User Manual

Allen-Bradley

Guard I/O EtherNet/IP Safety Modules

Catalog Numbers 1791ES-IB8XOBV4, 1791ES-IB16, 1732ES-IB12XOB4, 1732ES-IB12XOBV2









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Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

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.

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.
	**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).

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This manual contains new and updated information. Changes throughout this revision are marked by change bars, as shown to the right of this paragraph.

New and Updated Information

This table contains the changes made in this revision.

Topic	Page
Updated the terminology table.	10
Added a statement for the suitability of use.	12
Updated the precautions for use.	12
Updated the SIL level description for the modules.	13, 16
Added a description of network address translation (NAT).	14
Added catalog numbers for the new modules.	15
Added information for programming requirements for the new modules.	15
Added a section for power supply requirements.	15
Added a catalog number 1732ES module to the linear and star topology example.	16
Added an example of Device-level Ring (DLR) topology.	16
Added an attention statement for safe state of the module.	19
Added typical pulse width and period data for the new catalog number 1732ES modules.	21
Added an attention statement to not use test outputs as safety outputs.	21
Added a section for muting lamp operation.	28
Added an attention statement for connected loads to safety outputs.	30
Added a section for single-channel operation.	32
Updated the installation instructions in Chapter 3.	35
Added wiring examples for the 1732ES modules in Chapter 4.	57
Updates for NAT and configuration steps in Chapter 5.	69
Added rows in the values and states of the tags table.	77
Added 1732ES modules status indicators to Chapter 6.	87
Added I/O assembly, reference data, explicit messaging, and getting status messages information for 1732ES modules to Appendix A.	91
Added safety data for the 1732ES modules to Appendix B.	117
Added Appendix D, Specifications.	123
Added Appendix E, History of Changes.	133

Notes:

Preface

Studio 5000 Environment 9
Additional Resources 9
About the Specifications and Dimensions in This Manual 10
Terminology 10

Chapter 1

About the Modules

Before You Begin 11
Firmware Information and Downloads 12
Functional Safety Certificates 12
Understand Suitability for Use 12
Follow Precautions for Use 12
I/O Module Overview 13
About Catalog Numbers 15
Selecting a Power Supply 15
Programming Requirements 15
About CIP Safety in EtherNet/IP Safety Architectures 16
Identify Major Parts of the Module 17

Chapter 2

Understand the Operation of Safety Functions

Safe State 19
Self-diagnostic Functions 20
Configuration Lock 20
I/O Status Data 20
Safety Inputs 21
- Using a Test Output with a Safety Input 21
- Set Dual-channel Mode and Discrepancy Time 24
- Dual-channels, Equivalent 25
- Dual-channels, Complementary 26
- Safety Input Fault Recovery 27
- Input Delays 27

Muting Lamp Operation 28
Safety Outputs 30
- Safety Output with Test Pulse 30
- Dual-channel 31
- Single-channel 32
- Safety Output Fault Recovery 32

Controlling Devices 33

Chapter 3

Install the Module

Environment and Enclosure 35
- For 1791ES Modules 35
- For 1732ES Modules 36

Prevent Electrostatic Discharge 36

Environmental Considerations for Use 37
Follow Wiring Precautions 37
Follow DC Power Supply Precautions 39
Mount the Module 39
Module Spacing 40
Mount the 1791ES Modules on a DIN Rail 42
Mount the 1732ES Modules on a Wall or Panel 43
Grounding the 1732ES Modules 44
Set Network IP Address 45
Make Connections for 1791ES Modules 46
Power Connections 46
EtherNet/IP Connections 47
I/O Connections 47
Make Connections for 1732ES Modules 49
Power Connections 49
Power Pass Through 49
EtherNet/IP Connections 52
I/O Connections 53
Label the IP Address and Device Connections 55

Chapter 4

Wiring Examples

Wiring Examples for Safety Categories 57
Wiring by Application 61

Chapter 5

Configure the I/O Modules by Using the Logix Designer Application

Add Modules to the I/O Configuration Tree 69
Configure the Module Properties 71
Set the IP Address in the Logix Designer Application 71
Change the Module Definition 72
Configure the Safety Connections 78
Configuration Ownership – Reset Ownership 79
Configuration Signature 80
Configure the Module Inputs 80
Configure the Test Outputs 82
Configure the Module Outputs 83
Save and Download the Module Configuration 84

Chapter 6

Interpret the Module Status Indicators

1791ES Module Status Indicators 85
1732ES Module Status Indicators 87

Appendix A

Get Diagnostic Status from Modules by Using Explicit Messaging

Get Status Messages from 1791ES-IB8XOBV4 Modules 92
Get Status Messages from 1791ES-IB16 Modules 97
Get Status Messages from 1732ES Modules 102

I/O Data Supported by Each Module 106
I/O Assembly and Reference Data 109
1791ES Modules 109
1732ES Modules 112
Explicit Messages 115

Appendix B

Safety Data

Calculated Values 117

Appendix C

Configuration Reference Information

Parameter Groups 121

Appendix D

Specifications

Technical Specifications 123
1791ES Modules 123
1732ES Modules 125
Environmental Specifications 127
Certifications 130
Legislation and Standards 130
Europe 131
North America 131
Japan 131
EC Directives 131
EMC Directive 131
Compliance with EC Directives 132

Appendix E

History of Changes

1791ES-UM001D-EN-P, May 2013 133
1791ES-UM001C-EN-P, April 2009 133

Index

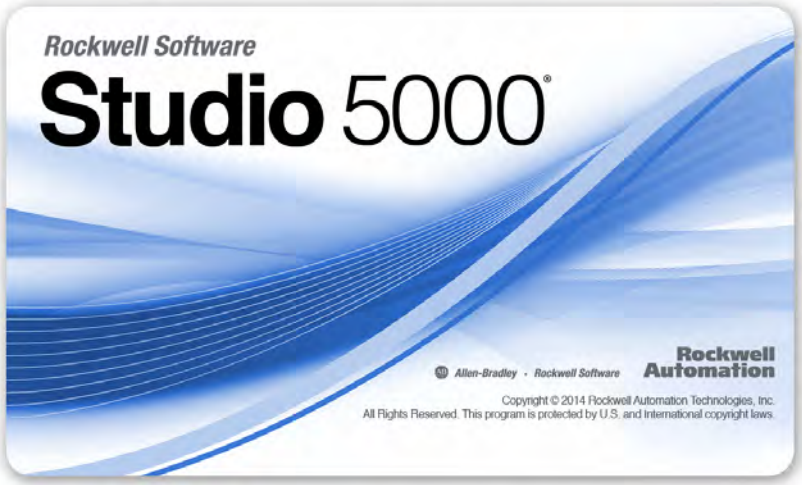
. 135

Notes:

Read and understand this manual before using the described products. Consult your Rockwell Automation representative if you have any questions or comments. This manual describes how to use Guard I/O™ modules.

Studio 5000 Environment

The Studio 5000 Automation Engineering & Design Environment™ combines engineering and design elements into a common environment. The first element is the Studio 5000 Logix Designer® application. The Logix Designer application is the rebranding of RSLogix™ 5000 software and will continue to be the product to program Logix5000™ controllers for discrete, process, batch, motion, safety, and drive-based solutions.



The Studio 5000® environment is the foundation for the future of Rockwell Automation® engineering design tools and capabilities. The Studio 5000 environment is the one place for design engineers to develop all of the elements of their control system.

Additional Resources

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

Resource	Description
CompactBlock™ Guard I/O EtherNet/IP Safety Modules Installation Instructions, publication 1791ES-IN001	Provides detailed specifications and information related to installation of 1791ES Guard I/O modules.
GuardLogix® 5570 Controllers User Manual, publication 1756-UM022	Provides information on how to install, configure, program, and use GuardLogix 5570 controllers in Studio 5000 Logix Designer projects.
GuardLogix 5570 Controller Systems Safety Reference Manual, publication 1756-RM099	Provides information on safety application requirements for GuardLogix 5570 controllers in Studio 5000 Logix Designer projects.
GuardLogix Controllers User Manual, publication 1756-UM020	Provides information on how to install, configure, program, and use GuardLogix 5560 and 5570 controllers in RSLogix 5000 projects.
GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093	Provides information on safety application requirements for GuardLogix 5560 and 5570 controllers in RSLogix 5000 projects.
GuardLogix Safety Application Instructions Safety Reference Manual, publication 1756-RM095	Provides reference information describing the GuardLogix Safety Application Instruction Set.

Resource	Description
EtherNet/IP Embedded Switch Technology Application Guide, publication ENET-AP005	Describes how to install, configure, and maintain linear and Device Level Ring (DLR) networks using Rockwell Automation EtherNet/IP devices with embedded switch technology.
Ethernet Design Considerations Reference Manual, publication ENET-RM002	Describes the required media components and how to plan for and install these required components.
ODVA Media Planning and Installation Manual, publication 00148-BR00, available from the EtherNet/IP™ Library at ODVA.org	Describes the required media components and how to plan for and install these required components.

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

About the Specifications and Dimensions in This Manual

Product specifications and accessories can change at any time based on improvements and other reasons. Consult with your Rockwell Automation representative to confirm actual specifications of purchased product. Dimensions and weights are nominal and are not for use for manufacturing purposes, even when tolerances are shown.

Terminology

Refer to the table for the meaning of common terms.

Term	Definition
1732ES modules	Also known as ArmorBlock® Guard I/O EtherNet/IP Safety Modules.
1791ES modules	Also known as CompactBlock Guard I/O EtherNet/IP Safety Modules.
Connection	Logical communication channel for communication between nodes. Connections are maintained and controlled between masters and slaves.
DLR	Acronym for Device Level Ring, a type of network topology.
EDS	Acronym for Electronic Data Sheet, a template that RSNetWorx™ software uses to display the configuration parameters, I/O data profile, and connection-type support for a given I/O module. These are simple text files used by RSNetWorx software for you to identify products and commission them on a network.
L-	Output +24V DC common.
M	Sinking output common channel, output switches to the common voltage.
MTBF	Acronym for mean time between failure, the average time between failure occurrences.
NAT	Acronym for network address translation, a service that lets modules reuse IP addresses throughout a network.
ODVA	Acronym for Open DeviceNet Vendor Association, a nonprofit association of vendors established for the promotion of CIP networks.
P	Sourcing output channel, output switches to the plus voltage.
PFD	Acronym for probability of failure on demand, the average probability of a system to fail to perform its design function on demand.
PFH	Acronym for probability of failure per hour, the probability of a system to have a dangerous failure occur per hour.
Proof test	Periodic test performed to detect failures in a safety-related system so that, if necessary, the system can be restored to an as-new condition or as close as practical to this condition.
S+	Output +24V DC.
SNN	Acronym for safety network number, which uniquely identifies a network across all networks in the safety system. You are responsible for assigning a unique number for each safety network or safety sub-net within a system.
Standard	Devices or portions of devices that do not participate in the safety function.

About the Modules

Topic	Page
Before You Begin	11
Understand Suitability for Use	12
Follow Precautions for Use	12
I/O Module Overview	13
About Catalog Numbers	15
Selecting a Power Supply	15
Programming Requirements	15
About CIP Safety in EtherNet/IP Safety Architectures	16
Identify Major Parts of the Module	17

Read this chapter for important overview information and precautions for use for the Guard I/O modules that implement the EtherNet/IP safety protocol. This chapter also includes an overview on how these I/O modules are used within a safety system.

Before You Begin

Follow these guidelines when using a module, noting that in this manual we use safety administrator to mean a person qualified, authorized, and responsible to secure safety in the design, installation, operation, maintenance, and disposal of the machine.

- Read and understand this manual before installing and operating the module.
- Keep this manual in a safe and accessible place where personnel can refer to it when necessary.
- Use the module properly according to the installation environment, performance, and functions of the machine.
- Verify that a safety administrator conducts a risk assessment on the machine and determines module suitability before installation.

For CE Low Voltage Directive (LVD) compliance, verify that the external power supply that provides power to the modules is rated safety extra-low voltage (SELV). Some Rockwell Automation Bulletin 1606 power supplies are SELV-compliant. See Switched Mode Power Supply Specifications Technical Data, publication 1606-TD002, and the installation instructions for the power supplies.

Firmware Information and Downloads

Verify that the Guard I/O firmware revision is correct prior to commissioning the safety system. Firmware information and downloads for safety modules are available at this link: http://www.rockwellautomation.com/rockwellautomation/support/pcdc.page.

Functional Safety Certificates

Safety certificates for Functional Safety modules are available at this link: http://www.rockwellautomation.com/rockwellautomation/certification/safety.page?

Understand Suitability for Use

Rockwell Automation is not responsible for conformity with any standards, codes, or regulations that apply to the combination of products in your application or use of the product.

Take all necessary steps to determine the suitability of the product for the systems, machine, and equipment with which it is used.

Know and observe all prohibitions of use applicable to this product.

Never use the products for an application involving serious risk to life or property without making sure that the system as a whole is designed to address the risks and that the Rockwell Automation product is properly rated and installed for the intended use within the overall equipment or system.

Use the module only in an environment that is within the general specifications of the module.

Follow Precautions for Use

Follow the precautions for use listed here and throughout this manual.



ATTENTION: Follow Safety Standards for Installation and Testing

- Use only appropriate components or devices complying with relevant safety standards corresponding to the required safety category and safety integrity level:
  - Conformity to requirements of the safety category and safety integrity level must be determined for the entire system.
  - We recommend you consult a certification body regarding assessment of conformity to the required safety integrity level or safety category.
- You must confirm compliance with the applicable standards for the entire system.
- Perform testing to confirm that all device configuration data and operation is correct before starting system operation.
- After installation of the module, a safety administrator must confirm the installation and conduct trial operation and maintenance procedures.

ATTENTION: Personnel responsible for the application of safety-related programmable electronic systems (PES) shall be aware of the safety requirements in the application of the system and shall be trained in using the system.

ATTENTION: Do not disassemble, repair, or modify the module. Any changes to the module can result in the loss of safety functions.

ATTENTION: Do not use EtherNet/IP standard I/O data or explicit message data as safety data.

ATTENTION: Installing or Replacing Modules

- When installing or replacing modules, clear any previous configuration before connecting the module to the network or connecting input or output power to the module.
- When replacing a device, configure the replacement device suitably and confirm that it operates correctly.

ATTENTION: In case of malfunction or damage, no attempts at repair should be made. The module should be returned to the manufacturer for repair. Do not dismantle the module.

I/O Module Overview

The Guard I/O modules implement the CIP safety protocol extensions over EtherNet/IP networks and provide various features for a safety system.

Use the modules to construct a safety-control network system that meets the requirements up to Safety Integrity Level Claim Limit 3 (SIL CL 3), as defined in IEC 61508 and Category 4 (CAT. 4), Performance Level e (PLe), as defined in ISO 13849-1.

Remote I/O communication for safety I/O data is performed through safety connections supporting CIP safety over an EtherNet/IP network, and data processing is performed in the safety controller.

The status and fault diagnostics of the I/O modules are monitored by a safety controller through a safety connection by using a new or existing EtherNet/IP network.

The following is a list of features common to Guard I/O modules:

- CIP safety and EtherNet/IP protocol conformance
- Safety inputs
  - Safety devices, such as emergency stop push buttons, gate switches, and safety light curtains, can be connected.
  - Dual-channel mode evaluates consistency between two input signals (channels), which allows use of the module for Safety Category 3 and 4.
  - Single-channel evaluates one input signal (channel), which allows use of the module Safe Inputs for safety Category 2 and in applications rated up to and including Performance Level d / SIL CL2.
  - The time of a logical discrepancy between two channels can be monitored by using a discrepancy time setting.
  - An external wiring short-circuit check is possible when inputs are wired in combination with test outputs.
  - Independently adjustable on and off delay is available per channel.
- Test outputs
  - Separate test outputs are provided for short circuit detection of a safety input (or inputs).
  - Power (24V) can be supplied to devices, such as safety sensors.
  - Test outputs can be configured as standard outputs.
  - All Guard I/O modules have numerous test outputs, of which some can be used for broken wire detection of a muting lamp.
- Safety outputs
  - Dual-channel mode evaluates consistency between two output signals (channels).
  - Safety outputs can be pulse tested to detect field wiring shorts to 24V DC and 0V DC.
- I/O status data – In addition to I/O data, the module includes status data for monitoring I/O circuits.
- Removable I/O connectors (only 1791ES modules) – I/O connectors support mechanical keying.
- Network address translation (NAT) support – Available in Logix Designer version 24 or later, NAT is a service that translates one IP address to another IP address via a NAT-configured switch. The switch translates the source and destination addresses within data packets as traffic passes between subnets. This service is useful if you need to reuse IP addresses throughout a network. For example, NAT makes it possible for devices that share a single IP address on a private subnet to be segmented into multiple identical private subnets while maintaining unique identities on the public subnet.

About Catalog Numbers

See the table for a description of the Guard I/O modules.

Catalog Number	Description	Enclosure Type Rating	Safety Inputs	Test Outputs(1)	Safety Outputs (solid-state)
1791ES-IB16	CompactBlock safety input module	Meets IP20	16	16	—
1791ES-IB8XOBV4	CompactBlock safety I/O module with solid-state outputs		8	8	8 bipolar outputs (4 pairs)
1732ES-IB12XOB4	ArmorBlock® safety I/O module with solid-state outputs	Meets IP67/IP65	12	12	4 sourcing outputs
1732ES-IB12XOBV2	ArmorBlock safety I/O module with solid-state outputs		12	12	4 bipolar outputs (2 pairs)

(1) Broken wires can be detected on the muting outputs.

Selecting a Power Supply

For CE LVD compliance, verify that the external power supply that provides power to the modules is safety extra-low voltage (SELV) rated. Some Rockwell Automation Bulletin 1606 power supplies are SELV-compliant. See Switched Mode Power Supply Specifications Technical Data, publication 1606-TD002, and the installation instructions for the modules.

ATTENTION: Prevent Electric Shock

To prevent electric shock, use a DC power supply that meets the following requirements:

- A DC power supply with double or reinforced insulation; for example, according to IED/EN 60950, or EN 50178, or a transformer according to IEC/EN 61558.
- A DC power supply satisfies requirement for class 2 circuits or limited voltage/current circuit stated in UL 508.
- An external power supply that is safety extra-low voltage (SELV) rated.

ATTENTION: Do not Exceed Specified Voltage

- Do not apply DC voltages exceeding the rated voltages to the module.
- Apply properly specified voltages to the module inputs. Applying inappropriate voltages causes the module to fail to perform its specified function, which leads to loss of safety functions or damage to the module.

Programming Requirements

Use the minimum software versions listed here.

Cat. No.	Studio 5000 Environment Version(1)	RSLogix 5000 Software Version (1) (EtherNet/IP Network)
1791ES-IB16	21	16
1791ES-IB8XOBV4		
1732ES-IB12XOB4		
1732ES-IB12XOBV2		

(1) This version or later.

About CIP Safety in EtherNet/IP Safety Architectures

Use Guard I/O modules in EtherNet/IP safety architectures as shown in the figure. The Guard I/O family is a set of I/O modules that when connected to an EtherNet/IP safety network are suitable for applications up to SIL CL 3 as defined in IEC 61508; and CAT. 4, PLe, as defined in ISO 13849-1.

Figure 1 - Safety Interlocking and Control Via CIP Safety (linear and star topology)

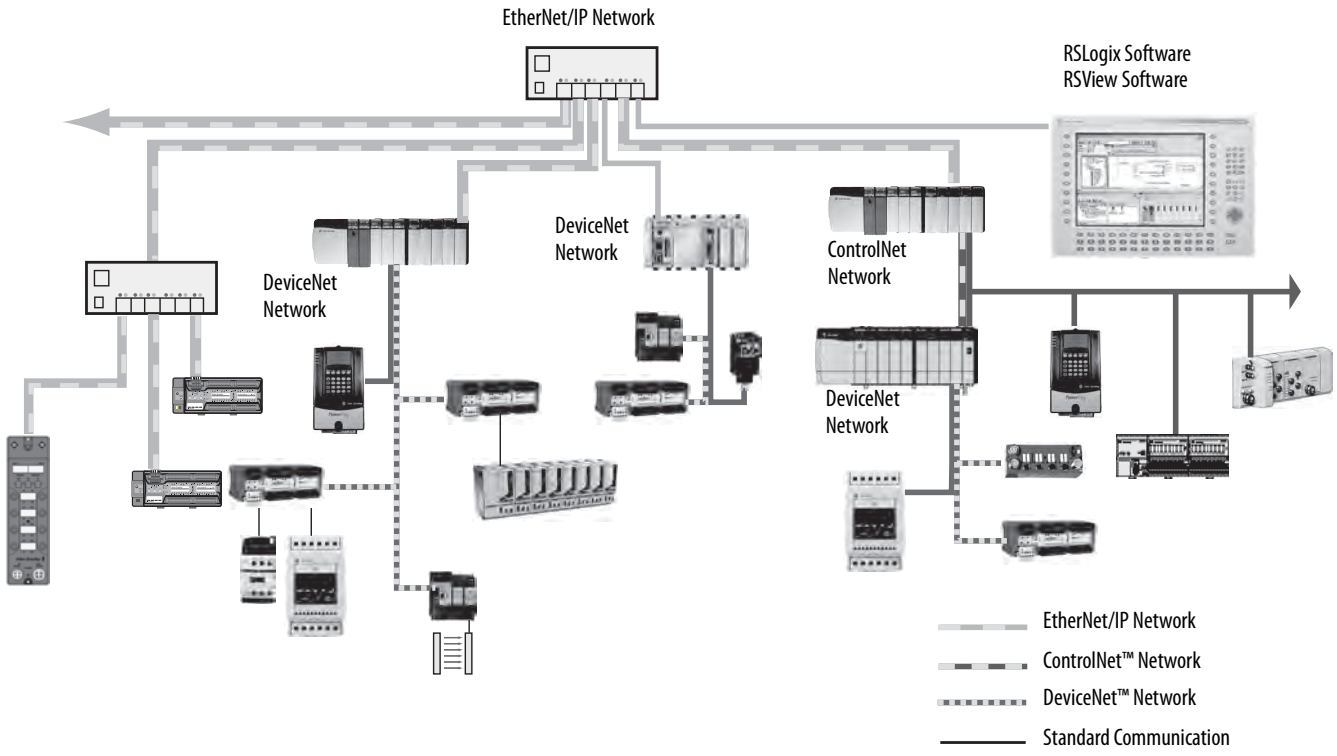
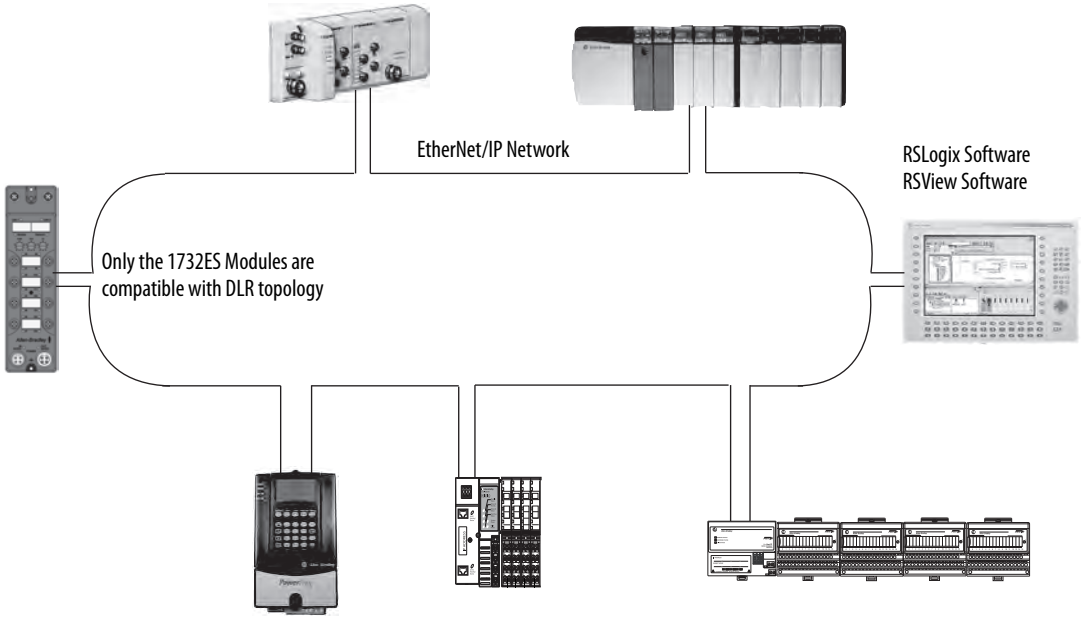


Figure 2 - Safety Interlocking and Control Via CIP Safety (DLR topology) Only 1732ES Modules



Safety controllers control the safety outputs. Safety or standard controllers can control the standard outputs.

Identify Major Parts of the Module

See the figure for module identification. See Chapter 3 for pinout information.

Figure 3 - 1791ES Modules

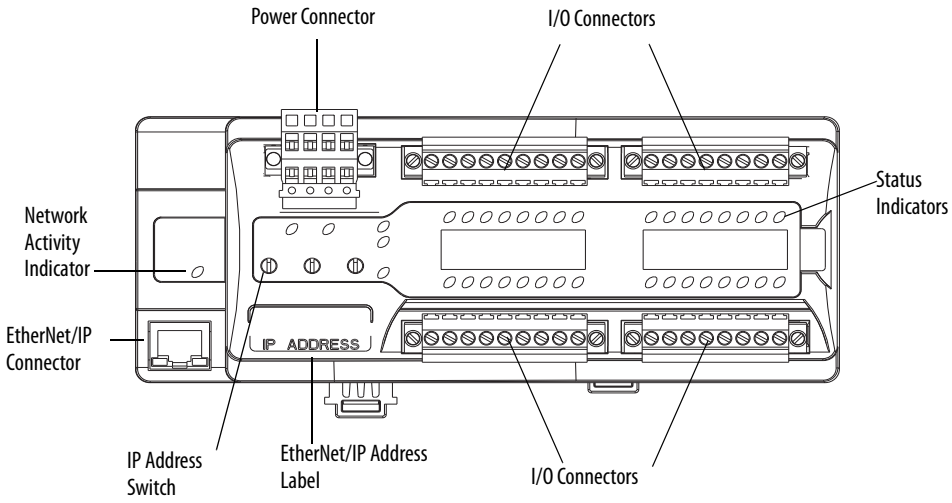
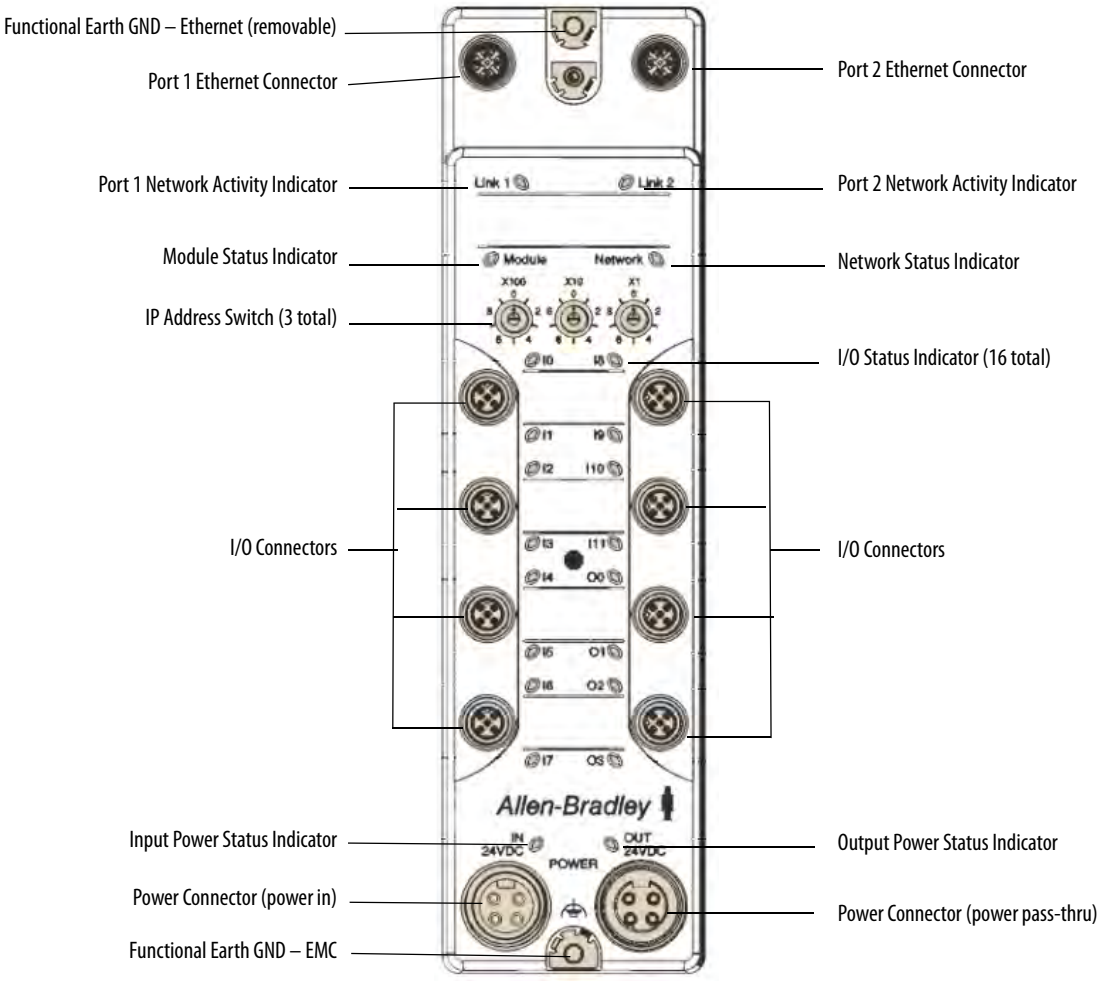


Figure 4 - 1732ES Modules



Notes:

Understand the Operation of Safety Functions

Topic	Page
Self-diagnostic Functions	20
Configuration Lock	20
I/O Status Data	20
Safety Inputs	21
Muting Lamp Operation	28
Safety Outputs	30
Controlling Devices	33

Read this chapter for information related to the safety functions of the modules. Also included is a brief overview on international standards and directives that you must be familiar with.

Safe State

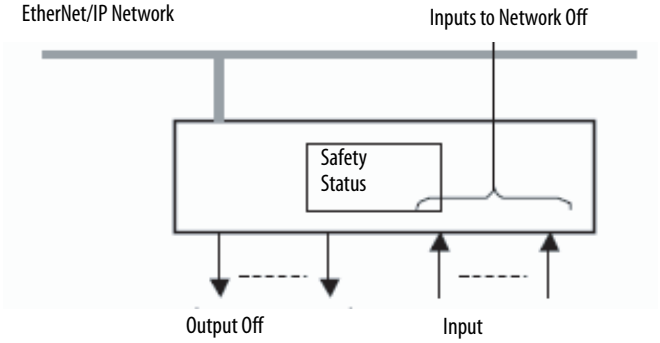
ATTENTION: Safety State of the Module

- Safety state of the inputs and outputs is defined as the off state.
- Safety state of the module and its data is defined as the off state.
- Use the Guard I/O module only in applications where the off state is the safety state.

The following status is the safety state of the Guard I/O modules:

- Safety outputs: off
- Safety input data to network: off

Figure 5 - Safety Status



The module is designed for use in applications where the safety state is the off state.

Self-diagnostic Functions

Self-diagnostics are performed when the power is turned on and periodically during operation. If a fatal internal module error occurs, the red module status (MS) indicator illuminates, and the safety outputs and input data and status to the network turn off.

Configuration Lock

After configuration data has been downloaded and verified, the configuration data within the module can be protected.

For GuardLogix systems, the status indicator is not used. Reference information about safety signatures in the GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093.

I/O Status Data

In addition to I/O data, the module provides status data for monitoring the I/O circuits. The status data includes the following data, which can be read by the controllers. Note that 1 = ON/Normal, and 0 = OFF/Fault/Alarm.

- Individual point input status
- Combined input status
- Individual point output status
- Combined output status
- Individual test output status
- Individual output readback (actual ON/OFF state of the outputs)

Status data indicate whether each safety input, safety output, or test output is normal (normal status: ON, faulted status: OFF). For fatal errors, communication connections can be broken, so the status data cannot be read.

Combined status is provided by an AND of the status of all safety inputs or all safety outputs. When all inputs or outputs are normal the respective combined status is ON. When one or more of them has an error the respective combined status is OFF. This is known as the combined safety input status or combined safety output status.

Safety Inputs

Read this section for information about safety inputs and their associated test outputs. A safety input can be used with test outputs. Safety inputs are used to monitor safety input devices.

Using a Test Output with a Safety Input

A test output can be used in combination with a safety input for short circuit detection. Configure the test output as a pulse test source and associate it to a specific safety input.

The test output can also be used as a power supply to source 24V DC for an external input circuit.

Figure 6 - Example Use of a 1791ES-IB16 Module

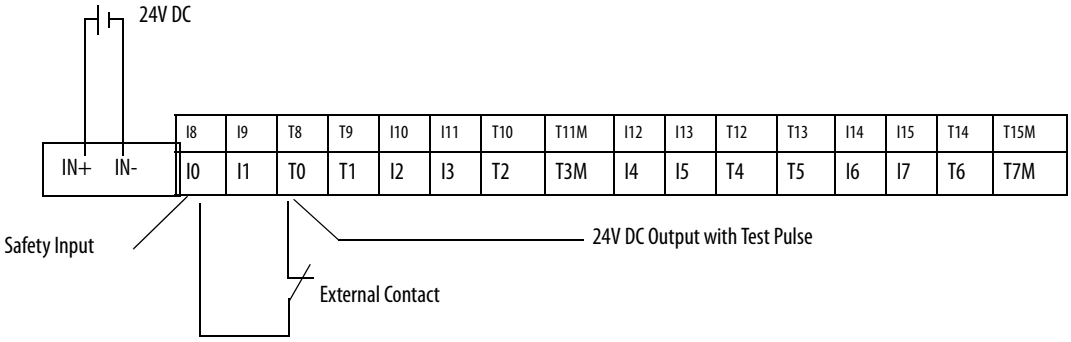
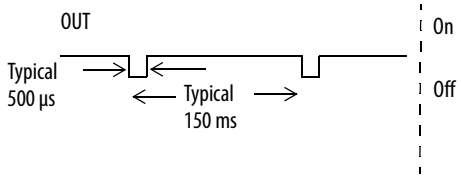


Table 1 - Typical Pulse Width and Period

Cat. No.	Pulse Width	Period
1791ES-IB8XOBV4	500 µs	150 ms
1791ES-IB16		
1732ES-IB12XOB4		
1732ES-IB12XOBV2		

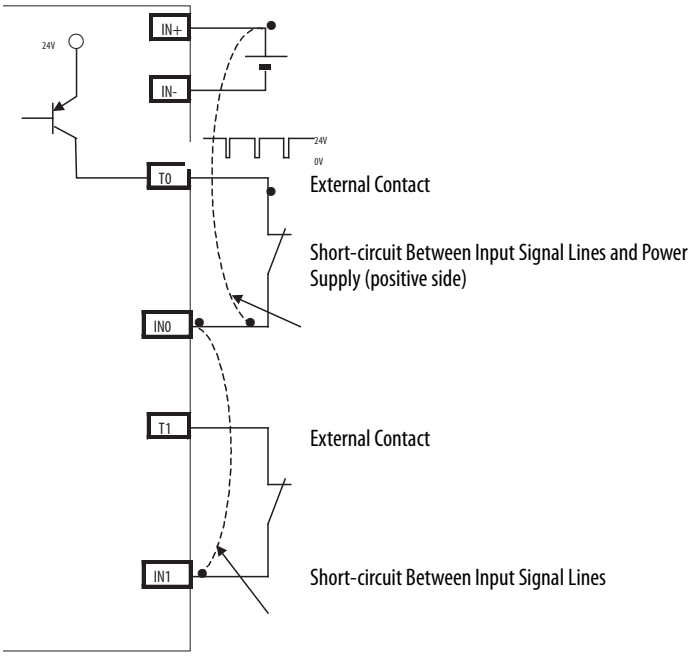
Figure 7 - Test Pulse in a Cycle



ATTENTION: Do not use test outputs as safety outputs. Test outputs do not function as safety outputs.

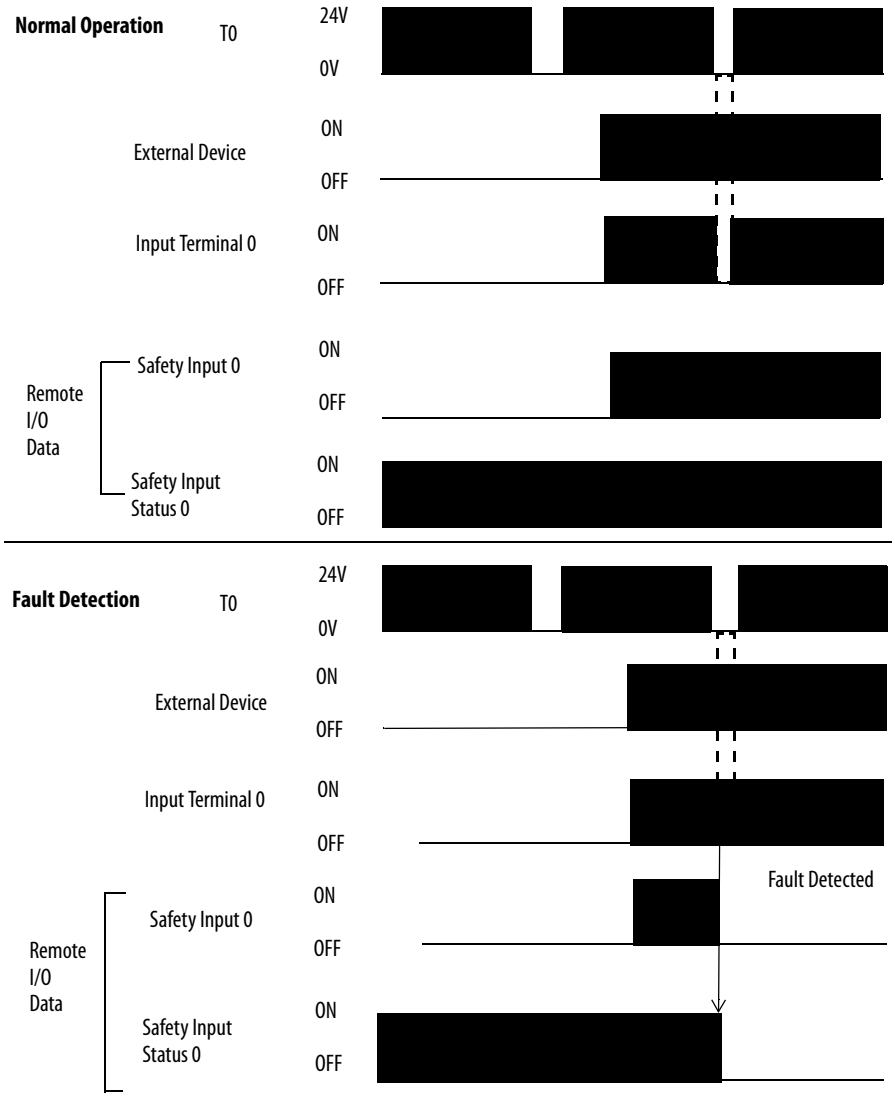
When the external input contact is closed, a test pulse is output from the test output terminal to diagnose the field wiring and input circuitry. By using this function, short-circuits between input signal lines and the power supply (positive side), and short-circuits between input signal lines can be detected.

Figure 8 - Short-circuit Between Input Signal Lines



If an error is detected, safety input data and safety input status turns off.

Figure 9 - Single Channel Normal Operation and Fault Detection (not to scale)



Set Dual-channel Mode and Discrepancy Time

To support redundant channel safety devices, the consistency between signals on two channels can be evaluated. Either equivalent or complementary can be selected. This function monitors the time during which there is a discrepancy between the two channels.

If the length of the discrepancy exceeds the configured discrepancy time (0...65,530 ms in increments of 10 ms), the safety input data and the individual-safety input status turn off for both channels.

IMPORTANT The dual-channel function is used with two consecutive inputs that are paired together, starting at an even input number, such as inputs 0 and 1; 2 and 3; and so on.

IMPORTANT Do not set the discrepancy time longer than necessary. The purpose of the discrepancy time is to allow for normal differences between contact switching when demands are placed on safety inputs. For this testing to operate correctly, only a single demand on the safety input is expected during the discrepancy time. If the discrepancy time is set too high, and multiple demands occur during this time, then both safety input channels will fault.

Table 2 shows the relation between input terminal states and controller input data and status.

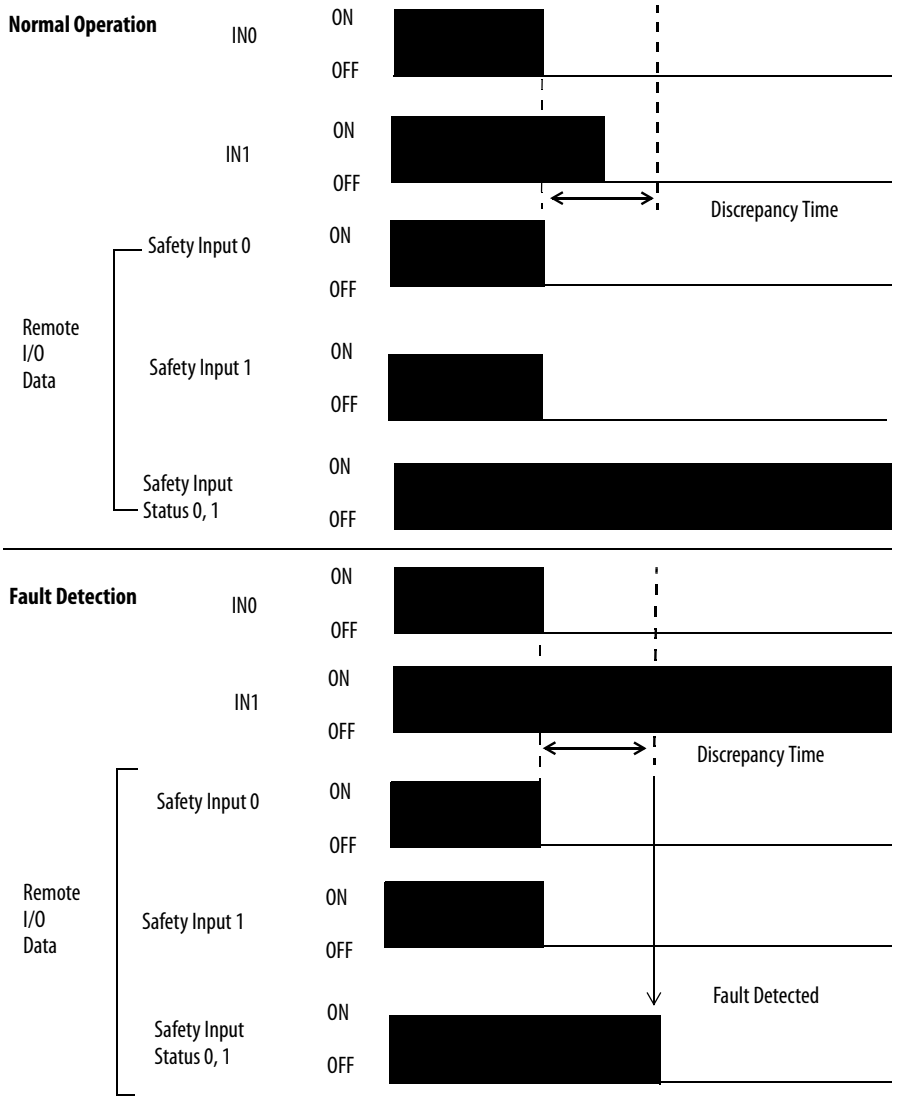
Table 2 - Terminal Input Status and Controller I/O Data

Dual-channel Mode	Input Terminal		Controller Input Data and Status				Dual- channel Resultant Data	Dual-channel Resultant Status
	IN0	IN1	Safety Input 0 Data	Safety Input 1 Data	Safety Input 0 Status	Safety Input 1 Status		
Dual-channels, Equivalent	OFF	OFF	OFF	OFF	ON	ON	OFF	Normal
	OFF	ON	OFF	OFF	OFF	OFF	OFF	Fault
	ON	OFF	OFF	OFF	OFF	OFF	OFF	Fault
	ON	ON	ON	ON	ON	ON	ON	Normal
Dual-channels, Complementary	OFF	OFF	OFF	ON	OFF	OFF	OFF	Fault
	OFF	ON	OFF	ON	ON	ON	OFF	Normal
	ON	OFF	ON	OFF	ON	ON	ON	Normal
	ON	ON	OFF	ON	OFF	OFF	OFF	Fault

Dual-channels, Equivalent

In Equivalent mode, both inputs of a pair must typically be in the same (equivalent) state. When a transition occurs in one channel of the pair, prior to the transition of the second channel of the pair, a discrepancy occurs. If the second channel transitions to the appropriate state prior to the discrepancy time elapsing, the inputs are considered equivalent. If the second transition does not occur before the discrepancy time elapses, the channels fault. In the fault state the input and status for both channels are set low (off). When configured as an equivalent dual pair, the data bits for both channels are sent to the controller as equivalent, both high or both low.

Figure 10 - Equivalent, Normal Operation and Fault Detection (not to scale)

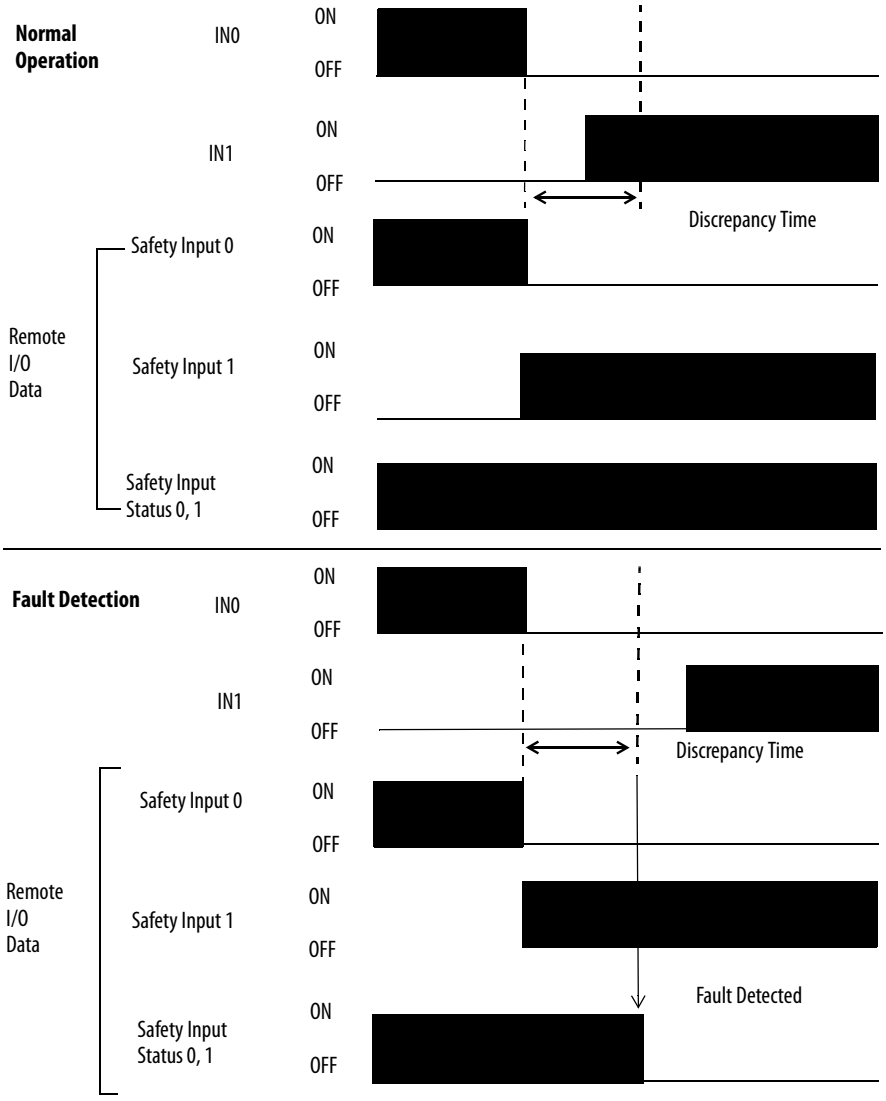


Dual-channels, Complementary

In Complementary mode, the inputs of a pair are typically in the opposite (complementary) state. When a transition occurs in one channel of the pair prior to the transition of the second channel of the pair, a discrepancy occurs. If the second channel transitions to the appropriate state prior to the discrepancy time elapsing, the inputs are considered complementary.

If the second transition does not occur before the discrepancy time elapses, the channels fault. The fault state of complementary inputs is the even-numbered input turned off and the odd-numbered input turned on. Note that if faulted, both channel status bits are set low. When configured as a complementary dual-channel pair, the data bits for both channels are sent to the controller in complementary, or opposite states.

Figure 11 - Complementary, Normal Operation and Fault Detection (not to scale)



Safety Input Fault Recovery

If an error is detected, the safety input data remains in the off state. Follow this procedure to activate the safety input data.

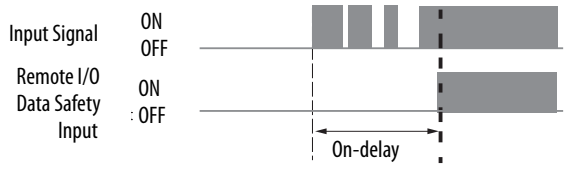
1. Remove the cause of the error.
2. Place the safety input (or safety inputs) into the safety state.

   The safety input status turns on (fault cleared) after the input-error latch time has elapsed. The I/O indicator (red) turns off. The input data can now be controlled.

Input Delays

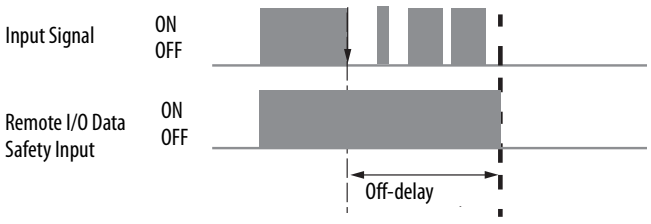
On-delay – An input signal is treated as logic 0 during the on-delay time (0...126 ms, in increments of 6 ms) after the input contact's rising edge. The input only turns on if the input contact remains on after the on-delay time has elapsed. This helps prevent rapid changes of the input data due to contact bounce.

Figure 12 - On-delay



Off-delay – An input signal is treated as logic 1 during the off-delay time (0...126 ms, in increments of 6 ms) after the input contact's falling edge. The input only turns off if the input contact remains off after the off delay time has elapsed. This helps prevent rapid changes of the input data due to contact bounce.

Figure 13 - Off-delay



Muting Lamp Operation

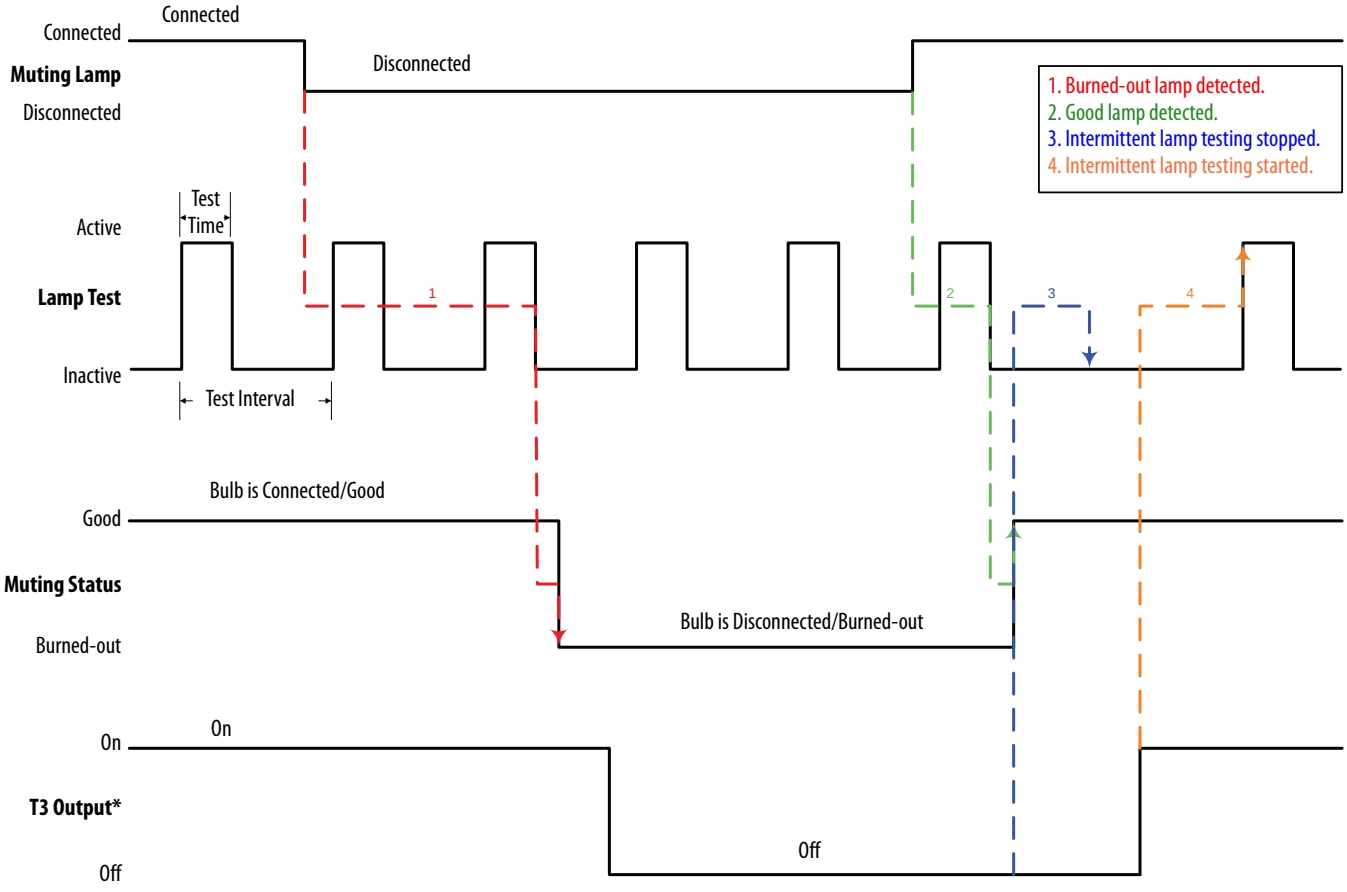
The 1732ES modules support this muting lamp feature. The feature was added to 1791ES modules in firmware revision 1.009. The operation of the muting status bits for the test outputs has changed. Certain test outputs are controlled by your PLC processor program to illuminate a muting lamp:

- T3 and T7 for 1791ES-IB8XOBV4
- T3, T7, and T11 for 1732ES-IB12XOB4 and 1732ES-IB12XOBV2
- T3, T7, T11, and T15 for 1791ES-IB16

Muting lamp status is monitored with a test that runs periodically during every test interval to detect a burned-out lamp. The test runs repeatedly when the test output is commanded on. The figure below explains how muting lamp operation, status, and fault detection are monitored.

TIP The lamp test interval is 3 seconds. Two consecutive failed lamp tests are required to declare a burned-out lamp condition. The lamp test may not run immediately after the test output is energized. It starts at the next 3-second interval. To allow time for two consecutive test intervals, program a minimum Test Output On Time of 6 seconds.

Figure 14 - Muting Lamp Timing Diagram



* IMPORTANT: The output is controlled by the user's program, not by the Muting Status bit.

Table 3 shows the expected behavior of the muting status bits. Keep these points in mind as well:

- When power is applied to the module, and a test output capable of operating as a muting output remains commanded off, the muting status defaults to on.

  This bit operation is designed to help prevent erroneous muting instruction faults from the GuardLogix controller. This bit status may not be the true indication of a burned-out lamp.

  IMPORTANT Before checking the state of the corresponding muting status, be sure the test output is commanded on. Once the test output is commanded on, a maximum time of 6 seconds is required for the module to detect a burned-out lamp.

- If a muting lamp circuit is open when power is applied to the module, the condition is detected when the test output is commanded on.
- When a lamp burns out and is replaced, the fault (muting status bit) returns to the normal condition, independent of the state of the test output.

Table 3 - Muting Status Bit Operation

Test Output Commanded State	Lamp Condition	Muting Status Bit	Description
ON	Bad (open circuit)	0	Repair lamp.
ON	Good	1	Normal condition. Lamp is operating properly.
OFF	Bad (open circuit)	0	If lamp remains off after a test output capable of operating as a muting output is cycled, repair the lamp.
OFF	Good	1	Normal condition.

Safety Outputs

Read this section for information about safety outputs.

ATTENTION: Serious injury can occur due to the breakdown of safety outputs. Do not connect loads beyond the rated value to the safety outputs.

Safety Output with Test Pulse

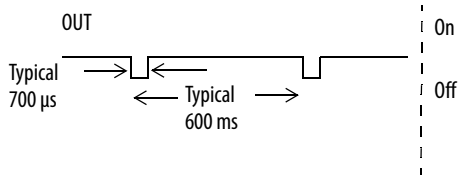
When the safety output is on, the safety output can be test pulsed, as shown in Table 4 and Figure 15.

Table 4 - Safety Output Test Pulse

Cat. No.	Pulse Width	Period
1791ES-IB8XOBV4	700 µs	600 ms
1732ES-IB12XOB4		
1732ES-IB12XOBV2		

By using this function, short-circuits between sourcing output signal lines and the power supply (positive side), short-circuits between sinking output signal lines and the power supply (negative side), and short-circuits between output signal lines of the same polarity (from sourcing output to sourcing output or from sinking output to sinking output) can be detected. If an error is detected, the safety output data and individual-safety output status turns off.

Figure 15 - Test Pulse in a Cycle

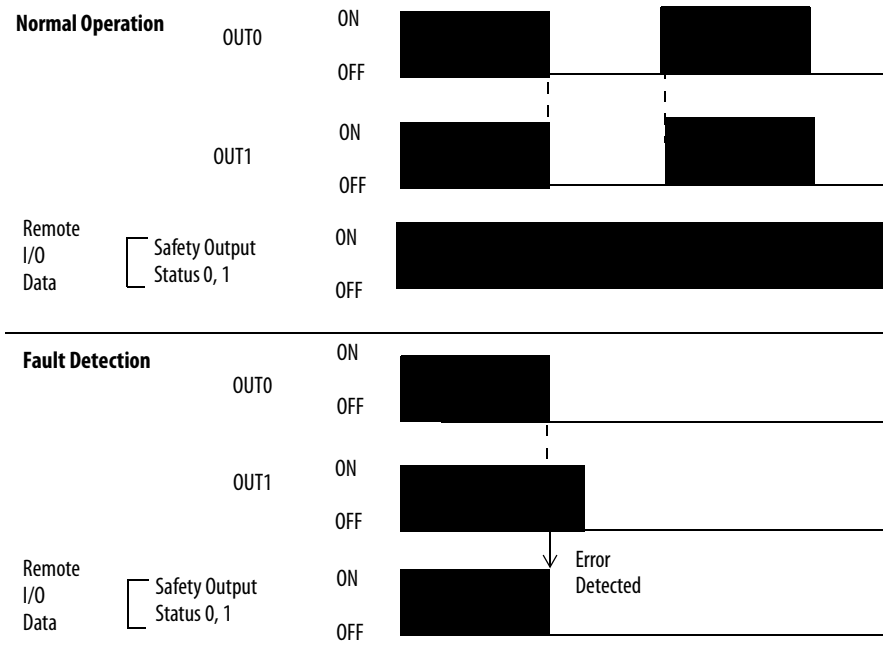


IMPORTANT To prevent the test pulse from causing the connected device to malfunction, pay careful attention to the input response time of the device.

Dual-channel

When the data of both channels is in the on state, and neither channel has a fault, the outputs are turned on. The status is normal. If a fault is detected on one channel, the safety output data and individual safety output status turn off for both channels.

Figure 16 - Dual-channel (not to scale)

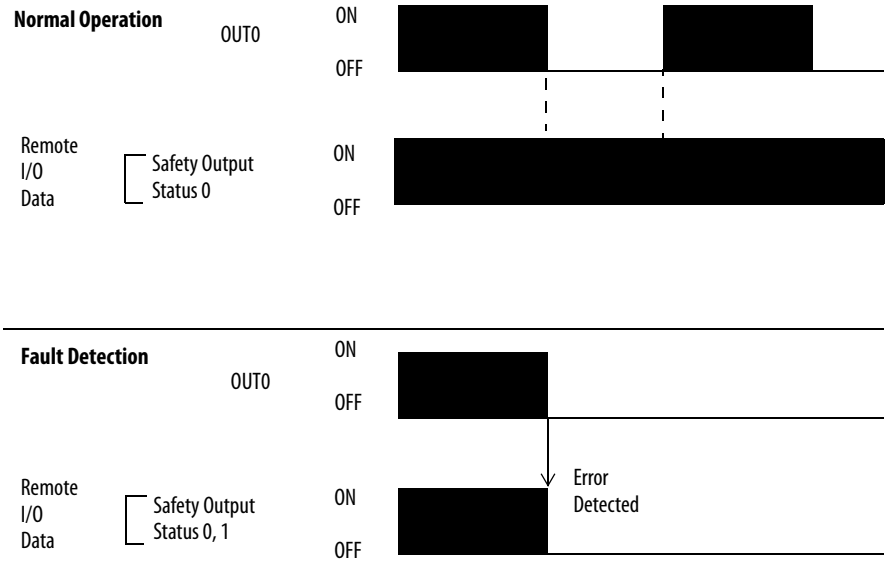


Single-channel

When the data of the channel is in the on state, and the channel does not have a fault, the output is turned on. The status is normal. If a fault is detected on the channel, the safety output data and individual safety output status turn off for the channel.

IMPORTANT Safety outputs configured for single-channel operation must be controlled as pairs for use in functional safety applications.

Figure 17 - Single-channel (not to scale)



Safety Output Fault Recovery

If a fault is detected, the safety outputs are switched off and remain in the off state.

Follow this procedure to reactivate the safety output data for modules with bipolar safety outputs (1791ES and 1732ES-IB12XOBV2 modules).

1. Remove the cause of the error.
2. Place the safety output (or safety outputs) into the safety state.

   The safety output status turns on (fault cleared) when the output-error latch time has elapsed. The I/O indicator (red) turns off. The output data can now be controlled.

For modules with sourcing-only safety outputs (only 1732ES-IB12XOB4 modules), safety output faults are considered critical enough to require a module power cycle to clear (a sourcing safety output channel shorted to output power supply positive).

For modules with sourcing-only safety outputs (only 1732ES-IB12XOB4 modules), one of these faults on any safety output channel results in all sourcing-only safety outputs being placed in the safe state (off).

Follow this procedure to reactivate the safety outputs after one of these faults.

1. Remove the cause of the error.
2. Power cycle the module.

The output data can now be controlled.

Controlling Devices

See the table for information about controlling devices.



ATTENTION: Use appropriate devices as indicated in the Controlling Device Requirements table. Serious injury can occur due to loss of safety functions.

Table 5 - Controlling Device Requirements

Device	Requirement	Allen-Bradley Bulletin Safety Components
Emergency stop switches	Use approved devices with direct opening mechanisms complying with IEC/EN 60947-5-1.	Bulletin 800F, 800T
Door interlocking switches, limit switches	Use approved devices with direct opening mechanisms complying with IEC/EN 60947-5-1 and capable of switching microloads of 24V DC 5 mA.	Bulletin 440K, 440G, 440H for interlock switch Bulletin 440P, 802T for limit switch
Safety sensors	Use approved devices complying with the relevant product standards, regulations, and rules in the country where used.	Any Guardmaster product
Relays with forcibly- guided contacts, contactors	Use approved devices with forcibly-guided contacts complying with EN 50205. For feedback purposes, use devices with contacts capable of switching micro loads of 24V DC 5 mA.	Bulletin 700S, 100S
Other devices	Evaluate whether devices used are appropriate to satisfy the requirements of safety category levels.	—

Notes:

Install the Module

Topic	Page
Environment and Enclosure	35
Prevent Electrostatic Discharge	36
Environmental Considerations for Use	37
Follow Wiring Precautions	37
Follow DC Power Supply Precautions	39

Topic	Page
Mount the Module	39
Set Network IP Address	45
Make Connections for 1791ES Modules	46
Make Connections for 1732ES Modules	49

Read and understand this section before you begin to install the module.

Environment and Enclosure

For 1791ES Modules

ATTENTION: This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating.

This equipment is not intended for use in residential environments and may not provide adequate protection to radio communication services in such environments.

This equipment is supplied as open-type equipment for indoor use. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA, or be approved for the application if non-metallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see the following:

- Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1, for more installation requirements.
- NEMA Standard 250 and EN/IEC 60529, as applicable, for explanations of the degrees of protection provided by enclosures.

ATTENTION: 1791ES modules are certified for use only within the surrounding air temperature range of -20…60 °C (-4…140 °F). The 1791ES modules must not be used outside of this range.

For 1732ES Modules



This equipment is intended for use in overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating.

This equipment is not intended for use in residential environments and may not provide adequate protection to radio communication services in such environments.

This equipment is supplied as enclosed equipment. It should not require additional system enclosure when used in locations consistent with the enclosure type ratings stated in the Specifications section of this publication. Subsequent sections of this publication may contain more information regarding specific enclosure type ratings, beyond what this product provides, that are required to comply with certain product safety certifications.

In addition to this publication, see the following:

- Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1, for more installation requirements.
- NEMA Standard 250 and EN/IEC 60529, as applicable, for explanations of the degrees of protection provided by enclosures.



ATTENTION: 1732ES modules are certified for use only within the surrounding air temperature range of -20…55 °C (-4…131 °F). The 1732ES modules must not be used outside of this range.

Prevent Electrostatic Discharge



ATTENTION: This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

Environmental Considerations for Use

Do not use the module in locations that are subject to these conditions:

- Direct sunlight
- Temperatures or humidity beyond the ranges noted in Specifications on page 123
- Condensation as the result of severe changes in temperature
- Corrosive or flammable gases
- Dust, especially iron dust (only 1791ES modules)
- Salts
- Water (only 1791ES modules)
- Oil or chemicals
- Shock or vibration beyond the range noted in Specifications on page 123

Do not clean the modules with these materials:

- Acetone
- Benzene
- Thinner

Follow Wiring Precautions



WARNING: Connecting and Disconnecting Wiring and Cables

- When you connect or disconnect the removable terminal block (RTB) or power cables with field-side power applied, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.
- If you connect or disconnect wiring or cables while the field-side power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.
- If you connect or disconnect the communication cables with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations.



ATTENTION: Wiring Guidelines

- Disconnect the module from the power supply before wiring or connecting cables. Devices connected to the module can operate unexpectedly if wiring is performed while power is supplied.
- Wire correctly after confirming the signal names of all terminals.
- Wire the Guard I/O modules properly so that 24V DC line does not touch the safety outputs accidentally or unintentionally.
- Do not route communication, input, or output wiring with conduit containing high voltage. Refer to Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.
- Wire conductors correctly and verify operation of the module before placing the system into operation. Incorrect wiring can lead to loss of safety function.

ATTENTION: Be Aware of Safety Requirements

Personnel responsible for the application of safety-related programmable electronic systems (PES) shall be aware of the safety requirements in the application of the system and shall be trained in using the system.

ATTENTION: Electrical Safety Considerations

To comply with the CE Low Voltage Directive (LVD), all connections to this equipment must be powered from a source compliant with the following:

- Safety Extra Low Voltage (SELV) Supply.
- Protected Extra Low Voltage (PELV) Supply.

If the devices (sensors) connected to the input connections require Class 2 power to operate, the auxiliary power connections of this equipment must be powered by a Class 2 source.

ATTENTION: Maintain IP Rating for 1732ES Modules

Make sure all connectors and caps on 1732ES modules are securely tightened to properly seal the connections against leaks and maintain IP enclosure type requirements.

Applicable only to 1732ES modules.

ATTENTION: You can configure Test Outputs to be used as standard outputs. You can connect actuators to Test Output points that are expecting a Standard configuration.

Test Output points configured as Pulse Test or Power Supply become active whenever you apply input power to the module. These configured functions are independent of the I/O connections to the module.

ATTENTION: If a module with Test Outputs configured as Pulse Test or Power Supply is incorrectly installed in an application where actuators are connected to these Test Output points, the actuators are activated when input power is applied.

To prevent this possibility, follow these procedures.

- When installing a module, be sure that the module is correctly configured for the application or in the out-of-box condition before applying input power.
- When replacing a module, be sure that the module is correctly configured for the application or in the out-of-box condition before applying input power.
- Reset modules to their out-of-box condition when removing them from an application.
- Be sure that all modules in replacement stock are in their out-of-box condition.

Follow DC Power Supply Precautions



ATTENTION: To prevent electric shock, use a DC power supply that meets these requirements:

- A DC power supply with double or reinforced insulation, for example, according to IED/EN 60950 or EN 50178 or a transformer according to IEC/EN 61558.
- A DC supply satisfies requirement for class 2 circuits or limited voltage/current circuit stated in UL 508.
- Use an external power supply that is safety extra-low voltage (SELV) rated.
- Follow these precautions for safe use.
- Wire conductors correctly and verify operation of the module before placing the system into operation. Incorrect wiring can lead to loss of safety function.
- Do not apply DC voltages exceeding the rated voltages to the module.
- Apply properly specified voltages to the module inputs. Applying inappropriate voltages causes the module to fail to perform its specified function, which leads to loss of safety functions or damage to the module.
- Never use test outputs as safety outputs. Test outputs are not safety outputs.
- Note that after installation of the module, a safety administrator must confirm the installation and conduct trial operation and maintenance.
- Do not disassemble, repair, or modify the module. This can result in loss of safety functions.
- Use only appropriate components or devices complying with relevant safety standards corresponding to the required safety category and safety integrity level.
  - Conformity to requirements of the safety category and safety integrity level must be determined for the entire system.
  - We recommend you consult a certification body regarding assessment of conformity to the required safety integrity level or safety category.
- Note that you must confirm compliance with the applicable standards for the entire system.
- Disconnect the module from the power supply before wiring. Devices connected to the module can operate unexpectedly if wiring is performed while power is supplied.

Mount the Module

Follow these guidelines to mount the manual:

- Modules can be mounted horizontally or vertically.
- Do not mount the module near any heat source that can increase the operating temperature of the module.
- Catalog number 1732ES-IB12XOB4 and 1732ES-IB12XOBV2 modules meets IP65/IP67 (when marked).
- Mount catalog number 1791ES-IB16 and 1791ES-IB8XOBV4 modules in an enclosure rated IP54 (IEC60529) or higher.

Module Spacing

Leave minimum spacing to the wiring duct or other objects for adequate ventilation and room for wiring.

Figure 18 - Required Spacing for 1791ES-IB16 and 1791ES-IB8X0BV4 Modules

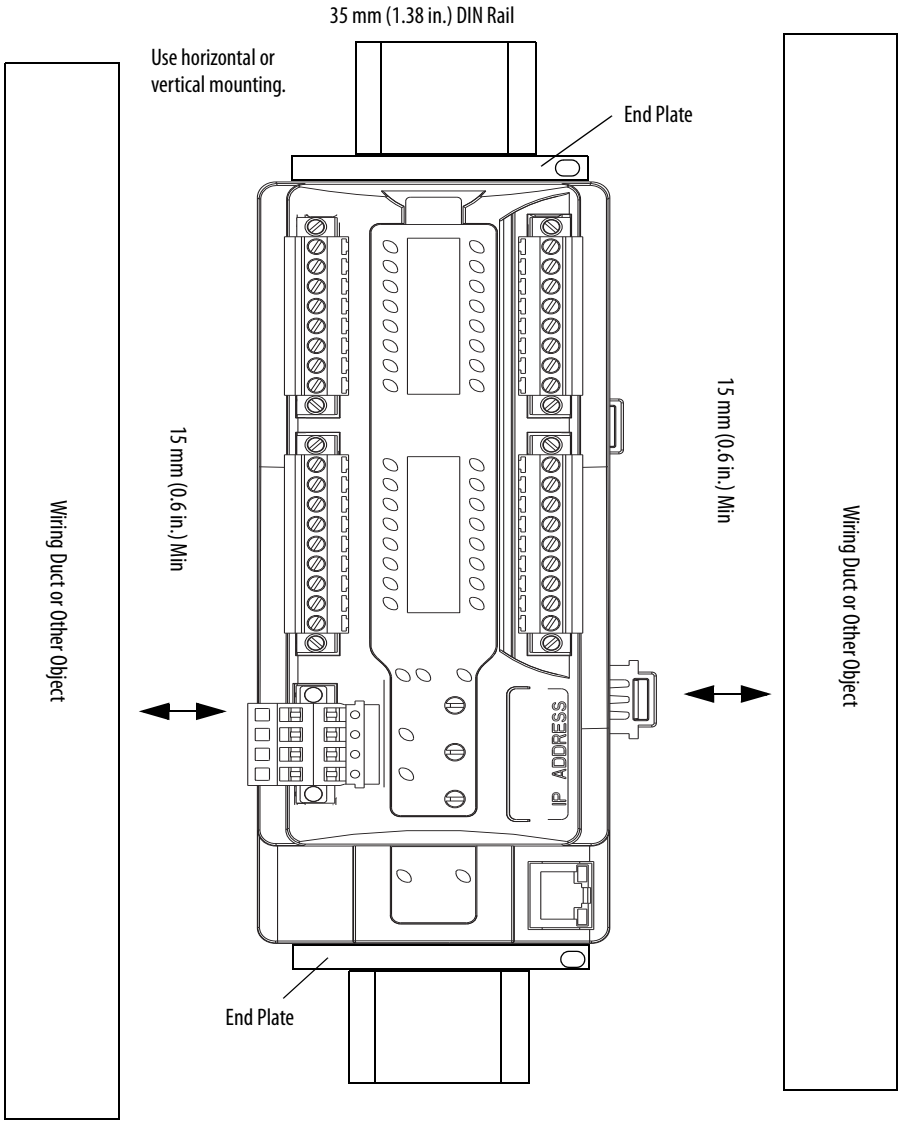
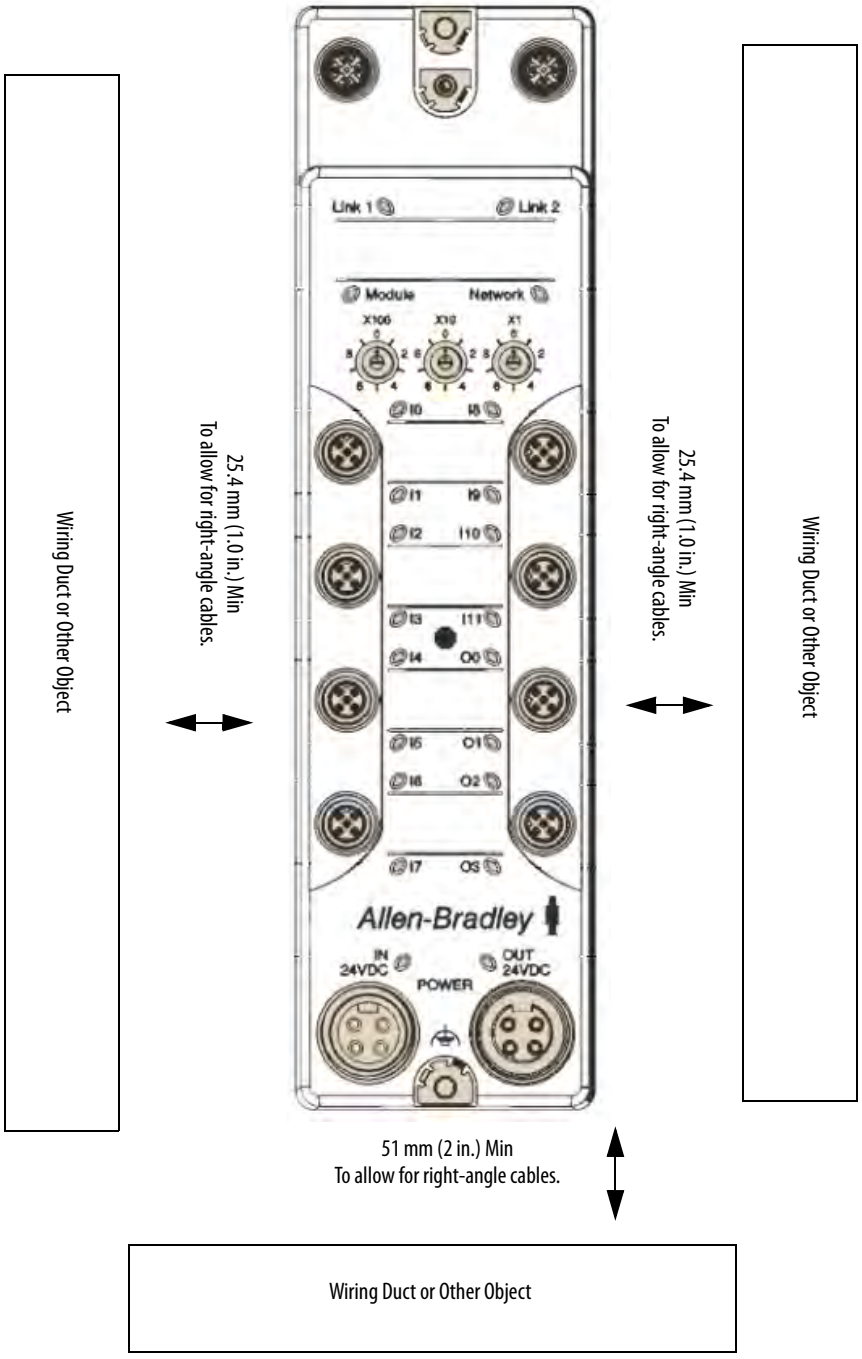


Figure 19 - Required Spacing for 1732ES-IB12X0B4 and 1732ES-IB12X0BV2 Modules

Use horizontal or vertical mounting.

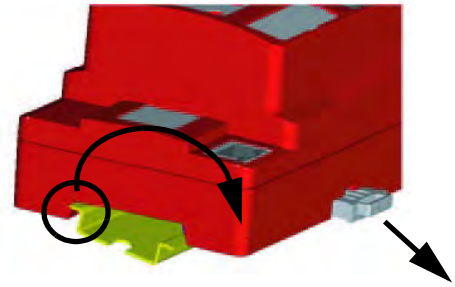


Mount the 1791ES Modules on a DIN Rail

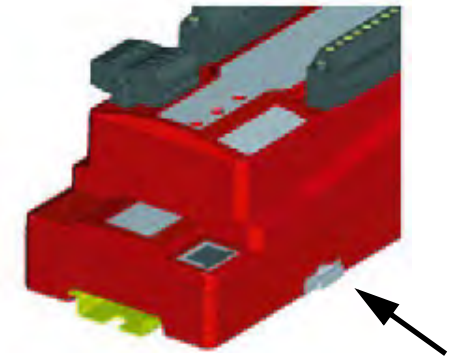
Use a DIN rail that is 35 mm (1.38 in.) wide to install the module in the control panel. Secure the 35 mm (1.4 in.) DIN rail properly with fasteners every 200 mm (7.87 in.). Use an end plate on each end of the module to secure it to the DIN rail.

Follow these steps to mount the module on a DIN rail.

1. Pry open the two gray latches to lock them in the open position.
2. Hook the module over the top of the DIN rail.



3. Rotate the module down until it makes full contact with the DIN rail.
4. Snap the latches back into place to secure the module to the rail.



5. Verify that the module is securely attached to the DIN rail.

Grounding

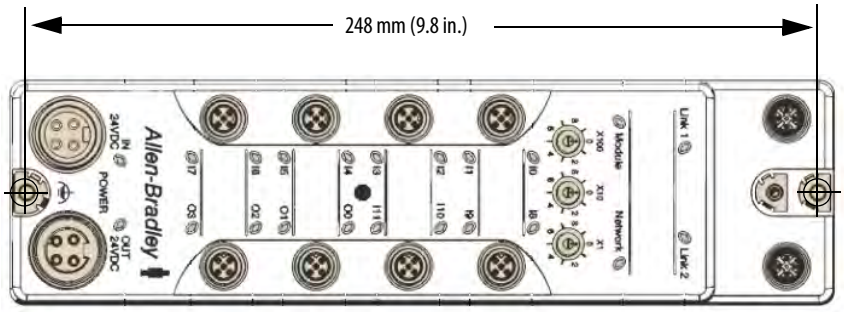
ATTENTION: This product is grounded through the DIN-rail-to-chassis ground. Use zinc plated yellow-chromate steel DIN rail to assure proper grounding. The use of other DIN rail materials (for example, aluminum and plastic) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding. Secure the DIN rail to the mounting surface approximately every 200 mm (7.87 in.) and use end plates to secure it to the DIN rail.

Mount the 1732ES Modules on a Wall or Panel

To mount the module on a wall or panel, use the screw holes provided in the module.

Follow these steps to mount the module.

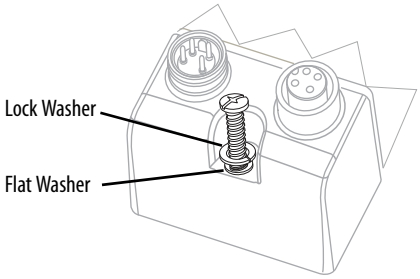
1. Use the mounting holes in the module as a guide to lay out the drill locations.
2. Mark the center of drill location with a pencil or marker.



3. Use a center punch to mark the drill locations.
4. Use a 4.5 mm (0.177 in.) drill to make the pilot holes.
5. Mount the module with two #8 (M4) screws.

Mount the Module in High Vibration Areas

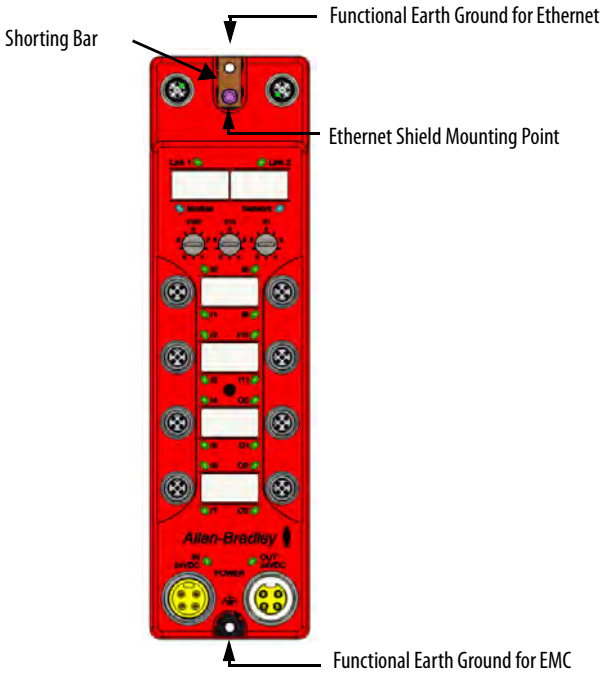
If you mount the module in an area that is subject to shock or vibration, use a flat washer and a lock washer to mount the module.



Torque the mounting screws to 0.68 N•m (6 lb•in.).

Grounding the 1732ES Modules

This figure shows the grounding features for the 1732ES modules.



Functional Earth Ground for Ethernet

The mounting screw at the top of the module is for the complex Ethernet shield grounding features. The rectangular 'shorting' bar is held in place by a conductive screw/washer combination which connects electrically to the metal shields of the Ethernet connectors internal to the module.

To ground the Ethernet shields at the module, leave the factory-installed 'shorting' bar with the conductive screw/washer combination in place and mount the module to an earth-grounded, conductive surface with conductive mounting hardware.

If you do not want to ground the Ethernet shields at the module, remove the 'shorting' bar and conductive screw/washer combination and mount the module to wall or panel.

TIP If the Ethernet shields are not grounded at the module, the mounting screw at the Ethernet end of the module is not required to make a connection with earth ground.

Functional Earth Ground for EMC

The mounting screw at the bottom of the module is required to be a conductive screw for EMC compliance. Mount the module to an earth-grounded, conductive surface using conductive mounting hardware to make the required connection with earth ground.

Set Network IP Address

The module ships with the rotary switches set to 999 and DHCP enabled.

WARNING: If you change the network IP switch settings while the power is on, an electrical arc can occur. This can cause an explosion in hazardous location installations. Be sure that power is removed, or the area is nonhazardous, before you change the network IP switch settings while the power is on.

ATTENTION: Set a suitable network IP addresses before connecting the module to a network.

IMPORTANT Catalog number 1732ES-IB12XOB4 and 1732ES-IB12XOBV2 modules have plastic dust caps that cover the network IP switches. Remove the dust caps to adjust the IP address switches.

The dust caps must be installed to maintain an IP65/67 rating.

Torque the dust caps to 0.3 ± 0.03 N•m (2.5 ±0.3 lb•in).

Perform one of these steps to set the network IP address:

- adjust the switches on the front of the module.
- use a Dynamic Host Configuration Protocol (DHCP) server, such as Rockwell Automation BootP/DHCP Server Utility.
- retrieve the IP address from nonvolatile memory.

The module reads the switches first to determine if the switches are set to a valid number. You set the network address by adjusting the three switches on the front of the module. Use a small-blade screwdriver to rotate the switches. Line up the small notch on the switch with the number setting you wish to use. Valid settings range from 001...254.

When the switches are set to a valid number, the module's IP address is 192.168.1.*xxx* (where *xxx* represents the number set on the switches). The module's subnet mask is 255.255.255.0 and the gateway address is set to 0.0.0.0. When the module is reading the network address set on the switches, the module does not have a host name assigned to it or use any Domain Name System.

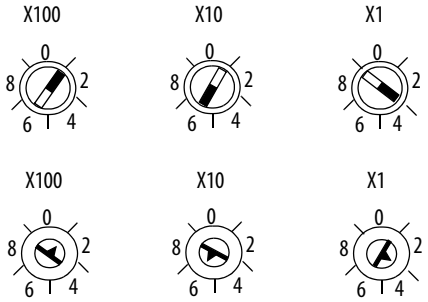
If the switches are set to an invalid number (such as 000 or a value greater than 254), the module checks to see if DHCP is enabled. If DHCP is enabled, the module asks for an address from a DHCP server. The DHCP server also assigns other Transport Control Protocol (TCP) parameters.

If DHCP is not enabled, the module uses the IP address (along with other TCP configurable parameters) stored in nonvolatile memory.

See Figure 20 on page 46 for an example of the network address switches.

Figure 20 - Example Network Address

This example shows the switches set at 163 with a network address being 192.168.1.163.



Make Connections for 1791ES Modules

Follow these guidelines when wiring the module:

- For stranded wire, install an insulation-covered ferrule (DIN 46228-4 standard compatible-type) at the ends before making wiring connections.
- Torque screws for the power connector to 0.56...0.79 N•m (5...7 lb•in).
- Torque screws for the I/O connectors to 0.5...0.56 N•m (4.5...5 lb•in).

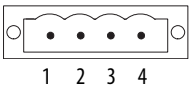
See the Ethernet Design Considerations Reference Manual, publication ENET-RM002, for information about Ethernet cable.

Power Connections

See Table 6 for a description of the pins in the power connector.

Table 6 - Power Connector Pin Descriptions

Pin No.	Signal
1	Input +24V DC power
2	Input power common
3	Output +24V DC power(1)
4	Output power common(1)



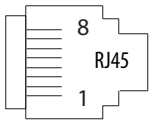
(1) NC on catalog number 1791ES-IB16 modules.

EtherNet/IP Connections

See Table 7 for a description of the pins in the EtherNet/IP connector.

Table 7 - EtherNet/IP Connector Pin Descriptions

Pin No.	Signal
8	No connection
7	No connection
6	Receive data minus
5	No connection
4	No connection
3	Receive data plus
2	Transmit data minus
1	Transmit data plus



I/O Connections

For wiring diagrams, see Wiring Examples on page 57.

IMPORTANT Because the I/O connector has a structure that helps prevent incorrect wiring, make connections at the specified locations corresponding to the terminal numbers.

See Figure 21 for a description of the pins in the I/O connector.

Figure 21 - I/O Connector Pin Descriptions

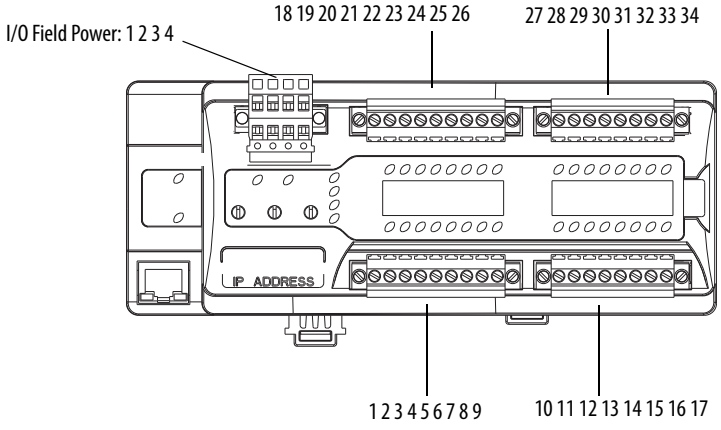


Table 8 - Terminal Positions for I/O Field Power

Terminal No.	Signal
1	Input +24V DC
2	Input -24V DC

Terminal No.	Signal
3	Output +24V DC(1)
4	Output -24V DC(1)

(1) Applies only to catalog number 1791ES-IB8XOBV4 module.

Table 9 - Terminal Positions for Terminal Numbers 1…18

Terminal No.	Signal
1	Functional earth
2	Safety input 0
3	Safety input 1
4	Test output 0
5	Test output 1
6	Safety input 2
7	Safety input 3
8	Test output 2
9	Test output 3/muting

Terminal No.	Signal
10	Safety input 4
11	Safety input 5
12	Test output 4
13	Test output 5
14	Safety input 6
15	Safety input 7
16	Test output 6
17	Test output 7/muting
18	Functional earth

Table 10 - Terminal Positions for Numbers 19…34

Terminal No.	Signal	
	Cat. No. 1791ES-IB8X0BV4 Module	**Cat. No. 1791ES-IB16 Module**
19	Safety output 0(1)/switch +24V DC	Safety input 8
20	Safety output 1(1)/switch 24V DC common	Safety input 9
21	L-/24V DC common	Test output 8
22	S+/24V DC	Test output 9
23	Safety output 2(2)/switch +24V DC	Safety input 10
24	Safety output 3(2)/switch 24V DC common	Safety input 11/muting
25	L-/24V DC common	Test output 10
26	S+/24V DC	Test output 11
27	Safety output 4(3)/switch +24V DC	Safety input 12
28	Safety output 5(3)/switch 24V DC common	Safety input 13
29	L-/24V DC common	Test output 12
30	S+/24V DC	Test output 13
31	Safety output 6(4)/switch +24V DC	Safety input 14
32	Safety output 7(4)/switch 24V DC common	Safety input 15
33	L-/24V DC common	Test output 14
34	S+/24V DC	Test output 15/muting

(1) Safety outputs 0/1 must be controlled as a pair.
(2) Safety outputs 2/3 must be controlled as a pair.
(3) Safety outputs 4/5 must be controlled as a pair.
(4) Safety outputs 6/7 must be controlled as a pair.

Make Connections for 1732ES Modules

See the Ethernet Design Considerations Reference Manual, publication ENET-RM002, for information about Ethernet cable.

Power Connections

This section describes the power connectors and recommended cables.

Table 11 - Power Connector Pin Description

Pin No.	Signal
1	Output +24V DC power
2	Input +24V DC power
3	Input power, common
4	Output power, common

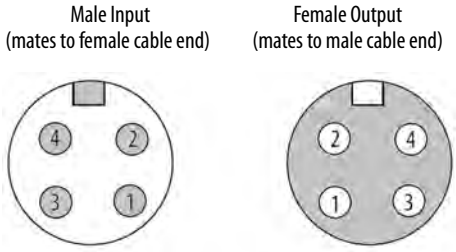


Table 12 - Recommended Power Cables

Description	Cat. No.
Mini right angle female to flying leads cord set	889N-R4AFC-6F(1)
Mini straight female to flying leads cord set	889N-F4AFC-6F(1)
Mini right angle male to flying leads cord set	889N-E4AFC-6F(1)
Mini straight male to flying leads cord set	889N-M4AFC-6F(1)
Mini right angle male to right angle female patch cord	889N-R4AFNE-2(2)
Mini straight male to straight female patch cord	889N-F4AFNM-2(2)

(1) Replace -6F (1.8 m [6 ft]) with -12 (3.7 m [12 ft]) or -20 (6.1 m [20 ft]) for additional standard cable lengths.
(2) Replace -2 (2 m [6.6 ft]) with -5 (5 m [16.4 ft]) or -10 (10 m [32.8 ft]) for additional standard cable lengths.

See http://www.ab.com/en/epub/catalogs/6005557/6005561/10508712/10513424/10513435/Introduction.html for more information.

Power Pass Through

The power required by the module is supplied via a 4-pin mini-style connector system. The module receives its required power through the male connector on the left. A female connector on the right is also provided so that power can be daisy chained from module to module.

IMPORTANT Use power pass through (daisy chaining of power) only for 'de-energize to trip' (safety state = OFF) applications.

Both modules require two 24V DC (nominal) supplies. These supplies are called the 'input +24V DC power' and the 'output +24V DC power'. The input +24V DC power provides power for the module control and Ethernet portions of the module, the safety input/test output circuits, and the test output loads. The output +24V DC power provides power for the safety output circuits and the safety output loads.

Internally, the input +24V DC power and output +24V DC power are isolated from each other.

IMPORTANT The maximum current that any pin on the power connectors can carry is10 A.

The input +24V DC power current required for a module in the daisy chain can be estimated as described here.

$I_{IP} \sim I_{IPM} + I_{TO} + I_{IPDC}$

Where:

I_{IP} is the input +24V DC power current through the module's male power connector.

I_{IPM} is the input +24V DC power current required by the module itself (with no test output load current).

I_{TO} is the total test output load current for test outputs N (0...11).

I_{IPDC} is the total input +24V DC power current through the module's female power connector (input +24V DC power current for the modules that follow in the daisy chain).

I_{IPM} can be approximated by 4.2 W divided by the input +24V DC power voltage.

The table input +24V DC power calculation shows an example input +24V DC power current calculation for a system of four modules. The input +24V DC power voltage is 24V DC in this example. Module 1 is the first module in the daisy chain. The table should be filled out starting with the last module in the daisy chain, in this example Module 4. Once **I_{IP}** is calculated for module 4, it transfers as the **I_{IPDC}** value for Module 3. This process continues for all modules in the daisy chain.

As can be seen in the cell with value set in bold, the maximum input +24V DC power current through the male power connectors in the daisy chain is 6.5A which is less than 10 A, so this system is adequate. If the **I_{IP}** value for a module in this or any daisy chained system were to exceed 10 A that system would not meet the module requirement that the maximum current that any pin on the power connectors can carry is 10 A.

Table 13 - Input +24V DC Power Calculation

Value	Module 1	Module 2	Module 3	Module 4
I_{IPDC}	4.875 A	3.250 A	1.625 A	0.000 A
I_{IPM}	0.175 A	0.175 A	0.175 A	0.175 A
I_{T00}	0.005 A	0.005 A	0.005 A	0.700 A
I_{T01}	0.005 A	0.005 A	0.005 A	0.700 A
I_{T02}	0.005 A	0.005 A	0.700 A	0.005 A
I_{T03}	0.005 A	0.005 A	0.700 A	0.005 A
I_{T04}	0.005 A	0.700 A	0.005 A	0.005 A
I_{T05}	0.005 A	0.700 A	0.005 A	0.005 A
I_{T06}	0.700 A	0.005 A	0.005 A	0.005 A
I_{T07}	0.700 A	0.005 A	0.005 A	0.005 A
I_{T08}	0.005 A	0.005 A	0.005 A	0.005 A
I_{T09}	0.005 A	0.005 A	0.005 A	0.005 A
I_{T010}	0.005 A	0.005 A	0.005 A	0.005 A
I_{T011}	0.005 A	0.005 A	0.005 A	0.005 A
I_{IP}	**6.500 A**	4.875 A	3.250 A	1.625 A

The output +24V DC power current required for a module in the daisy chain can be estimated as described here.

$I_{OP} \sim I_{OPM} + I_{SO} + I_{SNSO} + I_{OPDC}$

Where:

I_{OP} is the output +24V DC power current through the module's male power connector.

I_{OPM} is the output +24V DC power current required by the module itself (with no safety output load current).

I_{SO} is the total safety output load current for safety outputs N (safety outputs 0 and 2 for modules with bipolar safety outputs, or safety outputs 0...3 for modules with sourcing safety outputs).

I_{SNSO} is the total sensor output load current for the Output +24V DC power output pins (pin 1 in the output I/O connectors).

I_{OPDC} is the total output +24V DC power current through the module's female power connector (output +24V DC power current for the modules that follow in the daisy chain).

I_{OPM} can be approximated by 1.56 W divided by the output +24V DC power voltage for the 1732ES-IB12XOBV2 module, and can be approximated by 1.08W divided by the output +24V DC power voltage.

The table output +24V DC power calculation shows an example output +24V DC power current calculation for a system of four modules. The output +24V DC power voltage is 24V DC in this example. Module 1 is the first module in the daisy chain. Modules 1 and 3 have bipolar safety outputs, Modules 2 and 4 have sourcing safety outputs. The table should be filled out starting with the last module in the daisy chain, in this example Module 4. Once $\mathbf{I_{OP}}$ is calculated for module 4, it transfers as the $\mathbf{I_{OPDC}}$ value for Module 3. This process continues for all modules in the daisy chain.

As can be seen in the cell with value set in bold, the maximum output +24V DC power current through the male power connectors in the daisy chain is 9.02 A which is less than 10 A, so this system is adequate. If the $\mathbf{I_{OP}}$ value for a module in this or any daisy chained system were to exceed 10A, that system would not meet the module requirement that the maximum current that any pin on the power connectors can carry is 10 A.

Table 14 - Output +24V DC Power Calculation

Value	Module 1	Module 2	Module 3	Module 4
I_{opdc}	6.755 A	4.600 A	2.245 A	0.000 A
I_{opm}	0.065 A	0.045 A	0.065 A	0.045 A
I_{so0}	1.000 A	0.500 A	1.000 A	0.500 A
I_{so1}	–	0.500 A	–	0.500 A
I_{so2}	1.000 A	0.500 A	1.000 A	0.500 A
I_{so3}	–	0.500 A	–	0.500 A
I_{SNSO}	0.200 A	0.200 A	0.200 A	0.200 A
I_{op}	**9.020 A**	6.755 A	4.600 A	2.245 A

ATTENTION: To comply with the CE Low Voltage Directive (LVD), this equipment and all connected I/O must be powered from a source compliant with Safety Extra Low Voltage (SELV) or Protected Extra Low Voltage (PELV).

EtherNet/IP Connections

This section describes the EtherNet/IP connector and sample cables.

Table 15 - EtherNet/IP Connector Pin Description

Pin No.	Signal
1	Tx+
2	Rx+
3	Tx-
4	Rx-
5	Shell/Shield

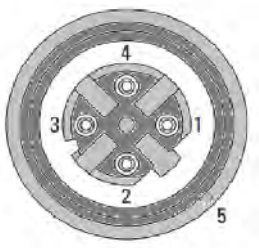


Table 16 - Sample EtherNet/IP Cables

Description	Cat. No.
M12 D-Coded straight to RJ45 patchcord	1585D-M4UBJM-2(1)
M12 D-Coded straight to flying leads cordset	1585D-M4UB-2(1)
M12 D-Coded straight to M12 straight patchcord	1585D-M4UBDM-2(1)
M12 D-Coded right angle to M12 right angle patchcord	1585D-E4UBDE-2(1)

(1) Replace -2 (2 m [6.6 ft]) with -1 (1 m [3.3 ft]), -5 (5 m [16.4 ft]) or -10 (10 m [32.8 ft]) for additional standard cable lengths.

See http://www.ab.com/en/epub/catalogs/6005557/6005561/10514505/10515166/Introduction.html for additional information.

I/O Connections

This section describes the I/O connectors and recommended cables.

Table 17 - I/O Connector Pin Description

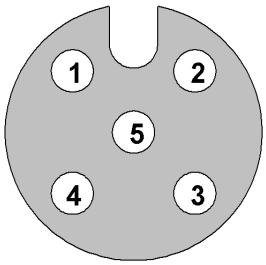
Pin No.	Input Signal	I/O Connector	Bipolar Output Signal	Sourcing Output Signal
1	Test out n+1		Output +24V DC power	Output +24V DC power
2	Input n+1		Output n+1 (N) (sinking)	Output n+1
3	Input common		Output power common	Output power common
4	Input n		Output n (P) (sourcing)	Output n
5	Test out n		Output power common	Output power common
Case	No connect		No connect	No connect

Figure 22 - I/O Connector Positions

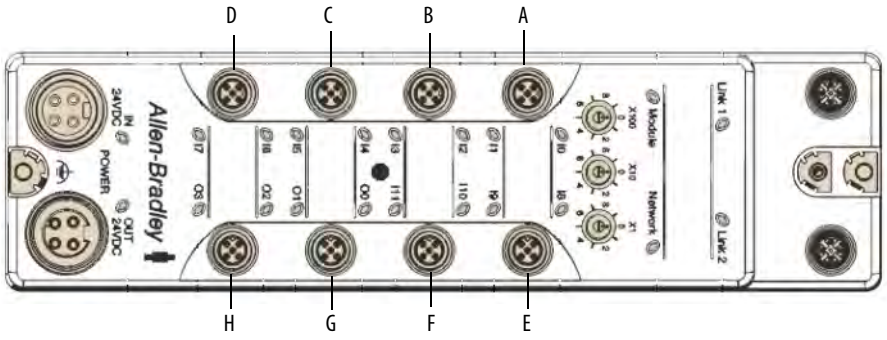


Table 18 - I/O Connector Pinouts

Safety Input Signals			
Terminal	**1732ES-IB12X0BV2 and 1732ES-IB12X0B4 Modules**	**Terminal**	**1732ES-IB12X0BV2 and 1732ES-IB12X0B4 Modules**
A-1	Test out 1	D-1	Test out 7
A-2	Safety input 1	D-2	Safety input 7
A-3	Input common	D-3	Input common
A-4	Safety input 0	D-4	Safety input 6
A-5	Test out 0	D-5	Test out 6
B-1	Test out 3	E-1	Test out 9
B-2	Safety input 3	E-2	Safety input 9
B-3	Input common	E-3	Input common
B-4	Safety input 2	E-4	Safety input 8
B-5	Test out 2	E-5	Test out 8
C-1	Test out 5	F-1	Test out 11
C-2	Safety input 5	F-2	Safety input 11
C-3	Input common	F-3	Input common
C-4	Safety input 4	F-4	Safety input 10
C-5	Test out 4	F-5	Test out 10

Safety Output Signals		
Terminal	**Only 1732ES-IB12X0BV2 Module**	**Only 1732ES-IB12X0B4 Module**
G-1	Output +24V DC power	Output +24V DC power
G-2	Safety output 1(1) (N) (sinking)	Safety output 1(3) (sourcing)
G-3	Output power common	Output power common
G-4	Safety output 0(1) (P) (sourcing)	Safety output 0(3) (sourcing)
G-5	Output power common	Output power common
H-1	Output +24V DC power	Output +24V DC power
H-2	Safety output 3(2) (N) (sinking)	Safety output 3(4) (sourcing)
H-3	Output power common	Output power common
H-4	Safety output 2(2) (P) (sourcing)	Safety output 2(4) (sourcing)
H-5	Output power common	Output power common

(1) Safety outputs 0/1 must be controlled as a pair.
(2) Safety outputs 2/3 must be controlled as a pair.
(3) Safety outputs 0/1 may be controlled individually or as a pair.
(4) Safety outputs 0/1 may be controlled individually or as a pair.

Table 19 - Recommended I/O Connector Cables

Description	Cat. No.
M12 right-angle male to flying leads cordset	889D-E5AC-2(1)
M12 straight-male to flying leads cordset	889D-M5AC-2(1)
M12 right-angle male to straight female patchcord	889D-F5ACDE-2(2)
M12 straight male to straight female patchcord	889D-F5ACDM-2(2)

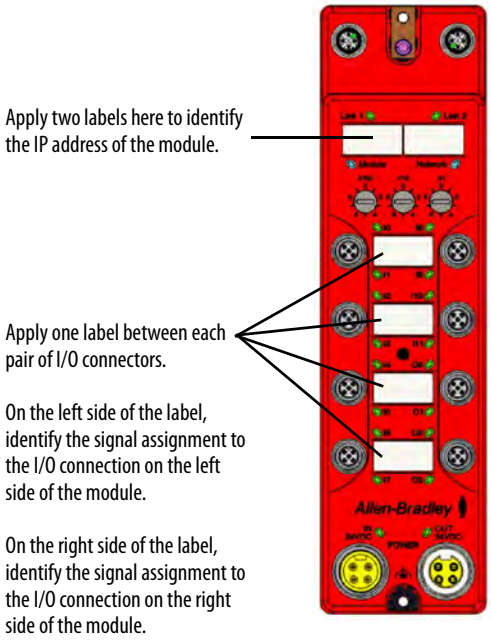
(1) Replace -2 (2 m [6.6 ft]) with -5 (5 m [16.4 ft]) or -10 (10 m [32.8 ft]) for additional standard cable lengths.
(2) Replace -2 (2m [6.6 ft]) with -0M3 (0.3 m [1.0 f t]), -1 (1 m [3.3 ft]), -5 (5 m [16.4 ft]), or -10 (10 m [32.8 ft]) for additional standard cable lengths.

See http://www.ab.com/en/epub/catalogs/6005557/6005561/6125318/8613745/8613769/8613771/Introduction.html for additional information.

Label the IP Address and Device Connections

The 1732ES module ships with 12 white labels that you can use to identify the IP address of the module, and the input and output connections. There are six areas on the module to place the labels, with six additional labels that can be used if the IP address or device connections change.

Use a pen or indelible marker with a fine tip to write on the labels. You can also use a printing device to print the data onto the label. Contact a Brady representative at http://www.bradyid.com and ask about printer compatibility for part number PTLEP-171-593.



IMPORTANT: Be sure that the surface of the module is clean and dry before you apply the labels to the module.

Notes:

Wiring Examples

Topic	Page
Wiring Examples for Safety Categories	57
Wiring by Application	61

Wiring Examples for Safety Categories

Read this chapter for information about wiring and safety categories. See the tables that show input device connection methods and their safety categories.

Table 20 - Input Device Connection Methods and Safety Categories

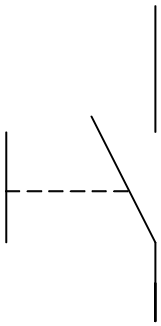
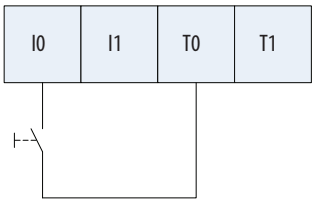
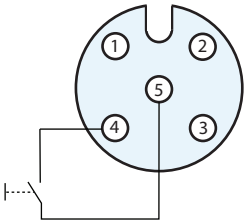
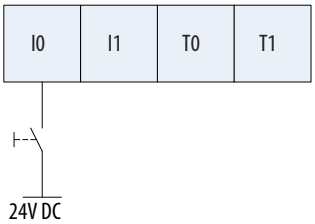
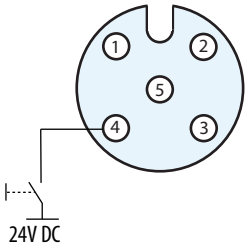
Connected Device	Test Pulse from Test Output	Connection	Schematic Diagram	Safety Category
Reset switch 	No	Connect the switch between I0 and T0. T0 must be configured as 24V power supply.	1791ES Modules  1732ES Modules  1 - Test Output 1 2 - Input 1 3 - Input Common 4 - Input 0 5 - Test Output 0	N/A
		Connect the switch between 24V DC and I0.	1791ES Modules  1732ES Modules  1 - Test Output 1 2 - Input 1 3 - Input Common 4 - Input 0 5 - Test Output 0	N/A

Table 20 - Input Device Connection Methods and Safety Categories (continued)

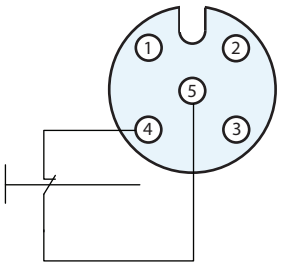
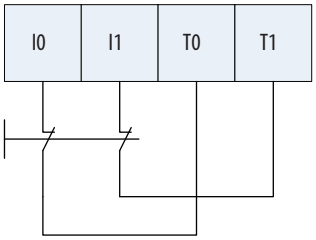
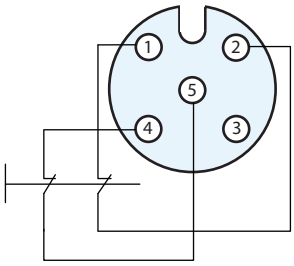
Connected Device	Test Pulse from Test Output	Connection	Schematic Diagram	Safety Category
Single-channel safety device	Yes	Connect the switch between I0 and T0	Only 1732ES Modules 1 - Test Output 1 2 - Input 1 3 - Input Common 4 - Input 0 5 - Test Output 0 	2
Emergency stop switch Door monitor	Yes	Connect the switches between I0 and T0, and I1 and T1	1791ES Modules  1732ES Modules 1 - Test Output 1 2 - Input 1 3 - Input Common 4 - Input 0 5 - Test Output 0 	4

Table 20 - Input Device Connection Methods and Safety Categories (continued)

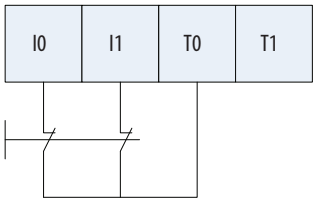
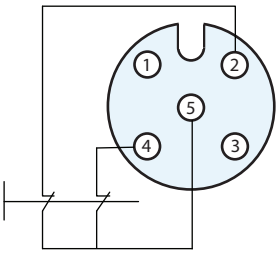
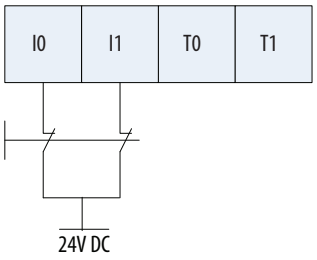
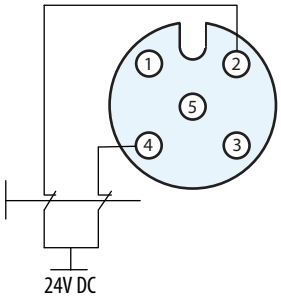
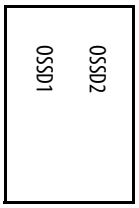
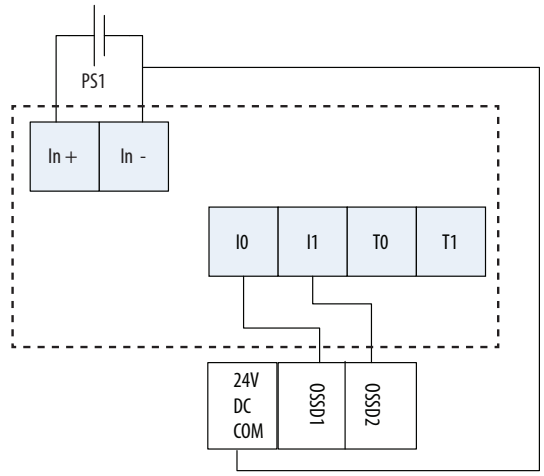
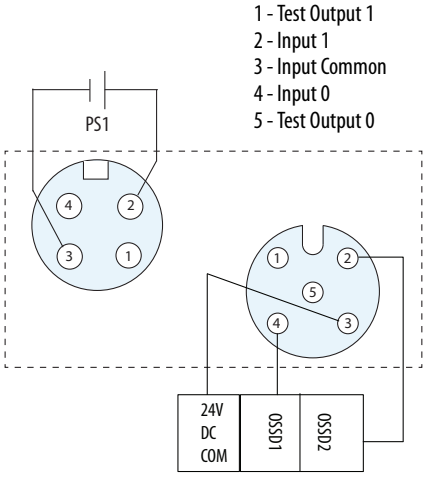
Connected Device	Test Pulse from Test Output	Connection	Schematic Diagram	Safety Category
Emergency stop switch Door monitor	No	Connect the switches between T0 and I0 and I1, noting that T0 is configured for 24V power supply.	1791ES Modules  1732ES Modules 1 - Test Output 1 2 - Input 1 3 - Input Common 4 - Input 0 5 - Test Output 0 	3
		Connect the switches between 24V DC and I0 and I1.	1791ES Modules  1732ES Modules 1 - Test Output 1 2 - Input 1 3 - Input Common 4 - Input 0 5 - Test Output 0 	

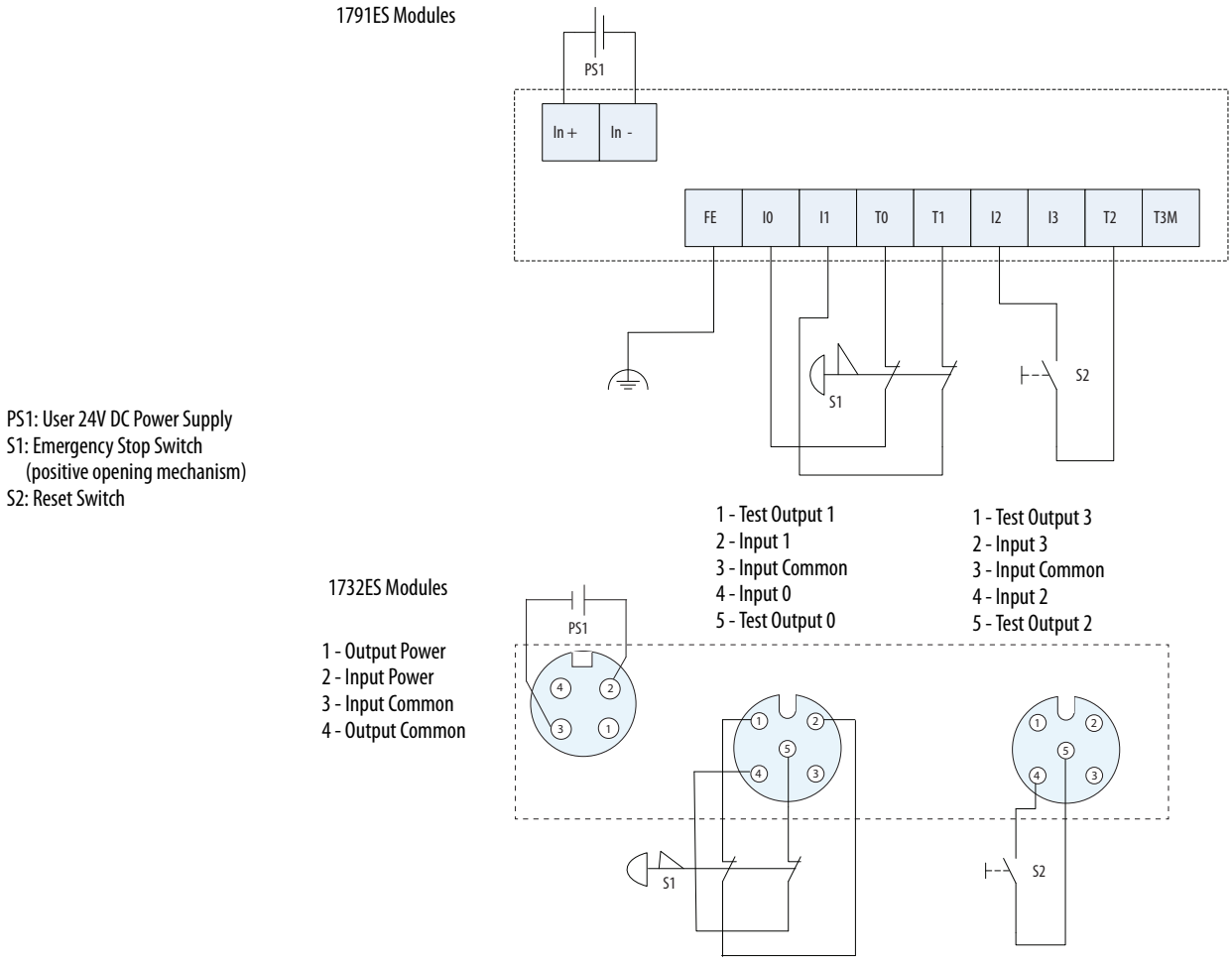
Table 20 - Input Device Connection Methods and Safety Categories (continued)

Connected Device	Test Pulse from Test Output	Connection	Schematic Diagram	Safety Category
Light curtain 	Yes	Connect the OSSD1 and OSSD2 to I0 and I1, respectively. Connect the 24V power supply commons.	1791ES Modules  1732ES Modules 1 - Output Power 2 - Input Power 3 - Input Common 4 - Output Common 	3 or 4 based on light curtain being used

Wiring by Application

Read this section for examples of wiring by application. See catalog number details for appropriate module.

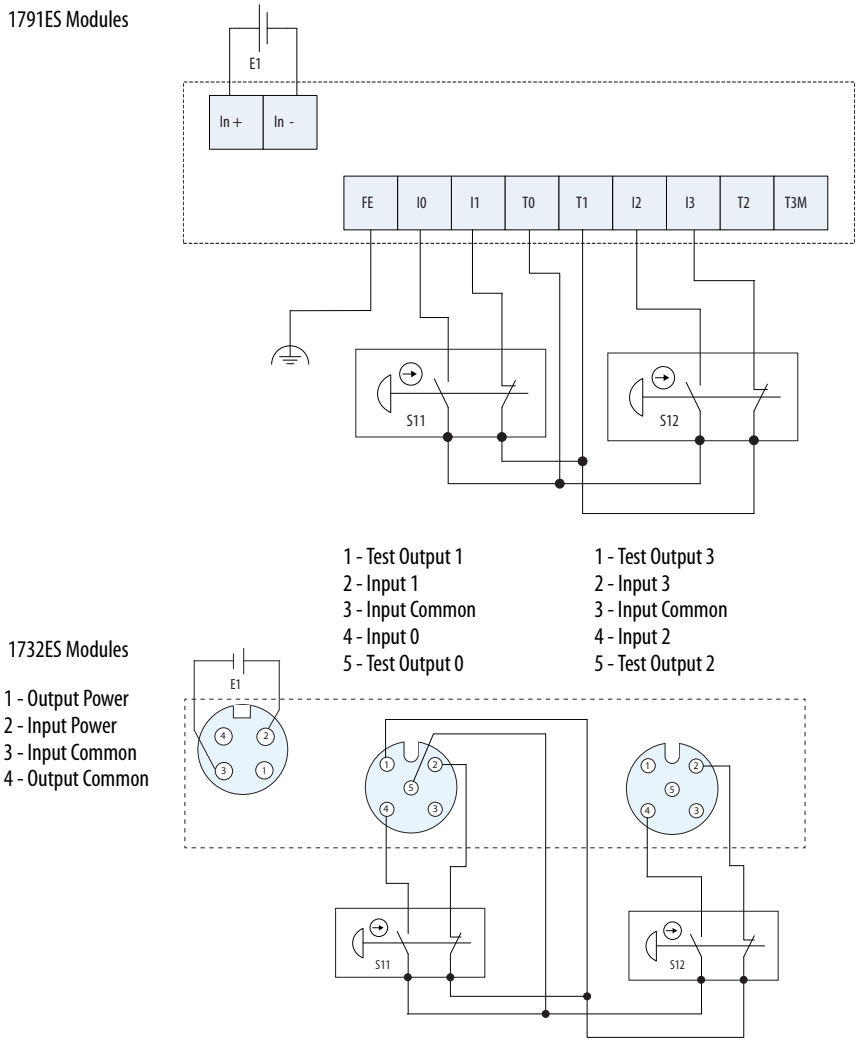
Figure 23 - Emergency Stop Switch Dual-channel Inputs with Manual Reset



Controller Configuration	Parameter Name	Configuration Setting
Safety Input 0	Safety Input 0 Channel Mode	Test Pulse from Test Output
	Safety Input 0 Test Source	Test Output 0
	Dual-channel Safety Input 0/1 Mode	Dual-channel Equivalent
	Dual-channel Safety Input 0/1 Discrepancy Time	100 ms (application dependent)
Safety Input 1	Safety Input 1 Channel Mode	Test Pulse from Test Output
	Safety Input 1 Test Source	Test Output 1
Safety Input 2	Safety Input 2 Channel Mode	Used as standard input
	Safety Input 2 Test Source	Not Used
	Dual-channel Safety Input 2/3 Mode	Single Channel
Test Output 0	Test Output 0 Mode	Pulse Test Output
Test Output 1	Test Output 1 Mode	Pulse Test Output
Test Output 2	Test Output 2 Mode	Power Supply Output

This example shows wiring and controller configuration when using the Guard I/O module. If used in combination with the programs in a safety controller, this wiring is Safety Category 4 in accordance with ISO 13849-1:2008 wiring requirements.

Figure 24 - Two-hand Monitor

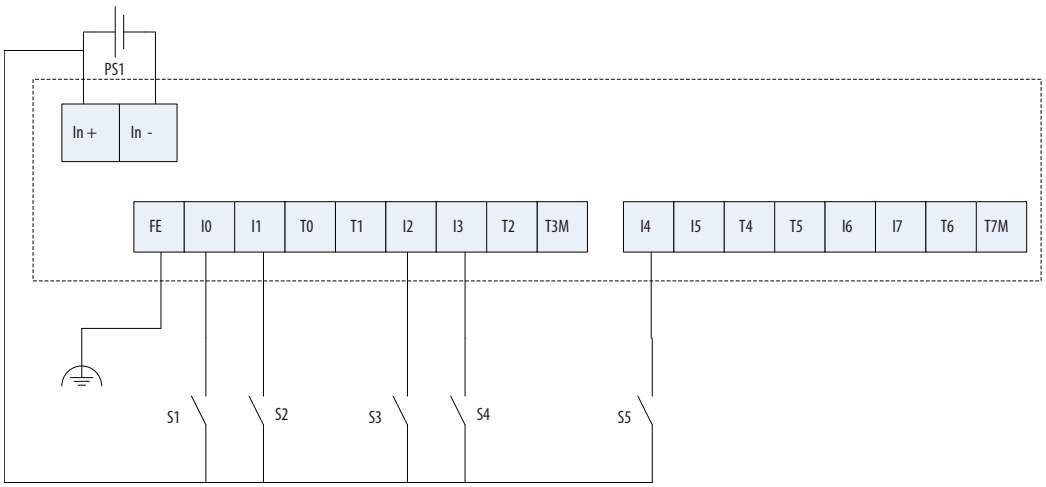


Controller Configuration	Parameter Name	Configuration Setting
Safety Input 0	Safety Input 0 Channel Mode	Test Pulse from Test Output
	Safety Input 0 Test Source	Test Output 0
	Dual Channel Safety Input 0/1 Mode	Dual Channel Complementary
	Dual Channel Safety Input 0/1 Discrepancy Time	100 ms (application dependent)
Safety Input 1	Safety Input 1 Channel Mode	Test Pulse from Test Output
	Safety Input 1 Test Source	Test Output 1
Safety Input 2	Safety Input 2 Channel Mode	Test Pulse from Test Output
	Safety Input 2 Test Source	Test Output 0
	Dual Channel Safety Input 2/3 Mode	Dual Channel Complementary
	Dual Channel Safety Input 2/3 Discrepancy Time	100 ms (application dependent)
Safety Input 3	Safety Input 3 Channel Mode	Test Pulse from Test Output
	Safety Input 3 Test Source	Test Output 1
Test Output 0	Test Output 0 Mode	Pulse Test Output
Test Output 1	Test Output 1 Mode	Pulse Test Output

This example shows wiring and controller configuration when using the Guard I/O module. If used in combination with the programs of a safety controller, the wiring is Category 4 in accordance with ISO 13849-1:2008 wiring requirements.

Figure 25 - Mode Select Switch

1791ES Modules



PS1: User 24V DC Power Supply
S1…S5: Switches

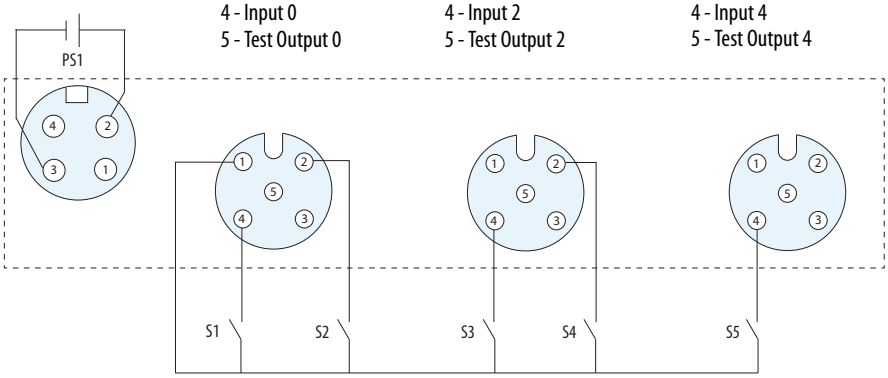
1 - Test Output 1
2 - Input 1
3 - Input Common
4 - Input 0
5 - Test Output 0

1 - Test Output 3
2 - Input 3
3 - Input Common
4 - Input 2
5 - Test Output 2

1 - Test Output 5
2 - Input 5
3 - Input Common
4 - Input 4
5 - Test Output 4

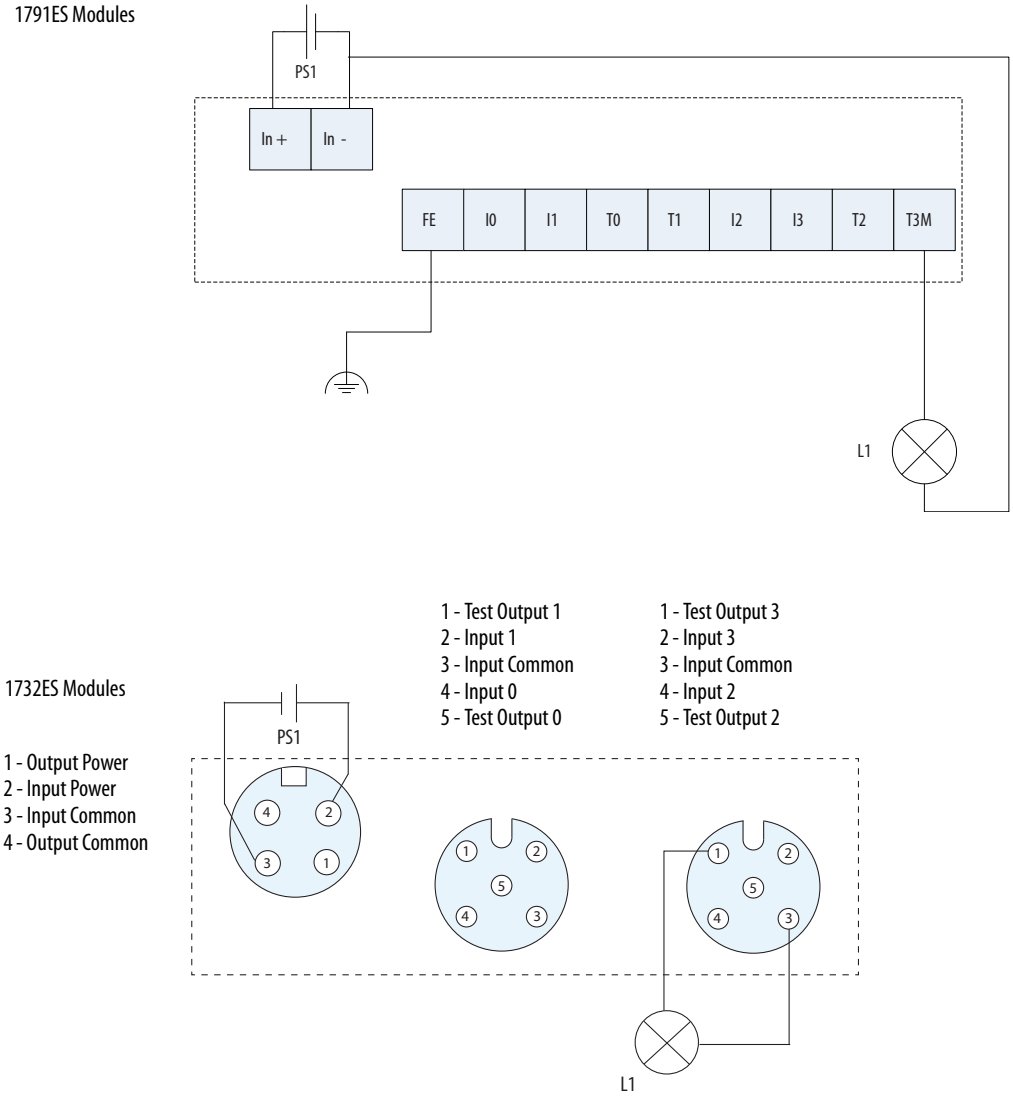
1732ES Modules

1 - Output Power
2 - Input Power
3 - Input Common
4 - Output Common



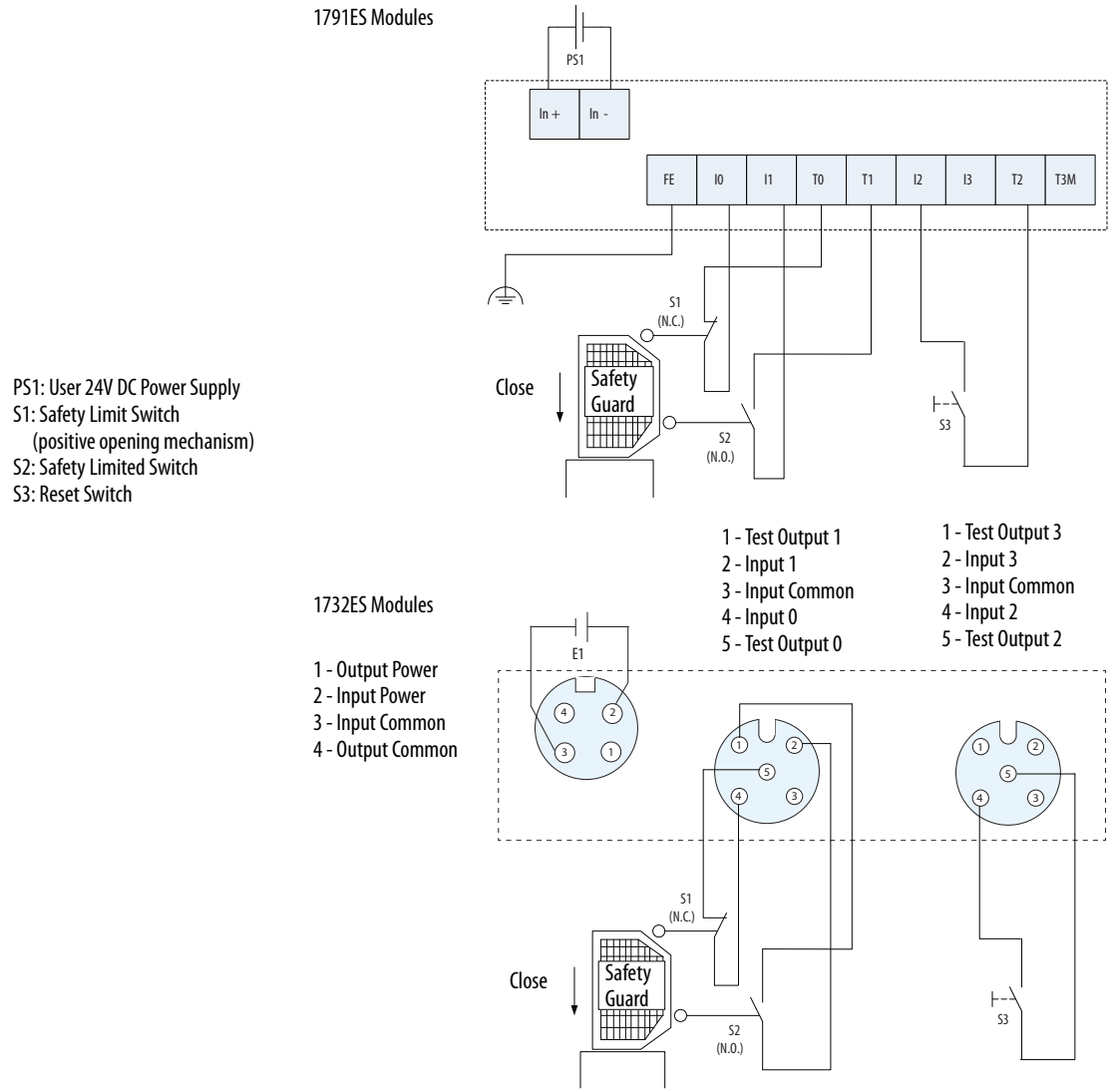
Controller Configuration	Parameter Name	Configuration Setting
Safety Input 0	Safety Input 0 Channel Mode	Safety Input
	Safety Input 0 Test Source	None
	Dual Channel Safety Input 0/1 Mode	Single Channel
Safety Input 1	Safety Input 1 Channel Mode	Safety Input
	Safety Input 1 Test Source	None
Safety Input 2	Safety Input 2 Channel Mode	Safety Input
	Safety Input 2 Test Source	None
	Dual Channel Safety Input 2/3 Mode	Single Channel
Safety Input 3	Safety Input 3 Channel Mode	Safety Input
	Safety Input 3 Test Source	None
Safety Input 4	Safety Input 4 Channel Mode	Safety Input
	Safety Input 4 Test Source	None
	Dual Channel Safety Input 4/5 Mode	Single Channel
Test Output 0	Test Output 0 Mode	Power Supply

Figure 26 - Muting Lamp Output



Controller Configuration	Parameter Name	Configuration Setting
Test Output 3	Test Output 3 Mode	Muting Lamp Output

Figure 27 - Limit Switch Dual-channel Inputs and a Manual Reset

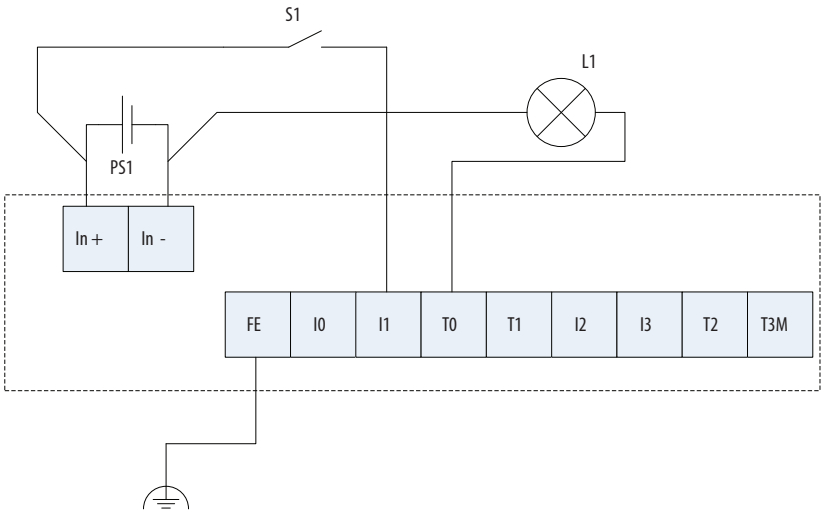


Controller Configuration	Parameter Name	Configuration Setting
Safety Input 0	Safety Input 0 Channel Mode	Test Pulse from Test Output
	Safety Input 0 Test Source	Test Output 0
	Dual-channel Safety Input 0/1 Mode	Dual-channel Equivalent
	Dual-channel Safety Input 0/1 Discrepancy Time	1000 ms (application dependent)
Safety Input 1	Safety Input 1 Channel Mode	Test Pulse from Test Output
	Safety Input 1 Test Source	Test Output 1
Safety Input 2	Safety Input 2 Channel Mode	Used as Standard Input
	Safety Input 2 Test Source	Not Used
	Dual-channel Safety Input 2/3 Mode	Single Channel
Test Output 0	Test Output 0 Mode	Pulse Test Output
Test Output 1	Test Output 1 Mode	Pulse Test Output
Test Output 2	Test Output 2 Mode	Power Supply Output

This example shows wiring and controller configuration when using the Guard I/O module with limit switch dual-channel inputs and a manual reset. If used in combination with the programs of a safety controller, the wiring is Category 4 in accordance with ISO 13849-1:2008 wiring requirements.

Figure 28 - Guard I/O Module with Limit Switch Dual-channel Inputs and a Manual Reset

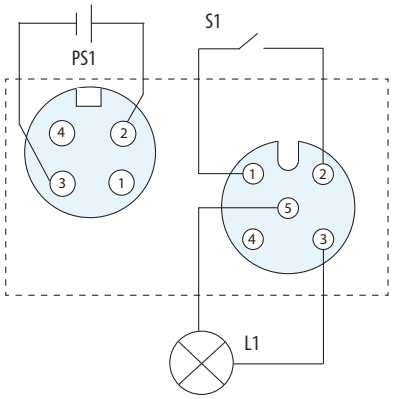
1791ES Modules



PS1: User 24V DC Power Supply
L1: Lamp
S1: Switch

1732ES Modules

1 - Output Power
2 - Input Power
3 - Input Common
4 - Output Common

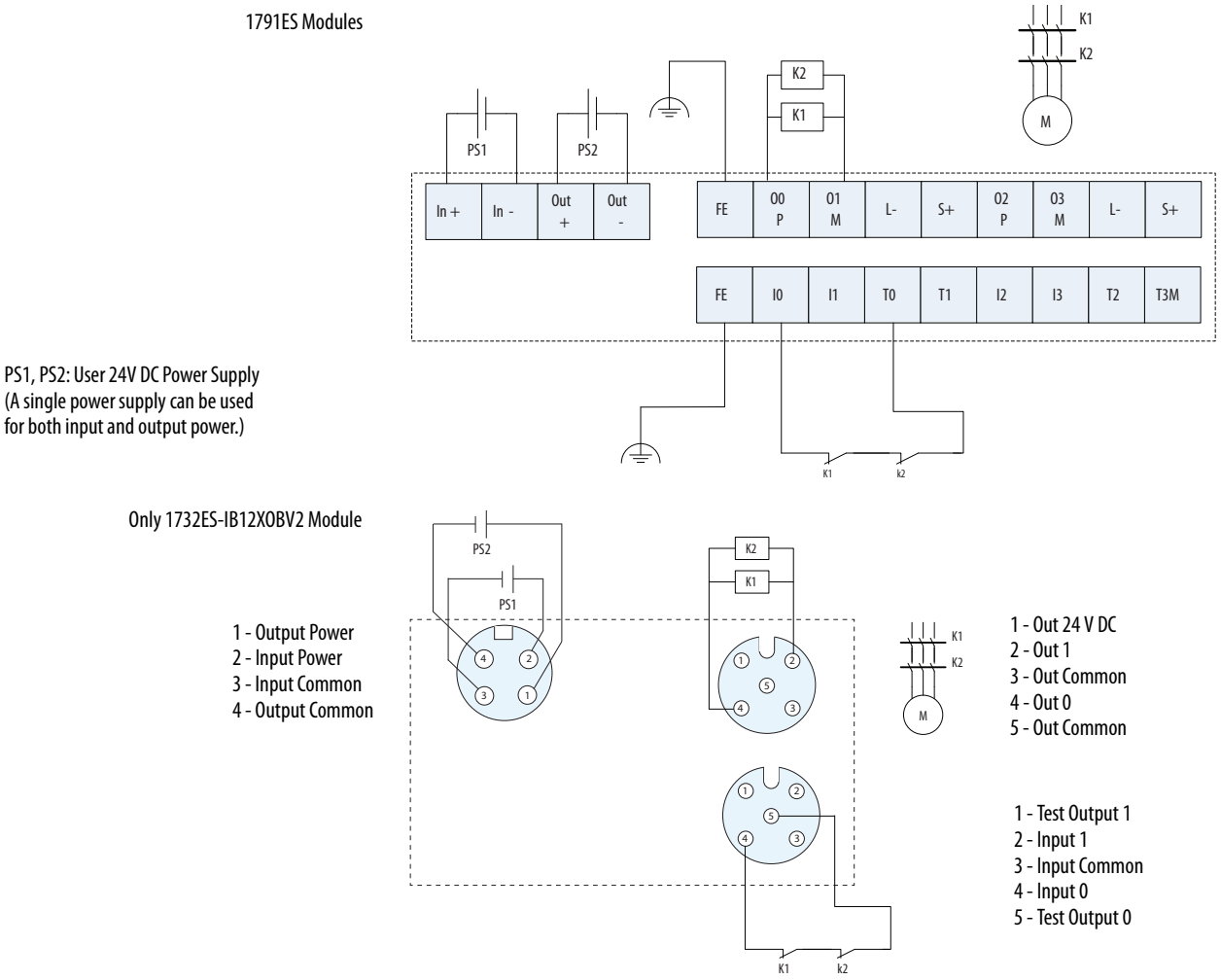


1 - Test Output 1
2 - Input 1
3 - Input Common
4 - Input 0
5 - Test Output 0

Controller Configuration	Parameter Name	Configuration Setting
Safety Input 1	Safety Input 1 Channel Mode	Standard Input
	Safety Input 1 Test Source	None
	Dual-channel Safety Input 0/1 Mode	Single Channel
Test Output 0	Test Output 0 Mode	Standard Output
Test Output 1	Test Output 1 Mode	Power Supply

Figure 29 - Dual-load Bipolar Outputs

IMPORTANT For the bipolar safety outputs to work as intended, you **must** connect the devices that are being controlled as shown in this figure. Connection of devices directly to 24V DC, 0V DC, or ground is strictly prohibited.

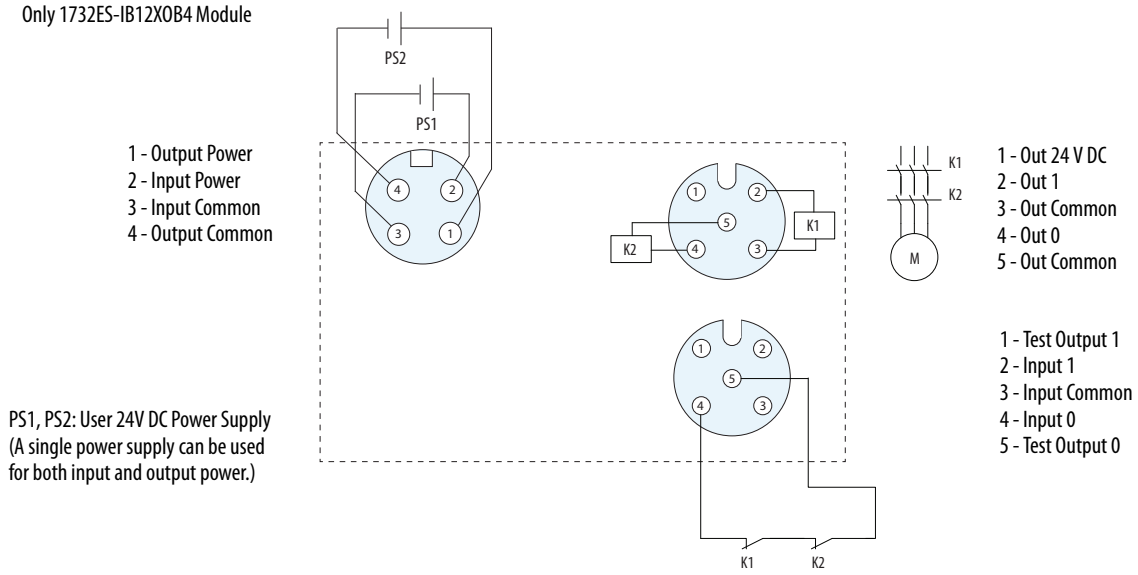


Controller Configuration	Parameter Name	Configuration Setting
Safety Input 0	Safety Input 0 Channel Mode	Test Pulse from Test Output
	Safety Input 0 Test Source	Test Output 0
	Dual-channel Safety Input 0/1 Mode	Single Channel
Test Output 0	Test Output 0 Mode	Pulse Test Output
Safety Output 0	Safety Output 0 Channel Mode	Safety Pulse Test
Safety Output 1	Safety Output 1 Channel Mode	Safety Pulse Test

The example shows wiring and configuration when using the Guard I/O module with solid-state outputs in Dual-channel mode.

Note that all safety outputs of this Guard I/O module are permanently configured for use as Dual-channel mode only. When used in combination with the programs of the safety controller, this circuit configuration is Safety Category 4 in accordance with ISO 13849-1:2008 wiring requirements.

Figure 30 - Dual-load Sourcing Outputs – Only 1732ES-IB12X0B4 Module



Controller Configuration	Parameter Name	Configuration Setting
Safety Input 0	Safety Input 0 Channel Mode	Test Pulse from Test Output
	Safety Input 0 Test Source	Test Output 0
	Dual-channel Safety Input 0/1 Mode	Single Channel
Test Output 0	Test Output 0 Mode	Pulse Test Output
Safety Output 0/1	Safety Output 0/1 Operation Type	Dual
Safety Output 0	Safety Output 0 Channel Mode	Safety Pulse Test
Safety Output 1	Safety Output 1 Channel Mode	Safety Pulse Test

The example shows wiring and configuration when using the 1732ES-IB12XOB4 Guard I/O module with solid-state outputs in Dual-channel mode.

When used in combination with the programs of the safety controller, this circuit configuration is Safety Category 4 in accordance with ISO 13849-1:2008 wiring requirements.

Configure the I/O Modules by Using the Logix Designer Application

Topic	Page
Add Modules to the I/O Configuration Tree	69
Configure the Module Properties	71
Configure the Safety Connections	78
Configure the Module Inputs	80
Configure the Test Outputs	82
Configure the Module Outputs	83
Save and Download the Module Configuration	84

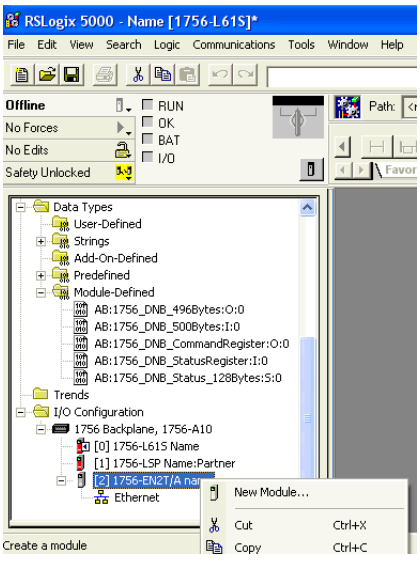
Use the Logix Designer application to configure the modules.

At the bottom of a dialog box, choose Help for information about how to complete entries in the dialog box. At the bottom of a warning dialog box, choose Help to get information about that specific error.

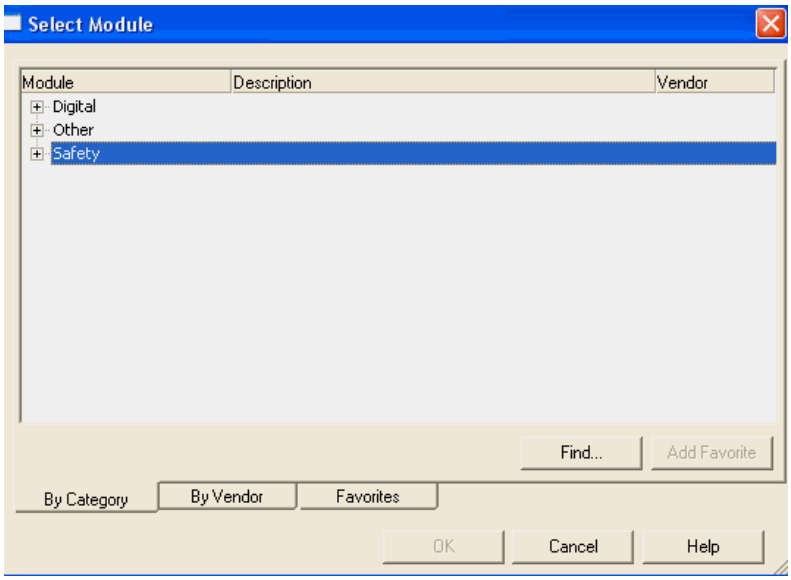
Add Modules to the I/O Configuration Tree

To add a module to the I/O configuration tree, follow these guidelines.

1. From the I/O Configuration tree, right-click the Ethernet bridge module, as shown in the figure, and choose New Module.

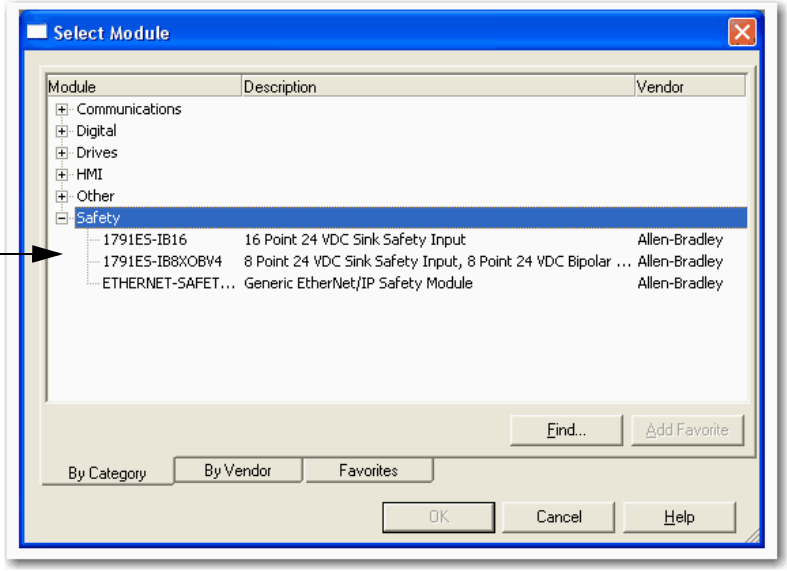


The Select Module dialog box is displayed with a list that includes Safety.



2. From the Select Module dialog box, choose the + next to Safety to see a list of safety modules

A list of safety modules appears here.

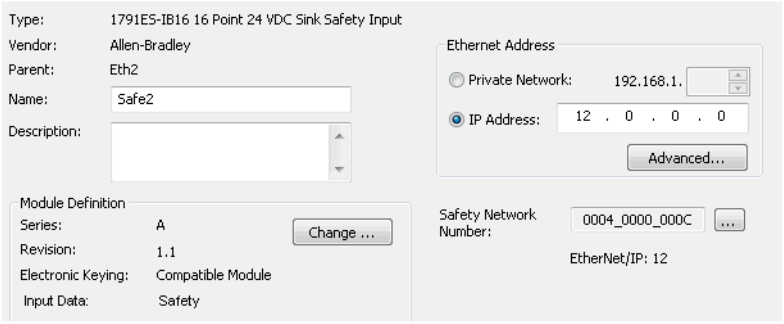


3. From the Select Module dialog box, choose the appropriate module, such as 1791ES-IB16, and OK at the bottom of the dialog box.

Configure the Module Properties

Follow these steps to configure the general properties of the module.

1. From the I/O configuration tree, double-click the module, such as the 1791ES-IB8XOBV4 module, to see the Module Properties dialog box.



2. Type a unique name for the module.
3. If desired, type a description.

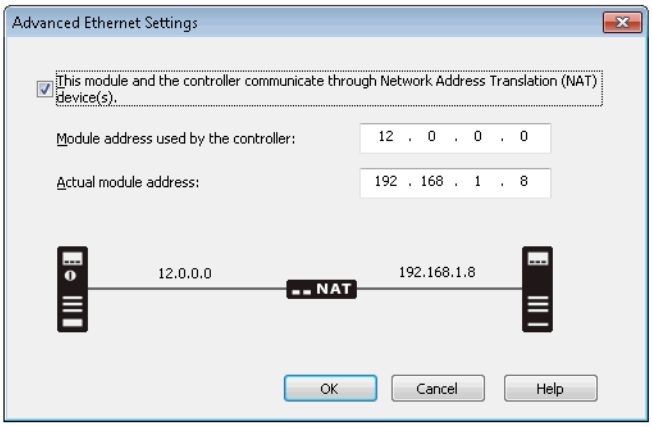
Note the safety network number (SNN). In most cases you can use the default provided by the Logix Designer application. For a detailed explanation of the safety network number (SNN), see the GuardLogix Controller Systems Safety Reference Manual listed in the Additional Resources on page 9.

Set the IP Address in the Logix Designer Application

If you are not using network address translation (NAT), type the IP address of the module in the IP Address field.

If you are using NAT, follow these steps:

1. In the IP Address field, type the IP address that the controller will use.
2. Click Advanced to open the Advanced Ethernet Settings dialog box.



3. Check the checkbox to indicate that this module and the controller communicate through NAT devices.

4. Type the actual module address.

   If you configured the IP Address using the rotary switches, this is the address you set on the module.

5. Click OK.

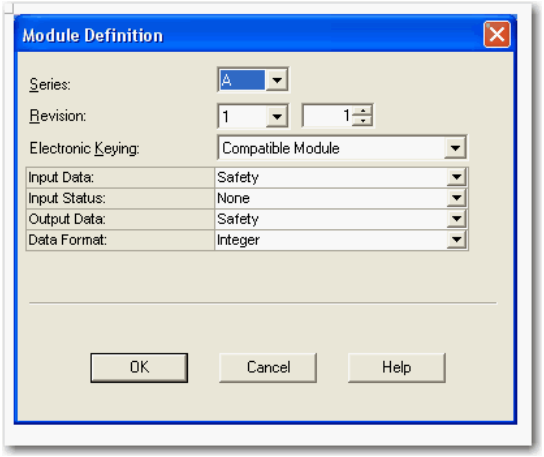
IMPORTANT	When NAT is used in a safety application with a GuardLogix controller, the module does not accept a safety connection unless the actual module address is provided.

Change the Module Definition

Click Change to open the Module Definition dialog box, where you can select values to configure what data and status tags to generate implicitly for the safety module.

See these sections for settings explanations:

- Input Data Options on page 72
- Input Status Options on page 74
- Output Data Options on page 76
- Values and States of Tags on page 77



Input Data Options

Choose from these options:

- Safety - Selecting Safety creates these tags for the target module:
  - RunMode: Module mode
  - ConnectionFaulted: Communication status

– Safety Data: Safety inputs from module

▶	IB8xOB8:I	{...}	{...}		AB:1791DS_IB8X...	Safety
	IB8xOB8:I.RunMode	0		Decimal	BOOL	Safety
	IB8xOB8:I.ConnectionFaulted	0		Decimal	BOOL	Safety
	IB8xOB8:I.Pt00Data	0		Decimal	BOOL	Safety
	IB8xOB8:I.Pt01Data	0		Decimal	BOOL	Safety
	IB8xOB8:I.Pt02Data	0		Decimal	BOOL	Safety
	IB8xOB8:I.Pt03Data	0		Decimal	BOOL	Safety
	IB8xOB8:I.Pt04Data	0		Decimal	BOOL	Safety
	IB8xOB8:I.Pt05Data	0		Decimal	BOOL	Safety
	IB8xOB8:I.Pt06Data	0		Decimal	BOOL	Safety
	IB8xOB8:I.Pt07Data	0		Decimal	BOOL	Safety

- Safety-Readback - This selection is not available for input-only safety modules. Selecting Safety-Readback creates both safety and readback tags, with readback indicating the presence of 24V on the output terminal.

IB8xOB8:I.Pt00Readback	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt01Readback	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt02Readback	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt03Readback	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt04Readback	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt05Readback	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt06Readback	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt07Readback	0		Decimal	BOOL	Safety

Input Status Options

Choose from these options.

IMPORTANT Status data is not SIL 3 data. Do not use status data to directly control a SIL 3 safety output.

- None - No status tags, only data for the inputs
- Point Status-Muting - A muting status tag for test output with muting output capability with point status for each input and output point

Name	Value	Force M	Style	Data Type	Class
IB8xOBV4_ES:I	{...}	{...}		AB:1791ES_I...	Safety
IB8xOBV4_ES:I.RunMode	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.ConnectionFaulted	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt00Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt01Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt02Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt03Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt04Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt05Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt06Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt07Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt00InputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt01InputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt02InputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt03InputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt04InputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt05InputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt06InputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt07InputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt00OutputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt01OutputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt02OutputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt03OutputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt04OutputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt05OutputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt06OutputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt07OutputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Muting03Status	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Muting07Status	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.OutputPowerStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.InputPowerStatus	0		Decimal	BOOL	Safety

- Combined Status-Muting
  - A single BOOL tag represents an AND of the status bits for all the input points. For example, if any input channel has a fault, this bit goes LO.(1)
  - A single BOOL tag represents an AND of the status bits for all the output points.(1)
  - A muting status tag for test output
    T3/T7 (for 1791ES-IB8XOBV4 modules)
    T3/T7/T11/T15 (for 1791ES-IB16 modules), and
    T3/T7/T11 (for 1732ES modules).

.

Name	Value	Force M	Style	Data Type	Class
IB8xOBV4_ES:I	{...}	{...}		AB:1791ES_I...	Safety
IB8xOBV4_ES:I.RunMode	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.ConnectionFaulted	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt00Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt01Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt02Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt03Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt04Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt05Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt06Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Pt07Data	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Muting03Status	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.Muting07Status	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.OutputPowerStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.InputPowerStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.CombinedOutputStatus	0		Decimal	BOOL	Safety
IB8xOBV4_ES:I.CombinedInputStatus	0		Decimal	BOOL	Safety

(1) When using combined status, use Explicit Messaging to read individual point status for diagnostic purposes.

Output Data Options

Choose from these options.

IMPORTANT The standard outputs on the module must not be used for safety purposes.

- None - Selecting None results in an input only connection to the module. Inputs and status are read, but no outputs are written.
- Safety - Selecting Safety creates the safety tags shown here and enables the safety outputs for use in the safety task.

IB8xOB8:O	{...}	{...}		AB:1791DS_IB8X...	Safety
IB8xOB8:O.Pt00Data	0		Decimal	BOOL	Safety
IB8xOB8:O.Pt01Data	0		Decimal	BOOL	Safety
IB8xOB8:O.Pt02Data	0		Decimal	BOOL	Safety
IB8xOB8:O.Pt03Data	0		Decimal	BOOL	Safety
IB8xOB8:O.Pt04Data	0		Decimal	BOOL	Safety
IB8xOB8:O.Pt05Data	0		Decimal	BOOL	Safety
IB8xOB8:O.Pt06Data	0		Decimal	BOOL	Safety
IB8xOB8:O.Pt07Data	0		Decimal	BOOL	Safety

- Test - Selecting Test creates these tags and enables the test outputs on the module. These outputs are **standard** outputs and must not be used for safety purposes.

IO_Node_03_IB8xOBV4:O.Test00Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test01Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test02Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test03Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test04Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test05Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test06Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test07Data	0		Decimal	BOOL	Safety

- Combined - Selecting Combined creates these tags and enables all module outputs - safety and test.

IO_Node_03_IB8xOBV4:O	{...}	{...}		AB:1791DS_IB8X...	Safety
IO_Node_03_IB8xOBV4:O.Pt00Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Pt01Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Pt02Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Pt03Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Pt04Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Pt05Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Pt06Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Pt07Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test00Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test01Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test02Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test03Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test04Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test05Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test06Data	0		Decimal	BOOL	Safety
IO_Node_03_IB8xOBV4:O.Test07Data	0		Decimal	BOOL	Safety

Values and States of Tags

This table shows the values and states of the tags.

Table 21 - Values and States of Tags

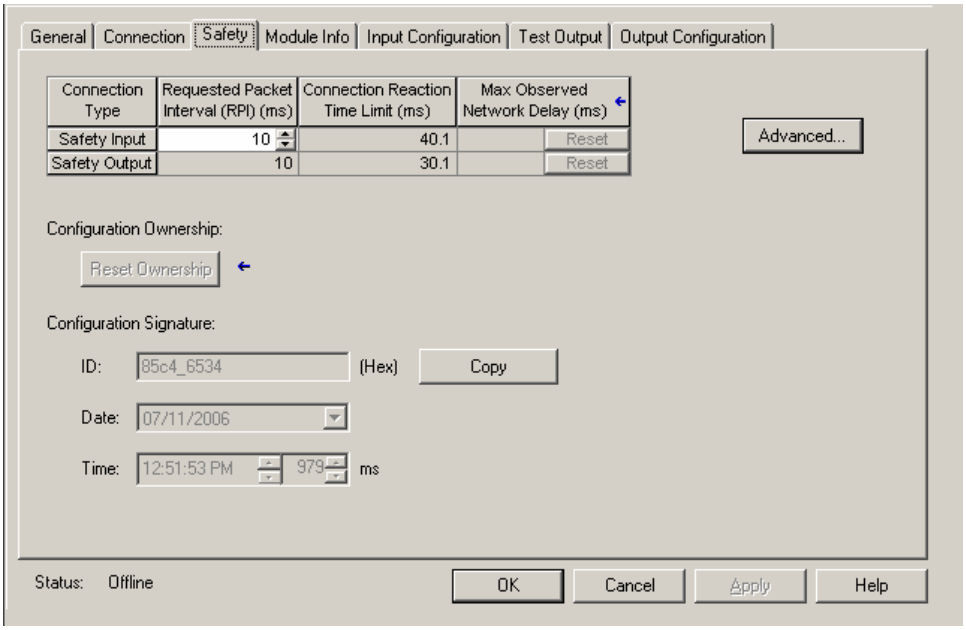
Data		Description
Input data	Run Mode STANDARD	Indicates whether consumed data is actively being updated by a device that is in one of these states. • Run mode: 1 • Idle State: 0
	Connection Faulted STANDARD	Indicates the validity of the safety connection between the safety producer and the safety consumer. • Valid: 0 • Faulted: 1
	Safety Input Data SAFETY	Indicates the ON/OFF status of each input circuit. • ON: 1 • OFF: 0
	Combined Safety Input Status SAFETY	An AND of the status of all input circuits. • All circuits are normal: 1 • An error was detected in one or more input circuits: 0
	Individual Safety Input Status SAFETY	Indicates the status of each input circuit. • Normal: 1 • Fault (Alarm): 0
	Combined Safety Output Status SAFETY	An AND of the status of all safety output circuits. • All circuits are normal: 1 • An error has been detected in one or more output circuits: 0
	Individual Safety Output Status SAFETY	Indicates the status of each safety output circuit. • Normal: 1 • Fault (Alarm): 0
	Muting Lamp Status SAFETY	Indicates the status when a test output is configured as a muting lamp output. • Normal: 1 • Fault (Alarm): 0
	Safety Output Monitor STANDARD	Monitors the outputs of the safety output circuits. • ON: 1 • OFF: 0
	Individual Test Output Status STANDARD	Indicates the status of each of the test output circuits. • Normal: 1 • Fault (Alarm): 0
	Input Power Error Bit STANDARD	Indicates if the field power supplied is within specification. • Power error: 1 • Power OK: 0
	Output Power Error Bit STANDARD	Indicates if the field power supplied is within specification. • Power error: 1 • Power OK: 0
Output data	Safety Output Data SAFETY	Controls the safety output. • ON: 1 • OFF: 0
	Standard Output Data STANDARD	Controls the test output when test output mode is set to a standard output. • ON: 1 • OFF: 0

IMPORTANT Safety denotes information the controller can use in safety-related functions. Standard denotes additional information that must not be relied on for safety functions.

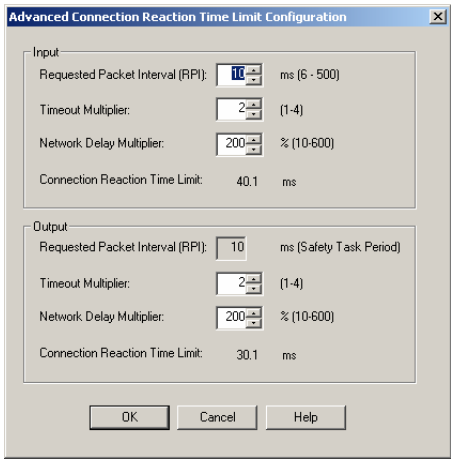
Configure the Safety Connections

Follow these steps to complete entries when you choose the Safety tab.

1. From the Module Properties dialog box, choose the Safety tab to see the Safety dialog box.



2. Click Advanced to configure Requested Packet Interval (RPI) and Configure Connection Reaction Time Limit (CRTL).



We suggest that you keep the Timeout Multiplier and Network Delay Multiplier at their default values of 2 and 200.

See GuardLogix Controllers User Manual, listed in the Additional Resources on page 9, for more information about the CRTL.

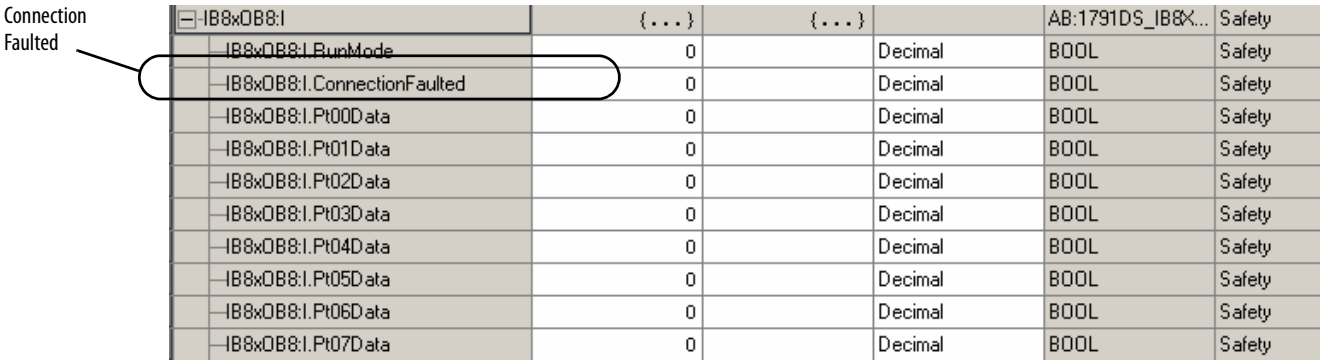
Make sure that input RPI is set to match the need. The smallest input RPI allowed is 6 ms. Selecting small RPI's consumes network bandwidth and can cause nuisance trips because other devices can't get access to the network.

As an example, a safety input module with only E-stop switches connected to it generally can work well with settings of 50...100 ms. An input module with a light curtain guarding a hazard can need the fastest response that is possible.

Selecting appropriate RPI's will result in a system with maximum (best) performance.

IMPORTANT Analyze each safety channel to determine what is appropriate. The default timeout multiplier of 2 and network delay multiplier of 200 will create an input connection reaction time limit of four times the RPI and an output connection reaction limit of three times the RPI. Changes to these parameters must be approved by a safety administrator.

A connection status tag exists for every connection.



IB8xOB8:I	{...}	{...}		AB:1791DS_IB8X...	Safety
IB8xOB8:I.RunMode	0		Decimal	BOOL	Safety
IB8xOB8:I.ConnectionFaulted	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt00Data	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt01Data	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt02Data	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt03Data	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt04Data	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt05Data	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt06Data	0		Decimal	BOOL	Safety
IB8xOB8:I.Pt07Data	0		Decimal	BOOL	Safety

If the RPI and CRTL for the network are set appropriately, then this status tag must always remain LO. Monitor all connection status bits to verify that they are not going HI intermittently due to timeouts.

Configuration Ownership – Reset Ownership

The connection between the owner and the Guard I/O module is based on the following items:

- Guard I/O EtherNet/IP address
- Guard I/O safety network number
- GuardLogix slot number
- GuardLogix safety network number
- Path from GuardLogix controller to Guard I/O module
- Configuration signature

If any of these items change, the connection between the GuardLogix controller and the Guard I/O module is lost, and the yellow yield in the project tree appears. Reset ownership to re-establish the connection by using this procedure.

1. Open the safety I/O module properties.
2. Choose the Safety tab.
3. From the dialog box, choose Reset ownership.

Configuration Signature

The configuration signature is created by the Logix Designer application and verified by the safety module. The configuration signature provides SIL 3 integrity of the configuration of a Guard I/O module.

- When a GuardLogix controller first connects to an unconfigured Guard I/O module, the complete configuration is downloaded to the I/O module.
- Any time the GuardLogix controller attempts to connect to a Guard I/O module, if the configuration signatures are the same, then the configuration does not need to be downloaded, because they already match.
- Any time the GuardLogix controller attempts to connect to a Guard I/O module and the signatures do not match, the module checks the IP address and safety network number. If these are all correct, the controller will attempt to configure the module.

Configure the Module Inputs

Table 22 shows the typical safety input parameters available on the Input Configuration tab. See Chapter 2 for related information.

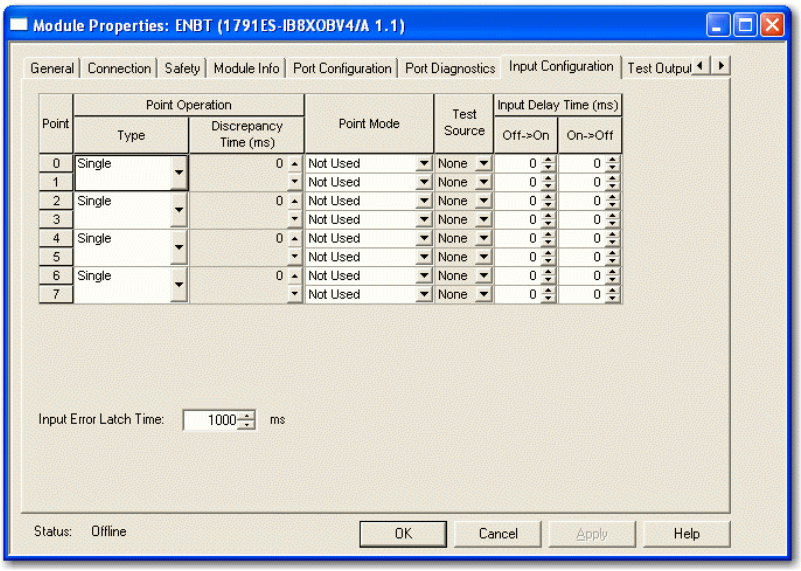
Table 22 - Typical Safety Input Parameters

Parameter Name	Value	Description
Input Point Operation Type	Single Channel	Inputs are treated as single channel.
	Dual-channel Equivalent	Inputs are treated as a dual-channel pair. The channels must match (be equal) within the discrepancy time or a fault is generated.
	Dual-channel Complementary	Inputs are treated as a dual-channel pair. The channels must disagree (be opposite) within the discrepancy time or a fault is generated.
Input Point Mode	Not Used	The input is disabled. It remains logic 0 if 24V is applied to the input terminal.
	Safety Test Pulse	Pulse testing is performed on this input circuit. A test source on the module must be used as the 24V source for this circuit. The test source is configured by using the test source pull-down. The pulse test detects shorts to 24V, and channel-to-channel shorts to other inputs.
	Safety	A safety input is connected but there is no requirement for the 1791ES module to perform a pulse test on this circuit. An example is a safety device that performs its own pulse tests on the input wires, such as a light curtain.
	Standard	A standard device, such as a reset switch, is connected. This point cannot be used in dual channel operation.
Safety Input Test Source	None	If pulse testing is being performed on an input point, then the test source that is sourcing the 24V for the input circuit must be selected. If the incorrect test source is entered, the result is pulse test failures on that input circuit.
	Test Output 0	
	Test Output 1	
	Test Output 2	
	Test Output 3	
	Test Output 4…15(1)	
Input Delay Time Off -> On	0…126 ms (in increments of 6 ms)	Filter time is for OFF to ON transition. Input must be high after input delay has elapsed before it is set logic 1.
Input Delay Time On -> Off	0…126 ms (in increments of 6 ms)	Filter time is ON to OFF transition. Input must be low after input delay has elapsed before it is set logic 0.
Safety Input Error Latch Time	0…65,530 ms (in increments of 10 ms)	Default is 1000 ms. The purpose for latching input errors is to make sure that intermittent faults that can only exist for a few milliseconds are latched long enough to be read by the controller. The amount of time to latch the error must be based on the RPI, the safety task watchdog, and other application-specific variables.

(1) There are eight test outputs on 1791ES-IB8XOBV4 modules, sixteen test outputs on 1791ES-IB16 modules, and twelve test outputs on 1732ES modules.

Follow these steps to configure the module inputs.

1. Click the Input Configuration tab.



2. For Point Operation Type, choose one of these values and a value for Discrepancy Time if set to Equivalent or Complementary:
   - Single
     Inputs are treated as single channels. Note that in many cases, dual-channel safety inputs are configured as two individual single channels. This does not affect pulse testing because it is handled on an individual channel basis.
   - Equivalent(1)
     Inputs are treated as a dual-channel pair. The channels must match within the discrepancy time or an error is generated.
   - Complementary(1)
     Inputs are treated as a dual-channel pair. They must be in opposite states within the discrepancy time or an error is generated.
3. For Point Mode, choose one of these values for each point, referring to the Safety Input Parameters table for additional information:
   - Not Used - Safety input channel is disabled
   - Safety Pulse Test - Safety input is configured for pulse test operation
   - Safety - The safety input is used with a safety field device
   - Standard - Safety input has a standard field device wired to it

(1) Be aware that configuring discrepancy time on safety I/O modules masks input inconsistent faults from the GuardLogix safety instructions. Status can be read by GuardLogix to obtain this fault information.

4. Complete entries, noting the following:
   - For each safety input on the module, you can define if the input will be pulse tested. If the inputs are pulse tested, select which test source to use.
   - Off -> On and On -> Off delay times can be configured per channel with each channel specifically tuned to match the characteristics of the field device for maximum performance.
   - Input Error Latch Time is the time the module holds an error to make sure the controller can detect it. This provides you more reliable diagnostics and enhances the chances that a nuisance error is detected.
5. Click OK at the bottom of the dialog box or a tab at the top of the dialog box.

Configure the Test Outputs

Table 23 provides information for configuring the test outputs.

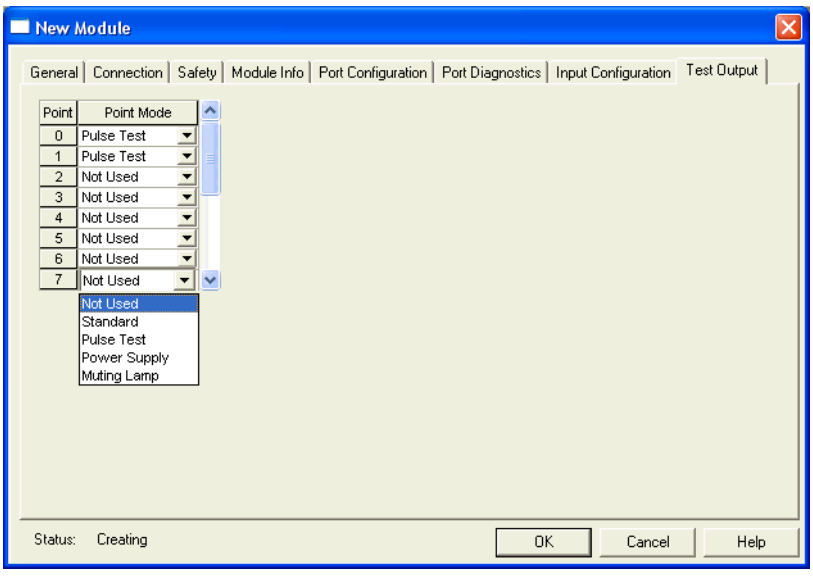
Table 23 - Configuring Test Outputs

Parameter Name	Value	Description	Default
Test Output Mode	Not Used	The test output is disabled.	Not Used
	Standard	The output point is enabled for use by the GuardLogix controller.	
	Pulse Test	The test output is being used as a pulse test source.	
	Power Supply	A constant 24V is placed on the output terminal. It can be used to provide power to a field device.	
	Muting Lamp Output (1)	An indicator lamp is connected to the output. When this lamp is energized, a burned-out bulb, broken wire, or short to GND error condition can be detected. Typically, the lamp is an indicator used in light curtain applications.	

(1) Terminal T3/T7 for 1791ES-IB8XOBV4 modules, terminal T3/T7/T11/T15 for 1791ES-IB16 modules, and terminal T3/T7/T11 for 1732ES modules.

Follow these steps to configure the test outputs.

1. Click the Test Outputs tab.



2. From the Port Mode pull-down menus, select the desired configuration option for each point.

Configure the Module Outputs

Table 24 provides information for configuring the test outputs.

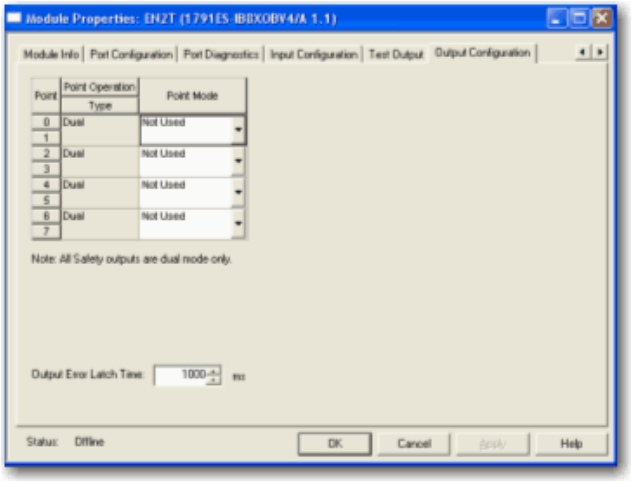
Table 24 - Guidelines for Configuring Safety Outputs

Parameter Name	Value	Description	Default
Point Operation Type	Dual	The 1791ES modules and the 1732ES-IB12XOBV2 module treat the outputs as a pair. It always sets them HI to LO as a matched pair. Safety logic must set both of these outputs ON or OFF at the same time or the module will declare a channel fault.	Dual-channel
	Single	The 1732ES-IB12XOB4 module can be configured with the outputs treated as single channels. Both channels of an output pair are set to either Single or Dual.(1)	
Point Mode	Not Used	The output is disabled.	Not Used
	Safety	The output point is enabled, and it does not perform a pulse test on the output.	
	Safety Pulse Test	The output point is enabled and performs a pulse test on the output. When the output is energized, the output pulses LO briefly. The pulse test detects if 24V remains on the output terminal during this LO pulse due to a short to 24V or if the output is shorted to another output terminal.	
Output Error Latch Time	0…65,530 ms (in increments of 10 ms)	The purpose for latching output errors is to make sure that intermittent faults that can only exist for a few milliseconds are latched long enough to be read by the controller. The amount of time to latch the errors is based on the RPI, the safety task watchdog, and other application-specific variables.	1000 ms

(1) Safety outputs configured for single-channel operation must be controlled as pairs for use in functional safety applications.

Follow these steps to configure the module outputs.

1. For Point Operation, all safety outputs must be controlled as pairs for use in functional safety applications(1).



2. For Point Mode, select Not Used, Safety, or Safety Pulse Test, referring to the Safety Output Parameters table for additional information.
3. Select a value for Output Error Latch Time. Output Error Latch Time is the time the module holds an error to make sure the controller can detect it. This provides you more reliable diagnostics and enhances the changes that a nuisance error is detected.
4. Click Apply from the bottom of the dialog box.

(1) Safety outputs on the 1732ES-IB12XOBV4 module can be set to single channel operation mode but then must be controlled as pairs to be used in functional safety applications. Use of safety outputs on 1791ES-IB8XOBV4 and 1732ES-IB12XOBV2 modules in functional safety applications requires the channel operation mode be set to Dual and the safety outputs be matched as pairs in software (always set high or low as a pair) in those applications.

Save and Download the Module Configuration

We recommend that after a module is configured you save your work.

If after downloading the program the MS and NS indicators on the Guard I/O module are not both solid green, this can be due to loss of ownership. The ownership is based on the following items:

- Guard I/O EtherNet/IP address
- Guard I/O safety network number
- GuardLogix slot number
- GuardLogix safety network number
- Path from GuardLogix controller to Guard I/O module
- Configuration signature

If any of these items change, the connection between the GuardLogix controller and the Guard I/O module is lost, and the yellow yield in the project tree appears. Reset ownership to re-establish the connection by using this procedure.

1. Open the safety I/O module properties.
2. Choose the Safety tab.
3. From the dialog box, choose Reset ownership.

Interpret the Module Status Indicators

Topic	Page
1791ES Module Status Indicators	85
1732ES Module Status Indicators	87

1791ES Module Status Indicators

See Figure 23 and Table 25...Table 32 for information on the 1791ES module indicators.

Figure 23 - 179ES1 Module Status Indicators

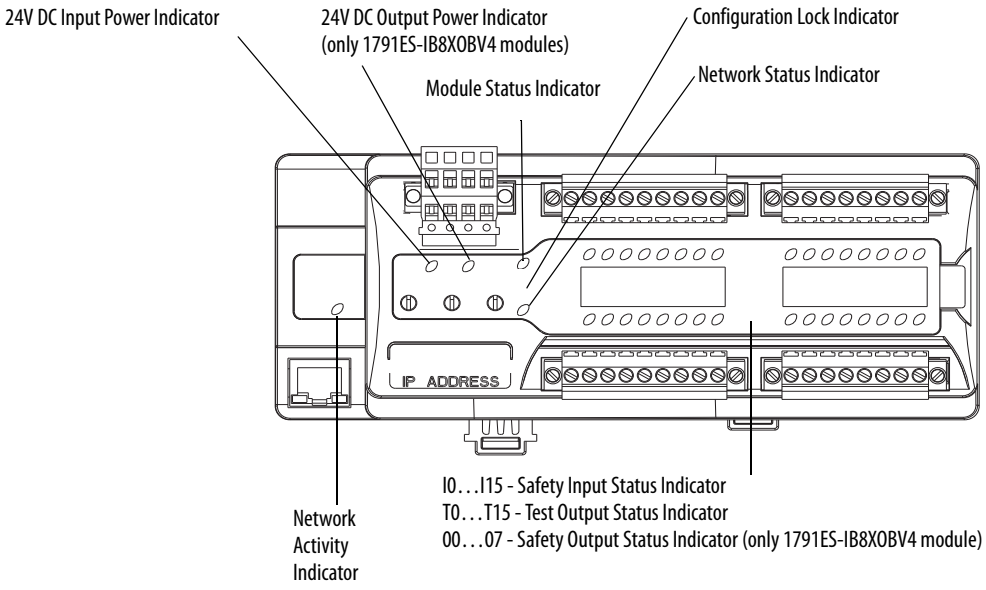


Table 25 - 24V DC Input Power Indicator

State	Status	Description	Recommended Action
Off	No power	No power is applied.	Apply power to this section.
Solid green	Normal operation	The applied voltage is within specifications.	None.
Solid yellow	Input power out of specification	The input power is out of specification.	Check your connectors, wiring, and voltages.

Table 26 - 24V DC Output Power Indicator

State	Status	Description	Recommended Action
Off	No power	No power is applied.	Apply power to this section.
Solid green	Normal operation	The applied voltage is within specifications.	None.
Solid yellow	Output power out of specification	The output power is out of specification.	Check your connectors, wiring, and voltages.

Table 27 - Module Status Indicator

State	Status	Description	Recommended Action
Off	No power	No power is applied to the power connector.	Apply power to this connector.
Solid green	Normal operation	The module is operating normally.	None.
Solid red	Unrecoverable fault	The module detected an unrecoverable fault.	Cycle power to the module. If problem persists, replace the module.
Flashing red and green	Module is unconfigured	Module needs commissioning due to missing, incomplete, or incorrect configuration.	Reconfigure the module. For additional information, inspect Network Status indicator.
	Device in self-test	The module is performing its power-cycle diagnostic tests.	Wait for the module to complete its power-cycle diagnostics.
Flashing green	Idle	Idle, waiting for connection from scanner.	Establish connection.
Flashing red	Recoverable fault	The module has detected a recoverable fault.	Cycle power to the module or reset the module.
	User-initiated firmware update in progress	User-initiated firmware update is in progress.	Wait for firmware update to complete.

Table 28 - Network Status Indicator

State	Status	Description	Recommended Action
Off	Module not online	The module does not have an IP address.	Verify your network is working properly.
Flashing green	Module online with no connections in established state	The module has acquired an IP address, but no connections are established.	Verify your network and module configuration.
Solid green	Module online with connections in established state	The module is operating normally.	None.
Flashing red	One or more I/O connections in timed-out state	The module detected a recoverable network fault.	Verify your network and module configuration.
	User-initiated firmware update	User-initiated firmware update is in progress.	Wait for firmware update to complete.
Solid red	Critical link failure	The module detected an error that prevents it from communicating on the network, such as duplicate IP address has been detected.	Cycle power to the module. Check network IP addressing.
Flashing red and green	Self-test	The module is performing its power-cycle diagnostic test.	Wait for the module to complete its power-cycle diagnostics.

Table 29 - Network Activity Indicator

State	Status	Recommended Action
Off	No link is established.	Establish link.
Flashing Green	Transmit or receive activity.	None.
Steady Green	Link is established	None.

Table 30 - Safety Input Status Indicator

State	Status	Description	Recommended Action
Off	Safety input off	The safety input is off or the channel is configured for not used.	Turn the safety input on or reconfigure the channel, if desired.
Solid yellow	Safety input on	The safety input is on.	None.
Solid red	Fault detected	A fault in the external wiring or input circuit detected.	Check configuration, field wiring, and devices. If no problem found, replace module.
Flashing red	Partner fault detected	A fault in the partner input circuit of a dual-input configuration detected.	Check the field wiring and verify your configuration for the partner circuit. If no problem found, replace module.

Table 31 - Test Output Status Indicator

State	Status	Description	Recommended Action
Off	Test output off	The test output is off or the channel is configured for not used.	Turn the test output on or reconfigure the channel, if desired.
Solid yellow	Output on	Output is on.	None.
Solid red	Fault detected	A fault in the external wiring or input circuit detected.	Check field wiring. If no problem found, replace module. For outputs configured for muting could indicate undercurrent or burned-out lamp.

Table 32 - Safety Output Status Indicator (only 1791ES-IB8XOBV4 modules)

State	Status	Description	Recommended Action
Off	Safety output off	The safety output is off or the channel is configured for not used.	Turn the safety output on or reconfigure the channel, if desired.
Solid yellow	Safety output on	The safety output is on.	None.
Solid red	Fault detected	A fault in the output circuit was detected.	Check the circuit wiring and end device. If no problem found, replace module.
		Both tags in a dual channel circuit do not have the same value.	Make sure logic is driving tag values to the same state (off or on).
Flashing red	Partner fault detected	A fault in the partner output circuit of a dual output configuration was detected.	Check the circuit wiring and end device of the partner. If no problem found, replace module.

1732ES Module Status Indicators

See Figure 31 and Table 33...Table 39 for information on the 1732ES module status indicators.

Figure 31 - 1732ES Module Status Indicators

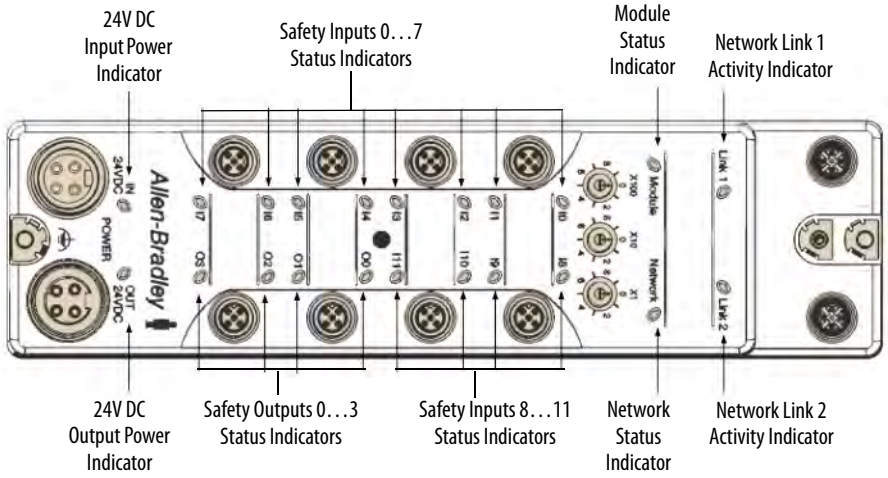


Table 33 - 24V DC Input Power Indicator

State	Status	Description	Recommended Action
Off	No power	No input power or severe input power overvoltage.	Apply power that is within specifications to this section.
Solid green	Normal operation	The applied voltage is within specifications.	None.
Solid yellow	Input power out of specification	The input power is out of specification.	Check your connectors, wiring, and voltages.

Table 34 - 24V DC Output Power Indicator

State	Status	Description	Recommended Action
Off	No power	No output power or severe output power overvoltage.	Apply power that is within specifications to this section.
Solid green	Normal operation	The applied voltage is within specifications.	None.
Solid yellow	Output power out of specification	The output power is out of specification.	Check your connectors, wiring, and voltages.

Table 35 - Module Status Indicator

State	Status	Description	Recommended Action
Off	No power	No power is applied to the input power connector or severe input power overvoltage.	Apply input power that is within specification to the module.
Solid green	Normal operation	The module is operating normally.	None.
Solid red	Unrecoverable fault	The module detected an unrecoverable fault.	Cycle power to the module. If problem persists, replace the module.
Flashing red and green	Module is unconfigured	Module needs commissioning due to missing, incomplete, or incorrect configuration.	Reconfigure the module. For additional information, inspect Network Status indicator.
	Device in self-test	The module is performing its power-cycle diagnostic tests.	Wait for the module to complete its power-cycle diagnostics.
Flashing green	Idle	Idle, waiting for connection from scanner.	Establish connection.
Flashing red	Recoverable fault	The module has detected a recoverable fault.	Cycle power to the module or reset the module.
	User-initiated firmware update in progress	User-initiated firmware update is in progress.	Wait for firmware update to complete.

Table 36 - Network Status Indicator

State	Status	Description	Recommended Action
Off	Module not online	The module does not have an IP address.	Verify your network is working properly.
Flashing green	Module online with no connections in established state	The module has acquired an IP address, but no connections are established.	Verify your network and module configuration.
Solid green	Module online with connections in established state	The module is operating normally.	None.
Flashing red	One or more I/O connections in timed-out state	The module detected a recoverable network fault.	Verify your network and module configuration.
	User-initiated firmware update	User-initiated firmware update is in progress.	Wait for firmware update to complete.
Solid red	Critical link failure	The module detected an error that prevents it from communicating on the network, such as duplicate IP address has been detected.	Cycle power to the module. Check network IP addressing.
Flashing red and green	Self-test	The module is performing its power-cycle diagnostic test.	Wait for the module to complete its power-cycle diagnostics.
	Waiting for TUNID	The module has received the proposed UNID and is waiting for the TUNID.	None.

Table 37 - Network Activity Indicators (link 1 and link2)

State	Status	Recommended Action
Off	No link is established.	Establish link.
Flashing Green	Transmit or receive activity.	None.
Steady Green	Link is established	None.

Table 38 - Safety Input Status Indicator

State	Status	Description	Recommended Action
Off	Safety input off	The safety input is off or the channel is configured for not used.	Turn the safety input on or reconfigure the channel, if desired.
Solid yellow	Safety input on	The safety input is on.	None.
Solid red	Fault detected	A fault in the external wiring or input circuit detected.	Check configuration, field wiring, and devices. If no problem found, replace module.
Flashing red	Partner fault detected	A fault in the partner input circuit of a dual-input configuration detected.	Check the field wiring and verify your configuration for the partner circuit. If no problem found, replace module.

Table 39 - Safety Output Status Indicator

State	Status	Description	Recommended Action
Off	Safety output off	The safety output is off or the channel is configured for not used.	Turn the safety output on or reconfigure the channel, if desired.
Solid yellow	Safety output on	The safety output is on.	None.
Solid red	Fault detected	A fault in the output circuit was detected.	Check the circuit wiring and end device. If no problem found, replace module.
		Both tags in a dual channel circuit do not have the same value.	Make sure logic is driving tag values to the same state (off or on).
Flashing red	Partner fault detected	A fault in the partner output circuit of a dual output configuration was detected.	Check the circuit wiring and end device of the partner. If no problem found, replace module.

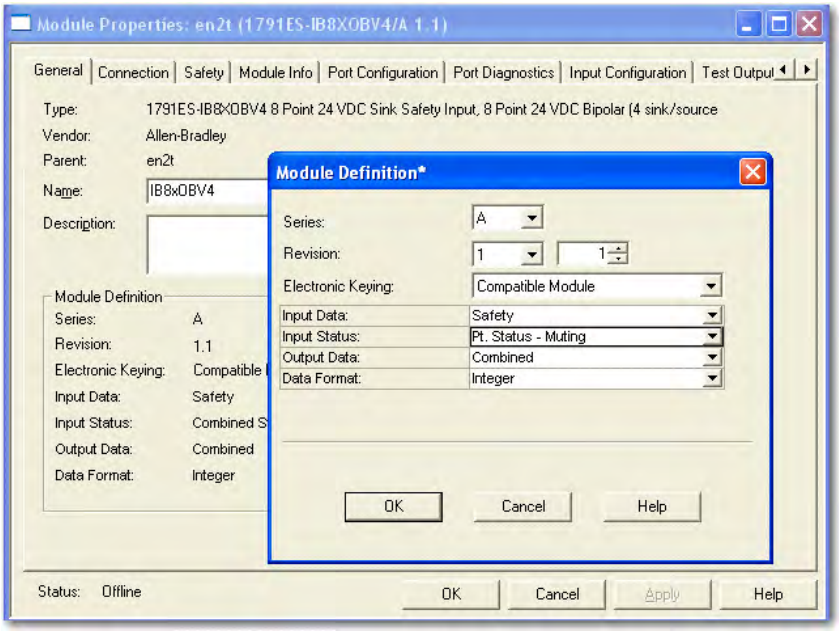
Notes:

Get Diagnostic Status from Modules by Using Explicit Messaging

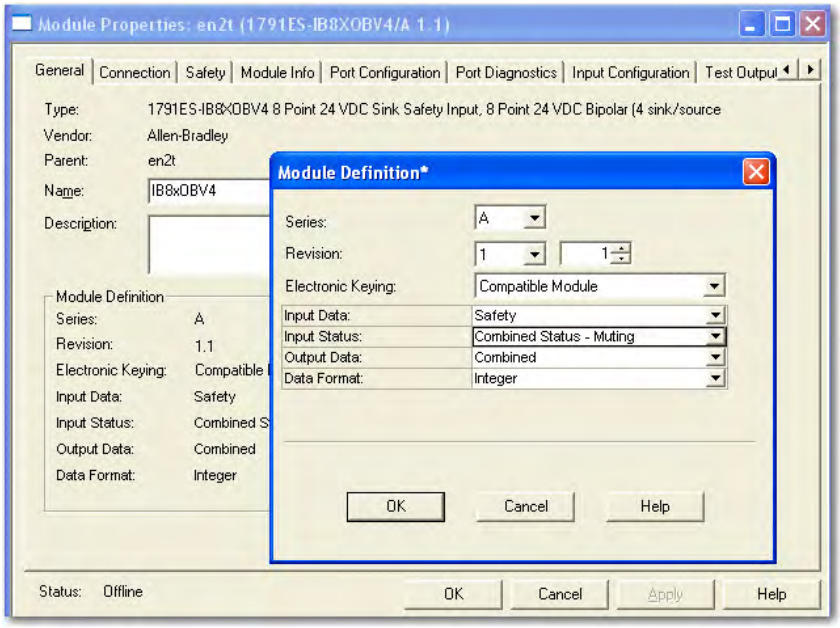
Topic	Page
Get Status Messages from 1791ES-IB8XOBV4 Modules	92
Get Status Messages from 1791ES-IB16 Modules	97
Get Status Messages from 1732ES Modules	102
I/O Data Supported by Each Module	106
I/O Assembly and Reference Data	109
Explicit Messages	115

This appendix provides information about how to use CIP Generic Message instructions (sometimes called Explicit Messaging) to get diagnostic status information from the modules.

You can implicitly obtain individual point status of the Guard I/O module from the Module Definition dialog box by choosing Pt. Status from the Input Status pull-down menu.



Another choice is to obtain overall status implicitly from the Module Definition dialog box by choosing Combined Status from the Input Status pull-down menu.

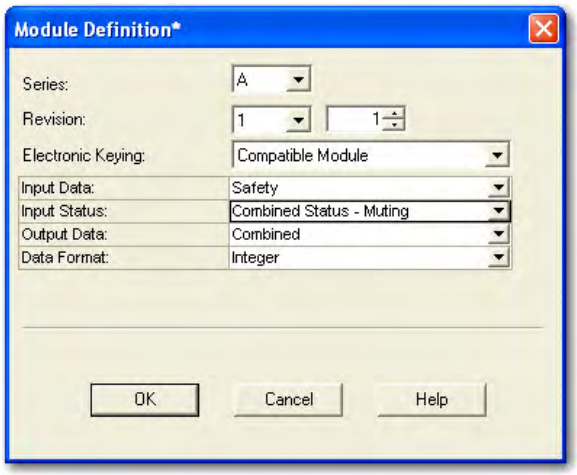


If the Combined Status changes, use Explicit Messaging to obtain the point level status.

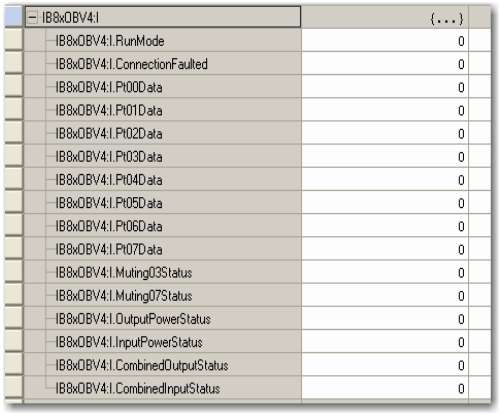
Get Status Messages from 1791ES-IB8XOBV4 Modules

Follow these steps to get status messages from 1791ES-IB8XOBV4 modules.

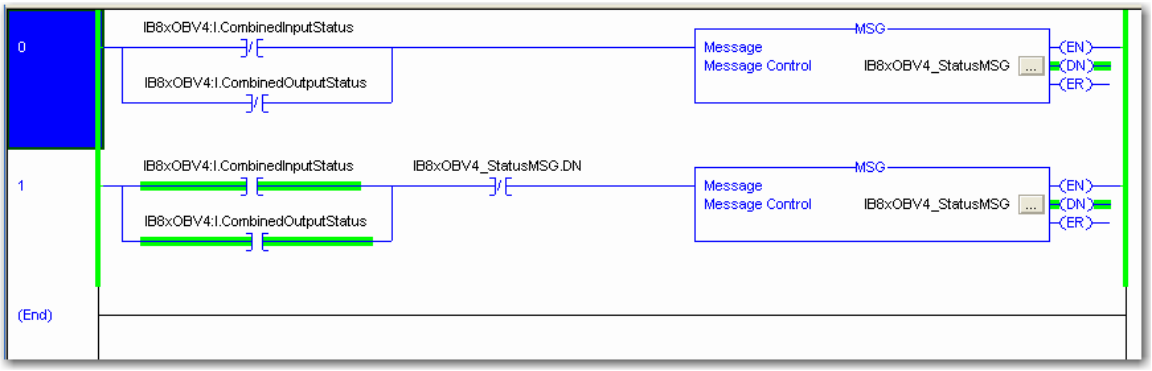
1. In the Module Definition dialog box, from the Input Status pull-down menu, choose Combined Status.



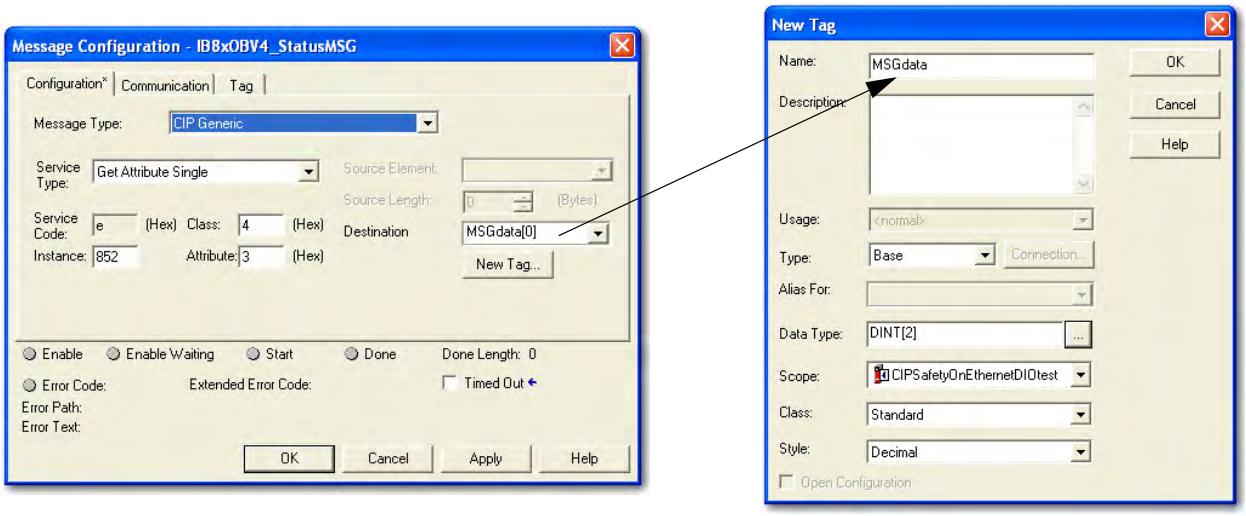
This creates a two-byte input assembly, as shown for the 1791ES-IB8XOBV4 module.



2. Use the CombinedInputStatus and CombinedOutputStatus bits to detect if one or more of the I/O points on the module have a fault.
   - If any input or output status bit goes to a value of 0 (0=error, 1=no error), use the CombinedInputStatus and CombinedOutputStatus bits to condition your MSG rungs as follows.
   - Note that the second rung can be used to read the status on mode transition and once a fault is detected, continue reading until the fault is corrected.
   - Place these rungs in the standard task.



Reference the figures below that show the MSG instruction parameters for reading Instance 852 from the 1791ES-IB8XOBV4 module.



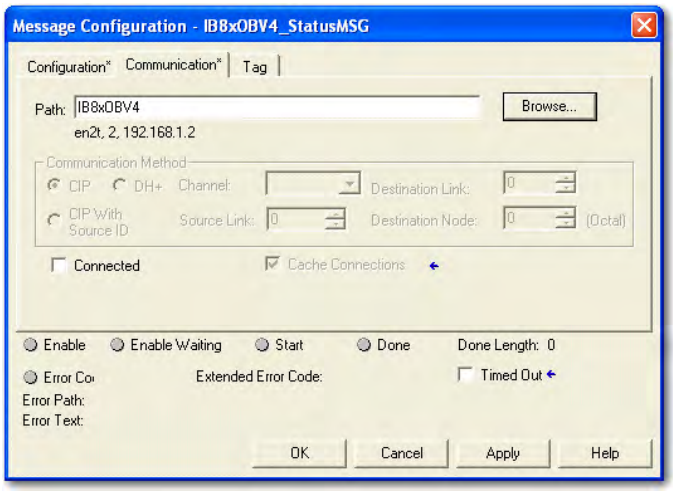
Instance 852 (354 hex) is 5 bytes in length, so the destination tag MSGdata must be at least 5 bytes in length to hold this data. The size is DINT[2] or 8 bytes (see Table 40).

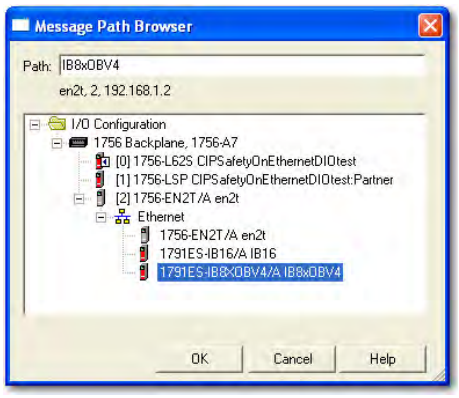
Table 40 - Layout of Instance 852 (354 hex) – 1791ES- IB8XOBV4 Module

Instance Hex (decimal)	Connection Type	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
354 (852)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status
		2	Safety Output 7 Status	Safety Output 6 Status	Safety Output 5 Status	Safety Output 4 Status	Safety Output 3 Status	Safety Output 2 Status	Safety Output 1 Status	Safety Output 0 Status
		3	Safety Output 7 Monitor	Safety Output 6 Monitor	Safety Output 5 Monitor	Safety Output 4 Monitor	Safety Output 3 Monitor	Safety Output 2 Monitor	Safety Output 1 Monitor	Safety Output 0 Monitor
		4	Reserved	Reserved	Input Power Error (1)	Output Power Error (1)	Reserved	Reserved	Muting Lamp 7 Status	Muting Lamp 3 Status

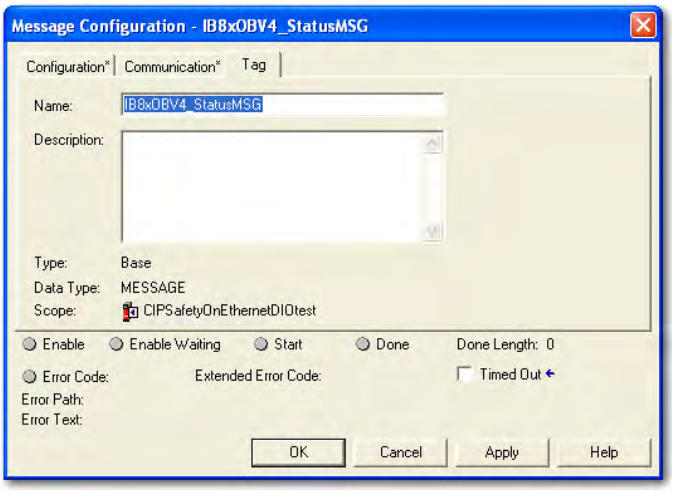
(1) This data is only diagnostic data. This data does not have safety integrity.

Click the Communication tab. This dialog box requires the path to the module. Click Browse to select the module that the MSG will read.





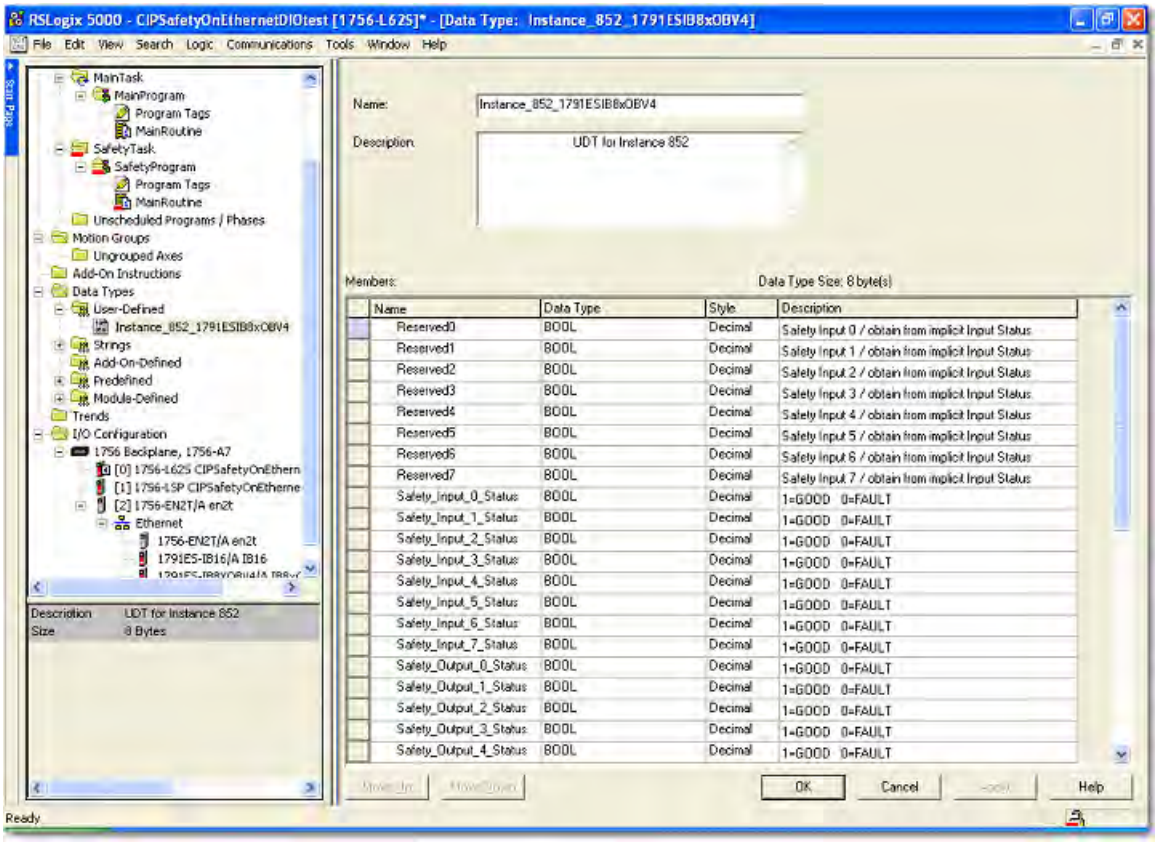
From the top of the Message Configuration dialog box, choose Tag to see this dialog box.



When the explicit message reads the data from the 1791ES-IB8XOBV4 module, the data appears in the MSGdata tags as shown.

MSGdata	{...}	{...}	Decimal	DINT[2]
+ MSGdata[0]	16776960		Decimal	DINT
− MSGdata[1]	19		Decimal	DINT
MSGdata[1].0	1		Decimal	BOOL
MSGdata[1].1	1		Decimal	BOOL
MSGdata[1].2	0		Decimal	BOOL
MSGdata[1].3	0		Decimal	BOOL
MSGdata[1].4	1		Decimal	BOOL
MSGdata[1].5	0		Decimal	BOOL
MSGdata[1].6	0		Decimal	BOOL
MSGdata[1].7	0		Decimal	BOOL

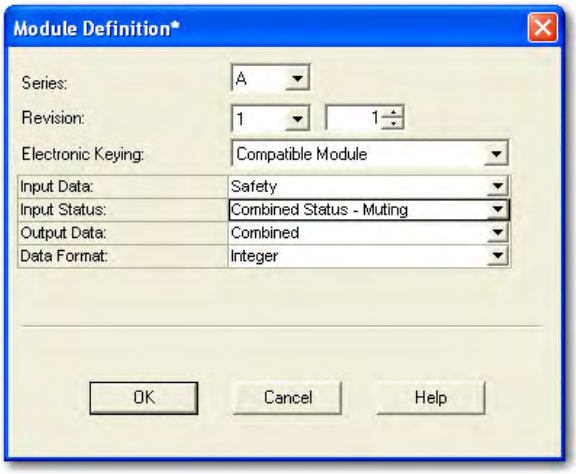
The first 32 bits of the instance are in MSGdata[0].0...31, and the final 8 bits are in MSGdata[1].0...7. These 40 bits must be mapped according to Instance 852. An easy method to do this mapping is to create a user-defined tag (UDT) for Instance 852. Once complete, it appears as follows.



Get Status Messages from 1791ES-IB16 Modules

Follow these steps to get status messages from 1791ES-IB16 modules.

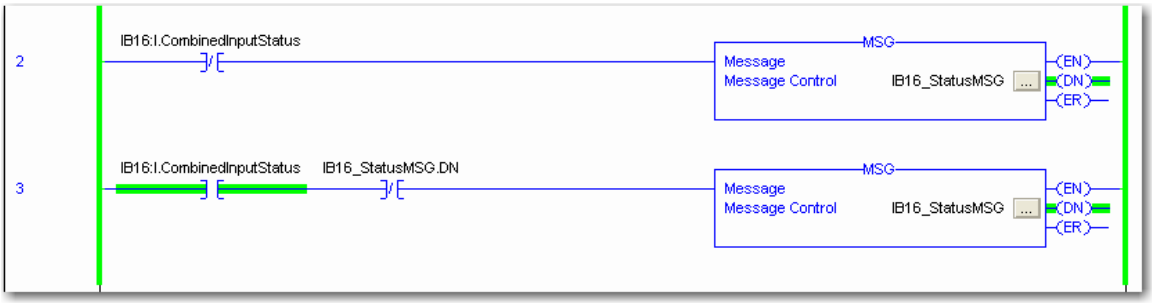
1. In the Module Definition dialog box, from the Input Status pull-down menu, choose Combined Status.



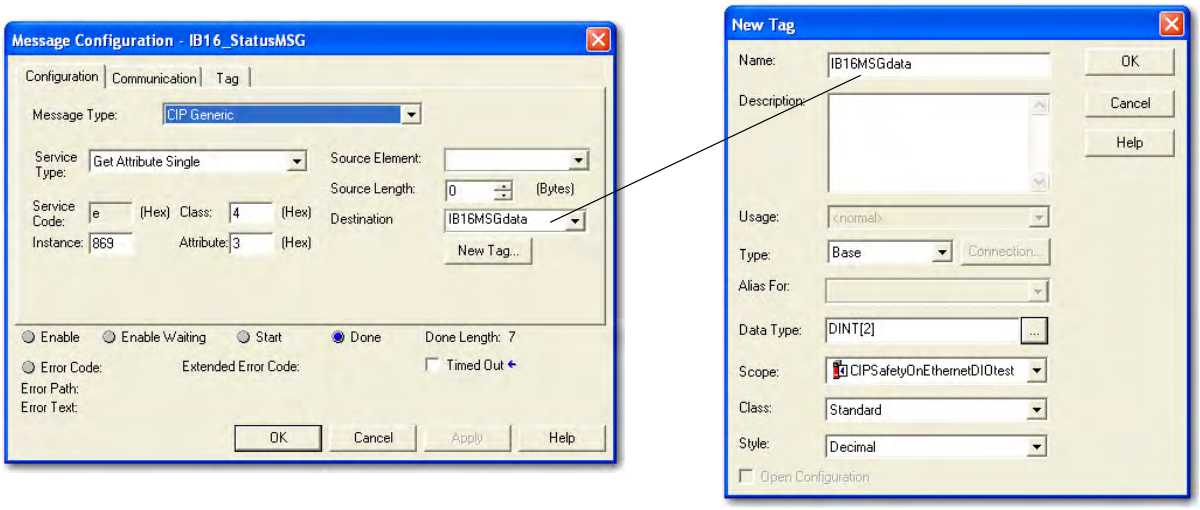
This creates a three-byte input assembly, as shown, for the 1791ES-IB16 module.

IB16:I	{...}
IB16:I.RunMode	0
IB16:I.ConnectionFaulted	0
IB16:I.Pt00Data	0
IB16:I.Pt01Data	0
IB16:I.Pt02Data	0
IB16:I.Pt03Data	0
IB16:I.Pt04Data	0
IB16:I.Pt05Data	0
IB16:I.Pt06Data	0
IB16:I.Pt07Data	0
IB16:I.Pt08Data	0
IB16:I.Pt09Data	0
IB16:I.Pt10Data	0
IB16:I.Pt11Data	0
IB16:I.Pt12Data	0
IB16:I.Pt13Data	0
IB16:I.Pt14Data	0
IB16:I.Pt15Data	0
IB16:I.Muting03Status	0
IB16:I.Muting07Status	0
IB16:I.Muting11Status	0
IB16:I.Muting15Status	0
IB16:I.InputPowerStatus	0
IB16:I.CombinedInputStatus	0

2. Use the CombinedInputStatus bit to detect if one or more of the I/O points on the module have a fault.
   - If any input status bits go to a value of 0 (0 = bad; 1 = good), use an explicit message to determine which individual data points have faulted.
   - Note that you can use the second rung to read the status on mode transition and once a fault is detected, continue reading until the fault is corrected.
   - Place these rungs in the standard task.



See the figures that show the MSG instruction parameters for reading Instance 869 from the 1791ES-IB16 module. See Appendix C of this manual for a layout of possible instances.



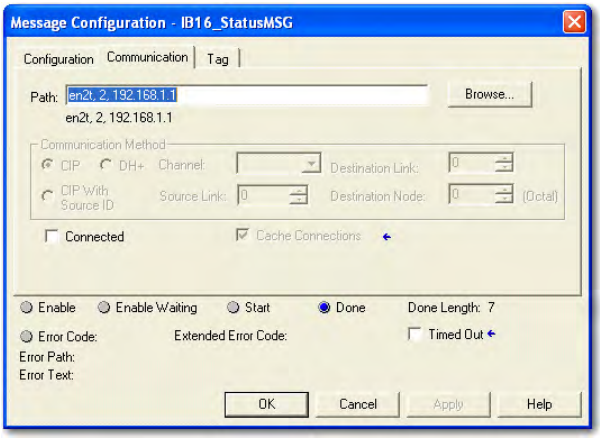
Instance 869 (365 hex) is 7 bytes in length, so the destination tag IB16MSGdata must be at least 7 bytes in length to hold this data. The size is DINT[2] or 8 bytes (see Table 41).

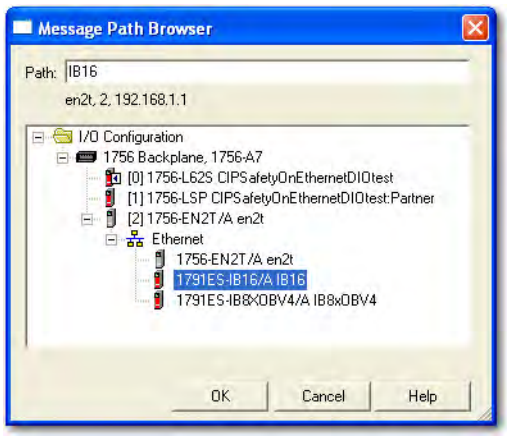
Table 41 - Layout of Instance 869 (365 hex) – 1791ES-IB16 Module

Instance Hex (decimal)	Connection Type	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
365 (869)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 15	Safety Input 14	Safety Input 13	Safety Input 12	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
		2	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status
		3	Safety Input 15 Status	Safety Input 14 Status	Safety Input 13 Status	Safety Input 12 Status	Safety Input 11 Status	Safety Input 10 Status	Safety Input 9 Status	Safety Input 8 Status
		4	Test Output 7 Status	Test Output 6 Status	Test Output 5 Status	Test Output 4 Status	Test Output 3 Status	Test Output 2 Status	Test Output 1 Status	Test Output 0 Status
		5	Test Output 15 Status	Test Output 14 Status	Test Output 13 Status	Test Output 12 Status	Test Output 11 Status	Test Output 10 Status	Test Output 9 Status	Test Output 8 Status
		6	Reserved	Reserved	Input Power Error (1)	Output Power Error (1)	Muting Lamp 15 Status	Muting Lamp 11 Status	Muting Lamp 7 Status	Muting Lamp 3 Status

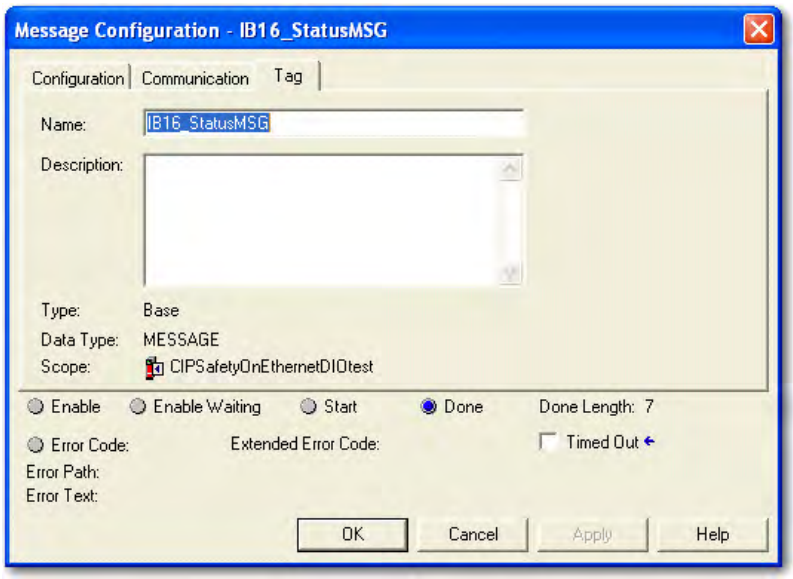
(1) This data is only diagnostic data. This data does not have safety integrity.

From the top of the Message Configuration dialog box, choose the Communication tab. This dialog box requires the path to the module. Click Browse to go to the module that the MSG will read.





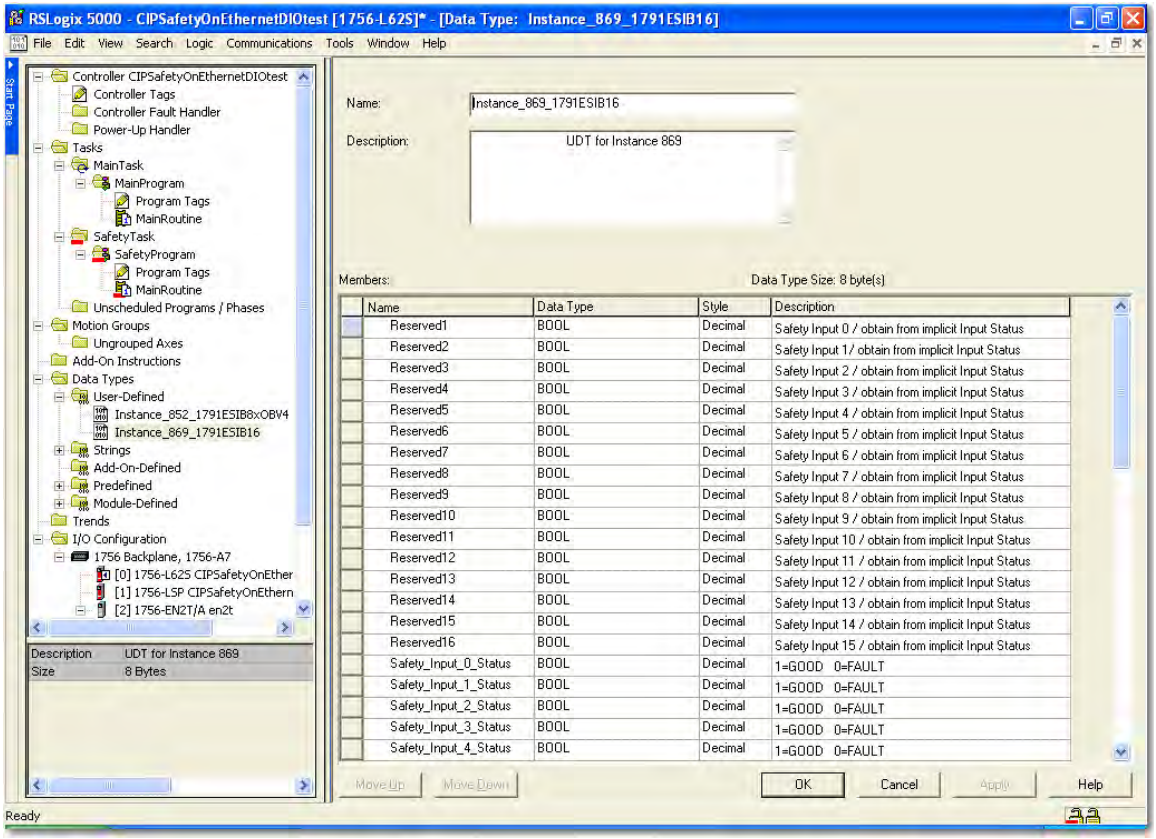
From the top of the Message Configuration dialog box, click Tag to see this dialog box.



When the explicit message reads the data from the 1791ES-IB16 module, the data appears in the MSGdata tags as shown.

IB16MSGdata	{...}	{...}	Decimal	DINT[2]	Standard
IB16MSGdata[0]	-65536		Decimal	DINT	Standard
IB16MSGdata[1]	1048575		Decimal	DINT	Standard
IB16MSGdata[1].0	1		Decimal	BOOL	Standard
IB16MSGdata[1].1	1		Decimal	BOOL	Standard
IB16MSGdata[1].2	1		Decimal	BOOL	Standard
IB16MSGdata[1].3	1		Decimal	BOOL	Standard
IB16MSGdata[1].4	1		Decimal	BOOL	Standard
IB16MSGdata[1].5	1		Decimal	BOOL	Standard
IB16MSGdata[1].6	1		Decimal	BOOL	Standard
IB16MSGdata[1].7	1		Decimal	BOOL	Standard
IB16MSGdata[1].8	1		Decimal	BOOL	Standard
IB16MSGdata[1].9	1		Decimal	BOOL	Standard
IB16MSGdata[1].10	1		Decimal	BOOL	Standard
IB16MSGdata[1].11	1		Decimal	BOOL	Standard
IB16MSGdata[1].12	1		Decimal	BOOL	Standard
IB16MSGdata[1].13	1		Decimal	BOOL	Standard
IB16MSGdata[1].14	1		Decimal	BOOL	Standard
IB16MSGdata[1].15	1		Decimal	BOOL	Standard
IB16MSGdata[1].16	1		Decimal	BOOL	Standard
IB16MSGdata[1].17	1		Decimal	BOOL	Standard
IB16MSGdata[1].18	1		Decimal	BOOL	Standard
IB16MSGdata[1].19	1		Decimal	BOOL	Standard
IB16MSGdata[1].20	0		Decimal	BOOL	Standard
IB16MSGdata[1].21	0		Decimal	BOOL	Standard
IB16MSGdata[1].22	0		Decimal	BOOL	Standard
IB16MSGdata[1].23	0		Decimal	BOOL	Standard

The first 32 bits of the instance are in IB16MSGdata[0].0...31, and the final 24 bits are in IB16MSGdata[1].0...23. Map these 56 bits according to Instance 869. An easy method to do this mapping is to create a user-defined tag (UDT) for Instance 869. Once you complete this, it appears as follows.

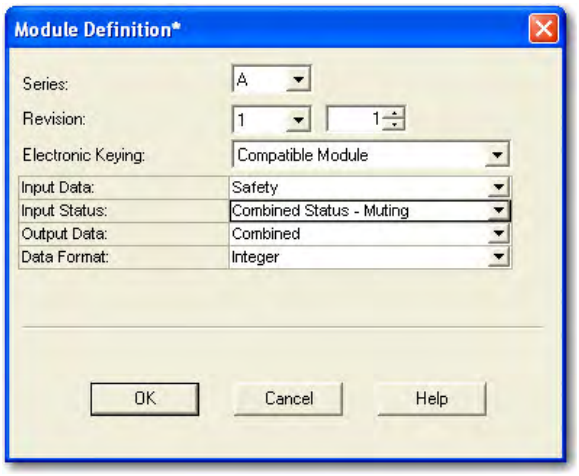


Get Status Messages from 1732ES Modules

Follow these steps to get status messages from 1732ES modules.

TIP The process is identical for the 1732ES-IB12XOBV2 and 1732ES-IB12XOB4 modules. Where necessary, the 1732ES-IB12XOBV2 module is used as the module reference name in tags.

1. In the Module Definition dialog box, from the Input Status pull-down menu, choose Combined Status.

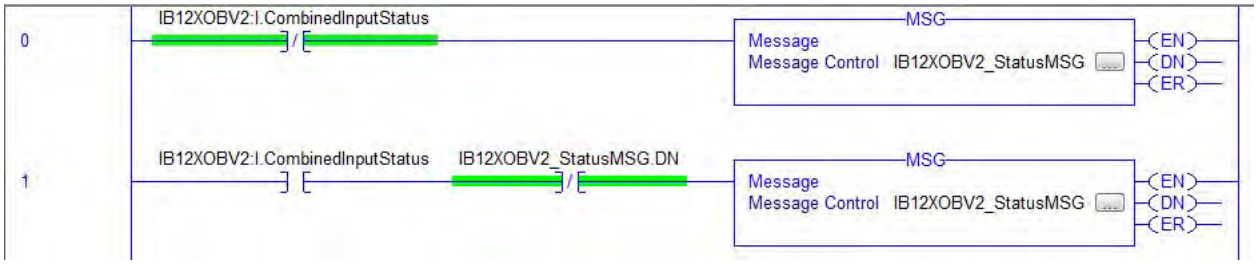


This creates a three-byte input assembly, as shown, for the 1732ES modules.

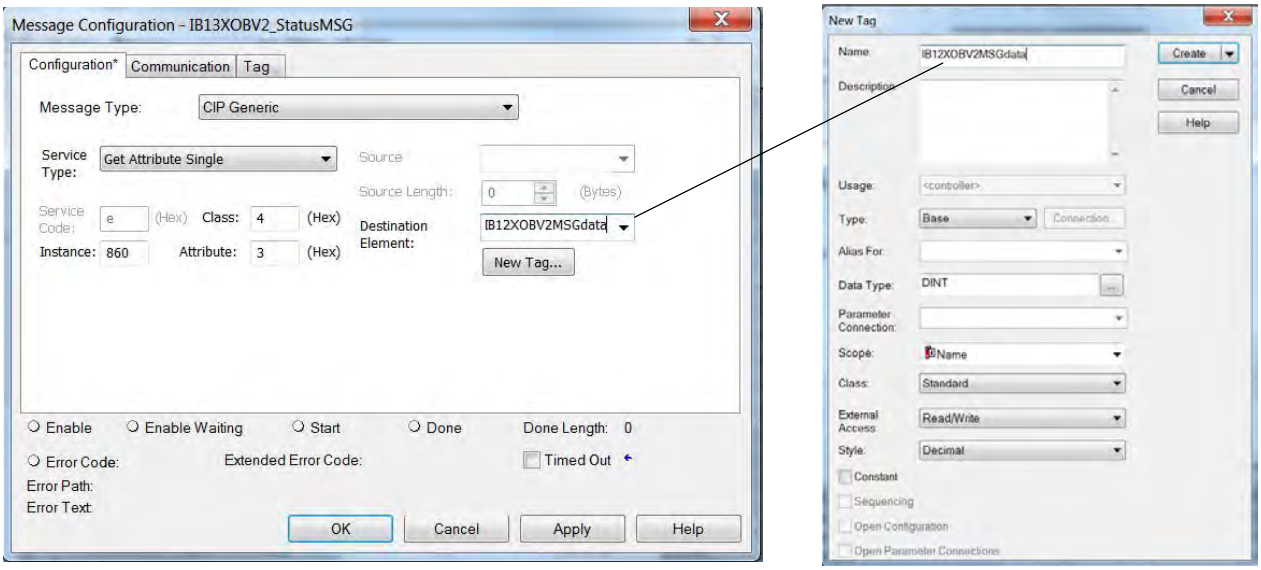
IB12XOBV2:I	{ . . . }
IB12XOBV2:I.RunMode	0
IB12XOBV2:I.ConnectionFaulted	0
IB12XOBV2:I.Pt00Data	0
IB12XOBV2:I.Pt01Data	0
IB12XOBV2:I.Pt02Data	0
IB12XOBV2:I.Pt03Data	0
IB12XOBV2:I.Pt04Data	0
IB12XOBV2:I.Pt05Data	0
IB12XOBV2:I.Pt06Data	0
IB12XOBV2:I.Pt07Data	0
IB12XOBV2:I.Pt08Data	0
IB12XOBV2:I.Pt09Data	0
IB12XOBV2:I.Pt10Data	0
IB12XOBV2:I.Pt11Data	0
IB12XOBV2:I.Muting03Status	0
IB12XOBV2:I.Muting07Status	0
IB12XOBV2:I.Muting11Status	0
IB12XOBV2:I.OutputPowerStatus	0
IB12XOBV2:I.InputPowerStatus	0
IB12XOBV2:I.CombinedOutputStatus	0
IB12XOBV2:I.CombinedInputStatus	0

2. Use the CombinedInputStatus and CombinedOutputStatus bits to detect if one or more of the I/O points on the module have a fault.
   - If any input or output status bits go to a value of 0 (0 = bad; 1 = good), use the CombinedInputStatus and CombinedOutputStatus bits to condition your MSG rungs as follows.

     Note that only use of the CombinedInputStatus bit is shown. Similar rungs should be created by using the CombinedOutputStatus bit instead of the CombinedInputStatus bit.
   - Note that the second rung can be used to read the status on mode transition and once a fault is detected, continue reading until the fault is corrected.
   - Place these rungs in the standard task.



See the figures that show the MSG instruction parameters for reading Instance 860 from the 1732ES module. See Appendix C of this manual for a layout of possible instances.



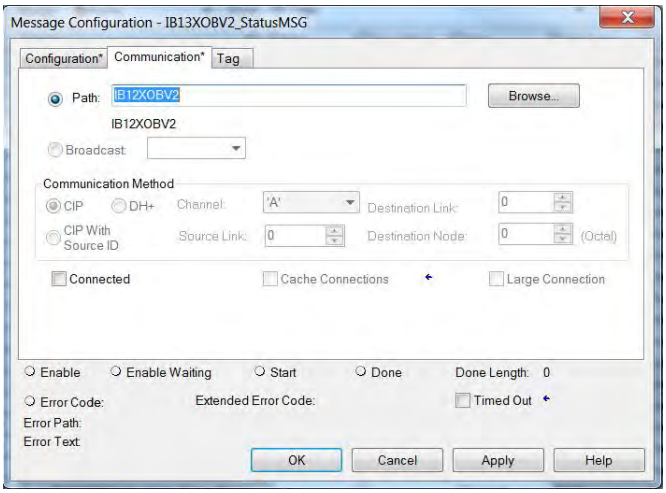
Instance 860 (35C hex) is 5 bytes in length, so the destination tag IB12XOBV2MSGdata must be at least 5 bytes in length to hold this data. The size is DINT[2] or 8 bytes (see Table 41).

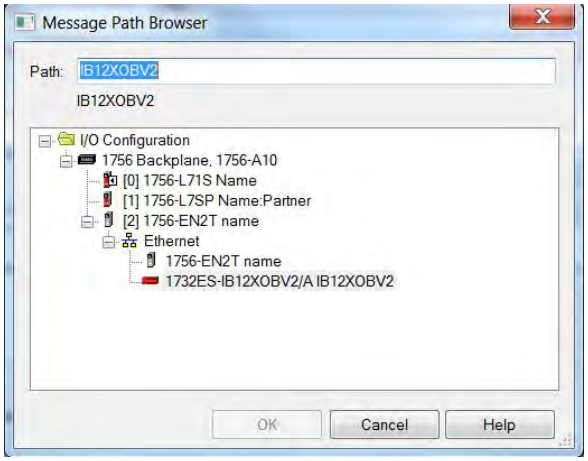
Table 42 - Layout of Instance 860 (35C hex) – 1732ES Modules

Instance Hex (decimal)	Connection Type	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
35C (860)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
		2	Safety Input 11 Status	Safety Input 10 Status	Safety Input 9 Status	Safety Input 8 Status	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status
		3	Safety Output 3 Monitor	Safety Output 2 Monitor	Safety Output 1 Monitor	Safety Output 0 Monitor	Safety Output 3 Status	Safety Output 2 Status	Safety Output 1 Status	Safety Output 0 Status
		4	Reserved	Reserved	Input Power Error(1)	Output Power Error(1)	Reserved	Muting Lamp 11	Muting Lamp 7	Muting Lamp 3

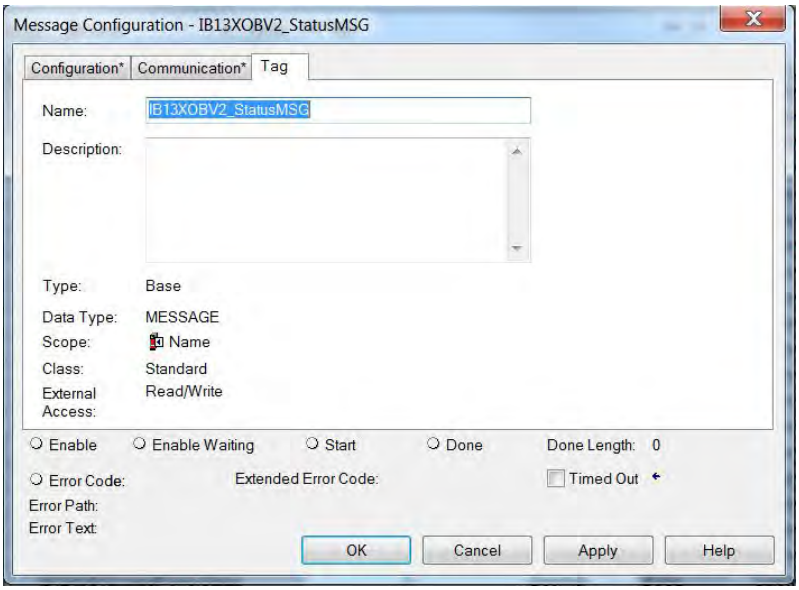
(1) This data is only diagnostic data. This data does not have safety integrity.

From the top of the Message Configuration dialog box, choose the Communication tab. This dialog box requires the path to the module. Click Browse to go to the module that the MSG will read.





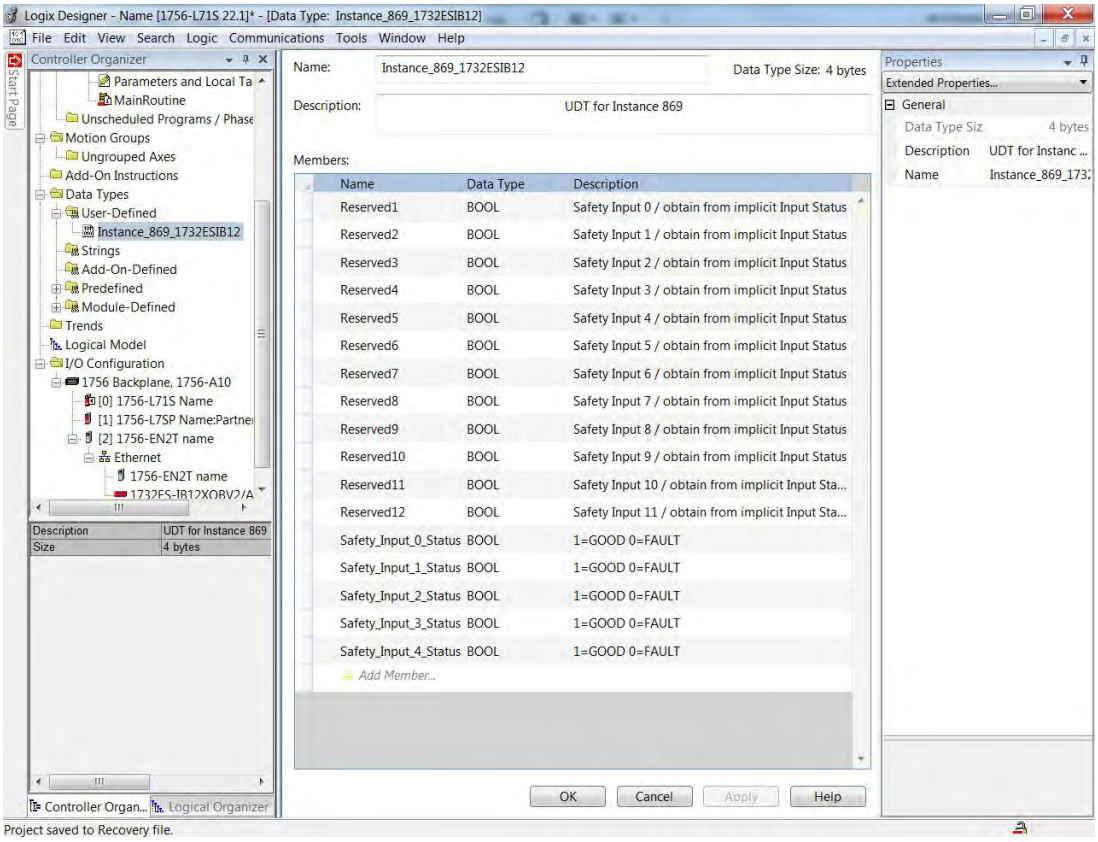
From the top of the Message Configuration dialog box, click Tag to see this dialog box.



When the explicit message reads the data from the 1732ES modules, the data appears in the MSGdata tags as shown.

IB12XOBV2MSGdata	0		Decimal	DINT	Standard
IB12XOBV2MSGdata.0	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.1	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.2	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.3	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.4	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.5	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.6	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.7	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.8	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.9	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.10	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.11	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.12	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.13	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.14	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.15	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.16	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.17	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.18	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.19	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.20	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.21	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.22	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.23	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.24	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.25	0		Decimal	BOOL	Standard
IB12XOBV2MSGdata.26	0		Decimal	BOOL	Standard

The first 32 bits of the instance are in IB12XOBV2MSGdata[0].0...31, and the final 8 bits are in IB12XOBV2MSGdata[1].0...7. Map these 40 bits according to Instance 860. An easy method to do this mapping is to create a user-defined tag (UDT) for Instance 860. Once you complete this, it appears as follows.



I/O Data Supported by Each Module

Table 43 shows a summary of default I/O data by module.

Table 43 - Default I/O Data

Module Cat. No.	Safety Connection	Assembly Instance (hex)
1791ES-IB16	Safety	225 and 23
1791ES-IB8XOBV4	Safety	204 and 234
1732ES-IB12XOBV2	Safety	20C and 233
1732ES-IB12XOB4	Safety	20C and 233

The tables show the I/O data supported by each module. See I/O Assembly and Reference Data on page 109 for data arrangements.

For I/O data, safety connections for up to four items, including one output, can be allocated for the master unit. Also, standard connections for up to two items can be allocated for the master unit.

Table 44 - 1791ES-IB8X0BV4 Modules

Input Data	Input Status	Assembly Instance
Safety	None	204(1)
	Point Status - Muting	334
	Combined Status - Muting	324
Safety - Readback	Point Status - Muting	354
	Point Status - Muting - Test Output	374
Output Data		**Assembly Instance**
Safety	–	234(1)
Test		22
Combined		2C4
None		C7

(1) The default Assembly Instance.

Table 45 - 1791ES-IB16 Modules

Input Data	Input Status	Assembly Instance
Safety	None	205
	Point Status - Muting	335
	Point Status - Muting - Test Output	365
	Combined Status - Muting	315
	Point Status	225(1)
Output Data		**Assembly Instance**
Test	–	23(1)
None		C7

(1) The default Assembly Instance.

Table 46 - 1732ES-IB12X0BV2

Input Data	Input Status	Assembly Instance
Safety	None	20C(1)
	Point Status - Muting	34C
	Combined Status - Muting	32C
Safety - Readback	Point Status - Muting	35C
	Point Status - Muting - Test Output	37C
Output Data		**Assembly Instance**
Safety	–	233 (1)
Test		25
Combined		3C4
None		C8

(1) The default Assembly Instance.

Table 47 - 1732ES-IB12X0BV2

Input Data	Input Status	Assembly Instance
Safety	None	20C[1]
	Point Status - Muting	34C
	Combined Status - Muting	32C
Safety - Readback	Point Status - Muting	35C
	Point Status - Muting - Test Output	37C
Output Data		**Assembly Instance**
Safety	–	233 [1]
Test		25
Combined		3C4
None		C8

(1) The default Assembly Instance.

I/O Assembly and Reference Data

This section provides information for I/O assembly and reference data.

1791ES Modules

The bits in the tag definitions of the Logix Designer application are different than those shown in the following section. The following defines the name associations for clarification with the programming software.

Table 48 - Bit Definitions and Logix Designer Tag Names

Bit Definitions	Logix Designer Application Tag Name
Safety Input 0	Pt00Data
Safety Input 15	Pt15Data
Safety Input 0 Status	Pt00InputStatus
Safety Input 15 Status	Pt15InputStatus
Safety In Status	InputStatus
Muting Lamp Status	MutingStatus
Safety Output 0	Pt00Data
Safety Output 7	Pt07Data
Standard Output 0	Test00Data
Standard Output 15	Test15Data
Safety Output 0 Status	Pt00OutputStatus
Safety Output 7 Status	Pt07OutputStatus
Safety Out Status	OutputStatus
Safety Output 0 Monitor	Pt00Readback
Safety Output 7 Monitor	Pt07Readback
Test Output 0 Status	Pt00TestOutputStatus
Test Output 15 Status	Pt15TestOutputStatus

See these tables for reference data concerning input and output data.

Table 49 - Input Data – 1791ES- IB8XOBV4 Modules

Instance Hex (decimal)	Connection Type	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
204 (516)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
224 (548)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status
301 (769)	Only standard	0	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Output Power Error [1]	Input Power Error
324 (804)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Combined Safety In Status	Combined Safety Out Status	Input Power Error [1]	Output Power Error [1]	Reserved	Reserved	Muting Lamp 7 Status	Muting Lamp 3 Status

Table 49 - Input Data – 1791ES- IB8XOBV4 Modules (Continued)

Instance Hex (decimal)	Connection Type	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
334 (820)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status
		2	Reserved	Reserved	Input Power Error (1)	Output Power Error (1)	Reserved	Reserved	Muting Lamp 7 Status	Muting Lamp 3 Status
344 (836)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status
		2	Safety Output 7 Status	Safety Output 6 Status	Safety Output 5 Status	Safety Output 4 Status	Safety Output 3 Status	Safety Output 2 Status	Safety Output 1 Status	Safety Output 0 Status
		3	Reserved	Reserved	Input Power Error (1)	Output Power Error (1)	Reserved	Reserved	Muting Lamp 7 Status	Muting Lamp 3 Status
354 (852)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status
		2	Safety Output 7 Status	Safety Output 6 Status	Safety Output 5 Status	Safety Output 4 Status	Safety Output 3 Status	Safety Output 2 Status	Safety Output 1 Status	Safety Output 0 Status
		3	Safety Output 7 Monitor	Safety Output 6 Monitor	Safety Output 5 Monitor	Safety Output 4 Monitor	Safety Output 3 Monitor	Safety Output 2 Monitor	Safety Output 1 Monitor	Safety Output 0 Monitor
		4	Reserved	Reserved	Input Power Error (1)	Output Power Error (1)	Reserved	Reserved	Muting Lamp 7 Status	Muting Lamp 3 Status
364 (868)	Safety and standard	0	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status
		1	Safety Output 7 Status	Safety Output 6 Status	Safety Output 5 Status	Safety Output 4 Status	Safety Output 3 Status	Safety Output 2 Status	Safety Output 1 Status	Safety Output 0 Status
		2	Test Output 7 Status	Test Output 6 Status	Test Output 5 Status	Test Output 4 Status	Test Output 3 Status	Test Output 2 Status	Test Output 1 Status	Test Output 0 Status
		3	Reserved	Reserved	Input Power Error (1)	Output Power Error (1)	Reserved	Reserved	Muting Lamp 7 Status	Muting Lamp 3 Status
374 (884)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status
		2	SafetyOutput7 Status	Safety Output 6 Status	Safety Output 5 Status	Safety Output 4 Status	Safety Output 3 Status	Safety Output 2 Status	Safety Output 1 Status	Safety Output 0 Status
		3	Safety Output 7 Monitor	Safety Output 6 Monitor	Safety Output 5 Monitor	Safety Output 4 Monitor	Safety Output 3 Monitor	Safety Output 2 Monitor	Safety Output 1 Monitor	Safety Output 0 Monitor
		4	Test Output 7 Status	Test Output 6 Status	Test Output 5 Status	Test Output 4 Status	Test Output 3 Status	Test Output 2 Status	Test Output 1 Status	Test Output 0 Status
		5	Reserved	Reserved	Input Power Error (1)	Output Power Error (1)	Reserved	Reserved	Muting Lamp 7 Status	Muting Lamp 3 Status
394 (916)	Only standard	0	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Output Power Error	Input Power Error
		1	Test Output 7 Status	Test Output 6 Status	Test Output 5 Status	Test Output 4 Status	Test Output 3 Status	Test Output 2 Status	Test Output 1 Status	Test Output 0 Status
3A4 (932)	Only standard	0	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Output Power Error	Input Power Error
		1	Safety Output 7 Monitor	Safety Output 6 Monitor	Safety Output 5 Monitor	Safety Output 4 Monitor	Safety Output 3 Monitor	Safety Output 2 Monitor	Safety Output 1 Monitor	Safety Output 0 Monitor
		2	Test Output 7 Status	Test Output 6 Status	Test Output 5 Status	Test Output 4 Status	Test Output 3 Status	Test Output 2 Status	Test Output 1 Status	Test Output 0 Status

(1) This data is only diagnostic data. This data does not have safety integrity.

Table 50 - Input Data – 1791ES-IB16 Modules

Instance Hex (decimal)	Connection Type	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
205 (517)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 15	Safety Input 14	Safety Input 13	Safety Input 12	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
225 (549)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 15	Safety Input 14	Safety Input 13	Safety Input 12	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
		2	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status
		3	Safety Input 15 Status	Safety Input 14 Status	Safety Input 13 Status	Safety Input 12 Status	Safety Input 11 Status	Safety Input 10 Status	Safety Input 9 Status	Safety Input 8 Status
300 (768)	Only standard	0	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Input Power Error
315 (789)	Safety and standard	0	SafetyInput7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 15 Status	Safety Input 14 Status	Safety Input 13 Status	Safety Input 12 Status	Safety Input 11 Status	Safety Input 10 Status	Safety Input 9 Status	Safety Input 8 Status
		2	Combined Safety In Status	Reserved	Input Power Error (1)	Reserved	Muting Lamp 15 Status	Muting Lamp 11 Status	Muting Lamp 7 Status	Muting Lamp 3 Status
335 (821)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 15	Safety Input 14	Safety Input 13	Safety Input 12	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
		2	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status
		3	Safety Input 15 Status	Safety Input 14 Status	Safety Input 13 Status	Safety Input 12 Status	Safety Input 11 Status	Safety Input 10 Status	Safety Input 9 Status	Safety Input 8 Status
		4	Reserved	Reserved	Input Power Error (1)	Reserved	Muting Lamp 15 Status	Muting Lamp 11 Status	Muting Lamp 7 Status	Muting Lamp 3 Status
365 (869)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 15	Safety Input 14	Safety Input 13	Safety Input 12	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
		2	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status
		3	Safety Input 15 Status	Safety Input 14 Status	Safety Input 13 Status	Safety Input 12 Status	Safety Input 11 Status	Safety Input 10 Status	Safety Input 9 Status	Safety Input 8 Status
		4	Test Output 7 Status	Test Output 6 Status	Test Output 5 Status	Test Output 4 Status	Test Output 3 Status	Test Output 2 Status	Test Output 1 Status	Test Output 0 Status
		5	Test Output 15 Status	Test Output 14 Status	Test Output 13 Status	Test Output 12 Status	Test Output 11 Status	Test Output 10 Status	Test Output 9 Status	Test Output 8 Status
		6	Reserved	Reserved	Input Power Error (1)	Output Power Error (1)	Muting Lamp 15 Status	Muting Lamp 11 Status	Muting Lamp 7 Status	Muting Lamp 3 Status
385 (901)	Only standard	0	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Input Power Error
		1	Test Output 7 Status	Test Output 6 Status	Test Output 5 Status	Test Output 4 Status	Test Output 3 Status	Test Output 2 Status	Test Output 1 Status	Test Output 0 Status
		2	Test Output 15 Status	Test Output 14 Status	Test Output 13 Status	Test Output 12 Status	Test Output 11 Status	Test Output 10 Status	Test Output 9 Status	Test Output 8 Status

(1) This data is only diagnostic data. This data does not have safety integrity.

Table 51 - Output Data – 1791ES-IB8X0BV4 Modules

Instance Hex (decimal)	Connection Type	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
22 (34)	Safety and standard	0	Standard Output 7[1]	Standard Output 6	Standard Output 5	Standard Output 4	Standard Output 3	Standard Output 2	Standard Output 1	Standard Output 0
234 (564)	Only safety	0	Safety Output 7	Safety Output 6	Safety Output 5	Safety Output 4	Safety Output 3	Safety Output 2	Safety Output 1	Safety Output 0
2C4 (708)	Only safety	0	Safety Output 7	Safety Output 6	Safety Output 5	Safety Output 4	Safety Output 3	Safety Output 2	Safety Output 1	Safety Output 0
		1	Standard Output 7	Standard Output 6	Standard Output 5	Standard Output 4	Standard Output 3	Standard Output 2	Standard Output 1	Standard Output 0

(1) Standard output signifies a test output configured as a standard output.

Table 52 - Output Data – 1791ES-IB16 Modules

Instance Hex (decimal)	Connection Type	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
23 (35)	Safety and standard	0	Standard Output 7	Standard Output 6	Standard Output 5	Standard Output 4	Standard Output 3	Standard Output 2	Standard Output 1	Standard Output 0
		1	Standard Output 15	Standard Output 14	Standard Output 13	Standard Output 12	Standard Output 11	Standard Output 10	Standard Output 9	Standard Output 8

1732ES Modules

The bits in the tag definitions of the Logix Designer application are different than those shown in the following section. The following defines the name associations for clarification with the programming software.

Table 53 - Bit Definitions and Logix Designer Tag Names

Bit Definitions	Logix Designer Application Tag Name
Safety Input 0…11	*ModuleName*:I.Pt00Data - Pt11Data
Safety Input 0…11 Status	*ModuleName*:I.Pt00InputStatus - Pt11InputStatus
Combined Safety In Status	*ModuleName*:I.InputStatus
Muting Lamp Status	*ModuleName*:I.MutingStatusXX where XX = 03, 07, 11
Safety Output 0…3	*ModuleName*:O.Pt00Data - Pt03Data
Safety Output 0…3 Status	*ModuleName*:I.Pt00OutputStatus - Pt03OutputStatus
Combined Safety Out Status	*ModuleName*:I.OutputStatus
Safety Output 0…3 Monitor	*ModuleName*:I.Pt00Readback - Pt03Readback
Test Output 0…11 Data	*ModuleName*:O.Test00Data - Test11Data
Test Output 0…11 Status	*ModuleName*:I.Pt00TestOutputStatus - Pt11TestOutputStatus
Input Power Status	*ModuleName*:I.InputPowerStatus
Output Power Status	*ModuleName*:I.OutputPowerStatus

See these tables for reference data concerning input and output data.

Table 54 - Input Data – 1732ES-IB12X0BV2 and 1732ES-IB12X0B4 Modules

Instance Hex (decimal)	Connection Type	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
20C (524)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Reserved	Reserved	Reserved	Reserved	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
22C (556)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
		2	Safety Input 11 Status	Safety Input 10 Status	Safety Input 9 Status	Safety Input 8 Status	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status
301 (769)	Only standard	0	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Output Power Error	Input Power Error
32C (812)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Reserved	Reserved	Reserved	Reserved	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
		2	Combined Safety In Status	Combined Safety Out Status	Input Power Error (1)	Output Power Error (1)	Reserved	Muting Lamp 11 Status	Muting Lamp 7 Status	Muting Lamp 3 Status
33C (828)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
		2	Safety Input 11 Status	Safety Input 10 Status	Safety Input 9 Status	Safety Input 8 Status	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status
		3	Reserved	Reserved	Input Power Error (1)	Output Power Error (1)	Reserved	Muting Lamp 11 Status	Muting Lamp 7 Status	Muting Lamp 3 Status
34C (844)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
		2	Safety Input 11 Status	Safety Input 10 Status	Safety Input 9 Status	Safety Input 8 Status	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status
		3	Reserved	Reserved	Reserved	Reserved	Safety Output 3 Status	Safety Output 2 Status	Safety Output 1 Status	Safety Output 0 Status
		4	Reserved	Reserved	Input Power Error (1)	Output Power Error (1)	Reserved	Muting Lamp 11 Status	Muting Lamp 7 Status	Muting Lamp 3 Status
35C (860)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
		2	Safety Input 11 Status	Safety Input 10 Status	Safety Input 9 Status	Safety Input 8 Status	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status
		3	Safety Output 3 Monitor	Safety Output 2 Monitor	Safety Output 1 Monitor	Safety Output 0 Monitor	Safety Output 3 Status	Safety Output 2 Status	Safety Output 1 Status	Safety Output 0 Status
		4	Reserved	Reserved	Input Power Error (1)	Output Power Error (1)	Reserved	Muting Lamp 11 Status	Muting Lamp 7 Status	Muting Lamp 3 Status

Table 54 - Input Data – 1732ES-IB12X0BV2 and 1732ES-IB12X0B4 Modules (Continued)

Instance Hex (decimal)	Connection Type	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
36C (876)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
		2	Safety Input 11 Status	Safety Input 10 Status	Safety Input 9 Status	Safety Input 8 Status	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status
		3	Test Output 7 Status	Test Output 6 Status	Test Output 5 Status	Test Output 4 Status	Test Output 3 Status	Test Output 2 Status	Test Output 1 Status	Test Output 0 Status
		4	Reserved	Reserved	Reserved	Reserved	Test Output 11 Status	Test Output 10 Status	Test Output 9 Status	Test Output 8 Status
		5	Reserved	Reserved	Input Power Error (1)	Output Power Error (1)	Reserved	Muting Lamp 11 Status	Muting Lamp 7 Status	Muting Lamp 3 Status
37C (892)	Safety and standard	0	Safety Input 7	Safety Input 6	Safety Input 5	Safety Input 4	Safety Input 3	Safety Input 2	Safety Input 1	Safety Input 0
		1	Safety Input 3 Status	Safety Input 2 Status	Safety Input 1 Status	Safety Input 0 Status	Safety Input 11	Safety Input 10	Safety Input 9	Safety Input 8
		2	Safety Input 11 Status	Safety Input 10 Status	Safety Input 9 Status	Safety Input 8 Status	Safety Input 7 Status	Safety Input 6 Status	Safety Input 5 Status	Safety Input 4 Status
		3	Safety Output 3 Monitor	Safety Output 2 Monitor	Safety Output 1 Monitor	Safety Output 0 Monitor	Safety Output 3 Status	Safety Output 2 Status	Safety Output 1 Status	Safety Output 0 Status
		4	Test Output 7 Status	Test Output 6 Status	Test Output 5 Status	Test Output 4 Status	Test Output 3 Status	Test Output 2 Status	Test Output 1 Status	Test Output 0 Status
		5	Reserved	Reserved	Reserved	Reserved	Test Output 11 Status	Test Output 10 Status	Test Output 9 Status	Test Output 8 Status
		6	Reserved	Reserved	Input Power Error (1)	Output Power Error (1)	Reserved	Muting Lamp 11 Status	Muting Lamp 7 Status	Muting Lamp 3 Status
39C (924)	Only standard	0	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Output Power Error	Input Power Error
		1	Test Output 7 Status	Test Output 6 Status	Test Output 5 Status	Test Output 4 Status	Test Output 3 Status	Test Output 2 Status	Test Output 1 Status	Test Output 0 Status
		2	Reserved	Reserved	Reserved	Reserved	Test Output 11 Status	Test Output 10 Status	Test Output 9 Status	Test Output 8 Status
3AC (940)	Only standard	0	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Output Power Error	Input Power Error
		1	Test Output 3 Status	Test Output 2 Status	Test Output 1 Status	Test Output 0 Status	Safety Output 3 Monitor	Safety Output 2 Monitor	Safety Output 1 Monitor	Safety Output 0 Monitor
		2	Test Output 11 Status	Test Output 10 Status	Test Output 9 Status	Test Output 8 Status	Test Output 7 Status	Test Output 6 Status	Test Output 5 Status	Test Output 4 Status

(1) This data is only diagnostic data. This data does not have safety integrity.

Table 55 - Output Data – 1732ES-IB12X0BV2 and 1732ES-IB12X0B4 Modules

Instance Hex (decimal)	Connection Type	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
25 (37)	Safety and standard	0	Standard Output 7	Standard Output 6	Standard Output 5	Standard Output 4	Standard Output 3	Standard Output 2	Standard Output 1	Standard Output 0
		1	Reserved	Reserved	Reserved	Reserved	Standard Output 11	Standard Output 10	Standard Output 9	Standard Output 8
233 (563)	Only safety	0	Reserved	Reserved	Reserved	Reserved	Safety Output 3	Safety Output 2	Safety Output 1	Safety Output 0
3C4 (964)	Only safety	0	Standard Output 3	Standard Output 2	Standard Output 1	Standard Output 0	Safety Output 3	Safety Output 2	Safety Output 1	Safety Output 0
		1	Standard Output 11	Standard Output 10	Standard Output 9	Standard Output 8	Standard Output 7	Standard Output 6	Standard Output 5	Standard Output 4

Explicit Messages

Explicit Messaging can also be used to read individual channel status for safety inputs, safety outputs, test outputs, and power status. Communication error settings can also be configured and monitored for test outputs as well.

Table 56 - Reading the Cause of the Safety Input Error

Explicit Message	Service	Function	Command (hex)					Response (hex)
			Service Code	Class ID	Instance ID	Attribute ID	Data Size	
Safety input cause of error (fault) information read	Get attribute Single	Reads the cause for the status bit (1…n), specified by the Instance ID, turning OFF.	0E	3D	01…n	6E	-	0: No error 01: Configuration invalid 02: External test signal error 03: Internal input error 04: Discrepancy error 05: Error in the other dual channel input

Table 57 - Reading the Cause of the Safety Output Error

Explicit Message	Service	Function	Command (hex)					Response (hex)
			Service Code	Class ID	Instance ID	Attribute ID	Data Size	
Safety output cause of error (fault) information	Get attribute single	Reads the cause for the status bit (1…n), specified by the Instance ID, turning OFF.	0E	3B	01…n	6E	-	0: No error 01: Configuration invalid 02: Over current detected 03: Short circuit detected 04: Output ON error 05: Error in the other dual channel output 08: Output data error 09: Short circuit detected at safety output

Table 58 - Monitoring the Test Output Point

Explicit Message	Service	Function	Command (hex)					Response (hex)
			Service Code	Class ID	Instance ID	Attribute ID	Data Size	
Test output cause of error (fault) information	Get attribute single	Reads the cause for the status bit (1…n), specified by the Instance ID, turning OFF.	0E	09	01…n	76	-	0 = No error 01: Configuration invalid 02: Overload detected 05: Output ON error 06: Undercurrent detected for muting lamp

Table 59 - Setting Hold/Clear for Communications Errors (test output)

Explicit Message	Service	Function	Command (hex)					Response (hex)
			Service Code	Class ID	Instance ID	Attribute ID	Data Size	
Setting for output state (hold or clear) after communication error	Get attribute single	Reads whether hold or clear is set as the output state after a communication error for a test output specified by the instance ID. The setting can be read for a specified number of points.	0E	09	01…08	05	–	1 byte 00: Clear 01: Hold
Setting for output state (hold or clear) after communication error	Set attribute single	Sets whether hold or clear as the output status after a communication error for an output specified by the instance ID. Sets whether a test output must hold its state or clear (turn off) after a communication error.	10	09	01…08	05	1 byte 00: Clear 01: Hold	

Safety Data

This appendix lists calculated values for probability of failure on demand (PFD), probability of failure per hour (PFH), and mean time to failure (MTTF). PFD and PFH calculations comply with IEC61508, edition 2, 2010.

Calculated Values

Calculated values of probability of failure on demand and probability of failure per hour appear in the Table 60 and must be calculated for the devices within the system to comply with the SIL level required for application.

Users must be responsible for following the requirements of ISO 13849-1:2008, to assess performance levels in their safety system.

Within the proof test interval, every I/O module must be functionally tested by individually toggling each input point and verifying that it is detected by the controller.

Additionally, each output point must be individually toggled by the controller and user-verified that the output point changes state.

For more information, refer to these publications.

Resource	Description
GuardLogix 5570 Controller Systems Safety Reference Manual, publication 1756-RM099	Provides information on safety application requirements for GuardLogix 5570 controllers in Studio 5000 Logix Designer projects.
GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093	Provides information on safety application requirements for GuardLogix 5560 and 5570 controllers in RSLogix 5000 projects.

Figure 24 - PFD Versus Proof Test Interval 1791ES-IB16 Module

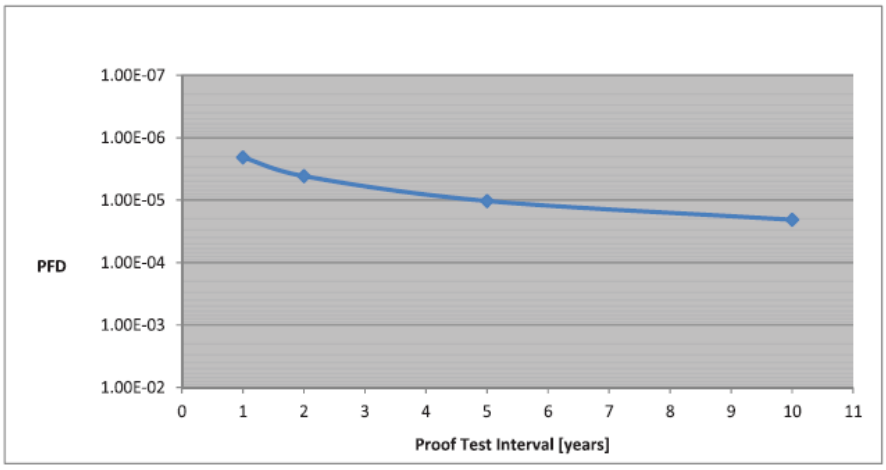


Figure 25 - PFD Versus Proof Test Interval 1791ES-IB8XOBV4 Module

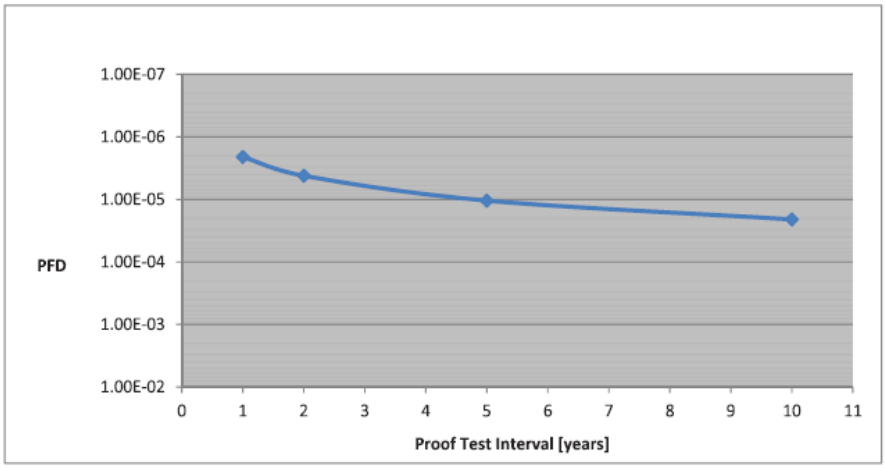
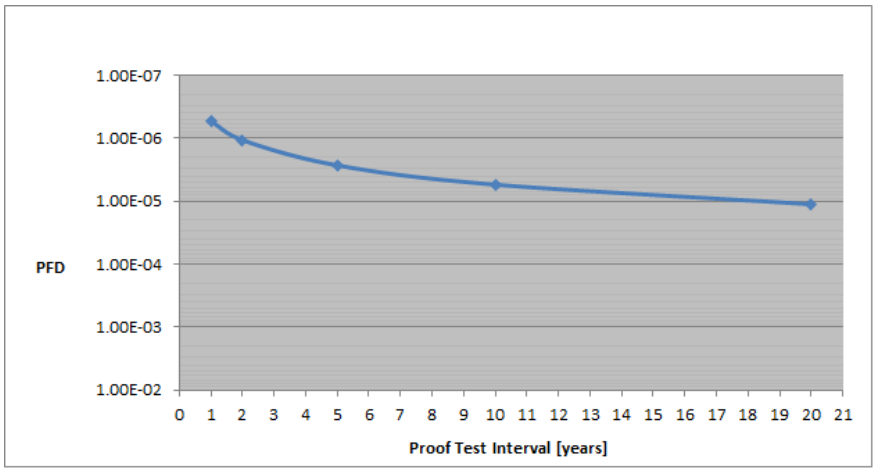


Figure 26 - PFD Versus Proof Test Interval 1732ES-IB12XOBV2 Module(1)



(1) Data is for both SIL3 dual-channel mode of operation and SIL2 single-channel Safety Inputs mode of operation.

Figure 27 - PFD Versus Proof Test Interval 1732ES-IB12XOB4 Module (1)

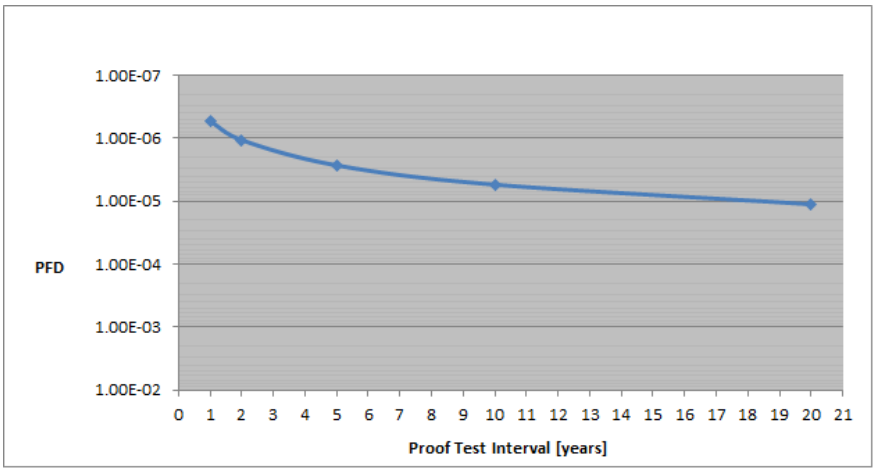


Table 60 - Calculated Values for Probability of Failure on Demand (PFD), Probability of Failure per Hour (PFH), and Mean Time To Failure (MTTF)

Cat. No.	Proof Test Interval		PFD (1/hour)	PFH (1/hour)	Spurious Trip Rate (STR)	$MTTF_{Spurious}$ (years)
	Year	Hour				
1791ES-IB16	1	8760	2.06E-06	4.98E-10	3.309E-06	34.48
	2	17520	4.13E-06			
	5	43800	1.03E-05			
	10	87600	2.06E-05			
1791ES-IB8XOBV4	1	8760	2.09E-06	5.04E-10	5.612E-06	20.33
	2	17520	4.17E-06			
	5	43800	1.04E-05			
	10	87600	2.09E-05			
1732ES-IB12XOBV2(1)	1	8760	5.33E-07	1.31E-10	6.73E-06	16.97
	2	17520	1.07E-06			
	5	43800	2.70E-06			
	10	87600	5.46E-06			
	20	175200	1.12E-05			
1732ES-IB12XOB4(1)	1	8760	5.33E-07	1.31E-10	6.66E-06	17.14
	2	17520	1.07E-06			
	5	43800	2.70E-06			
	10	87600	5.46E-06			
	20	175200	1.12E-05			

(1) Data is for both SIL3 dual-channel mode of operation and SIL2 single-channel Safety Inputs mode of operation.

Table 61 - Product Failure Rates (failures per hour)

Cat. No.	λ_S	λ_{DD}	λ_{DU}
1791ES-IB16	1.57E-06	1.54E-06	4.98E-10
1791ES-IB8XOBV4	2.71E-06	2.68E-06	5.04E-10
1732ES-IB12XOB4(1)	3.95E-07	3.95E-07	1.31E-10
1732ES-IB12XOBV2(1)	3.95E-07	3.95E-07	1.31E-10

(1) Data is for both SIL3 dual-channel mode of operation and SIL2 single-channel Safety Inputs mode of operation.

Notes:

Configuration Reference Information

The modules have these parameter groups: general parameters, safety input, test output, safety output.

Parameter Groups

See the tables for the settings in each parameter group. All parameters are set by using the Logix Designer application.

Table 62 - General Parameters

Parameter Name	Value	Description	Default
Safety Output Error Latch Time	0…65,530 ms (in increments of 10 ms)	Safety output errors are latched for this time.	1000 ms
Safety Input Error Latch Time	0…65,530 ms (in increments of 10 ms)	Safety input or test output errors are latched for this time.	1000 ms

Table 63 - Safety Input Parameters

Parameter Name	Value	Description
Input Point Operation Type	Single Channel	Use as single channel.
	Dual-channel Equivalent	Use as dual-channel. Normal when both channels are ON or OFF.
	Dual-channel Complementary	Use as dual-channel. Normal when one channel is ON and the other channel is OFF.
Input Point Mode	Not Used	External input device is not connected.
	Safety Test Pulse	Use with a contact output device and in combination with a test output. By using this setting, short-circuits between input signal lines and the power supply (positive side) and short-circuits between input signal lines can be detected.
	Safety	A solid-state output safety sensor is connected.
	Standard	A standard device, such as a reset switch, is connected.
Safety Input Test Source	Not Used	The test output that is used with the input. n is dependent on the module catalog number.
	Test Output 0 to n	
Input Delay Time Off -> On	0…126 ms (in increments of 6 ms)	Filter time for OFF to ON transition
Input Delay Time On -> Off	0…126 ms (in increments of 6 ms)	Filter time for ON to OFF transition

IMPORTANT When configuring a test output for Pulse Test mode, verify the corresponding safety input is configured for safety pulse test.

Table 64 - Test Output Parameters

Parameter Name	Value	Description	Default
Test Output Mode	Not Used	An external device is not connected.	Not Used
	Standard	The output is connected to a standard device.	
	Pulse Test	A contact output device is connected. Use in combination with a safety input.	
	Power Supply	The power supply of a Safety Sensor is connected. The voltage supplied to I/O power (V, G) is output from the test output terminal.	
	Muting Lamp Output 1791ES-IB8XOBV4 module = T3 and T7 1791ES-IB16 module = T3, T7, T11, and T15 1732ES modules = T3, T7, and T11	An indicator is connected and turned ON to detect broken lines in an external indicator.	

Table 65 - Safety Output Parameters

Parameter Name	Value	Description	Default
Output Point Mode	Not Used	An external output device is not connected.	Not Used
	Safety	When the output is ON, the test pulse is not output (remains ON).	
	Safety Pulse Test	By using this function, short-circuits between output signal lines and the power supply (positive side) and short-circuits between output signal lines can be detected.	
Output Point Operation Type	Single Channel(1)	Use as single channel.	Dual-channel
	Dual-channel	Use as dual-channel. When both channels are normal, outputs can be turned ON.	

(1) Safety outputs configured for single-channel operation must be controlled as pairs for use in functional safety applications.

Specifications

Topic	Page
Technical Specifications	123
Environmental Specifications	127
Certifications	130
Legislation and Standards	130
EC Directives	131

Technical Specifications

This section provides technical specifications for the modules.

1791ES Modules

For 1791ES modules, see Table 66 and Table 67.

Table 66 - 1791ES Modules – Technical Specifications

Attribute	Value
Safety input	
Inputs type	Current sinking
Voltage, on-state input, min	11V DC
Current, on-state input, min	3.3 mA
Voltage, off-state input, max	5V DC
Current, off-state, max	1.3 mA
IEC 61131-2 (input type)	Type 3
Pulse test output	
Output type	Current sourcing
Pulse test output current	0.7 A per output 8 A total module at 40 °C (104 °F) 6 A total module at 60 °C (140 °F) for 1791ES-IB8XOBV4 (see temperature versus current derating) 8 A total module at 60 °C (140 °F) for 1791ES-IB16
Residual voltage, max	1.2V
Output leakage current, max	0.1 mA
Short circuit protection	Yes
Current, max	25 mA – current, max (to avoid fault when used as a muted lamp output)

Table 66 - 1791ES Modules – Technical Specifications (continued)

Attribute	Value
Current, min	5 mA – current, min (at which fault indication is generated when used as a muted lamp output)
Safety output	
Output types	Current sourcing/current sinking – bipolar pair
Output current rating	2 A max per point 8 A total module at 40 °C (104 °F) (see temperature versus current derating) 6 A total module at 60 °C (140 °F)
On-state voltage drop	+/- 0.6V
Leakage current	+/- 1.0 mA(1)
Internal resistance from P to M terminal	3.25 kΩ
Short circuit detection	Yes (short high and low and cross-circuit fault detection)
Short circuit protection	Electronic
Aggregate current of module	8 A at 40 °C (104 °F), 6 A at 60 °C (140 °F) (see product temperature versus current derating)
Pilot duty rating	2.5 A inrush for 1791ES-IB8XOBV4 module
Number of outputs	4, dual-channel

(1) Includes the presence of a single P stuck-high or M stuck-low short.

Table 67 - 1791ES Modules – General

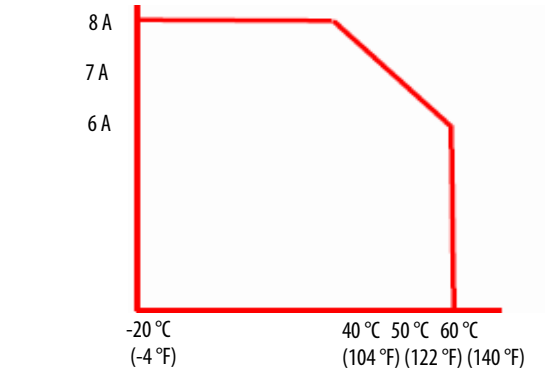
Attribute	Value
North American temp code	T4A
Enclosure type rating	Meets IP20
Communication current consumption	250 mA at 24V DC
Operating voltage range	19.2…28.8V DC (24V DC, -20…20%)
Isolation voltage	1791ES-IB16 - 50V (continuous), basic insulation - type tested at 800V DC for 60 s between input channels and network 1791ES-IB8XOBV4 - 50V (continuous), basic insulation - type tested at 800V DC for 60 s between input and output channels and between I/O and network
Product temperature versus current derating	 Product Temperature Versus Current Derating (combined current from both input and output supplies)
Wiring category(1)	2 - on signal ports, 2 - on power ports, 2 -on communication ports

Table 67 - 1791ES Modules – General (continued)

Attribute	Value
Wire size	Power and I/O wiring: 0.34…1.5 mm^2 (22…16 AWG) solid or stranded copper wire rated at 75 °C (167 °F) or greater, 1.2 mm (3/64 in.) insulation max
Weight, approx.	600 g (1.32 lb)
Dimensions (HxWxD), approx.	80 x 196 x 77 mm (3.2 x 7.7 x 3 in.) with terminal block
	77 x 196 x 62 mm (3 x 7.7 x 2.5 in.) without terminal block

(1) Use this Conductor Category information for planning conductor routing. See Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

1732ES Modules

For 1732ES modules, see Table 68 and Table 69.

Table 68 - 1732ES Modules – Technical Specifications

Attribute	Value
Safety input	
Inputs type	Current sinking
Voltage, on-state input	11…30V DC
Current, on-state input	3.5 mA
Voltage, off-state input, max	5V DC
Current, off-state, max	1 mA
IEC 61131-2 (input type)	Type 3
Pulse test output	
Output type	Current sourcing
Pulse test output current (each)	0.7 A max per point at 40 °C (104 °F) 0.3 A max per point at 55 °C (131 °F) (see Product temperature versus pulse test output current derating on page 126)
Residual voltage, max	1.2V
Output leakage current, max	0.1 mA
Short circuit protection	Yes
Current, max	25 mA – current, max (to avoid fault when used as a muted lamp output)
Current, min	5 mA – current, min (at which fault indication is generated when used as a muted lamp output)
Safety output	
Output types	1732ES-IB12XOBV2: Current sourcing/current sinking bipolar pair 1732ES-IB12XOB4: Current sourcing
Output current rating (each)	1732ES-IB12XOBV2: 2 A max per point, bipolar outputs 1732ES-IB12XOB4: 1 A max per point, sourcing outputs
On-state voltage drop, max	1.15V
Leakage current	1732ES-IB12XOB4: +/-0.1 mA 1732ES-IB12XOBV2: +/-1.0 mA(1)

Table 68 - 1732ES Modules – Technical Specifications (continued)

Attribute	Value
Internal resistance from sourcing to sinking terminal	1732ES-IB12XOBV2: 3.25 kΩ 1732ES-IB12XOB4: N/A
Short circuit detection	Yes (short high and low and cross-circuit fault detection)
Short circuit protection	Electronic
Pilot duty rating	1732ES-IB12XOBV2: 2.5 A inrush 1732ES-IB12XOB4: N/A
Number of outputs	Safety outputs 1732ES-IB12XOB4 module, 4 sourcing outputs 1732ES-IB12XOBV2 module, 4 bipolar outputs, (2 pairs)
Sensor power output current rating (pins 1, 3, and 5 of each output signal I/O connector)	2 A max per point at 40 °C (104 °F) 1 A max per point at 55 °C (131 °F) (see Product temperature versus sensor power current derating (per pin) on page 127)

(1) Includes the presence of a single sourcing output stuck-high or sinking output stuck-low fault.

Table 69 - 1732ES Modules – General

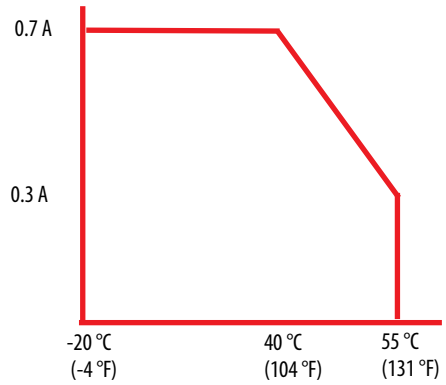
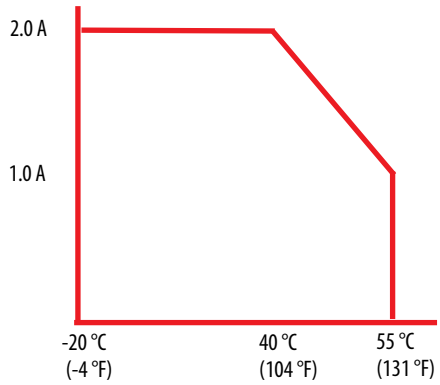
Attribute	Value
Enclosure type rating	Meets IP65/IP67 (when marked)
Product current consumption (not including Test output or Safety output load current)	1732ES-IB12XOBV2: • In power (no load): 19.2…28.8V DC, 175 mA at 24V DC • Out power (no load): 19.2…28.8V DC, 65 mA at 24V DC 1732ES-IB12XOB4: • In power (no load): 19.2…28.8V DC, 175 mA at 24V DC • Out power (no load): 19.2…28.8V DC, 45 mA at 24V DC
Operating voltage range	19.2…28.8V DC (24V DC, -20…20%)
Module power connector rating	10 A max per pin
Isolation voltage	50V (continuous), Basic Type, Input Power and I/O to Ethernet, Input Power and I/O to Output Power and IO, and Output Power and IO to Ethernet Tested at 707V DC for 60s
Product temperature versus pulse test output current derating	 Product Temperature Versus Pulse Test Output Current Derating

Table 69 - 1732ES Modules – General (continued)

Attribute	Value
Product temperature versus sensor power current derating (per pin)	 Product Temperature Versus Sensor Power Current Derating (per pin)
Wiring category(1)	2 - on signal ports 2 - on power ports 2 - on communication ports
Weight, approx.	786 g (1.73 lb)
Dimensions (HxWxD), approx.	70 x 259 x 69 mm (2.8 x 10.2 x 2.7 in.) without cables

(1) Use this Conductor Category information for planning conductor routing. See Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications

This section provides environmental specifications for the modules.

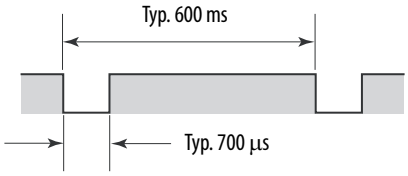
- For 1791ES modules, see Table 70 on page 127.
- For 1732ES modules, see Table 71 on page 128.

Table 70 - 1791ES Modules – Environmental Specifications

Attribute	Value
Temperature, operating	IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -20…60 °C (-4…140 °F)
Temperature, nonoperating	IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock): -40…85 °C (-40…185 °F)
Relative humidity	IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat): 5…95% noncondensing
Vibration	IEC 60068-2-6 (Test Fc, Operating): 5 g at 10…500 Hz
Shock, operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): 30 g
Shock, nonoperating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): 50 g
Emissions	CISPR 11: Group 1, Class A
ESD immunity	IEC 61000-4-2: 8 kV contact discharges 10 kV air discharges

Table 70 - 1791ES Modules – Environmental Specifications (continued)

Attribute	Value
Radiated RF immunity	IEC 61000-4-3: 10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM at 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM at 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz
Conducted RF immunity	IEC 61000-4-6: 10V rms with 1 kHz sine-wave 80% AM from 150 kHz…80 MHz
EFT/B immunity	IEC 61000-4-4: ±4 kV at 5 kHz on power ports ±3 kV at 5 kHz on signal ports ±2 kV at 5 kHz on communication ports
Surge transient immunity	IEC 61000-4-5: ±1 kV line-line (DM) and ±2 kV line-earth (CM) on power ports ±1 kV line-line (DM) and ±2 kV line-earth (CM) on signal ports ±2 kV line-earth (CM) on communication ports
Reaction time	
Input reaction time, max	16.2 ms + set values of ON/OFF delays
Output reaction time, max	6.2 ms + (20 ms) relay response time
Signal sequence	



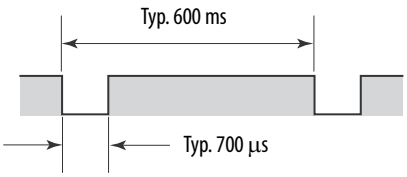
While safety outputs are in an on state, the signal sequence shown in the figure is output continuously for fault diagnosis. Confirm response time of device connected to safety outputs so the device does not malfunction due to off pulse.

Table 71 - 1732ES Modules – Environmental Specifications

Attribute	Value
Temperature, operating	IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -20…55 °C (-4…131 °F)
Temperature, nonoperating	IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock): -40…85 °C (-40…185 °F)
Relative humidity	IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat): 5…95% noncondensing
Vibration	IEC 60068-2-6 (Test Fc, Operating): 5 g at 10…500 Hz
Shock, operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): 30 g
Shock, nonoperating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): 50 g
Emissions	IEC 61000-6-4

Table 71 - 1732ES Modules – Environmental Specifications (continued)

Attribute	Value
ESD immunity	IEC 61000-4-2: 4 kV contact discharges 10 kV air discharges
Radiated RF immunity	IEC 61000-4-3: 10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM at 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM at 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz 3V/m with 1 kHz sine-wave 80% AM from 2700…6000 MHz
Conducted RF immunity	IEC 61000-4-6: 10V rms with 1 kHz sine-wave 80% AM from 150 kHz…80 MHz
EFT/B immunity	IEC 61000-4-4: ±2 kV at 5 kHz on power ports ±1 kV at 5 kHz on signal ports ±1 kV at 5 kHz on communication ports
Surge transient immunity	IEC 61000-4-5: ±2 kV line-earth (CM) on power ports ±2 kV line-earth (CM) on signal ports ±2 kV line-earth (CM) on communication ports
Reaction time	
Input reaction time, max	16.2 ms + set values of ON/OFF delays
Output reaction time, max	6.2 ms + (20 ms) relay response time
Signal sequence	



While safety outputs are in an on state, the signal sequence shown in the figure is output continuously for fault diagnosis. Confirm response time of device connected to safety outputs so the device does not malfunction due to off pulse.

Certifications

This section provides certification information for the 1791ES and 1732ES modules.

Table 72 - 1791ES and 1732ES Modules – Certifications

Certification	Value	
Certifications (when product is marked)(1)	CE	European Union 2004/108/EC EMC Directive, compliant with these norms: EN 61326-1; Meas./Control/Lab, Industrial Requirements EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
	RCM	Australian Radiocommunications Act, compliant with: EN 61000-6-4; Industrial Emissions
	Ethernet/IP	ODVA conformance tested to CIP Safety on EtherNet/IP specifications
	KC	Korean Registration of Broadcasting and Communications Equipment, compliant with Article 58-2 of Radio Waves Act, Clause 3
	TÜV	Capable of Cat. 4/PL e according to EN ISO 13849-1 and SIL 3 according to EN 62061/IEC 61508(2)

(1) See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

(2) When used with specified firmware revisions, and as described in the Safety Reference Manual, publication 1756RM-099, and the Guard I/O EtherNet/IP Safety Modules, publication 1791ES-UM001.

Legislation and Standards

Read this section to familiarize yourself with related legislation and standards information. Relevant international standards include the following:

- IEC 61508:2010 Edition 2 (SIL 1...3)
- IEC 61131-2
- IEC 60204-1
- IEC 61000-6-2
- IEC 61000-6-4

The modules received the following certification from ODVA, when product is marked.

- EtherNet/IP Conformance
- EtherNet/IP Safety Conformance

Europe

The type approval of TÜV-Rheinland addresses compliance to applicable requirements of the following directives and standards:

- EU legislation
  - Low-voltage Directive 73/23/EEC
  - EMC Directive 89/336/EEC
- European standards
  - EN 61508 (SIL1-3)
  - EN 61131-2
  - EN 60204-1
  - IEC 61000-6-2
  - IEC 61000-6-4
  - ISO 13849-1:2008

North America

In North America, the TÜV-Rheinland type approval includes Guard I/O compliance to the relevant standards and related information including the following:

- U.S. standards - ANSI RIA15.06, ANSI B11.19, NFPA 79
- The modules are UL-certified functionally safe and carry the NRGF label, when product is marked (only 1791ES modules).
- The modules received UL Listing to standards of U.S. and Canada including the following, when product is marked (only 1791ES modules).

Japan

In Japan, type test requirements are provided in Article 44 of the Industrial Safety and Health Law. These requirements apply to complete systems and cannot be applied to a module by itself. Accordingly, to use the module in Japan as a safety device for press machine or shearing tool pursuant to Article 42 of the above-mentioned law, it is necessary to apply for testing of the entire system (only 1791ES modules).

EC Directives

These products conform to the EMC Directive and Low-voltage Directive. For additional information, refer to the relevant installation instructions.

EMC Directive

Rockwell Automation devices that comply with EC directives also conform to the related EMC standards so that they can more easily be built into other devices

or the overall machine. The actual products have been checked for conformity to EMC standards. Whether they conform to the standards in the system used by the customer, however, must be confirmed by the customer.

EMC-related performance of Rockwell Automation devices that comply with EC directives vary depending on the configuration, wiring, and other conditions of the equipment or control panel in which the Rockwell Automation devices are installed. The customer must, therefore, perform the final check to confirm that devices and the overall machine conform to EMC standards.

Compliance with EC Directives

EtherNet/IP products that comply with EC directives must be installed as follows:

- All Type IP20 EtherNet/IP units must be installed within control panels.
- Use reinforced insulation or double insulation for the DC power supplies used for the communication power supply, internal- circuit power supply, and the I/O power supplies.
- EtherNet/IP products that comply with EC directives also conform to the Common Emission Standard (EN 50081-2). Radiated emission characteristics (10-m regulations) can vary depending on the configuration of the control panel used, other devices connected to the control panel, wiring, and other conditions. You must confirm that the overall machine or equipment complies with EC directives.

History of Changes

This appendix summarizes the revisions to this manual. Reference this appendix if you need information to determine what changes have been made across multiple revisions.

1791ES-UM001D-EN-P, May 2013

Table 73 - May 2013 Changes

Topic
Additional Resources
Studio 5000 Environment
Programming Requirements
Safety Data

1791ES-UM001C-EN-P, April 2009

Table 74 - April 2009 Changes

Topic
Safety Inputs
Typical Pulse Width and Period
Test Pulse in a Cycle
Safety Outputs
Typical Pulse Width and Period
Test Pulse in a Cycle
Dual-load Bipolar Safety Output Important Statement
Updated important statement about the values and states of tags

The history of changes for 1791ES-UM001B-EN-P were not recorded.

Notes:

Symbols

+24V DC power current
input 50
output 51

Numerics

1732ES-IB12XOB4 15
1732ES-IB12XOBV2 15
1791ES-IB16 15
1791ES-IB8XOBV4 15

A

additional resources 9
administrator, safety 11
architectures, safety 16

B

before you begin 11
BootP/DHCP 45
bulletin 1606 power supplies 11

C

CAT. 4, PLe 13, 16
catalog numbers 15
CE LVD compliance 15
certification 130
CIP generic message instructions 91
clean the modules 37
common terms 10
compliance with EC directive 132
configuration
reference information 121
configuration signature 80
configure the module 69
conformity
codes 12
regulations 12
standards 12
controlling devices 33
CRTL 78

D

DC power supply according to
EN 50178 15
IED/EN 60950 15
UL 508 15
Device Level Ring 10
diagnostic status information 91
diagnostics 20
fault 13
status 13
dialog
Safety 78
DIN rail 42
directives 131
discrepancy time 24
DLR
See Device Level Ring.
door interlocking switches 33
dual-load bipolar outputs 67, 68
dynamic host configuration protocol 45

E

electric shock, preventing 39
Electronic Data Sheet 10
EMC Directives 131
emergency stop switch 33, 61
EN 50081-2 132
EtherNet/IP cables, recommended 53
EtherNet/IP safety network 16
explicit messages 115
Explicit Messaging 91, 92
explosion hazards 37
external power supply 15

F

fatal errors 20
fault recovery 27, 32
features of Guard I/O modules 14
firmware revision information for Guard I/O modules 12
forcibly-guided contacts 33

G

get point status information 91
glossary 10
Guard I/O firmware revision information 12
Guard I/O module features 14
Guardmaster product 33

H

help button 69

I

I/O
configuration tree 69
connectors 14
data 20
module overview 13
status data 14
I/O assembly and reference data 109
I/O connector cables, recommended 54

I/O data 106
IEC 61508 13, 16
IEC61508 117
international standards 130
IP address 45
IP rating for 1732ES modules 38
ISO 13849-1 13, 16
  2008 117

J

Japan 131

L

legislation 130
limit switches 33

M

maximum current 50
mean time between failure 10, 117
model types 15
module definition 72
mounting guidelines 39
MTBF
  See mean time between failure.
MTTF 117
muting lamp 28
muting lamp output wiring 64

N

NAT 71
  See network address translation.
network (IP) address 45
network address switches 46
network address translation 10, 14, 71
node address setting 45
North America 131

O

ODVA 10, 130
off-delay function 27
on-delay function 27
online help 69
out-of-box condition 38
outputs
  safety 14
  test 14

P

parameter groups 121
PFD 117
  See probability of failure on demand.
PFH 117
  See probability of failure per hour.
point status information 91
power pass through 49
precautions for use 12
probability of failure
  on demand 117
  per hour 117
probability of failure on demand 10
probability of failure per hour 10
programming requirements 15
proof test interval 117
publications, related 9

R

redundant channel safety devices 24
related publications 9
replacement stock 38
reset ownership 79
rotary switches 45
RPI 78
RSLogix 5000 software
  version 15

S

safety
  administrator 12
  category 12
  integrity level 12
safety architectures 16
safety functions
  safety input 21
  safety output 30
safety inputs 14
safety network number 10, 71
safety outputs 14
safety precautions 130
safety signatures 20
safety state 19
self-diagnostics 20
SELV- compliant power supplies 11
set network (IP) address 45
SIL CL 3 13, 16
SLogix 5000 software
  version 15
SNN 71
  See safety network number.
software versions 15
standards 130, 131
status bits
  muting 28, 29
status data 20
status messages
  from 1732ES modules 102
  from 1791ES-IB16 modules 97
  from 1791ES-IB8XOBV4 modules 92

status, combined 20
Studio 5000 environment 9
version 15

T

tag values and states
input data 77
output data 77
terminology 10
test outputs 14, 28
topology
DLR 16
linear 16
star 16
transformer, according to
IEC/EN 61558 15
Transport Control Protocol 45

U

understand the operation of safety functions
19

W

wiring by application
dual-load bipolar outputs 67
dual-load sourcing outputs – only 1732ES-IB12XOB4 module 68
emergency stop switch dual-channel inputs with manual reset 61
Guard I/O module with limit switch dual-channel inputs and a manual reset 66
limit switch dual-channel inputs and a manual reset 65
mode select switch 63
muting lamp output 64
two-hand monitor 62
wiring examples 57
door monitor 58, 59
emergency stop switch 58, 59
light curtain 60
reset switch 57
single-channel safety device 58
wiring guidelines 37, 46
wiring requirements
ISO 13849-1:2008 61, 62, 65, 67, 68

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