Introduction

This example describes how to set up, wire and program a SmartGuard 600 safety controller for use with a light curtain in a bidirectional muting application. The typical application would be in an environment where there is motion of material into and out of a guarded safety zone.

Features and Benefits

- Programmable safety logic is used to control and monitor the bidirectional muting behavior of light curtain.
- Expandable as needed by adding additional safety inputs or outputs.
- Easier integration into Logix controllers and HMIs through standard DeviceNet network communication.
- Provides safety interlocking with GuardLogix, GuardPLC, or other SmartGuard safety controllers.
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://literature.rockwellautomation.com) 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.

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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. |
| IMPORTANT | Identifies information that is critical for successful application and understanding of the product. |
| 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. |
| 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. |
General Safety Information

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

**ATTENTION**
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

The figure below shows a robotic conveyor application in which the hazard is enclosed by physical guarding and the entrance to the robot cell is guarded by a Type 4 light curtain. The raw material is fed into the robot cell via a conveyor.

The conveyor is bidirectional and is used to feed in and move out the material from the hazardous area. Muting of the light curtain takes place at the entrance of the robot cell.

The status of the muting lamps and the light curtain is monitored by the SmartGuard 600 controller. Two safety output contactors are wired to the outputs on the SmartGuard 600 controller.

The SmartGuard 600 controller is programmed using RSNetWorx for DeviceNet software. You must be familiar with this software to use this document.
Safety Function

The following diagrams show bidirectional muting using four sensors.

**Entrance Diagram**

A muting sequence is explained in the following steps.

1. In the block diagram above, there is no object between the sensors and the Active Optoelectronic Protective Device (AOPD), so the Output Ready signal is on.

2. As the workpiece moves to the right and sensors 1 and 2 turn on sequentially at the entrance (sensors S4 and S3 turn on sequentially at the exit), muting is allowed (the AOPD safety function is disabled) and the Muting signal goes on.

3. As the workpiece continues advancing, the Output Ready signal is kept on even if the AOPD is obstructed.

4. As the workpiece continues advancing, the workpiece is no longer detected by sensor 3 at the entrance (sensor 2 at the exit), the muting status is cleared (the AOPD safety function is enabled), and the Muting signal turns off.

The setup distance requirements are the same as for Time-difference Input Pattern 1 – Serial as described in the Muting: Function Block Section, page 13.
Example Bill of Material

This application example uses these components.

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1752-L24BBB</td>
<td>SmartGuard 600 packaged controller</td>
<td>1</td>
</tr>
<tr>
<td>440L-PAJ0320YD</td>
<td>GuardShield light curtain</td>
<td>1</td>
</tr>
<tr>
<td>42GRU-9200-QD</td>
<td>Photo-electric sensors</td>
<td>4</td>
</tr>
<tr>
<td>100S-C</td>
<td>Safety contactors</td>
<td>2</td>
</tr>
<tr>
<td>440L-AMUTLP10M</td>
<td>Muting lamp with 10m cable</td>
<td>1</td>
</tr>
<tr>
<td>1606-XL</td>
<td>24V DC power supply</td>
<td>1</td>
</tr>
</tbody>
</table>

This application example requires the following software:
- RSNetWorx for DeviceNet software, version 8.00.01
- RSLinx Classic software, version 2.51 or newer
- USB Drivers for SmartGuard 600 safety controller

Setup and Wiring

For detailed information on installing and wiring, refer to the product manuals listed in the Additional Resources on page 21.

System Overview
Configuring the SmartGuard 600 controller requires you to connect the USB cable, configure the drivers, and name the local inputs and outputs.

**Configuring USB Driver**

The USB drivers must be installed and recognized.

1. Install the USB driver needed for communicating to SmartGuard 600 controller on the programming station personal computer.
2. Connect the USB cable between the SmartGuard controller and the programming station.
3. Wait for Windows operating system to recognize the new USB device.
4. Open RSLinx Classic software by clicking the RSLinx service icon in the Windows System Tray (lower right corner of your window).
5. If this service is not running, double-click the RSLinx Classic icon on the desktop.
   
   ![RSLinx Classic Icon](image)

6. Choose Communications > Configure Drivers to set up communication to the controller.
7. Use the pull-down menu to select the SmartGuard USB Driver from the list and click Add New.

8. Click OK to confirm the name of the driver.

9. Use the pull-down menu to select the 1752 SmartGuard USB Port from the list and click OK.

10. Click Close to complete.

11. Minimize the RSLinx Classic dialog.

**Going Online in RSNetWorx for DeviceNet Software**

This series of steps explains how to start a new project to confirm that the driver has been uploaded from the network.

1. Open RSNetworx for DeviceNet software by double-clicking the icon on the desktop.
2. Choose File > New to start a new project.

3. Select DeviceNet Configuration from the list and click OK.

4. Click the RSWho button to go online.

5. Select the SmartGuard USB driver from the list and click OK.
6. Click OK again to confirm the initial upload from the network.

The network displays SmartGuard 600 controller at node 3 as shown below.

![SmartGuard 600 controller at node 3](image)

7. In the RSNetWorx online graph, double-click the 1752-L24BBB SmartGuard controller to open the properties panel.

The screen should look like this.

![SmartGuard controller properties](image)
Configuring SmartGuard Local Inputs and Outputs

The final steps in configuring the SmartGuard 600 controller require naming the inputs and outputs.

1. Click the Local Input/Test Output tab.
   Give the local I/O meaningful names so they are easier to recognize later in the programming editor.
2. Using the wiring diagram, assign names to your inputs as shown below.
3. Under the General tab, double-click the first entry in the list above, labeled No. 00.

4. Home the signal LC_CH1 and set the mode as Used as Safety Input.

According to the wiring diagram, this is light curtain OSSD1.
5. Enter other signal as displayed below.

6. Go to the Test Output tab under Local Input/Test Output tab and enter the signal Mute Imp as displayed below.
7. Go to the Local Output tab and enter the signals as displayed below.

Programming

To program the SmartGuard 600 controller, the programming editor is opened and the function blocks are located.

1. Click the Logic tab.

2. Click Edit to open the editor.
3. When the editor opens, notice there are two sections: the Function List section and the Workspace section.

4. Look in the Safety Device area of the Function Block tab for the EDM, Restart and Muting Function blocks.

**Mutting: Function Block**

The Muting function block temporarily disables detection in a light curtain while the muting sensor is being triggered. While the muting function is operating, machine operation is not stopped, so an object may pass through the light curtain sensing field.

In addition, the Muting function block has an override function that can forcibly disable operation of the light curtain and cause the machine to operate while the light curtain is obstructed (for example, when a pallet has stopped in the light curtain’s detection zone, the machine can be forced to operate to remove the pallet).
An input pattern that matches the user application must be selected as the muting sensor detection method.

<table>
<thead>
<tr>
<th>Input Pattern</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time-difference input pattern 1</td>
<td>This pattern is suitable for applications at a conveyor entrance.</td>
</tr>
<tr>
<td></td>
<td>Use this pattern when muting operation based on the input time difference</td>
</tr>
<tr>
<td></td>
<td>between two inputs: muting input 1 and muting input 2.</td>
</tr>
<tr>
<td></td>
<td>There are two methods: the parallel method, which uses two muting sensors,</td>
</tr>
<tr>
<td></td>
<td>and the serial method, which uses four muting sensors.</td>
</tr>
<tr>
<td>Time-difference input pattern 2</td>
<td>This pattern is suitable for applications at a conveyor entrance or exit.</td>
</tr>
<tr>
<td></td>
<td>Use this pattern when muting operation based on the input time difference</td>
</tr>
<tr>
<td></td>
<td>between two inputs: muting input 1 (input 4 at the exit) and muting input 2</td>
</tr>
<tr>
<td></td>
<td>(input 3 at the exit).</td>
</tr>
<tr>
<td>Simultaneous input pattern</td>
<td>This pattern is suitable for application in which muting is controlled by</td>
</tr>
<tr>
<td></td>
<td>a switch input.</td>
</tr>
<tr>
<td></td>
<td>Use this pattern to temporarily mute sensor operation when the operator is</td>
</tr>
<tr>
<td></td>
<td>placing an object in the machine opening.</td>
</tr>
</tbody>
</table>

Since the goal is to achieve bidirectional muting, select Sequential Muting (both directions).
Set other parameters referring to the table below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting range</th>
<th>Default setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Type (AOPD output)</td>
<td>EDual Channel Equivalent (NC/NC)</td>
<td>Dual Channel Equivalent</td>
</tr>
<tr>
<td></td>
<td>EDual Channel Complementary (NC/NO)</td>
<td></td>
</tr>
<tr>
<td>Discrepancy Time (AOPD output)</td>
<td>10...500 ms in 10-ms increments (See note 1.)</td>
<td>30 ms</td>
</tr>
<tr>
<td></td>
<td>A discrepancy time check will not be performed if 0 is set.</td>
<td></td>
</tr>
<tr>
<td>Input Type (Override signal)</td>
<td>ESingle Channel</td>
<td>Dual Channel Equivalent</td>
</tr>
<tr>
<td></td>
<td>EDual Channel Equivalent (NC/NC)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EDual Channel Complementary (NC/NO)</td>
<td></td>
</tr>
<tr>
<td>Discrepancy Time (Override signal)</td>
<td>10...500 ms in 10-ms increments (See note 1.)</td>
<td>30 ms</td>
</tr>
<tr>
<td></td>
<td>A discrepancy time check will not be performed if 0 is set.</td>
<td></td>
</tr>
<tr>
<td>Max. Override Time</td>
<td>500 ms...127.5 s in 500-ms increments</td>
<td>60 s</td>
</tr>
<tr>
<td>Number of Sensor Inputs</td>
<td>1 input, 2 inputs, 4 forward inputs, or 4 bidirectional inputs (See note 2.)</td>
<td>2 inputs</td>
</tr>
<tr>
<td>Max. Muting Time</td>
<td>500 ms...127.5 s in 500-ms increments</td>
<td>60 s</td>
</tr>
<tr>
<td></td>
<td>0...500 ms in 10-ms increments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The muting time will be unlimited if 0 is set.</td>
<td></td>
</tr>
<tr>
<td>Max. Synchronization Time (between S1 and S2 or between S4 and S3)</td>
<td>30 ms...3 s in 10-ms increments (See note 1.)</td>
<td>3 s</td>
</tr>
</tbody>
</table>

Note 1: The timer SV must be longer than the NE1A-series controllers cycle time.

Note 2: Each input must be set according to the sensor detection method.

- 1 input: Simultaneous input
- 2 inputs: Time-difference input 1 (parallel)
- 4 inputs (forward): Time-difference input 1 (serial)
- 4 inputs (bidirectional): Time-difference input 2

1. Double-click the Restart function block and notice that several functions within the block can be set up.
2. From the Parameter tab, click Reset Signal.

3. For the value, select Rising Edge from the pull-down menu.

   For this application example, it does not matter what is selected for the Reset type because a momentary switch is used.

4. Connect these blocks to the inputs and outputs that were chosen earlier.

5. Click the Input tab in the Function list.

6. Expand the SmartGuard inputs.

7. Expand the Safety Input section.

8. Observe the local inputs that were configured earlier. Similarly, observe the local outputs.
9. Create the connections between the function blocks and connect the input and output signals as shown.

10. Click Apply in the upper left corner of the editor.

11. Click OK to confirm.


13. Click the SmartGuard Properties dialog to send the program to the controller.

14. Click Apply to confirm.
Online Monitoring (Not Muted)

In these steps the contactors are energized and the code is monitored.

1. Click the Mode/Cycle Time tab.

The SmartGuard controller can be changed from Idle mode or Program mode to Execute or Run mode.

2. Click Change Mode at the bottom of the window.

3. Click Execute and then OK to change modes.

The contactors should energize.

4. To observe the program online, return to the Logic tab and click Edit.
5. Click the Monitoring button to begin observing the code online.

The Light Curtain inputs and the relay outputs turn green to indicate that they are logically true.

6. Press the Reset button.

The contactors connected to the Safety outputs will turn on.
Performance Data

**Timing Chart For Time-difference Input Pattern 2: Entrance**

**Timing Chart For Time-difference Input Pattern 2: Exit**

**Forward Motion (muting)**
Additional Resources

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

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SmartGuard 600 Controller User Manual, publication 1752-UM001</td>
<td>Provides information for configuring, operating and troubleshooting the SmartGuard 600 controller.</td>
</tr>
<tr>
<td>ArmorBlock Guard I/O DeviceNet Safety Module Installation Instructions, publication 1732DS-IN001</td>
<td>Provides installation instructions for ArmorBlock Guard I/O DeviceNet Safety Module.</td>
</tr>
<tr>
<td>Guard I/O DeviceNet Safety Modules User Manual, publication 1791DS-UM001</td>
<td>Provides information for configuring, operating and troubleshooting Guard I/O DeviceNet Safety Modules.</td>
</tr>
<tr>
<td>GuardShield Safety Light Curtain and GuardShield Remote Teach Installation Instructions, publication PN-20857</td>
<td>Provides installation instructions for GuardShield Safety Light Curtain.</td>
</tr>
<tr>
<td>Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1</td>
<td>Provides general guidelines for installing a Rockwell Automation industrial system.</td>
</tr>
</tbody>
</table>

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