

NHP SAFETY REFERENCE GUIDE

440C



SAFETY FUNCTION DOCUMENTS

SafeZone Scanner with a
Configurable Safety Relay



Authorised
Distributor

Safety Function Documents: 440C

Safety-Related Stop Initiated by a SafeZone Scanner

Products: Guardmaster 440C-CR30 Configurable Safety Relay, 442L SafeZone Laser Scanner, 100S-C Safety Contactors

Safety Rating: CAT. 3, PLd to ISO 13849-1: 2008



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Introduction

This safety function application technique explains how to wire and configure a Guardmaster® 440C-CR30 configurable safety relay to monitor both an E-Stop and a SafeZone™ laser scanner. If an object intrudes into the SafeZone laser-scanner sensing field, if the E-Stop is actuated or if a fault is detected in the monitoring circuit, the 440C-CR30 relay de-energizes the final control devices, in this case, a pair of 100S-C safety contactors. The safety scanner can be used in either vertical or horizontal applications to detect the intrusion of personnel or objects into the sensing field. You configure the safety scanner's warning and safety fields by using the Safety Configuration and Diagnostics (SCD) software supplied with each scanner.

Important User Information

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

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

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

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

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

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Important User Information cont

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).

Contact NHP to find out more about our safety risk assessment services.

General Safety Information

Contact Rockwell Automation to find out more about our safety risk assessment services.

IMPORTANT This application example is for advanced users and assumes that you are trained and experienced in safety system requirements.



ATTENTION: Perform a risk assessment to make sure all task and hazard combinations have been identified and addressed. The risk assessment can require additional circuitry to reduce the risk to a tolerable level. Safety circuits must take into consideration safety distance calculations, which are not part of the scope of this document.

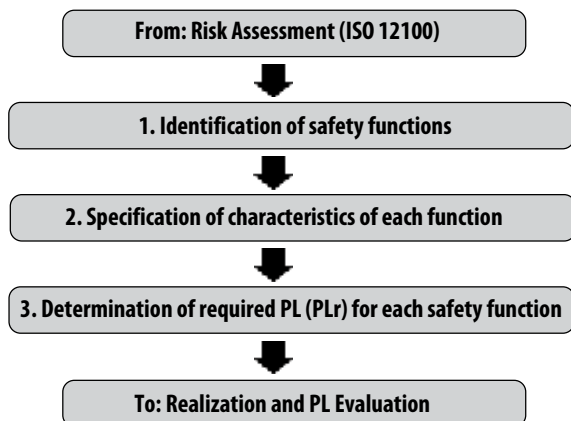
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Safety Function Realization: Risk Assessment

The required performance level is the result of a risk assessment and refers to the amount of the risk reduction to be carried out by the safety-related parts of the control system. Part of the risk reduction process is to determine the safety functions of the machine. In this application, the performance level required (PLr) by the risk assessment is Category 3, Performance Level d (CAT. 3, PLd), for each safety function. A safety system that achieves CAT. 3, PLd, or higher, can be considered control reliable. Each safety product has its own rating and can be combined to create a safety function that meets or exceeds the PLr.



Area Scanner Single Zone Safety Function

This application technique includes two safety functions:

1. Safety-related stop function initiated by presence in the protective area of the safety scanner.
2. Safety-related stop function initiated by actuation of an E-Stop button.

Safety Function Requirements

Interrupting the configured sensing zone of the laser scanner stops and prevents hazardous motion by removing power to the motor. The motor coasts to a stop (Stop Category 0). When the scanner is reset, hazardous motion and power to the motor do not resume until a secondary action occurs—the Start button is depressed. A fault at the laser scanner is detected before the next safety demand. The safe distance from the location of the laser scanner to the hazard must be established per ISO 13855:2010 such that hazardous motion must be stopped before the user can reach the hazard.

Pressing the E-Stop button stops hazardous motion by removing power to the motor. Releasing the E-Stop does not restart hazardous motion. Once the Reset button is pressed and all faults are cleared, the system is enabled to accept a separate Start command.

The safety functions in this application technique each meet the requirements for Category 3, Performance Level d (CAT. 3, PLd), per ISO 13849-1 and control reliable operation per ANSI B11.19.

Functional Safety Description

Hazardous motion is stopped or prevented by interrupting the sensing field of the SafeZone laser scanner. The laser scanner and the E-Stop are connected to the Guardmaster 440C-CR30 software configurable safety relay. The 440C-CR30 relay provides two solid-state safety outputs that control power to the 100S-C contactor coils. Whenever the 440C-CR30 relay disables its outputs, hazardous motion is stopped. When all safety input signals are correct, no faults are detected, and the Reset button is pressed, the 440C-CR30 is enabled to accept a separate Start command.

The E-Stop is connected to the 440C-CR30 relay inputs EI_00 and EI_01, which uses pulse-checking to monitor the EStop for actuation and faults. Whenever the E-Stop is actuated, the 440C-CR30 relay disables its safety outputs and hazardous motion is stopped. When all safety input signals are correct, no faults are detected, and the Reset button is pressed (for 0.25...3.0 seconds), then released, the 440C-CR30 relay re-energizes its safety outputs EO_18 and EO_19 providing power to the contactor coils.

In summary, when the laser scanner is blocked or the E-Stop is actuated, the contactors drop out. When the laser scanner is unblocked, the E-Stop is released, and the reset button is pressed, the contactors are energized.

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Bill of Material

This application uses these products.

Cat. No.	Description	Quantity
442L-SFZNMZ	SafeZone multizone scan head and I/O module	1
442L-CSFZNMZ-10	10M prewired 13 conductor memory module	1
442L-ACUSB-2	2 meter RS232 programming cable with USB connector	1
440C-CR30-22BBB	Guardmaster 440C-CR30 software configured safety relay, PLe SIL 3, 22 safety I/O, embedded serial port, USB programming port, 2 plug-in slots, 24V DC	1
800F-1YP8	800F 1-hole enclosure E-Stop station, plastic, PG, twist-to-release 60 mm, non-illuminated, 1 N.O. / 2 N.C.	1
800FM-G611MX10	800F push button, metal, guarded, blue, R, metal latch mount, 1 N.O. contact, 0 N.C. contacts, standard	1
100S-C09EJ23BC	Modular Control System (MCS) 100S-C safety contactor, 9 A, 24V DC (with electrical coil), bifurcated contact	2

Setup and Wiring

For detailed information on installing and wiring, refer to the publications listed in the Additional Resources on the back cover.

System Overview

INFORMATION: A multizone scanner, configured as a singlezone scanner, was used in this safety function.

The Guardmaster 440C-CR30 software configurable safety relay monitors the input from the SafeZone laser scanner control and the E-Stop. The laser scanner control provides two PNP outputs that are de-energized when an object interrupts the field of view.

When an intrusion in the SafeZone sensing area is detected, a pair of 100S-C safety contactors, K1 and K2, are deenergized.

The contactors are controlled by the 440C-CR30 relay. These are wired in a redundant configuration and are tested on startup for faults.

These de-energized contactors remove power to the motor and the motor coasts to a stop (Stop Category 0). When the laser scanner control returns to the non-interrupted state, the contactors in the output do not energize until the system is reset by a momentary push button.

The 440C-CR30 relay also monitors the E-Stop circuit for faults. Open-circuit faults, shorts to 24V DC, shorts to GND, output faults, and cross-channel faults are detected. When a fault is detected, or when the E-Stop is actuated, the 440CCR30 relay responds by de-energizing the 100S-C contactor coils, removing power to the motor. The motor coasts to a stop (Stop Category 0).

Two N.C. contacts, one from each of the safety contactors, are connected as part of the reset circuit. The outputs of the 440C-CR30 relay can only be energized if both safety contactors are in a proper de-energized state.

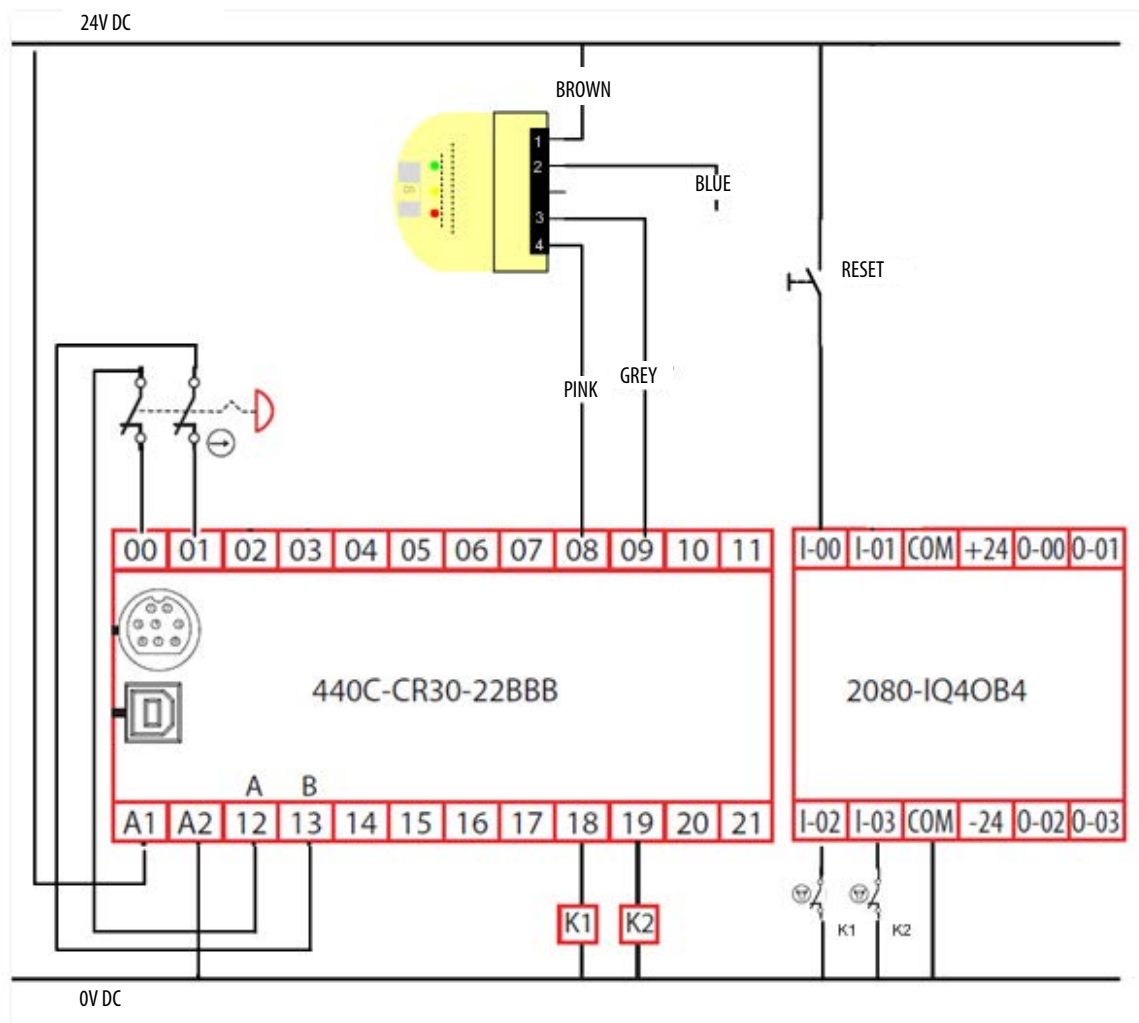
The system is to be designed such that no single fault results in the safety system failing to perform its safety function. A single fault is detected before the next demand on the safety system. The system cannot be reset until the fault is corrected.

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Electrical Schematic



Configuration

Configure the SafeZone laser scanner by using the Safety Configuration and Diagnostics (SCD) software supplied with each scanner. SCD software, revision 3.0.0, is used in this application technique.

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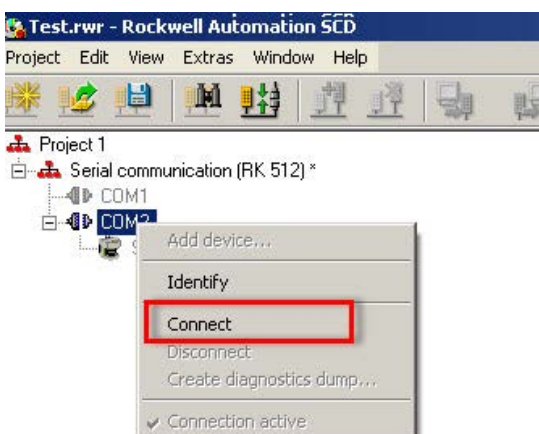
Configure the SafeZone Laser Scanner

Follow these steps to configure the SafeZone laser scanner.

1. Connect the scanner's USB cable to the PC and verify that the correct Com port is set on the PC.
TIP This example uses the Com2 port.
2. Start the SCD software.



3. To go online, locate your project and expand Serial communication.
4. Right-click Com2 and choose Connect.



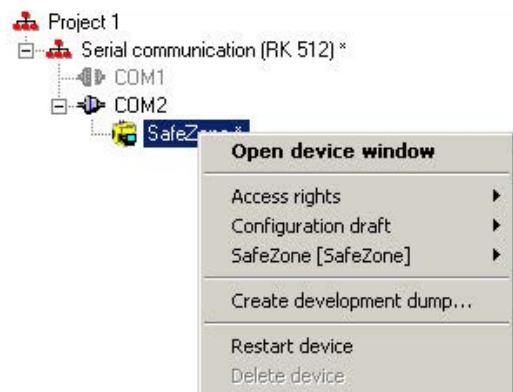
The Configuration software searches for and connects to the scanner.

5. Click Continue.

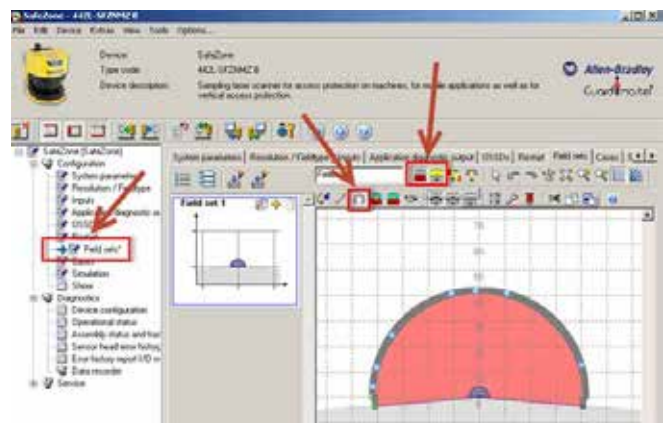
When the connection is made, the scanner name appears in Blue.



6. To configure the scanner, right-click the scanner and choose Open device window.



The device window opens. This window provides the Arc drawing tool, which lets you configure the protective and warning fields for your facility.



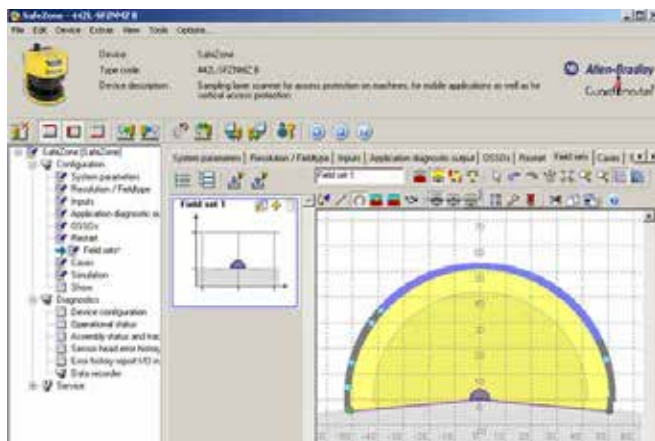
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Configure the SafeZone Laser Scanner cont

- To configure the protective and warning field, use the Arc drawing tool.



- When you finish configuring the protective and warning field, click Transfer to transfer the information to the scanner.

The Transfer dialog box appears.



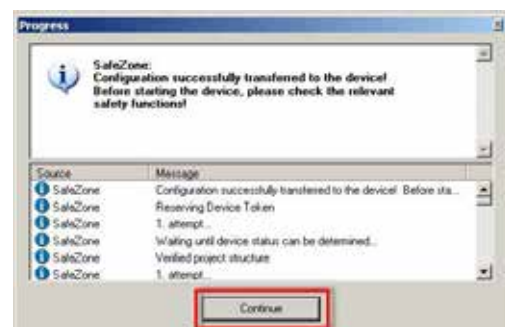
- Click Yes.
A Progress dialog box appears and displays warning notices for the parameters you set for the scanner.



- Review the warning notices, make any necessary adjustments to the confirmation, and when you are satisfied with the results, click Continue. A configuration window appears.



- Review the configuration details, and if you are satisfied that the configuration meets your requirements, click Release. A second Progress dialog box appears and displays information about the transfer progress.



- Once the transfer is complete, click Continue.
The Progress dialog box closes, and the application returns you to the main window of the SCD software.

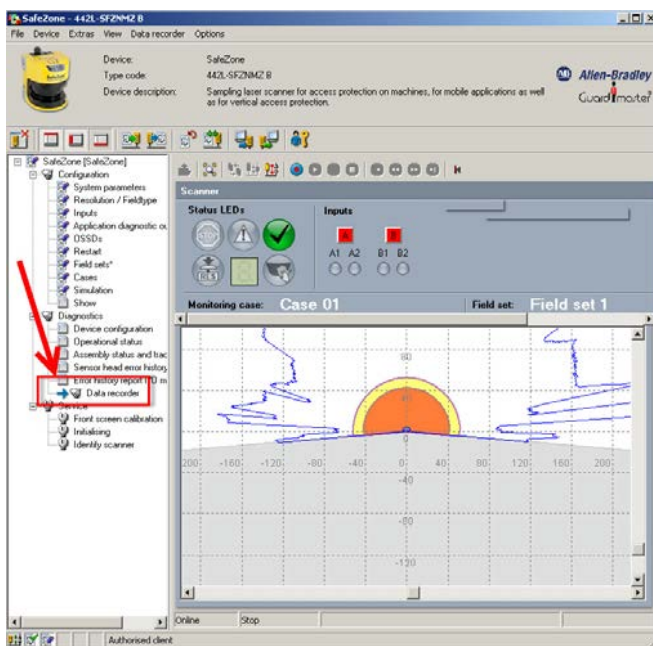
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Configure the SafeZone Laser Scanner cont

- To verify that your programmed field is running, select the Data-Recorder in the Diagnostic group.



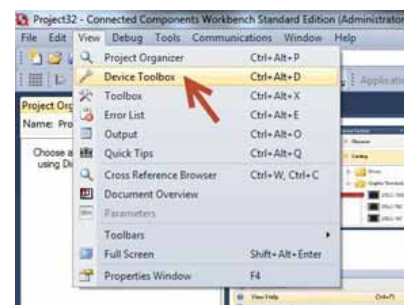
The SCD software displays a real-time view of the status of the warning and protective fields you configured.

Configure the 440C-CR30 Relay

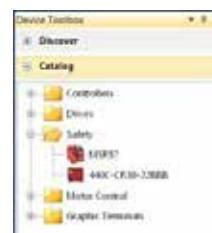
The 440C-CR30 relay is configured by using Connected Components Workbench™ software, release 6.01 or later. A detailed description of each step is beyond the scope of this document. Knowledge of the Connected Components Workbench software is assumed.

Follow these steps to configure the Guardmaster 440C-CR30 relay by using the Connected Components Workbench software.

- In Connected Components Workbench software, choose View and then Device Toolbox.



- Select 440C-CR30-22BBB.



- In the Project Organizer, double-click the Guardmaster_440C_CR30 relay.



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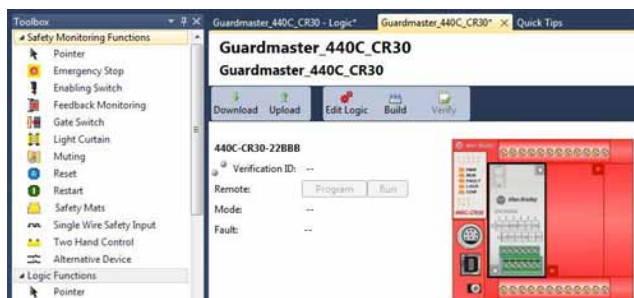
Configure the 440C-CR30 Relay cont

- To add the plug-in I/O module called for in the schematic, right-click the left plug-in module space and choose the 2080-IQ4OB4 module.



TIP: The I/O module is shown in standard gray because it is not a safety I/O module. That is not a problem in this application because the standard I/O module is not used to connect safety signals. Inputs such as Feedback and Reset button are not considered strict, safety signals. By using the standard I/O module for these non-safety signals, you can reserve the limited number of safety inputs and outputs for true safety signals.

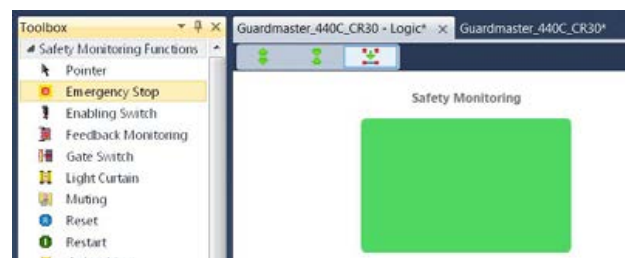
- Click Edit Logic to open the Connected Components Workbench Workspace.
- From the View pull-down menu, choose Toolbox.



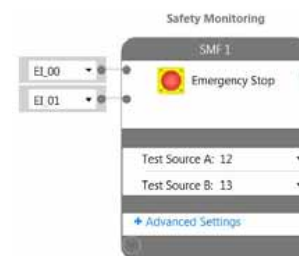
Configure the Inputs

Follow these steps to configure the inputs.

- Select Emergency Stop.

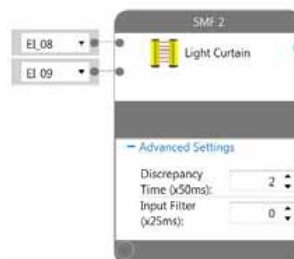


- Drag Emergency Stop to the green rectangle under Safety Monitoring and release it.



Connected Components Workbench software has assigned input terminals EI_00 and EI_01 on the left side of the block. The software automatically assigns the next unused terminal for a newly added device. The terminals can be changed to any unused input terminal, but in this case, leave the default. Because an E-Stop is an electro-mechanical device, the software has automatically added terminals 12 and 13 as test sources. Numbers 12 and 13 refer to multipurpose terminals 12 and 13 (MP_12 and MP_13).

- To add the Scanner monitoring block, use a Light curtain block for the scanner because it also uses OSSD type outputs.
- Choose inputs EI_08 and EI_09 for the scanner.



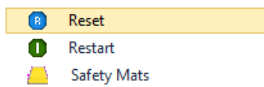
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Configure the Inputs cont

5. Add a Reset.



6. Change the Reset input to Plug-In input P1_00 to complete the configuration of the inputs.

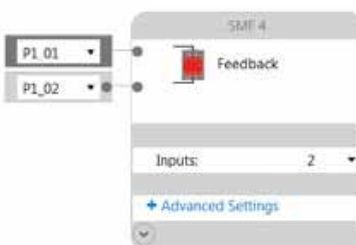
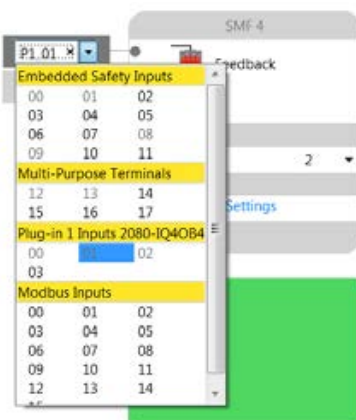


7. Add a Feedback Monitoring input.



The software assigns it to the next available input terminal, which in this case is EI_02.

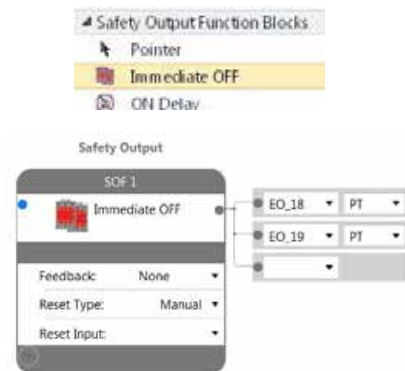
8. Change the number of inputs to 2, and use the Input pull-down menu to select plug-in inputs P1_01 and P1_02 instead.



Configure the Outputs

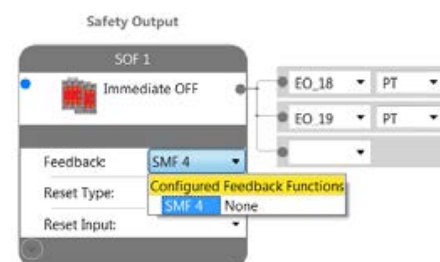
Follow these steps to configure the safety and diagnostic outputs

1. Select and drag the Immediate OFF safety output function block to the top position in the Safety Output column of the Workspace.

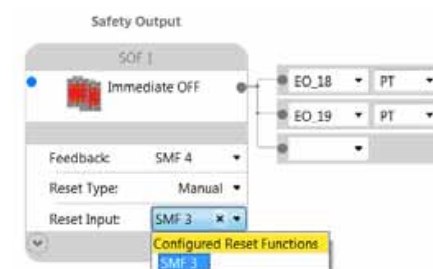


The software automatically assigns two outputs to the next available safety outputs, which in this case are EO_18, and EO_19, and leaves one blank, unassigned output. One, two, or three outputs may be configured. Because we are using EO_18 and EO_19 as our outputs, no I/O changes are required.

2. Change the Feedback input to SMF 4.



3. Change the Reset Input to SMF 3.



4. Configuration of the safety outputs is complete.

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Configure the Logic

The logic ties the inputs to the outputs, making the outputs respond to the inputs in the manner required.

1. Add an AND function to the Logic Level A.
2. Click the blue dot on the E-Stop input block, and notice that the dot turns gray.
3. Click the blue dot on the LLA1 block to connect the blocks.
4. Connect the output of the Light Curtain block SMF 2 to LLA1.
5. Connect the output of the LLA1 block to the input of the Immediate OFF block SOF 1.
 The software automatically adds the Pass Through blocks because no additional Logic Functions are being used.

The completed logic looks like this.



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Configure the Status Indicators

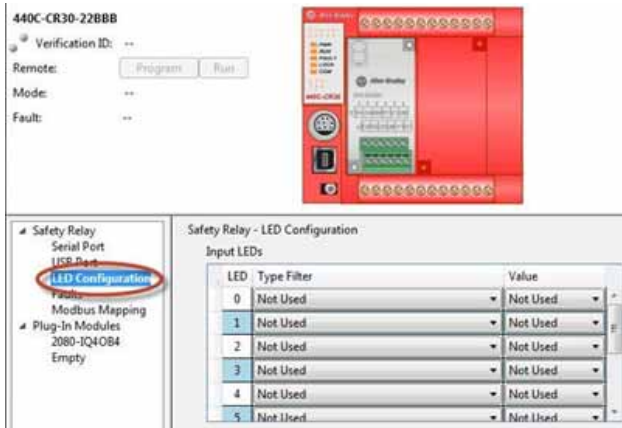
The 440C-CR30 relay lets you configure ten input status indicators and six output status indicators. These status indicators can be very helpful while testing the system during installation and commissioning. They are also useful for monitoring the system in operation.

To configure LED status indicators to show the status of the E-Stop (Terminals 00 and 01), and SafeZone laser scanner, follow these steps.

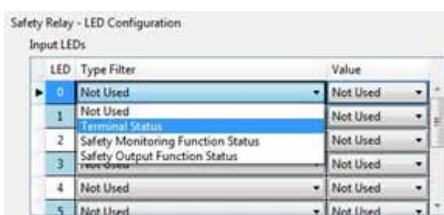
1. Click Guardmaster_440C_CR30.



2. Select LED configuration.



3. Choose Terminal Status as the Type Filter for LED 0.



4. Select Terminal 00 as the Value for LED 0.

LED	Type Filter	Value
0	Terminal Status	Terminal 00
1	Terminal Status	Terminal 00
2	Terminal Status	Terminal 08
3	Terminal Status	Terminal 09
4	Safety Monitoring Function Status	SMF 3
5	Safety Monitoring Function Status	SMF 4

In this example, the E-Stop inputs on are displayed on LED 0 and 1. The Scanner inputs are displayed on LED 2 and 3. LED 4 and 5 display the status of the Reset and Feedback monitoring blocks.

5. Configure the remaining Input LED status indicators as shown.
6. Configure the Output LED status indicators as shown.

LED	Type Filter	Value
0	Terminal Status	Terminal 18
1	Terminal Status	Terminal 19
2	Safety Output Function Status	SOF 1
3	Not Used	Not Used
4	Not Used	Not Used
5	Not Used	Not Used

K1 Coil
K2 Coil
E-Stop SOF

Confirm the Validity of the Build

Follow these steps to confirm the validity of the logic by using the Build feature in Connected Components Workbench software.

1. Click Guardmaster_440C_CR30 in the bar above the Workspace.
2. Click Build.



A Build Succeeded message confirms that the configuration is valid.



If an error or omission is discovered during a build, a message is displayed that details the error so that it can be corrected. After you correct the error, you need to perform the build again.

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Save and Download the Project

Follow these steps to save and download the project.

1. From the File menu, choose Save as to save the project.

INFORMATION: Saving the project with a new name closes the workspace windows.

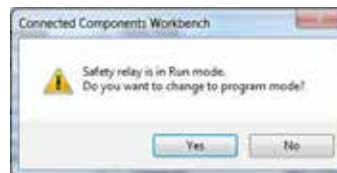
2. In the Project Organizer window, double-click Guardmaster_440C_CR30 to open the workspace.
3. Power up the 440C-CR30 safety relay.
4. Connect the USB cable to the 440C-CR30 relay.
5. Click Download.



6. In the Connection Browser, expand the AB_VBP-1 Virtual Chassis and select the Guardmaster 440C-CR30-22BBB.



7. Click OK.
8. Click Yes to change from Run to Program mode.



9. When the download is complete, click Yes to change from Program to Run mode.



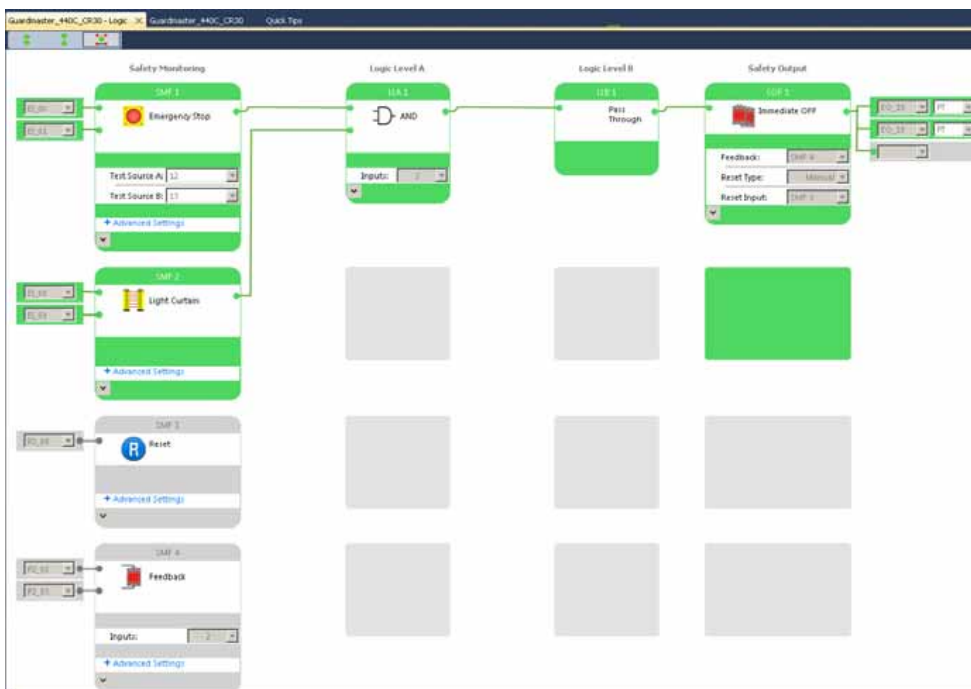
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Save and Download the Project cont

10. Click Edit Logic to see the online diagnostics.



Green indicates that a block is True or that an input or output terminal is ON. Flashing green indicates that a Safety Output Function is ready to be Reset.

The online diagnostics mode of the 440C-CR30 relay can be very helpful during the verification process.

11. Review the information in Calculation of the Performance Level on page 24 and Verification and Validation Plan on page 26 before proceeding with Verification of the Configuration on page 29.

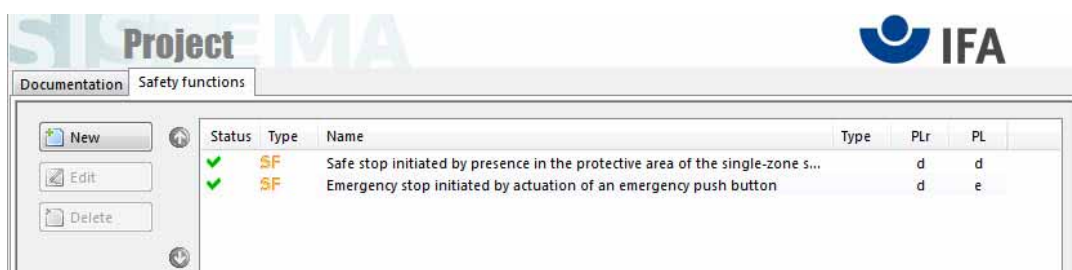
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 Safety Rating: CAT. 3, PLd to ISO 13849-1: 2008

Calculation of the Performance Level

When properly implemented, these safety functions can achieve a safety rating of Category 3, Performance Level d (CAT. 3, PLd), according to ISO 13849-1: 2008, as calculated by using the SISTEMA software PL calculation tool.



Status	Type	Name	Type	PLr	PL
✓	SF	Safe stop initiated by presence in the protective area of the single-zone s...		d	d
✓	SF	Emergency stop initiated by actuation of an emergency push button		d	e

The Performance Level and Category achieved by each subsystem of the SafeZone laser scanner safety function, as calculated by SISTEMA, is shown below.



Status	Type	Name	PL	PFH [1/h]	CCF score	DCavg [%]	MTTFd [a]	Category	Requirements of the categ
✓	SB	Presence Sensing: SafeZone 442L S	d	4,46E-7	not relevant	not relevant	not relevant	3	fulfilled
✓	SB	Software Configurable Safety Relay: 440C-CR30	e	1E-8	not relevant	not relevant	not relevant	4	fulfilled
✓	SB	100S Contactors	e	9.05E-10	65 (fulfilled)	99 (High)	2500 (High)	4	fulfilled

The Performance Level and Category achieved by each subsystem of the emergency stop safety function, as calculated by SISTEMA, is shown below.



Status	Type	Name	PL	PFH [1/h]	CCF score	DCavg [%]	MTTFd [a]	Category	Requirements of the categ
✓	SB	Estop	e	2.47E-8	65 (fulfilled)	99 (High)	100 (High)	3	fulfilled
✓	SB	Software Configurable Safety Relay: 440C-CR30	e	1E-8	not relevant	not relevant	not relevant	4	fulfilled
✓	SB	100S Contactors	e	9.05E-10	65 (fulfilled)	99 (High)	2500 (High)	4	fulfilled

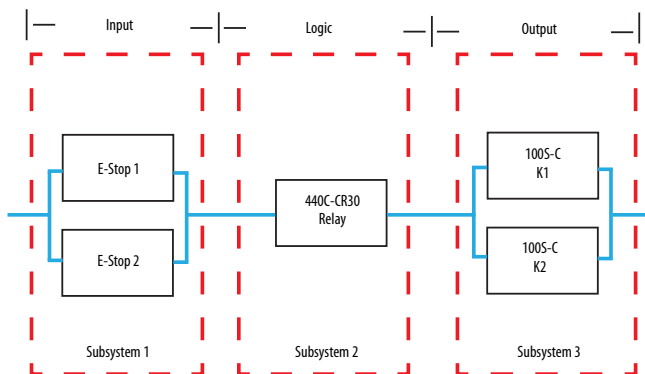
Safety Function Documents: 440C

Safety-Related Stop Initiated by a SafeZone Scanner

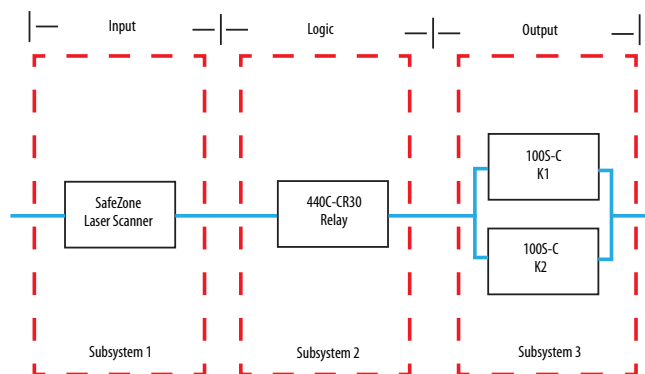
Products: Guardmaster 440C-CR30 Configurable Safety Relay, 442L SafeZone Laser Scanner, 100S-C Safety Contactors
Safety Rating: CAT. 3, PLd to ISO 13849-1: 2008

Calculation of the Performance Level cont

The E-Stop safety function can be modeled as follows.



The presence-sensing SafeZone laser scanner safety function can be modeled as follows.



Because these are electro-mechanical devices, the safety contactor data includes the following:

- Mean Time to Failure, dangerous (MTTFd)
- Diagnostic Coverage (DCavg)
- Common Cause Failure (CCF)

Electro-mechanical devices' functional safety evaluations include the following:

- How frequently they are operated
- Whether they are effectively monitored for faults
- Whether they are properly specified and installed

SISTEMA calculates the MTTFd by using B10d data provided for the contactors along with the estimated frequency of use, entered during the creation of the SISTEMA project.

The DCavg (99%) for the contactors is selected from the Output Device table of ISO 13849-1 Annex E, Direct Monitoring. The DCavg (99%) for the E-Stop is selected from the Input Device table of ISO 13849-1 Annex E, Cross Monitoring.

The CCF value is generated by using the scoring process outlined in Annex F of ISO 13849-1. The complete CCF scoring process must be performed when actually implementing an application. A minimum score of 65 must be achieved.

The Emergency Stop function is a complementary protective measure which is intended to be used with other safeguarding measures and protective devices to sufficiently reduce risk. The emergency stop function shall be designed not to impair the effectiveness of the other protective devices or safety functions. For emergency stop devices in accordance with IEC 60947-5-5, a fault exclusion for mechanical aspects is allowed up to PLd if the maximum number of operations is considered. However, the actual number of operations (NOP) is used for the purposes of the MTTFd calculation in this document.

Safety Function Documents: 440C

Safety-Related Stop Initiated by a SafeZone Scanner

Products: Guardmaster 440C-CR30 Configurable Safety Relay, 442L SafeZone Laser Scanner, 100S-C Safety Contactors
Safety Rating: CAT. 3, PLd to ISO 13849-1: 2008

Verification and Validation Plan

Verification and validation play important roles in the avoidance of faults throughout the safety system design and development process. ISO 13849-2 sets the requirements for verification and validation. The standard calls for a documented plan to confirm that all of the safety functional requirements have been met.

Verification is an analysis of the resulting safety control system. The Performance Level (PL) of the safety control system is calculated to confirm that the system meets the required Performance Level (PLr) specified. The SISTEMA software is typically used to perform the calculations and assist with satisfying the requirements of ISO 13849-1.

Verification and Validation is a functional test of the safety control system to demonstrate that the system meets the specified requirements of the safety function. The safety control system is tested to confirm that all of the safety-related outputs respond appropriately to their corresponding safety-related inputs. The functional test includes normal operating conditions in addition to potential fault injection of failure modes. A checklist is typically used to document the validation of the safety control system.

Prior to validating the system, confirm that the Guardmaster 440C-CR30 configurable safety relay has been wired and configured in accordance with the installation instructions.

Safety Function Documents: 440C

Safety-Related Stop Initiated by a SafeZone Scanner

Products: Guardmaster 440C-CR30 Configurable Safety Relay, 442L SafeZone Laser Scanner, 100S-C Safety Contactors
Safety Rating: CAT. 3, PLd to ISO 13849-1: 2008

Verification and Validation Checklist

GENERAL MACHINERY INFORMATION			
Machine Name / Model Number			
Machine Serial Number			
Customer Name			
Test Date			
Tester Name(s)			
Schematic Drawing Number			
Configurable Safety Relay			
Safety Wiring and Relay Configuration Verification			
Test Step	Verification	Pass/Fail	Changes/Modifications
1	Visually inspect the 440C-CR30 circuit to verify that it is wired as documented in the schematics.		
2	Visually inspect the SafeZone laser scanner to verify that it is wired as documented.		
Normal Operation Verification - The 440C-CR30 configurable safety relay responds properly to all normal Start, Stop, Reset, and E-Stop commands.			
Test Step	Verification	Pass/Fail	Changes/Modifications
1	Initiate a Start command. Both contactors energize for a normal machine run condition. Verify proper machine-status indication and 440C-CR30 relay status indication.		
2	Initiate a Stop command. Both contactors de-energize for a normal machine Stop condition. Verify proper machine-status indication and 440C-CR30 relay status indication.		
3	While the system is running, interrupt the SafeZone laser scanner. Both contactors are de-energized and open for a normal safe condition. Verify proper machine-status indication and 440C-CR30 relay status indication if configured.		
4	While the system is stopped, interrupt the SafeZone laser scanner and initiate a Start command. Both contactors remain de-energized and open for a normal safe condition. Verify proper machine-status indication and 440C-CR30 relay status indication.		
5	Initiate a Reset command. Both contactors remain de-energized. Verify proper machine-status indication and 440C-CR30 relay status indication.		
Validation of Safe Response to Abnormal Operation - The safety system responds properly to all foreseeable faults with corresponding diagnostics.			
SafeZone Laser Scanner			
Test Step	Validation	Pass/Fail	Changes/Modifications
1	While the system is running, remove the channel 1 wire from the input EI_08. Both contactors de-energize. Verify proper machine-status indication and 440C-CR30 relay status indication. Repeat for channel 2.		
2	While the system is running, short channel 1 terminal EI_08 of the 440C-CR30 relay to 24V DC. Both contactors de-energize. Verify proper machine-status indication and 440C-CR30 relay status indication. Repeat for channel 2.		
3	While the system is running, short channel 1 terminal EI_08 of the 440C-CR30 relay to 0V DC. Both contactors de-energize. Verify proper machine-status indication and 440C-CR30 relay status indication. Repeat for channel 2.		
4	While the system is running, short channels 1 and 2 (terminal EI_08 and 09) of the 440C-CR30 relay. Both contactors are de-energized. Verify proper machine-status indication and 440C-CR30 relay status indication.		
Validation of Safe Response to Abnormal Operation - The safety system responds properly to all foreseeable faults with corresponding diagnostics.			
Safety Contactor Output Tests			
Test Step	Validation	Pass/Fail	Changes/Modifications
1	While the system is running, remove the contactor feedback from the safety relay. All contactors remain energized. Initiate a Stop command followed by a Reset command. The relay does not restart or reset. Verify proper machine status indication and 440C-CR30 relay status indication.		

Safety Function Documents: 440C

Safety-Related Stop Initiated by a SafeZone Scanner

Products: Guardmaster 440C-CR30 Configurable Safety Relay, 442L SafeZone Laser Scanner, 100S-C Safety Contactors
Safety Rating: CAT. 3, PLd to ISO 13849-1: 2008

Verification and Validation Checklist – E-Stop Safety Function

GENERAL MACHINERY INFORMATION			
Machine Name / Model Number			
Customer Name			
Test Date			
Tester Name(s)			
Schematic Drawing Number			
Configurable Safety Relay			
Safety Wiring and Relay Configuration Verification			
Test Step	Verification	Pass/Fail	Changes/Modifications
1	Visually inspect the safety relay circuit to verify that it is wired as documented in the schematics.		
2	Visually inspect the 440C-CR30 rotary switch settings to verify that they are correct as documented.		
Normal Operation Verification - The safety system responds properly to all normal Start, Stop, E-Stop, and Reset commands.			
Test Step	Verification	Pass/Fail	Changes/Modifications
1	Initiate a Start command. Both contactors energize for a normal machine run condition. Verify proper machine-status indication and 440C-CR30 relay status indication.		
2	Initiate a Stop command. Both contactors de-energize for a normal machine Stop condition. Verify proper machine-status indication and 440C-CR30 relay status indication.		
3	While the system is running, press the E-Stop button. Both contactors deenergize and open for a normal safe condition. Verify proper machine-status indication and 440C-CR30 relay status indication. Repeat for all E-Stop buttons.		
4	While the system is stopped, press the E-Stop button and initiate a Start command. Both contactors remain de-energized and open for a normal safe condition. Verify proper machine-status indication and 440C-CR30 relay status indication. Repeat for all E-Stop buttons.		
5	Initiate a Reset command. Both contactors remain de-energized. Verify proper machine-status indication and 440C-CR30 relay status indication.		
Validation of Safe Response to Abnormal Operation – The safety system responds properly to all foreseeable faults with corresponding diagnostics.			
E-Stop Input Tests			
Test Step	Validation	Pass/Fail	Changes/Modifications
1	While the system is running, remove the channel 1 EI_00 wire from the 440CCR30 relay input. Both contactors de-energize. Verify proper machine-status indication and 440C-CR30 relay status indication. Repeat for channel 2.		
2	While the system is running, short channel 1 terminal EI_00 to 24V DC. Both contactors de-energize. Verify proper machine-status indication and 440CCR30 relay status indication. Repeat for channel 2.		
3	While the system is running, short channel 1 terminal EI_00 to 0V DC. Both contactors de-energize. Verify proper machine-status indication and 440CCR30 relay status indication. Repeat for channel 2.		
4	While the system is running, short channel 1 and 2, EI_00 to EI_01. Both contactors de-energize. Verify proper machine-status indication and 440CCR30 relay status indication.		
Validation of Safe Response to Abnormal Operation - The safety system responds properly to all foreseeable faults with corresponding diagnostics.			
Safety Contactor Output Tests			
Test Step	Validation	Pass/Fail	Changes/Modifications
1	While the system is running, remove the contactor feedback from the safety relay. All contactors remain energized. Initiate a Stop command followed by a Reset command. The relay does not restart or reset. Verify proper machinestatus indication and 440C-CR30 relay status indication.		

Safety Function Documents: 440C

Safety-Related Stop Initiated by a SafeZone Scanner

Products: Guardmaster 440C-CR30 Configurable Safety Relay, 442L SafeZone Laser Scanner, 100S-C Safety Contactors
Safety Rating: CAT. 3, PLd to ISO 13849-1: 2008

Verification of the Configuration

The system must verify the configuration of each individual application by using the Verify command. If the 440C-CR30 configurable safety relay is not verified, it will fault after 24 hours of operation.



ATTENTION: The verification process should be documented in the safety system's technical file.

Follow these steps to download and verify the configuration.

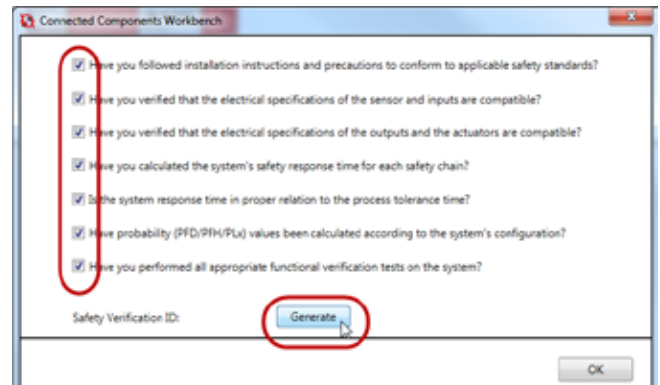
1. Make sure the 440C-CR30 relay is powered up and connected to your workstation via the USB cable.
2. Confirm that the upper right-hand corner of the Connected Components Workbench Project tab shows that the 440C-CR30 relay is connected. If the relay is not connected, click Connect to Device to establish the software connection.



3. Click Verify.



4. Answer all the questions and check each box, if completed.

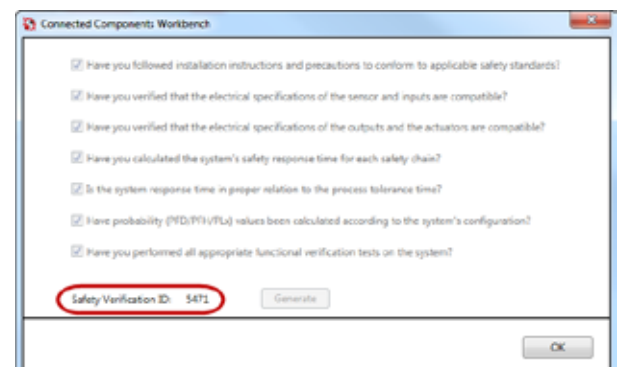


IMPORTANT: All of the boxes must be marked in order to Generate the Verification ID.

5. Click Generate.
6. Click Yes to proceed with the verification.



7. Click Yes to change to Run mode.
8. Record the Safety Verification ID in the machine's documentation.



This process is the feedback to the 440C-CR30 relay that the system verification and functional tests have been completed. The unique verification ID can be used to check if changes have been made to a configuration file. Any change to the configuration removes the Safety Verification ID. Subsequent verification actions generate a different verification ID. The Safety Verification ID is displayed in Connected Components Workbench software only when you are connected to the 440C-CR30 relay.

Safety Function Documents: 440C

Safety-Related Stop Initiated by a SafeZone Scanner

Products: Guardmaster 440C-CR30 Configurable Safety Relay, 442L SafeZone Laser Scanner, 100S-C Safety Contactors
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Additional Resources

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

Resource	Description
SafeZone Singlezone and Multizone Safety Laser Scanner User Manual, publication 442LUM003	Provides information on how to mount, install, commission, operate, and maintain the SafeZone laser scanner.
Guardmaster 440C-CR30 Software Configurable Safety Relay Quick Start Guide, publication 440C-QS001	Provides information on how to configure a Guardmaster 440C-CR30 configurable safety relay to communicate with a PanelView Component terminal via Modbus communication protocol.
Guardmaster 440C-CR30 Configurable Safety Relay User Manual, publication 440C-UM00	Provides detailed information on how to install, configure, operate, and troubleshoot a Guardmaster 440C-CR30 configurable safety relay.
Safety Contactors with DC Coil Installation Instructions, publication 100S-IN006	Provides instructions on how to install 100S-C safety contactors.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines on how to install a Rockwell Automation® industrial system.
Safety Products Catalog, publication S117-CA001 website http://www.rockwellautomation.com/rockwellautomation/catalogs/overview.page	Provides information about Rockwell Automation safety products.
Product Certifications website, available from the Product Certifications link on http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at <http://www.rockwellautomation.com/literature/>.

To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Safety Function Documents: 440C

Safety-Related Stop Initiated by a SafeZone Scanner

Products: Guardmaster 440C-CR30 Configurable Safety Relay, 442L SafeZone Laser Scanner, 100S-C Safety Contactors
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Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at <http://www.rockwellautomation.com/literature/>.

For more information on Safety Function Capabilities, visit:

http://marketing.rockwellautomation.com/safety/en/safety_functions

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

Safety Function Document

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Neither NHP nor any of the manufacturers portrayed in this and any related publications accept responsibility for any errors or omissions contained therein nor any misapplications resulting from such errors or omissions.

Risk assessments should be conducted by authorized persons. The purchaser and installer are responsible for ensuring the safety system(s) incorporating these products complies with all current regulations and applicable standards.

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