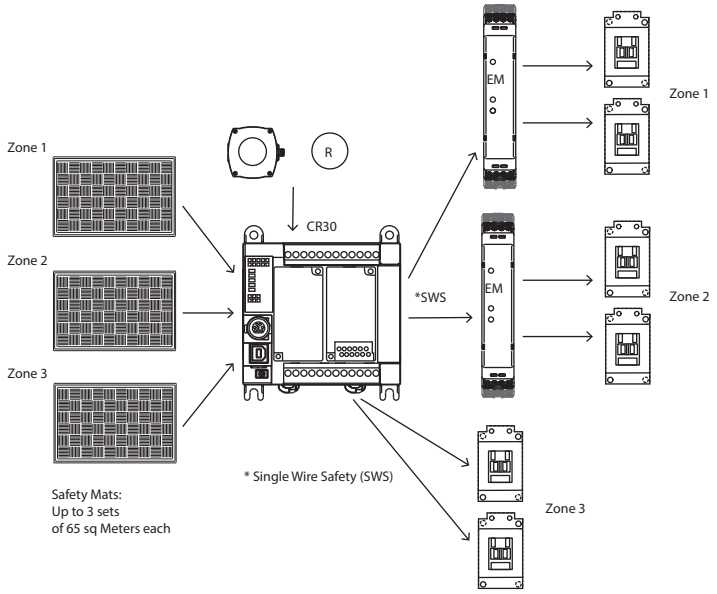


Figure 4 - Three independent zones global E-stop common reset

A CR30 based system can also be integrated into a larger control system using its standard Modbus capability through the 440C-ENETR communications module.

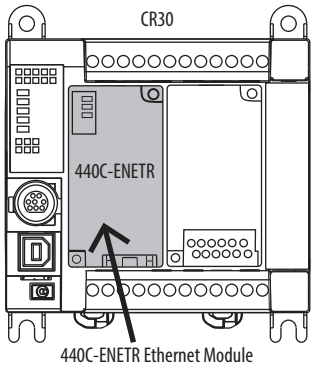


Figure 5 - Optional Ethernet connectivity

The Ethernet module can be used to provide status information or diagnostic data.

Table 1 - Comparison of selected specifications and features

Functional Safety Data	440F-028XX Mat Manager	440C-CR30-22BBB (CR30)	440R-EM4R2 (EM)
SIL Claim Limit in accordance with IEC/EN 61508	SIL CL 2	SIL CL 3	SIL CL 3
Performance Level in accordance with ISO 13849-1	PLd	Ple	PLe
Category in accordance with ISO 13849-1	3	4	4
Enclosure/Environmental			
Packaging	IP65, Steel Enclosure	IP20, DIN mount	IP20, DIN mount
Power Supply/Operating Voltage	depending on model: 24V DC 115V AC 115V AC or 230V AC	24V DC, SELV/PELV (+10%, -15%)	24V DC, SELV/PELV (+10%, -15%)
Safety Mat Connections	depending on model: Eight four-pin micro Eight cable grips	wire to terminals	wire to terminals
Safety Outputs	depending on model:	depending on Mat Inputs/Zones	
Type	6 N.O Isolated Contacts or 2 N.O Isolated Contacts	1 Mat Input/Zone: 6 N.O., Solid State, sourcing or 2 Mat Inputs/Zones: 4 N.O., Solid State, sourcing or 3 Mat Inputs/Zones: 2 N.O., Solid State, sourcing	4 N.O. Isolated Contacts
Current Ratings	4 A/250V AC, 3 A/30V DC	0.5 A/24V DC, Sourcing	1.5 A/250V AC, 2 A/30V DC
Communication/Connectivity	depending on model: none or 1 N.C Aux. contact or 1 N.O. Aux. contact	1 N.C, Solid State, sourcing Aux. two wire safety (SWS) Ethernet (with optional plug-in module	1 N.C, Solid State, sourcing Aux. Single Wire Safety (SWS)
Safety Mats			
Maximum Number of Zones	1	3	NA
Maximum Monitored Area per Zone	100 square meters	65 square meters	NA
Maximum Monitored Area per Zone	100 square meters	195 (3 Zones X 65) square meters	NA

* Up to 10 EMs can be controlled by each CR30 SWS.

Rockwell Automation maintains current product environmental information on its website at http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page.

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