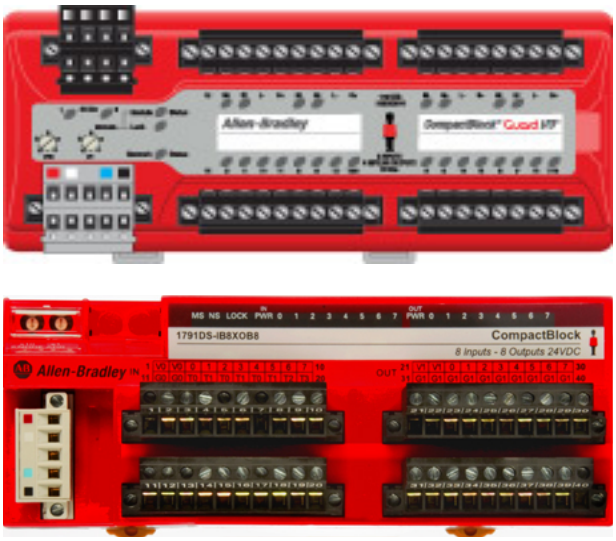
Use Cases of Guard I/O Modules Bipolar Output and Sourcing Output

Safety Rating: Category 3 or 4, according to EN954-1.



Introduction

The safety circuits illustrated in this Safety Application Example highlight the operation and differences between 1791DS-IB8XOBV4 (bipolar outputs) and 1791DS-IB8XOB8 (sourcing outputs).

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.

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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

Safety Function

With sourcing outputs, each output is wired to only one side of each load and the other side is grounded. One challenge with sourcing outputs is if a short to 24V DC occurs, power cannot be removed from the loads, keeping them energized.

With bi-polar outputs, two output terminations (labeled P and M) are wired to the load(s) with P and M switched on or off simultaneously. This design controls power flow to both sides of each load, making the circuit bipolar. With bi-polar outputs, a short to 24V DC will not cause the load(s) to energize since there is no path for current to flow.

Example Bill of Material

This application example refers to these components.

Catalog Number	Description	Quantity
1791DS-IB8XOBV4	Guard I/O module (8 inputs, 4 bipolar outputs)	1
1791DS-IB8XOB8	Guard I/O module (8 inputs, 8 sourcing outputs)	1
1791ES-IB8XOBV4	Guard I/O module (8 inputs 4, bipolar outputs)	*
1732DS-IB8XOBV4	Guard I/O module (8 inputs 4, bipolar outputs)	*

* These modules could be substituted in this example.

Basic Output Wiring – Sourcing Output and Bipolar Output

Conceptually, Figure 1 represents the major difference between the two circuits. The 1791DS-IB8XOB8 circuit is only a single fault away from a dangerous failure. The 1791DS-IB8XOBV4 circuit requires two faults (output 0 and output 1 shorted to 24V DC and Common, respectively) for a dangerous failure to occur.

Wiring

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

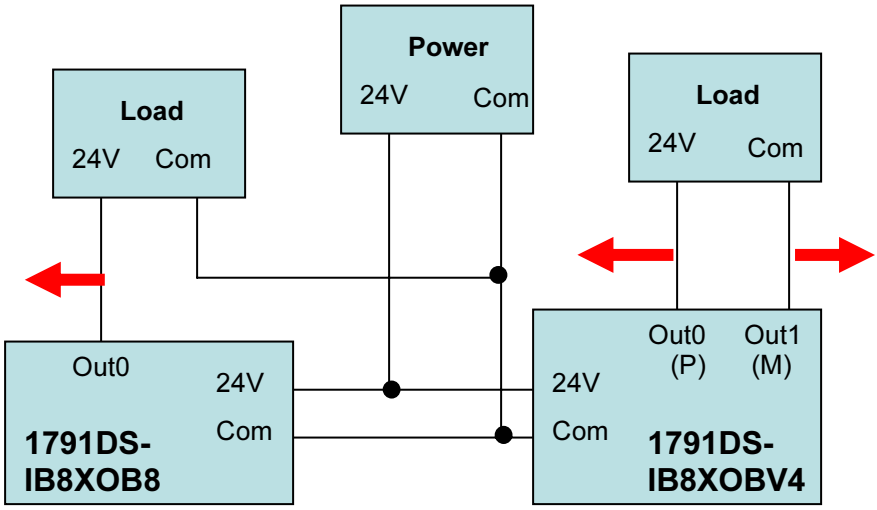

Figure 1: Basic wiring of sourcing output module (1791DS-IB8XOB8) and bipolar output module (1791DS-IB8XOBV4).

Typical Category 3 / Category 4 Output Circuit

Figure 2 illustrates how each module controls a typical redundant safety circuit. Each circuit uses two outputs, two wires, and two contactors which fulfills the typical requirements for CAT 3 and CAT 4 circuits. With the addition of the second contactor to each module, both circuits now require two faults before a dangerous failure occurs (see Figure 2). The difference with this circuit is that after the first fault, either the K1 or K2 contactor is energized, but neither the K3 nor K4 contactor is energized after a single fault because the other side of DC power can be dropped out. The fact that K1 or K2 can be energized by a single fault is not a safety issue because the redundant contactor is still able to drop out the load.

Wiring

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

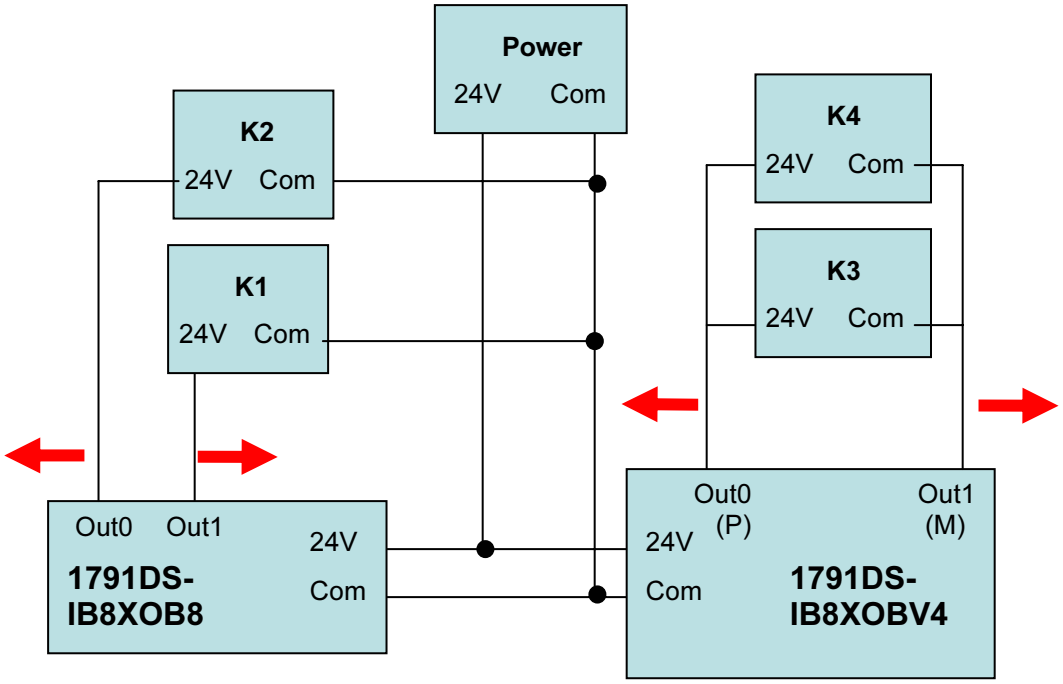

Figure 2: Typical Category 3 or 4 Output Circuit

Controlling Multiple Contactors with a Single Module

Typically, an 1791DS-IB8XOB8 and a 1791DS-IB8XOBV4 module control an equivalent number of contactors when wired for CAT 3 or CAT 4 systems (see Figure 3).

The examples shown here do not represent the maximum number of contactors that can be controlled by these modules. If multiple safety devices are within a single zone (see Figure 4), many contactors may be controlled by a single output or output pair. The limitation is the amount of current draw and more importantly, inrush current from the contactor coils. See Figure 4 for an example.

1791DS-IB8XOB8 circuits are rated for 0.5 A and 1791DS-IB8XOBV4 circuits are rated to 2 A. This lets additional contactors be used per output or zone for the 1791DS-IB8XOBV4 circuits.

1791DS-IB8XOBV4 circuits shut down when 2.5 A is reached. You must consider inrush current when designing these circuits.

Wiring

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

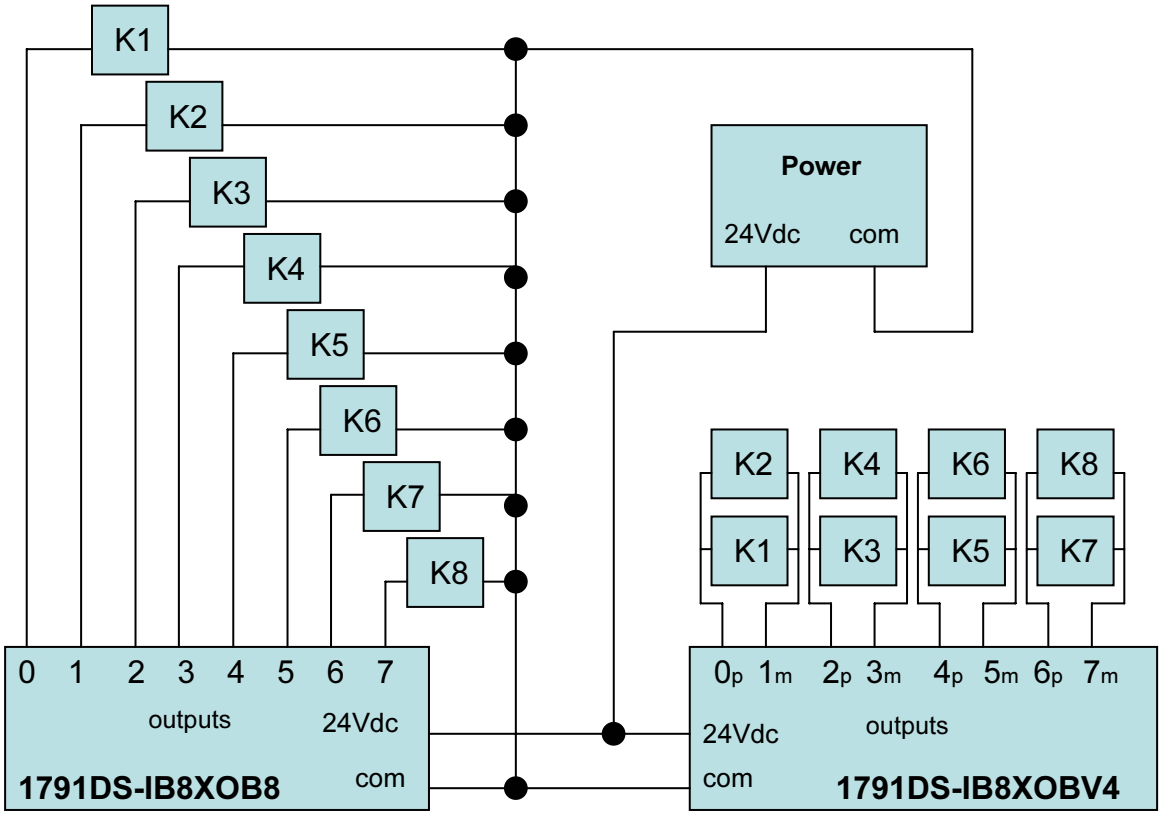

Figure 3: Typical wiring for safety output contactors

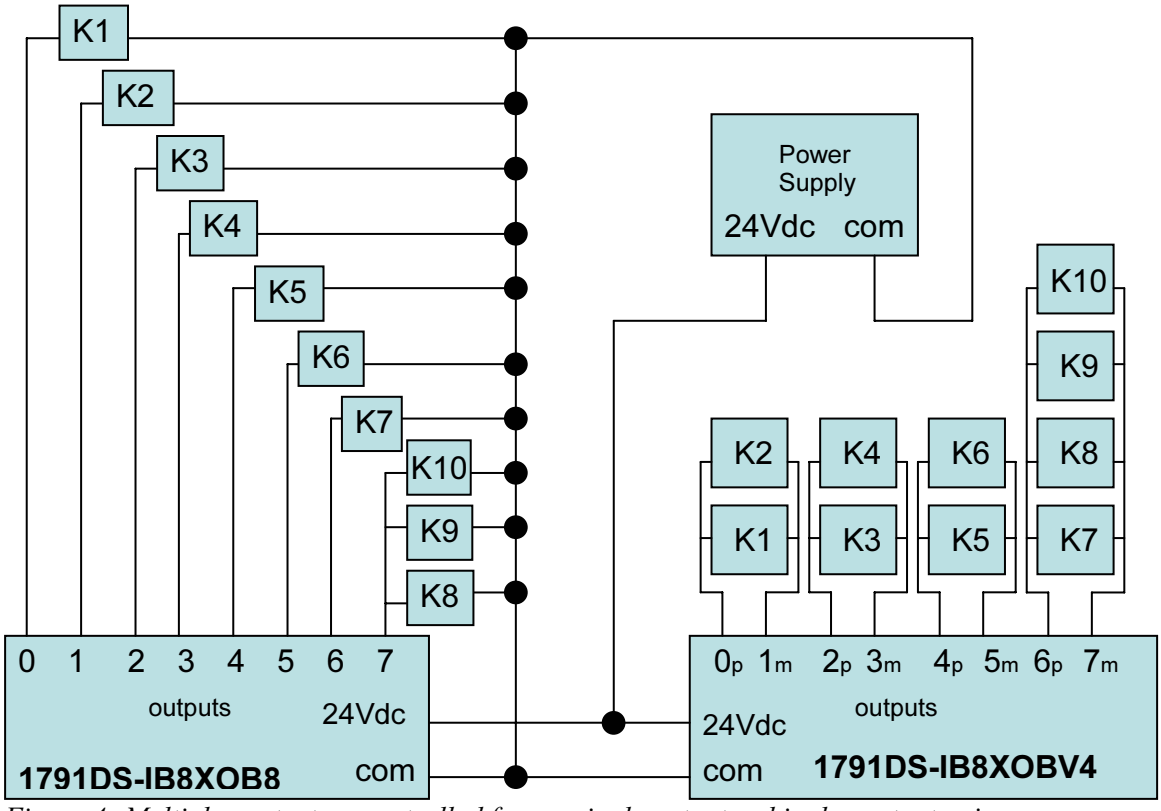

Figure 4: Multiple contactors controlled from a single output or bipolar output pair.

The P and M outputs on the 1791DS-IB8XOBV4 modules operate as an equivalent pair. There are four bipolar output pairs on the 1791DS-IB8XOBV4 and 1791ES-IB8XOBV4 modules, for example. These four pairs are:

- Output 0 / 1
- Output 2 / 3
- Output 4 / 5
- Output 6 / 7

These output pairs *must* be logically equivalent. If output 0 was logic 0 (LO) and output 1 was logic 1 (HI), both output channels would fault, and the output channel status would go LO.

For this reason, the wiring shown in Figure 5 CANNOT be used to increase the number of outputs that can be independently controlled using bipolar outputs. The two loads cannot be controlled individually, because P and M, an output pair, must always be logically equivalent.

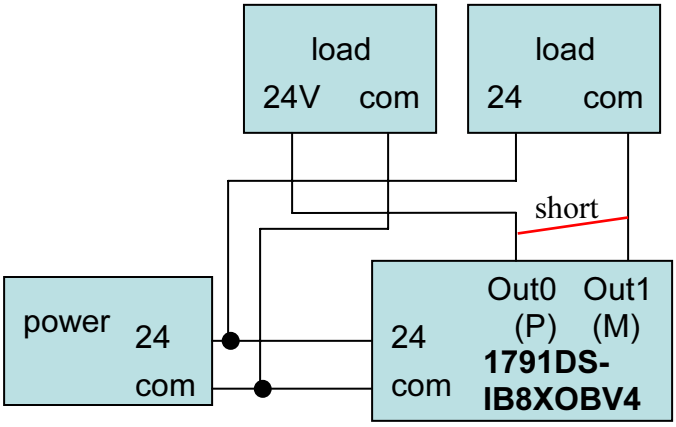

*Figure 5: **Incorrect** wiring (output pairs Out0 and Out1 must be logically equivalent)*

IMPORTANT	Even if you wish to control the loads above simultaneously, you cannot use this wiring because you are a single short away from a dangerous failure. The short between P and M, shown in Figure 5, causes both loads to energize with no way to turn them off, because the power source is external to the module.

When the safety outputs are wired to solid state inputs, then the bipolar pairs cannot be used and P must be the source of 24V DC. One example of this is the use of the safe stop inputs of the Guardmaster MSR57P speed monitoring safety relay.

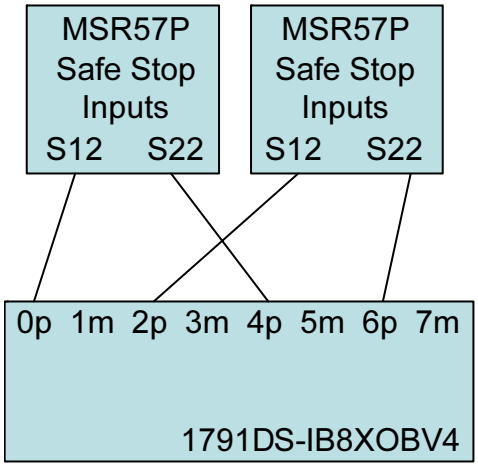

Figure 6: MSR57P relay with Guard I/O module

When controlling these types of inputs, Rockwell Automation recommends the wiring shown in Figure 6, because the eight outputs are electronically controlled by four components (in pairs) on the I/O module, as illustrated in Figure 7.

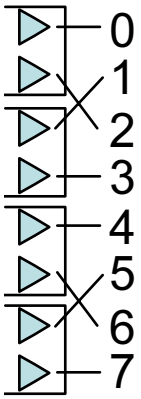

Figure 7: I/O module outputs

Do not control a dual input device, such as the MSR57P safe stop inputs using outputs 0 and 2 because they are controlled by the same operational amplifier within the I/O module. A failure of this single component could lead to a dangerous failure.

Reaction to Faults

Overall, 1791DS-IB8XOB8 and 1791DS-IB8XOBV4 output circuit faults react in a similar manner. The only exception occurs when an 1791DS-IB8XOB8 channel shorts to 24V DC. This is the only short for which the circuit cannot be shutdown.

This table lists all the shorts for these circuits and the basic module reaction to them.

Module	Short	Reaction
1791DS-IB8XOB8	Short to 24V DC	The pulse test detects a short, but the 24V DC source cannot be shutdown.
	Short to 0V DC	Overcurrent causes the circuit to shutdown.
	Channel-to-channel short	The pulse test detects shorted channels and drops them both out.
	Wire OFF	No fault is generated. The circuit simply drops out.
1791DS-IB8XOBV4	P short to 24V DC	The pulse test catches the fault. M is dropped out and the circuit shut down.
	M short to 0V DC	The pulse test catches the fault. P is dropped out and the circuit shut down.
	Channel-to-channel short	A direct short occurs between plus and minus. Overcurrent causes the circuit to shut down.
	P short to 0V DC	
	M short to 24V DC	
	Wire OFF	No fault is generated. The circuit simply drops out.

The only fault that is 'sticky' is an 1791DS-IB8XOB8 channel shorted to 24V DC. This fault causes the output status bits to remain LO until the short is fixed. All of the other faults clear, even if the short remains, when the following two conditions are met:

1 – The Output Error Latch Time expires
2 – Faulted outputs set the logic LO (0)

The only fault that is detectable when the outputs are in the OFF state is an 1791DS-IB8XOB8 channel shorted to 24V DC. Other faults are detectable on power-up. See Power Up Fault Detection on page 11 for more details.

As a result, for some faults other then 1791DS-IB8XOB8 channel shorted to 24V DC, you must be aware that the fault status within the module can clear itself even if the short still exists. This means that nothing prohibits a user from attempting to restart the outputs with the short still in place. When the restart is attempted, the outputs may go HI until the next pulse test (600 ms later), at which time the output channels are again shutdown. If this abbreviated restart is unacceptable due to hardware damage or other reasons, you must 'latch' that output channel fault, and use standard operational procedures to make sure that a restart is not attempted until the fault has been diagnosed and fixed.

The faults for which the restart could be an issue are the ones for which there is not a direct short between plus and minus. Overcurrent faults typically trip out the circuit before the outputs coils can fire. The faults where the restart is an issue are shown below in **bold**.

Module	Short	Reaction
1791DS-IB8XOB8	short to 24V DC	Restart is not an issue because status remains LO until the short is cleared.
	short to 0V DC	Restart is not an issue due to overcurrent.
	Channel-to-channel short	**Outputs will restart until next pulse test.**
	Wire OFF	Restart is not an issue because a circuit cannot be made.
1791DS-IB8XOBV4	P short to 24V DC	**Outputs will restart until next pulse test.**
	M short to 0V DC	
	Channel-to-channel short	Restart is not an issue due to overcurrent.
	P short to 0V DC	
	M short to 24V DC	
	Wire OFF	Restart is not an issue because a circuit cannot be made.

Another approach to avoiding the restart issue is to monitor the output circuits by wiring them back to inputs, and avoid restarting when these inputs are not in the correct state. For the 1791DS-IB8XOB8 channel-to-channel short, this scheme should work. However, the feedback wiring for the 1791DS-IB8XOBV4 circuits causes an issue that still needs to be resolved. The M (common side) needs an interposing relay so that it can be wired back to a 24V DC input. As shown in Figure 6, this creates a path from the 24V DC source, through the relay coil, into M, then through an internal module circuit back out P, and into In0. This causes In0, which is monitoring P, to always be HI.

Wiring

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

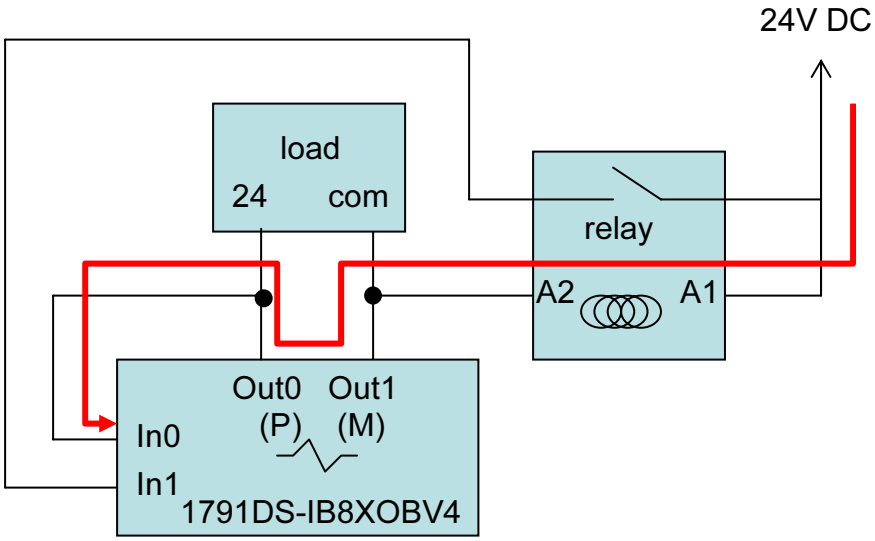

Figure 7: Outputs wired back into the inputs for monitoring.

Power-up Fault Detection

There are no differences between the 1791DS-IB8XOB8 and 1791DS-IB8XOBV4 circuits for power-up fault detection. Shorts to external 24V DC are detected on power-up on both modules. This table lists all possible faults and indicates if they are detected on power-up.

Module	Short	Detected on Power-up
1791DS-IB8XOB8	Short to 24V DC	Yes
	Short to 0V DC	No
	Channel-to-channel short	No
	Wire OFF	No
1791DS-IB8XOBV4	P short to 24V DC	Yes
	M short to 0V DC	No
	Channel-to-channel short	No
	P short to 0V DC	No
	M short to 24V DC	Yes
	Wire OFF	No

Fault Detection

In general, the outputs have to be energized for any faults to be detected. The only exception to this rule is that the 1791DS-IB8XOB8 module can detect a short to 24V DC when it is OFF.

An 1791DS-IB8XOBV4 module can detect a channel-to-channel short with or without pulse-testing, while the 1791DS-IB8XOB8 module requires a pulse test to detect this fault.

If pulse-testing not used on either 1791DS-IB8XOB8 module or the 1791DS-IB8XOBV4 module, then only faults that generate an overcurrent will be detected. Pulse-testing is required on either the 1791DS-IB8XOB8 module or the 1791DS-IB8XOBV4 module to detect the faults that do not generate an overcurrent.

The tables on the following pages illustrate the fault detection capabilities and reactions of the modules for different types of faults.

Fault Detection Tables

Data provided in the tables on the following pages was gathered by using the code from the Safety Accelerator Toolkit, SAFETY-CL002A-EN-C. Tables show fault conditions and reactions for each module.

1791DS-IB8XOB8 Faults When Outputs Are Energized

In the cases illustrated below, the fault occurred when outputs were energized. The Output Error Latch Time (OELT) is set to 5 seconds.

		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
Fault Condition		**Before OELT**	**During OELT**	**After OELT**	**Before OELT**	**During OELT**	**After OELT**
Short to 24V DC	Output Data	Hi/Hi	Lo/Lo	Lo/Lo	Fault Undetectable		
	Output Status	Hi/Hi	Lo/Lo	Lo/Lo			
	Readback	Hi/Hi	Hi/Lo	Hi/Lo			
	Status Indicators (Outputs)	Amber/Amber	Red/Flashing Red	Red/Flashing Red			
	ROUT Fault Present Bit	Lo	Hi	Hi			
Reaction: The fault is detected at power-up in both safety and safety pulse-test configurations. The output status bits remain LO until the fault is fixed. Restart is possible only after the fault is fixed.							

		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
Fault Condition		**Before OELT**	**During OELT**	**After OELT**	**Before OELT**	**During OELT**	**After OELT**
Short to 0V DC	Output Data	Hi/Hi	Lo/Lo	Lo/Lo	Hi/Hi	Lo/Lo	Lo/Lo
	Output Status	Hi/Hi	Lo/Lo	Hi/Hi	Hi/Hi	Lo/Lo	Hi/Hi
	Readback	Hi/Hi	Lo/Lo	Lo/Lo	Hi/Hi	Lo/Lo	Lo/Lo
	Status Indicators (Outputs)	Amber/Amber	Red/Flashing Red	Off/Off	Amber/Amber	Red/Flashing Red	Off/Off
	ROUT Fault Present Bit	Lo	Lo	Lo	Lo	Lo	Lo
Reaction: Overcurrent causes trip. Output status bits are held LO until Output Error Latch Time expires. Restart occurs until an overcurrent causes the circuit to trip.							

		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
Fault Condition		**Before OELT**	**During OELT**	**After OELT**	**Before OELT**	**During OELT**	**After OELT**
Channel -to-channel(1)	Output Data	Hi/Hi	Lo/Lo	Lo/Lo	Fault Undetectable		
	Output Status	Hi/Hi	Lo/Lo	Hi/Hi			
	Readback	Hi/Hi	Lo/Lo	Lo/Lo			
	Status Indicators (Outputs)	Amber/Amber	Red/Red	Off/Off			
	ROUT Fault Present Bit	Lo	Lo	Lo			
Reaction: Pulse test detects the short and both channels drop out. Output status bits are held LO until the Output Error Latch Time expires. Outputs will restart until the next pulse test.							

(1) No difference between single and dual-channel configurations.

		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
Fault Condition		**Before OELT**	**During OELT**	**After OELT**	**Before OELT**	**During OELT**	**After OELT**
Wire OFF	Output Data	Fault Undetectable| with 1 Feedback Wire			Fault Undetectable with 1 Feedback Wire		
	Output Status						
	Readback						
	Status Indicators (Outputs)						
	ROUT Fault Present Bit						
Reaction: The load drops out. With one feedback signal, the feedback signal remains LO. Restart is possible when the fault is fixed.							

1791DS-IB8XOB8 Faults When Outputs Are De-energized

In the cases illustrated below, the fault occurred when outputs were de-energized. The Output Error Latch Time (OELT) is set to 5 seconds.

		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
Fault Condition		**Before OELT**	**During OELT**	**After OELT**	**Before OELT**	**During OELT**	**After OELT**
Short to 24V DC	Output Data	Lo/Lo	Lo/Lo	Lo/Lo	Lo/Lo	Lo/Lo	Lo/Lo
	Output Status	Hi/Hi	Lo/Lo	Lo/Lo	Hi/Hi	Lo/Lo	Lo/Lo
	Readback	Lo/Lo	Hi/Lo	Hi/Lo	Lo/Lo	Hi/Lo	Hi/Lo
	Status Indicators (Outputs)	Off/Off	Red/Flashing Red	Red/Flashing Red	Off/Off	Red/Flashing Red	Red/Flashing Red
	ROUT Fault Present Bit	Lo	Hi	Hi	Lo	Hi	Hi
Reaction: The output status bits remain LO until the fault is fixed. Restart is possible only after the fault is fixed.							

		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
Fault Condition		**Before OELT**	**During OELT**	**After OELT**	**Before OELT**	**During OELT**	**After OELT**
Short to 0V DC	Output Data	Fault Undetectable			Fault Undetectable		
	Output Status						
	Readback						
	Status Indicators (Outputs)						
	ROUT Fault Present Bit						

		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
Fault Condition		**Before OELT**	**During OELT**	**After OELT**	**Before OELT**	**During OELT**	**After OELT**
Channel-to-channel	Output Data	Fault Undetectable			Fault Undetectable		
	Output Status						
	Readback						
	Status Indicators (Outputs)						
	ROUT Fault Present Bit						

		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
Fault Condition		**Before OELT**	**During OELT**	**After OELT**	**Before OELT**	**During OELT**	**After OELT**
Wire OFF	Output Data	Fault Undetectable|			Fault Undetectable		
	Output Status						
	Readback						
	Status Indicators (Outputs)						
	ROUT Fault Present Bit						

1791DS-IB8XOBV4 Faults When Outputs Are Energized

In the cases illustrated below, the fault occurred when outputs were energized. The Output Error Latch Time (OELT) is set to 5 seconds.

		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
Fault Condition		**Before OELT**	**During OELT**	**After OELT**	**Before OELT**	**During OELT**	**After OELT**
P Short to 24V DC	Output Data	Hi/Hi	Lo/Lo	Lo/Lo	Fault Undetectable		
	Output Status	Hi/Hi	Lo/Lo	Hi/Hi			
	Readback	Hi/Hi	Lo/Lo	Lo/Lo			
	Status Indicators (Outputs)	Amber/Amber	Red/Flashing Red	Off/Off			
	ROUT Fault Present Bit	Lo	Lo	Lo			
Reaction: The pulse test detects the short. M drops out. Output status bits are held LO until the Output Error Latch Time expires. Outputs will restart until the next pulse test.							

		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
Fault Condition		**Before OELT**	**During OELT**	**After OELT**	**Before OELT**	**During OELT**	**After OELT**
M Short to 0V DC	Output Data	Hi/Hi	Lo/Lo	Lo/Lo	Fault Undetectable		
	Output Status	Hi/Hi	Lo/Lo	Hi/Hi			
	Readback	Hi/Hi	Lo/Lo	Lo/Lo			
	Status Indicators (Outputs)	Amber/Amber	Flashing Red/Red	Off/Off			
	ROUT Fault Present Bit	Lo	Lo	Lo			
Reaction: The pulse test detects the short. P drops out. Output status bits are held LO until the Output Error Latch Time expires. Outputs will restart until the next pulse test.							

		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
Fault Condition		**Before OELT**	**During OELT**	**After OELT**	**Before OELT**	**During OELT**	**After OELT**
Channel -to- channel	Output Data	Hi/Hi	Lo/Lo	Lo/Lo	Hi/Hi	Lo/Lo	Lo/Lo
	Output Status	Hi/Hi	Lo/Lo	Hi/Hi	Hi/Hi	Lo/Lo	Hi/Hi
	Readback	Hi/Hi	Lo/Lo	Lo/Lo	Hi/Hi	Lo/Lo	Lo/Lo
P Short to 0V DC	Status Indicators (Outputs)	Amber/Amber	Red/Red	Off/Off	Amber/Amber	Red/Red	Off/Off
M Short to 24V DC	ROUT Fault Present Bit	Lo	Lo	Lo	Lo	Lo	Lo
Reaction: An overcurrent causes the circuit to trip. Output status bits are held LO until the Output Error Latch Time expires. Restart occurs until an overcurrent causes the circuit to trip.							

		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
Fault Condition		**Before OELT**	**During OELT**	**After OELT**	**Before OELT**	**During OELT**	**After OELT**
Wire OFF	Output Data	Hi/Hi	Lo/Lo	Lo/Lo	Hi/Hi	Lo/Lo	Lo/Lo
	Output Status(1)	Hi/Hi	Hi/Hi	Hi/Hi	Hi/Hi	Hi/Hi	Hi/Hi
	Readback	Hi/Hi	Lo/Lo	Lo/Lo	Hi/Hi	Lo/Lo	Lo/Lo
	Status Indicators (Outputs)	Amber/Amber	Off/Off	Off/Off	Amber/Amber	Off/Off	Off/Off
	ROUT Fault Present Bit	Lo	Hi	Hi	Lo	Hi	Hi
Reaction: The load drops out. ROUT FP depends on the location of the wire break. Output status bits are not held LO. Restart is possible when the fault is fixed. A feedback fault occurs if the wire breaks between the module and the first contactor because logic HI and feedback (FB) are undetectable if the wire breaks between contactors, assuming only one feedback wire.							

(1) No module faults if Wire OFF.

1791DS-IB8XOBV4 Faults When Outputs Are De-energized

In the cases illustrated below, the fault occurred when outputs were de-energized. The Output Error Latch Time (OELT) is set to 5 seconds.

Fault Condition		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
		Before OELT	During OELT	After OELT	Before OELT	During OELT	After OELT
PShort to 24V DC	Output Data	Fault Undetectable except on power-up (ON or OFF)			Fault Undetectable except on power-up (ON or OFF)		
	Output Status						
	Readback						
	Status Indicators (Outputs)						
	ROUT Fault Present Bit						

Fault Condition		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
		Before OELT	During OELT	After OELT	Before OELT	During OELT	After OELT
M Short to 0V DC	Output Data	Fault Undetectable			Fault Undetectable		
	Output Status						
	Readback						
	Status Indicators (Outputs)						
	ROUT Fault Present Bit						

Fault Condition		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
		Before OELT	During OELT	After OELT	Before OELT	During OELT	After OELT
Channel-to-channel P short to 0V DC M short to 24V DC	Output Data	Fault Undetectable M short to 24V DC detected at power-up either ON or OFF			Fault Undetectable M short to 24V DC detected at power-up either ON or OFF		
	Output Status						
	Readback						
	Status Indicators (Outputs)						
	ROUT Fault Present Bit						

Fault Condition		Safety Pulse Test with Dual Point Operation			Safety (No Pulse Test) with Dual Point Operation		
		Before OELT	During OELT	After OELT	Before OELT	During OELT	After OELT
Wire OFF	Output Data	Fault Undetectable|			Fault Undetectable		
	Output Status						
	Readback						
	Status Indicators (Outputs)						
	ROUT Fault Present Bit						

Additional Resources

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

Resource	Description
Guard I/O DeviceNet Safety Modules User Manual, publication 1791DS-UM001	Provides information on installing, configuring, and operating Guard I/O modules on DeviceNet networks.
Guard I/O EtherNet/IP Safety Modules User Manual, publication 1791ES-UM001	Provides information on installing, configuring, and operating Guard I/O modules on EtherNet/IP networks.
Guardmaster MSR57P Speed Monitoring Safety Relay User Manual, publication 440R-UM004	Provides information on installing, configuring, and operating an MSR57P relay.

You can view or download publications at http://www.rockwellautomation.com/literature. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

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