

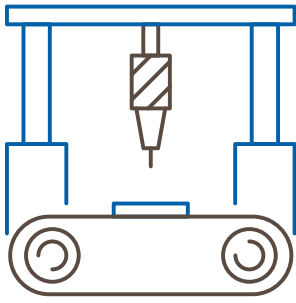


Altech's Solution to Fault Masking

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Introduction

How do you really know when there is a fault with your machine? Is there any way a fault can be “masked” as though it’s not really there, making your machine more dangerous to personnel? The unfortunate answer to this last question is yes, which leads to the need for a solution, which is why we created this white paper.



Let us explain how this situation can even occur. When several safety switches are wired in a series configuration, often called a daisy chain, and a single contact or wire short occurs in one of the safety switch components—such as a door or panel monitoring switch—it is detected by the safety relay the moment the door or panel is opened. Typically, a safety relay goes into a “fault” mode, which requires the error to be corrected and power be reset to the safety relay before the machine can be restarted.

A masking situation occurs when the door with a shorted fault is closed, and a different door is opened and then closed again. This creates an unintended resetting of the safety relay overriding the detection of the original fault. This means that the control system essentially interprets that sequence of operations as an indication that the fault has been corrected. At this point, the machine can be restarted—even though the original fault condition still exists.

This sequence of events could possibly lead to what is called a double fault, where both safety channels of the monitoring switch or sensor short without detection. This allows the faulty door or panel to be opened while the machine is running, putting the machine and personnel in danger. ISO has addressed this situation with ISO/TR 24119: Safety of Machinery—Evaluation of fault masking serial connection of interlocking devices associated with guards with potential free contacts.



Preventing Fault Masking

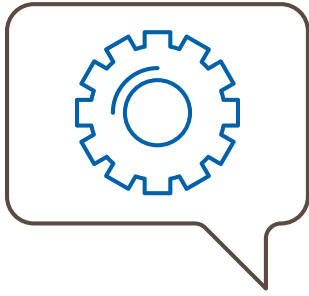
To prevent fault masking, Altech has introduced its SMART Safety System that features redundant OSSD (Output Signal Switching Device) safety outputs (Fig. 1). The SMART Safety System offers a safety rating of up to PLe, Cat.4/SIL CL 3 even when multiple switches are used in series via redundant OSSD outputs. How the SMART system works is that there are two pulsed 24 V dc signals used inside the device. The non-tripped state carries the 24 V signal, while the tripped state drops to 0 V dc.

The OSSD outputs self-check in this way: In the non-tripped state, the outputs periodically pulse low. The protective device checks the output to be sure it does go low when commanded to do so. If not, the output has either failed or shorted to 24 V somewhere. So, during an idle signal, the 24 V signal is periodically pulsed to 0 V. An active signal is issued when both lines present 0 V—a single line presenting 0 V for a duration longer than the test pulse indicates an event.



Fig. 1 RFID non-contact switch, with OSSD safety outputs and diagnostics, mounted on the door of a robotics cell.

Sensors are run in a cascading order. The first sensor checks its state and, if closed, sends a signal to the second sensor, which repeats this action and moves to the third sensor, and so on all the way down the line for up to 32 daisy chained sensors. This means that in the event of any interruption in this sequence of events—such as a door being opened, a panel being breached or any other fault that might prevent the final OSSD signal from reaching the last position—machine power will be turned off by the safety relay until the fault is repaired.



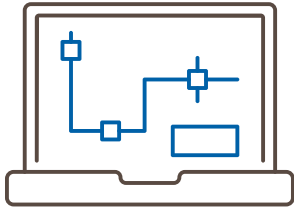
Diagnostics and Communications

Once a fault causes power to be shut down, the system needs to be able to diagnose where the problem lies and then communicate that information to the proper locations. In these instances, the more information available the better. Understanding the operations and potential challenges with your machinery translates into fewer interruptions in production and less downtime altogether.

Altech's DCD (Daisy Chain Diagnostics) system offers more than 20 different types of diagnostics information which can be monitored through the use of an internal bus system that acquires the information at the end of the series cable. Once the data is there it can be accessed by the machine's control system via IO-Link technology, allowing it to be displayed for analysis on an a standard USB port, PLC or Android Smartphone or tablet using NFC (Near Field Communications) technology (and can also be converted to be read by Profibus using a bridge). This diagnostics system operates completely independently of the safety outputs.

Another example of when the DCD system adds value is the SMART Safety System's "Fault Tolerant Outputs," which are used to prevent unnecessary machine shutdowns. If both OSSD safety outputs are lost—caused by an unsafe condition like a door being opened—the machine will immediately shut down. *However*, if only one output is lost, which can be the result of a fault in the sensor itself or its wiring, the sensor will indicate such a condition with a *flashing code* and transmit that event through the DCD system. After 20 minutes the machine will be shut down.



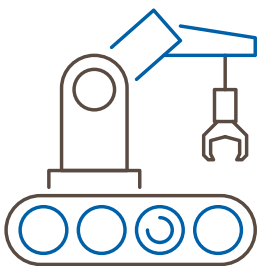


Additional Features and Benefits

The sensors offered by Altech are designed for series operation and feature easy plug-in installation and maintenance convenience through an M12 connection system. These sensors are designed to save time but also to eliminate wiring errors. Individual sensors are connected to the sensor chain “main line” using a T-connector, while the sensor chain main line incorporates a four-conductor unshielded cable for additional cost savings. The series line is ended using a standard terminal cap.

Depending on the device, different data are available, such as actuator detection, operating voltage warnings, status of internal or external feedback loop, actuator code received and device temperature. In order to simplify the assignment of information being collected the SMART Safety System is able to permanently assign a name and descriptive text to each device, safety chain and machine, making it easier for the user to identify the corresponding device.

A fault memory system stores typical fault data. In the DCD, error messages are stored using a time stamp and can be retrieved via all interfaces if needed. Thanks to the NFC function, this information can be read even if there is no voltage on the diagnostic module—providing efficient troubleshooting that leads to a faster restart time for defective machines.



Industry 4.0 and Machine Safety

For those companies seriously looking at the benefits of Industry 4.0 (Fig. 2), Altech offers a complete safety system line made up of the SRF safety sensor, Emergency Stop device, SEU connection box and Safety controller SCR DI. Designed in and operated properly, each of these lines provide specific characteristics that will help make your operation more efficient and safer.

The SRF is a non-contact RFID safety sensor used to monitor moveable guards such as flaps, doors and protective hoods. The sensors are compact and flexible for applications that require small footprints. As mentioned, they offer high defeat protections according to ISO/TR 24119. Each device accepts several coding types; offers diagnostics, including the DCD system that submits a complete status image of a sensor; and accepts intelligent sensor inputs, which allow mechanical contacts to be integrated into the series connection.

Their emergency stop and enclosure used for direct integration into an SRF sensor chain features a twist to release button and an optical status display via LED, as well as the transmission of the device status using the DCD diagnostic to the machine control system. Emergency stops provide simple integration into the sensor chain using M12 connections, which allows diagnostic information to be available for every emergency stop device available. The devices also monitor machine compliance via regular test cycles.



Fig 2. Smart safety system components run in series with M12 connectors to a safety/diagnostic relay.

SEU connection boxes provide for the connection of existing dry contact electromechanical safety switches and sensors, such as interlocks or other emergency stop devices, all of which can be integrated into the SRF safety chain. Status data can also be transmitted to the connection box via DCD diagnostics.

The company’s safety controller SCR DI is provided with IO-Link to provide the best in safety monitoring using OSSD signals. The system can provide diagnostic information via an Android smartphone with NFC capabilities to facilitate large cost savings during commissioning, maintenance and troubleshooting operations. The DCD diagnostic data is transmitted through the company’s IO-Link technology for safety monitoring, diagnostics and communications. Plus, its slim design saves space inside your control cabinet.

The incorporation of the proper safety components along every level of your application will assure that your equipment and people are safe. Each component must be designed in to adhere to ISO standards, while providing all the necessary safety features needed for your application. Altech’s solutions are geared toward saving time and costs during installation, maintenance and repair operations.