Hazardous Location Switch Amplifiers with Safeguarding Devices

Bulletin Number 937TH
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.

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.

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

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

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>937-SG001-EN-P</td>
<td>Intrinsic Safety Module Selection Guide</td>
</tr>
<tr>
<td>937-PP001-EN-P</td>
<td>Bul. 937 Intrinsic Safety Modules Product Profile</td>
</tr>
<tr>
<td>5117-CA001-EN-P</td>
<td>Safety Products Catalog</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>
<tr>
<td>Product Certifications website, <a href="http://www.ab.com">http://www.ab.com</a></td>
<td>Provides declarations of conformity, certificates, and other certification details.</td>
</tr>
</tbody>
</table>

You can view or download publications at [http://www.rockwellautomation.com/literature/](http://www.rockwellautomation.com/literature/). To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.
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Introduction

The purpose of this document is two-fold:

1. Shows examples of how certain safeguarding devices should be connected to the Bul. 937 isolating switch amplifiers when safeguarding device are needed in Class I, Division 1 (Zones 0 and 1) hazardous locations.

2. Indicates what Category and Performance Level can be achieved in accordance with ISO 13849-1.

These switch amplifiers have a SIL 2 rating per IEC 61508.

ATTENTION: You are responsible for ensuring and documenting that your safety system meets all the requirements of either ISO 13849-1 or IEC 61508 and the hazardous location requirements, as applicable.

The switch amplifiers that are included in this report listed in the table below. These require 24V DC supply. Allen-Bradley® also offers these same products in 115V AC and 230V AC supply.

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>937TH-DISAR-DC2</td>
<td>Dual channel with relay output</td>
</tr>
<tr>
<td>937TH-DISRS-DC1</td>
<td>Single channel with relay output</td>
</tr>
<tr>
<td>937TH-DISAT-DC2</td>
<td>Dual channel with transistor output</td>
</tr>
<tr>
<td>937TH-DISTS-DC1</td>
<td>Single channel with transistor output</td>
</tr>
</tbody>
</table>

The safeguarding devices in this document are considered simple devices. They act as simple switches, not requiring external power sources to execute their function. These include three types of products:

- Those interlocks that contain only mechanically actuated contacts (not guardlocking or solid-state outputs). e.g., Elf™, Cadet™, Trojan™, MT-GD2
- Safety mats
- Safety edges

This application guide uses a Guardmaster® Safety Relay DIS as the interface to the switch amplifiers. The DIS has two dual-channel inputs and performs pulse testing of its inputs when mechanical contacts are used. Many other safety relays can be substituted for the DIS relay.

WARNING: You must determine that the switch amplifier is approved for the intended hazardous location.
Switch Amplifiers

Block Diagrams

The block diagrams of the dual output switch amplifiers are shown in Figure 1. Note the key characteristics:

Figure 1 - Block Diagrams

1. The hazardous location side terminals are: 1/2 and 3/4. Note the + and - notations. The output voltage on the hazardous side is 10V max, and the current is limited to 17.1 mA.

2. All have the same nonhazardous location side terminals: 5/6, 7/8. The maximum rating of the transistors is 30V DC.

3. Both have four switch setting on the front: These switch settings are marked S1, S2, S3, and S4. They can be set to positions I or II. The single channel unit only uses S1- S3.

4. Both have DIN Rail connections: power, ground, and an error output.

5. This document shows most wiring examples with the relay output to take advantage of the pulse testing diagnostics of the downstream safety relay. The transistor output units provide the same safety performance level, but with fewer diagnostics.
Safety Ratings

These amplifiers are rated up to SIL 2 for safety performance against IEC61508. Based on their SIL 2 data, the following data can be used to determine their performance level in accordance with ISO13849-1.

These amplifiers have a hardware fault tolerance (HFT) of 0. This means that a single fault can lead to a dangerous failure. As such, they can only achieve a maximum rating of Cat 2 per ISO13849-1, provided a testing capability is added. If no testing is added, then the rating is Cat 1. However, if two amplifiers are used in parallel, the circuit structure can meet Cat 3.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Relay Output</th>
<th>Transistor Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware Fault Tolerance (HFT)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ISO13849-1 Category</td>
<td>1 if using only one</td>
<td>1 if using only one</td>
</tr>
<tr>
<td></td>
<td>3 if two used in parallel</td>
<td>3 if two used in parallel</td>
</tr>
<tr>
<td>λ_total (safety function)</td>
<td>254 FIT</td>
<td>137 FIT</td>
</tr>
<tr>
<td>Single Channel</td>
<td>309 FIT</td>
<td></td>
</tr>
<tr>
<td>Dual Channel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Switch Amplifier LEDs

The description of the LEDs applies to the example schematics in this document.

<table>
<thead>
<tr>
<th>LED</th>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWR</td>
<td>Green</td>
<td>24V DC Power is applied between terminals 9 and 10.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>No Power applied between terminals 9 and 10.</td>
</tr>
<tr>
<td>OUT/CHK</td>
<td>Amber</td>
<td>1. Input is closed or 2. a low resistance or short circuit exists across R2 or R4 when the input is open.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>1. Input is open or 2. R1 or R3 is exhibiting a high resistance with the input closed.</td>
</tr>
<tr>
<td></td>
<td>Flashing Red</td>
<td>A low resistance or short circuit across R1 or R3 when the input is closed.</td>
</tr>
</tbody>
</table>
Chapter 3

Interlock with Mechanical Contacts

The Trojan T15 safety interlock switch has two mechanical contacts. These contacts are normally closed when the gate is closed. The four switch settings on the switch amplifier must be set for normal operation and line fault detection.

**Cat 1 PLC Example Schematic**

![Cat 1 PLC Example Schematic](image)

**Circuit Operation**

With the safety gate closed, the contacts of the interlock are closed. With the E-stop reset, the DIS is ready for Reset. Press the Reset button to enable the drive. Press the Start button to start the drive. Opening the safety gate or pressing the E-stop initiates a Category 0 stop. The motor coasts to a stop.
Fault Analysis

1. An open circuit on either of the Trojan T15 circuits immediately causes the safety relay to issue a stop command to the PF525 drive, if it is running or prevents the starting of the motor.

2. A short circuit across either of the T15 contacts is detected when the safety gate goes from an open to closed state.

3. Short circuits at terminals 5, 6, 7, and 8 to 24V or to ground are detected by the pulse testing DIS safety relay and immediately result in a safe-state.

4. Short circuits between any two of terminals 5, 6, 7, and 8 are detected by the pulse testing DIS safety relay and immediately result in a safe-state.

5. The Bul. 937 switch amplifier has a hardware fault tolerance of 0, so a single fault can lead to both outputs being on, and therefore the PF525 drive will not turn off when the safety gate is opened.

Although the Bul. 937 has a hardware fault tolerance of 0, the use of the dual channel switch amplifier along with using both contacts of the interlock switch is preferred over the single-channel switch amplifier.

Safety Rating

The safety function that is initiated by the Trojan T15 interlock switch has a maximum rating of Category 1, performance level of PLc per ISO13849-1. This rating is due to the zero hardware fault tolerance of the Bul. 937TH.

The safety function that is initiated by the E-stop push button has a maximum rating Category 3 performance level of PLd per ISO13849-1. This rating is limited by the rating of the PowerFlex PF525 drive.
**SISTEMA Help**

When entering the Bul. 937 into SISTEMA, the subsystem must be assigned Category 1, due to the zero hardware fault tolerance. Be sure to check the three boxes in the “Requirements for Category.”

**Figure 3 - Cat 1 PLC Requirement for Category**

At the Element level, enter 309 into the “Rate of dangerous failure.”

**Figure 4 - Rate of Dangerous Failure**
Cat 3 PLd Example Schematic

Two single-channel switch amplifiers are required to achieve a Cat 3 PLd. One contact from the interlock switch is connected to one of the switch amplifiers; the other contact is connected to the second switch amplifier.

Figure 5 - Cat 3 PLd Example Schematic

Circuit Operation

With the safety gate closed, the contacts of the interlock are closed. With the E-stop reset, the DIS is ready for Reset. Press the Reset button to enable the drive. Press the Start button to start the drive. Opening the safety gate or pressing the E-stop initiates a Category 0 stop. The motor coasts to a stop.
Fault Analysis

1. An open circuit on either of the Trojan T15 circuits causes the safety relay to issue a stop command to the PF525 drive, if it is running or prevents the starting of the motor.

2. A short circuit across either of the T15 contacts is detected when the safety gate goes from an open to closed state.

3. Short circuits at terminals 5 and 6 to 24V or to ground are detected by the pulse testing DIS safety relay and immediately result in a safe-state.

4. Short circuits between any two of terminals 5 and 6 of both amplifiers are detected by the pulse testing DIS safety relay and immediately result in a safe-state.

5. If one of the Bul. 937 switch amplifiers fail to danger with its output on, the DIS safety relay performs the safety function due to the proper performance of the second amplifier.

Safety Rating

The safety function that is initiated by the Trojan T15 interlock switch has a maximum rating Category 3, performance level of PLd per ISO13849-1. With two Bul. 937 switch amplifiers connected in parallel, the hardware fault tolerance is 1. The DIS safety relay performs diagnostics on the two switch amplifiers to raise the diagnostic coverage to >60%.

The safety function that is initiated by the E-stop push button has a maximum rating Category 3 performance level of PLd per ISO13849-1. This rating is limited by the rating of the PowerFlex PF525 drive.
SISTEMA Help

When entering the Bul. 937 into SISTEMA, the subsystem must be assigned Category 3, due to the single-hardware fault tolerance. Be sure to check the three boxes in the “Requirements for Category.”

**Figure 6 - Cat3 PLd Requirements for Category**

Since we are using the single channel device, use $254$ for the FIT rate of each channel.

**Figure 7 - Rate of Dangerous Failure**
The DIS safety relay performs diagnostic coverage of at least 60%.

**Figure 8 - Diagnostic Coverage**

With the dual channel device, a Common Cause Failure number must be entered. You must ensure that their practices employed reach a value of 65.

**Figure 9 - CCF Number**
Notes:
Chapter 4

Safety Mats

Allen-Bradley Guardmaster safety mats are constructed as two parallel plates. Two wires are attached to each plate. As such, two special conditions must be considered.

1. When you step on the mat, a short circuit condition is created. The interfacing device must be able to detect and handle the difference between the open and short circuit conditions.

2. The parallel plates of the mat act as a capacitor. The bigger the mat systems; the larger the capacitance value. Therefore the interfacing device must be able to ignore the influence of the capacitor effect.

One plate of the mat is connected to both of the “+” sides (terminals 1 and 3) of the switch amplifier, and the other plate is connected to the “-” sides (terminals 2 and 4).

Switches S1 and S2 are set to Inverted Operation and S3 and S4 are set for enable Line Fault detection.
Operating Performance

Figure 11 shows an example of the input switch signal for a large safety mat system. A capacitance substitution box was connected in parallel with a sample mat to simulate the large mat system. The switch amplifier performed properly with capacitance values up to 59 μF. This far exceeds that maximum allowable mat size for safety relays, which is 100 square meters.

When stepping on the mat, a short circuit condition exists and the signal goes directly to 0 volts. When stepping off the mat, the switch amplifier must charge the capacitance of the plates, so the turn on signal is a little slower, depending on the capacitance of the safety mat.

Figure 11 - Large Safety Mat System Input Switch Signal

Note: Fast actuations (5...28 ms) of the safety mat can cause the DIS safety relay to turn OFF and stay OFF. To rectify this condition, simply step on the mat again.

Fault Analysis

1. An open circuit of any mat wires is not detected immediately; the open circuit is detected when the operator steps on the mat (demand is placed on the safety function). Stepping on the mat causes the safety relay to turn off. When the operator steps off the mat the switch amplifier will not reset.

2. Since the connections are between + and -, a short circuit across these connections is the same as stepping on the mat. The outputs turn OFF and the machine goes to a safe (OFF) state.

3. Short circuits at terminals 5, 6, 7, and 8 to 24V or to ground are detected by the pulse testing DIS safety relay and immediately result in a safe-state.

4. Short circuits between any two of terminals 5, 6, 7, and 8 are detected by the pulse testing DIS safety relay and immediately result in a safe-state.

5. The Bul. 937 switch amplifiers have a hardware fault tolerance of 0, so a single fault can lead to both outputs being on, and therefore the PF525 drive will not turn off when someone is stepping on the safety mat.
Safety Rating

The safety function that is initiated by the safety mat has a maximum safety rating of Cat 1, PLc per ISO 13849-1.

The safety function that is initiated by the E-stop has a maximum safety rating of Cat 3, PLd per ISO 13849-1. This safety rating is limited by the safety rating of the PF525 drive.

Cat 3 PLd Example Schematic

One plate of the mat is connected to both of the “+” sides (terminals 1) of the switch amplifier, and the other plate is connected to the “-” sides (terminals 2).

Switch S1 is set to Inverted Operation, and S3 is set to enable Line Fault detection.
Operating Performance

With the absence of anyone on the mat, the outputs of the switch amplifiers are on. With the E-stop reset, the DIS safety relay is ready for reset. Press the reset button to enable the PF525. Press the Start button to start the motor turning.

Stepping on the mat causes the outputs of the switch amplifiers to turn OFF. This, in turn, causes the outputs of the DIS safety relay to turn OFF. The PF525 drive executes a category 0 stop and the motor coasts to a stop.

Fault Analysis

1. An open circuit of any of the mat wires is not detected immediately; the open circuit is detected when the operator steps on the mat (demand is placed on the safety function). Stepping on the mat causes the safety relay to turn off. When the operator steps off the mat the switch amplifier will not reset.

2. Since the connections are between + and -, a short circuit across these connections is the same as stepping on the mat. The outputs turn OFF, and the machine goes to a safe (OFF) state.

3. Short circuits at terminals 5, 6, 7, and 8 to 24V or to ground are detected by the pulse testing DIS safety relay and immediately result in a safe-state.

4. If one of the Bul. 937 switch amplifiers fails to danger with its output on, the DIS safety relay performs the safety function due to the proper performance of the second amplifier.

Safety Rating

The safety function that is initiated by the safety mat has a maximum safety rating of Cat 3, PLd per ISO 13849-1.

The safety function that is initiated by the E-stop has a maximum safety rating of Cat 3, PLd per ISO 13849-1. This safety rating is limited by the safety rating of the PF525 drive.
Chapter 5

Safedge

The Allen-Bradley Guardmaster Safedge™ safety edges are constructed with conductive and non-conductive rubber. Two wires run the full length of the edge. As such, two special conditions must be considered.

1. When you depress the edge, a small resistance is created. As you further depress the edge, the resistance drops. The interfacing device must be able to detect the small resistance.

2. The energy provided by the interfacing device must not cause the Safedge to burn (for example, do not connect the Safedge directly across 24V.)

Cat 1 PLC with Internal Resistor Example Schematic

Since the Safedge is a normally open safety device, two resistors are required in the hazardous location side to detect faults.

The Safedge can be ordered with either a 6K or 15K internal terminating resistor. Although both resistors will work, the 6K termination is recommended because the 15K resistor causes a delay in turning off (i.e., increased response time).

The 1K series resistor has tolerance from 400…2K.

Figure 13 - Cat 1 PLC with Internal Resistor Example Schematic
**Operating Performance**

With no pressure applied to the edge, the output of the switch amplifier is closed. With the E-stop released, the DIS is ready for reset. Press the reset button, and the PF525 drive is ready to run. Use the Start and Stop buttons to turn the motor on and off.

When enough pressure is applied to the edge, the circuit inside the edge is closed. The switch amplifier turns off its outputs and the DIS relay commands the PF525 drive to execute a Category 0 (coast to) stop.

**Note:** Very fast actuations (5 to 28ms) of the edge may cause the DIS safety relay to turn OFF and stay OFF. To rectify this condition, simply press the edge again.

**Failure Analysis**

1. An open circuit on the edge is detected immediately by the Bul. 937 switch amplifier. The amplifier turns off its output and initiates a coast to stop command to the PF525 drive.

2. A short circuit in the edge circuit is similar to applying pressure to the edge. The Bul. 937 immediately detects the short circuit and initiates a stop command.

3. A short circuit of terminals 1 or 2 to +24V or to ground has no effect on the performance of the safety system. This is because these terminals are galvanically isolated from the power supply.

4. Short circuits at terminals 5, 6, 7, and 8 to 24V or to ground will be detected by the pulse testing DIS safety relay and immediately result in a safe state.

5. The Bul. 937 switch amplifier has a hardware fault tolerance of 0, so a single fault may lead to both outputs being on, and therefore the PF525 drive will not turn off when the edge is pressed.

**Safety Rating**

The safety function that is initiated by the safety edge has a maximum safety rating of Cat 1, PLc per ISO 13849-1.

The safety function that is initiated by the E-stop has a maximum safety rating of Cat 3, PLd per ISO 13849-1. This safety rating is limited by the safety rating of the PF525 drive.
The Safedge product can also be ordered with entrance and exit wires and no internal resistor. When ordered this way, the Safedge can be connected to a dual input switch amplifier.

**Figure 14 - Cat 1 PLC without Internal Resistor Example Schematic**

Note that the positive connection of the edge must be connected to the positive voltage terminals of the switch amplifier.

Switches S1 and S2 are set to Inverted Operation, and S3 and S4 are set to enable Line Fault detection.

**Operating Performance**

With no pressure applied to the edge, the output of the switch amplifier is closed. With the E-stop released, the DIS is ready for reset. Press the reset button, and the PR525 drive is ready to run. Use the Start and Stop buttons to turn the motor on and off.

When enough pressure is applied to the edge, the circuit inside the edge is closed. The switch amplifier turns off its outputs, and the DIS relay commands the PF525 drive to execute a Category 0 (coast to) stop.

**Note:** Very fast actuations (5...28 ms) of the edge may cause the DIS safety relay to turn OFF and stay OFF. To rectify this condition, simply press the edge again.
Failure Analysis

1. An open circuit on the edge is detected by the DIS safety relay when the edge is pressed. When the edge is released, the DIS safety relay turns OFF and remains OFF until the fault is corrected and the edge is cycled.

2. A short circuit in the edge circuit is similar to applying pressure to the edge. The Bul. 937 immediately detects the short circuit and initiates a stop command.

3. A short circuit of terminals 1 or 2 to +24V or to ground has no effect on the performance of the safety system. This is because these terminals are galvanically isolated from the power supply.

4. Short circuits at terminals 5, 6, 7, and 8 to 24V or to ground will be detected by the pulse testing of the DIS safety relay and immediately result in a safe state.

5. The Bul. 937 switch amplifier has a hardware fault tolerance of 0, so a single fault may lead to both outputs being on, and therefore the PF525 drive will not turn off when the edge is pressed.

Safety Rating

The safety function that is initiated by the safety edge has a maximum safety rating of Cat 1, PLc per ISO 13849-1.

The safety function that is initiated by the E-stop has a maximum safety rating of Cat 3, PLd per ISO 13849-1. This safety rating is limited by the safety rating of the PF525 drive.
Cat 3 PLd Example Schematic

Using the Safedge with entrance and exit wires and two single channel switch amplifiers, a Cat 3 PLd rating can be achieved.

Figure 15 - Cat 3 PLd Example Schematic

Note that the positive connection of the edge must be connected to the positive voltage of the switch amplifiers.

Switch S1 is set to Inverted Operation, and S3 is set to enable Line Fault detection.
**Operating Performance**

With no pressure applied to the edge, the outputs of the switch amplifiers are closed. With the E-stop released, the DIS is ready for reset. Press the reset button, and the PF525 drive is ready to run. Use the Start and Stop buttons to turn the motor on and off.

When enough pressure is applied to the edge, the circuit inside the edge is closed. The switch amplifier turns off its outputs and the DIS relay commands the PF525 drive to execute a Category 0 (coast to) stop.

**Note:** Very fast actuations (5...28ms) of the edge may cause the DIS safety relay to turn OFF and stay OFF. To rectify this condition, simply press the edge again.

**Fault Analysis**

1. An open circuit on the edge is detected by the DIS safety relay when the edge is pressed. When the edge is released, the DIS safety relay remains OFF until the fault is corrected and the edge is cycled.

2. Since the connections are between + and -, a short circuit across these is the same as applying pressure to the edge. The outputs turn OFF and the machine goes to a safe (OFF) state.

3. Short circuits at terminals 5, 6, 7, and 8 to 24V or to ground will be detected by the pulse testing DIS safety relay and immediately result in a safe state.

4. Short circuits between any two of terminals 5, 6, 7, and 8 will be detected by the pulse testing DIS safety relay and immediately result in a safe state.

5. If one of the Bul. 937 switch amplifiers fails to danger with its output on, the DIS safety relay will perform the safety function due to the proper performance of the second amplifier.

**Safety Rating**

The safety function that is initiated by the safety edge has a maximum safety rating of Cat 3, PLd per ISO 13849-1.

The safety function that is initiated by the E-stop has a maximum safety rating of Cat 3, PLd per ISO 13849-1. This safety rating is limited by the safety rating of the PF525 drive.
Chapter 6

Transistor Output

The transistor output switch amplifier can be used instead of the relay output. The safety rating remains the same. Some faults are not detected, but do not lead to the loss of the safety function.

Schematic

In the schematic below, the dark lines are different as compared to the switch amplifier with relay outputs.

Figure 16 - Example Schematic
## Fault Analysis

<table>
<thead>
<tr>
<th>Fault Description</th>
<th>DIS Output Status Before Fault</th>
<th>Status After Fault</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>S12 to 24V DC ON</td>
<td>Not detected. Will be detected by the DIS on next demand.</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>S12 to 24V Common ON</td>
<td>Detected - DIS output turns OFF No change to 937TH</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>S22 to 24V DC ON</td>
<td>Not detected. Will be detected by the DIS on next demand.</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>S22 to 24V Common ON</td>
<td>Detected - DIS output turns OFF No change to 937TH</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>S12 to S22 ON</td>
<td>Not detected</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>S12 to 24V DC OFF</td>
<td>Not detected immediately. The DIS will detect this fault after the next demand.</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>S12 to 24V Common OFF</td>
<td>Not detected immediately. The DIS will detect this fault after the next demand.</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>S22 to 24V DC OFF</td>
<td>Not detected immediately. The DIS will detect this fault after the next demand.</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>S22 to 24V Common OFF</td>
<td>Not detected immediately. The DIS will detect this fault after the next demand.</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>S12 to S22 OFF</td>
<td>Not detected</td>
<td>OK</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** OK status means that the output of the DIS was in a safe state after the fault was introduced.
Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At [http://www.rockwellautomation.com/support](http://www.rockwellautomation.com/support) you can find technical and application notes, sample code, and links to software service packs. You can also visit our Support Center at [https://rockwellautomation.custhelp.com/](https://rockwellautomation.custhelp.com/) for software updates, support chats and forums, technical information, FAQs, and to sign up for product notification updates.

In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit [http://www.rockwellautomation.com/services/online-phone](http://www.rockwellautomation.com/services/online-phone).

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

<table>
<thead>
<tr>
<th>United States or Canada</th>
<th>1.440.646.3434</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside United States or Canada</td>
<td>Use the Worldwide Locator at <a href="http://www.rockwellautomation.com/rockwellautomation/support/overview.page">http://www.rockwellautomation.com/rockwellautomation/support/overview.page</a>, or contact your local Rockwell Automation representative.</td>
</tr>
</tbody>
</table>

New Product Satisfaction Return

Rockwell Automation tests all of its products to help ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

<table>
<thead>
<tr>
<th>United States</th>
<th>Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside United States</td>
<td>Please contact your local Rockwell Automation representative for the return procedure.</td>
</tr>
</tbody>
</table>

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/](http://www.rockwellautomation.com/literature/).


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