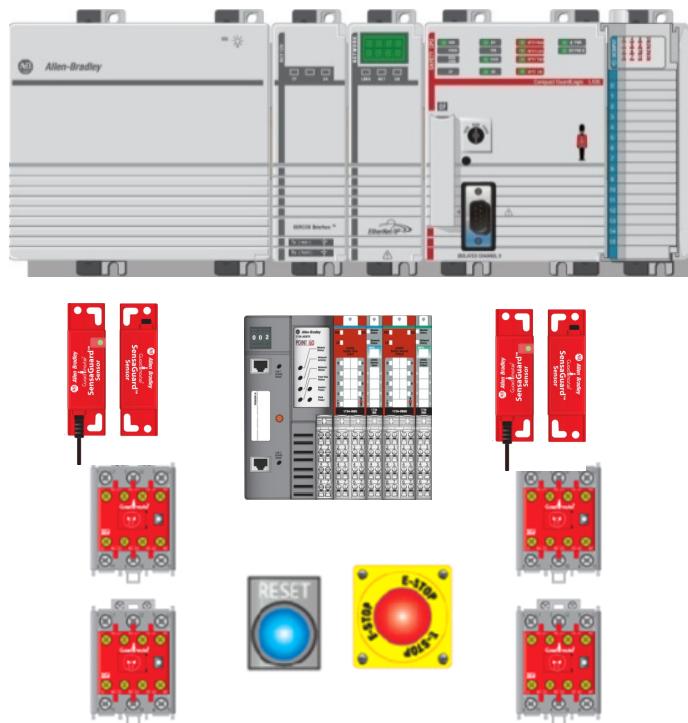


## **GuardLogix: Dual Zone Gate Protection with E-stop and SensaGuard Switch**

Safety Rating: PLe, Cat. 4 to EN ISO 13849.1 2008



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## Introduction

This application example explains how to wire, configure, and program a Compact GuardLogix® controller and POINT Guard I/O™ module to monitor a two-zone safety system. Each zone consists of a safety gate which, once opened, removes power from a redundant pair of 100S contactors. This is duplicated in the second zone. Both zones are also protected by a global E-stop that shuts down both zones safely when it is actuated.

This example uses a Compact GuardLogix controller, but is applicable to any GuardLogix controller.

## Features and Benefits

- Standard and safety applications run in a single controller.
- Standard and safety I/O modules can use the same Ethernet adapter and network(s).
- Safety status and diagnostics can be easily read by the standard application or by other devices over an Ethernet or ControlNet network.
- The application can be expanded and incorporated into your application by adding the additional I/O required.

## Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication [SGI-1.1](#) available from your local Rockwell Automation® sales office or online at <http://www.rockwellautomation.com/literature>) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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

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

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

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

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

	<b>WARNING:</b> 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.
<b>IMPORTANT</b>	Identifies information that is critical for successful application and understanding of the product.
	<b>ATTENTION:</b> 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.
	<b>SHOCK HAZARD:</b> Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	<b>BURN HAZARD:</b> Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

## General Safety Information

<b>IMPORTANT</b>	This application example is for advanced users and assumes that you are trained and experienced in safety system requirements.
	<b>ATTENTION:</b> A risk assessment should be performed to make sure all task and hazard combinations have been identified and addressed. The risk assessment may 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.

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

## Description

This application monitors two zones. Each zone is protected by a SensaGuard™ safety switch. If either gate is opened, the output contactors are de-energized, shutting down any associated machinery for that zone. The reset is manual. Both zones are also protected by a global E-stop switch. If the E-stop is actuated, then both sets of contactors de-energize.

## Safety Function

Each SensaGuard safety switch is connected to a pair of safety inputs of a 1734-IB8S module. The I/O module is connected via CIP Safety over an EtherNet/IP network to the Compact GuardLogix safety controller, 1768-L43S. The safety code in the safety processor monitors the status of the safety inputs using a pre-certified safety instruction named Dual Channel Input Stop (DCS). The safety code is run in parallel in a 1oo2 processor configuration. When all conditions are satisfied, the safety gate is closed, no faults are detected on the input modules, the global E-stop is not actuated, and the reset push button is pressed, a second certified function block called Configurable Redundant Output (CROUT) checks the status of the final control devices, a pair of 100S redundant contactors. The controller then issues an output signal to the 1734-OBS module to switch ON a pair of outputs to energize the safety contactors. The global E-stop function is also monitored by a DCS instruction. If the global E-stop is actuated, it shuts down both zones.

## Bill of Material

This application example uses these components.

Catalog Number	Description	Quantity
440N-Z21SS2A	SensaGuard switch Non-contact plastic RFP,	2
800FM-G611MX10	800F Reset Push Button - Metal, Guarded, Blue, R, Metal Latch Mount, 1 N.O. Contact(s), Standard,	4
100S-C09ZJ23C	Bulletin 100S-C - Safety Contactors	2
1768-ENBT	CompactLogix™ EtherNet/IP Bridge Module	1
1768-L43S	CompactLogix L43 Processor, 2.0 MB Standard Memory, 0.5 MB Safety Memory	1
1768-PA3	Power Supply, 120/240 VAC Input, 3.5 A @ 24V DC	1
1769-ECR	Right End Cap/Terminator	1
1734-AENT	24V DC Ethernet Adapter	1
1734-TB	Module Base with Removable IEC Screw Terminals	4
1734-IB8S	Safety Input Module	2
1734-OB8S	Safety Output Module	1
1783-US05T	Stratix 2000™ Unmanaged Ethernet Switch	1

## Setup and Wiring

For detailed information on installing and wiring, refer to the product manuals listed in the [Additional Resources](#) on page [16](#).

### System Overview

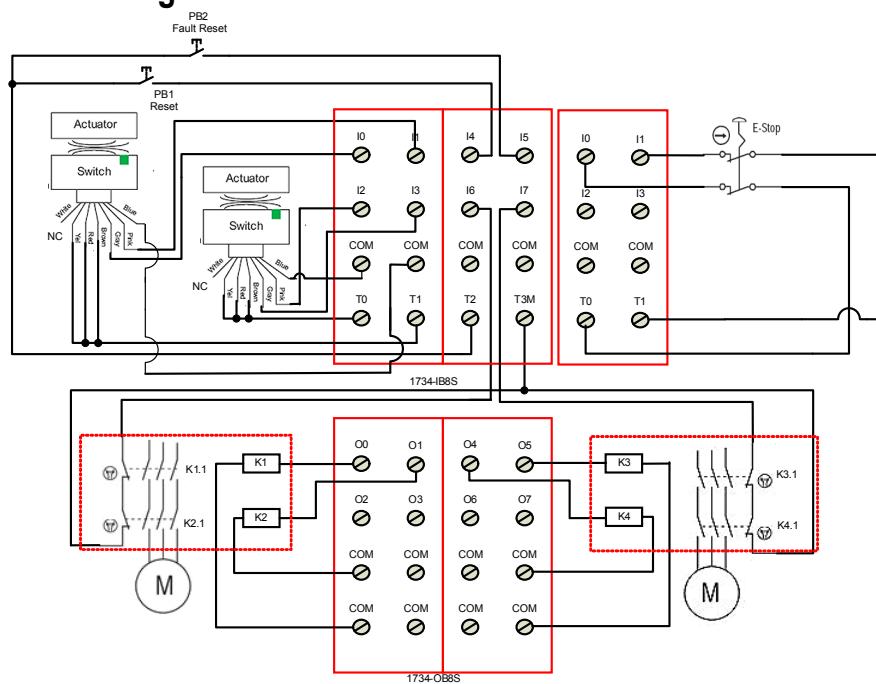
The 1734-IB8S input module monitors inputs from both the SensaGuard switches.

Sensaguard uses OSSD outputs which carry out periodic testing of the outputs. Thus, it is the OSSD outputs that are testing the integrity of the wiring between the SensaGuard switch and the safety inputs.

The Test pulse outputs are used as 24V sources.

The final control device is a pair of 100S safety contactors, K1 and K2. The contactors are controlled by the 1734-OBS safety output module. These are wired in a redundant configuration and are tested on startup for faults. The start-up test is achieved by monitoring the feedback circuit into input 2 (I2), before the contactors are energized. This is accomplished by using a Configurable Redundant Output (CROUT) instruction. The system is reset by the momentary push button, PB1.

### Wiring



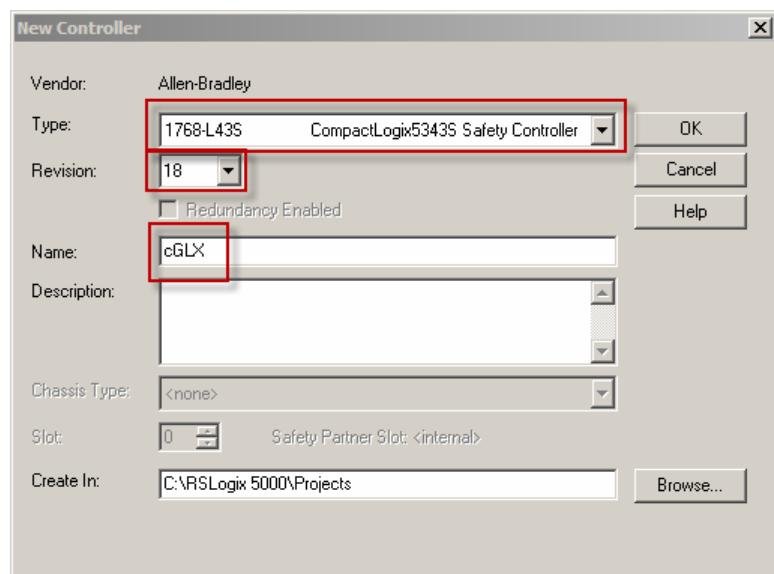
## Configuration

The Compact GuardLogix controller is configured by using RSLogix™ 5000, version 18 or later. You must create a new project and add the I/O modules. Then, configure the I/O modules for the correct input and output types. A detailed description of each step is beyond the scope of this document. Knowledge of the RSLogix programming environment is assumed.

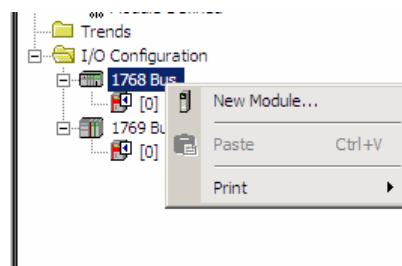
## Configure the Controller and Add I/O Modules

Follow these steps.

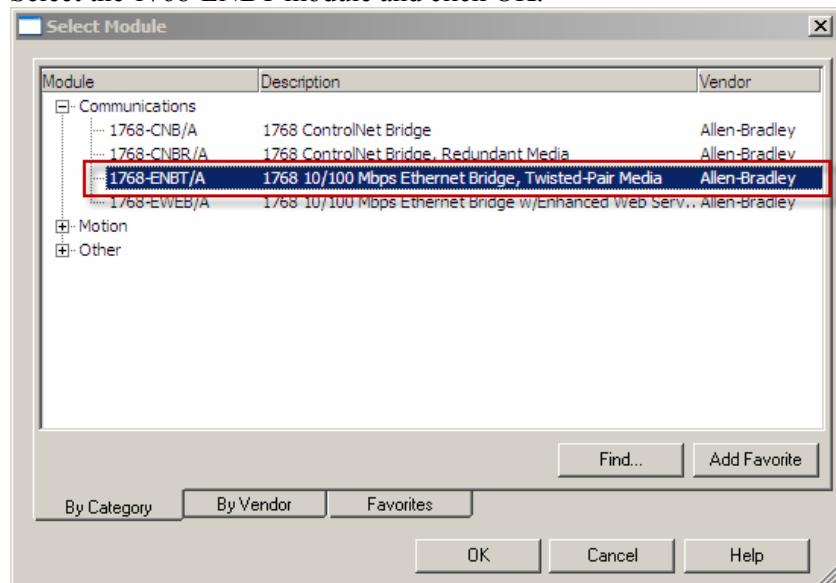
1. In RSLogix 5000 software, create a new project.



2. In the Controller Organizer, add the 1768-ENBT module to the 1768 Bus.

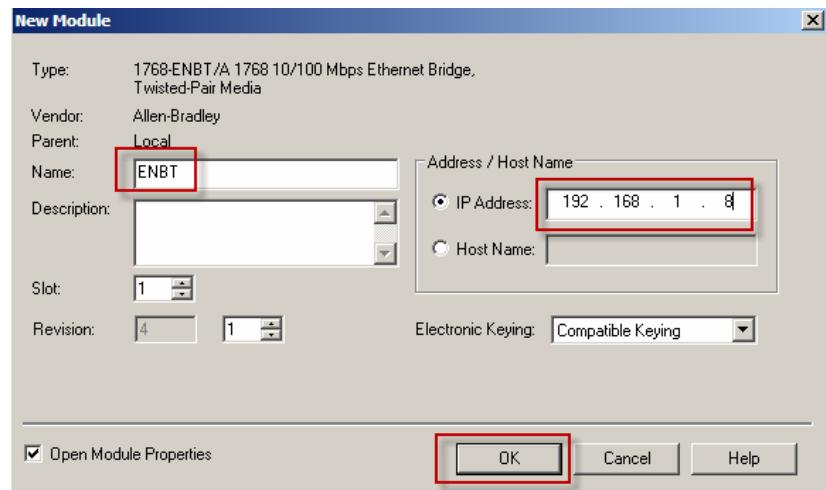


3. Select the 1768-ENBT module and click OK.

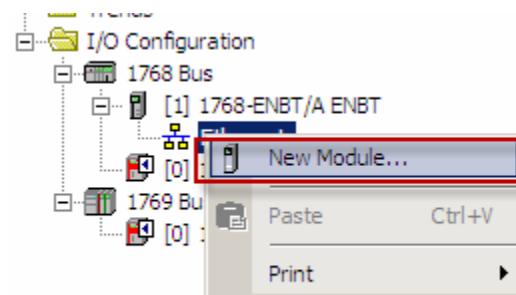


4. Name the module, type its IP address, and click OK.

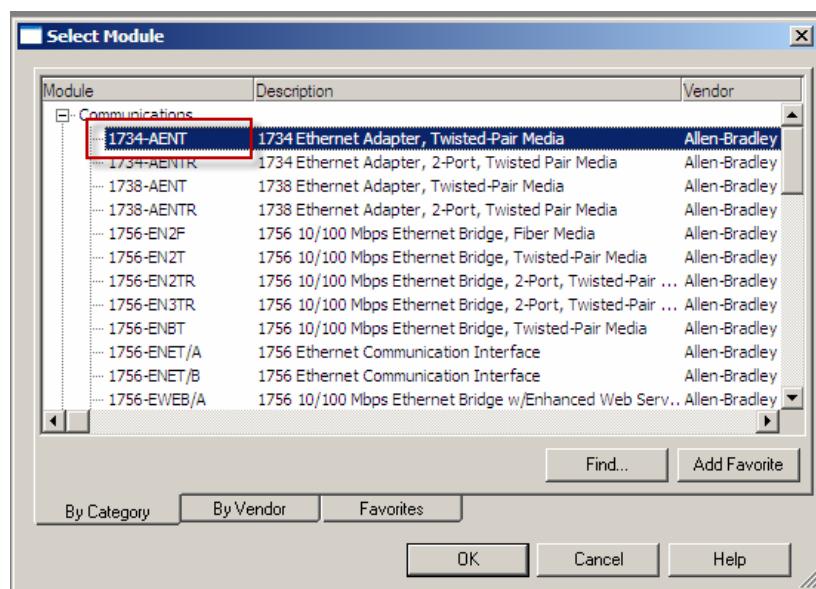
We used 192.168.1.8 for this application example. Yours may be different.



5. Add the 1734-AENT adapter by right-clicking the 1768-ENBT module in the Controller Organizer and choosing New Module.



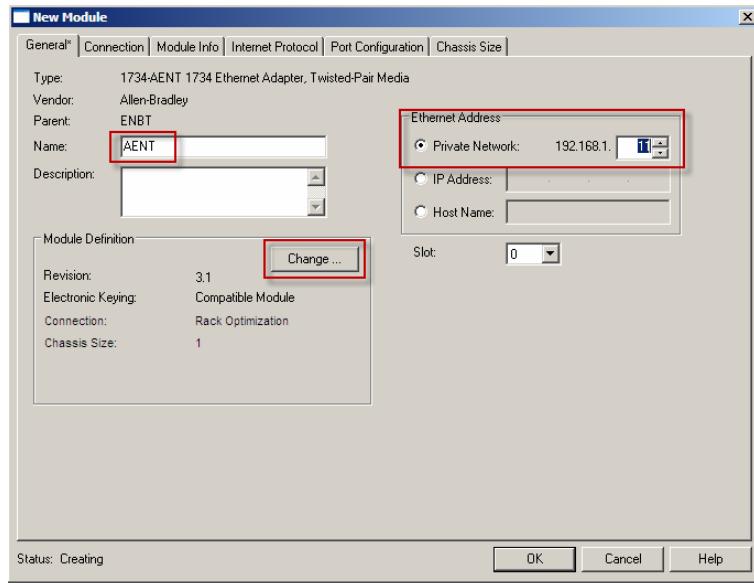
6. Select the 1734-AENT adapter and click OK.



7. Name the module, type its IP address, and click OK.

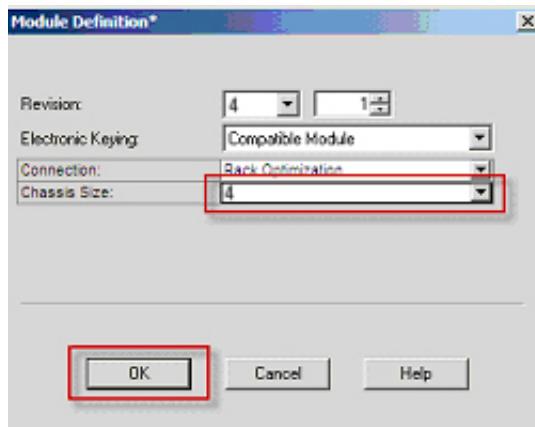
We used 192.168.1.11 for this application example. Yours may be different.

8. Click Change.

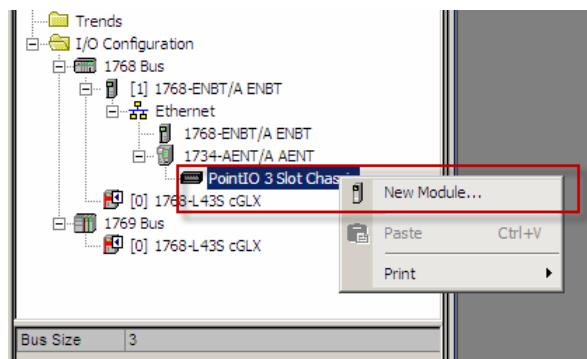


9. Set the Chassis Size as 4 for the 1734-AENT adapter and click OK.

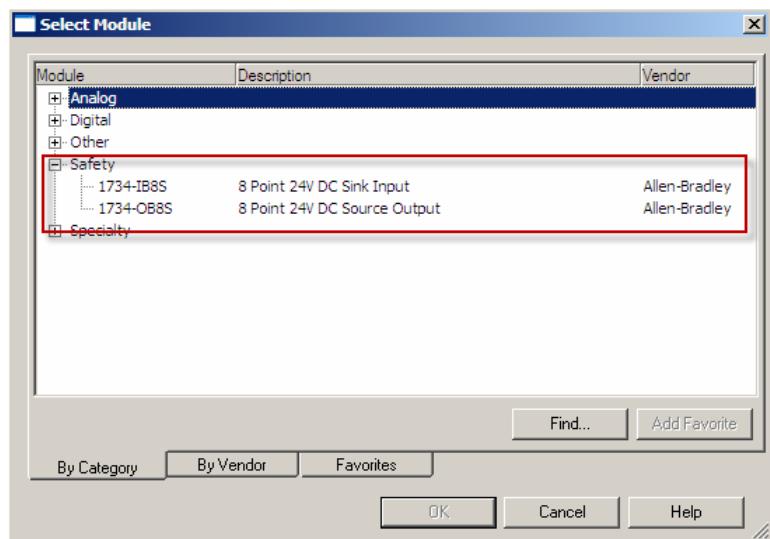
Chassis size is the number of modules that will be inserted in the chassis. The 1734-AENT adapter is considered to be in slot 0, so for two input modules and one output module, the chassis size is 4.



10. In the Controller Organizer, right-click the 1734-AENT adapter and choose New Module.



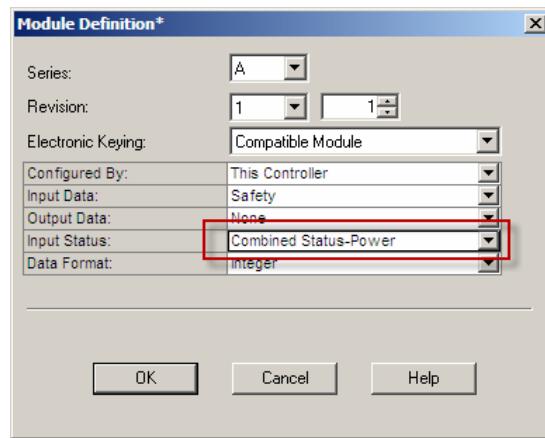
11. Expand Safety, select the 1734-IB8S module, and click OK.



12. In the New Module dialog box, name the device 'CellGuard\_1' and click Change.



13. When the Module Definition dialog box opens, change the Input Status to Combined Status-Power, and click OK.

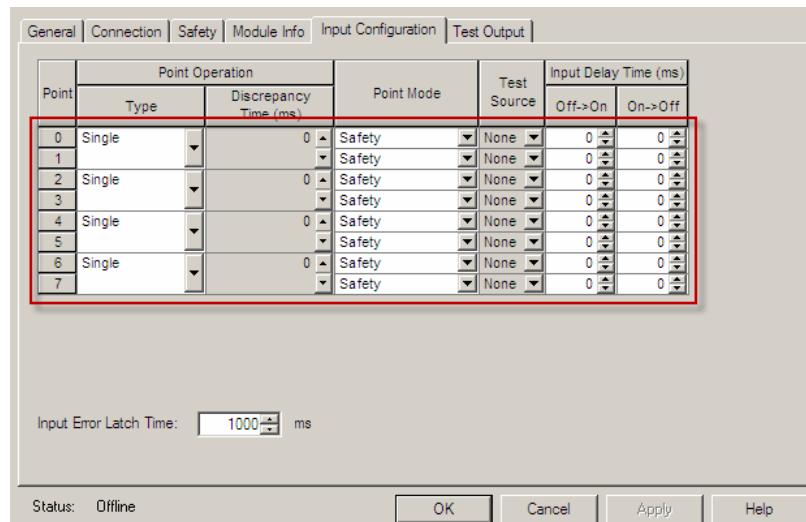


14. Close the Module Properties dialog box by clicking OK.  
 15. Repeat steps 10 -14 to add a second 1734-IB8S safety input module and a 1734-OB8S safety output module.

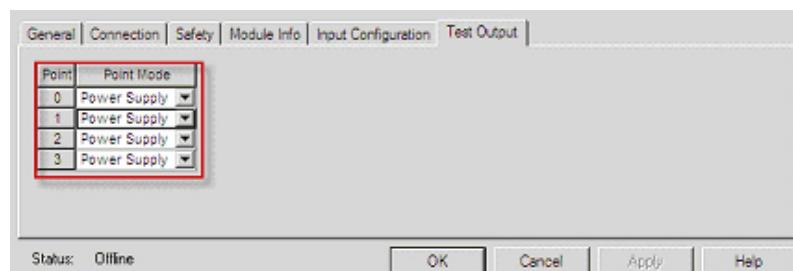
## Configure the I/O Modules

Follow these steps to configure the POINT Guard I/O modules.

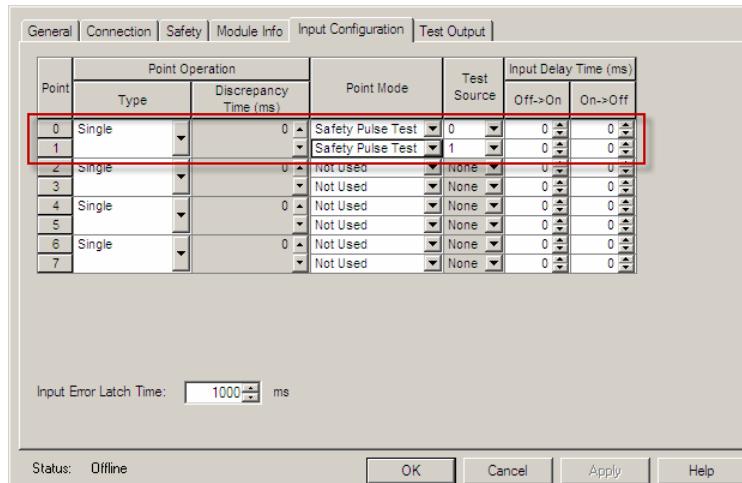
1. In the Controller Organizer, right-click a 1734-IB8S module and choose Properties.
2. Click Input Configuration and configure the module as shown.



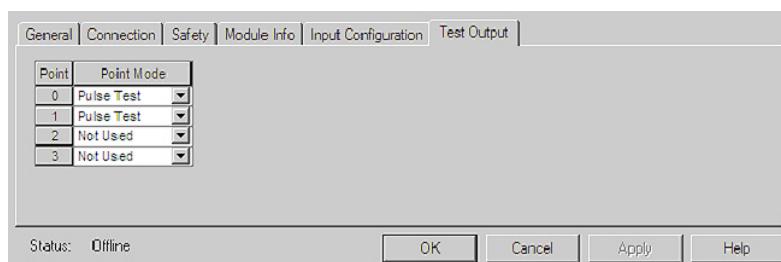
3. Click Test Output and configure the module as shown.



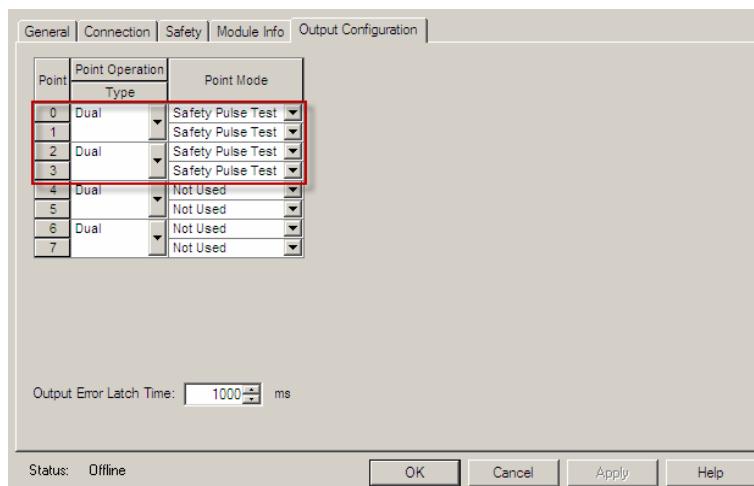
4. Click OK.
5. In the Controller Organizer, right-click the second 1734-IB8S module and choose Properties.
6. Click Input Configuration and configure the module as shown.



7. Click Test Output and configure the module as shown.



8. Click OK.
9. In the Controller Organizer, right-click the 1734-OB8S module and choose Properties.
10. Click Output Configuration and configure the module as shown.



11. Click OK.

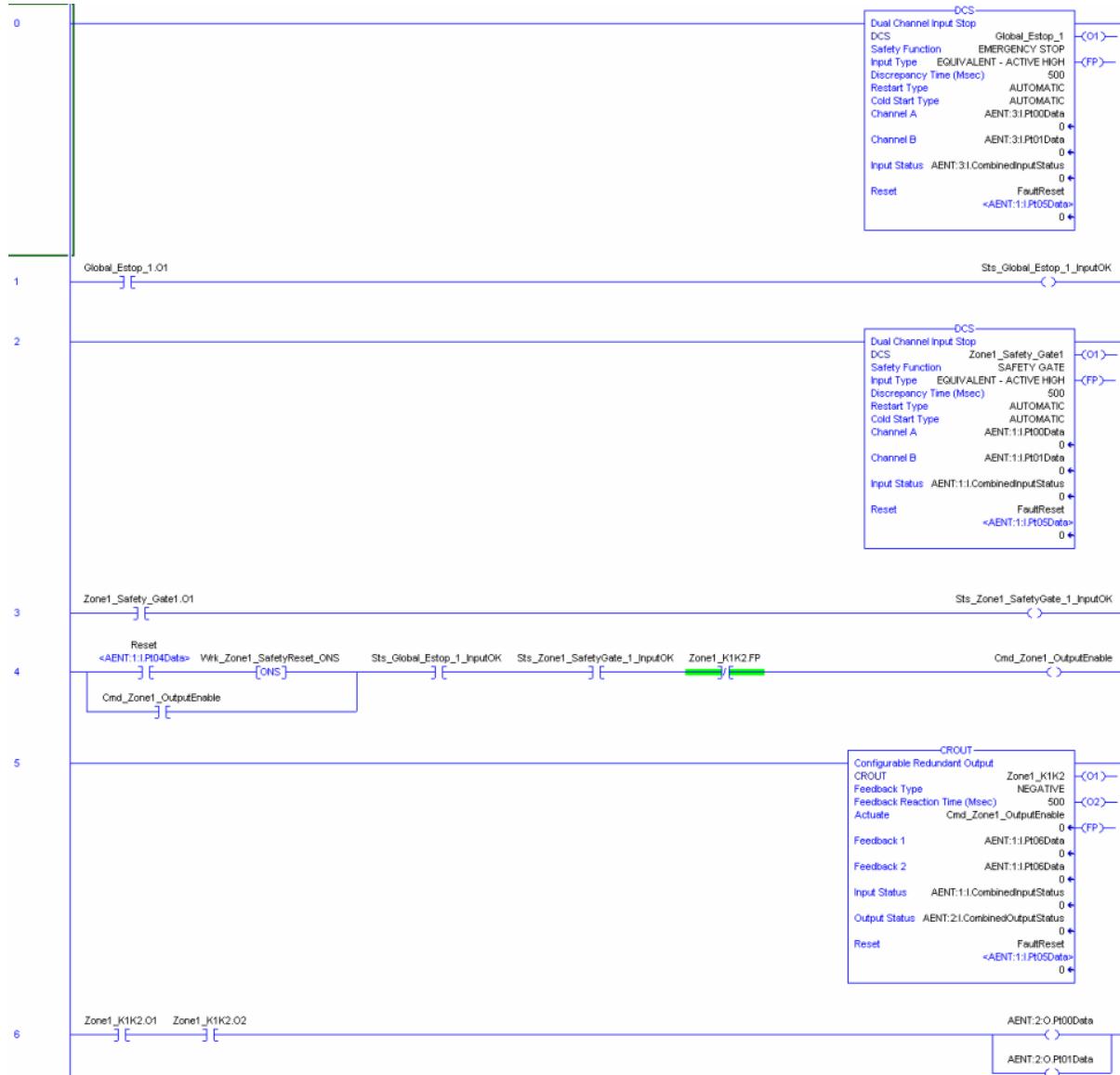
## Programming

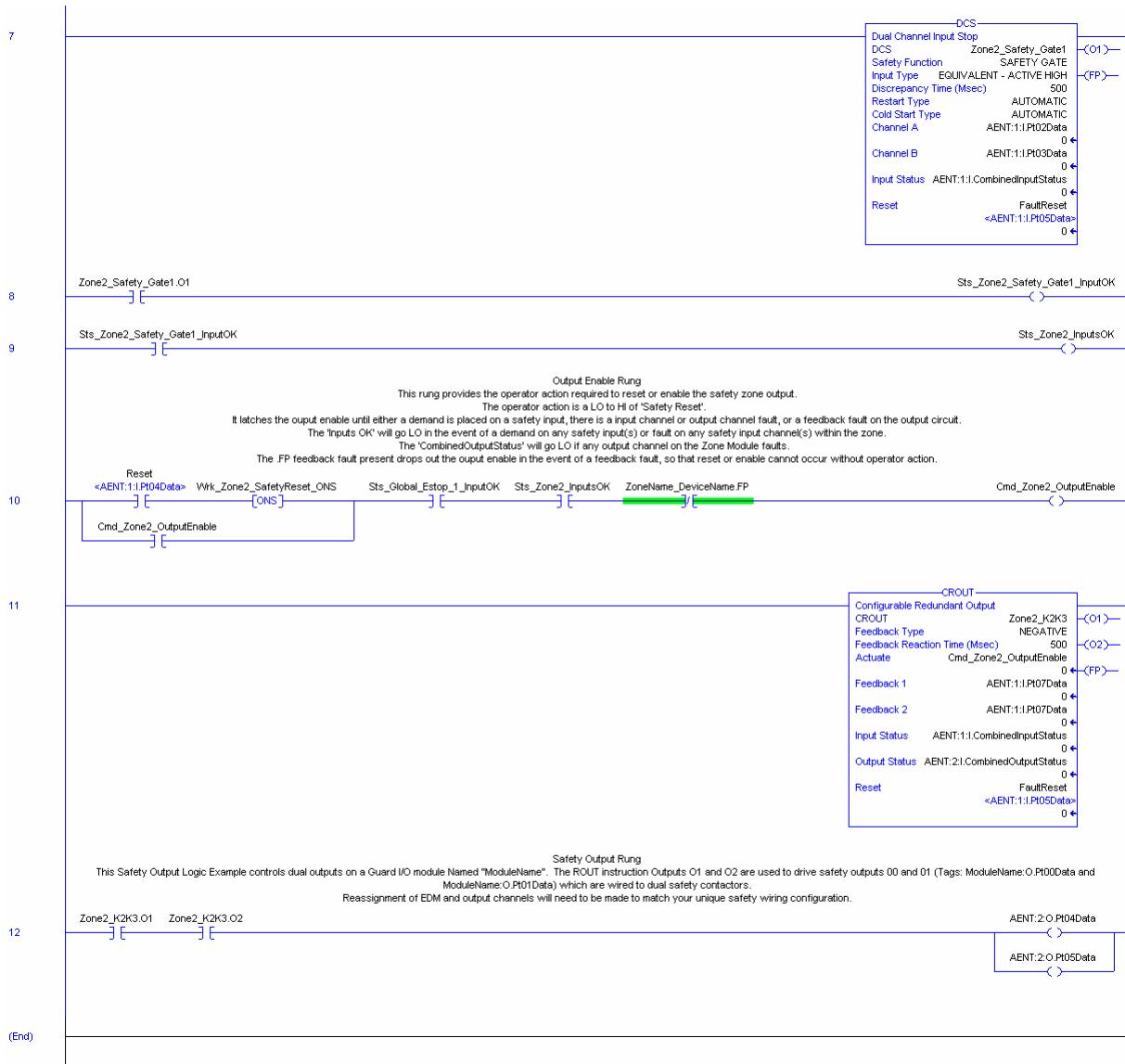
The Dual Channel Input Stop (DCS) instruction monitors dual-input safety devices whose main function is to stop a machine safely, for example, an E-stop, light curtain, or safety gate. This instruction can only energize Output 1 when both safety inputs, Channel A and Channel B, are in the active state as determined by the Input Type parameter, and the correct reset actions are carried out. The DCS instruction monitors dual-input channels for consistency (Equivalent – Active High) and detects and traps faults when the inconsistency is detected for longer than the configured Discrepancy Time (ms).

The Configurable Redundant Output (CROUT) instruction controls and monitors redundant outputs. The reaction time for output feedback is configurable. The instruction supports positive and negative feedback signals.

The safety application code in the safety output routine prevents outputs from restarting if the input channel resets automatically, providing anti-tiedown functionality for the Circuit Reset.

The InputOK status is used as a permissive in the safety output routines.

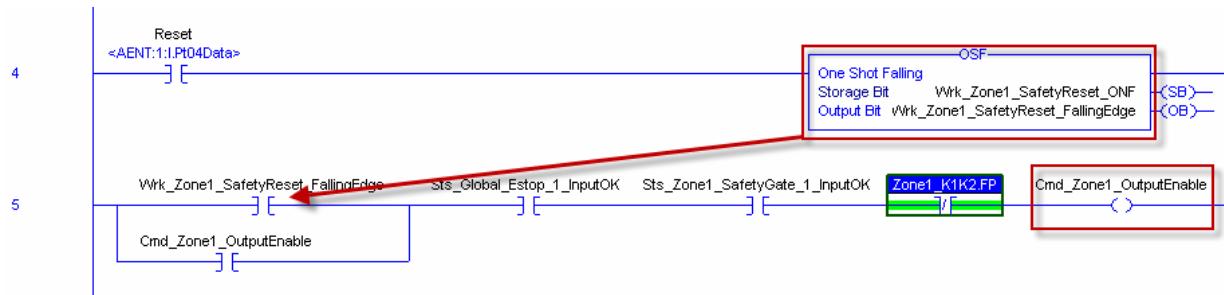




## Falling Edge Reset

ISO 13849-1 stipulates that instruction reset functions must occur on falling edge signals. To comply with this requirement, add a **One Shot Falling** instruction to the rung immediately preceding the Cmd\_Zone1\_OutputEnable rung. Then use the OSF instruction Output Bit tag as the reset bit for the following rung. The Cmd\_Zone1\_OutputEnable is then used to Enable the CROUT instruction.

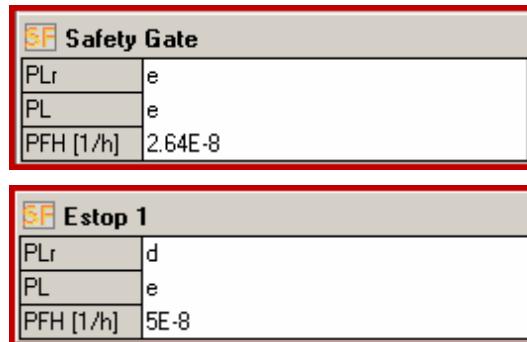
Modify the reset code as shown below.



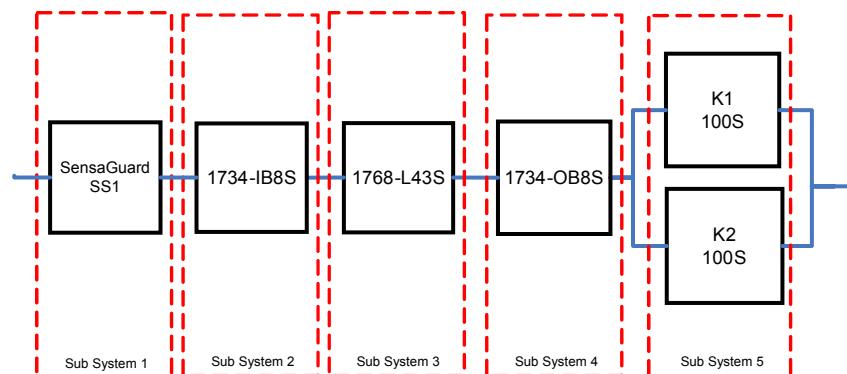
## Performance Data

When configured correctly, each safety function can achieve a safety rating of PLe, Cat. 4 according to EN ISO 13849.1 2008.

Calculations are based on operation 360 days per year for 16 hours per day with an actuation of the safety gate once every hour for a total of 5760 operations per year. The global E-stop function is tested once per month.



Each safety function and can be represented as follows.



<b>SB Interlock Switch: SensaGuard</b>	
PL	e
PFH [1/h]	1.12E-9
Cat.	4
MTTFd [a]	<i>not relevant</i>
DCavg [%]	<i>not relevant</i>
CCF	<i>not relevant</i>

<b>SB Safety I/O: 1734-IB8S</b>	
PL	e
PFH [1/h]	2.25E-10
Cat.	4
MTTFd [a]	<i>not relevant</i>
DCavg [%]	<i>not relevant</i>
CCF	<i>not relevant</i>

<b>SB Safety PLC: Compact GuardLogix 1768</b>	
PL	e
PFH [1/h]	2.1E-10
Cat.	4
MTTFd [a]	<i>not relevant</i>
DCavg [%]	<i>not relevant</i>
CCF	<i>not relevant</i>

<b>SB Safety I/O: 1734-OB8S</b>	
PL	e
PFH [1/h]	2.29E-10
Cat.	4
MTTFd [a]	<i>not relevant</i>
DCavg [%]	<i>not relevant</i>
CCF	<i>not relevant</i>

<b>SB Contactors</b>	
PL	e
PFH [1/h]	2.47E-8
Cat.	4
MTTFd [a]	100 (High)
DCavg [%]	99 (High)
CCF	65 (fulfilled)

## Additional Resources

For more information about the products used in this example refer to these resources.

Resource	Description
Compact GuardLogix Controllers User Manual, publication <a href="#">1768-UM002</a>	Provides information on configuring, operating, and maintaining Compact GuardLogix controllers.
POINT Guard I/O Safety Modules Installation and User Manual, publication <a href="#">1734-UM013</a>	Provides information on installing, configuring, and operating POINT Guard I/O modules.
GuardLogix Controller Systems Safety Reference Manual, publication <a href="#">1756-RM093</a>	Contains detailed requirements for achieving and maintaining safety ratings with the GuardLogix controller system.
GuardLogix Safety Application Instruction Set Reference Manual, publication <a href="#">1756-RM095</a>	Provides detailed information on the GuardLogix Safety Application Instruction Set.
Safety Accelerator Toolkit for GuardLogix Systems Quick Start Guide, publication <a href="#">IASIMP-QS005</a>	Provides a step-by-step guide to using the design, programming, and diagnostic tools in the Safety Accelerator Toolkit.

[Safety Products Catalog](#)

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