Redundant I/O System

Catalog Numbers 1715-AENTR, 1715-IB16D, 1715-OB8DE, 1715-IF16, 1715-OF8I
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).
# Table of Contents

## Preface
- About This Publication
- Before You Begin
  - Required Software
  - Download Firmware, AOP, EDS, and Other Files
  - Summary of Changes
- Additional Resources

## Chapter 1
**Redundancy System Overview**
- Redundant 1715 Adapters
- 1715 I/O Modules
- 1715 I/O Modules in SIL 2 Applications
- System Architecture
  - Termination Assemblies
  - Base Unit Structure
  - 1715-AENTR Adapters
  - I/O Modules
  - Module Positioning in the 1715 Redundant I/O System
- Layout the Hardware
  - System Context
  - Simplex Architecture
  - Duplex Architecture
  - Mixed Architecture
  - Bus Diagram
- Switchover Considerations
  - Obtaining a New IP Address
  - Ethernet Topology
  - Communication on the EtherNet/IP Network
- System Performance
  - Input / Output Traffic Prioritization
  - Connections
  - RPI
  - Connection and Data Format
  - Timestamping

## Chapter 2
**Installation Instructions**
- Environment and Enclosure
- Prevent Electrostatic Discharge
- European Hazardous Location Approval
- Multi-point Network Communication Connections
- Field-side Power
- Removal and Insertion Under Power (RIUP) Fuses
- North American Hazardous Location Approval
Before You Begin ......................................................... 36
   Ensure that Warranty is Not Compromised .................. 36
   Graphical Representation ...................................... 36
   Parts List ......................................................... 36
   Required Tools ................................................... 37
   Spacing Requirements ........................................... 37

System Hardware Components ................................ 38
   1715-AENTR Adapter Redundant Pair ......................... 38
   1715 Digital and Analog I/O Modules ......................... 39
   1715-A2A Adapter Base Unit .................................. 40
   1715-A3IO I/O Base Unit ...................................... 43
   I/O Termination Assemblies ................................... 44
   1715-C2 Expansion Cable ..................................... 49
   1715-N2T and 1715-N2S Slot Filler Covers ................. 50

Power Requirements .............................................. 50
   Cooling Requirements .......................................... 51
   Heating Requirements ......................................... 51
   Specify an Enclosure ............................................. 51

System Software ..................................................... 51

Module Placement ................................................... 53
   Base Units ...................................................... 54
   Install Summary ................................................ 55
      Step 1: Enclosure DIN Rail Assembly ...................... 56
      Step 2: Build the System ................................... 56

Product Dimensions ............................................... 56
   DIN Rail Mounting Dimensions ............................... 56

DIN Rail Assembly .................................................. 57
   Component Size and Weights .................................. 58
   Install the Power Supply ...................................... 60
   Install the Adapter Base Unit ................................. 61
   Install the I/O Base Unit ...................................... 62
   Install Termination Assembly to I/O Base Unit .......... 64
      Mount Termination Assemblies ............................. 65
   Mount I/O Expansion Cable ................................... 67
      Cable Assembly ................................................ 67
      Expansion Cable .............................................. 68
      Install Expansion Cable ..................................... 69
   Wire the Adapter ................................................ 72
      Connect the 24V DC System Power ......................... 72
      Wire the Ground Connection ................................ 73
   Connect Field Wiring ............................................ 74
      Recommended Circuits for Digital Inputs ................. 75
      Recommended Circuits for Digital Outputs .............. 80
   1715-OB8DE Digital Output Module FBD ....................... 82
      Recommended Circuits for Analog Inputs ................. 86
      Recommended Wiring for Analog Output Modules ....... 94
   Connect the Adapter to the Ethernet Network .............. 96

Module Keying .......................................................... 97
   Verify Coding Pegs .............................................. 99
   Electronic Keying ............................................... 100
More Information ........................................... 101
Install the Adapters ........................................ 101
Assign an IP Address ....................................... 104
   Step 1: Assign an IP Address on the BOOTP/DHCP Server ... 105
   Step 2: Configure the Module with RSLinx Classic Software ... 108
Install the I/O Modules .................................... 110
Install Slot Filler Covers .................................. 112
Remove Modules .......................................... 112

Chapter 3

Security

Protected Mode ............................................ 115
   Strategy .................................................. 115
Web-Server Control ....................................... 115
   Enable / Disable ....................................... 115

Chapter 4

Digital I/O Operation

1715 Digital Module Overview ............................ 117
   1715-IB16D Digital Input Module ....................... 118
   1715-OB8DE Digital Output Module .................... 118
   Common Features ...................................... 119
Determining Input Module Compatibility .............. 119
   Termination Assemblies ................................ 120
Determining Output Module Compatibility ............ 120
   Termination Assemblies ................................ 120
Using Features Common to 1715 Standard Digital I/O Modules ... 120
   Removal and Insertion Under Power (RIUP) ........... 120
   Module Fault Reporting ............................... 121
   Fully Software Configurable ......................... 121
   Module Inhibiting .................................... 121
   Status Indicator Information ......................... 122
Features Specific to 1715-IB16D Digital Input Modules ... 122
   Data Transfer on Either Cyclic Time or Change of State .... 122
   Set RPI .................................................. 123
   Enable Change of State ................................ 123
   Field-side Diagnostics ................................ 124
Features Specific to 1715-OB8DE Digital Output Modules ... 124
   Field Power Status Integers ......................... 125
   Field Fault Detection ................................ 125
   Configurable Point-level Output Fault States ............ 127
   Output Data Echo .................................... 127
   Fusing ................................................. 128
   Diagnostic Latch Information ....................... 129
   Shutdown State .................................... 130
   Energize-on-communication-failure .................... 131
   De-energize-to-trip .................................. 131
   Disable Line Test .................................... 131
Fault and Status Reporting between Input Modules and Controllers ... 132
Chapter 5

Using 1715 Analog I/O Module Features

Chapter 6

Configure the Redundant I/O System
Step 3: Add a 1756-EN2TR Module to the Project ...................... 163
Add the 1715-AENTR Adapter to the I/O Configuration Tree ........ 165
Step 1: Configure the Adapter for the EtherNet/IP Network .......... 165
Options for Setting the IP Addresses of 1715-AENTR Modules .... 165
Ethernet Network ..................................................................... 166
Step 2: Add the 1715-AENTR Adapter to the Project ................. 166
Obtaining System Status ......................................................... 175
1715-IB16D Digital Input Module ........................................... 177
Add the Digital Input Module to the Project ......................... 177
Step 1: Add the Digital Input Module in Duplex Mode .......... 177
Step 2: Add the Digital Input Module in Simplex Mode ......... 182
1715-OB8DE Digital Output Module ....................................... 185
Step 1: Add the Digital Output Module in Duplex Mode ....... 185
Step 2: Add the Digital Output Module in Simplex Mode ....... 187
1715-IF16 Analog Input Module ............................................. 189
Add the Analog Input Module to the Project ....................... 189
Step 1: Add the Analog Input Module in Duplex Mode ....... 189
Step 2: Add the Analog Input Module in Simplex Mode ...... 192
1715-OF8I Analog Output Module .......................................... 193
Add the Analog Output Module to the Project ................... 193
Step 1: Add the Analog Output Module in Duplex Mode ....... 193
Step 2: Add the Analog Output Module in Simplex Mode .... 198

Chapter 7
1715 Redundant I/O System in SIL 2 Safety Applications

SIL 2 Safety Application Requirements .................................. 201
1715 I/O Modules in SIL 2 Safety Applications ....................... 202
Typical Configurations ......................................................... 203
Internal Diagnostics ............................................................... 206
Power Supplies ....................................................................... 206
Requirements for Using 1715 I/O Modules .............................. 207
Energize-to-action Requirements ....................................... 207
Requirements for ControlLogix-based SIL 2 Applications .... 208
Add-On Instructions ............................................................... 208
Connection Reaction Time Limit ........................................... 208
Using the 1715 Adapter in SIL 2 Applications ....................... 208
Reaction to Faults ................................................................... 208
Using 1715 I/O Modules in SIL 2 Applications ....................... 209
Input Modules ........................................................................ 209
Considerations for Sensor and Actuator Configurations ........ 212
Configure SIL 2 Operation ..................................................... 213
Enable SIL 2 Operation ......................................................... 213
Specify the Connection Reaction Time Limit and Requested Packet Interval ......................................................... 213
Set Safe State Values for Inputs ............................................. 215
Check SIL 2 Reset Status ....................................................... 216
View Module Information ....................................................... 216
Diagnostic Data ..................................................................... 216
Reaction Times ...................................................................... 217
System Reaction Time ............................................................ 217
Appendix C

Reconfigure a Module Online

- Use Ladder Logic to Reconfigure an I/O Module ........................................ 269
- Reconfigure a Module Via Studio 5000 Logix Designer Application ............. 269
- Reconfigure a Module Via Ladder Logic ..................................................... 270

Appendix D

PFD and PFH Calculations for a SIL 2 System

- About PFD and PFH Calculations ............................................................... 273
- Determine Which Values to Use ................................................................. 273
- Calculations for 1715 I/O Modules .............................................................. 273
  - PFD Calculations with 24-hour MTTR .................................................... 274
- Communications Data ................................................................................ 276

Appendix E

SIL 2 Applications Checklist

1715 I/O Modules ............................................................................................. 277

Appendix F

I/O Tag Definitions

1715-AENTR Adapter ..................................................................................... 279
1715-IB16D .................................................................................................... 280
1715-OB8DE .................................................................................................. 282
1715-IF16 ....................................................................................................... 284
1715-OF8I ..................................................................................................... 285

Appendix G

History of Changes .......................................................................................... 287

Index ............................................................................................................... 291
About This Publication

This manual explains how to install and configure the 1715 Redundant I/O System. This redundant, modular system is designed to work with a ControlLogix® Enhanced Redundancy System. This system provides fault tolerant I/O and redundancy for use in critical process applications.

This manual is intended for the following individuals, who:

- Understand how to configure and use a ControlLogix System, and a ControlLogix Enhanced Redundancy System
- Understand how to configure remote devices on an Ethernet/IP network.

Before You Begin

Before you begin using your 1715 Redundant I/O System, verify that you have the software that is required to install and configure your system.

Required Software

This list identifies the minimum software versions that are required to use your 1715 Redundant I/O System:

- Either RSLogix 5000® or Studio 5000® software
- RSLogix 5000 programming software, version 20
- Non-SIL 2 applications using revision 2.x of 1715 can use version 19
- RSLogix 5000 requires Microsoft Windows Vista; Microsoft Windows 7, 32- and 64-bit; and Microsoft Windows 2003 Server operating systems
- Studio 5000 environment version 21 or later
- Studio 5000 requires Microsoft Windows Vista; Microsoft Windows 7, 32- and 64-bit; and Microsoft Windows 2003 Server operating systems
- ControlFLASH™ software version 13.00.00 or later
- Adapter Add-on Profile at rok.auto/pcdc.
- I/O Modules Add-on Profile at rok.auto/pcdc.
- Add-on Instructions at rok.auto/pcdc.

ATTENTION: ControlLogix L7 controllers are certified in RSLogix 5000 version 20 or later for SIL 2 operations. See the latest certifications for software and firmware at rok.auto/certifications. See the TÜV website at http://www.tuvasi.com for SIL 2 certification listings.

Download Firmware, AOP, EDS, and Other Files

Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes from the Product Compatibility and Download Center at rok.auto/pcdc.

Summary of Changes

This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.
### Additional Resources

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

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715 Redundant I/O System Technical Specifications, publication 1715-TD001</td>
<td>Provides technical specifications for components of the 1715 Redundant I/O System.</td>
</tr>
<tr>
<td>EtherNet/IP Network Configuration User Manual, publication ENET-UM001</td>
<td>Describes how you can use EtherNet/IP modules with your Logix 5000™ controller and communicate with various devices on the Ethernet network.</td>
</tr>
<tr>
<td>ControlLogix Enhanced Redundancy System, publication 1756-UM535</td>
<td>Provides design and configuration information for a ControlLogix Redundancy System.</td>
</tr>
<tr>
<td>ControlLogix Digital I/O Modules User Manual, publication 1756-UM058</td>
<td>Describes how to install, configure, and troubleshoot ControlLogix digital I/O modules.</td>
</tr>
<tr>
<td>ControlLogix Analog I/O Modules User Manual, publication 1756-UM009</td>
<td>Describes how to install, configure, and troubleshoot ControlLogix analog I/O modules.</td>
</tr>
<tr>
<td>Using ControlLogix in SIL 2 Applications Safety Reference Manual, publication 1756-RM001</td>
<td>Describes the guidelines for using ControlLogix controllers in a SIL 2 safety application.</td>
</tr>
<tr>
<td>Safety Guidelines for the Application, Installation, and Maintenance of Solid-state Control, publication 501-11</td>
<td>Designed to harmonize with NEMA Standards Publication No. ICS 1.1-1987 and provides general guidelines for the application, installation, and maintenance of solid-state control in the form of individual devices or packaged assemblies incorporating solid-state components.</td>
</tr>
<tr>
<td>Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1</td>
<td>Provides general guidelines for installing a Rockwell Automation industrial system.</td>
</tr>
<tr>
<td>Product Certifications website, rok.auto/certifications</td>
<td>Provides declarations of conformity, certificates, and other certification details.</td>
</tr>
</tbody>
</table>

You can view or download publications at [rok.auto/literature](http://rok.auto/literature).
Chapter 1

Redundancy System Overview

The 1715 Redundant I/O System lets a ControlLogix® controller communicate to a remote, redundant I/O chassis by using EtherNet/IP. The 1715 Redundant I/O system provides fault tolerance and redundancy for critical processes by using a redundant adapter pair and multiple I/O modules that have diagnostics and are easily replaceable.

The modular architecture lets you build and adapt a system to suit the specific needs of an installation. The architecture lets you choose from different levels of adapter and I/O fault protection.

The 1715 Redundant I/O System consists of a two-slot adapter base unit that houses a redundant adapter pair. The adapter base unit is connected to up to eight I/O base units, which can hold up to 24 I/O modules (three I/O modules per I/O base unit) when connected together. The I/O modules can be configured in any combination of simplex or duplex pairs, depending on the mode of operation needed. The I/O base units can be connected directly to the adapter base unit and other I/O base units, or through expansion cables.

The 1715 Redundant I/O System is a modular system in which the adapter and I/O base units snap together by using mating connectors and retaining clips to form the backplane. One module in a duplex pair can be removed and replaced without system interruption. The base units, via termination assemblies, provide the interconnections for power, adapter, and I/O data. Once connected, the base units form the single mechanical assembly or backplane.

Redundant 1715 Adapters

The redundant, partnered adapters monitor inputs/outputs and diagnostics for the I/O in the remote chassis. If a fault occurs in one of the redundant adapters, an IP address switchover occurs and I/O monitoring and communication to the ControlLogix System continues without interruption. This switchover is transparent to the user. Status indicators and status information available to the ControlLogix application enables you to determine the status of each 1715-AENTR adapter.

1715 I/O Modules

Both digital and analog I/O modules are available for use in this system, depending on your needs. I/O modules can be used singly or in pairs, providing configuration in either Simplex or Duplex modes.
Table 1 lists the 1715 modules that can be used in this system.

### Table 1 - Modules Available for the 1715 Redundant I/O System

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-AENTR x 2</td>
<td>A pair of Ethernet adapters</td>
</tr>
<tr>
<td>1715-IB16D</td>
<td>A 16-channel digital input module</td>
</tr>
<tr>
<td>1715-OB8DE</td>
<td>An 8-channel digital output module</td>
</tr>
<tr>
<td>1715-IF16</td>
<td>A 16-channel analog input module</td>
</tr>
<tr>
<td>1715-OF8I</td>
<td>An 8-channel analog output module</td>
</tr>
</tbody>
</table>

### 1715 I/O Modules in SIL 2 Applications

With the inclusion of diagnostics for the CIP messaging channel, the 1715 Redundant I/O system can be used for SIL 2 safety applications. For information about SIL 2 safety applications, see Chapter 7 and Chapter 8.

### System Architecture

The 1715 Redundant I/O System operates with a pair of 1715-AENTR adapters.

When designing your control system by using the 1715 Redundant I/O System, you can use digital and analog I/O modules in one of these ways:

- One I/O module in Simplex mode
- One I/O module with the option to add a second module
- A pair of I/O modules that work in Duplex mode

You must decide the layout of your I/O before building your system, but you can add more I/O at any time.

The use of termination assemblies communicates the I/O mode of operation you choose (Simplex or Duplex) to your system through the backplane (the adapter and I/O base units).

### Termination Assemblies

The termination assembly (TA) matches your software configuration for simplex or duplex. Attached to an I/O base, the TA can start in any slot and can span multiple connected bases. When modules are used in Duplex mode, one module can be absent and the system still runs.

### Base Unit Structure

The adapter base unit is always the leftmost base unit in the connection chain. The total length of the base unit connection chain, including all expansion cables cannot exceed 10 m (32.81 ft).

An adapter always occupies slot 0 or 1.

An adapter base unit can support up to 8 I/O base units (up to 24 I/O modules).
**1715-AENTR Adapters**

The leftmost adapter position, or slot, is 0. The rightmost adapter slot is 1. One redundant adapter pair always occupies slots 0 and 1 of the system. ‘A’ designates the primary adapter partner and ‘B’ designates the secondary adapter partner of the redundant adapter pair. This system is designed to run with two adapters. It can run with one adapter for a limited time while replacing a damaged module, but ideally, needs both adapters running simultaneously.

| IMPORTANT | There is no method for configuring a system to use only one 1715-AENTR adapter. If you use only one 1715-AENTR adapter, the unused module generates errors. A ‘partner’ adapter can be installed or removed for replacement, while the 1715 Redundant I/O System is operational. The ‘partner’ adapter can be identified by the Network Status Light Emitting Diode (LED) flashing green. During replacement of the module, there is a one-time, up to a maximum 500 ms, delay to the system. |

**I/O Modules**

I/O module slots are numbered from 2...25, based on distance from the adapter base unit. If duplex I/O module pairs are used, the two modules of the pair must be in adjacent slots. The left, lower slot number is considered the slot number and address for the pair. Any combination of simplex modules and duplex pairs can be used in one or more connected I/O base units.

| IMPORTANT | A ‘partner’ I/O module can be installed or removed while the 1715 Redundant I/O System is operational, without impact to the rest of the system. |

**Module Positioning in the 1715 Redundant I/O System**

There are 26 total slot positions in the system numbered from 0...25. The first two positions always contain the redundant adapter pair, in slots 0 and 1. The remaining positions begin numbering at slot 2 and contain the I/O modules, ending at slot position number 25. Any combination of simplex or duplex I/O module pairs can be used in the I/O base units. See Table 2 for a sample of what a system could look like.

Expansion cables can be used to connect base units, as shown in Figure 1 on page 17.

The sample system configuration in Example 1 does not match the system layout that is displayed in Example 2. Example 1 and Example 2 are different examples of possible configurations you can have for your system.
<table>
<thead>
<tr>
<th>System Slot Number</th>
<th>Base Unit Type</th>
<th>Module Position/Slot Number by Base Unit Type</th>
<th>Module Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Adapter</td>
<td>0</td>
<td>Adapter A</td>
</tr>
<tr>
<td>1</td>
<td>Adapter</td>
<td>1</td>
<td>Adapter B</td>
</tr>
<tr>
<td>2</td>
<td>I/O</td>
<td>01 First I/O base unit</td>
<td>Module A of first duplex pair</td>
</tr>
<tr>
<td>3</td>
<td>I/O</td>
<td>02</td>
<td>Module B of first duplex pair</td>
</tr>
<tr>
<td>4</td>
<td>I/O</td>
<td>03</td>
<td>Module A of second duplex pair</td>
</tr>
<tr>
<td>5</td>
<td>I/O</td>
<td>04 Second I/O base unit</td>
<td>Module B of second duplex pair</td>
</tr>
<tr>
<td>6</td>
<td>I/O</td>
<td>05</td>
<td>First simplex module</td>
</tr>
<tr>
<td>7</td>
<td>I/O</td>
<td>06</td>
<td>Module A of third duplex pair</td>
</tr>
<tr>
<td>8</td>
<td>I/O</td>
<td>07 Third I/O base unit</td>
<td>Module B of third duplex pair</td>
</tr>
<tr>
<td>9</td>
<td>I/O</td>
<td>08</td>
<td>Second simplex module</td>
</tr>
<tr>
<td>10</td>
<td>I/O</td>
<td>09</td>
<td>Third simplex module</td>
</tr>
<tr>
<td>11…25</td>
<td>I/O</td>
<td>10…24 Fourth…eighth I/O base unit</td>
<td>Any combination of simplex/duplex pair modules</td>
</tr>
</tbody>
</table>
This section discusses how to lay out the hardware for the system by topology.
**System Context**

The redundant I/O subsystem must be connected to one ControlLogix redundancy system, or any Logix system that supports I/O via the EtherNet/IP™ network. The topologies that the 1756-EN2T or 1756-EN2TR modules support, DLR (Ring) or Star, establish all connections via the Ethernet network.

For more information about DLR topologies, see the EtherNet/IP Embedded Switch Technology Application Guide, publication ENET-AP005.

*Figure 2 - 1715 Redundant I/O System DLR (Ring) Topology Attached to a 1756 ControlLogix Enhanced Redundancy System*
To prevent ground loops caused by shielded cables, RJ45 shields on the ethernet ports on the 1715 adapter base unit are connected to earth through a parallel resistance / capacitance circuit arrangement as shown in Figure 4 below:
Simplex Architecture

Simplex I/O modules fail-safe on the first detected module fault. The process under control shuts down when the fault is detected.

This configuration is suitable for high and low demand module applications.
Figure 5 - Simplex Architecture – Input and Output

![Simplex Architecture Diagram]

**Duplex Architecture**

An example configuration of dual input modules and adapters, and an output module is shown in Figure 6. A redundant input or redundant output module provides fault tolerance for module failures. The duplex arrangement can be used for low demand and high demand applications.
Figure 6 - Duplex Architecture Duplex Inputs, Simplex Output
Termination assemblies can span across I/O base units.

**Mixed Architecture**

There can be a mixture of architectures within one system. Figure 8 shows simplex and dual I/O configurations with dual processors.
Bus Diagram

A detailed drawing of the backplane is shown Figure 9.
Switchover Considerations

Each 1715 Redundant I/O System uses one IP address as the primary IP address for all communication on the EtherNet/IP network. The redundant adapter pair consists of two active modules, a primary adapter and its partner, a secondary module. For this document, the primary module is referred to as module ‘A’ and the secondary module is referred to as module ‘B’.

On power-up, the adapter in the leftmost slot is considered the primary module (when two adapters are present) because it uses the primary IP address, and because it is the module responsible for receiving/transmitting to ControlLogix controller on the EtherNet/IP network.

The module in the rightmost slot is considered the secondary module partner and uses the primary IP address +1. For example, if the primary module in the leftmost slot has an IP address of ‘N’, then the secondary module in the rightmost slot, has an IP address of ‘N+1’.

Both modules are always active and are responsible for monitoring all inputs and outputs, monitoring diagnostics in the system, and reading and writing data from/to I/O simultaneously. When the primary module receives a write, it notifies the secondary module of the data to write and which module to write it to. At a synchronized point in time, both adapters physically write to the I/O.
The adapters negotiate which module is primary, depending on the status of the system. If the primary module is unable to perform its role, for example, if a fault occurs in the primary module, then the secondary module becomes the new primary, assuming the IP address of the primary module, taking over the role of communication. The primary module is the only module of the pair that produces data on the EtherNet/IP network.

If there is a fault, the IP address swapping between the primary module and the secondary module takes no longer than 20 ms from the time of the initiating fault. The secondary module is the new primary and handles all communication. (Depending on the structure of your Ethernet configuration, this time can be impacted.)

This IP address swap is transparent to the user. You can detect which module the primary module is by examining the Network status indicator near the top of each adapter. On the primary adapter, the Network status indicator is solid green; on the secondary adapter, the Network status indicator flashes green.

Once a swap occurs, the ‘new’ primary module remains the primary unless there is a good reason to swap over again. If the B module becomes the primary module because you must replace the A module, that is not enough cause to swap IP addresses back again. Module B remains as the primary module.

**Obtaining a New IP Address**

The IP address of the primary module is stored in the adapter base unit through interaction with the TCP/IP object. If a stored primary IP address is available, the adapter uses that address. If a stored primary IP address is not available, then the adapter uses BOOTP/DHCP to obtain an IP address.

The adapter transmits DHCP requests, but is able to process a BOOTP/DHCP response from either a DHCP or BOOTP server. If the BOOTP/DHCP request is unsuccessful, the secondary adapter (that is, Module B), attempts to obtain the IP address of the primary module through BOOTP/DHCP.

The adapters continue to attempt BOOTP/DHCP configuration until an IP address is obtained, alternating between adapters A and B. Once an adapter has obtained the IP address, the secondary module can use that IP address +1.

Once an adapter has a primary IP address, it confirms that it does not have a duplicate IP address. See EtherNet/IP Network Configuration User Manual, publication ENET-UM001. The Network Status indicator displays duplicated IP addresses by showing solid RED.

For additional information about assigning an IP address for the first time, see Chapter 2, [Assign an IP Address on page 123](#).

**Ethernet Topology**

The 1715 Redundant I/O System supports DLR (Ring) and Star Topologies.
For a DLR (Ring) Topology, the Ethernet ports of the adapters are configured with the outward-facing ports (Port 1 of Module A and Port 2 of Module B) operating as a 2-port switch. Port 2 of Module A and Port 1 of Module B are chained together.

**Figure 10 - DLR (Ring) Ethernet Topology**

For a STAR Topology, the Ethernet ports of the adapters are configured with the leftmost ports (Port 1 of Module A and Port 1 of Module B) operating as a 2-port switch. The rightmost ports on each adapter are left unused.

**Figure 11 - STAR Ethernet Topology**

**Communication on the EtherNet/IP Network**

Communication to a simplex module is addressed to the slot number for that module. CIP communication to modules in a duplex configuration (including the adapters) is addressed to the lowest slot number for the module pair.

The adapters respond with CIP errors for attempts to communicate to an I/O module of a type that is not the same as the physically installed module.

The termination assembly type (simplex/duplex) determines the CIP messages for corresponding CIP objects that the adapter processes for each I/O module.

**System Performance**

This section discusses connections and RPI settings for the 1715 Redundant I/O System.

**Input / Output Traffic Prioritization**

**Note:** In order to respect its IO schedule, the 1715 privileges class 1 (IO) traffic over class 3 traffic.

**Connections**

The adapter has one required connection and does not support a rack connection.

Each I/O module has one required connection (simplex or duplex).

For example, the system in Figure 12 has five I/O modules. Four are duplex and one is simplex. They are all configured for data connection.
The example in Figure 12 shows six connections; one for each entry in the configuration.

Table 3 - RSLogix 5000® or Studio 5000 Logix Designer® Configuration

<table>
<thead>
<tr>
<th>Connection</th>
<th>Module</th>
<th>Duplex/Simplex</th>
<th>Module Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1715-AENTR</td>
<td>Duplex</td>
<td>Ethernet Adapter</td>
</tr>
<tr>
<td>1</td>
<td>1715-IB16D</td>
<td>Duplex</td>
<td>16-point Digital Input</td>
</tr>
<tr>
<td>1</td>
<td>1715-OB8DE</td>
<td>Duplex</td>
<td>8-point Diagnostic Digital Output</td>
</tr>
<tr>
<td>1</td>
<td>1715(IF16</td>
<td>Duplex</td>
<td>8-point Analog Input</td>
</tr>
<tr>
<td>1</td>
<td>1715-OF8I</td>
<td>Duplex</td>
<td>8-point Analog Digital Input</td>
</tr>
<tr>
<td>1</td>
<td>1715(IF16</td>
<td>Simplex</td>
<td>16-point Analog Input</td>
</tr>
</tbody>
</table>

The digital module connections use change-of-state triggers, and the adapter and analog module connections use cyclic triggers.

**RPI**

The RPI you set specifies the maximum amount of time between data updates. The 1715 modules support an RPI range of 60…750 ms.

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Minimum RPI</th>
<th>Maximum RPI</th>
<th>Default RPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-AENTR</td>
<td></td>
<td>750 ms</td>
<td>180 ms</td>
</tr>
<tr>
<td>1715-IB16D</td>
<td>80 ms</td>
<td></td>
<td>80 ms</td>
</tr>
<tr>
<td>1715-OB8DE</td>
<td></td>
<td></td>
<td>80 ms</td>
</tr>
<tr>
<td>1715-IF16</td>
<td></td>
<td></td>
<td>120 ms</td>
</tr>
<tr>
<td>1715-OF8I</td>
<td></td>
<td></td>
<td>120 ms</td>
</tr>
</tbody>
</table>

**Connection and Data Format**

The adapter and I/O modules each support one data connection for input/output data. Listen Only connections are not supported.
Timestamping

A timestamp is the time an event occurred. It is recorded by the 1715 system and passed to ControlLogix. Timestamp resolution is in μs, but 1715 is accurate to 10 ms typical.
Chapter 2

Installation Instructions

This chapter explains how to build the 1715 Redundant I/O System. These installation instructions include how to build the backplane by connecting the adapter and I/O base units and mounting them on DIN rails within a cabinet, how to install and wire the termination assemblies, how to mount the adapter and the I/O modules onto the system, and how to use expansion cables to allow for additional space requirements for the system within an enclosure.
Environment and Enclosure

**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. 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 additional installation requirements
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by enclosures

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.

**ATTENTION:** Do not insert or remove a module, base unit or termination assembly while power is applied. Interruption of the backplane can result in unintentional operation or machine motion.

**ATTENTION:** For UL approved installations, the 1715-088DE output power source must be isolating, wired with a minimum of 0.75 mm² (18 AWG) wire and fused with a rating of 32V DC min/5 A max.

**ATTENTION:** Do not wire more than 1 conductor on any single terminal.

**ATTENTION:** This equipment is not resistant to sunlight or other sources of UV radiation.
European Hazardous Location Approval

The following applies when the product bears the Ex Marking.

This equipment is intended for use in potentially explosive atmospheres as defined by European Union Directive 94/9/EC and has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of Category 3 equipment intended for use in Zone 2 potentially explosive atmospheres, given in Annex II to this Directive. Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN 60079-15 and EN 60079-0.

ATEX/IECEx Certification:
Certificate number: DEMKO 11 ATEX 7928686X

II 3G Ex nA IIC T4 Gc
Certificate number: IECEx UL 15.0032X
Ex nA IIC T4 Gc

The ambient temperature range is -25...+60 °C (-13...+140 °F) for all models.

Essential Health and Safety Requirements:

Special Conditions for Safe Use:
• All models: the ambient temperature range is -25 ...+60 °C (-13...+140 °F)
• Subject devices are to be installed in an ATEX/IECEx Certified, IP54, tool accessible enclosure that has been evaluated to the requirements of EN 60079-0: 2012 + A11:2013, EN 60079-15: 2010 and IEC 60079-0: Edition 6, IEC 60079-15: Edition 4. Enclosure is to be marked with the following: “Warning - Do not open when energized”. After installation of subject devices into the enclosure, access to termination compartments shall be dimensioned so that conductors can be readily connected. Grounding conductor should have a minimum cross sectional area of 3.31 mm² (12 AWG).
• Subject devices are for use in an area of not more than pollution degree 2 in accordance with IEC 60664-1.
• Subject devices are to use conductors with a minimum conductor temperature rating of 85 °C (185 °F).
• Subject devices are to be installed in the vertical orientation only.

WARNING:
• This equipment shall be mounted in an ATEX-certified enclosure with a minimum ingress protection rating of at least IP54 (as defined in IEC60529) and used in an environment of not more than Pollution Degree 2 (as defined in IEC 60664-1) when applied in Zone 2 environments. The enclosure must have a tool-removable cover or door.
• This equipment shall be used within its specified ratings defined by Rockwell Automation.
• Provision shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 140% of the rated voltage when applied in Zone 2 environments.
• This equipment must be used only with ATEX certified Rockwell Automation Termination Assemblies.
• Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
• Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.
• Enclosure must be marked with the following: ‘Warning - Do not open when energized.’ After installation of equipment into the enclosure, access to termination compartments shall be dimensioned so that conductors can be readily connected.

For more information, refer to
• 1715 Series Redundant I/O System - ATEX certificate, publication 1715-CT002.
• 1715 Series Redundant I/O System - IECEx certificate, publication 1715-CT001.
**Multi-point Network Communication Connections**

**WARNING:** If you connect or disconnect the communication cable 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. Be sure that power is removed or the area is nonhazardous before proceeding.

---

**Field-side Power**

**WARNING:** If you connect or disconnect wiring while the field-wire 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.

---

**Removal and Insertion Under Power (RIUP) Fuses**

**WARNING:** If you insert or remove a base unit or termination assembly while power is applied, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed before proceeding.

**WARNING:** Do not remove or replace fuses when energized. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.
North American Hazardous Location Approval

The following information applies when operating this equipment in hazardous locations.

Products marked ‘CL I, DIV 2, GP A, B, C, D’ are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest ‘T’ number) be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.

Informations sur l'utilisation de cet équipement en environnements dangereux.

Les produits marqués ‘CL I, DIV 2, GP A, B, C, D’ ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.

EXPLOSION HAZARD
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.
- Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Substitution of components may impair suitability for Class I, Division 2.
- If this product contains batteries, they must only be changed in an area known to be nonhazardous.

RISQUE D'EXPLOSION –
- Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement.
- Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit.
- La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2.
- S'assurer que l'environnement est classé non dangereux avant de changer les piles.
Before You Begin

This section lists important information that you must consider before starting to build your 1715 Redundant I/O System:

- Review the parts list and identify the system components.
- Review the power requirements for the system and for field devices.
- Review design considerations for heating and cooling.
- Specify an enclosure.
- Install the necessary software.

Ensure that Warranty is Not Compromised

ATTENTION: Failing to install retaining clips and properly secure the Terminal Assembly (TA) can lead to connector / pin damage on the modules and the 1715-A3IO. Failure to comply with this Attention Notice will render the Warranty void and the equipment will not be covered.

Graphical Representation

IMPORTANT Throughout this manual, some graphics do not depict the actual hardware as required. These graphics are for representational purposes only and do not necessarily reflect the actual component layout of your system.

Parts List

These parts are available to build a 1715 Redundant I/O System. Their description and catalog part numbers are as follows.

Table 4 - Parts Table

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-AENTR</td>
<td>Adapter</td>
</tr>
<tr>
<td>1715-IB16D</td>
<td>16-channel digital input module</td>
</tr>
<tr>
<td>1715-OB8DE</td>
<td>8-channel digital output module</td>
</tr>
<tr>
<td>1715-IF16</td>
<td>16-channel analog input module</td>
</tr>
<tr>
<td>1715-OF8I</td>
<td>8-channel analog output module</td>
</tr>
<tr>
<td>1715-A2A</td>
<td>2-slot adapter base unit</td>
</tr>
<tr>
<td>1715-A3IO</td>
<td>3-slot I/O base unit</td>
</tr>
<tr>
<td>1715-TASIB16D</td>
<td>Termination assembly - digital input simplex</td>
</tr>
<tr>
<td>1715-TADIB16D</td>
<td>Termination assembly - digital input duplex</td>
</tr>
<tr>
<td>1715-TASOB8DE</td>
<td>Termination assembly - digital output simplex</td>
</tr>
<tr>
<td>1715-TADOB8DE</td>
<td>Termination assembly - digital output duplex</td>
</tr>
<tr>
<td>1715-TASF16</td>
<td>Termination assembly - analog input simplex</td>
</tr>
<tr>
<td>1715-TADF16</td>
<td>Termination assembly - analog input duplex</td>
</tr>
<tr>
<td>1715-TASF8</td>
<td>Termination assembly - analog output simplex</td>
</tr>
<tr>
<td>1715-TADOF8</td>
<td>Termination assembly - analog output duplex</td>
</tr>
<tr>
<td>1715-N2T</td>
<td>Tall slot filler cover</td>
</tr>
<tr>
<td>1715-N2S</td>
<td>Short slot filler cover</td>
</tr>
<tr>
<td>1715-C2</td>
<td>Expansion cable - 2 m</td>
</tr>
</tbody>
</table>
**Required Tools**

The installation and maintenance of the 1715 Redundant I/O System requires these tools:

- Screwdriver, 0.8 x 9.0 mm (1/25 x 3/8 in.), for module clamp screws and slot filler covers
- Torque screwdriver, 0.6 x 3.0 mm (1/40 x 1/8 in.), for DC power wiring terminals
- Torque screwdriver, 0.4 x 2.0 mm (1/64 x 5/64 in.), for field wiring terminals
- Two open-end wrenches, 10 mm (0.39 in.), for ground stud nuts
- A 2.5 mm (0.10 in.) Allen wrench

**Spacing Requirements**

You must consider spacing requirements before mounting your system.

---

**IMPORTANT** Make sure that you meet the minimum spacing requirements shown.

Allow 15.3...20 cm (6.0...8.0 in.) between chassis and a heat source, and chassis and cabinet, and allow 5.1 cm (2.0 in.) between wireway and top or bottom of chassis.

Dimensions are in cm (in.).

**Figure 13 - Cabinet**

---

**IMPORTANT** When installing the system in a chassis, note that chassis are intended to be mounted horizontally only. Install the modules in the chassis in a vertical orientation only.
The 1715 Redundant I/O System is a remote redundant I/O system that was developed to communicate with a Logix controller in a ControlLogix® enhanced redundant system by using the EtherNet/IP network and includes these components:

- A pair of 1715-AENTR adapters serves as a ‘proxy’ for all EtherNet/IP messages to and from redundant I/O modules.
- 1715 digital and analog I/O modules.
- A 1715-A2A dual redundant I/O adapter base unit connects to a 1715-A3IO I/O module base unit to form the backplane for the system.
- Termination assemblies are available in Simplex and Duplex configuration. They mount onto the 1715-A3IO I/O module base unit, and connect the I/O modules to the I/O wiring.
- Each 1715-A3IO I/O base unit holds up to three I/O modules. Up to 24 I/O modules can be added to the system.
- The system is built on DIN rails within a cabinet enclosure.
- 1715-C2 expansion cables can be used to allow for space restrictions of the system within the cabinet.

**IMPORTANT** Conformal coating is standard on all 1715 modules.

The general system layout for the 1715 Redundant I/O System consists of the following hardware components.

**1715-AENTR Adapter Redundant Pair**

The 175 adapter communicates via the EtherNet/IP network to a 1756 ControlLogix controller, which conveys system I/O data.
1715 Digital and Analog I/O Modules

Your system can be configured with any combination of I/O modules, and in either Simplex or Duplex mode. These I/O modules can be included in your system:

- 1715-IB16D 16-channel digital input module
- 1715-OB8DE 8-channel digital output module
- 1715-IF16 16-channel analog input module
- 1715-OF8I 8-channel analog output module

**IMPORTANT** Do not open this module door, or plug or insert anything into the port behind the module door unless instructed to do so by technical support.
Figure 15 - 1715 Digital and Analog I/O Modules

1715-A2A Adapter Base Unit

The adapter base unit holds a pair of adapters.
Adapter Base Unit Fuses

The 1715-A2A adapter base unit contains four fuses.

To replace the fuses, follow this procedure.

1. Lift the door to access the fuses.
   
   The fuses are labeled from F1...F4, from left to right. The replacement fuse part number is Littelfuse 0154004.DRT.

2. With a pair of small long-nosed pliers, remove and replace the blown fuse.
Lift door to access fuses

Use replacement fuse 4 A slow blow fuses in OMNI-BLOK holders manufactured by Littelfuse. Remove and replace with a pair of long-nosed pliers.

Figure 16 - Power Routing of Adapter Base Unit Fuses

Fuses F1 and F3 have independent tags under the 1715-AENTR module status flags. For example, in Figure 17, F3 is blown or adapter power is missing to the PWR-2 connector.
The F2 and F4 fusing faults of the 1715 I/O modules cannot be pinpointed. All healthy I/O module status indicators showing solid red indicates a blown F2 or F4 fuse.

The adapter tags indicate each individual I/O module tag, ModAFault and ModBFault, as shown in Figure 18.

**Figure 17 - Fuse Tags**

![Fuse Tags Table]

The F2 and F4 fusing faults of the 1715 I/O modules cannot be pinpointed. All healthy I/O module status indicators showing solid red indicates a blown F2 or F4 fuse.

**Figure 18 - Adapter Tags Indicate Faults**

![Adapter Tags Table]

**IMPORTANT** After any fuse replacement or power-related issue on PWR-1/PWR-2, the Reset button on the 1715-AENTR must be pressed to clear the fault and reset the status indicator back to solid green.

**1715-A310 I/O Base Unit**

The I/O base unit holds up to three I/O modules.
I/O Termination Assemblies

I/O termination assemblies are inserted into the I/O base units. There are eight types of termination assemblies (two for each module) depending on the architecture of your system and the I/O modules you are going to use.

### Table 5 - I/O Termination Assembly Descriptions

<table>
<thead>
<tr>
<th>I/O Module</th>
<th>Termination Assembly Cat. No.</th>
<th>Termination Assembly Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-IB16D</td>
<td>1715-TASIB16D</td>
<td>Digital input simplex</td>
</tr>
<tr>
<td></td>
<td>1715-TADIB16D</td>
<td>Digital input duplex</td>
</tr>
<tr>
<td>1715-OB8DE</td>
<td>1715-TASOB8DE</td>
<td>Digital output simplex</td>
</tr>
<tr>
<td></td>
<td>1715-TADOB8DE</td>
<td>Digital output duplex</td>
</tr>
</tbody>
</table>
Digital Input Termination Assemblies

Digital input termination assemblies support these features:

- 16-channel simplex TA provides termination for 16 digital input channels
- Industry-standard field device connections at terminal blocks
- 24V DC digital input channels with a load of 5.11 kΩ per input channel
- Individually fused channels with over voltage input protection

There are two types of digital input termination assemblies:

- A 1715-TASIB16D, 16-channel simplex TA that provides termination for 16 digital input channels and mates with one 1715-IB16D digital input module
- A 1715-TADIB16D, 16-channel duplex TA that provides termination for 16 digital input channels and mates with up to two 1715-IB16D digital input modules

Table 5 - I/O Termination Assembly Descriptions

<table>
<thead>
<tr>
<th>I/O Module</th>
<th>Termination Assembly Cat. No.</th>
<th>Termination Assembly Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-IF16</td>
<td>1715-TASIF16</td>
<td>Analog input simplex</td>
</tr>
<tr>
<td></td>
<td>1715-TADIF16</td>
<td>Analog input duplex</td>
</tr>
<tr>
<td>1715-OF8I</td>
<td>1715-TASOF8</td>
<td>Analog output simplex</td>
</tr>
<tr>
<td></td>
<td>1715-TADOF8</td>
<td>Analog output duplex</td>
</tr>
</tbody>
</table>
The simplex termination assembly routes the input signals to one input module. In duplex arrangements, the input signals are routed to two parallel modules.

See page 79 for detailed wiring instructions.

**Digital Output Termination Assemblies**

Digital output termination assemblies support these features:

- Provide connections for eight output channels
- Industry-standard field device connectors
- 24V DC operation
- Provide a fused field voltage supply to the module

There are two types of digital output termination assemblies:

- A 1715-TASOB8DE digital output, 24V DC, 8-channel, simplex TA that provides termination for 8 digital output channels and mates with one 1715-OB8DE digital output module
- A 1715-TADOB8DE digital output, 24V DC 8-channel duplex TA that provides fault tolerant operation for 8 digital output channels and mates with redundant 1715-OB8DE digital output modules
Analog Input Termination Assemblies

Analog input termination assemblies support these features:

- 16 input channels for a simplex/duplex configuration
- Industry-standard field device connections at the terminal blocks
- Analog input channels with a high reliability 120 Ω precision resistor termination per input channel
- Individually fused channels with over voltage input protection

There are two types of analog input termination assemblies:

- A 1715-TASIF16, 16-channel simplex TA that provides termination for 16 single-ended analog input channels and mates with one 1715-1F16 16-channel analog input module. There is no channel isolation.
- A 1715-TADIF16, 16-channel duplex TA that provides termination for 16 isolated analog input channels and mates with up to two 1715-1F16 16-channel analog input modules. The channels are isolated.

See page 84 for detailed wiring instructions.
Analog output termination assemblies support these features:

- Eight output channels for a simplex/duplex configuration
- Industry-standard field device connections at the terminal blocks
- Analog output channels provide 4…20 mA DC for external field devices
- Duplex termination assembly provides increased fault tolerance for output channels

There are two types of analog output termination assemblies:

- A 1715-TASOF8, 8-channel simplex TA that provides termination for 8 single-ended analog output channels and mates with one 1715-OF8I 8-channel analog output module
- A 1715-TADOF8, 8-channel duplex termination assembly provides fault tolerant operation for 8 analog output channels through inter-module communication and by routing the output source current from two modules to the same field device

See page 92 for detailed wiring instructions.
**Chapter 2          Installation Instructions**

**Figure 22 - 1715-TASOF8 and 1715-TAD0F8 Analog Output Termination Assemblies**

**1715-TASOF8**
Analog Output Simplex
Termination Assembly

**1715-TAD0F8**
Analog Output Duplex
Termination Assembly

---

**IMPORTANT**
The dual termination assembly does this by supporting inter-module communication for current sync operation and by routing the channel outputs from two 8-channel analog output modules in parallel to 8 field devices. Therefore, each field device receives a current source from a channel on each of two modules. So if one module fails, or one or more channels fail on a module, the outputs from the second module continues to supply the field devices.

---

**1715-C2 Expansion Cable**

A 2 m (6.56 ft) expansion cable is available to connect I/O modules to field devices, and to allow for space restrictions within the enclosure of the system.

**IMPORTANT**
- 1715-C2 cables must be secured when installed; use the provided screws to secure the cable.
- 1715-C2 cables are rated 30V/9.6 A.
**1715-N2T and 1715-N2S Slot Filler Covers**

Slot filler covers are available in two sizes to cover empty slots in your system. Use the tall cover (catalog number 1715-N2T) when no termination assembly is present. Use the short cover (catalog number 1715-N2S) when a slot has a termination assembly, but no module.

**Power Requirements**

A 24V DC power supplied is required. See [Install the Power Supply on page 60](#) for complete details.

**ATTENTION:** 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) or Protected Extra Low Voltage (PELV)
Cooling Requirements

The 1715-AENTR adapter is designed to operate in its specified environment without forced air cooling. Forced air cooling can be needed in individual circumstances, such as when the system shares its enclosure with other heat producing equipment.

Adequate ventilation must be provided for the system and the ambient temperature in the enclosure must not be higher than the maximum operating value of 60 °C (140 °F).

The adapter dissipates all power that it uses as heat. This is the power that is supplied to the terminals on the 1715-A2A adapter base unit. The I/O modules dissipate some of the power they take from the field power source as heat. The actual amount of heat depends on the number of channels in use.

Heating Requirements

If enclosure is in colder environments, temperatures must be kept at -20 °C (-4 °F) or above.

Specify an Enclosure

An enclosure for the 1715 Redundant I/O System must be designed for the specific environmental conditions that are present. It must support the weight of the system, provide mechanical protection, and remove the heat that the system creates. If the application of the adapter is not using existing power sources, the power supply units can be placed inside the enclosure.

ATTENTION: The modules contain static-sensitive devices that can be damaged by incorrect handling. Label the exterior surface of the enclosure to caution personnel to observe anti-static precautions when handling the modules.

System Software

The firmware on your 1715 Redundant I/O System can be updated with the following ControlFLASH™ files:
Chapter 2          Installation Instructions

- Adapter ControlFLASH
- Adapter Recovery ControlFLASH
- I/O Module ControlFLASH

The files are available from the Product Compatibility and Download Center website.

The Adapter module contains two sets of firmware. The normal firmware is the operational firmware and allows connections from a Logix Controller. The Recovery firmware is used to update the firmware in the I/O modules and help diagnose problems. The normal and Recovery firmware are updated with separate ControlFLASH files.

Before starting check that:
- RSLinx® Gateway has been installed and configured
- The BOOTP server has been configured with the MAC address and suitable IP address for the 1715-AENTR
- The correct ControlFLASH file for the 1715-AENTR module or I/O module has been installed
- If updating 1715 I/O module firmware, ensure that the 1715-AENTR Recovery mode firmware from 1715 revision 3.001 or later is installed and running (Recovery mode firmware revision 1.011 or later)

Dual 1715-AENTR modules are updated at the same time.

Each I/O module is updated separately, even if it is fitted to a dual termination assembly.

Update procedure:
- Run the ControlFLASH program
- Select the type of module from the list
- Browse to the 1715-AENTR and open it, open the Backplane, then select the module to be updated.
- Select the version of firmware to be sent to the module
- Update the module
- The firmware will be downloaded and stored on the module - this will take between 2 minutes and 25 minutes
- Control FLASH will report the success or failure of the update
- Repeat for other modules that need to be updated

See document 1756-UM105 ControlFLASH firmware Upgrade Kit User Manual in the Literature Library for detailed instructions for using ControlFLASH

When updating the firmware, it is recommended that RSWho is not actively browsing the 1715-AENTR or the associated I/O modules.
Module Placement

A general overview of a typical redundant I/O system layout is shown here.

**IMPORTANT** The 1715-AENTR modules revision I6 contain base code. Both the normal and recovery mode firmware must be updated. 1715-AENTR modules newer than revision I6 and all I/O modules contain the latest firmware at manufacture time. It may be necessary to change the firmware to be compatible with your system, or to upgrade to the latest version.

**IMPORTANT** The latest certifications for software and firmware can be found at [rok.auto/certifications](http://rok.auto/certifications). See the TÜV website at [http://www.tuvasi.com](http://www.tuvasi.com) for SIL 2 certification listings.

**IMPORTANT** When updating firmware the 1715 Redundant I/O System is offline. It must be in Recovery mode, or there must be no active connections.

**IMPORTANT** ControlFLASH can be used to update the firmware in the adapter module. From 1715 revision 3.001 and later, when in Recovery mode, ControlFLASH can be used to update the firmware in the I/O modules. (This is available in the Adapter Recovery ControlFLASH version 1.011 and later.)

**IMPORTANT** After upgrading a revision 1.005 1715 chassis to revision 2.001 or later, power to the 1715 chassis must be cycled.
This illustration is only an example and is for illustrative purposes only.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adapter base unit</td>
</tr>
<tr>
<td>2</td>
<td>Adapter A module</td>
</tr>
<tr>
<td>3</td>
<td>Adapter B module</td>
</tr>
<tr>
<td>4</td>
<td>I/O base unit</td>
</tr>
<tr>
<td>5</td>
<td>Simplex I/O module</td>
</tr>
<tr>
<td>6</td>
<td>Duplex I/O module - first in pair</td>
</tr>
<tr>
<td>7</td>
<td>Duplex I/O module - second in pair</td>
</tr>
<tr>
<td>8</td>
<td>I/O base unit</td>
</tr>
<tr>
<td>9</td>
<td>Simplex I/O module</td>
</tr>
<tr>
<td>10</td>
<td>Duplex I/O module - first in pair</td>
</tr>
<tr>
<td>11</td>
<td>Duplex I/O module - second in pair</td>
</tr>
<tr>
<td>12</td>
<td>Power connections</td>
</tr>
<tr>
<td>13</td>
<td>Ethernet connections</td>
</tr>
</tbody>
</table>

The adapter and base units are DIN-rail mounted and connections are chained together from left to right.

**Base Units**

The adapter base unit is always the leftmost base unit in the connection chain. The total length of the base unit backplane length, including all expansion cables cannot exceed 10 m (32.81 ft).

A base slot (adapter or I/O) consumes an address whether it is full or empty. The first adapter in the pair occupies slot 0 and is on the left, the second adapter occupies slot 1 and is on the right. Only adapters can occupy the slots of the adapter base.

An adapter base unit can support up to 8 I/O base units (up to 24 I/O modules) on its right side.

Module positions within the I/O base units are numbered from 2...25, the leftmost position being slot 2.

The total number of slot positions in the system is 26; adapters occupy slots 0...1 and I/O modules occupy slots 2...25.

Expansion cables can be used to connect base units, as shown here.
Install Summary

The 1715 Redundant I/O System is a modular system. The adapter and I/O base units snap together by using mating connectors and retaining clips to form the backplane.

The base units provide the interconnections for power, adapter, and I/O data. Once connected, the base units form one mechanical assembly, or backplane.
Step 1: Enclosure DIN Rail Assembly

The 1715 Redundant I/O System is assembled on DIN rails within an enclosure.

After deciding on an enclosure, install the DIN rails before building your system.

Step 2: Build the System

After assembling the DIN rail enclosure, follow these steps in this order to build your redundant I/O system.

1. Mount a 24V, user-supplied, power supply.
   
   See the instructions that came with the power supply.
2. Mount the adapter base unit onto the DIN rails.
3. Mount the I/O base units onto the DIN rails.
4. Insert retaining clips to connect adapter and I/O base units.
5. Install anchor end stops onto the DIN rails.
6. Mount termination assemblies to the base units.
7. Mount I/O expansion cable, if needed.
8. Wire the adapter base.
   • Connect to power.
   • Wire the ground.
   • Connect to field wiring.
9. Connect the adapter to the Ethernet network.
10. Module keying/verify coding peg positions.
11. Install the adapter redundant module pair.
12. Install the I/O modules.
13. Install slot filler covers over unused slots.

Product Dimensions

This section outlines the space requirements for your 1715 Redundant I/O System.

DIN Rail Mounting Dimensions

The system requires free space of at least 140 mm deep (5.51 in.) from front to back between the rear panel of an enclosure and the inside of an enclosure door.
**IMPORTANT** Allow sufficient free space around the base units. Every installation needs space on at least three sides, as follows:
- Space above, to manipulate and install field wiring
- Space below, to enable modules to fit and to be able to grasp a module during removal
- Space to the right, to maneuver an I/O base unit during assembly or in the event of installing a new base unit

**IMPORTANT** Minimum clearance between the product and the adjacent equipment must be 15.3...20 cm (6.0...8.0 in.) between chassis and a heat source, and allow 5.1 cm (2.0 in.) between wireway and top or bottom of chassis.

DIN rail mounting is shown in the following figure.

---

### DIN Rail Assembly

The 1715 Redundant I/O System is mounted on DIN rails within an enclosure. Pay special attention to dimensions needed for base unit placement.

For each pair of DIN rails, mount the lower rail with its center line 101 mm (3.98 in.) below the center line of the upper rail.

Free space must also be provided on each end of the DIN rail for the end stops, if necessary.
## Component Size and Weights

### Table 6 - Component Sizes

<table>
<thead>
<tr>
<th>Item</th>
<th>Size (H x W x D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapter base unit</td>
<td>224 x 84 x 30 mm (8.82 x 3.31 x 1.18 in.)</td>
</tr>
<tr>
<td>I/O module base unit</td>
<td>233 x 126 x 18 mm (9.25 x 5 x 0.75 in.)</td>
</tr>
<tr>
<td>Module</td>
<td>166 x 42 x 118 mm (6.5 x 1.625 x 4.625 in.)</td>
</tr>
</tbody>
</table>

The total depth of a base unit and module is 136 mm (5.375 in.).

### Figure 24 - Module Dimensions

All module dimensions are the same, whether they are adapters or I/O modules.
Be sure that the mounting assembly can support the weight of the components by using this table.
Table 7 - Component Weights

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Component</th>
<th>Weight g (oz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-A2A</td>
<td>Adapter base unit</td>
<td>283 (9.98)</td>
</tr>
<tr>
<td>1715-A3I0</td>
<td>I/O base unit</td>
<td>220 (7.76)</td>
</tr>
<tr>
<td>1715-AENTR</td>
<td>Adapter</td>
<td>420 (14.82)</td>
</tr>
<tr>
<td>1715-IB16D</td>
<td>Digital input module</td>
<td>360 (12.70)</td>
</tr>
<tr>
<td>1715-IF16</td>
<td>Analog input module</td>
<td>360 (12.70)</td>
</tr>
<tr>
<td>1715-OB80E</td>
<td>Digital output module</td>
<td>290 (10.23)</td>
</tr>
<tr>
<td>1715-OF81</td>
<td>Analog output module</td>
<td>340 (11.99)</td>
</tr>
<tr>
<td>1715-TASIB16D</td>
<td>Digital input simplex termination assembly</td>
<td>133 (4.69)</td>
</tr>
<tr>
<td>1715-TADIB16D</td>
<td>Digital input duplex termination assembly</td>
<td>260 (9.17)</td>
</tr>
<tr>
<td>1715-TASIF16</td>
<td>Analog input simplex termination assembly</td>
<td>133 (4.69)</td>
</tr>
<tr>
<td>1715-TADIF16</td>
<td>Analog input duplex termination assembly</td>
<td>260 (9.17)</td>
</tr>
<tr>
<td>1715-TASOB80E</td>
<td>Digital output simplex termination assembly</td>
<td>133 (4.69)</td>
</tr>
<tr>
<td>1715-TADOB80E</td>
<td>Digital output duplex termination assembly</td>
<td>260 (9.17)</td>
</tr>
<tr>
<td>1715-TASOF81</td>
<td>Analog output simplex termination assembly</td>
<td>133 (4.69)</td>
</tr>
<tr>
<td>1715-TADOF81</td>
<td>Analog output duplex termination assembly</td>
<td>260 (9.17)</td>
</tr>
<tr>
<td>1715-N2S</td>
<td>Short blank slot filler</td>
<td>40 (1.41)</td>
</tr>
<tr>
<td>1715-N2T</td>
<td>Tall blank slot filler</td>
<td>50 (1.76)</td>
</tr>
<tr>
<td>Power supply</td>
<td>User-supplied</td>
<td>Varies</td>
</tr>
</tbody>
</table>

(1) All weights are approximate.

Install the Power Supply

Power supplies must be installed to the left of the adapter base unit in a position where the 24V DC supply wiring can be kept reasonably short. Figure 26 shows an example of a mounted power supply.

ATTENTION: 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) or Protected Extra Low Voltage (PELV)

ATTENTION: In high demand energize to trip and continuous demand mode of operation the power supply for the 1715-AENTR should include over voltage protection and supply a maximum of 32 V.

Figure 26 - Power Supply

The 1715 Redundant I/O System requires 24V DC power with a tolerance between 18...32V DC. The system has been designed to operate with most
commercially available industrial uninterruptible power supplies (UPS). To select a suitable power supply, calculate the overall system load that must be powered (by using the following table), include any additional devices and add a contingency allowance between 25...50%.

<table>
<thead>
<tr>
<th>Component</th>
<th>Power Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapter</td>
<td>8.0 W</td>
</tr>
<tr>
<td>Digital input module</td>
<td>4.0 W</td>
</tr>
<tr>
<td>Analog input module</td>
<td>4.0 W</td>
</tr>
<tr>
<td>Digital output module</td>
<td>3.0 W</td>
</tr>
<tr>
<td>Analog output module</td>
<td>3.6 W</td>
</tr>
<tr>
<td>Power supply</td>
<td>Varies</td>
</tr>
</tbody>
</table>

**Install the Adapter Base Unit**

The adapter base unit supports a pair of adapters. The adapter base unit has connections for two power feeds, four Ethernet ports, and two adapters on the front of the unit, and one I/O base connector on the right-hand side of the unit. The connections for the adapters are commonly referred to as adapter slots.

To mount the 1715-A2A adapter base unit, follow these steps.

1. Place the 1715-A2A adapter base unit onto the DIN rails and position them toward the left, leaving space for the I/O base units to the right.
2. Secure the adapter base unit onto the DIN rails by sliding the retaining lever (below the base unit) to the left, as far as it goes, until it latches in the locked position.
Install the I/O Base Unit

You can install up to three I/O modules on an I/O base unit. The I/O base unit has an incoming I/O base connector on the left-hand side of the unit, an outgoing I/O base connector on the right-hand side, and, on the front, connections for three I/O termination assemblies and three I/O modules. The locations for each I/O termination assembly and I/O module connectors are paired, and together represent an I/O module slot.

To mount the 1715-A310 base unit, follow these steps.
1. Mount each 1715-A310 base unit onto the DIN rails to the right of the 1715-A2A adapter base unit.
2. Slide the base unit to the left until the joining connectors are fully mated.
3. Secure the I/O base unit onto the DIN rails by sliding the bottom retaining lever (below the base unit) as far to the left as it goes until it latches in the locked position.

4. Insert the retaining clips into the top and the bottom slots to connect the adapter base unit to the I/O base unit.
5. Attach anchor end stops to the top of the DIN rails once all base units are mounted.

Typical types of end stops.

**Install Termination Assembly to I/O Base Unit**

I/O termination assemblies determine the type of I/O modules that can be installed in a particular slot. The I/O termination assemblies provide the mechanism to connect the field wiring specific to the I/O module type to the back of one or more installed I/O modules. I/O termination assemblies are available in single-width and double-width varieties. A single-width I/O termination assembly connects the field wiring to one I/O module slot for simplex operation, where a double-width I/O termination assembly connects the field wiring to two I/O module slots for duplex/redundant operation. I/O termination assemblies can span I/O base unit boundaries, though the I/O base units must be connected directly. I/O termination assemblies are keyed so
that only I/O modules appropriate to the termination assembly type can be installed.

Each redundant I/O subsystem supports a maximum of 24 I/O module slots, which can be configured with 24 simplex I/O termination assemblies, 12 duplex I/O termination assemblies, or any combination in between.

Once the base units and termination assemblies have been installed, the insertion and removal of modules does not disturb other electrical connections.

**Mount Termination Assemblies**

Termination assemblies connect to I/O base units. A combination of duplex and simplex Termination Assemblies may be mounted. A duplex Termination Assembly may be mounted across two I/O base units. The combination that is used depends on the specific configuration requirements of the system.

To connect termination assemblies to I/O base units, follow these steps.

1. Insert the termination assembly (TA) retaining clip on the back of the termination assembly into the slot on the I/O base unit.
2. Press in and slide the assembly upward as far as it goes until it locks in place.
3. Make sure the retaining tab clips over the circuit board to secure the TA in position.
Mount I/O Expansion Cable

The expansion cable assembly connects an I/O base unit to another I/O base unit or to the adapter base unit. It lets extra I/O to be added at another location (for example, on another DIN rail). The cable is 2 m long and provides connection for up to 24 I/O modules. The maximum length of an entire bus, or backplane, (the combination of I/O base units and expansion cables) is 10 m.

The assembly consists of a cable, terminated by multi-way plugs, and a pair of adapters.

The expansion cable offers these features:
- Two-meter cable length
- Secure with retaining screws and screw cap screws
- Connects all command and response signals and system power
- Screened to reduce emissions

Cable Assembly

The cable assembly consists of an SCSI-3 cable and two ferrites. The ferrites are snap-on components that reduce resonance emissions.
Fit the ferrites 50 mm (1.97 in.) from each end and secure with cable ties either side of the ferrites.

![Diagram of cable assembly]

Table 8 - Cable Assembly

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SCSI-3 cable</td>
</tr>
<tr>
<td>2</td>
<td>Ferrite</td>
</tr>
<tr>
<td>3</td>
<td>Cable-tie</td>
</tr>
</tbody>
</table>

**Expansion Cable**

The expansion cable has a left cable adapter and a right cable adapter. Connect one end to the right-hand bus connector of an I/O base (or adapter base) unit. The other end connects to the left-hand bus connector of an I/O base unit.

![Diagram of I/O Expansion Cable Adapters]

Table 9 - I/O Expansion Cable Adapters

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cable socket assembly</td>
</tr>
<tr>
<td>2</td>
<td>SCSI-3 cable</td>
</tr>
<tr>
<td>3</td>
<td>Ferrite</td>
</tr>
<tr>
<td>4</td>
<td>Cable plug assembly</td>
</tr>
</tbody>
</table>
Expansion cables are available in 2 m (78.74 in.) lengths.

Terminate are not required at the end of the bus (last base unit).

**Install Expansion Cable**

To install an expansion cable, follow these steps.

**Connect to a 1715-A310 3-slot I/O Base Unit**

1. To extend from the right-hand side of an I/O base unit, insert a cable plug assembly into the I/O backplane connector.

**Table 9 - Expansion Cable Components**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M3 Socket Cap Screw</td>
</tr>
<tr>
<td>2</td>
<td>Cable plug assembly</td>
</tr>
<tr>
<td>3</td>
<td>Cable socket assembly</td>
</tr>
<tr>
<td>4</td>
<td>M3 Nut</td>
</tr>
</tbody>
</table>

**IMPORTANT** Adapter base units can only be extended from the right side.
2. When installing the cable on the left side of the base unit, insert a cable socket assembly into the I/O backplane connector.

3. Insert an M3 nut into the base unit molding assembly as shown.
4. Secure the plug or socket assembly by inserting the two M3 socket cap screws.
5. Tighten the screws with a 2.5 mm Allen wrench.
6. Install the cable end into the plug or socket assembly and tighten the retaining screws by hand.
7. Fit the cable plug or socket assembly to the other I/O base unit and secure as in steps 3 and 4.
8. Fit the other end of the cable into the cable plug or socket assembly.

Connect to a 1715-A2A 2-slot Adapter Base Unit

1. When installing the expansion cable from the right-hand side, insert a cable plug assembly into the 1715-A2A adapter base unit connector.

2. Follow steps 3, 4, and 5.
3. Insert the cable end into the cable plug assembly and tighten the retaining screws by hand.
4. Fit the cable socket assembly to the I/O base unit and secure as in steps 4 and 5.
5. Fit the other end of the cable into the cable socket assembly.
**Wire the Adapter**

The 1715 adapter base unit has a series of screw terminal blocks to terminate power connections to ease cable installation.

**Connect the 24V DC System Power**

The 1715 modules are designed to operate from two independent 24V DC sources with a common return. Power is connected to the two plugs, ‘PWR-1’ and ‘PWR-2’ on the adapter base plate. Power is distributed to the I/O modules through the base units.

**Figure 28 - Connect System Power**

**ATTENTION:** To comply with the CE Low Voltage Directive (LVD), all connections to this equipment must be powered from a source compliant with safety extra low voltage (SELV) or protected extra low voltage (PELV).
For each power supply connection, follow these steps.

1. Connect the negative line from the power supply, typically labeled ‘OV’, to the left-hand terminal.
2. Connect the positive line from the power supply, typically labeled ‘+24V’, to the right-hand terminal.
3. Apply a minimum tightening torque of 0.5 N•m (0.37 lb•ft) to the terminal screws.

For maximum protection, be sure that the PWR-1 and PWR-2 plugs are supplied from independent 24V DC sources as in Figure 29. Only having one power supply plug connection causes a Rack Status fault status indicator to illuminate on adapters.

Figure 29 - Independent Power Sources

### Wire the Ground Connection

The system can have up to three separate ground systems:

- An AC Safety Ground (sometimes called the ‘dirty ground’) to help protect you in the event of a fault. The ground stud on the adapter base unit must be connected to the AC safety ground, along with all exposed metalwork, such as DIN rails.
- An Instrument Ground (sometimes called the ‘clean ground’ or ‘OV DC ground’) to provide a good stable OV reverence for the system. Every signal return must be referenced to the instrument ground, which is isolated from the AC Safety Ground.

<table>
<thead>
<tr>
<th>Wiring Attribute</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductor cross section, stranded maximum</td>
<td>2.5 mm² (12 AWG)</td>
</tr>
<tr>
<td>Conductor cross section, solid maximum</td>
<td>2.5 mm² (12 AWG)</td>
</tr>
<tr>
<td>Stripping length</td>
<td>7 mm (9/32 in.)</td>
</tr>
</tbody>
</table>

ATTENTION: To comply with UL restrictions, all connections to this equipment must be powered from a UL Listed source compliant with Limited Voltage/Current per UL 508.
- Some field wiring needs shielded (screened) cable. There can be a Shield Ground and the AC Safety and Instrument Grounds to provide a common point to terminate cable shields.

Connect the adapter base unit ground stud to the AC safety ground bus bar of the system:
- Use an M6 lug on the end of the ground wire.
- Place the lug below the second nut on the ground stud between two washers and use two 10 mm (0.39 in.) wrenches to tighten the nuts.
- Use a minimum conductor wire size of 4 mm² (10 AWG).

**Figure 30 - Adapter Base Unit Ground Connection Detail**

**Connect Field Wiring**

Connect the field wiring to the screw terminal blocks on the termination assemblies.

<table>
<thead>
<tr>
<th><strong>IMPORTANT</strong></th>
<th>The termination assemblies have integral fuses.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IMPORTANT</strong></td>
<td>You must use safety wiring principles if the applicable standards for the system require you take precautions to avoid external short circuits, because the internal diagnostics in the 1715 adapter do not detect external short circuits between channels. These standards include NFPA-72.</td>
</tr>
</tbody>
</table>

**ATTENTION:** To comply with the CE Low Voltage Directive (LVD), all connections to this equipment must be powered from a source compliant with safety extra low voltage (SELV) or protected extra low voltage (PELV).

**ATTENTION:** To comply with UL restrictions, all connections to this equipment must be powered from a UL Listed source compliant with Limited Voltage/Current per UL 508.
Recommended Circuits for Digital Inputs

These circuits can be used for simplex and duplex configurations of digital input modules. Fit a fuse in each circuit to help protect the field wiring.

Figure 31 - Standard Input
Figure 32 - Line Monitored Inputs

Threshold Settings for Line Monitored Field Devices

For information about setting threshold values, see Threshold Values for Digital Inputs on page 299.

It is recommended that you do a manual calibration drift check every two years. See Calibration Drift Checks on page 311.
Figure 33 provides a Function Block Diagram of the 1715 digital input module illustrating the input circuits, isolation circuits, internal power supplies, and the input data management by the FPGA. Each input signal is routed through a termination assembly to two input measurement devices. These devices determine the input status and channel condition and generate the input data for the ControlLogix controller.

The digital input module receives commands from the adapter and converts the channel input data into secure digital data packets. Signal power and isolation circuits separate out each input channel from the rest of the system and protect the system components from field faults.

The internal isolated power supply from the 24V DC dual redundant system power inputs produces module power. The isolated power supply provides power to the module and is protected by over-voltage and undervoltage detection circuits. Supply voltage monitoring initiates a warning signal and Power-off Protection mode when a power failure is detected.

Internal diagnostics test the module every application cycle to see whether values are within the 1%-value fault band, and if appropriate, report a fault.

An independent watchdog arrangement also monitors the module operation and provides more fault containment by activating a shutdown mechanism if a fault is detected. For SIL 2 systems the time to active the shutdown mechanism can be configured in the CRTL on the SIL 2 Safety tab in the module profile in RSLogix/Logix Designer. For non-SIL 2 systems it is set at 10 seconds.
The adapter also monitors the input data paths and can detect faults within each input channel. A visual indication of the module status and individual channel status is provided by an array of front panel indicators.

The range of termination assemblies can accept one or two input modules. Each assembly provides passive signal load termination and fuse over-voltage protection on each input channel. The system provides flexible and scalable input connectivity through mating termination assemblies with the relevant number of input modules.

Field Wiring of Digital Input Termination Assemblies

The termination assembly routes each digital input through a circuit. See Figure 34. The input channel is protected with a 50 mA fuse. When an extreme over-voltage is applied to the input, the fuse blows. Each digital input signal is terminated by a 5.11 kΩ high reliability load and is fed to the input circuit of the input module.

Figure 34 - 1715-TASIB16D Digital Input Termination Assembly Input Circuit
Chapter 2          Installation Instructions

Figure 35 - 1715-TASIB16D and 1715-TADIB16D Digital Input Termination Assemblies

Terminal Block Cable Entry This Side

1715-TASIB16D Digital Input
Simplex Termination
Assembly

1715-TADIB16D Digital Input
Duplex Termination Assembly

Field Connections This Side

Figure 36 - Connections to 1715-TASIB16D Simplex Nonisolated Digital Input 16-channel Termination Assembly

OV  OV  CH0  CH1  CH2  CH3
CH4  CH5  CH6  CH7  CH8  CH9
CH10 CH11 CH12 CH13 CH14 CH15

Rockwell Automation Publication 1715-UM001J-EN-P - December 2020 79
Apply a minimum tightening torque of 0.5 N•m (0.37 lb•ft) to the terminal screws.

**Figure 37 - Connections to 1715-TADIB16D Duplex Digital Input 16-channel Termination Assembly**

Apply a minimum tightening torque of 0.5 N•m (0.37 lb•ft) to the terminal screws.

**Digital Input Slew Tolerance**

It is possible during sustained periods of abnormal input voltage slewing that channels can be declared faulted as a consequence of diagnostics that are otherwise designed to verify the channels are operating within their designed safety accuracy.

To avoid spurious declaration of channel faults, it is necessary to ensure that the input signal condition satisfies the maximum slew rate criteria that are defined in the 1715 Redundant I/O System Specifications Technical Data, publication 1715-TD001. So it can be necessary to condition the input signal with low-pass filtering.

**Field Loop Circuits for Digital Inputs**

The recommended digital input field loop circuits for the 1715-IB16D digital input module are shown on page 75.

For line monitored digital input loop circuit wiring and recommended threshold values, see Appendix B.

**Recommended Circuits for Digital Outputs**

This circuit is suitable for simplex and duplex configurations of digital output modules. The two 10 A fuses that are shown are supplied with the adapter in
the output termination assembly. They help protect all output circuits that are associated with the particular termination assembly.

**ATTENTION:** For inductive loads, connect a diode at the actuator to protect the adapter against back EMF.
Chapter 2          Installation Instructions

1715-OB8DE Digital Output Module FBD

Figure 38 - 1715-OB8DE Functional Bock Diagram (FBD)

See Figure 38. Two independent output switch control units control the field output channel. The field output circuitry is galvanically isolated from the processor input commands and response lines by an isolated interface circuit. This architecture helps protect the system processors from faults in the output control circuits of the module and possible field device faults.

The internal isolated power supply produces module power, which the dual redundant system power inputs supply. Over- and undervoltage protection is applied to the module internal power supply outputs.

Command packets are received from the processor module via the EtherNet/IP network. The output switch control units decode and vote the output data that is addressed to them and set the output FET switches accordingly. The output voltages are produced from the 24V DC field power input voltages by a power combiner circuit. Each output channel has a pair of FET switches arranged in a series that are independently controlled. Load current and voltage monitoring is provided for each switch. Output channel protection makes sure that the output circuit is switched off when the channel load current exceeds a safe limit.
A reverse voltage protection circuit makes sure that externally applied voltages to any output channel do not generate current flow backwards into the module outputs.

In Duplex redundant mode, the two fail-safe output switches per channel are combined in a parallel arrangement so that they automatically form a fault-tolerant output configuration. In this configuration, removal and of an output module is possible without any disruption to a live system.

The module has a range of self-checking functionality. Short circuit and open circuit line monitoring is provided on all outputs. In addition, each output channel is tested and checked for ‘stuck-on’ and ‘stuck-off’ conditions on the output switch pairs. The ‘stuck-on’/‘stuck-off’ test is performed on one 1715-OB8DE module per minute.

Field Wiring of Digital Output Termination Assemblies

The 1715-TASOB8DE and 1715-TADOB8DE consist of a simple PCB, screw termination blocks (16 terminals), two 10A fuses with a plastic fuse cover, coding pegs, field terminal connectors and connectors to connect the module to the command, and response buses.

**Figure 39 - 1715-TASOB8DE and 1715-TADOB8DE Digital Output Termination Assemblies**
Apply a minimum tightening torque of 0.5 N•m (0.37 lb•ft) to the terminal screws.

The 24V DC field voltages VFIELD 1 and VFIELD 2, used by the output module for the output field voltages, are connected at the terminal blocks and fed via two replaceable 10 A fuses, F1 and F2. These fuses give protection for the output module against field faults. Field OV (VFIELD RTN) is also routed from the output module connectors to the terminal block.
Digital Output Slew Tolerance

It is possible during sustained periods of abnormal field supply or output signal condition slewing that channels can be declared faulted as a consequence of diagnostics that are otherwise designed to verify the channels are operating within their designed safety accuracy.
To avoid spurious declaration of channel faults, it is necessary to ensure that the field supply voltage and output signal condition satisfies the maximum slew rate criteria that are defined in the 1715 Redundant I/O System Specifications Technical Data, publication 1715-TD001.

Field Loop Circuits for Digital Outputs

The field loop circuit for a digital output is shown in Figure 44.

**IMPORTANT**
The field power 5A fuses comply with UL508 requirements. The 5A fuses are No. 396/TE5 5A time lag fuse; UL 248-14, 125 V,T Leadfree; manufactured by Littelfuse.

- You can use Class 2 power supplies for the +24V DC field voltage instead of the two 5A fuses. The NEC defines Class 2 as providing less than 100 watts (at 24V).
- When digital output modules are configured as a redundant pair, the minimum load current that is required for channels with line monitoring is 20 mA.

**Figure 44 - Digital Output (Simplex or Duplex) Field Loop Circuit**

![Figure 44 - Digital Output (Simplex or Duplex) Field Loop Circuit](image)

Recommended Circuits for Analog Inputs

This section describes the layout for analog inputs.
**Chapter 2           Installation Instructions**

1715-TASIF16 Analog Input Termination Assembly Functional Block Diagram

**Figure 45** is the diagram for the analog input termination assembly.

Each input signal is routed through the termination assembly to two input measurement devices. These devices determine the input status and channel condition and generate the input data for the controller.

Signal and power isolation circuits separate each input channel from the rest of the system, thus protecting the system components from field faults.

The internal isolated power supply from the 24V DC dual redundant system power inputs produces module power. The isolated power supply provides power to the module and is protected by over-voltage and undervoltage detection circuits. Supply voltage monitoring initiates a warning signal and Power-off Protection mode when a power failure is detected.

Internal diagnostics, which the adapter controls, test the module at routine intervals of 50…100 ms. An independent watchdog arrangement also monitors the module operation and provides more fault containment by activating a shutdown mechanism when a fault is detected.

**IMPORTANT**  If a fault occurs during normal operation in a duplex configured system, a faulted input module can be removed and replaced without disrupting the input signals to a live system.

Use extreme caution when removing and inserting I/O modules under power because bending or damaging the pins can fault the system.
The module also monitors the input data paths and can detect faults within each input channel. A visual indication of the module status and individual channel status is provided by an array of front panel indicators and can be connected to tags within the Studio 5000 Logix Designer® application.

The termination assemblies can accept one or two input modules. Each termination assembly provides passive signal load termination and over-voltage protection for each input channel. The system provides flexible input connectivity by mating specific termination assemblies with the relevant number of input modules.

**Field Loop Circuits for Analog Inputs**

These circuits can be used for simplex and duplex configurations of analog input modules. Fit a suitably rated fuse, “F1” in each circuit to help protect the field wiring, terminal block and 4mA -20mA current generator.

This field loop connection method is used for two-wire field devices.

**Figure 46 - Two-wire Analog Input Field Loop Circuit**

This field loop connection is used for three-wire analog field devices. Fit a suitably rated fuse, “F2” in each circuit to help protect the field wiring, terminal block and 4mA -20mA current generator.
This field loop connection method is used for four-wire analog field devices. Fit a suitably rated fuse, “F3” in each circuit to help protect the field wiring, terminal block and 4mA - 20mA current generator.

**Field Wiring of Analog Input Termination Assemblies**

The termination assembly routes each analog input through a circuit similar to that shown in **Figure 49**. The input channel is protected with a 50 mA fuse.
When an extreme over voltage is applied to the input, the fuse blows. Each analog input channel is terminated using a pair of high accuracy resistors presenting a combined termination resistance of 120 Ω. The input module monitors the channel current by measuring the voltage drop across each resistor. The fuses have a plastic fuse cover that must be kept in the closed position during normal operation. Standard field wiring connections are made at the terminal blocks on the termination assembly.

With a simplex termination assembly, the input signals are routed to one input module. In duplex configurations, they are routed in parallel to two modules.

**IMPORTANT** These resistors must be considered as part of the field loop circuit. Each channel has a 50 mA fuse to prevent component damage in over-current situations.

Figure 49 - Analog Input Termination Assembly Input Circuit

When an analog input module is configured as dual, the analog field loop that is connected to channel 0 is automatically fed to both modules. The system automatically votes the data from the input modules so that you have only one value that is presented to the application. The application program is presented with channel 0 and channel 1 values in a fault tolerant manner so that if either input module is lost, both values are still available to the application program.
**Analog Input Slew Tolerance**

It is possible during sustained periods of abnormal input current slewing that channels can be declared faulted as a consequence of diagnostics that are otherwise designed to verify the channels are operating within their designed safety accuracy.

To avoid spurious declaration of channel faults, it is necessary to ensure that the input signal condition satisfies the maximum slew rate criteria that are defined in the 1715 Redundant I/O System Specifications Technical Data, publication 1715-TD001. So it can be necessary to condition the input signal with low-pass filtering or sensor slew rate configuration.

**Analog Input Module Field Devices**

If there are two field devices, you normally connect them to two channels of a fault tolerant pair of modules, for example to channel 0 and to channel 1.

The two input values (0 and 1) then must be voted by using logic or a function block in the application program. This is accomplished by taking either the lowest or highest value, depending on the application. The other option is to use the two values in two simplex input modules, for example, both using channel 0. In this case, the values must still be voted in the application program in the same way as previously stated, but the system has less fault tolerance, as the loss of one module removes one of the inputs.
Figure 51 - Connections to 1715-TASIF16 Simplex Nonisolated Analog Input Termination Assembly-16-channel

Apply a minimum tightening torque of 0.5 N⋅m (0.37 lb⋅ft) to the terminal screws.

Figure 52 - Connections to 1715-TADIF16 Duplex Isolated Analog Input Termination Assembly

Apply a minimum tightening torque of 0.5 N⋅m (0.37 lb⋅ft) to the terminal screws.

**HART Secondary Master**

The HART Secondary Master is a hand held monitor/controller used by field engineers to check and reconfigure the settings of field equipment. In order that the Rockwell modules interface and operate with this equipment an additional 120 Ω resistor assembly is required in the connecting circuit.
**IMPORTANT**  It is the responsibility of the Installation Engineer to ensure that the HART secondary Master is correctly installed. Information regarding HART equipment may be obtained from the HART website.

http://en.hartcomm.org/
http://en.hartcomm.org/hcp/tech/aboutprotocol/
aboutprotocol_how.html

**Figure 53 - Connections for 120 Ω Resistor & Secondary Master**

2-Wire Analog Input

![Diagram of connections](image)

**Figure 53** above shows the addition of the 120 Ω resistor and HART Secondary Master to the Two-wire Analog Input Field Loop Circuit shown in **Figure 46**.

The above circuit can be accomplished by connecting the secondary Master and 120 Ω resistor assembly to the 0 V terminal and required channel terminal on the terminal block as shown in **Figure 54** below.
Chapter 2          Installation Instructions

Figure 54 - Connection of 120 Ω Assemblies and Secondary Masters to Terminal Blocks

The left circuit of Figure 54 above represents the secondary master connected to the Channel 2 terminal of a simplex termination assembly.

The right circuit of Figure 54 above represents the secondary master connected to the Channel 9 terminals of a duplex termination assembly.

For both circuits the secondary master is powered through a field power supply unit.

Recommended Wiring for Analog Output Modules

This section describes the wiring for analog outputs.
**Field Wiring of Analog Output Termination Assemblies**

**Figure 55 - 1715-TASOF8 and 1715-TADOF8 Analog Output Termination Assemblies**

**Analog Output Slew Tolerance**

Analog output channel voltage slew is unconstrained with the limits set by the compliance operating voltage range of the module.

**Field Loop Circuit for Analog Outputs**

The field loop circuit for an analog output is shown in **Figure 56**.
Field Power Circuit for Analog Outputs

An alternative method is shown in Figure 57. The figure shows when the field power is used to supply the load.

Connect the Adapter to the Ethernet Network

The adapter supports DLR (Ring) and Star topologies. For more details on topologies, see System Architecture on page 16.

**IMPORTANT** For wiring details, see Table 11.
The adapter has four autosensing 10/100BASE-TX Ethernet ports for connecting to a local area network through a minimum Cat5e shielded twisted pair (STP) Ethernet cable. There are two ports for each adapter.

**IMPORTANT**  The 1715 Redundant I/O System requires the use of a minimum Cat5e shielded twisted pair (STP) Ethernet cable.

The adapter Ethernet ports are on the 1715-A2A adapter base unit and are identified in this table.

<table>
<thead>
<tr>
<th>1715-AENTR Adapter</th>
<th>10/100BASE-TX Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapter A</td>
<td>A1, A2</td>
</tr>
<tr>
<td>Adapter B (where present)</td>
<td>B1, B2</td>
</tr>
</tbody>
</table>

**IMPORTANT**  Most network connections use straight-through cables. Crossover cables are not needed due to the intelligence or functionality of the switch. If a direct connection is required from the adapter to the personal computer (for example, during setup), it can be necessary to use a crossover cable. This depends on the characteristics of the interface in the personal computer.

The fixed connectors on the adapter are female RJ45 modular jacks. Use a minimum Cat5e shielded twisted pair (STP) cable with male RJ45 modular jacks for network cabling.

Connect the network cables to the sockets on the 1715-A2A adapter base unit.

To connect the adapter to the Ethernet network, follow these steps.

1. Insert the RJ45 modular jack on the cable into the appropriate socket for each network connection.
2. Make sure that the length of the cable does not exceed 100 m (328 ft).

**Module Keying**

Module keying, or polarization, prevents the wrong module from being inserted into the wrong base unit. Modules are supplied with coding pegs that are already fitted, so the modules are already ‘keyed’.

Electronic Keying is used within the Logix Designer application. See [Electronic Keying on page 100](#) for more information.
The legend for the coding pegs showing the peg positions is shown on the lower left of the adapter base unit and on each I/O termination assembly. The positions are numbered 1...6. The three coding pegs are lettered A, B, and C with A being on the top. Each peg, or key, is fitted in the base unit so that the index recess is next to the relevant numbered position. See Figure 59, which shows a photograph of the Adapter Base Unit. Coding peg A is absent.

### Table 12 - Allocations of Coding Pegs

<table>
<thead>
<tr>
<th>Application</th>
<th>Key A</th>
<th>Key B</th>
<th>Key C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715 Adapter Base Unit</td>
<td>Not Available</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1715 Digital Input Termination Assemblies</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1715 Analog Input Termination Assemblies (for analog input modules)</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>1715 Digital Output Termination Assemblies (for digital output modules)</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Verify Coding Pegs

To verify that each coding peg, also known as a polarizing pin, is positioned correctly, follow these steps.

1. Review the diagram on the adapter base unit that shows the six possible positions for a coding peg.
2. Examine a coding peg (fitted) and identify the index recess on the hexagonal flange.

3. See Table 12 and verify that each coding peg is fitted so its index recess is next to the relevant numbered position.

Electronic Keying

Electronic Keying reduces the possibility that you use the wrong device in a control system. It compares the device that is defined in your project to the installed device. If keying fails, a fault occurs. These attributes are compared.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor</td>
<td>The device manufacturer.</td>
</tr>
<tr>
<td>Device Type</td>
<td>The general type of the product, for example, digital I/O module.</td>
</tr>
<tr>
<td>Product Code</td>
<td>The specific type of the product. The Product Code maps to a catalog number.</td>
</tr>
<tr>
<td>Major Revision</td>
<td>A number that represents the functional capabilities of a device.</td>
</tr>
<tr>
<td>Minor Revision</td>
<td>A number that represents behavior changes in the device.</td>
</tr>
</tbody>
</table>

The following Electronic Keying options are available.
Carefully consider the implications of each keying option when selecting one.

### More Information

For more detailed information on Electronic Keying, see Electronic Keying in Logix 5000™ Control Systems Application Technique, publication LOGIX-AT001.

### Install the Adapters

Install two 1715-AENTR adapters.
To install the 1715-AENTR adapters on to the 1715-A2A two-slot base unit, follow these steps.

**IMPORTANT** You must inspect the connector pins before you install the modules. If you install modules with bent or damaged connector pins, it can damage the backplane connectors.

Also, inspect the socket contacts on the backplane, and for an I/O module, on the mating termination assembly. If a contact is damaged, do not attempt to install the module.

1. Inspect the connector pins.

2. Inspect the identification labels on the sides of the adapters and record the location and the module information that is shown on the label.

This helps you when installing a new or replacement module in the future by allowing you to order the replacement parts without disturbing the system.

3. Check the coding pegs on the 1715-A2A adapter backplane and verify that they match the sockets on the back of the adapter.

4. Verify that the slot on the head of the adapter clamp screw is vertical.
5. Record the MAC addresses.

The MAC addresses are between slot 0 and 1 of the adapter base. Every hardware component has its own unique MAC address. This hardware address is affixed to the hardware on a label.

6. Place the new module on to the dowel pin on the adapter base unit.
7. Push the adapter in until the dowel pin and connectors are fully mated. The status indicators listed in **Table 13** illuminate. The table is a quick installation reference. For more detailed status indicator information, see **Appendix A**.

**Table 13 - Start-up Sequence**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Status</td>
<td>Steady green</td>
</tr>
<tr>
<td>Redundancy Status</td>
<td>Flashes, then steady green</td>
</tr>
<tr>
<td>Network Status</td>
<td>Off</td>
</tr>
<tr>
<td>Rack Status</td>
<td>Off, then steady green</td>
</tr>
<tr>
<td>Ethernet 1</td>
<td>Dependent on Ethernet connection status</td>
</tr>
<tr>
<td>Ethernet 2</td>
<td>Dependent on Ethernet connection status</td>
</tr>
</tbody>
</table>

8. Turn the locking screw on the front of the module a 1/4 turn clockwise to lock, by using a 9 mm screwdriver. Each module has a locking screw that secures it to its base unit. The module has an interlock that detects when a module is locked or unlocked.

**IMPORTANT** Modules run only in the locked position.

For information about the functionality of the Reset button, see **Reset Button on page 289**.

**Assign an IP Address**

Before you can use the hardware, you must assign an IP address to the primary adapter. This is done by associating an IP address to the MAC address of the primary hardware component, in this case, the adapter base unit.

Assign only one primary IP address to the MAC address.

You only assign one IP address to this hardware. The firmware automatically assigns the secondary IP address, which is the primary IP address + 1. The secondary module is not visible in the RSLinx® Classic RSWho tool. It responds to an Ethernet ping of its IP address.
Any BOOTP/DHCP server can be used to assign IP addresses.

**Step 1: Assign an IP Address on the BOOTP/DHCP Server**

To assign an address, follow this procedure to launch the BOOTP/DHCP server.

1. From the Start button, choose Programs>Rockwell Software®>BOOTP-DHCP Server>BOOTP-DHCP Server.


These settings are transmitted to the module along with your IP address, so verify that they are the correct settings.
**IMPORTANT**

- The adapter must be physically connected to the network running the BOOTP server.
- Multiple MAC address requests are received. The lowest MAC addresses correspond to the leftmost adapter slot, or primary adapter. Do not assign an IP address to the higher MAC address requests, as these addresses correspond to the rightmost adapter slot, or secondary module.
- We recommend that you manually enter the MAC address. Sometimes the settings of your personal computer can prevent you from obtaining MAC address requests from your BOOTP/DHCP server. Please check the documentation for your BOOTP/DHCP server for more help. Refer to Knowledge Base article 32648 for more details. [https://rockwellautomation.custhelp.com/app/answers/detail/a_id/32648](https://rockwellautomation.custhelp.com/app/answers/detail/a_id/32648)
- The MAC address is found on the label on the front of the adapter backplane. The top MAC address corresponds to the primary adapter in the leftmost slot.
3. Click OK.

The Request History panel displays the hardware addresses of modules issuing BOOTP requests.

4. Click New to type in the MAC address.

5. Enter the MAC address that you found at the top of the label on the adapter backplane.

6. Double-click the hardware (MAC) address of the module to be configured.

The New Entry window appears.

7. Enter the MAC address in the Ethernet Address (MAC): field.
8. Enter the IP address that you want to use in the IP address field.

9. Click OK.

**IMPORTANT**
- IP addresses can be recovered, if needed, in the Module Properties tab.
- The second adapter (rightmost) has a MAC address that is the first adapter's (leftmost) MAC address + 2 in HEX.

10. Click Disable BootP/DHCP to set from dynamic to static.

**Step 2: Configure the Module with RSLinx Classic Software**

To use RSLinx Classic software to configure the adapter on the Ethernet network, follow these steps.

1. Launch RSLinx Classic software.
2. From the Communications menu, choose RSWho.
3. Navigate in RSWho to the Ethernet network.
4. If a 1715 device is not recognised a question mark will be displayed instead of the icon of the module or backplane. Right-click on the device and select "Upload EDS file from device".
5. Right-click the 1715 EtherNet/IP module and choose Module Configuration.

6. Click the Port Configuration tab.

The Module Configuration dialog box appears.

7. For Network Configuration Type, click **Static** to assign this configuration to the port.
   a. In the IP Address field, verify the IP address.
   b. In the Network Mask field, verify the network mask address.

   The other fields are optional depending on your network and/or IT requirements. Verify or complete as needed.
8. Click OK.

**Install the I/O Modules**

The I/O modules that are used for the 1715 Redundant I/O system are as follows:

- 1715-IB16D 16-channel digital input module
- 1715-OB8DE 8-channel digital output module
- 1715-IF16 16-channel analog input module
- 1715-OF8I 8-channel analog output module

**Figure 60 - I/O Modules**

Modules are installed by pressing them onto the 1715-A3IO three-slot base unit. Follow these steps.

1. Inspect the connector pins, see page 102.
2. Inspect the identification labels on the sides of the modules and record the location and the module information that is shown on the label. This helps you when installing a new or replacement module in the future by allowing you to order the replacement parts without disturbing the system.

3. Check the coding pegs on the termination assembly and verify that they match the sockets on the back of the I/O module, see page 102.
4. Verify that the slot on the head of the module clamp screw is vertical, see page 102.
5. Place the new module on to the dowel pin on the I/O base unit, see page 103.

6. Push the module in until the connectors are fully mated.

The status indicators listed in Table 14 illuminate depending on which module you are installing. The table is a quick installation reference. For more detailed status indicator information, see Appendix A.

Table 14 - Start-up Sequence

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Status</td>
<td>Green</td>
</tr>
<tr>
<td>Redundancy Status</td>
<td>Off</td>
</tr>
<tr>
<td>Network Status</td>
<td>Red</td>
</tr>
<tr>
<td>Channel 0...7, 8...15</td>
<td>Off</td>
</tr>
</tbody>
</table>

7. Turn the locking screw on the front of the module a 1/4 turn clockwise to lock, see page 104.
   - The Redundancy Status indicator of the 1715-IB16D digital input module shows RED when the screw is locked.
   - The Redundancy Status indicator of the 1715-IF16 analog input module shows RED when the screw is locked.

The module enters its start-up sequence. This takes approximately 3 seconds.

If the module is the first module in a TA group with a running adapter, it displays the following status indicators. See Table 15.
8. If the module is installed next to other modules that are already online, the start-up sequence completes.

When startup is complete, the status indicators light as follows.

If the module fails to go online, see the troubleshooting guide in Chapter 9.

**Install Slot Filler Covers**

To install the slot filler covers, follow these steps.

1. Place a slot filler cover on the empty slot.
2. Screw the clamp screw 90° to the lock position by using a 9 mm screwdriver.

**Remove Modules**

Modules can be removed online without shutting down the system or upsetting the process in redundant configurations only. However, pulling out simplex module impacts the process.
Remove modules by carefully pulling them out of the base unit by using this procedure.

1. Turn the locking screw on the front of the module 1/4 turn counterclockwise.

The screw slot is vertical when the module is unlocked.

2. Carefully remove the module from the base unit.

**IMPORTANT** Make sure that you pull the module straight out when removing it from the base unit. Do not rock, or tilt the module while pulling it out, as it could damage the dowel pins.
Security

Protected Mode Strategy

The adapter uses the implicit Input/Output I/O) strategy to enter and exit protected mode. The use of an implicit I/O strategy means that no user action is required to enter or leave protected mode. Actions prevented in protected mode are listed in Table 16 below.

The 1715-AENTR recovery image does not support I/O (so does not enter protected mode) and so ControlFLASH™ is available at any time.

Table 16 - Actions that are prevented in Protected Mode

<table>
<thead>
<tr>
<th>List No.</th>
<th>Prevented Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The reset of the 1715-AENTR is prohibited if it is producing or consuming I/O or if it is bridging to an I/O module.</td>
</tr>
<tr>
<td>2.</td>
<td>The reset of an I/O module is prohibited if it is producing or consuming I/O.</td>
</tr>
<tr>
<td>3.</td>
<td>The ControlFlashing of a 1715-AENTR is prevented when in protected mode.</td>
</tr>
</tbody>
</table>

The 1715-AENTR recovery image does not support I/O (so does not enter protected mode) and so ControlFLASH™ is available at any time.

Web-Server Control Enable / Disable

The 1715-AENTR contains a web-server that can provide diagnostic information to a web browser.

In revision 3.x and later the web-server is disabled by default. In revision 2.x and earlier the web-server is always enabled.

In revision 3.x and later the web-server can be enabled/disabled via the Security tab of the 1715-AENTR module Add On Profile, as shown in Figure 61 below.

To access the diagnostic information a user must direct their web browser to the IP address assigned to the 1715-AENTR.
Figure 61 - Checkbox to enable web-server

WARNING!

To protect against security threats you are advised not to enable the Webserver.

Enable Webserver
Chapter 4

Digital I/O Operation

1715 Digital Module Overview

The 1715 digital I/O modules are I/O modules that provide On/Off detection and actuation. By using the Producer-Consumer network model, digital I/O modules can produce information when needed while providing more system functions.

The 1715 digital I/O modules mount in a 1715 Redundant I/O System and use an I/O termination assembly that is mounted in an I/O base unit to communicate via redundant 1715 adapters.

Before you install and use your module, you must do the following:

- Install and ground a user-supplied, 24V DC power supply.
- Determine if you are using your digital I/O module in Simplex or Duplex mode.
- Install the correct termination assembly that is based on your determination for either simplex or duplex operation.
- Configure the project in RSLogix 5000® software or the Logix Designer application to accept the number and type of modules for the project.

Each digital I/O module is an isolated module that plugs into one position of the I/O base unit and a termination assembly that is mounted to the base unit. Digital I/O modules can be configured in RSLogix™ programming software as simplex or duplex and then by selecting one of the two available termination assemblies and the required number of modules.

Termination assemblies provide termination for the field I/O channels and, by the use of coding pegs and sockets, are matched to a specific digital I/O module. Module keying can also be set in the project. Field connections are made at the terminal block connectors on the termination assembly.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715 Digital Module Overview</td>
<td>117</td>
</tr>
<tr>
<td>Determining Input Module Compatibility</td>
<td>119</td>
</tr>
<tr>
<td>Determining Output Module Compatibility</td>
<td>120</td>
</tr>
<tr>
<td>Using Features Common to 1715 Standard Digital I/O Modules</td>
<td>120</td>
</tr>
<tr>
<td>Features Specific to 1715-IB16D Digital Input Modules</td>
<td>122</td>
</tr>
<tr>
<td>Features Specific to 1715-OB8DE Digital Output Modules</td>
<td>124</td>
</tr>
<tr>
<td>Fault and Status Reporting between Input Modules and Controllers</td>
<td>132</td>
</tr>
<tr>
<td>Fault and Status Reporting between Output Modules and Controllers</td>
<td>132</td>
</tr>
</tbody>
</table>
The digital I/O modules and termination assemblies for the 1715 Redundant I/O System are as follows.

**Types of ControlLogix Digital I/O Modules and Components**

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-IB16D</td>
<td>16-channel digital input module</td>
</tr>
<tr>
<td>1715-OB8DE</td>
<td>8-channel digital output module</td>
</tr>
<tr>
<td>1715-TASIB16D</td>
<td>16-channel digital input simplex termination assembly</td>
</tr>
<tr>
<td>1715-TADIB16D</td>
<td>16-channel digital input duplex termination assembly</td>
</tr>
<tr>
<td>1715-TASOB8DE</td>
<td>8-channel digital output simplex termination assembly</td>
</tr>
<tr>
<td>1715-TADOB8DE</td>
<td>8-channel digital output duplex termination assembly</td>
</tr>
</tbody>
</table>

**1715-IB16D Digital Input Module**

The digital input interface is a combination of digital input modules and termination assemblies. The 24V DC isolated digital input modules have a flexible and fail-safe design. The 1715-IB16D interfaces 16 digital input channels and can be configured in RSLogix programming software as simplex or duplex by selecting one of the two available termination assemblies and the required number of modules.

**IMPORTANT** When the 1715-IB16D digital input module is used with the 1715-TASIB16D simplex termination assembly, it is nonisolated.

The 1715-IB16D digital input module features are as follows:

- Flexible, modular construction for user-configured I/O applications
- 16-channel connection capability
- Suitable for simplex, duplex connections, and fault tolerant applications
- Independent, galvanically isolated input channels
- Built-in diagnostic testing and independent watchdog facility
- Module removal and replacement online and, when in Duplex mode, no interruption of the signal inputs
- Input voltage data is provided for line monitoring and field fault detection
- Timestamp value per channel recording the time of any transition of state from ON->OFF or OFF->ON. Note that this value will be overwritten with each change of state of the input.

**1715-OB8DE Digital Output Module**

The digital output module interface consists of a combination of digital output modules and digital output termination assemblies. Each module provides 8 isolated output channels and plugs into one position of the I/O base unit and a corresponding termination assembly. Digital outputs can be configured as simplex or duplex.

The 1715-OB8DE digital output module has a flexible, fail-safe design, with eight field output channels. The module output can be up to 1A continuous for each channel.
Chapter 4          Digital I/O Operation

The 1715-OB8DE digital output module features are as follows:

- Eight isolated output channels per module
- Fail-safe design and operation
- Suitable for simplex and duplex connections for fault tolerant applications
- Duplex series output switches with overload protection for each channel
- Voltage and current monitoring on each channel with reverse current protection
- Short circuit and open circuit line fault detection
- Dual redundant field power feed capabilities without the need for external diodes
- When fitted in duplex configuration, modules can be replaced online without system interruption

**ATTENTION:** Maintenance must be performed only by qualified personnel, otherwise, personal injury or death, or damage to the system can result.

Common Features

The table lists several features available on 1715 digital I/O modules.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal and Insertion Under Power (RIUP)</td>
<td>You can remove and insert modules while power is applied.</td>
</tr>
<tr>
<td>Module level fault reporting and field-side diagnostic detection</td>
<td>Fault and diagnostic detection capabilities that provide you the information necessary to most effectively and efficiently use your module and troubleshoot your application.</td>
</tr>
</tbody>
</table>

Determining Input Module Compatibility

The 1715 digital input modules interface to sensing devices and detect whether they are ON or OFF. The 1715 digital input modules convert DC ON/OFF signals from user devices to appropriate logic level for use within the 1715 Redundant I/O System. Typical input devices include the following:

- Proximity switches
- Limit switches
- Selector switches
- Float switches
- Push button switches

When designing a system by using 1715 digital input modules, you must consider these items:

- The voltage necessary for your application
- Whether you need a solid state device
- Current leakage
- If your application uses sinking or sourcing wiring

For more information on digital input modules, see the 1715 Technical Specifications, publication 1715-TD001.
Termination Assemblies

There are two types of termination assemblies for the digital input modules. The application of your system determines which termination assembly you need:

- 1715-TASIB16D 16-channel, digital input simplex termination assembly
- 1715-TADIB16D 16-channel, digital input duplex termination assembly

Determining Output Module Compatibility

1715 digital output modules can be used to drive various output devices. Typical output devices compatible with the 1715 digital outputs include the following:

- Motor starters
- Solenoids
- Indicators

When designing a system, do the following:

- Make sure that the outputs can supply the necessary surge and continuous current for proper operation.
- Make sure that the surge and continuous current are not exceeded. Damage to the module could result.

When sizing output loads, check the documentation that is supplied with the output device for the surge and continuous current necessary to operate the device.

The 1715 digital outputs can directly drive the 1715 digital inputs. The exceptions are DC diagnostic input modules. When diagnostics are used, a shunt resistor is required for leakage current.

For more information specifically on the compatibility of motor starters to output modules, see ControlLogix Digital I/O Modules, publication 1756-UM058.

Termination Assemblies

There are two types of termination assemblies for the digital output modules. The application of your system determines which termination assembly you need:

- 1715-TASOB8DE 8-channel, digital output, simplex termination assembly
- 1715-TADOB8DE 8-channel, digital output duplex termination assembly

Using Features Common to 1715 Standard Digital I/O Modules

The following features are common to all 1715 digital I/O modules.

Removal and Insertion Under Power (RIUP)

All 1715 digital I/O modules can be inserted and removed from the I/O base unit while power is applied. This feature lets you have greater availability of the
overall control system because, while the module is being removed or inserted, there is no additional disruption to the rest of the controlled process.

Module Fault Reporting

1715 digital I/O modules provide hardware and software indication when a module fault has occurred. The status indicator of each module, and the Logix Designer application, graphically displays this fault and includes a fault message describing the nature of the fault. This feature lets you determine how your module has been affected and what action must be taken to resume normal operation.

Fully Software Configurable

The Studio 5000 Logix Designer® application uses a custom, easily understood interface to write configuration. All module features are enabled or disabled through the I/O configuration portion of the software. You can also use the software to interrogate any module in the system to retrieve the following:

- Vendor
- Product Type
- Product Code
- Revision
- Serial Number
- Product Name

By eliminating such tasks as setting hardware switches and jumpers, the software makes module configuration easier and more reliable.

Module Inhibiting

Module inhibiting lets you indefinitely suspend a connection between an owner-controller and a digital I/O module without having to remove the module from the configuration. This process lets you temporarily disable communication to a module, such as to perform maintenance. You can do this in the following ways:

- You write configuration for an I/O module but inhibit the module to prevent it from communicating with the owner-controller. In this case, the owner does not establish a connection and configuration is not sent to the module until the connection is uninhibited.
- In your application, a controller already owns a module, has downloaded configuration to the module, and is exchanging data over the connection between the devices. In this case, you can inhibit the module and the owner-controller behaves as if the connection to the module does not exist.
These examples are instances where you can use module inhibiting:

- You want to upgrade / replace digital I/O modules. This procedure is only required when either changing / replacing a single simplex module or when both duplex modules are removed before one is replaced. We recommend that you do the following.
  a. Inhibit the module.
  b. Perform the upgrade (module change).
  c. Uninhibit the module.

- You are using a program that includes a module that is not physically installed, but you do not want the controller to look for a module that does not exist yet. In this case, you can inhibit the module in your program until it physically resides in the proper slot.

### Status Indicator Information

Each 1715 digital I/O module has a status indicator on the front of the module that lets you check the module health and operational status of a module. The status indicator displays vary for each module.

See Appendix A, 1715 Digital Input Module on page 286, for detailed status indicator information.

### Features Specific to 1715-IB16D Digital Input Modules

The features that are described in this section are available on 1715 digital input modules.

### Data Transfer on Either Cyclic Time or Change of State

Digital input modules always send data at the RPI, but they send data only at a change of state if the COS feature is enabled. COS is more efficient than RPI because it multicasts data only when a change occurs.

The table describes the two ways a module sends data to the owner-controller.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requested packet interval</td>
<td>A user-defined rate at which the module updates the information sent to its owner-controller. This is also known as Cyclic Data Transfer.</td>
</tr>
<tr>
<td>Change of state</td>
<td>Configurable feature that, when enabled, instructs the module to update its owner-controller with new data whenever a specified input point transitions from On to Off and Off to On. The data is sent at the RPI rate when there is no change of state. By default, this setting is always enabled for input modules.</td>
</tr>
</tbody>
</table>
Set RPI

The Connection tab on the Module Properties dialog box lets you enter a requested packet interval (RPI). The RPI guarantees the slowest rate at which data is multicast to the owner-controller.

The actual data transfer rate of the module can be faster than the RPI setting. But, the RPI provides a defined, maximum period when data is transferred to the owner-controller.

1. Choose from the options in the Connection tab.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requested Packet Interval (RPI)</td>
<td>Enter an RPI value or use the default.</td>
</tr>
<tr>
<td>Inhibit Module</td>
<td>Check the box to prevent communication between the owner-controller and the module. This option lets the module be maintained without faults being reported to the controller.</td>
</tr>
<tr>
<td>Major Fault On Controller If Connection Fails While in Run Mode</td>
<td>Check the box to create a major fault if there is a connection failure with the module while in Run mode. For important information on this checkbox, see 'Configure a Major Fault to Occur' in the Logix 5000™ Controllers Information and Status Programming Manual, publication 1756-PM015.</td>
</tr>
</tbody>
</table>
| Use Unicast Connection over EtherNet/IP | Choose between Unicast and Multicast for EtherNet/IP connections. This checkbox is enabled when the module supports Unicast at the current revision and any part of the module path crosses EtherNet/IP. It is checked and dimmed when the module supports only Unicast and any part of the module path crosses the EtherNet/IP network. The checkbox is not checked and dimmed if these conditions are true:  
  - The current revision of the module does not support Unicast. If a module is Multicast only, no revision supports Unicast.  
  - The module is proxied (for example, 1734, 1738 and 1794 modules) and the current revision of the parent does not support Unicast. Unicast is not supported with ControlLogix® Redundancy, version 19.52. For more details refer to Knowledge Base article 118315.  
  https://rockwellautomation.custhelp.com/app/answers/detail/a_id/118315 |

2. Click OK.

Enable Change of State

The Point column (on the left side of the Configuration tab) lets you determine whether a change of state occurs when a field device becomes Off to On or On to Off.
1. On the Module Properties dialog box, click the Configuration tab.

![Configuration Tab](image)

2. Do one of the following:
   - Check a checkbox to enable COS for a specific point for either Off to On or On to Off.
   - Clear the checkbox to disable the COS for a specific point.
3. Click OK.

See Threshold Values for Digital Inputs on page 261 for setting custom threshold configurations.

**Field-side Diagnostics**

If using the 1715-IB16D thresholds, you are responsible for designing a circuit that provides unique voltage levels for Wire OFF, OFF, ON, and shorted to 24V DC. This typically involves an inline and shunt resistor. Typical values for the inline resistor are 3.9 kΩ. A typical value for the shunt resistor is 15 kΩ. This generates an OFF voltage of 5V DC and an ON voltage of 14V DC if the supply voltage is 24V DC.

The digital input module can detect the voltage level, much like an analog input module. There are no circuit tests on field wiring. You define your diagnostic granularity by using custom thresholds that are built in to the channel configuration. For full diagnostics, you design a circuit for which the OFF state is, for example, 5V DC, and the ON state, which is, for example, 15V DC. Wire OFF creates 0V DC, which falls below the OFF threshold, and OpenWire fault status is set HI. A short to 24V DC is above the ON threshold, and Short Circuit fault status is sent HI.

**Features Specific to 1715-OB8DE Digital Output Modules**

The features that are described in this section are available on all 1715 digital output modules.
Field Power Status Integers

The field power status integers (all DINT) supply data to the application, about the field power supplies to a group of digital output modules.

Group Field Power Current

Values:
- 0 to 8,000 mA or greater (limited by capacity of DINT variable)

Description:
Reports the total current that all the active digital output modules in a group are drawing from the field power supply. Accuracy is ±10%.

Field Power Voltage 1

Values:
- 0 to 48,000 mV or larger (limited by capacity of DINT variable)

Description:
Reports the voltage from the field power supply for the specified module and field power input. Accuracy is ±500 mV.

Field Power Voltage 2

Values:
- 0 to 48,000 mV or larger (limited by capacity of DINT variable)

Description:
Reports the voltage from the field power supply for the specified module and field power input. Accuracy is ±500 mV.

Field Fault Detection

Detection criteria differs depending on whether the output is energized or de-energized.

Energized open circuit

Current per channel is <10 mA regardless of whether the digital output module is on its own or in dual pair.

Energizing short circuit

When energizing, the output switch is set to flow a constant current of 2.5 A for up to 50 ms (5 A if dual module). If the voltage across the output switch fails to fall below 3 V within this time, then the output load is deemed to be short circuited and the output is switched off.
Energized short circuit

After the output is energized a different calculation is used. Any current in excess of 2.5 A (5 A if a dual module) is integrated and the duration time is multiplied by current; the product is energy. The current and corresponding duration are measured and compared with the output switch ratings.

The following list shows the nominal times for which particular bands of current are tolerated before the switch declares short circuit and de-energizes:

- $< 5$ A: 25.7 ms
- $\geq 5$ A, $< 10$ A: 3.2 ms
- $\geq 10$ A, $< 15$ A: 1.7 ms
- $\geq 15$ A, $< 20$ A: 1.0 ms
- $\geq 20$ A: 0.9 ms

These times also account for additional delays associated with current filtering implemented to reduce impact of Electro-Magnetic Interference (EMI).

Energized field fault

A field fault is declared when the channel voltage is $\geq 1$ V above the field supply voltage (VF).

De-energized open circuit

The channel voltage is pulled up to $(VF/2)-0.75$ V, through an impedance of 26 kΩ in each module (so 13 kΩ for a dual pair) when open circuit and de-energized. In this state it is declared as open circuit if the channel voltage is within the band of voltage around this point.

The load must draw the channel voltage down below $(VF/3)$ for it to be seen as present, so it must still flow a small current when de-energized. The current can be calculated as:

$$\frac{((VF/6)-0.75 \text{ V})}{\text{impedance}}$$

Where the impedance is 26 kΩ or 13 kΩ as above.

De-energized short circuit

A short circuit cannot be detected when de-energized without a partial supply of current.

The output current is ramped up until it reaches 50 mA, or the output electro motive force (EMF) increases by 2 volts, or the calculated energy of the pulse reaches 5 mJ (a timeout condition also exists to catch module faults but this is of no concern to short circuit detection). Having reached either threshold, the actual change in voltage is divided by the actual change in current to yield a value representing the field load resistance. If this is less than 10 Ω then a short circuit is declared. The test currently occurs once per minute sequenced across all output modules.
Chapter 4          Digital I/O Operation

Configurable Point-level Output Fault States

Individual outputs can be independently configured to unique fault states, either On, Off, or Hold if there is a communication failure or Program mode.

Follow these steps to enable a fault state.

1. On the Module Properties dialog box, click the Configuration tab.

2. Choose the Fault mode.

   Click OK.

Output Data Echo

- Inhibiting a module is handled the same way as a communication failure.
- Setting the radio button to "Leave outputs in Program Mode state" will cause the outputs to go to the Program Mode state when inhibited.
- Setting the radio button to "Change outputs to Fault Mode state" will cause the outputs to go to the Fault Mode state when inhibited.

During normal operation, when a processor sends out an output command to the 1715 system, the output module that is targeted for that command returns the commanded state of the output to the system. This process verifies that the module has received the command and tries to execute it.
Monitor Fault Bits

The Output Data Echo matches only the commanded state of the outputs if the module is operating under normal conditions. If there is an anomaly with the module, the commanded state and the Output Data Echo cannot match.

You can monitor the fault bits for your output points for fault conditions. If a fault occurs, the fault bit is set and your program alerts you to the condition. In this case, the output data echo cannot match the commanded state of the outputs.

If there is a mismatch between the commanded state of the outputs and the Output Data Echo, check your output module for these conditions:

- Communication fault
- Connection is inhibited
- Blown fuse - Module does not turn on output if overload/short circuit is detected

Fusing

Some digital outputs have internal electronic or mechanical fusing to prevent too much current from flowing through the module. This feature helps protect the module from electrical damage. Other modules require external fusing.

The 1715-OB8DE module uses electronic fusing.

You can reset an electronic fuse through the Logix Designer application or through ladder logic running on a controller. This feature has a corresponding tag that can be examined in the user program in the event of a fault.

See Table 18 to determine what fuse to use in your application.

Table 17 - Recommended Fuses

<table>
<thead>
<tr>
<th>Circuit Type</th>
<th>Cat. No.</th>
<th>Fusing on the module</th>
<th>Recommended Fuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>1715-OB8DE(1)(2)(3)</td>
<td>Yes - Fused on a per point basis</td>
<td>Electronically fused</td>
</tr>
</tbody>
</table>

(1) Electronic protection is not intended to replace fuses, circuit breakers, or other code required wiring protection devices.
(2) The electronic protection of this module has been designed to provide protection for the module from short circuit conditions. The protection is based on a thermal cut-out principle. If there is a short circuit condition on an output channel, that channel limits the current within milliseconds after its thermal cut-out temperature has been reached.
(3) The module does not provide protection against reverse polarity or wiring to AC power sources.

Follow these steps to reset a fuse.

1. On the Module Properties dialog box, click the Configuration tab.
2. Click Reset for a particular point on the module to reset a fuse.
3. Click OK.

**Diagnostic Latch Information**

Diagnostic latching lets this module latch a fault in the set position once it has been triggered, even if the error condition causing the fault to occur disappears.

The Reset Diagnostic Latch service can clear latched diagnostic features.

**IMPORTANT** Diagnostic latches are also reset through a software reset or when the power is cycled for the I/O module.

Follow these steps to enable diagnostic latch of information.
1. On the Module Properties dialog box, click the Configuration tab.
2. Do one of the following:
   - Check a checkbox to enable diagnostic latching for a specific point.
   - Clear the checkbox to disable diagnostic latching for a specific point.

3. Click OK.

**Shutdown State**

The output module shutdown state defines the behavior of the output module if communications to the module fail within the timeout period or if the processor is put into Program mode. This occurs on a channel-by-channel basis. These principles apply for the 1715 analog and digital output modules.

The shutdown state can be configured to these values:

- On-energize
- Off-de-energize
- Hold last state
During normal operation with an adapter present, the state of the outputs can be configured when no connections from a Logix controller are active.

Analog output modules can be configured to OFF, HOLD LAST VALUE, or GOTO SPECIFIED VALUE.

**IMPORTANT** In Shutdown mode, the analog output module will TURN OFF all channel status indicators irrespective of the value being output.

**Energize-on-communication-failure**

The 1715 Redundant I/O System can be a part of an energize-on communication failure system. This means that during a system fault, the output module can be set so that the output is energized. This is on a point-by-point basis. The following are examples of energize-to-trip uses:

- A fan that runs a ventilation system
- Emergency lights

**De-energize-to-trip**

During output, when a system fault occurs, the output module can be set so that the output is de-energized. This is on a point-by-point basis. The following are examples of de-energize-to-trip uses:

- Motor starters
- Safety contactors

**Disable Line Test**

The digital output module incorporates line test functionality that can report and indicate 'no load' field faults. This functionality can be enabled or disabled by checking or unchecking the box. This is on a point-by-point basis.
Chapter 4  Digital I/O Operation

Fault and Status Reporting between Input Modules and Controllers

The 1715 digital input modules unicast fault and status data to any owner-controllers. All input modules maintain a module-fault word, the highest level of fault reporting. Additional fault information is provided in separate tags.

The table lists the tag that can be examined in ladder logic to indicate when a fault has occurred for a standard input module.

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module-fault word</td>
<td>This word provides fault summary reporting. Its tag name is Fault. This word is available on all digital input modules.</td>
</tr>
<tr>
<td>Fault</td>
<td>DINT Fault (Radix = Binary) - 0 at least one module present</td>
</tr>
<tr>
<td></td>
<td>- FFFFFFFF No Logix connection, all additional tags are not valid</td>
</tr>
<tr>
<td>Simplex Digital Input Module Additional Tags Include</td>
<td></td>
</tr>
<tr>
<td>GroupFault</td>
<td>BIT - 1 if any point on the module is faulted/failed</td>
</tr>
<tr>
<td>PtFault</td>
<td>INT (Radix = Binary) - 1 bit per point 0...15; 1 if point is faulted/failed</td>
</tr>
<tr>
<td>OpenWire</td>
<td>INT (Radix = Binary) - 1 bit per point 0...15; 1 indicates open wire</td>
</tr>
<tr>
<td>ShortCircuit</td>
<td>INT (Radix = Binary) - 1 bit per point 0...15; 1 indicates short circuit</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>INT (Radix = Binary) - 1 bit per point 0...15; 1 indicates indeterminate</td>
</tr>
<tr>
<td>Duplex Digital Input Module Additional Tags Include</td>
<td></td>
</tr>
<tr>
<td>ModAFault</td>
<td>BOOL - 0 Good, 1 fault or module not present</td>
</tr>
<tr>
<td>ModBFault</td>
<td>BOOL - 0 Good, 1 fault or module not present</td>
</tr>
<tr>
<td>GroupFault</td>
<td>BOOL - 1 if any point on either module is faulted/failed</td>
</tr>
<tr>
<td>ModAGroupFault</td>
<td>BOOL - 1 if any point on Module A is faulted/failed</td>
</tr>
<tr>
<td>ModBGroupFault</td>
<td>BOOL - 1 if any point on Module B is faulted/failed</td>
</tr>
<tr>
<td>PtFault</td>
<td>INT (Radix = Binary) - 1 bit per point 0...15; 1 if point is faulted/failed</td>
</tr>
<tr>
<td>ModAPIFault</td>
<td>INT (Radix = Binary) - 1 bit per Channel 0...15; 1 if channel has failed on module A</td>
</tr>
<tr>
<td>ModBPIFault</td>
<td>INT (Radix = Binary) - 1 bit per Channel 0...15; 1 if channel has failed on module B</td>
</tr>
<tr>
<td>OpenWire</td>
<td>INT (Radix = Binary) - 1 bit per point 0...15; 1 indicates open wire</td>
</tr>
<tr>
<td>ShortCircuit</td>
<td>INT (Radix = Binary) - 1 bit per point 0...15; 1 indicates short circuit</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>INT (Radix = Binary) - 1 bit per point 0...15; 1 indicates indeterminate</td>
</tr>
</tbody>
</table>

All words are 32-bit, although only the number of bits appropriate for the density of each module are used.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Set Bits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication fault</td>
<td>All 32 bits are set to 1, regardless of the module's density.</td>
</tr>
</tbody>
</table>

This illustration offers an overview of the fault reporting process on 1715 standard digital input modules.

A communication fault sets all bits in the module-fault word.

Fault and Status Reporting between Output Modules and Controllers

The 1715 digital output modules unicast fault and status data to any owner-controllers. All output modules maintain a module-fault word, the highest level of fault reporting. Additional fault information is provided in separate tags.

The table lists the tags that can be examined in ladder logic to indicate when a fault has occurred for a standard output module.
## Digital I/O Operation

### Simplex Digital Output Module Tags Include

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault</td>
<td>DINT Fault (Radix = Binary) - 0 at least one module present, data good</td>
</tr>
<tr>
<td></td>
<td>- FFFFFFFF No Logix connection, data bad, all additional tags are not valid</td>
</tr>
<tr>
<td>ReadBack</td>
<td>SINT (Radix = Binary) - 1 bit readback per point 0...7</td>
</tr>
<tr>
<td>GroupFault</td>
<td>BOOL - 1 if any point on the module is faulted/failed</td>
</tr>
<tr>
<td>PtFault</td>
<td>SINT (Radix = Binary) - 1 bit per point 0...7; 1 if point is faulted/failed</td>
</tr>
<tr>
<td>NoLoad</td>
<td>SINT (Radix = Binary) - 1 bit per point 0...7; 1 indicates no load</td>
</tr>
<tr>
<td>ShortCircuit</td>
<td>SINT (Radix = Binary) - 1 bit per point 0...7; 1 indicates short circuit</td>
</tr>
</tbody>
</table>

### Duplex Digital Output Module Tags Include

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault</td>
<td>DINT Fault (Radix = Binary) - 0 at least one module present</td>
</tr>
<tr>
<td></td>
<td>- FFFFFFFF No Logix connection, all additional tags are not valid</td>
</tr>
<tr>
<td>ReadBack</td>
<td>SINT (Radix = Binary) - 1 bit readback per point 0...7</td>
</tr>
<tr>
<td>ModAFault</td>
<td>BOOL - 0 Good, 1 fault or module not present</td>
</tr>
<tr>
<td>ModBFault</td>
<td>BOOL - 0 Good, 1 fault or module not present</td>
</tr>
<tr>
<td>GroupFault</td>
<td>BOOL - 1 if any point on either module is faulted/failed</td>
</tr>
<tr>
<td>ModAGroupFault</td>
<td>BOOL - 1 if any point on Module A is faulted/failed</td>
</tr>
<tr>
<td>ModBGroupFault</td>
<td>BOOL - 1 if any point on Module B is faulted/failed</td>
</tr>
<tr>
<td>PtFault</td>
<td>INT (Radix = Binary) - 1 bit per point 0...15; 1 if point is faulted/failed on both modules</td>
</tr>
<tr>
<td>ModAPtFault</td>
<td>INT (Radix = Binary) - 1 bit per Channel 0...15; 1 if channel has failed on module A</td>
</tr>
<tr>
<td>ModB PtFault</td>
<td>INT (Radix = Binary) - 1 bit per Channel 0...15; 1 if channel has failed on module B</td>
</tr>
<tr>
<td>NoLoad</td>
<td>SINT (Radix = Binary) - 1 bit per point 0...7; 1 indicates no load</td>
</tr>
<tr>
<td>ShortCircuit</td>
<td>SINT (Radix = Binary) - 1 bit per point 0...7; 1 indicates short circuit</td>
</tr>
</tbody>
</table>
Notes:
### Using 1715 Analog I/O Module Features

#### 1715 Analog Module Overview

The 1715 analog I/O modules mount in a 1715 Redundant I/O System and use an I/O termination assembly that is mounted in an I/O base unit to communicate via redundant 1715 adapters.

Before you install and use your module, you must do the following:

- Install and ground a user-supplied, 24V DC power supply.
- Determine whether you are using your analog I/O module in Simplex or Duplex mode.
- Install the correct termination assembly that is based on your determination for either simplex or duplex operation.

Each analog I/O module is an isolated module that plugs into one position of the I/O base unit and a termination assembly that is mounted to the base unit. Analog I/O modules can be configured in Logix Designer programming software as simplex (not redundant) or duplex (redundant).

Termination assemblies provide termination for the field I/O channels and, by the use of coding pegs and sockets, are matched to a specific analog I/O module. Module keying can also be set in the RSLogix 5000® or Logix Designer project. Field connections are made at the terminal block connectors on the termination assembly.

The analog I/O modules and termination assemblies for the 1715 Redundant I/O System are as follows.

#### Table 18 - Types of ControlLogix® Analog I/O Modules and Components

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-IF16</td>
<td>16-channel analog input module</td>
</tr>
<tr>
<td>1715-OF8I</td>
<td>8-channel analog output module</td>
</tr>
<tr>
<td>1715-TASIF16</td>
<td>16-channel analog input simplex termination assembly</td>
</tr>
<tr>
<td>1715-TADIF16</td>
<td>16-channel analog input duplex termination assembly</td>
</tr>
<tr>
<td>1715-TASOF8I</td>
<td>8-channel analog output simplex termination assembly</td>
</tr>
<tr>
<td>1715-TADOF8I</td>
<td>8-channel analog output duplex termination assembly</td>
</tr>
</tbody>
</table>
**1715-IF16 Analog Input Module**

The analog input interface is a combination of input modules and analog input termination assemblies. The 16-channel analog input module has a flexible and fail-safe design.

The 1715-IF16 analog input module features are as follows:

- Flexible, modular construction for user-configured I/O applications
- 16-channel connection capability
- Suitable for simplex, duplex connections, and fault tolerant applications
- Independent, galvanically isolated input channels
- Built-in diagnostic testing and independent watchdog facility
- Module removal and replacement online and, when in Duplex mode, no interruption of the signal inputs

The internal isolated power supply from the 24V DC dual redundant system power inputs produces module power. The isolated power supply provides power to the module and is protected by over-voltage and undervoltage detection circuits. Supply voltage monitoring initiates a warning signal and Power-off Protection mode when a power failure is detected.

Internal diagnostics test the module at routine intervals. An independent watchdog arrangement also monitors the module operation and provides more fault containment by activating a shutdown mechanism when a fault is detected.

**IMPORTANT** If a fault occurs during normal operation in a duplex configured system, an input module can be removed and replaced without disrupting the input signals to a live system.

The adapter also monitors the input data paths and can detect faults within each input channel. A visual indication of the module status and individual channel status is provided by an array of front panel indicators and can be connected to application variables and viewed in the Logix Designer application.

The termination assemblies can accept one or two input modules. Each termination assembly provides passive signal load termination and over-voltage protection for each input channel. The system provides flexible input connectivity by mating specific termination assemblies with the relevant number of input modules.

**Table 19 - Performance Criteria for the Analog Input Module**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Input value least significant bit</td>
<td>0.98 µA</td>
</tr>
<tr>
<td>Channel Measurement Error at 25 °C (77 °F) ± 2 °C (± 3.6 °F) After 1 year at 40 °C (104 °F)</td>
<td>0.21% ± 10 µA</td>
</tr>
<tr>
<td>After 2 years at 40 °C (104 °F)</td>
<td>0.22% ± 10 µA</td>
</tr>
<tr>
<td>After 5 years at 40 °C (104 °F)</td>
<td>0.23% ± 10 µA</td>
</tr>
<tr>
<td>Temperature drift</td>
<td>(0.01% ± 0.5 µA per °C)</td>
</tr>
</tbody>
</table>
1715-OF8I Analog Output Module

The analog output interface consists of analog output modules and output termination assemblies. Each module provides eight isolated output channels and plugs into the I/O base unit and a corresponding termination assembly.

Termination assemblies provide termination for eight output channels and the coding pegs make sure they mate only with an analog output module. Field connections are connected to the terminal block connectors on the termination assembly.

The analog module provides 4…20 mA output current from each channel for field devices.

The 1715-OF8I analog output module features are as follows:
- Flexible module structure for a user configurable system
- Supports eight field devices
- Secure communication between modules for fault tolerant operation
- Operates as a simplex or duplex configuration
- Two-terminal current regulating device

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Input value least significant bit (control)</td>
<td>0.98 µA</td>
</tr>
<tr>
<td>Data Output value least significant bit (monitor)</td>
<td>3.9 µA</td>
</tr>
<tr>
<td>Channel Measurement Error at 25 °C (77 °F) ± 2 °C (±3.6 °F)</td>
<td>0.30% ± 10 µA</td>
</tr>
<tr>
<td>After 1 year at 40 °C (104 °F)</td>
<td>0.35% ± 10 µA</td>
</tr>
<tr>
<td>After 2 years at 40 °C (104 °F)</td>
<td>0.44% ± 10 µA</td>
</tr>
<tr>
<td>Temperature drift</td>
<td>(0.01% ± 0.1 µA) per °C</td>
</tr>
</tbody>
</table>

**ATTENTION:** Maintenance must be performed only by qualified personnel, otherwise, personal injury or death, or damage to the system can result.

The features that are common to all 1715 and ControlLogix® analog I/O modules are listed in **Table 21**. The features are described later in this section.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal and Insertion Under Power (RIUP)</td>
<td>137</td>
</tr>
<tr>
<td>Module Fault Reporting</td>
<td>138</td>
</tr>
<tr>
<td>Fully Software Configurable</td>
<td>138</td>
</tr>
<tr>
<td>Status Indicator Information</td>
<td>138</td>
</tr>
</tbody>
</table>

**Removal and Insertion Under Power (RIUP)**

All 1715 I/O modules can be inserted and removed from the chassis while power is applied. This feature allows greater availability of the overall control system.
because, while the module is being removed or inserted, there is no additional disruption to the rest of the controlled process.

**Module Fault Reporting**

The 1715 analog I/O modules provide hardware and software indication when a module fault has occurred. Each module has a status fault indicator and the Logix Designer application graphically displays this fault and include a fault message describing the nature of the fault. This feature lets you determine how your module has been affected and what action must be taken to resume normal operation.

**Fully Software Configurable**

The Logix Designer application uses a custom, easily understood interface to write configuration. All module features are enabled or disabled through the I/O configuration portion of the software.

You can also use the software to interrogate any module in the system to retrieve:

- Vendor
- Product Type
- Product Code
- Revision
- Serial Number
- Product Name

By eliminating such tasks as setting hardware switches and jumpers, the software makes module configuration easier and more reliable.

The keying options available with your 1715 analog I/O are outlined in [Chapter 2](#).

**Status Indicator Information**

Each 1715 analog I/O module has status indicators on the front of the module that allow you to check the module health and operational status of a module.

**Module Inhibiting**

Module inhibiting lets you indefinitely suspend a connection between an owner-controller and an analog I/O module. This process can occur in either of these ways:

- You write configuration for an I/O module but inhibit the module to prevent it from communicating with the owner-controller. In this case, the owner does not establish a connection and configuration is not sent to the module until the connection is uninhibited.
• In your application, a controller already owns a module, has downloaded configuration to the module, and is exchanging data over the connection between the devices. In this case, you can inhibit the module and the owner-controller behaves as if the connection to the module does not exist.

**IMPORTANT** Whenever you inhibit an output module, it enters the Program mode and all outputs change to the state configured for the Program mode. For example, if an output module is configured so that the state of the outputs goes to zero (0) during Program mode, whenever that module is inhibited, the outputs go to zero (0).

These examples are instances where you can need to use module inhibiting:

• You want to upgrade an analog I/O module. We recommend that you do the following.
  a. Inhibit the module.
  b. Perform the upgrade.
  c. Uninhibit the module.

• You are using a program that includes a module that is not physically installed, but you do not want the controller to look for a module that does not exist yet. In this case, you can inhibit the module in your program until it physically resides in the proper slot.

### Scaling

The limits field is a variable that lets you set the channel output current values based on a scaling factor. You set the minimum and maximum output values by using the scaling factor. The scaling factor requires you to set a percentage of the engineering values. This gives a linear transformation between the engineering values and the output scaled values across the defined range.

The default minimum and maximum values are 0% equals 4 mA and 100% equals 20 mA.

Regardless of the Limits field settings, the output current is clamped at 0...24 mA maximum.

The module can operate with values beyond the 4...20 mA range. If an input signal beyond the low and high signals is present at the module (for example, 3 mA), that data is represented in terms of the engineering units set during scaling. Table 22 shows example values that can appear based on the example that is mentioned previously.

<table>
<thead>
<tr>
<th>Current</th>
<th>Engineering Units Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 mA</td>
<td>0%</td>
</tr>
<tr>
<td>12 mA</td>
<td>50%</td>
</tr>
<tr>
<td>20 mA</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Operating Modes

This section discusses operating modes for the analog input and output modules.
Online Mode

When fully online and operational, each channel provides a regulated current over a 1…24 mA range for the analog input module and a 0…24 mA range for the analog output module. The current values are set for each channel by the commanded values that are received from the running application. The module indicators are GREEN, and with all module indicators GREEN, none of the channels are in the failed state; however, the channel indicators depend on the individual channel status.

In the online mode, you can add a module to a group (in a duplex TA), or change a module in a pair, with no impact on the reported channel values or deviation between the regulated current. The unaffected module of a pair provides the full output values.

Offline Mode

The module is in the Offline mode when it is installed, but is not locked in position (locking screw that is not engaged). All channel outputs are off and the channel indicators are OFF. The Healthy indicator is GREEN and the Ready indicator goes OFF, while the Run indicator is RED. The module enters the Shutdown mode when locked in position.

When a critical power fault is detected, the module automatically enters the Shutdown mode and the Healthy indicator goes RED before it goes into Ready mode.

Shutdown Mode

In the Shutdown mode, all channels regulate their output to shutdown settings for each channel. The Ready and Run indicators are RED.

In a group arrangement, one module can be in shutdown while the other can continue to be online and in the Run mode and regulate the output according to the commanded values.

When the module is communicating with the processors in Shutdown mode, it transitions to the Ready mode. If there is an application running, it transitions to the Recover mode.

Ready Mode

All channels are off when in the Ready mode, the Ready indicator is GREEN and the Run indicator is RED while the channel indicators are OFF. When an application is started, the module transitions to the Run mode.

When a module loses communication with the processor, then it transitions back to the Shutdown mode.
Run Mode

In the Run mode, all channels regulate the output current to the commanded value for each individual channel. The Ready and Run indicators are GREEN. You must make sure that all user-required values have been set (by using RSLogix 5000® or Logix Designer application) before transitioning the module to Run mode.

If, for any reason, a module does not receive commanded values, then the module transitions to the Shutdown mode.

Shutdown States

You can configure the channel shutdown states to do one of the following:

- Turn-off/de-energize the channel
- Hold last state
- Regulate the output to a specified value

The shutdown state defaults to turn-off/de-energize.

IMPORTANT

If no indicators are lit when module is inserted, the base unit may not have an incoming power supply, or the module may be faulty.

HART

This section discusses The Highway Addressable Remote Transducer (HART®) communication protocol, which is an open standard owned by the more than 100 member companies in the HART Communication Foundation (HCF). Products use the HART protocol to provide both analog 4–20 mA and digital signals. Digital signals are combined with analog signals to provide control and status data for field devices.

HART is available in revision 3.x and later.

HART Features

The support for HART in the 1715 Redundant I/O System has the following features:

- HART support on every analog input and output channel
- Variables for each analog input and output channel to monitor HART device information

Configuration of HART Variables

The Controller tags created when an analog input module (1715-IF16), or analog output module (1715-OF8I), are added to an application, contain variables to monitor HART data.
Make sure that your HART field devices support HART command 0 ('read unique ID') and HART command 3 ('read current and four dynamic variables'), the 1715 redundant I/O system uses these commands to communicate with the HART devices.

The 1715 analog input and output modules use HART command #03 to collect data from the field device as defined by Revision 5 of the HART specification. The data available from HART enabled field devices is reported to the application in the AB:1715_ChHART_Struct sub-structure of the modules input tag.

The structures provide the following:
- Process measurements and measurement status.
- Errors on HART communication seen by the field device.
- Status of the field device.
- Time in milliseconds since the data was last updated.

You can monitor the status of the field device and use this to report diagnostic errors and manual configuration changes.

The HART data is also available to the user for monitoring purposes via the HART Device Info tab of the I/O module properties.

**Precautions for HART in a Safety System**

**IMPORTANT** If you use HART in a safety system, take these precautions:
- Do not use HART variables as the primary initiator for a Safety Instrumented Function. The HART protocol does not meet the applicable integrity levels for Safety Instrumented Functions.
- Make sure that HART is disabled for field devices that do not have a locked configuration. This will prevent the use of HART to change a device configuration.
- Make sure that the custom data for the device (this is the data provided in response to HART command #03) is used in accordance with the device manufacturers published recommendations.

**Configure HART for Field Device Monitoring**

When an analog module is added to the RSLogix™ application, input, output and configuration tags for the module are automatically created. The input tags contain AB:1715_ChHART_Struct sub-structures for HART data. The configuration tags contain a HartEn variable that is used to enable HART on individual channels.
To configure an analog channel to use HART to monitor a field device, HART must be enabled for the I/O module, as well as the channel the device is connected to. To enable HART do the following:

1. Double click on the I/O module in the Controller Organizer to display the I/O module properties. On the General tab, update the Module Definition to enable HART:

![Module Properties](image)

2. Enable HART on the channels to which the devices are connected. To do this for an 1715-IF16, set the I/O module configuration variable `<AENTR>..<slot>.C.HartEn`. For example, enabling HART on all channels for a module in slot 2:

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Force Mask</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA0.2 C</td>
<td>...</td>
<td>...</td>
<td>Decimal</td>
<td>INT</td>
</tr>
<tr>
<td>HA0.2 C HartEn</td>
<td>...</td>
<td>...</td>
<td>Bool</td>
<td>HART</td>
</tr>
<tr>
<td>HA0.2 C HartEn 0</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 1</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 2</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 3</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 4</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 5</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 6</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 7</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 8</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 9</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 10</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 11</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 12</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 13</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 14</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
<tr>
<td>HA0.2 C HartEn 15</td>
<td>1</td>
<td></td>
<td>Bool</td>
<td></td>
</tr>
</tbody>
</table>

For a 1715-OF8I there is a BOOL variable for each channel to enable HART:
3. Repeat for all the I/O modules and channels that you want to monitor.

**AB:1715_ChCHART_Struc**

The AB:1715_ChCHART_Struc is sub-structure within the analog modules input tag. It is used to contain the HART data from the device.

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Type</th>
<th>Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>HARTPV</td>
<td>REAL</td>
<td>Variable Primary loop current variable</td>
<td></td>
</tr>
<tr>
<td>HARTSV</td>
<td>REAL</td>
<td>Variable Second loop current variable</td>
<td></td>
</tr>
<tr>
<td>HARTTV</td>
<td>REAL</td>
<td>Variable Third loop current variable</td>
<td></td>
</tr>
<tr>
<td>HARTQV</td>
<td>REAL</td>
<td>Variable Fourth loop current variable</td>
<td></td>
</tr>
<tr>
<td>PVStatus</td>
<td>SINT</td>
<td>Status</td>
<td>Primary variable status: 0x00: variable is not connected. 0x0C (decimal -64): variable is connected.</td>
</tr>
<tr>
<td>SVStatus</td>
<td>SINT</td>
<td>Status</td>
<td>Second variable status. Values as for Primary.</td>
</tr>
<tr>
<td>TVStatus</td>
<td>SINT</td>
<td>Status</td>
<td>Third variable status. Values as for Primary.</td>
</tr>
<tr>
<td>QVStatus</td>
<td>SINT</td>
<td>Status</td>
<td>Forth variable status. Values as for Primary.</td>
</tr>
<tr>
<td>CommandStatus</td>
<td>SINT</td>
<td>Status</td>
<td>Command error summary. If bit 7 is 1 then the remaining bit indicate communications errors as follows: Bit 6: vertical parity error. Bit 5: overrun error. Bit 4: framing error. Bit 3: longitudinal parity error. Bit 2 reserved, set to 0. Bit 1: buffer overflow. Bit 0: not used. If bit 7 is 0 the remaining bits contain a command specific response code in the range 0 to 127. Some common response codes are: 0: Success – command completed successfully. 32: Busy – the device is performing a function that cannot be interrupted by this command. 64: Command not implemented – the device does not support the command.</td>
</tr>
</tbody>
</table>

---

144  Rockwell Automation Publication 1715-UM001J-EN-P - December 2020
Chapter 5          Using 1715 Analog I/O Module Features

HART Pass-Through

The HART Pass-Through feature enables using an external asset management system to manage HART compatible field devices connected to a 1715 controller.

HART Pass-Through uses the device type manager (DTM) standard, defined by the HART Communication Foundation, to enable using any asset management system which using the generic 'Frame' standard. Examples of compatible tools are the Fieldcare application by Endress+Hauser and the FactoryTalk® AssetCentre software by Rockwell Automation.

Using HART Pass-Through

The Controller tags created when an analog input module (1715-IF16), or analog output module (1715-OF8I), are added to an application, contain variables to monitor HART data.

To use HART Pass-Through, you have to install the 1715-DTM software on the computer which is running the asset management system. You can then enable and disable the HART Pass-Through capability of the 1715 Adapter.

For an analog module, HART data is available to the application in the ChHart array element of the modules input tag when the module has HART enabled, for example:

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Type</th>
<th>Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>FieldStatus</td>
<td>SINT</td>
<td>Status</td>
<td>Field Device status:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 7: field device malfunction.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 6: configuration changed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 5: cold start.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 4: more status available.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 3: analog output current fixed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 2: analog output saturated</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 1: non-primary variable out of limits</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 0: primary variable out of limits</td>
<td></td>
</tr>
<tr>
<td>ExternalDeviceStatus</td>
<td>SINT</td>
<td>Status</td>
<td>Extended field device status:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 7: undefined.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 6: undefined.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 5: undefined.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 4: undefined.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 3: undefined.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 2: critical power failure.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 1: device variable alert.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit 0: maintenance required.</td>
<td></td>
</tr>
<tr>
<td>DataAge</td>
<td>SINT</td>
<td>Time</td>
<td>Time, in seconds, that indicates the age of the HART data as follows:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0..127 : Age in seconds of the current data values.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-1 : Values un-initialized (i.e. no successful read at all, this will be the power up condition)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-2 : Values are &gt; 127 seconds old</td>
</tr>
</tbody>
</table>
Once HART Pass-Through has been enabled, HART device data can be viewed on the HART Device Info tab of a module properties:

**HART Pass-Through Features**

The support for HART Pass-Through in the 1715 Adapter has these features:

- Pass-Through support for HART standards 5, 6 and 7.
- Support for CIP HART object services ox4b, ox5a, ox5b, ox5c, ox5e, ox5f and ox60.
- Supports the 1715-DTM provided by Rockwell Automation.
Precautions for HART Pass-Through in a Safety System

**IMPORTANT** If you use HART Pass-Through in a safety system, take these precautions:
- Observe the precautions in Precautions for HART in a Safety System
- Make sure that HART Pass-Through is enabled only under control of the application.
- Make sure that HART Pass-Through is enabled only when necessary.
- Configure the application to generate an alarm if Hart Pass-Through is enabled on any safety-critical channel of any module.

Installing the 1715-DTM

The 1715-DTM is the device type manager for the HART Pass-Through feature in a 1715 system. It must be installed on the Windows computer which is running the asset management system. For the PC specification refer to the Preface chapter, Required Software.

To install the DTM, do the following:

1. Locate the file named setup.exe and run it.
2. If the computer onto which the DTM is being installed does not contain the Microsoft packages required to support the DTM, the following screen is displayed, in which case click Install.

3. Click Next.
4. Accept the terms of the license agreement, click Next.

5. Fill out the customer information, click Next.

6. Change the destination folder if required, click Next.
7. Review the installation setting, click Install.

8. Once the DTM has installed, click Finish.

**Updating the Asset Management System DTM Catalogue**

Once the DTM is installed, the DTM catalogue of the asset management system must be updated. For example, the Rockwell AssetCentre DTM
The updated DTM catalogue will contain the following 3 1715 DTMs:

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Protocol</th>
<th>Description</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rockwell Automation</td>
<td>EtherNet/IP (CIP)</td>
<td>1715 EtherNet/IP Gateway DTM</td>
<td>3.1.0</td>
</tr>
<tr>
<td>Rockwell Automation</td>
<td>EtherNet/IP (CIP), HART</td>
<td>1715-F16</td>
<td>3.1</td>
</tr>
<tr>
<td>Rockwell Automation</td>
<td>EtherNet/IP (CIP), HART</td>
<td>1715-DF8I</td>
<td>3.1</td>
</tr>
</tbody>
</table>

The purpose and usage of the DTMs is explained in the following sections.

### Enable HART Pass-Through in the Controller

The 1715 DTM uses HART Pass-Through to communicate with HART devices. Before it can do this, HART Pass-Through must be enabled for the 1715, and HART enabled on the channels that HART devices are connected to.

To enable HART Pass-Through, do the following:

1. Open the RSLogix application containing the 1715 Adapter and its I/O modules.
2. Enable HART on the I/O modules and channels to which you wish to perform Pass-Through requests, see previous section on how to do this.
3. Enable HART Pass-Through for the 1715 by setting the output tag `<AENTR>:O.HARTPassThrough`:

   | - HAIO:O.HARTPassThrough | [... ] |
   | :------------------------+-------|
   | + HAIO:O.HARTPassThrough | 210000_0000_0000_0000_0000_0000_0000_0001 |
   | - HAIO:Enable            | 1     |

4. Compile and download the application.

### Using Factory Talk Asset Center with Analog Modules

In order to use the DTMs, a DTM network must first be configured in the asset management system.

Using the Rockwell AssetCentre, for example, do the following:

1. Make sure the DTM catalogue is up to date, see previous section on how to do this.
2. Right click on the Host PC icon at the top of the tree, click Add DTM. Select a ’1715 EtherNet/IP Gateway DTM’, click OK.

3. Right click on the ‘1715 EtherNet/IP Gateway DTM’ that has just been added, click Add DTM. Select a 1715-IF16 or 1715-OF8I, depending on the type of physical I/O module present. Repeat for each I/O module.

4. Now add the HART device DTM’s. Right click on an I/O module, select Add DTM. Select the device DTM, then select the I/O channel to which the device is connected. Note that the first I/O channel number is 0.

5. The 1715 I/O DTMs must also be configured as described below. This can be done before or after adding the device DTMs.

---

**1715-DTM Configuration**

**1715 EtherNet/IP Gateway DTM**

This DTM does not require configuration.
To configure the 1715-IF16 or 1715-OF8I DTM, follow the steps below:

1. If the DTM is online take it offline by right clicking on the DTM and selecting Offline.

2. Right click on the I/O DTM, select Configuration from the pop-up menu.

3. Enter the IP address of the 1715 Adapter, and select the I/O module slot position. Note that the first I/O slot number is 2. Click ‘OK’. Either Apply or OK must be clicked for the changes to take effect. Changes are ignored if Next is clicked on its own.
1715-DTM HART Diagnostics

The DTM provides a Diagnostics function that enables the user to determine the state of any HART devices connected to a 1715 I/O module. To access the Diagnostics function using AssetCentre, do the following:

1. Ensure that the I/O module DTM is online. To do this right click on the I/O module and select Online from the menu.

2. Right click on the I/O module and select the Diagnosis function.
3. On the Diagnostics dialogue click Scan On. The DTM queries each channel to determine whether or not a responding HART device is connected.

For a channel with a connected device, the device information is displayed. The DTM refreshes this at intervals given by the Scan Interval.

If a channel does not have a device attached, the DTM periodically queries the channel in order to detect a newly connected device.

4. Click Next to exit.

**IMPORTANT** In order to use the Diagnostic function, the DTM must be online, so ensure that the DTM is online before opening the Diagnostics dialogue. Diagnostic controls are disabled (greyed out) if the DTM is offline when the Diagnostic dialogue is opened. The online status of the DTM is displayed at the bottom of the Diagnostics dialogue.

**IMPORTANT** No device DTMs have to be configured in order to use the Diagnostics function.
**IMPORTANT**  The Scan Interval can be reduced, but doing so may prevent other clients, for example RSLogix 5000, from communicating with the 1715 to retrieve HART information.
Notes:
Configure the Redundant I/O System

Now that the hardware portion of the system is installed, you can configure your 1715 Redundant I/O System by using the software applications that you installed from the Product Compatibility and Download Center at rok.auto/pcdc. See System Software on page 59.

Before You Begin

Before you begin configuring the 1715-AENTR modules in the redundant chassis, verify that these tasks have been completed:

- Make sure that RSLogix 5000® programming software, version 20 or later, or Studio 5000® environment, version 21 or later, is installed.
- Make sure that the drivers are installed by using RSLinx® Classic software, version 2.57 or later.
- Make sure that the firmware is at the latest revision and the software is at the latest version.
- Make sure that both Add-on Profiles are installed on your system:
  - One for the 1715 adapter
  - One for the 1715 I/O modules

Install the Software

Install the following software:

- RSLogix 5000 programming software, version 20 or later, or Studio 5000 environment, version 21 or later
- RSLinx® Classic software, version 2.57 or later

Install the Add-on Profiles

You must install two Add-on Profiles — one for the adapters, version 2.01.014 or later, and one for each of the I/O modules, version 3.01.014 or later. (The four I/O module Add-on Profiles are contained in one file.)
See the latest certifications for software and firmware at rok.auto/certifications. See the TÜV website at http://www.tuvasi.com for SIL 2 certification listings.

The Add-on Profiles can be found on the Product Compatibility and Download Center at rok.auto/pcdc.

Once the Add-on Profiles are installed on your computer, they can be accessed through RSLogix 5000 software and/or the Logix Designer application.

With the Add-on Profiles, you are able to do the following:
- Add and configure the redundant adapter pair.
- Add and configure I/O modules in Simplex mode.
- Add and configure I/O modules in Duplex mode.
- Monitor diagnostics for I/O modules.

To install the Add-on Profiles, follow these steps.

| IMPORTANT | Make sure any instances of RSLogix 5000 programming software or Logix Designer application are shut down before beginning. |

Product Installation

Installation of product, this is achieved using the PCDC Website

To download the Add-on Profiles for the 1715 adapter and I/O modules, go to the Product Compatibility and Download Center at rok.auto/pcdc.

EDS Files

The 1715 modules contain the EDS files for installation into RSLinx software. You can right-click the module in RSLinx Classic software and upload the EDS file into RSLinx Classic software without downloading EDS files from the typical download site. Follow these steps to upload from RSLinx Classic software.

1. Open RSLinx Classic software.
2. In the RSWho tree, right-click the Ethernet adapter and choose Upload EDS file from device.
3. Choose Upload EDS file from device from the pull-down menu.

4. Follow the prompts in the Rockwell Automation EDS Wizard.

In the rare case that you must update an EDS file, you have to go to Get Support Now to obtain the correct files. Also note that when you download the EDS files, you see the Chassis EDS files that you do not see if you upload from the module. These files are necessary for chassis selection choices only in the Logix Designer application. Keep in mind that these are virtual chassis product numbers and not literal catalog numbers. See the example in Figure 62.
Create the Project in RSLogix 5000 or Studio 5000 Logix Designer

Once the Add-on Profile is installed, you are ready to create the RSLogix 5000 or Logix Designer project. In this section, you do the following:

- Create a project.
- Configure the 1756 controller in the project.
- Add the 1756-EN2TR module to the project.

Step 1: Create the New Project

1. Launch the application and start a new project for the 1715 Redundant I/O System.
2. In the application, from the File menu, choose New to open the New Project dialog box.

The New project dialog box appears.
3. In the New Project dialog box, from the Type pull-down menu, choose your ControlLogix controller from the list.

4. Enter the project filename and select a location to store the project file. Then click the Next button.

The previous example shows the 1756-L75 controller in slot 0.

5. Choose the Revision, Chassis size, Slot number and Security Authority of your ControlLogix controller, Then click the Finish button.

You now see the new controller in the I/O Configuration tree of the Controller Organizer.
Chapter 6  Configure the Redundant I/O System

Step 2: Configure the Controller in the Project

1. To configure the controller, in the Controller Organizer, from the I/O Configuration folder, right-click the new controller that you created and choose Properties.

   ![Controller Organizer screenshot](image1)

   ![Controller Properties dialog box](image2)

   The Controller Properties dialog box appears.
2. In the Controller Properties dialog box, set controller configuration information for the open project, and when online—for the attached controller.

   The tabs that appear are particular to the type of controller you have selected.

3. Click OK when you are done configuring each tab for your controller.

   For a complete description of each tab and the appropriate configuration settings, refer to rok.auto/literature and type in the name of your controller under Keyword search.

Next, add a ControlLogix Ethernet communication module to the project to let the ControlLogix chassis communicate with the 1715 Redundant I/O System. The type of module you add depends on the needs of your system.

**Step 3: Add a 1756-EN2TR Module to the Project**

1. In the Logix Designer project, right-click the 1756 backplane in the I/O Configuration folder, and choose New Module.
Chapter 6          Configure the Redundant I/O System

The Select Module dialog box appears.

2. Expand the Communications list, select the 1756-EN2TR module, and click OK.

The Module Properties dialog box appears.

3. Name the module, enter the IP address, enter the Slot number (we chose 1 for this example).
4. Click Change.
5. Choose your Electronic Keying method, see Electronic Keying on page 118.
6. Click OK.
7. To complete configuration of the 1756 Ethernet module, refer to the EtherNet/IP Network Configuration User Manual, publication ENET-UM001.

The I/O configuration folder of your project now looks similar to this.
Add the 1715-AENTR Adapter to the I/O Configuration Tree

Once the project, controller and Ethernet module are configured, you are ready to add the 1715 adapter. In this section, you do the following:

- Add the 1715-AENTR adapter to the project.
- Configure the adapter for the EtherNet/IP Network.

**Step 1: Configure the Adapter for the EtherNet/IP Network**

Plan IP addresses by doing the following:

- You must use two IP addresses.
- You must know the subnet mask for the Ethernet network the redundant modules are to operate on.

**Options for Setting the IP Addresses of 1715-AENTR Modules**

You can set the IP address of the redundant AENTR modules in the adapter base by using the following:

- A BOOTP/DHCP utility. A BOOTP/DHCP utility is provided with the Logix Designer application out of the box. See Step 1: Assign an IP Address on the BOOTP/DHCP Server on page 123.
Chapter 6  Configure the Redundant I/O System

- Module Configuration properties that are specified in RSLinx Classic software, if the modules are already configured.
- Module Properties dialog box that is accessed by using RSLogix 5000 programming software or the Logix Designer application, if the modules are already configured.

If you are configuring your redundant EtherNet/IP modules by using any of the software options that are listed previously, see the EtherNet/IP Network Configuration User Manual, publication ENET-UM001 for more information.

Ethernet Network

We recommend that static IP addresses be assigned to EtherNet/IP modules in Logix 5000 control systems.

We recommend that you do not use dynamic IP addresses because if a power outage or other network failure occurs, modules with dynamic IP addresses can be assigned new addresses when the failure is resolved. If the IP addresses of modules change, you could experience a loss of control or other serious complications with your system.

However, if you must use the DHCP feature, you can use the Stratix® 8000 switch, which can be configured to provide the same IP address to any given port.

See EtherNet/IP Network Configuration User Manual, publication ENET-UM001, for more information.

Step 2: Add the 1715-AENTR Adapter to the Project

1. In the Logix Designer project, right-click the Ethernet network icon in the I/O Configuration folder, and choose New Module.

The Select Module dialog box appears.
2. Expand the Communications list, select the 1715-AENTR module, and click OK.

The redundant Module Properties dialog box appears.

3. Name the module, enter the IP address.

The Slot numbers for the adapters are always 0 and 1.
4. Click Change.

The Module Definition dialog box appears.
Chapter 6 Configure the Redundant I/O System

5. Click OK.
6. Click the Connection tab.

The Connection tab appears.
7. Click the Module Info A Tab.

The Module Info A tab appears.

The Module A Info Tab displays module and status information about the primary adapter, in slot 0 or 1. (During initial setup, the primary adapter is installed in slot 0. If an IP address swap occurs, the primary adapter is now in slot 1.)

This tab also lets you reset a module to its power-up state. The information on this tab is not displayed if you are one of the following:

- Offline
- Currently creating a module
Table 25 - Module Info A Parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification</td>
<td>Displays the module's:</td>
</tr>
<tr>
<td></td>
<td>• Vendor</td>
</tr>
<tr>
<td></td>
<td>• Product Type</td>
</tr>
<tr>
<td></td>
<td>• Product Code</td>
</tr>
<tr>
<td></td>
<td>• Revision</td>
</tr>
<tr>
<td></td>
<td>• Serial Number</td>
</tr>
<tr>
<td></td>
<td>• Product Name</td>
</tr>
<tr>
<td>Status</td>
<td>Displays the module's current operational state</td>
</tr>
<tr>
<td>Major/Minor Fault</td>
<td>Displays the fault type</td>
</tr>
<tr>
<td>Configured</td>
<td>Displays a yes or no value, which indicates whether the module has been configured by an owner controller who is connected to it. Once a module has been configured, it stays configured until the module is reset or power is cycled, even if the owner drops connection to the module. This information only applies to I/O modules and does not apply to adapters, scanners, bridges, or other communication modules.</td>
</tr>
<tr>
<td>Owned</td>
<td>Displays a yes or no value indicating whether an owner controller is connected to the module.</td>
</tr>
<tr>
<td>Module Identity</td>
<td>Displays</td>
</tr>
<tr>
<td></td>
<td>• Match</td>
</tr>
<tr>
<td></td>
<td>• Mis-match</td>
</tr>
<tr>
<td>Reset</td>
<td>Click Reset to return a module to its power-up state by emulating the cycling of power.</td>
</tr>
<tr>
<td>Refresh Module</td>
<td>Click Refresh Module to refresh the tab with new data from the module.</td>
</tr>
</tbody>
</table>

8. Click the Module Info B tab.

The Module Info B tab appears.

The Module B Info Tab displays module and status information about the secondary adapter, in slot 0 or 1. (During initial setup, the secondary adapter is
installed in slot 1. If an IP address swap occurs, the secondary adapter is now in slot 0.)

This tab also lets you reset a module to its power-up state. The information on this tab is not displayed if you are one of the following:

- Offline
- Currently creating a module

See Table 25 on page 171.

9. Click the Internet Protocol tab.

You must be online to configure the Internet Protocol settings.

The Internet Protocol tab appears.

Table 26 - Internet Protocol Parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
</table>
| Internet Protocol (IP) Settings | Displays the IP settings Configuration mode of the module. Click the appropriate button to configure the IP settings:  
- Manually configure the IP settings  
- Obtain IP settings automatically by using BOOTP  
- Obtain IP settings automatically by using DHCP  
Internet Protocol (IP) Settings controls appear dimmed when:  
- Offline  
- Online and a module mismatch or communication error occurs  
- BOOTP or DHCP is not supported |
| Physical Module IP Address      | Displays the physical IP address of the module or, if you chose to configure the IP settings manually, enter a valid physical module IP address. |
| Subnet Mask                     | Displays the subnet mask of the module or, if you chose to configure the IP settings manually, enter a valid subnet mask. |
| Gateway Address                 | Displays the gateway IP address of the module or, if you chose to configure the IP settings manually, enter a valid gateway address. |
10. Click the Port Configuration tab.

The Port Configuration tab appears.
11. Click the Network tab.

The Network tab appears.

12. Click OK.
The I/O Configuration folder of your project now looks similar to this.

Obtaining System Status

There are two ways to access the status of the primary and secondary adapters:
- Via the Add-on Profile while online with the application
- Via the tags in the owner controller

Check Adapter Status While Online via the Add-on Profile

To check the status of the primary and secondary adapters while online, follow these steps.

1. In the application, from the I/O Configuration Tree, right-click the 1715 adapter and choose Properties.

The Module Properties dialog box appears.
2. Click the Module Info A or Module Info B tabs.

Adapter status information displays.

*Check Adapter Status via the Owner Controller Tags*

To check the status of the primary and secondary adapters through the owner controller tags, follow these steps.

1. Go online with the controller.
2. Double-click the Controller Tags folder in the Controller Organizer.

The Controller Tags window appears.
3. Locate the adapter status tag.

   The adapter status tag name is followed by ‘:S.’

4. Expand the twisty for the adapter status tag to view the status information for the primary and secondary adapters.

### 1715-IB16D Digital Input Module

#### Add the Digital Input Module to the Project

Once the 1715-AENTR adapter is configured in the project, you are ready to add I/O modules to the project. In this section, you do the following:

- Add a 1715-IB16D digital input module in Duplex mode to the project.
- Add a 1715-IB16D digital input module in Simplex mode to the project.

Depending on which configuration you choose, you can skip the steps that do not apply.

#### Step 1: Add the Digital Input Module in Duplex Mode

1. To add a 1715-IB16D Digital Input module in Duplex mode to the project, right-click the 1715-AENTR adapter and choose New Module.
2. Expand the Digital module list, select the 1715-IB16D module, and click OK.

The General tab appears.
3. Click Change.

The Module Definition dialog box appears.

![Module Definition dialog box](image)

**Table 29 - General Parameters for the Digital Input Module in Duplex Mode**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Displays the type and description of the module being created (read-only).</td>
</tr>
<tr>
<td>Vendor</td>
<td>Displays the vendor of the module being created (read-only).</td>
</tr>
<tr>
<td>Parent</td>
<td>Displays the name of the parent module (read-only).</td>
</tr>
<tr>
<td>Name</td>
<td>Enter the name of the module.</td>
</tr>
<tr>
<td>Description</td>
<td>Enter a description for the module here, up to 128 characters. You can use any printable character in this field. If you exceed the maximum length, the software ignores any extra characters.</td>
</tr>
<tr>
<td>Slot A</td>
<td>Choose the slot number in which the module resides.</td>
</tr>
<tr>
<td>Slot B</td>
<td>When your module is configured for duplex, the slot number in which the redundant module resides is displayed. When configured for duplex, the Slot B field is shown for reference only.</td>
</tr>
<tr>
<td>Change</td>
<td>Click Change to access the Module Definition dialog box. From the Module Definition dialog box, you can change the values that define the module definition, Electronic Keying, and Minor Revision.</td>
</tr>
</tbody>
</table>

**Table 30 - Module Definition Parameters for Digital Input Module Duplex Mode**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series</td>
<td>Choose the Series of the module. Only the series that the module supports are displayed.</td>
</tr>
<tr>
<td>Revision</td>
<td>Major: Choose the Revision of the module. Minor: Sets the minor revision of the module. The valid range is 1...255. This field is enabled while offline, and while in the Program, Remote Program, and Remote Run modes. For SIL 2 application choose version 3.01.07 or later for 1715 I/O modules.</td>
</tr>
<tr>
<td>Electronic Keying</td>
<td>Choose the Electronic Keying that you wish to use for the selected module. Valid values are Compatible Module (default), Exact Match, or Disable Keying. See Electronic Keying on page 118.</td>
</tr>
</tbody>
</table>
The Module Properties dialog box appears.

4. Verify Redundant is Yes for Duplex mode.

   Note the additional module slot on the Module Properties dialog box.

   See Online Help in the application for more information on how to set Module Definition parameters.

5. Click OK.

6. Click the Connection tab.

   The Connection tab appears. See page 169.

7. Click the Module Info A tab.

   The Module Info A tab appears.
See page 170 for a definition of parameters on the Module Info A tab.

8. Click the Module Info B tab.

The Module Info B tab appears. You set the parameters for Module B the same way as Module A. See page 171.

9. Click the Configuration tab.
Chapter 6          Configure the Redundant I/O System

10. Click OK.

**Step 2: Add the Digital Input Module in Simplex Mode**

To add a 1715-IB16D Digital Input module in Simplex mode to the project, follow these steps.

1. Add the new module, see page 177.
2. Select the 1715-IB16D Digital Input module, see page 178, and click OK.

The General tab appears.

---

**Table 31 - Configuration Parameters for Duplex Mode**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point</td>
<td>Click the point number to configure parameters for the specified point (0...15).</td>
</tr>
<tr>
<td>Enable Change of State</td>
<td>Check which points trigger production of data on Change of State. If the box is checked, Change of State is enabled for a particular state transition that by the column header indicates. If the box is unchecked, Change of State is disabled. Enable Change of State appears dimmed only when in Hard Run mode (0...15).</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>Choose from the following three pre-selected threshold types for each point:</td>
</tr>
<tr>
<td></td>
<td>• Full – Thresholds are used that work with the Rockwell Automation preferred end-of-line devices to support open-wire and short circuit protection and diagnostics.</td>
</tr>
<tr>
<td></td>
<td>• None – Thresholds are used that are appropriate for use with no end-of-line device. This option does not support open-wire and short circuit protection and diagnostics.</td>
</tr>
<tr>
<td></td>
<td>• Custom – You provide the thresholds. The default matches the Full thresholds.</td>
</tr>
<tr>
<td>Custom Thresholds</td>
<td>Click Edit to display the Edit Custom Thresholds dialog box and edit thresholds for the selected point.</td>
</tr>
<tr>
<td></td>
<td>When offline or online (including Hard Run mode), the Edit button is enabled when the Custom diagnostics type is selected. This option does not support open-wire and short circuit protection and diagnostics.</td>
</tr>
<tr>
<td>Open Wire Detection</td>
<td>Select if the thresholds allow for open wire detection (for example, if the threshold 2 value is not 0). By default, the header checkbox is selected and all points (0...15) are selected. If the header checkbox is cleared, all points (0...15) are cleared. To select open wire detection for a specific point, check the checkbox in the appropriate row for that point.</td>
</tr>
<tr>
<td>Latch Diagnostics</td>
<td>Select if line fault alarms are latched until reset (including Open Wire Detection and Short Circuit detection). By default, the header checkbox is selected and all points (0...15) are selected. If the header checkbox is cleared, all points (0...15) are cleared.</td>
</tr>
<tr>
<td>Reset Latch Diagnostics</td>
<td>Click Reset to reset the diagnostic latch serviced.</td>
</tr>
<tr>
<td>Enable Change of State for Diagnostic Transitions</td>
<td>Select whether Change of State is enabled when any diagnostic event occurs.</td>
</tr>
<tr>
<td>Full And Custom Diagnostics Require Use Of An Appropriate End-of-line Device</td>
<td>Specifies that a custom end device must be used when using full or custom diagnostics.</td>
</tr>
</tbody>
</table>
3. Enter the module name.

Notice that there are still two slot numbers that are displayed, indicating that the module is in the default Duplex mode.

4. Click Change.

The Module Definition dialog box appears.

5. Change the module default from Redundant= Yes to Redundant=No to run the module in Simplex mode.

See page 179 for more setup information.

6. Click OK.
Chapter 6          Configure the Redundant I/O System

A Verify Module Properties dialog box appears

7. Click Yes.

A new General tab appears in Simplex mode.

Notice there is now only one slot number that is displayed and Redundant now is ‘No’.

8. Click the Connection tab, see page 169.
9. Click the Module Info tab, see page 170.
10. Click the Configuration tab, see page 181.
11. Click OK.

The I/O configuration folder of your project now looks similar to this.
1715-OB8DE Digital Output Module

Add the Digital Output Module to the Project

In this section, you do the following:
- Add a 1715-OB8DE digital output module in Duplex mode to the project.
- Add a 1715-OB8DE digital output module in Simplex mode to the project.

Step 1: Add the Digital Output Module in Duplex Mode

1. To add a new 1715-OB8DE digital output module in Duplex mode to the project, right-click the 1715-AENTR adapter and choose New Module.

   The Select Module dialog box appears.

2. Expand the Digital module list and select the 1715-OB8DE module, and click OK.

   The General tab appears.

3. Enter the parameters.

   They are similar to the settings on page 178.
4. Click Change.
5. Enter the parameters, see page 179.
6. Click OK.
7. Click the Connection tab, see page 169.
8. Click the Module Info A tab, see page 170.
9. Click the Module Info B tab, see page 170.
10. Click the Configuration tab.

The Configuration tab appears.

---

Table 32 - Configuration Parameters for Digital Output Module in Duplex Mode

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point</td>
<td>Click the point number to configure parameters for the specified point (0…7).</td>
</tr>
<tr>
<td>No Load Detection</td>
<td>By default, the header checkbox is selected and all points (0…7) are selected. If the header checkbox is cleared, all points (0…7) are cleared. To specify no load detection for a specific point, check the checkbox in the appropriate row for that point. To clear no load detection for a specific point, clear the checkbox in the appropriate row for that point.</td>
</tr>
<tr>
<td>Latch No Load Diagnostics</td>
<td>Choose if load fault alarms are latched until reset (including Open Wire Detection and Short Circuit detection). By default, the header checkbox is selected and all points (0…7) are selected. If the header checkbox is cleared, all points (0…7) are cleared. To select load fault alarms are latched until reset for a specific point, check the checkbox in the appropriate row for that point. To clear load fault alarms are latched until reset for a specific point, clear the checkbox in the appropriate row for that point.</td>
</tr>
<tr>
<td>Reset Latched Diagnostics</td>
<td>Click Reset to reset the diagnostic latch service. When online and in Program mode, Remote Program mode, Run mode, the Reset button is enabled for a point. When offline, the Reset button is dimmed for a point.</td>
</tr>
<tr>
<td>Reset Fuse</td>
<td>Click Reset to reset the fuse reset short/overload service. When online and in Program mode, Remote Program mode, Run mode, the Reset button is enabled for a point. When offline, the Reset button is dimmed for all points.</td>
</tr>
</tbody>
</table>

11. Click the Fault/Program Action tab.

The Fault/Program Action tab appears.
Table 33 - Fault/Program Action Parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point</td>
<td>Click the point number to configure parameters for the specified point (0…7).</td>
</tr>
<tr>
<td>Output State During</td>
<td></td>
</tr>
<tr>
<td>Program mode</td>
<td></td>
</tr>
<tr>
<td>• On</td>
<td>This value Indicates the following controller tag settings</td>
</tr>
<tr>
<td>• Off</td>
<td>• ProgMode = 0</td>
</tr>
<tr>
<td>• Hold</td>
<td>• ProgValue = 1</td>
</tr>
<tr>
<td>Fault mode</td>
<td></td>
</tr>
<tr>
<td>• On</td>
<td>• FaultMode = 0</td>
</tr>
<tr>
<td>• Off</td>
<td>• FaultValue = 1</td>
</tr>
<tr>
<td>• Hold</td>
<td>• FaultMode = 1</td>
</tr>
<tr>
<td>Communication Failure If Communication Fail in Program Mode</td>
<td>Specify the action to take when communication fail in Program mode. Choose one of the following:</td>
</tr>
<tr>
<td>• Leave outputs in Program mode state - When selected, lets you maintain outputs in the Program mode state (default). When cleared, changes outputs to the Fault mode state. Leave outputs in Program mode state appears dimmed only when in Hard Run mode.</td>
<td></td>
</tr>
<tr>
<td>• Change outputs to Fault mode state - When selected, lets you change outputs to the Fault mode state. When cleared, changes outputs to the Program mode state. Change outputs to Fault mode state appears dimmed only when in Hard Run mode.</td>
<td></td>
</tr>
</tbody>
</table>

12. Click OK.

**Step 2: Add the Digital Output Module in Simplex Mode**

Add a 1715-IB16D Digital Input module in Simplex mode to the project.

1. Add the new module, see page 177.
2. Select the 1715-OB8DE Digital Output module, see page 177, and click OK.

The General tab appears.
3. Enter the module name.

Notice that there are still two slot numbers that are displayed, indicating that the module is in the default Duplex mode.

4. Click Change, see step 6 and step 7 on page 184, and step 8 on page 184.

A new General tab appears in Simplex mode.

Notice there is now only one slot number available and Redundant is ‘No’, indicating that the module is now in Simplex mode.

5. Click the Connection tab, see page 169.

6. Click the Module Info tab, see page 170.

7. Click the Configuration tab, see page 186.

8. Click the Fault/Program Action tab, see page 186.

9. Click OK.

The I/O configuration folder of your project now looks similar to this.
Configure the Redundant I/O System

Chapter 6

1715-IF16 Analog Input Module

Add the Analog Input Module to the Project

In this section, you do the following:

- Add a 1715-IF16 analog input module in Duplex mode to the project.
- Add a 1715-IF16 analog input module in Simplex mode to the project.

Step 1: Add the Analog Input Module in Duplex Mode

Add a 1715-IF16 Analog Input module in Duplex mode to the project.

1. Add the new module, see page 177.

   The Select Module dialog box appears.

2. Expand the Analog module list, select the 1715-IF16 module, and click OK.

   The General tab appears.
See figure on page 178 for detailed parameter information for the General tab.

3. Click Change.

The Module Definition dialog box appears.
4. Click OK.
5. Click the Connection tab, see page 169.
6. Click the Module Info A tab, see page 170.
7. Click the Module Info B tab, see page 171.
8. Click the Configuration tab.

The Configuration tab appears.

Table 34 - Module Definition Parameters for Analog Input Module

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series</td>
<td>Choose the Series of the module.</td>
</tr>
<tr>
<td>Revision</td>
<td>Choose the Revision of the module.</td>
</tr>
<tr>
<td>Electronic Keying</td>
<td>Choose the Electronic Keying that you wish to use for the selected module.</td>
</tr>
<tr>
<td>Connection</td>
<td>Leave as 'Data' - Listen Only is not supported.</td>
</tr>
<tr>
<td>Input Data</td>
<td>Display Only.</td>
</tr>
<tr>
<td>Data Format</td>
<td>Display Only.</td>
</tr>
<tr>
<td>Redundant</td>
<td>Yes indicates Duplex mode.</td>
</tr>
</tbody>
</table>

SIL 2 Safety

Choose No if SIL 2 operation is not required. Choose Yes to enable SIL 2 operation. The safety pull-down menu appears only if using Add-on Profile version 2.01.007 or later. Two new tabs are available for SIL 2 configuration if you choose Yes. For information on SIL 2 configuration, see Chapter.

Table 35 - Configuration Parameters for the Analog Input Duplex Module

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel</td>
<td>Click the channel number to configure parameters for the specified channel (0...15).</td>
</tr>
<tr>
<td>Current Range</td>
<td>Displays the current range (0...20 mA) for the channel. This field is read-only.</td>
</tr>
<tr>
<td>Low Signal</td>
<td>Enter the Low Signal value for the channel (between 0.0...20.0 mA). The default is 4.0 mA. This value must be less than the High Signal value. Low Signal and Low Engineering values are shown in pairs.</td>
</tr>
</tbody>
</table>
Table 35 - Configuration Parameters for the Analog Input Duplex Module

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Engineering</td>
<td>Enter the Low Engineering value for the channel (between -9999999...99999999). The default is 0.0. Low Signal and Low Engineering values are shown in pairs.</td>
</tr>
<tr>
<td>High Signal</td>
<td>Enter the High Signal value for the channel (between 0.0...20.0 mA). The default is 20.0 mA. This value must be greater than the Low Signal value. High Signal and High Engineering values are shown in pairs.</td>
</tr>
<tr>
<td>High Engineering</td>
<td>Enter the High Engineering value for the channel (between -9999999...99999999). The default is 100.0. High Signal and High Engineering values are shown in pairs.</td>
</tr>
</tbody>
</table>

9. Click OK.

Step 2: Add the Analog Input Module in Simplex Mode

Add a 1715-IF16 Analog Input module in Simplex mode to the project.

1. Add the new module, see page 177.
2. Select the 1715-IF16 module, see step 2 on page 189.

The General tab appears.

![General tab image]

See Figure on page 178 for General parameter settings.

3. Click Change, referring to Figure on page 190 for Module Definition parameter settings.
4. Change Redundant to No to place the module in Simplex mode.
5. Click OK.

The Verify Module Properties dialog box appears. See page 184.

6. Click Yes.

A new General tab appears showing only one slot as available. The module is now in Simplex mode.
7. Click the Connection tab, see page 169.
8. Click the Module Info A tab, see page 171.
9. Click the Configuration tab, see page 191.
10. Click OK.

The I/O configuration folder of your project now looks similar to this.

1715-OF8I Analog Output Module

Add the Analog Output Module to the project

In this section, you do the following:
- Add a 1715-OF8I analog output module in Duplex mode to the project.
- Add a 1715-OF8I analog output module in Simplex mode to the project

Step 1: Add the Analog Output Module in Duplex Mode

1. Add the new module, see page 177.

The Select New Module dialog box appears.
2. Expand the Analog module list, select the 1715-OF8I module, and click OK.

The General tab appears.

See page 178.

3. Click Change.

4. Verify that Redundant is Yes.

See page 190.

5. Click OK.

6. Click the Connection tab, see page 169.

7. Click the Module Info A tab, see page 170.

8. Click the Module Info B tab, see page 171.

9. Click the Configuration tab.

The Configuration tab appears.
10. Click the Limits tab.

The Limits Configuration tab appears.
Table 37 - Limits Parameters for Analog Output Duplex Module

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel</td>
<td>Click the channel number to configure parameters for the specified channel (0…7).</td>
</tr>
<tr>
<td>High Clamp Limit</td>
<td>Enter a High Clamp Limit (between -9999999…99999999). The default is 100.0000. The High Clamp Limit must be greater than the Low Clamp Limit. Any out of range value causes a profile validation error. HI appears dimmed only when in Hard Run mode.</td>
</tr>
<tr>
<td>Unlatch High Clamp Limit</td>
<td>Click Unlatch High Clamp Limit to send a message to the module to unlatch a High Limit Alarm (online only). Unlatch (High Clamp) is enabled when online (including Hard Run mode) and when Latch Limit Alarms is selected. Unlatch (High Clamp) is dimmed when offline and online (including Hard Run mode) when Latch Limit Alarms is cleared.</td>
</tr>
<tr>
<td>Low Clamp Limit</td>
<td>Enter a Low Clamp Limit (between -9999999…99999999). The default is 0.0000. The Low Clamp Limit must be less than the High Clamp Limit. Any out of range value causes a profile validation error. LO appears dimmed only when in Hard Run mode.</td>
</tr>
<tr>
<td>Unlatch Low Clamp Limit</td>
<td>Click Unlatch Low Clamp Limit to send a message to the module to unlatch a Low Limit Alarm (online only). Unlatch (Low Clamp) is enabled when online (including Hard Run mode) and when Latch Limit Alarms is selected. Unlatch (Low Clamp) is dimmed when offline and online (including Hard Run mode) when Latch Limit Alarms is cleared.</td>
</tr>
<tr>
<td>Unlatch All</td>
<td>Click Unlatch All to send a message to the module to unlatch all latched alarms (High Limit, Low Limit and Ramp Alarm).</td>
</tr>
<tr>
<td>Ramp in Run Mode</td>
<td>Check this checkbox to establish whether to limit the rate of change of the output. If selected, then changes due to command values, fault actions, and program actions are limited to the specified ramp rate.</td>
</tr>
<tr>
<td>Ramp Rate</td>
<td>Enter the maximum ramp rate for changes in the output value (in seconds). The default is blank, which results in an auditing error. This default forces you to enter an appropriate value.</td>
</tr>
<tr>
<td>Unlatch Ramp Rate</td>
<td>Click Unlatch Ramp Rate to send a message to the module to unlatch based on Ramp Rate. Unlatch (Ramp Rate) is enabled when online (including Hard Run mode) and when Latch Rate Alarm is selected. Unlatch (Low Clamp) is dimmed when offline and online (including Hard Run mode) when Latch Rate Alarm is cleared.</td>
</tr>
<tr>
<td>Disable All Alarms</td>
<td>Check the checkbox to not report Latch Limit and Latch Rate Alarms in the input tag. By default, Disable All Alarms is enabled and cleared.</td>
</tr>
<tr>
<td>Latch Limit Alarms</td>
<td>Check the checkbox if you want the High Clamp and Low Clamp Limit Alarms to be latched until a message resets them or by the use of a latch reset member of the output tag. By default, Latch Limit Alarms is enabled and cleared.</td>
</tr>
<tr>
<td>Latch Rate Alarm</td>
<td>Check the checkbox if you want the Rate Alarm to be latched until it is reset either by a message or by use of a latch reset member of the output tag. By default, Latch Rate Alarm is dimmed and cleared.</td>
</tr>
</tbody>
</table>
11. Click the Fault/Program Action tab.

The Fault/Program Action tab appears.

---

### Table 38 - Fault/Program Action Parameters for Analog Output Duplex Module

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel</td>
<td>Click the channel number to configure parameters for the specified channel (0…7).</td>
</tr>
<tr>
<td>Fault Mode</td>
<td>For a channel, choose the behavior of the output channel when a communication fault occurs. Choose between Hold Last State and Use Fault Value. The default is Hold Last State.</td>
</tr>
<tr>
<td>Fault Value</td>
<td>Enter a fault value (between -999999 and 99999999). The Fault Value must also be in the range of Low Alarm &lt;= Fault Value &lt;= High Alarm. The default is 0.0. Fault Value is enabled (excluding Hard Run mode) when the Fault mode is set to Use Fault Value. Fault Value is dimmed (including Hard Run mode) when the Fault mode is set to Hold Last State.</td>
</tr>
<tr>
<td>Ramp to Fault Value</td>
<td>Check the Ramp to Fault Value checkbox to transition the channel from the current value to the fault value (when in Fault mode and limited by Ramp Rate). The default is cleared. Ramp to Fault Value is enabled (excluding Hard Run mode) when the Fault mode is set to Use Fault Value. Ramp to Fault Value is dimmed (including Hard Run mode) when the Fault mode is set to Hold Last State.</td>
</tr>
<tr>
<td>Program Mode</td>
<td>For a channel, choose the behavior of the output channel when there is a transition to Program mode. Choose between Hold Last State and Use Program Value. The default is Hold Last State.</td>
</tr>
<tr>
<td>Program Value</td>
<td>Enter a program value (between -999999…99999999). The Program Value must also be in the range of Low Alarm &lt;= Program Value &lt;= High Alarm. The default is 0.0. Program Value is enabled (excluding Hard Run mode) when the Program mode is set to Use Program Value. Program Value is dimmed (including Hard Run mode) when the Program mode is set to Hold Last State.</td>
</tr>
</tbody>
</table>
12. Click OK.

**Step 2: Add the Analog Output Module in Simplex Mode**

1. Add the new module, see page 177.
2. Select the 1715-OF8I Analog Output Module, referring to step 2 on page 194, and click OK.

The General tab appears.

See figure on page 178 for General parameter settings.

3. Click Change, referring to Figure on page 190 for Module Definition parameter settings.
4. Change Redundant to No to place the module in Simplex mode.
5. Click OK.

The Verify Module Properties dialog box appears. See page 184.

6. Click Yes.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ramp to Program Value</td>
<td>Check the Ramp to Program Value checkbox to transition the channel from the current value to the program value (when in Program mode and limited by Ramp Rate). The default is cleared. Ramp to Program Value is enabled (excluding Hard Run mode) when the Program mode is set to Use Program Value. Ramp to Program Value is dimmed (including Hard Run mode) when the Program mode is set to Hold Last State.</td>
</tr>
<tr>
<td>Program Mode Communication Failure Output State</td>
<td>Choose the output state when there is communication failure in Program mode (Program mode or Fault mode). The default is Program mode.</td>
</tr>
</tbody>
</table>
| Ramp Rate                       | Displays the Ramp Rate for the channel as it is displayed on the Module Properties dialog box - Limits tab (1715-OF8I). To change this value, enter a Ramp Rate value on the Module Properties dialog box - Limits tab (1715-OF8I). Ramp Rate is enabled when online in the following:  
  - Program mode  
  - Remote Program mode  
  - Remote Run mode |
A new General tab appears showing only one slot as available. The module is now in Simplex mode.

7. Click the Connection tab, see page 169.
8. Click the Module Info tab, see page 194.
9. Click the Configuration tab, see page 194.
10. Click the Limits tab, see page 195.
11. Click the Fault/Program Action tab, see page 197.
12. Click OK.

The I/O configuration folder of your project now looks similar to this.
Notes:
Chapter 7

1715 Redundant I/O System in SIL 2 Safety Applications

This chapter provides information on using 1715 I/O modules in a low demand SIL CL (claim limit) 2 system, such as a ControlLogix®-based SIL 2 system. For SIL 2 safety application requirements specific to installing, programming, and operating a ControlLogix application, refer to the Using ControlLogix in SIL 2 Applications Safety Reference Manual, publication 1756-RM001.

**SIL 2 Safety Application Requirements**

To use the 1715 Redundant I/O system in SIL 2 safety applications, you must have revision 2.001 or later, of the adapter firmware, the latest Add-on Profiles, and the 1715 SIL 2 Add-On Instructions.

---

**IMPORTANT**

The TÜV Rheinland Group has approved the 1715 Redundant I/O System for use in safety-related applications up to and including SIL 2 according to these standards:

- IEC 61508, edition 2.0
- IEC 61511

Approval requirements are based on the standards current at the time of certification. See Appendix D, PFD and PFH Calculations for a SIL 2 System.

---

**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.
1715 I/O Modules in SIL 2 Safety Applications

1715 I/O modules, firmware revision 2.001 and later (a), can be used in safety applications up to and including SIL 2. Your system can be configured with any combination of I/O modules, and in either Simplex or Duplex mode.

Two new tabs have been added to the Module Properties dialog box to configure modules for use in SIL 2 Safety applications:

- The SIL 2 Safety tab lets you configure the RPI, connection reaction time limit, access diagnostic data, and perform a SIL 2 reset, if necessary
- The Input States When CRTL Expires tab lets you define the safe state for inputs

For more information on SIL 2 application requirements for 1715 I/O modules, see these resources:

- Chapter 8, for information about Add-On Instructions for SIL 2 1715 I/O module applications
- Appendix D, for PFD and PFH calculations.
- Appendix E, for a SIL 2 application checklist.
- Using ControlLogix controllers in SIL 2 Applications Safety Reference Manual, publication 1756-RM001, for detailed requirements for installing, programming, and operating a SIL 2 ControlLogix-based safety system.
- For specifications and certifications relating to a 1715 Redundant I/O system, refer to the 1715 Redundant I/O System Technical Specifications, publication 1715-TD001.

These 1715 devices can be included in a SIL 2 system.

(a) See the Module Revision Release List available from the Product Certifications link on at rok.auto/certifications.
Chapter 7          1715 Redundant I/O System in SIL 2 Safety Applications

See the latest certifications for software and firmware at rok.auto/certifications. See the TÜV website at http://www.tuvasi.com for SIL 2 certification listings.

All I/O modules include line monitoring capability. We recommend that you use line monitoring for safety-related I/O. Safety-related I/O refers to an annunciator being available to an input or output that is attached to a field device. For energize-to-action (normally de-energized) I/O, you must enable line monitoring.

Typical Configurations

The 1715 system supports single module configurations, where it is acceptable to either stop the system or allow the signals corresponding to that module to change to their default fail-safe state. It also supports fault-tolerant I/O configurations where the system is required to continue operating in the event of a fault.

Fault tolerant systems have redundant modules that let the system continue operation in the presence of a fault. The system fails safe if another fault occurs.

All configurations can be used for safety-related applications. Choose the appropriate configurations that are based on the fault tolerance requirements of your application.

Table 39 - 1715 Devices in a SIL 2 System

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Firmware Revision</th>
<th>Description</th>
<th>Termination Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-AENTR</td>
<td>2.001 or later</td>
<td>Ethernet adapter redundant module</td>
<td>N/A</td>
</tr>
<tr>
<td>1715-IB16D</td>
<td>2.001 or later(1)</td>
<td>16-channel digital input module</td>
<td>1715-TASIB16D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1715-TADIB16D</td>
</tr>
<tr>
<td>1715-OB8DE</td>
<td>2.001 or later(1)</td>
<td>8-channel digital output module</td>
<td>1715-TASOB8DE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1715-TADOB8DE</td>
</tr>
<tr>
<td>1715-IF16</td>
<td>2.001 or later(1)</td>
<td>16-channel analog input module</td>
<td>1715-TASIF16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1715-TADIF16</td>
</tr>
<tr>
<td>1715-DF8</td>
<td>2.001 or later(1)</td>
<td>8-channel analog output module</td>
<td>1715-TASOF8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1715-TADOF8</td>
</tr>
<tr>
<td>1715-A2A</td>
<td>N/A</td>
<td>Adapter base unit</td>
<td>N/A</td>
</tr>
<tr>
<td>1715-A3IO</td>
<td>N/A</td>
<td>I/O module base unit</td>
<td>N/A</td>
</tr>
<tr>
<td>1715-N2T</td>
<td>N/A</td>
<td>Tall slot filler cover</td>
<td>N/A</td>
</tr>
<tr>
<td>1715-N2S</td>
<td>N/A</td>
<td>Short slot filler cover</td>
<td>N/A</td>
</tr>
<tr>
<td>1715-C2</td>
<td>N/A</td>
<td>Expansion cable - 2 m</td>
<td>N/A</td>
</tr>
</tbody>
</table>

(1) For revision 3.001 and later, the 1715 I/O module firmware displayed is the revision that is installed on the I/O module. For earlier revisions 1715 I/O module firmware is displayed as the same level of the firmware of the 1715-AENTR module regardless of the actual firmware level in the 1715 I/O module.
DLR Topology

Figure 63 - Simplex DLR with a ControlLogix Controller

For duplex configurations, a SIL 2 fault-tolerant architecture has dual input, dual adapter, and dual output modules. The input modules operate in 1oo2 (1 out of 2) under no fault conditions and degrade to 1oo1 (1 out of 1) upon detection of the first fault in either module. The modules fail-safe if faults occur on both modules. The adapters operate in 1oo2 under no-fault conditions and degrade to 1oo1 upon detection of the first fault. A duplex system could therefore be 1oo2 reverting to 1oo1 on the first detected fault and reverting to fail-safe when both modules have a fault. Fail-safe is defined as the ‘de-energized’ or ‘off’ state.

The Ethernet architecture has no affect on SIL 2 safety functions. You can use either of these example drawings, or any other appropriate Ethernet network. From a safety aspect, if the Ethernet packets are not sent successfully, then the SIL 2 safety functions go to their respective safe states.
Figure 64 - Duplex DLR with a ControlLogix Controller

SIL 2 ControlLogix Safety Loop

Figure 65 - Simplex Star with a ControlLogix Controller

Star Topology
Internal Diagnostics

The 1715 adapters feature internal diagnostics to identify faults that develop during operation and raise appropriate alarm and status indications. The diagnostic systems run automatically and check for system faults that are associated with the I/O modules and field faults that are associated with field I/O circuits.

The internal diagnostics detect and reveal both safe and dangerous failures. In a duplex configuration, for example, diagnostics can address dangerous failures and therefore the duplex system can be 1oo2 reverting to 1oo1 on the first detected fault and reverting to fail-safe when both modules have a fault.

Power Supplies

On de-energize-to-trip, two power supplies can be used if fault tolerance is required on the power supplies.

If only one power supply is used, both of the power connections must be connected to it (system power can be from another power supply to the I/O modules).

For energize-to-action, dual power supplies are required for both the system and field supplies. The system provides the power supply monitoring, but this needs to be connected in the application.
Requirements for Using 1715 I/O Modules

You must follow these requirements when using 1715 I/O modules in a SIL 2 application.

**IMPORTANT**
- In safety applications, channel discrepancy alarms must be monitored by the application program and used to provide an alarm to operations personnel.
- Equipment must be installed and wired in accordance with the product installation and wiring instructions in this manual.
- For energize-to-action systems, you must follow the additional requirements on page 207.

The maximum duration for single-channel operation of I/O modules depends on the specific process and must be specified individually for each application. For high availability, Rockwell Automation suggests you use two 1715-AENTR adapters. If one of the modules faults, the adapters can operate in a simplex arrangement up to the duration of the mean time to repair (MTTR) when used in SIL 2 applications.

Energize-to-action Requirements

Certain applications can require energize-to-action for inputs or outputs or both.

**IMPORTANT**
Energize-to-action configurations can be used only if the following apply:
- At least two independent power sources must be used for both the system and field supplies. The system provides the power supply monitoring, but this needs to be connected in the application. These power sources must provide emergency power for a safe process shutdown or a time span that is required by the application.
- Each power source must feature power integrity monitoring with safety-critical input read-back into the system controller or implicit power monitoring that is provided by the I/O modules. Any power failure must trigger an alarm.
- Unless provided implicitly in the I/O modules, all safety-critical inputs and outputs must be fitted with external line and load integrity monitoring and safety-critical read-back of the line-status signals. Any line or load failure must trigger an alarm.
- The application program must be designed to shut down energize-to-action SIL 2 safety instrumented functions if a faulty simplex adapter or output module has not been replaced within the mean time to repair (MTTR).
- For SIL 2 high demand, energize-to-action applications, you must use two output modules.

In cases where one or more outputs is used in an energize-to-action configuration, all specific requirements that are listed previously must be implemented for all associated inputs.

**IMPORTANT**
SIL 1 applications must use the wiring and measures that are defined for SIL 2 applications. Energize-to-action requires line monitoring for any SIL application.
**Requirements for ControlLogix-based SIL 2 Applications**

**Add-On Instructions**

The Add-On Instructions provide a mechanism to verify the validity of data that is transferred between the ControlLogix controller and the 1715 adapter. When you use the Add-On Instructions, the sender of the data adds check data to the produced data. The receiver of the data uses the check data to verify the integrity of the consumed data.

**IMPORTANT**

To meet SIL 2 application requirements in a ControlLogix system, you must use the 1715 Add-On Instructions that are described in Chapter 8.

**Connection Reaction Time Limit**

The Connection Reaction Time Limit (CRTL) setting defines the maximum time that the connection can operate with old data, before substituting the configured safe state values. If the CRTL expires, the receiver requires a SIL 2 Reset before valid data is provided again.

For an input module, if the CRTL expires before the Add-On Instruction detects valid data, the value of the affected input assembly transitions to the configured safe state value. A SIL 2 reset is required before inputs transition from the safe state to field values.

For an output module, if the CRTL expires before the 1715 firmware detects that valid output data is received from the Logix controller the output data transitions to the configured safe state values. In this case, a SIL 2 Reset is required before outputs can be re-energized.

**Using the 1715 Adapter in SIL 2 Applications**

The 1715-AENTR adapter performs the following functions:

- External communication with the controller via an Ethernet network
- Communication with I/O modules, such as receiving input values, sending output values, and coordinating diagnostics
- Enforcement of the output CRTL on data that is received from a ControlLogix controller

For high availability, use two 1715-AENTR adapters in simplex and duplex SIL 2 applications.

**Reaction to Faults**

The 1715-AENTR adapter reports faults via status indicators that turn red when a fault is detected in the adapter. Fault indications are also sent to the user application. These variables provide the following information:

- Module presence
- Module health and status
- Channel health and status
- An echo of the front panel indications
Using 1715 I/O Modules in SIL 2 Applications

I/O modules can be replaced or installed online without affecting controller operation, provided at least one module is installed and is fully operational. However, each module must be installed one at a time and allowed to start up before the next module is installed.

Input Modules

The simplex and duplex termination assemblies are safety critical, that is, an input or output that is attached to a field device, and provide termination for 16 channels. They connect the field signals to the input modules. Both digital and analog input termination assembly circuits have fuse protection.

Input modules support high availability when configured for duplex operation and using the appropriate termination assembly.

Input modules can be configured to operate in SIL 2 energize-to-action or de-energize-to-trip applications.

Reactions to Faults

If an input channel is not capable of reporting a voltage within a safety accuracy specification of 1% of the full scale measurement range, then the module returns safe values to the processor. Signals transition to a safe state if the module scan time exceeds the connection reaction time limit (CRTL).

All I/O modules feature status indicators and can also report faults via application variables. All modules provide the following status information:

- Module presence
- Module health and status
- Channel health and status
- Field faults
- An echo of the front panel indicators for each module

For more information about status indicators, see Status Indicators on page 283.

Safety Accuracy

The I/O input modules determine the channel state and the line fault state by comparing the reported input values with user-programmed threshold values. For each channel of a module, two independent measurements are made. The discrepancy between these measurements is monitored to determine if it is within the safety accuracy limit.

The channel is in fault and the last valid value is held until after the CRTL period if the values are outside these limits:

- Digital input module = 4%
- Analog input module = 1%

After the CRTL period, the value changes to 0.
When using dual modules that are both reporting valid channel data, the lowest value is used. If one module of a pair reports a fault on a channel, the value of the operational module is used.

**ATTENTION:** In safety critical applications, the discrepancy alarms must be monitored by the application program and used to provide an alarm to operations personnel.

Digital Output Modules

The digital output module is rated at SIL 2 as a fail-safe module. Each module provides the following safety functions:

- Output channel signals are based on commands from the controller.
- Redundant voltage and current measurements are sent to the controller for monitoring and diagnostics.
- Modules feature over-current and over-voltage channel protection.
- Diagnostic tests are executed on command from the adapter and results are reported back to the adapter.
- On powerup or module insertion, all output channels are set to the de-energized (fail-safe) state until command states are received from the controller. Each channel is driven individually according to the command state values.
- The module enters a Shutdown mode when the time between controller communication exceeds the CRTL.
- If a module fails, then all of its channels are set to the de-energized state.

The digital output termination assembly is safety critical and comes in two sizes - simplex or duplex. Termination assemblies have fuses for field output power and eight field termination connections for the output signals.

Output modules support high availability when configured for duplex operation and using the appropriate termination assembly.

Reaction to Faults

If an output module faults, the following status information is reported:

- Module presence
- Module health and status
- Channel health and status
- Field faults
- An echo of the front panel indicators for each module

If any of the following internal conditions exist, the output module fails safe:

- Internal software error is detected
- Over-temperature condition is detected
- Power supply rails are out of tolerance

The digital output module incorporates line test functionality that can detect and indicate 'no load' field faults. This functionality can be enabled or disabled.
Chapter 7          1715 Redundant I/O System in SIL 2 Safety Applications

Shutdown Modes

When the module is in Shutdown mode, the Ready and Run indicators turn red. During module configuration, you choose how you want the output channels to behave in the Shutdown mode, whether due to fault or Program mode. Output module channels can be configured to provide the following channel values:

- De-energized (OFF), which is the default fail-safe value
- Hold Last State

Analog Output Modules

The analog output module can be used in applications where the output current is in the range 4...20 mA during normal operation including trip/action value and where 0 mA is the fail-safe value. In these applications, one 1715-OF8I output module is sufficient for SIL 2 requirements, two modules provide a 1oo2 level.

The analog output module is rated at SIL 2 as a fail-safe simplex module and when used in a 1oo2 configuration as a duplex module with these features:

- Commanded values and scaling factor
The fail-safe lowest commanded value irrespective of the scaling factor is 0 mA. The application cannot change the scaling factor; only an online update can change the scaling factor.

- Fail-safe guard band

The fail-safe guard is 1% (0…2 mA) and not user-configurable.

**Reaction to Faults**

If an output module faults, the following status information is reported:

- Module presence
- Module health and status
- Channel health and status
- Field faults
- An echo of the front panel indicators for each module

If any of the following internal conditions exist, the output module fails safe:

- An internal software error is detected
- A power feed combiner over-temperature condition is detected

**Shutdown Mode**

When the module is in the Shutdown mode, the Ready and Run indicators turn red. The default state is OFF (de-energized).

---

**Considerations for Sensor and Actuator Configurations**

The function of a signal must be considered. In many cases, redundant sensor and actuator configurations can be used, or differing sensor and actuator types provide alternate detection and control possibilities. Plant facilities frequently have related signals such as start and stop signals. In these cases, it is important to make sure that failures beyond the fault-tolerant capability of the system do not result in either inability to respond safely or in inadvertent operation. In some cases, this requires that channels be on the same module, to make sure that a module failure results in the associated signals failing-safe.

It is often necessary to separate signals across modules. Where non-redundant configurations are employed, it is especially important to make sure that the fail-safe action is generated in case of failures within the system.

Field loop power and its affect on inputs (sensors and modules) and outputs (modules and actuators) must be considered. For normally energized configurations, field-loop power loss leads to fail-safe reaction.
Where separate supplies power field signals, power separation must be maintained between modules so that isolation is maintained.

**Configure SIL 2 Operation**

To configure 1715 modules for SIL 2 applications you must enable each 1715 module in your system for SIL 2 operation, and set its connection reaction time limit (CRTL) and module requested packet interval (RPI). In addition, for input modules, you must configure safe state input values.

**IMPORTANT** See [Electronic Keying on page 118](#).

**Enable SIL 2 Operation**

Follow these steps to enable a module for SIL 2 operation.

1. On the Module Definition dialog box, from the Series pull-down menu, choose Series A.
2. From the Revision pull-down menu, choose 2.001 or later.
3. From the Connection pull-down menu, choose Data.
4. From the Redundant pull-down menu, choose No for single modules with simplex termination assemblies or Yes if you are using two modules with duplex termination assemblies.
5. From the SIL 2 Safety pull-down menu, choose Yes.

**Specify the Connection Reaction Time Limit and Requested Packet Interval**

On the SIL 2 Safety tab of the module, enter the requested packet interval (RPI) and connection reaction time limit (CRTL). The module RPI is the same as the setting on the Connection tab.
The default value for the CRTL is 10,000 ms. The valid range is 1000…60,000 ms.

Considerations for Setting the CRTL

The value of the CRTL forms part of the safety considerations for the system. You are responsible for calculating and verifying that the CRTL meets the safety reaction time for your safety function.

IMPORTANT For information about how to configure the safety reaction time for your safety application, see page 217.

- In a 1715 system, the CRTL value is assigned to individual modules during module configuration.
- If the input CRTL is not met, the controller presents fail-safe input values to the application logic. Each time a valid packet is received from an input module, the controller resets the CRTL. If the CRTL ever times out, the controllers present fail-safe input values to the application logic.
- Each time a valid packet is received from the controller, the output module resets the CRTL. If the CRTL ever times out, the output module assumes the fail-safe state.

IMPORTANT The default fail-safe state for all 1715 modules is de-energized.

- It is recommended that the CRTL remain at the default of four times the RPI so that one invalid packet does not put the system into the safe state.
For example, if the RPI = 120 ms, then consider 480 ms as the minimum CRTL. The information in the next section helps determine the maximum setting for the CRTL.

**Determining the Appropriate CRTL Value**

Use the following method to confirm whether the default value is acceptable or you must change the CRTL value for your application.

This equation governs the value of CRTL for the I/O connections:

\[
\text{CRTL} \leq \frac{\text{CRTL}_{\text{euc}}}{2} - (\text{sensor delay} + \text{actuator delay})
\]

where CRTL\text{euc} is the process safety time for the equipment under control (euc).

**EXAMPLE** Consider a system function using one sensor and one actuator given the following parameters:
- CRTLeuc: 10,000 ms
- Sensor delay: 250 ms
- Time for actuator (an ESD valve) to fully operate: 1750 ms

In this example, the setting of CRTL for the I/O connections is less than or equal to 3000 ms.

**Set Safe State Values for Inputs**

You must define the safe state values for inputs if the SIL 2 data verification checks have determined that the connection is not valid and the Connection Reaction Time Limit (CRTL) has expired.

The default safe state value for digital inputs is OFF; for analog input modules, the safe state value is 0. Follow these steps to change the default values.

1. Click the Input States When CRTL Expires tab.
2. Use the pull-down menus to choose values for each input point.
3. Click OK.
Check SIL 2 Reset Status

If one of more errors have persisted longer than the Connection Reaction Time Limit (CRTL), the connection uses safe state values and requires a reset to recover. When online, the SIL 2 reset status is displayed on the SIL 2 Safety tab for output modules.

Click Reset to reset the connection and enable the output modules to control their outputs based on logic. To reset the connection for input modules, create a reset tag within the Add-On Instruction. See Chapter 8 for details.

View Module Information

The configuration signature that is displayed on the SIL 2 Safety tab is composed of an ID number, date, and time. The signature is updated whenever the module configuration is changed. You can use this signature to enforce the use of a specific configuration within your application. The signature is found in the CRC member of the SIL 2 configuration tag of the module. This is the only occasion where you access this tag directly.

If you want to keep a record of the signature, you can click Copy to copy the signature to the Windows clipboard.

Diagnostic Data

While online, click Diagnostics on the SIL 2 Safety tab to view data on the SIL 2 Safety Diagnostics dialog box, shown in the following figure.
Reaction Times

To determine the system reaction time of any control chain, you must add up the reaction times of all of components of the safety chain.

System Reaction Time

System Reaction Time = Sensor Reaction Time + Logix System Reaction Time + Actuator Reaction Time

Figure 67 - System Reaction Time

Logix System Reaction Time

The following sections provide information on calculating the Logix System Reaction Time for a simple input-logic-output chain and for a more complex application using produced/consumed safety tags in the logic chain.
**Simple Input-logic-output Chain**

Figure 68 - Logix System Worst-case Reaction Time for Simple Input to Logic to Output

1. Safety Input Module Delay
2. Safety Input Connection Reaction Time Limit
3. Safety Task Period plus Safety Task Watchdog time
4. Safety Output Connection Reaction Time Limit
5. Safety Output Module Delay

The Logix System Reaction Time for any simple input to logic to output chain consists of these five components.

1. Safety input module reaction time plus input delay time
2. Safety Input Connection Reaction Time Limit
3. Safety Task Period plus Safety Task Watchdog time
4. Safety Output Connection Reaction Time Limit
5. Safety output module reaction time

**Configuring the SIL 2 Task Period and Watchdog**

This SIL 2 task is a periodic task with priority (1). See the Using ControlLogix SIL 2 Applications Reference Manual, publication 1756-RM001.

**SIL Task/Program Instructions**

The user application must contain one SIL task that is composed of programs and routines. The SIL 2 task must be the top priority task of the controller and the user-defined watchdog must be set to accommodate the SIL 2 task.

**IMPORTANT** Motion-related functions are not allowed and must not be used.

**IMPORTANT** You must dedicate a specific task for safety-related functions and set that task to the highest priority (1). SIL 2 safety logic and logic that is intended for use in non-SIL 2 functions must be separate.

The task period and task watchdog are configured in the Task Properties dialog box.
Chapter 7          1715 Redundant I/O System in SIL 2 Safety Applications

Configuring the Output Module Program/Fault Actions

For a SIL 2 safety system, you are responsible for making sure that the SIL 2 related safety code, including the SIL 2 Add-On Instructions, are being scanned using a safety task watchdog.


Safety Watchdog

Configure the properties of the task that is used for safety correctly for your application.

- Priority: must be the highest-priority task in the application (lowest number).
- Watchdog: the value that is entered for the SIL 2 safety task must be large enough for all logic in the task to be scanned.

If the task execution time exceeds the watchdog time, a major fault occurs on the controller. Users must monitor the watchdog and program the system outputs to transition to the safe state (typically the OFF state) in the event of a major fault occurring on the controller. For more information on faults, see the Using ControlLogix in SIL 2 Safety Applications Reference Manual.

This handles all fault scenarios:

- If a controller fault, such as a watchdog fault occurs, the controller goes to program mode, which causes the 1715 I/O to go to the Program Mode states.
- If there is a system fault that causes a communications loss to the I/O modules, then the 1715 I/O goes to the Fault Mode states.
- If there is a CRTL (Connection Reaction Time Limit) timeout in the 1715-AENTR adapter, then the 1715 output modules go to the Fault Mode states.

For the 1715-OB8DE, the configuration is found under the Fault/Program Action tab.
For the 1715-OF8I, the configuration is found under the Fault/Program Action tab.

**Additional Resources**

For more information on using 1715 I/O modules in SIL 2 applications, see the following resources:

- Chapter 8 Using SIL 2 Add-On Instructions with 1715 Redundant I/O Modules on page 221
- Appendix D, PFD and PFH Calculations for a SIL 2 System on page 273
- Appendix E, SIL 2 Applications Checklist on page 277
- ControlLogix Controllers in SIL 2 Applications, publication 1756-RM001
Using SIL 2 Add-On Instructions with 1715 Redundant I/O Modules

SIL 2 Add-On Instructions Overview

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIL 2 Add-On Instructions Overview</td>
<td>221</td>
</tr>
<tr>
<td>SIL 2 Check Data</td>
<td>224</td>
</tr>
<tr>
<td>Add-On Instruction Inputs</td>
<td>225</td>
</tr>
<tr>
<td>Add-On Instruction Outputs</td>
<td>226</td>
</tr>
<tr>
<td>Download and Import the Add-On Instructions</td>
<td>227</td>
</tr>
<tr>
<td>Configure an Input Module Add-On Instruction</td>
<td>230</td>
</tr>
<tr>
<td>Configure an Output Module Add-On Instruction</td>
<td>233</td>
</tr>
<tr>
<td>Using the Add-On Instruction Data Tags in an Application Program</td>
<td>237</td>
</tr>
<tr>
<td>Performing a SIL 2 Reset</td>
<td>238</td>
</tr>
</tbody>
</table>

IMPORTANT

To achieve SIL 2 with 1715 I/O modules in a ControlLogix® system, you must use these Add-On Instructions. The SIL 2 Add-On Instructions verify the validity of data that is transferred between the ControlLogix controller and the 1715 modules via the 1715-AENTR adapter. See Download and Import the Add-On Instructions on page 227.

As you proceed with this chapter, be aware that when using the 1715 SIL 2 Add-On Instructions, you do not read inputs directly from the input table, nor do you write directly to the output tags. You read inputs from an Add-On Instruction tag that is called ‘reconciled input data,’ and write outputs to an Add-On Instruction tag called ‘requested output data.’

There is an Add-On Instruction that is required for the 1715-AENTR adapter, as well. The status data from the 1715-AENTR adapter must be validated by using this Add-On Instruction.

You cannot view the logic of each Add-On Instruction because it is source protected.

Table 40 - SIL 2 Add-On Instructions

<table>
<thead>
<tr>
<th>Module</th>
<th>System Configuration</th>
<th>Add-On Instruction Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-IB16D</td>
<td>Simplex</td>
<td>IB16D_Simplex_SIL2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IB16D_Simplex_SIL2_V3</td>
</tr>
<tr>
<td></td>
<td>Duplex</td>
<td>IB16D_Duplex_SIL2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IB16D_Duplex_SIL2_V3</td>
</tr>
</tbody>
</table>
An additional Add-On Instruction called CRC_calculator is automatically imported when any of the Add-On Instructions that are listed previously are imported. The CRC_calculator instruction calculates the CRC for incoming packets and compares the result against the actual CRC received in the packet. The instruction also calculates the CRC that is placed in the outgoing packet. SIL 2 check data is added to data packets by the producer and the consumer verifies this check data to determine the validity of the data transfer.

For input data from the 1715 modules, the 1715-AENTR adapter is the producer and the ControlLogix controller is the consumer. The 1715-AENTR adapter adds the check data, and the Add-On Instructions verify that valid data is received within the connection reaction time limit (CRTL) of the module. If valid data is not received within the CRTL, the instruction substitutes the configured safe state values of the module in place of the invalid data.

For output data to the 1715 modules, the ControlLogix controller is the producer and the 1715-AENTR adapter is the consumer. The Add-On Instructions add SIL 2 diagnostic information (check data) to the module assemblies, including a sequence number, source and destination IDs, and CRC. The 1715-AENTR adapter verifies that valid data is received within the CRTL. Outputs are placed into the safe state if the CRTL expires.

The 1715 input modules send data only in one direction, from the 1715-AENTR adapter to the ControlLogix controller. In contrast, for the 1715 output modules, data is sent in both directions (status to the controller and output data from the controller).

The Add-On Instructions perform error rate monitoring on the input data they process to verify that the maximum allowed error rate for SIL 2 has not been exceeded. The error rate monitoring is performed automatically, requires no

<table>
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<tr>
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<td></td>
<td>Duplex</td>
<td>OB8DE_Duplex_SIL2</td>
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<td>OB8DE_Duplex_SIL2_V3</td>
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<td>1715-IF16</td>
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<td>1715-OF8I</td>
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<td>AENTR_SIL2</td>
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<td></td>
<td></td>
<td>AENTR_SIL2_V3</td>
</tr>
</tbody>
</table>
user configuration, and shuts down a link (force Add-On Instruction outputs to shutdown states and require a SIL 2 Reset) immediately when it is detected.

The Add-On Instructions provide an output (CRC_error) that indicates if this condition has occurred.

A SIL 2 Reset can be used to reset this condition.

The following figures illustrate how the Add-On Instructions work with input and output data.

Figure 69 - Diagram of Input Module Add-On Instruction

Important: The 1715-IF16 module is shown, but the example also applies to the 1715-IB16D module.
Figure 70 - Diagram of Output Module Add-On Instruction

**SIL 2 Check Data**

The instructions gather data from the module-defined configuration tags for the following check data values.

---

Important: The 1715-OF8 module is shown, but the example also applies to the 1715-OB8DE module.
Table 41 - Check Data Values

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VariantID</td>
<td>This is the revision of the module, which is always 2.</td>
</tr>
<tr>
<td>SourceIP</td>
<td>For input assemblies, this is the IP address of the 1715 adapter. For output assemblies, this is the IP address of the ControlLogix Ethernet module.</td>
</tr>
<tr>
<td>DestinationIP</td>
<td>For input assemblies, this is the IP address of the ControlLogix Ethernet module. For output assemblies, this is the IP address of the 1715 adapter.</td>
</tr>
<tr>
<td>SourceSlot</td>
<td>For input assemblies, this is the slot number of the 1715 module. For output assemblies, this is the slot number of the ControlLogix controller.</td>
</tr>
<tr>
<td>DestinationSlot</td>
<td>For input assemblies, this is the slot number of the ControlLogix controller. For output assemblies, this is the slot number of the 1715 module.</td>
</tr>
</tbody>
</table>

The instructions add or check data for these fields.

Table 42 - Add or Check Data Fields

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
</table>
| SequenceNumber | The instruction monitors a sequence number in the module-defined Input Data tag. In normal operation, the sequence number increments by 1 with each incoming packet:  
• If the sequence number is a duplicate or is lower than expected, data is discarded as invalid. The CRTL is not reset.  
• If the sequence number is higher than expected but within a deadband of 100, the data packet is accepted. Data remains valid and the CRTL is reset.  
• If the sequence number is more than 100 greater than the expected number, the data is discarded as invalid. The CRTL is not reset.  
For each output packet, the instruction increments the sequence number, starting with 0 when the connection is initially established. Important: The sequence number is not configurable. |
| CRC            | The instruction calculates a CRC on the input data based on the module-defined input tag and compares this value against the CRC in the input data. If the CRCs do not match, the data is discarded as invalid.  
The instruction calculates a CRC on the output data based on the complete module-defined output tag. This CRC is added to the 1715 module-defined output tag. |
| SIL2ResetNeeded| (output modules only) After the CRTL expires, the 1715-AENTR adapter adds this flag to the SIL 2 check data to indicate that it is providing the safe state values, not valid application data to the output modules. A reset is necessary before providing valid application data. |

Add-On Instruction Inputs

The Add-On Instructions use these inputs.

Table 43 - Add-On Instruction Inputs

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Config_Data</td>
<td>The Add-On Instruction gets the appropriate SIL 2 check data values from this module-defined configuration tag. The instruction uses this check data to populate the 1715 output data and verify the 1715 input data. You must point to this tag when configuring the Add-On Instruction.</td>
</tr>
<tr>
<td>Requested_Output_Data</td>
<td>Only for output modules: This user-defined Requested Output Data tag contains data from the program logic. The output Add-On Instruction takes this requested output data, adds the check data, and places this data in the module-defined Output Data tag.</td>
</tr>
<tr>
<td>Output_Data</td>
<td>This is the raw data sent to the 1715 module. You must point to this tag when configuring the Add-On Instruction.</td>
</tr>
</tbody>
</table>
| Reconciled_Input_Data| If the Add-On Instruction examines the check data and determines that the input data is valid, the data in this tag is a duplicate of the original data that is received from the input module.  
If the Add-On Instruction examines the check data and determines that the data is not valid, the safe state values are substituted in the Reconciled Input Data tag.  
This is the input data to be used in the logic program. |
Chapter 8          Using SIL 2 Add-On Instructions with 1715 Redundant I/O Modules

Add-On Instruction Outputs

The Add-On Instructions generate these outputs.

Table 43 - Add-On Instruction Inputs

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input..Data</td>
<td>This is the raw data from the 1715 module. You must point to this tag when configuring the Add-On Instruction.</td>
</tr>
<tr>
<td>Module..RPI</td>
<td>Enter this value manually from the module properties. Use the exact value to optimize system bandwidth.</td>
</tr>
<tr>
<td>Reset</td>
<td>The reset function requires a L0 to HI transition of this tag. It resets faults and directs the ControlLogix controller to stop transferring the safe state data and start transferring the actual data, if the SIL 2 check data is verified. This tag is also sent to the 1715 output modules so that outputs can be reset from the safe state.</td>
</tr>
</tbody>
</table>

Table 44 - Add-On Instruction Outputs

<table>
<thead>
<tr>
<th>Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Valid</td>
<td>This value is HI if the Add-On Instruction is moving the input data to the Reconciled Input Data tag without substituting safe state values. This value remains HI if packets are being discarded but the CRTL has not timed out. During this time, the reconciled input data is not updated and data is no longer current. If the CRTL expires, the safe state values are placed into the Reconciled Input Data tag.</td>
</tr>
<tr>
<td>Valid Data Being Received</td>
<td>If valid data is being received from the module this output is HI regardless of whether this data is being moved to the Reconciled Input Data tag. This output must be HI before you perform a SIL 2 Reset to begin moving actual data to the Reconciled Input Data tag. This output goes LO if a valid data packet is not received for a time equaling three (3) Module RPIs. If this output is toggling LO, verify that the RPI entered into the Add-On Instruction matches the actual module RPI. The periodic task rate can also affect this output. If the periodic task rate is too high, then the packets are not processed often enough. See the 1715 SIL 2 task recommendations in this manual for configuration recommendations.</td>
</tr>
<tr>
<td>Reset Tiedown Fault</td>
<td>If the reset button is HI for longer than 3 seconds, a tiedown fault is declared. The fault is cleared when the reset button transitions to LO.</td>
</tr>
<tr>
<td>CRC Error</td>
<td>CRC Error is HI if the accumulated error count (for detected CRC errors) has exceeded the allowable threshold.</td>
</tr>
<tr>
<td>Duplicate Sequence Number</td>
<td>If the sequence number is a duplicate, data is discarded as invalid and this output is set HI to indicate the reason.</td>
</tr>
<tr>
<td>Low Sequence Number</td>
<td>If the sequence number is lower than expected, data is discarded as invalid and this output is set HI to indicate the reason.</td>
</tr>
<tr>
<td>High Sequence Number</td>
<td>If the sequence number is higher than expected, data is discarded as invalid and this output is set HI to indicate the reason.</td>
</tr>
<tr>
<td>Source IP Error</td>
<td>If any of these check data values, described on page 224, do not match the values in the 1715 module configuration, data is declared invalid and discarded. The appropriate output is set HI to indicate the reason.</td>
</tr>
<tr>
<td>Source Slot Error</td>
<td></td>
</tr>
<tr>
<td>Destination IP Error</td>
<td></td>
</tr>
<tr>
<td>Destination Slot Error</td>
<td></td>
</tr>
<tr>
<td>Variant ID Error</td>
<td></td>
</tr>
<tr>
<td>Module Connection Status</td>
<td>This output is set LO if the Add-On Instruction detects a connection loss. Input data is declared invalid and the CRTL is not reset. When the connection is re-established, this output is set HI.</td>
</tr>
<tr>
<td>Add-On Instruction Running</td>
<td>If the 1715 module is at the correct firmware revision level (Variant ID = 2) and the logic in the Add-On Instruction is being scanned, this output toggles at the rate of the RPI.</td>
</tr>
<tr>
<td>SIL 2 Output Reset Needed</td>
<td>Only for output modules: This output is set HI if a SIL 2 Reset is necessary reset the outputs from the safe state and begin controlling outputs programmatically. See Performing a SIL 2 Reset on page 238.</td>
</tr>
<tr>
<td>CRTL Countdown</td>
<td>A countdown of the amount of time remaining before the CRTL expires.</td>
</tr>
<tr>
<td>Number of Discarded Data Packets</td>
<td>A count of the data packets that have been discarded as invalid.</td>
</tr>
</tbody>
</table>
Download and Import the Add-On Instructions

The SIL 2 Add-On Instructions are available from the Product Compatibility and Download Center website.

**IMPORTANT** Before you import the Add-On Instructions to your project, you must do the following.
1) Add your I/O modules to the project in the I/O configuration tree and configure them properly.
2) SIL 2 = Yes must be selected when configuring the module.
   This creates the data types and tags that you must use in the Add-On Instruction.

Follow these steps to add the instructions to your project.
1. Right-click the Add-On Instructions folder and choose Import Add-On Instruction.
2. Select the appropriate Add-On Instruction and click Import.
3. Click OK on the Import Configuration dialog box.
4. Repeat steps 1…3 for each Add-On Instruction you require.

The Add-On Instructions folder now contains the instructions that you imported. The instructions also appear in the Add-On tab of the instruction toolbar. The CRC calculator Add-On Instruction also appears.

**IMPORTANT** You see the following warning for each Add-On Instruction import except the first one. Each Add-On Instruction import overwrites the Add-On Instruction that is called ‘CRC Calculator,’ and this warning appears because it is source protected. Click OK.

The appropriate data types are now available in your project.

**Figure 71 - Data Types for 1715-IB16D Module with Duplex Configuration**

Import Add-On Instructions to Upgraded Projects

To upgrade a project with new Add-On Instructions, follow these steps.
1. Upgrade the Add-on Profiles to SIL 2-capable versions.
2. Configure SIL 2=Yes in the module configuration and click Apply to create the required module defined data types.
3. Import the new Add-On Instructions.

Create a Periodic Task for SIL 2 Safety Functions

We recommend that your user application contains one SIL task that is composed of programs and routines that contain all logic for the SIL 2-rated safety functions. This task must be the top-priority task of the controller, and the user-defined watchdog must be set to accommodate the SIL task.

This task must be separate from all logic for the non-SIL 2-rated functions.

Follow these steps to create the SIL 2 periodic task.

1. In the Controller Organizer, right-click the Tasks folder and choose New Task.

2. Name the Task (SIL 2, for example).
3. Select the Type ‘Periodic’.

1715 SIL 2 Periodic Task ‘Period’ Configuration

The following are recommendations to configure the periodic task ‘period’ for SIL 2 applications. Set the period to the minimum 1715 SIL 2 module RPI divided by 2. For example, if the default RPIs are used.

Table 45 – Module Default RPIs

<table>
<thead>
<tr>
<th>1715 Module</th>
<th>RPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapters</td>
<td>180 ms</td>
</tr>
<tr>
<td>Digital modules</td>
<td>60 ms</td>
</tr>
<tr>
<td>Analog modules</td>
<td>120 ms</td>
</tr>
</tbody>
</table>

1. Make the period $60/2 = 30$ ms.
2. Set the priority to 1.
3. Set the Task Watchdog based on the following.
   a. How long it takes to run the SIL 2 code (see AOI Scan Times on page 235).
   b. How small the task watchdog must be to help verify that safety reaction times are met (see Safety Reaction Time Calculations on page 236).

If you do not have the information that is required to complete the watchdog time, leave the default of 500 ms and adjust it later when you have more information.

4. Click OK.
Chapter 8          Using SIL 2 Add-On Instructions with 1715 Redundant I/O Modules

5. Right-click on the newly created task and choose New Program.
6. Type a name for the program.
7. Verify that it is scheduled in the SIL 2 task.

![New Program window]

8. Right-click the newly created program and choose New Routine.
9. Name the routine.
10. Select the appropriate Type.

   Ladder or Function Block is recommended for SIL 2 safety functions.
11. Click OK.

**IMPORTANT** Create as many SIL 2 programs and routines as required for the SIL 2 logic, keeping in mind the goal is to have logic that is the following:
- Easy to understand
- Easy to trace
- Easy to change
- Easy to test
- Well-documented

**Configure an Input Module Add-On Instruction**

Use the following instructions to configure an input module.

**IMPORTANT** The 1715-AENTR adapter functions as an input module when using 1715 SIL 2 Add-On Instructions.

Follow these steps to configure an input module Add-On Instruction.

1. From the Instruction toolbar Add-On tab, add the Add-On instruction to your routine.
2. Create a tag for the Add-On Instruction by using the default data type and Read/Write External Access.

   The tag can be controller- or program-scoped.
3. Create a reset tag by using the default data type and Read/Write External Access.

The tag can be controller- or program-scoped.

4. Choose the module configuration tag.

If you have multiple modules, be sure to choose the configuration tag for the appropriate module.
5. Choose the module input tag.
   a. If you have multiple I/O modules, be sure to choose the input tag for the appropriate module.

   b. For the 1715 adapters, choose the status tag.
6. Create a tag for the Reconciled Input Data by using the default data type and Read/Write External Access.

The tag can be controller- or program-scoped.

![Tag Configuration Example](image)

7. Enter the module RPI.

![Module Configuration Dialog](image)

To optimize system bandwidth, type the same RPI value from the Module Configuration dialog box.

**Configure an Output Module Add-On Instruction**

Follow these steps to configure an output module Add-On Instruction.

1. Add the Add-On Instruction to your routine from the Add-On tab of the instruction toolbar.

2. Create a tag for the Add-On Instruction by using the default data type and Read/Write External Access.

The tag can be controller- or program-scoped.
3. Create a reset tag by using the default data type and Read/Write External Access.

   The tag can be controller- or program-scoped.

4. Choose the module configuration tag.

   If you have multiple modules, be sure to choose the configuration tag for the appropriate module.

5. Choose the module input tag.

   If you have multiple modules, be sure to choose the input tag for the appropriate module.

6. Create a tag for the Reconciled Input Data by using the default data type and Read/Write External Access.

   The tag can be controller- or program-scoped.

7. Choose the module-defined output tag.

   If you have multiple modules, be sure to choose the output tag for the appropriate module.
8. Create a tag with the appropriate Add-On Instruction data type for theRequested Output Data.

9. Enter the module RPI.

To optimize system bandwidth, type the same RPI value from the module configuration.

### Add-On Instruction Scan Times

**Table 46 - Maximum Scan Rates Measured - The L75 Controller was used for taking measurements.**

<table>
<thead>
<tr>
<th>Module</th>
<th>Add-On Instruction</th>
<th>Data Type</th>
<th>Scan Rate µs (max measured)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-AENTR</td>
<td>AENTR_SIL2</td>
<td>Duplex</td>
<td>455</td>
</tr>
<tr>
<td>1715-IB16D</td>
<td>IB16D_Simplex_SIL2</td>
<td>Simplex</td>
<td>340</td>
</tr>
<tr>
<td>1715-IB16D</td>
<td>IB16D_Duplex_SIL2</td>
<td>Duplex</td>
<td>378</td>
</tr>
<tr>
<td>1715-IF16</td>
<td>IF16_Simplex_SIL2</td>
<td>Simplex</td>
<td>831</td>
</tr>
<tr>
<td>1715-IF16</td>
<td>IF16_Duplex_SIL2</td>
<td>Duplex</td>
<td>832</td>
</tr>
</tbody>
</table>
Table 46 - Maximum Scan Rates Measured - The L75 Controller was used for taking measurements.

<table>
<thead>
<tr>
<th>Module</th>
<th>Add-On Instruction</th>
<th>Scan Rate µs (max measured)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-OB8DE</td>
<td>OB8DE_Simplex_SIL2</td>
<td>501</td>
</tr>
<tr>
<td>1715-IF16</td>
<td>IF16_Simplex_SIL2</td>
<td>951</td>
</tr>
<tr>
<td>1715-OB8DE</td>
<td>OB8DE_Duplex_SIL2</td>
<td>964</td>
</tr>
<tr>
<td>N/A</td>
<td>CRC Calculator</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 47 - Maximum Scan Rates V3 Measured- The L75 Controller was used for taking measurements.

<table>
<thead>
<tr>
<th>Module</th>
<th>Add-On Instruction</th>
<th>Scan Rate µs (max measured)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-AENTR</td>
<td>AENTR_SIL2_V3</td>
<td>507</td>
</tr>
<tr>
<td>1715-IB16D</td>
<td>IB16D_Simplex_SIL2_V3</td>
<td>982</td>
</tr>
<tr>
<td>1715-IF16</td>
<td>IF16_Simplex_SIL2_V3</td>
<td>676</td>
</tr>
<tr>
<td>1715-IF16</td>
<td>IF16_Duplex_SIL2_V3</td>
<td>686</td>
</tr>
<tr>
<td>1715-OB8DE</td>
<td>OB8DE_Simplex_SIL2_V3</td>
<td>950</td>
</tr>
<tr>
<td>1715-OB8DE</td>
<td>OB8DE_Duplex_SIL2_V3</td>
<td>1012</td>
</tr>
<tr>
<td>1715-OF8</td>
<td>OF8_Simplex_SIL2_V3</td>
<td>1048</td>
</tr>
<tr>
<td>1715-IF16</td>
<td>IF16_Simplex_HART_SIL2_V3</td>
<td>1055</td>
</tr>
<tr>
<td>1715-IF16</td>
<td>IF16_Duplex_HART_SIL2_V3</td>
<td>692</td>
</tr>
<tr>
<td>1715-OF8</td>
<td>OF8_Simplex_HART_SIL2_V3</td>
<td>1058</td>
</tr>
<tr>
<td>N/A</td>
<td>CRC Calculator_V3</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Safety Reaction Time Calculations

The 1715 AOIs process data at a rate of the module RPI / 2. For example, if the 1715-IF16 RPI = 100 ms, the 1715 IF16 AOI processes the most recent packet every 50 ms. This provides a compromise between controller bandwidth (not processing the packets too often using old data) and overall 1715 screw to screw performance. Because the 1715 AOIs run on a time basis, the input module AOI and the output module AOI can be asynchronous. See page 228 for more information. The periodic task rate affects the actual process rate and periodic task scan time.

The worst-case safety reaction time can be calculated using the formulas that are shown in the following example.

For the following example, assume the following:

- 1715 Input Module RPI = 60 ms
- 1715 Output Module RPI = 80 ms
- SIL 2 Task Period = 30 ms
- SIL 2 Task Watchdog = 20 ms
- AOI Module RPI=60 ms
Chapter 8          Using SIL 2 Add-On Instructions with 1715 Redundant I/O Modules

If you are not using COS, the worst-case reaction time from input screw terminal to output screw terminal is equal to 210 ms plus the following:

- Input RPI
- Output RPI
- Add-On Instruction Module RPI/2
- SIL 2 Task Period x 2
- SIL 2 Task Watchdog x 2

If you are using COS, the worst-case reaction time from input screw terminal to output screw terminal is equal to 270 ms plus the following:

- Output RPI
- Add-On Instruction Module RPI/2
- SIL 2 Task Period x 2
- SIL 2 Task Watchdog x 2

Using the Add-On Instruction Data Tags in an Application Program

The following illustrations provide basic examples of how the Requested_Output_Data tag and the Reconciled_Input_Data tag could be used in program logic. Data is written to the requested output and read from the reconciled input, while the raw data in the module-defined input and output tags is ignored.

Table 48 - Worst Case Reaction Time Calculations

<table>
<thead>
<tr>
<th>Worst Case Factors</th>
<th>Value</th>
<th>Fixed Time (ms)</th>
<th>User Configurable Time (ms)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715 Input Module Delay</td>
<td></td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1715 Backplane Rate</td>
<td></td>
<td>65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1715-AENTR Delay</td>
<td></td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Data to ControlLogix</td>
<td>COS=NO</td>
<td>1715 Input Module RPI</td>
<td>60</td>
<td>COS = Change of State</td>
</tr>
<tr>
<td></td>
<td>COS=YES</td>
<td>Fixed</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Add-On Instruction Module RPI</td>
<td>AOI Module RPI/2</td>
<td>30</td>
<td></td>
<td>Value that is entered into the AOI Module_RPI parameter</td>
</tr>
<tr>
<td>ControlLogix SIL2 Task Watchdog</td>
<td>SIL 2 Task Watchdog</td>
<td>20</td>
<td></td>
<td>ControlLogix system runs input module AOI and controls requested output</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Assumes requested output in same SIL 2 task as 1715 SIL 2 AOIs</td>
</tr>
<tr>
<td>Add-On Instruction Module RPI</td>
<td>AOI Module RPI/2</td>
<td>30</td>
<td></td>
<td>Value that is entered into the AOI Module_RPI parameter</td>
</tr>
<tr>
<td>ControlLogix SIL2 Task Watchdog</td>
<td>SIL 2 Task Watchdog</td>
<td>20</td>
<td></td>
<td>ControlLogix system runs output module Add-On Instruction and places</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>requested outputs in output module raw data</td>
</tr>
<tr>
<td>Output Data to 1715-AENTR</td>
<td>1715 Output Module RPI</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1715-AENTR Delay</td>
<td></td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1715 Backplane Rate</td>
<td></td>
<td>65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1715 Output Module Delay</td>
<td></td>
<td>15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Performing a SIL 2 Reset

SIL 2 communication between a Logix controller and 1715 modules is achieved by the sender of the data encoding additional check data into the produced tag and the receiver of that tag by using that extra data (and time) to determine the data that is received is valid.

Data can travel in either direction, that is, CLX -> 1715 and 1715 -> CLX.

Each time the data passes the checks, it is deemed valid. If the checks fail for a period > the CRTL value assigned to the module, a SIL 2 Reset is required.

A SIL 2 Reset acknowledges that there has been a fault within the data and that new data, if valid, must once again be used.

The following diagram shows 1715 module output behavior.
When using input tags, that is, data from a 1715 input module to a ControlLogix controller, the 1715 module that produces the input tag generates more check data as part of the tag. It is the responsibility of the ControlLogix application to use appropriate Add-On Instructions to validate the received data. The behavior of the Add-On Instructions in processing input data is as follows.

A SIL 2 reset of output modules can be performed only by clicking Reset on the SIL 2 Safety tab of the Module Properties dialog box, or a LO to HI transition of the reset tag in the 1715 SIL 2 Add-On Instructions.
Chapter 8  Using SIL 2 Add-On Instructions with 1715 Redundant I/O Modules

S0 CLX App Init
Reconciled Input = Configured Defaults
Data Valid = FALSE
CRTL Timer started

Initialisation Complete

S1 Application Running

Valid SIL2 Data Received

S3 Application Running
Reconciled Input = Received Input Data
DataValid = TRUE

Valid SIL2 Data Update NOT Received
Within CRTL

Valid SIL2 Data Update NOT Received
Within CRTL

S4 Reconciled Input = Configured Defaults
DataValid = FALSE

Valid SIL2 Data Update NOT Received
Within CRTL

SIL2 Reset

S5 Reset CRTL Timer
Waiting For Valid Data

NOTE: - Whenever Data Valid = FALSE the AOI must be Reset as errors have been found in the SIL2 transmission from 1715 module to CLX input tag.
Chapter 9

Redundant I/O System Diagnostics

Diagnostic Features

Many of the diagnostic functions that are associated with an analog module are provided by proxy by the adapter. These tables summarize the functions for each module type.

Table 49 - 1715-AENTR Adapter Diagnostic Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy level</td>
<td>Duplex only.</td>
</tr>
<tr>
<td>Redundancy status</td>
<td>The status of each module of a duplex pair is available in the input tag.</td>
</tr>
<tr>
<td>Communication</td>
<td>Various communication diagnostic information is available through the input tag. For each physical Ethernet port, this includes: Link status, duplex setting, speed, and auto-negotiation status. For the module, this includes: CIP on EtherNet/IP timeout count, CIP on EtherNet/IP connection count, CIP on EtherNet/IP network Lost Packets count, TCP Connection count, and CPU utilization.</td>
</tr>
</tbody>
</table>

Table 50 - 1715-IB16D Module Diagnostic Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy level</td>
<td>Simplex or duplex.</td>
</tr>
<tr>
<td>Redundancy status</td>
<td>The status of each module of a duplex pair is available in the input tag.</td>
</tr>
<tr>
<td>Change of state transport</td>
<td>The connection trigger for the discrete modules is to be change of state.</td>
</tr>
<tr>
<td>Points that trigger production</td>
<td>The trigger for change of state production is selectable on a point basis for values and on a module basis for diagnostics.</td>
</tr>
<tr>
<td>Open wire detection</td>
<td>With an appropriate end-of-line device installed and the open wire detection diagnostic is enabled, a fault is indicated when an open wire condition is detected. The fault indication is reset when the open wire condition no longer exists. Open wire detection can be disabled to prevent unused points from indicating faults.</td>
</tr>
<tr>
<td>Short circuit detection</td>
<td>With an appropriate end-of-line device installed and the short circuit detection diagnostic is enabled, a fault is indicated when a short circuit is detected. The fault indication is reset when the short is removed.</td>
</tr>
<tr>
<td>Overload protection</td>
<td>User-serviceable fuses are included in the termination assembly.</td>
</tr>
<tr>
<td>Diagnostic latch</td>
<td>When latching is enabled, diagnostic alarms are latched until they are reset. This aids in detecting intermittent issues. For input modules, latch reset occurs only through messaging.</td>
</tr>
<tr>
<td>Configurable thresholds</td>
<td>To allow flexibility in the use and choice of end-of-line devices, you can select the thresholds for detection of inputs, short circuits, and open wires.</td>
</tr>
</tbody>
</table>
Table 51 - 1715-OB8DE Module Diagnostic Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy level</td>
<td>Simplex or duplex.</td>
</tr>
<tr>
<td>Redundancy status</td>
<td>The status of each module of a duplex pair is available in the input tag.</td>
</tr>
<tr>
<td>Change of state transport</td>
<td>The connection trigger for the discrete output is change of state. Data is produced when output data is consumed, or when diagnostic data changes state, or at the Requested Packet Interval. Unlike the discrete input module, change of state production cannot be disabled for the discrete output module.</td>
</tr>
<tr>
<td>No load detection</td>
<td>A fault is indicated when no load is detected while the output point is in the off state. No load detection can be disabled to prevent alarms from appearing for unused points.</td>
</tr>
<tr>
<td>Short circuit detection</td>
<td>A fault is indicated when a short circuit/over current condition is detected. The fault indication is reset when the following occurs. 1. Point is commanded off. 2. A short reset service is sent to the module. 3. A reset is done through a bit in the output tag.</td>
</tr>
<tr>
<td>Diagnostic latch</td>
<td>When latching is enabled, diagnostic alarms are latched until they are reset. This aids in detecting intermittent issues. For output modules, latch reset can occur either through messaging or through a member of the output tag.</td>
</tr>
<tr>
<td>Fault mode</td>
<td>When a connection from a controller exists, and the connection is interrupted, the module outputs take on a user-selected state. This Fault mode is either Off, On or Hold Last State.</td>
</tr>
<tr>
<td>Program mode</td>
<td>When a connection from a controller exists, and the controller is not in Run mode, the module outputs take on a user-selected state. This Program (a.k.a. ‘Idle’) mode is either Off, On or Hold Last State.</td>
</tr>
<tr>
<td>Program to fault enable</td>
<td>When enabled, the outputs assume the fault value when a communication fault occurs while in Program mode.</td>
</tr>
<tr>
<td>ReadBack</td>
<td>The state of each output point is reflected in the input tag.</td>
</tr>
</tbody>
</table>

Table 52 - 1715-IF16 Module Diagnostic Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy level</td>
<td>Simplex or duplex.</td>
</tr>
<tr>
<td>Redundancy status</td>
<td>The status of each module is available in the input tag.</td>
</tr>
<tr>
<td>Input range</td>
<td>Fixed as 0…20 mA.</td>
</tr>
<tr>
<td>Wiring</td>
<td>Single-ended only.</td>
</tr>
<tr>
<td>Data format</td>
<td>Read-only.</td>
</tr>
<tr>
<td>Scaling</td>
<td>Support choice of signal and engineering range.</td>
</tr>
<tr>
<td>Underrange overrange</td>
<td>Diagnostic alarms are provided when the signal goes above or below what the module can detect. (Zero or less is considered underrange.)</td>
</tr>
<tr>
<td>Rolling timestamp</td>
<td>1 ms resolution.</td>
</tr>
<tr>
<td>Real time sample rate</td>
<td>Fixed RTS.</td>
</tr>
</tbody>
</table>

Table 53 - 1715-OF8I Module Diagnostic Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy level</td>
<td>Simplex or duplex.</td>
</tr>
<tr>
<td>Redundancy status</td>
<td>The status of each module is available in the input tag.</td>
</tr>
<tr>
<td>Input range</td>
<td>Fixed as 0…20 mA.</td>
</tr>
<tr>
<td>Scaling</td>
<td>Support choice of signal and engineering range.</td>
</tr>
<tr>
<td>ReadBack</td>
<td>The state of each output point is reflected in the input tag.</td>
</tr>
<tr>
<td>Hold for initialization and enable</td>
<td>Hold for initialization causes outputs to hold present state until the value commanded by the controller matches the value at the output screw terminal within 0.1% of full scale, providing a bumpless transfer. A bit in the configuration tag selects whether Hold For Initialization is used. A bit in the input tag indicates when a channel is holding.</td>
</tr>
<tr>
<td>Fault mode/Fault value</td>
<td>When a connection from a controller exists, and the connection is interrupted, the module outputs take on a user-selected state. This Fault mode is either a user-defined value or Hold Last State.</td>
</tr>
<tr>
<td>Program module/Program value</td>
<td>When a connection from a controller exists, and the controller is not in Run mode, the module outputs take on a user-selected state. This Program (a.k.a. ‘Idle’) mode is either a user-defined value or Hold Last State.</td>
</tr>
</tbody>
</table>
Ramp to run
Enables ramping of the output value during Run mode between the current output level and a newly requested output. Ramping defines the maximum rate that the output is allowed to transition at, based upon the configured rate by the Maximum Ramp Rate.

Ramp to program
Enables ramping to the output value to a user-defined program value. Ramping defines the maximum rate that the output is allowed to transition based on the configured Maximum Ramp Rate.

Ramp to fault
Enables ramping of the output value to a user-defined fault value. Ramping defines the maximum rate that the output is allowed to transition at based on the configured Maximum Ramp Rate.

Maximum Ramp Rate
A limit on the rate of change of the output, in engineering units (per scaling) per second. The Maximum Ramp Rate applies when any of the Ramp to Run, Ramp to Program, or Ramp to Fault features are enabled.

Ramp rate alarm
A diagnostic that is triggered when the rate of change of the output is limited by the Maximum Ramp Rate.

Ramp alarm latch
When latching is enabled, the Ramp Rate Alarm is latched and the unit is explicitly reset.

Ramp alarm unlatch
When a Ramp Rate Alarm is latched, a bit in the output image can be used to unlatch the alarm. The unlatch is triggered on a rising edge. If the change in the channel value is still limited by the Maximum Ramp Rate when the latch is attempted, the alarm remains. (A direct-to-module message can also be used to unlatch an alarm.)

Clamp limits/Clamp limit alarms
Changing limits the output from the analog module to remain within a range that the controller configures, even when the controller commands an output outside that range. When a command value exceeds a clamp limit (either above the High clamp or below the Low clamp), the output is commanded to the clamp value and an alarm is indicated in the input tag.

Clamp alarm latch
When latching is enabled, Clamp Limit Alarms are latched until they are reset. This aids in detecting intermittent issues.

Clamp alarm unlatch
When a clamp alarm is latched, a bit in the output image can be used to unlatch the alarm. The unlatch is triggered on a rising edge. If the point is still clamped when the unlatch is attempted, the clamp and alarm remains. (A direct-to-module message can also be used to unlatch an alarm.)

Not a number
A bit in the input tag indicates when the controller has commanded an output value that is not a number.

---

Table 53 - 1715-OF8I Module Diagnostic Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ramp to run</td>
<td>Enables ramping of the output value during Run mode between the current output level and a newly requested output. Ramping defines the maximum rate that the output is allowed to transition at, based upon the configured rate by the Maximum Ramp Rate.</td>
</tr>
<tr>
<td>Ramp to program</td>
<td>Enables ramping to the output value to a user-defined program value. Ramping defines the maximum rate that the output is allowed to transition based on the configured Maximum Ramp Rate.</td>
</tr>
<tr>
<td>Ramp to fault</td>
<td>Enables ramping of the output value to a user-defined fault value. Ramping defines the maximum rate that the output is allowed to transition at based on the configured Maximum Ramp Rate.</td>
</tr>
<tr>
<td>Maximum Ramp Rate</td>
<td>A limit on the rate of change of the output, in engineering units (per scaling) per second. The Maximum Ramp Rate applies when any of the Ramp to Run, Ramp to Program, or Ramp to Fault features are enabled.</td>
</tr>
<tr>
<td>Ramp rate alarm</td>
<td>A diagnostic that is triggered when the rate of change of the output is limited by the Maximum Ramp Rate.</td>
</tr>
<tr>
<td>Ramp alarm latch</td>
<td>When latching is enabled, the Ramp Rate Alarm is latched and the unit is explicitly reset.</td>
</tr>
<tr>
<td>Ramp alarm unlatch</td>
<td>When a Ramp Rate Alarm is latched, a bit in the output image can be used to unlatch the alarm. The unlatch is triggered on a rising edge. If the change in the channel value is still limited by the Maximum Ramp Rate when the latch is attempted, the alarm remains. (A direct-to-module message can also be used to unlatch an alarm.)</td>
</tr>
<tr>
<td>Clamp limits/Clamp limit alarms</td>
<td>Changing limits the output from the analog module to remain within a range that the controller configures, even when the controller commands an output outside that range. When a command value exceeds a clamp limit (either above the High clamp or below the Low clamp), the output is commanded to the clamp value and an alarm is indicated in the input tag.</td>
</tr>
<tr>
<td>Clamp alarm latch</td>
<td>When latching is enabled, Clamp Limit Alarms are latched until they are reset. This aids in detecting intermittent issues.</td>
</tr>
<tr>
<td>Clamp alarm unlatch</td>
<td>When a clamp alarm is latched, a bit in the output image can be used to unlatch the alarm. The unlatch is triggered on a rising edge. If the point is still clamped when the unlatch is attempted, the clamp and alarm remains. (A direct-to-module message can also be used to unlatch an alarm.)</td>
</tr>
<tr>
<td>Not a number</td>
<td>A bit in the input tag indicates when the controller has commanded an output value that is not a number.</td>
</tr>
</tbody>
</table>

For more information on 1715-IB16D module diagnostics and information about how to set threshold values for digital inputs, see Appendix C.
Appendix A

Status Indicators

The front panel module status indicators report general status and fault status. Faults can also be reported via the user application, sourced from system variables or I/O connection points. Faults are classified as listed here:

- System faults
- Module faults
- Channel faults
- Field faults

Faults

Faults are described here.

System Faults

If redundant adapters are fitted, then the Rack Status indicator on both adapters simultaneously turns RED.

A system fault is indicated when a fault is detected on any module (including the adapter) or any channel. When this type of fault occurs in the system, the Rack Status indicator on the adapters turns red.

Module Faults

A module fault is indicated when a detected fault is isolated to the hardware of a specific module. The Module Status indicator turns RED on the faulty module and then the Rack Status indicator on the adapter turns RED.

It is possible during sustained periods of abnormal field voltage and/or current slewing for channels to be declared faulted as a consequence of diagnostics that are otherwise designed to verify the channels are operating within their designed safety accuracy. For details of slew rate limitations, refer to the 1715 Redundant I/O System Specifications Technical Data, publication 1715-TD001.
Appendix A          Status Indicators

Channel Faults

A channel fault is indicated when a detected, faulty channel is isolated to a hardware fault on a specific channel of an I/O module. All channel faults are also reported as a module fault. This means that the CHANNEL indicator turns RED, the Module Status indicator turns RED, and the Rack Status indicator on the adapter also turns RED.

A channel fault on an input module indicates that the channel with the fault no longer contributes to the reported values. In a dual configuration, as long as one channel is not faulted, valid data continues to be reported.

If a channel fault on an output module occurs, the channel continues to drive the output to the best of its ability, in most cases. Otherwise, a fail-safe state occurs.

In dual configuration, the output values continue as determined by the adapter as the second module outputs the full current.

It is possible during sustained periods of abnormal field voltage and/or current slewing for channels to be declared faulted as a consequence of diagnostics that are otherwise designed to verify the channels are operating within their designed safety accuracy. For details of slew rate limitations, refer to the 1715 Redundant I/O System Specifications Technical Data, publication 1715-TD001.

Field Faults

A field fault is indicated when a detected fault condition is isolated to a field condition or field device and the cause is not the hardware that is associated with the channel or output module. Examples are an open circuit field connection, no field power, or an out-of-range signal. A CHANNEL indicator flashing AMBER indicates these faults. Steady AMBER indicates that the channel is ON or in range.

User Application Fault Indications and Logging

The information available includes the following:

- Module presence (that is, Shutdown or Run modes)
- Module health and status (that is, Module Status or Fault)
- Channel health and status (that is, individual channel Module Status/fault or field fault)
- An echo of the front panel indicators for each module

Troubleshooting Faults

Follow this troubleshooting procedure to diagnose field faults.
1. Note the affected channel as a field fault can indicate that there is a blown fuse on an input channel.

2. Check the input field connections to the faulty channel to find the source of the over voltage that caused the fuse to blow.

3. After you have removed the source of the over voltage, replace the blown fuse by following these steps.

   The fuse can be changed with the termination assembly still installed. You do not have to remove it.

   a. Lift the plastic cover that covers the fuses.

   b. Use a fuse removal tool to lever the fuse out of the fuse holder and replace the fuse.

   You can use these types of replacement fuses.

<table>
<thead>
<tr>
<th>Component</th>
<th>Fuse Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog Input Termination Assembly</td>
<td>Littelfuse No. 396/TE5 50 mA time lag fuse; UL 248-14, 125 V, T Leadfree</td>
</tr>
<tr>
<td>Digital Input Termination Assembly</td>
<td>Littelfuse No. 396/TE5 50 mA time lag fuse; UL 248-14, 125 V, T Leadfree</td>
</tr>
<tr>
<td>Digital Output Termination Assembly</td>
<td>Littelfuse Type 651 Omni-Blok 10 A, 125 V very fast acting fuse; Surface mount fuse block 154 010</td>
</tr>
</tbody>
</table>

   c. Close the plastic cover.

**1715 Adapter**

The adapter has these status indicators.
### Status Indicators for the 1715-AENTR Adapter

Status indicators for the 1715-AENTR adapter are shown in this table.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Module Status</td>
</tr>
<tr>
<td>B</td>
<td>Redundancy Status</td>
</tr>
<tr>
<td>C</td>
<td>Network Status</td>
</tr>
<tr>
<td>D</td>
<td>Rack Status</td>
</tr>
<tr>
<td>E</td>
<td>Ethernet 1 &amp; 2</td>
</tr>
<tr>
<td>F</td>
<td>Reset</td>
</tr>
</tbody>
</table>

![Diagram of 1715-AENTR Adapter with status indicators]
### Table 54 - Adapter Status Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steady off</td>
<td>No power - There is no power to the module.</td>
<td></td>
</tr>
<tr>
<td>Steady green</td>
<td>Module operational - The module has been configured without any faults.</td>
<td></td>
</tr>
<tr>
<td>Flashing green</td>
<td>Standby - The module has not been configured.</td>
<td></td>
</tr>
<tr>
<td>Flashing red (with steady red for network status)</td>
<td>An address conflict has been detected.</td>
<td></td>
</tr>
<tr>
<td>Flashing red (with flashing green for network status)</td>
<td>Module firmware is being updated with ControlFLASH™</td>
<td></td>
</tr>
<tr>
<td>Flashing red (with NOT steady red and NOT flashing green for network status)</td>
<td>Recoverable fault detected.</td>
<td></td>
</tr>
<tr>
<td>Steady red</td>
<td>Major fault - The module has detected a nonrecoverable fault.</td>
<td></td>
</tr>
<tr>
<td>Flashing green/red</td>
<td>Self-test - The module is performing its power-on self-tests.</td>
<td></td>
</tr>
<tr>
<td>Flashing amber</td>
<td>Unlocked - Adapter is unlocked from a previously locked state.</td>
<td></td>
</tr>
<tr>
<td><strong>Redundancy Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steady off</td>
<td>No power, unlocked, or no partner - The module is not locked (via the locking screw), or no partner module is present.</td>
<td></td>
</tr>
<tr>
<td>Steady green</td>
<td>Synchronized - The module is synchronized with the partner module (redundant operation).</td>
<td></td>
</tr>
<tr>
<td>Flashing green</td>
<td>Partner detected, synchronizing - The partner module has been detected and is synchronizing with its partner module in preparation for redundant operation.</td>
<td></td>
</tr>
<tr>
<td>Steady red</td>
<td>Synchronization fault - The partner module is present, but unable to synchronize (no redundant operation).</td>
<td></td>
</tr>
<tr>
<td>Flashing green/red</td>
<td>Self-test - The module is performing its power-on self-tests.</td>
<td></td>
</tr>
<tr>
<td>Flashing amber</td>
<td>Unlocked - Adapter is unlocked from a previously locked state.</td>
<td></td>
</tr>
<tr>
<td><strong>Network Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steady off</td>
<td>No power, unlocked, no IP address - The module has no power, or the module is not locked (via the locking screw), or no IP address has been assigned or obtained.</td>
<td></td>
</tr>
<tr>
<td>Steady green</td>
<td>Connected - The module has at least one established connection (either to itself or to an I/O module).</td>
<td></td>
</tr>
<tr>
<td>Flashing green</td>
<td>No connections - The module has an IP address, but there are no established connections (either to itself or an I/O module).</td>
<td></td>
</tr>
<tr>
<td>Flashing red</td>
<td>Connection timeout - One or more of the connections (either to itself or to an I/O module) has timed out.</td>
<td></td>
</tr>
<tr>
<td>Steady red</td>
<td>Duplicate IP - The module has detected that its IP address is already in use.</td>
<td></td>
</tr>
<tr>
<td>Steady red (with flashing red for module status)</td>
<td>An address conflict has been detected.</td>
<td></td>
</tr>
<tr>
<td>Flashing green/red</td>
<td>Self-test - The module is performing its power-on self-tests.</td>
<td></td>
</tr>
<tr>
<td>Flashing amber</td>
<td>Unlocked - Adapter is unlocked from a previously locked state.</td>
<td></td>
</tr>
<tr>
<td><strong>Rack Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steady off</td>
<td>No power, unlocked - The module has no power or it is not locked (via the locking screw).</td>
<td></td>
</tr>
<tr>
<td>Steady green</td>
<td>Rack operational - All modules in the rack are operating without fault.</td>
<td></td>
</tr>
<tr>
<td>Steady red</td>
<td>Fault - At least one module in the rack has detected a fault. Examine the other modules in the rack for their status indicator condition.</td>
<td></td>
</tr>
<tr>
<td>Flashing green/red</td>
<td>Self-test - The module is performing its power-on self-tests.</td>
<td></td>
</tr>
<tr>
<td>Flashing amber</td>
<td>Unlocked - Adapter is unlocked from a previously locked state.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix A  Status Indicators

Reset Button

The reset button does the following three functions:

- **Firmware recovery**: Press the Reset button while cycling power if communication during a firmware upgrade is interrupted that causes the module to become inoperable. Cycle power to the module while pressing the button. This places the adapter in Safe mode so that you can flash it again.

- **Recover a lost IP address**: Press and hold the Reset button while cycling power. This places the module in Safe mode. Cycle power again without holding the Reset button. This re-enables BootP mode. The adapter requests a new IP address.

- **Fault reset**: Certain faults on an I/O module require a hard reset. Pressing the Reset button during operation resets the fault.

Repeat the above steps to install the redundant adapter.

### 1715 Digital Input Module

The digital input module has these status indicators.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unlabeled Status 1</td>
<td>Steady off</td>
<td>No power - The module has no power or is not in recovery mode.</td>
</tr>
<tr>
<td>Located directly below Rack Status - used in Recovery mode</td>
<td>Steady amber</td>
<td>Recovery mode - The module is in Recovery mode.</td>
</tr>
<tr>
<td></td>
<td>Flashing amber</td>
<td>Unlocked - Adapter is unlocked from a previously locked state.</td>
</tr>
<tr>
<td>Unlabeled Status 2</td>
<td>Steady off</td>
<td>No power - The module has no power or is not in recovery mode.</td>
</tr>
<tr>
<td>Located directly below Unlabeled Status 1 - used in Recovery mode</td>
<td>Steady amber</td>
<td>Recovery mode - The module is in Recovery mode.</td>
</tr>
<tr>
<td></td>
<td>Flashing amber</td>
<td>Unlocked - Adapter is unlocked from a previously locked state.</td>
</tr>
<tr>
<td>Ethernet 1 and 2</td>
<td>Steady off</td>
<td>No power, no link - There is no power or an Ethernet link is not established.</td>
</tr>
<tr>
<td></td>
<td>Steady green</td>
<td>Link present - A valid Ethernet link has been established.</td>
</tr>
<tr>
<td></td>
<td>Amber</td>
<td>Activity - Tx and/or Rx activity is present.</td>
</tr>
</tbody>
</table>
Status indicators for the 1715-IB16D digital input module are shown in this table.

### Table 55 - Digital Input Module Status Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Healthy</td>
<td>Healthy - general status display</td>
</tr>
<tr>
<td></td>
<td>Steady off</td>
<td>No power.</td>
</tr>
<tr>
<td></td>
<td>Steady green</td>
<td>Module operational - The module has been configured and is operating without any faults.</td>
</tr>
<tr>
<td></td>
<td>Flashing green</td>
<td>Standby - The module has not been configured.</td>
</tr>
<tr>
<td></td>
<td>Steady red</td>
<td>Fault - A fault has been detected on the module.</td>
</tr>
<tr>
<td>B</td>
<td>Ready</td>
<td>Ready - redundancy status indicator</td>
</tr>
<tr>
<td></td>
<td>Steady off</td>
<td>No power or no partner module present.</td>
</tr>
<tr>
<td></td>
<td>Steady green</td>
<td>Synchronized - Synchronized with partner module; redundant operation.</td>
</tr>
</tbody>
</table>
The digital output module has these status indicators.

### 252 Rockwell Automation Publication 1715-UM001J-EN-P - December 2020

#### Table 55 - Digital Input Module Status Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run</td>
<td>Steady off</td>
<td>No power; no backplane communication - No power or the module is not</td>
</tr>
<tr>
<td></td>
<td>Steady green</td>
<td>Connected - The module has at least one established connection.</td>
</tr>
<tr>
<td></td>
<td>Flashing green</td>
<td>No connections - The module is communicating over the backplane, but there are no established connections.</td>
</tr>
<tr>
<td>Channel 0...7, 8...15</td>
<td>Steady off</td>
<td>Off/de-energized, no backplane communication - The channel is off/de-energized or the module is not communicating over the I/O backplane.</td>
</tr>
<tr>
<td></td>
<td>Steady amber</td>
<td>On/energized - The channel is on/energized.</td>
</tr>
<tr>
<td></td>
<td>Flashing amber</td>
<td>Field fault - A field fault has been detected on this channel.</td>
</tr>
<tr>
<td></td>
<td>Steady red</td>
<td>Fault - A fault has been detected on this channel.</td>
</tr>
</tbody>
</table>

### 1715 Digital Output Module

The digital output module has these status indicators.

#### Indicator Description

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Healthy - general status display</td>
</tr>
</tbody>
</table>
Status indicators for the 1715-OB8DE digital output module are shown in this table.

### Table 56 - Digital Output Module Status Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>Steady off</td>
<td>No power.</td>
</tr>
<tr>
<td></td>
<td>Steady green</td>
<td>Module operational - The module has been configured and is operating without any faults.</td>
</tr>
<tr>
<td></td>
<td>Flashing green</td>
<td>Standby - The module has not been configured.</td>
</tr>
<tr>
<td></td>
<td>Steady red</td>
<td>Fault - A fault has been detected on this module.</td>
</tr>
<tr>
<td>Ready</td>
<td>Steady off</td>
<td>No power or no partner module present.</td>
</tr>
<tr>
<td></td>
<td>Steady green</td>
<td>Synchronized - Synchronized with partner module; redundant operation.</td>
</tr>
<tr>
<td>Run</td>
<td>Steady off</td>
<td>No power; no backplane communication - No power or the module is not communicating over the backplane.</td>
</tr>
<tr>
<td></td>
<td>Steady green</td>
<td>Connected - The module has at least one established connection.</td>
</tr>
<tr>
<td></td>
<td>Flashing green</td>
<td>No connections - The module is communicating over the backplane, but there are no established connections.</td>
</tr>
<tr>
<td>Channel 0...7</td>
<td>Steady off</td>
<td>Off/de-energized - The channel is off/de-energized.</td>
</tr>
<tr>
<td></td>
<td>Steady amber</td>
<td>On/energized - The channel is on/energized.</td>
</tr>
<tr>
<td></td>
<td>Flashing amber</td>
<td>Field fault - A field fault has been detected on this channel.</td>
</tr>
<tr>
<td></td>
<td>Steady red</td>
<td>Fault - A fault has been detected on this channel.</td>
</tr>
</tbody>
</table>

### 1715 Analog Input Module

The digital output module has these status indicators.
Status indicators for the 1715-IF16 analog input module are shown in this table.

**Table 57 - Analog Input Module Status Indicators**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Healthy</td>
<td>Healthy - general status display</td>
</tr>
<tr>
<td>B</td>
<td>Ready</td>
<td>Ready - redundancy status indicator</td>
</tr>
<tr>
<td>C</td>
<td>Run</td>
<td>Run - network status indicator</td>
</tr>
<tr>
<td>D</td>
<td>Channel 0...7, 8...15</td>
<td>Channel status indicators</td>
</tr>
<tr>
<td></td>
<td>Steady off</td>
<td>No power.</td>
</tr>
<tr>
<td></td>
<td>Steady green</td>
<td>Module operational - The module has been configured and is operating without any faults.</td>
</tr>
<tr>
<td></td>
<td>Flashing green</td>
<td>Standby - The module has not been configured.</td>
</tr>
<tr>
<td></td>
<td>Steady red</td>
<td>Fault - A fault has been detected on the module.</td>
</tr>
<tr>
<td>Ready</td>
<td>Steady off</td>
<td>No power or no partner module present.</td>
</tr>
<tr>
<td></td>
<td>Steady green</td>
<td>Synchronized - Synchronized with partner module; redundant operation.</td>
</tr>
</tbody>
</table>
1715 Analog Output Module

The analog output module has these status indicators.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Healthy - general status display</td>
</tr>
</tbody>
</table>

Table 57 - Analog Input Module Status Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run</td>
<td>Steady off</td>
<td>No power; no backplane communication - No power or the module is not communicating over the backplane.</td>
</tr>
<tr>
<td></td>
<td>Steady green</td>
<td>Connected - The module has at least one established connection.</td>
</tr>
<tr>
<td></td>
<td>Flashing green</td>
<td>No connections - The module is communicating over the backplane, but there are no established connections.</td>
</tr>
<tr>
<td>Channel 0...7, 8...15</td>
<td>Steady off</td>
<td>No signal, no backplane communication - There is no signal on the channel or the module is not communicating over the I/O backplane.</td>
</tr>
<tr>
<td></td>
<td>Steady amber</td>
<td>Signal present - A valid signal has been detected (that is, measured signal &gt;= 0.4 mA).</td>
</tr>
<tr>
<td></td>
<td>Flashing amber</td>
<td>Field fault - A field fault has been detected on this channel.</td>
</tr>
<tr>
<td></td>
<td>Steady red</td>
<td>Fault - A fault has been detected on this channel.</td>
</tr>
</tbody>
</table>
Status indicators for the 1715-OF8I analog output module are shown in this table.

### Table 58 - Analog Output Module Status Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Healthy</th>
<th>Ready</th>
<th>Run</th>
<th>Channel 0...7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State</strong></td>
<td>Steady off</td>
<td>Steady off</td>
<td>Steady off</td>
<td>Steady off</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>No power.</td>
<td>No power or no partner module present.</td>
<td>No power; no backplane communication – No power or the module is not communicating over the backplane.</td>
<td>Off/de-energized - The channel is not being driven (that is, output current &lt; 0.4 mA).</td>
</tr>
<tr>
<td></td>
<td>Steady green</td>
<td>Steady green</td>
<td>Steady green</td>
<td>Steady amber</td>
</tr>
<tr>
<td></td>
<td>Module operational - The module has been configured and is operating without any faults.</td>
<td>Synchronized - Synchronized with partner module; redundant operation.</td>
<td>Connected - The module has at least one established connection.</td>
<td>On/energized - The channel is being driven (i.e. output current is &gt;= 0.4 mA).</td>
</tr>
<tr>
<td></td>
<td>Flashing green</td>
<td></td>
<td>Flashing green</td>
<td>Flashing amber</td>
</tr>
<tr>
<td></td>
<td>Standby - The module has not been configured.</td>
<td></td>
<td>No connections - The module is communicating over the backplane, but there are no established connections.</td>
<td>Field fault - A field fault has been detected on this channel.</td>
</tr>
<tr>
<td></td>
<td>Steady red</td>
<td></td>
<td></td>
<td>Steady red</td>
</tr>
<tr>
<td></td>
<td>Fault - A fault has been detected on the module.</td>
<td></td>
<td></td>
<td>Fault - A fault has been detected on this channel.</td>
</tr>
</tbody>
</table>
Threshold Values for Digital Inputs

This section describes how to calculate and set threshold values for digital inputs.

The module determines the channel state and the line fault status by comparing the channel input voltage with defined threshold values. Line faults, such as short circuit and wire off, can be determined by using different input voltage values.

With this module, you can define custom threshold values or use a set of preset default values. The types of threshold values you choose initially for the module become inherent in each channel; you can define different thresholds for individual channels later.

The threshold values determine which end-of-line (EOL) resistor value you choose, and vice versa, depending on whether you choose the threshold values first, or the EOL resistor values first.

By considering these two components—EOL resistor values and the threshold values, we can arrive at the diagnostic settings for the module.

Figure 74 - Common EOL Device Scenario
Threshold Diagnostics Settings

There are three types of threshold diagnostics settings to choose from in the Logix Designer application:

- Full Diagnostics Configuration
- None Diagnostics Configuration
- Custom Diagnostics Configuration

![Threshold Settings Diagram]

**Figure 75 - Threshold Settings**
Full Diagnostics Configuration

Selecting Full in the Diagnostics pull-down menu loads a set of threshold default values into the threshold settings. **This must be selected if an EOL is used.**

**Figure 76 - Full Diagnostics Threshold Default Values**

For a full-diagnostics setting configuration, use these resistor values.

**Table 59 - Full Diagnostics Resistor Values**

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>15 kΩ (1%) - power 0.5 W (max power dissipated 0.128 W)</td>
</tr>
<tr>
<td>R2</td>
<td>3.9 kΩ (1%) - power 0.5 W (max power dissipated 0.128 W)</td>
</tr>
<tr>
<td>Loop supply voltage</td>
<td>24V DC (±10%)</td>
</tr>
</tbody>
</table>

**IMPORTANT** These are the most common commercially available EOL devices.

None Diagnostics Configuration

Selecting None in the Diagnostics pull-down menu loads another set of default values into the threshold settings. **This is selected when no EOL devices are used.**

**Figure 77 - None Diagnostics Threshold Default Values**

Based on these settings, if the switch is closed, the input reports an ‘on’ condition anytime the voltage is above ~14.5V, but does not report a short circuit, because there is no way to get the voltage to rise to 32V.
The same is true with an ‘off’ condition. The module reports an ‘off’ condition anytime the voltage is below ~5.5V, but does not report a wire off, because it has to go below 0V to do so.

Custom Diagnostics Configuration

For custom diagnostics, you calculate and enter the threshold values.

To calculate the desired values, see Calculate Threshold and Resistor Values on page 261.

Once calculated, follow these steps to enter the settings.
1. From the Diagnostics pull-down menu, choose Custom.
2. Click Edit from the Custom Thresholds column.
3. Enter the desired value ranges into the Threshold dialog boxes.
Calculate Threshold and Resistor Values

To arrive at the correct diagnostic settings, you must know one of the two values—either the threshold values or the resistor values, and then calculate the other set of values from the known values.

The following example shows a typical EOL arrangement for an Emergency Shutdown Device.

**Figure 78 – Field Loop Circuit for Line Monitored Digital Input for Emergency Shutdown Systems (ESD)**

You must realize that by virtue of R1 and R2, in combination with the internal impedance and field switch position of the module, various voltage levels are produced at the input terminal that the threshold values can characterize.

Knowing the resistor values allows you to calculate the voltage levels to arrive at the threshold settings.

Use **Figure 79** and **Figure 80**, and the resistor values you choose, to determine how the system responds to various field wiring conditions, so that the threshold values can be set. For our example, we used the resistor values in **Table 59 on page 259**.

**Calculate the Voltage for Off/On Conditions for Threshold Values**

The following examples calculate the voltage for an ‘off’ condition with the switch opened and closed.

*Open Switch/Off Condition*

With SW1 open, current flows through R1 and R2 (15 + 3.9 kΩ = 18.9 kΩ). We can calculate the voltage that is present at the input of the input module and by using a voltage divider circuit, we can calculate the voltage for an ‘off’ condition.
If 5.1V is present, we know that the switch is in the off position. We can enter a range into the threshold that lets 5.1V to be an off condition. We used 3.0 ... 6.5V as the range. So, if the voltage drops below 3.0V, it is considered a wire off. If it goes above 6.5V, it is considered indeterminate.
Closed Switch/On Condition

If SW1 is closed, then current only flows through R2, so to calculate the voltage present at the input module, use the R2 value of 3.9 kΩ/Rtotal.

Figure 80 – Closed Switch/On Condition
If 13.6V is present, the switch is in the on position. A range can be entered into the threshold value that lets 13.6V be an on condition. We used 19...10.5V as the range. So, if the voltage drops below 10.5V, it is indeterminate and if it goes above 19V, it is a short circuit.
Calculate On/Off Condition for Resistor Values

If a threshold value is set and we wanted to figure out which resistors to use, we can follow these examples.

*On Condition*

For an on condition, use the following formulas.

In this case, the module load is 5.1 kΩ and the supply voltage is assumed to be 24V DC. So, for this example, use Figure 81 and choose 13V DC, because it is a value within the range in the threshold tables.
4.3 kΩ is a close standard value, so we use 3.9 kΩ, which changes the voltage slightly, but not enough to cause the range to change.

**Off Condition**

For an off condition, we must add a resistor to the formula. We already know that R2 is 3.9 kΩ, so we can use that, too.
In this example, 15.4 k\(\Omega\) is a close standard value, so we use 15 k\(\Omega\), which changes the voltage slightly, but not enough to make us change our range.

### Calibration Drift Checks

The 1715I/O analog modules are calibrated at the factory with a default calibration. As time passes, the electrical specifications of various electronic components of your analog module drift.

To make sure the best possible accuracy in measurements that your analog input module makes and signals that your analog output module generates are maintained, it is recommended to perform a calibration drift check every two years for most applications.

Although the purpose of checking the calibration of analog modules is the same for input and output modules, to verify that the accuracy and repeatability of the module is maintained, the procedures that are involved differ per module.

When you check the calibration of input modules, you use current, voltage, or ohms calibrators to send a signal to the module and check the correct values are reported.
When you calibrate output modules, you use a digital multimeter (DMM) to measure the signal that the module is sending out.

<table>
<thead>
<tr>
<th>IMPORTANT</th>
<th>Before beginning calibration checking, do the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Stop the process your output module is controlling or your input module is tracking.</td>
</tr>
<tr>
<td></td>
<td>• Disconnect input signals and connect test signals. Any control that depends on the normal input signals does not have them during the calibration check process.</td>
</tr>
<tr>
<td></td>
<td>• Disconnect output signals and connect a suitable measuring instrument. Any control that depends on the outputs from this module does not have them during the calibration check process.</td>
</tr>
<tr>
<td></td>
<td>• Make sure the equipment, a Multimeter, is calibrated.</td>
</tr>
</tbody>
</table>

The calibration drift process can impair control.

When you begin the calibration check process, if a real-time connection is open, the module points you are calibrating can fault. We recommend that you change your controller to Program mode before beginning calibration.

| IMPORTANT | The 1715-IF16 and 1715-OF8 modules can be operated with multiple ranges. Verify that the appropriate Output Range or Input Range is selected before continuing with the calibration check procedure. |

The two general functions in the calibration check process are as follows:

• Attaching/generating a Low Reference Signal
• Attaching/generating a High Reference Signal

Verify that the physical values correspond to the module read/produced values within desired tolerances. If not, consider replacement of the affected module.
Reconfigure a Module Online

Use Ladder Logic to Reconfigure an I/O Module

If an I/O module supports reconfiguration, you can reconfigure the module via one of the following:

- Studio 5000 Logix Designer® application
- An MSG instruction in program logic

**IMPORTANT**
Consider these guidelines in SIL 2 applications:

- We recommend configuring SIL 2 safety applications offline. Even if the Logix controller and RSLogix 5000® software permit online SIL 2 configuration (that is, module interface option changes, import of the Add-On Instructions, and so forth) a **download** to the processor is **required**.
- Enabling SIL 2 on spare modules while **online** is **not supported**.
- Where a module is used without SIL 2 enabled and SIL 2 is then enabled for that module, a power cycle of the rack is required to force the new configuration to the module. The same is true where a module is used with SIL 2 enabled, and SIL 2 is then disabled for that module.
- A programming terminal is not normally connected.

**ATTENTION:** Use care when changing the configuration of an I/O module. You could inadvertently cause the I/O module to operate incorrectly.

Reconfigure a Module Via Studio 5000 Logix Designer Application

To reconfigure a module, perform this procedure.

1. In the Logix Designer application, right-click a module in the I/O Configuration tree and choose Properties.

The Module Properties dialog box appears.
2. Reconfigure the I/O module.
3. Click OK.

**Reconfigure a Module Via Ladder Logic**

It is sometimes advantageous to change the functional operation of a module in the ControlLogix® system automatically via the user program instead of by using the Logix Designer application to reconfigure it. This way, changes in the process can dictate when the reconfiguration takes place rather than you performing that function manually.

The 1715 modules support sending a MSG instruction of type Module Reconfigure. This MSG instruction can be sent to a module to reconfigure it without stopping the module.

Use a MSG instruction of type Module Reconfigure to send new configuration information to an I/O module. During the reconfiguration, the following occurs:

- Input modules continue to send input data to the controller.
- Output modules continue to control their output devices.

The following steps are used in this example when reconfiguring a module via ladder logic.

1. Move new configuration parameters to the Configuration portion of the tag structure that is associated with the module.
2. Use a message instruction to send a Reconfigure Module service to the same module.
Before the new configuration parameters are sent to the module, you must make sure that their relationship to each other is in a format the module accepts and that the values are within the range the module accepts, otherwise the module can fault or the reconfiguration attempt can fail.

**IMPORTANT** Reconfiguring analog modules via ladder logic can be limited to functions that involve only the changing of values. We do not recommend that enabling or disabling features be done via ladder logic. Use the Logix Designer application to enable or disable these features.
Notes:
PFD and PFH Calculations for a SIL 2 System

About PFD and PFH Calculations

Probability of failure on demand (PFD) is the SIL value for a safety-related system as related directly to order-of-magnitude ranges of its average probability of failure to satisfactorily perform its safety function on demand. IEC 61508 quantifies this classification by stating that the frequency of demands for operation of the safety system is no greater than once per year in the Low Demand mode.

PFD calculations are commonly used for process safety applications and applications where emergency stop devices (ESDs) are used.

Although PFD values are associated with each of the three elements constituting a safety-related system (the sensors, the actuators, and the logic element), they can be associated with each component of the logic element, that is, each module of a programmable controller.

Probability of failure per hour (PFH) is typically used to describe safety performance for high demand applications. Tables in this chapter present PFD and PFH values for components that TÜV evaluates.

Determine Which Values to Use

IMPORTANT You are responsible for determining which of the values that are provided are appropriate for your SIL 2-certified system. Determine which values to use based on the modules that are used in your system and the system configuration.

Each of the PFD and PFH calculated values that are provided in this manual is based on the configuration that the module can be used in, which is 1001, 1002, 1002D, or 2002.

Calculations for 1715 I/O Modules

For the calculations presented in this chapter, these values were used as the two application-dependent variables:

- All calculations use a mission time (T₁) of 20 years
- Each section lists the mean time to repair (MTTR)
• PFDde = Probability of failure on demand for de-energize to action systems
• PFD = Probability of failure on demand for energize to action systems
• SFFde = Safe failure fraction for de-energize to action systems
• SFF = Safe failure fraction for energize to action systems
• PFHde = Probability of failure per hour for de-energize to action systems
• PFH = Probability of failure per hour for energize to action systems

Common Terms

\( \lambda = \) failure rate = \( \frac{1}{MTBF} \)

\( \lambda_s = \) rate of safe failures

\( \lambda_d = \) rate of dangerous failures = \( (\lambda_{du} + \lambda_{dd}) \)

\( \lambda_{du} = \) dangerous, undetected failure rate = \( \lambda_d \times (1-DC) \)

\( \lambda_{dd} = \) dangerous, detected failure rate = \( \lambda_d \times DC \)

\( SFF = \) safe failure fraction = \( \frac{\lambda_s + \lambda_{dd}}{\lambda_s + \lambda_{du} + \lambda_{dd}} \)

\( T_{CE} = \) channel equivalent down time = \( \frac{\lambda_{du}}{\lambda_d x (T/2 + MRT)} + (\lambda_{dd}/\lambda_d x MTTR) \)

\( DC = \) diagnostic coverage

1oo2 Configuration (For energize to action: Dual 1715-OB8DE or 1715-OF8I)

\( STR_{1oo2} = \) Spurious Trip Rate = \( 2 x (\lambda_s + \lambda_{dd}) + \beta x (\lambda_s + \lambda_{dd}) \)

\( T_{CE_{1oo2}} = \) system equivalent down time = \( \frac{\lambda_{du}}{\lambda_d x (T/3 + MRT)} + (\lambda_{dd}/\lambda_d x MTTR) \)

\( PFH_{1oo2} = \) 2 x \[ \lambda_{du}/\lambda_d x T_{CE} + (\lambda_{dd}/\lambda_d x MTTR) \]

2oo2 Configuration (For de-energize to trip: Dual 1715-OB8DE or 1715-OF8I)

\( STR_{2oo2} = \) Spurious Trip Rate = \( 2 x (\lambda_s + \lambda_{dd}) x (\lambda_s + \lambda_{dd}) x MTTR + \beta x (\lambda_s + \lambda_{dd}) \)

\( PFH_{2oo2} = \) 2 x \( PFH_{1oo2} \)

1oo2D Configuration (Dual configuration of 1715-AENTR, 1715-IB16D, or 1715-IF16)

\( STR_{1oo2D} = \) Spurious Trip Rate = \( 2 x (\lambda_s + \lambda_{dd}) x (\lambda_s + \lambda_{dd}) x MTTR + \beta x (\lambda_s + \lambda_{dd}) \)

\( T_{CE'} = \) \( \frac{\lambda_{du} x (T/2 + MRT)}{\lambda_{du} + \lambda_{dd} + \lambda_{sd}} \)

\( T_{GE'} = \) \( T/3 + MRT \)

\( PFH_{1oo2D} = \) \[ 2 x (1-\beta) x \lambda_{du} x ((1-\beta) x \lambda_{du} + (1-\betaD) x \lambda_{dd} + \lambda_{sd}) x T_{CE'} x T_{GE'} + 2 x (1-K) x \lambda_{dd} x T_{CE'} + (\beta x \lambda_{du} x (T/2 + MRT)) \]

PFD and PFH values in this manual are calculated with formulas explained in IEC 61508, Part 6, Annex B. See IEC 61508, Part 6, for more information about calculating PFD values for your system.

**PFD Calculations with 24-hour MTTR**

The PFD calculations in Table 60 are calculated for a 20-year mission time and are specific to 1715 I/O components in ControlLogix® systems.

### Table 60 - PFD Calculations for 1715 I/O Components

<table>
<thead>
<tr>
<th>Cat No.</th>
<th>Series</th>
<th>Firmware Version(1)</th>
<th>Description</th>
<th>Simplex Configuration</th>
<th>Duplex Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1715-AENTR</td>
<td>A</td>
<td>3.003</td>
<td>Ethernet adapter redundant module</td>
<td>PFDde</td>
<td>PFD</td>
</tr>
<tr>
<td>1715-IB16D</td>
<td>A</td>
<td>3.001</td>
<td>16-channel digital input module</td>
<td>6.44E-05</td>
<td>8.67E-05</td>
</tr>
</tbody>
</table>

(1) The firmware version includes the release date and release notes.
### De-energize-to-trip 20-year Mission Time

#### Table 61 - De-energize-to-trip (20-year Mission Time)

<table>
<thead>
<tr>
<th>Cat No.</th>
<th>Series</th>
<th>Firmware Version(1)</th>
<th>Description</th>
<th>Simplex Configuration</th>
<th>Duplex Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PFDe</td>
<td>PFDe</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PFDe</td>
<td>PFDe</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PFDe</td>
<td>PFDe</td>
</tr>
<tr>
<td>1715-IF16</td>
<td>A</td>
<td>3.001</td>
<td>16-channel analog input module</td>
<td>6.4E-05</td>
<td>8.7E-05</td>
</tr>
<tr>
<td>1715-O80DE</td>
<td>A</td>
<td>3.001</td>
<td>8-channel digital output module</td>
<td>2.8E-05</td>
<td>8.8E-05</td>
</tr>
<tr>
<td>1715-OF8I</td>
<td>A</td>
<td>3.001</td>
<td>8-channel analog output module</td>
<td>4.7E-05</td>
<td>1.4E-04</td>
</tr>
</tbody>
</table>

(1) For the latest approved versions, see the Revision Release List available from the Product Certifications link at rok.auto/certifications.

### Energeto-action 20-year Mission Time

#### Table 62 - Energeto-action (20-year Mission Time)

<table>
<thead>
<tr>
<th>Cat No.</th>
<th>Series</th>
<th>Firmware Version</th>
<th>Description</th>
<th>MTTR 24 Hours</th>
<th>20-year Mission Time</th>
<th>Simplex Configuration</th>
<th>Duplex Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For the latest approved versions, see the Revision Release List available from the Product Certifications link at rok.auto/certifications.
Communications Data

The PFH value for the I/O Communications Data with the Controller is:

- PFH = 1E-08
# SIL 2 Applications Checklist

## 1715 I/O Modules

The following checklist is required for planning, programming, and startup of a SIL 2-certified system that uses 1715 I/O modules. It can be used as a planning guide and during proof testing. If used as a planning guide, the checklist can be saved as a record of the plan.

### Checklist for 1715 I/O Modules

<table>
<thead>
<tr>
<th>No.</th>
<th>For SIL 2 Applications</th>
<th>Fulfilled</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Are you using the SIL 2-certified 1715 modules only with the corresponding firmware release listed in Revision Release List (available from the Product Certification link at <a href="http://rok.auto/certifications">rok.auto/certifications</a>) for your safety application?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2.</td>
<td>Have all modules been installed in accordance with the instructions in this manual?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3.</td>
<td>Has a risk analysis been completed to determine the required SIL for your application?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4.</td>
<td>Has fault detection time been specified?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5.</td>
<td>Where fault detection time is greater than the controller reaction time limit (CRTL), does the safety-related I/O configuration provide a fail-safe configuration?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6.</td>
<td>Has the safety-related timing for each safety-related function, including CRTL and fault tolerance period been established?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7.</td>
<td>Does the application program shut down the SIL 2 safety functions if a faulty module has not been replaced within the Mean Time to Restoration (MTTR) assumed for the system in the Probability of Failure on Demand (PFD) calculations?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8.</td>
<td>Has the application program been configured to monitor the discrepancy alarms and alert operators when a discrepancy alarm occurs?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9.</td>
<td>Is the safety accuracy adequate for the application?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10.</td>
<td>Have variables been configured to report the safety accuracy value for each channel?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>11.</td>
<td>Have variables been configured to report safe values when the safety accuracy value of a channel fails because it is reported to be below the 1% accuracy figure?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>12.</td>
<td>Has the maximum duration for single channel operation of an I/O module been specified in accordance with the application requirements?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.</td>
<td>Have you used two 1715-AENTR adapters in SIL 2 simplex and duplex configurations?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.</td>
<td>Have you set the Shutdown mode option for each output channel to OFF?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>15.</td>
<td>If digital output channels have been configured for Hold Last State, has the impact on the safety functions been addressed?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16.</td>
<td>Have you used the SIL 2 Add-On Instructions in accordance with the information in this manual?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>17.</td>
<td>Have you performed all appropriate proof tests?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>No.</td>
<td>For Energize-to-action SIL 2 Applications</td>
<td>Fulfilled</td>
<td>Comment</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------------------------------------------------------------------------------------</td>
<td>-----------</td>
<td>---------</td>
</tr>
<tr>
<td>1.</td>
<td>Are the redundant power sources inherently constrained to output less than 32 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>If there any safety-related, normally de-energized outputs, have you provided redundant power sources,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>power failure warning, and line monitoring?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Do energize-to-action configurations conform to the restrictions (defined in this manual) that must be</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>applied when using these configurations?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>For energize-to-action SIL 2 applications, have dual output modules been configured?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## I/O Tag Definitions

### 1715-AENTR Adapter

This section describes the tags that are associated with the 1715-AENTR adapter.

#### Table 63 - Input

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault</td>
<td>DINT, Binary</td>
<td>Adapter fault bit: 0 when at least one adapter is present and reporting valid data, 0xFFF_FFFF when no adapters are present, no Logix connection exits, or reported data is invalid.</td>
</tr>
</tbody>
</table>
| Status           | DINT, bit field | Adapter redundancy and power status:  
|                  |               | Bit 0: ModAFault 0 = good 1 = fault or module not present  
|                  |               | Bit 1: ModBFault 0 = good 1 = fault or module not present  
|                  |               | Bit 8: Power1Fault 0 = good 1 = fault or module not present  
|                  |               | Bit 9: Power2Fault 0 = good 1 = fault or module not present  |
| LinkStatus       | DINT, bit-field | Adapter Ethernet port status:  
|                  |               | Bit 0: PortA1Connected 0= Inactive 1 = Active  
|                  |               | Bit 2: PortA2Connected 0= Inactive 1 = Active  
|                  |               | Bit 3: PortB1Connected 0= Inactive 1 = Active  
|                  |               | Bit 4: PortB2Connected 0= Inactive 1 = Active  |
| FullDuplex       | DINT, bit-field | Adapter Ethernet port half/full duplex status:  
|                  |               | Bit 0: PortA1FullDuplex 0= Inactive 1 = Active  
|                  |               | Bit 2: PortA2Duplex 0= Inactive 1 = Active  
|                  |               | Bit 3: PortB1Duplex 0= Inactive 1 = Active  
|                  |               | Bit 4: PortB2Duplex 0= Inactive 1 = Active  |
| PortATANSTatus   | SINT, enumerated | Enumerated adapter Ethernet port auto-negotiation status:  
|                  |               | Value | Description |
|                  |               | 0     | Auto-negotiation in progress |
|                  |               | 1     | Auto-negotiation of duplex and speed detection failed; by using a default value for speed and duplex |
|                  |               | 2     | Auto-negotiation of duplex but detected speed; by using a default value for duplex |
|                  |               | 3     | Successfully negotiated duplex and speed |
|                  |               | 4     | Auto-negotiation not attempted, by using forced speed and duplex values |
### Appendix F  I/O Tag Definitions

**1715-IB16D**

This section describes the tags that are associated with the 1715-IB16D module.

#### Table 63 - Input

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>PortA2ANStatus</td>
<td>SINT, enumerated</td>
<td>Enumerated adapter Ethernet port auto-negotiation status:</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Value</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5-255</td>
</tr>
<tr>
<td>PortB1ANStatus</td>
<td>SINT, enumerated</td>
<td>Enumerated adapter Ethernet port auto-negotiation status:</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Value</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
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<td></td>
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<td></td>
<td>2</td>
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<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5-255</td>
</tr>
<tr>
<td>PortB2ANStatus</td>
<td>SINT, enumerated</td>
<td>Enumerated adapter Ethernet port auto-negotiation status:</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Value</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
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<tr>
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<td>2</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5-255</td>
</tr>
<tr>
<td>PortA1Speed</td>
<td>DINT</td>
<td>Interface speed in Mbps that is in use, for example, 10 Mbps or 100 Mbps,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or 0 when port is active</td>
</tr>
<tr>
<td>PortA2Speed</td>
<td>DINT</td>
<td>Interface speed in Mbps that is in use, for example, 10 Mbps or 100 Mbps,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or 0 when port is active</td>
</tr>
<tr>
<td>PortB1Speed</td>
<td>DINT</td>
<td>Interface speed in Mbps that is in use, for example, 10 Mbps or 100 Mbps,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or 0 when port is active</td>
</tr>
<tr>
<td>PortB2Speed</td>
<td>DINT</td>
<td>Interface speed in Mbps that is in use, for example, 10 Mbps or 100 Mbps,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or 0 when port is active</td>
</tr>
<tr>
<td>CIPTimeouts</td>
<td>DINT</td>
<td>Total of all Connection Manager object Connection Timeout values</td>
</tr>
<tr>
<td>TCPConnections</td>
<td>DINT</td>
<td>Total number of active CIP connections</td>
</tr>
<tr>
<td>CIPLostPackets</td>
<td>DINT</td>
<td>Total of all CIP packets</td>
</tr>
<tr>
<td>TCPConnections</td>
<td>DINT</td>
<td>Total of all TCP connections</td>
</tr>
<tr>
<td>CUPUtilization</td>
<td>DINT</td>
<td>Echo of Connection Manager object CPU_Utilization attribute</td>
</tr>
</tbody>
</table>

**Table 64 - 16-channel Digital Input, Simplex**

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault</td>
<td>DINT, Binary</td>
<td>Module fault bit: 0 when a module is present and reporting valid data, DxFF_FFFF when no module is present, no Logix connection exists, or reported data is valid</td>
</tr>
<tr>
<td>Data</td>
<td>INT</td>
<td>Input state, one bit per channel for channels 0...15: 0 = Off/de-energized</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = On, energized</td>
</tr>
<tr>
<td>Status</td>
<td>DINT, bit-field</td>
<td>Redundancy and power status:</td>
</tr>
</tbody>
</table>
### Table 64 - 16-channel Digital Input, Simplex

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bit Name</strong></td>
<td><strong>Description</strong></td>
<td></td>
</tr>
<tr>
<td>8 GroupFault</td>
<td>0 = Good</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 = Any channel or module faulted/failed</td>
<td></td>
</tr>
<tr>
<td>PtFault</td>
<td>Channel fault status; one bit per channel for channels 0...15:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0 = Normal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 = Channel is faulted/failed</td>
<td></td>
</tr>
<tr>
<td>Open Wire</td>
<td>Open wire diagnostic status; one bit per channel for channels 0...15:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0 = Normal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 = Indicates open wire detected</td>
<td></td>
</tr>
<tr>
<td>ShortCircuit</td>
<td>Short circuit diagnostic status; one bit per channel for channels 0...15:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0 = Normal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 = Indicates short circuit detected</td>
<td></td>
</tr>
<tr>
<td>Indeterminate</td>
<td>Indeterminate diagnostic status; one channel per channel for channels 0...15:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0 = Normal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 = Indicates indeterminate input voltage detected</td>
<td></td>
</tr>
<tr>
<td>Timestamps</td>
<td>One element per channel.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NB each timestamp is equivalent DINT[2] representing a 64-bit value (number of microseconds since 1st January 1970). An ADI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>‘SystemTime.84bit.Interpreted’ is available to convert such timestamps to a more manageable format with individual values for Day, month, year etc.</td>
<td></td>
</tr>
</tbody>
</table>

### Table 65 - 16-channel Digital Input, Duplex

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault</td>
<td>DINT, Binary</td>
<td>Module fault bit: 0 when one module is present and reporting valid data, OxFF_FFFF when no modules are present, no Logix connection exists, or reported data is invalid.</td>
</tr>
<tr>
<td>Data</td>
<td>INT</td>
<td>Input state, one bit per channel for channels 0...15: 0 = Off/de-energized 1 = On, energized</td>
</tr>
<tr>
<td>Status</td>
<td>DINT, bit-field</td>
<td>Redundancy and power status:</td>
</tr>
<tr>
<td></td>
<td>Bit</td>
<td>Name</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>ModAFault</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>ModAFault</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>GroupFault</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>GroupFault</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>ModAGroupFault</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>ModAGroupFault</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>ModBGroupFault</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>ModBGroupFault</td>
</tr>
<tr>
<td>PtFault</td>
<td>INT</td>
<td>Channel fault status; one bit per channel for channels 0...15:</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Normal</td>
</tr>
<tr>
<td>Open Wire</td>
<td>INT</td>
<td>Open wire diagnostic status; one bit per channel for channels 0...15:</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Normal</td>
</tr>
<tr>
<td>ShortCircuit</td>
<td>INT</td>
<td>Short circuit diagnostic status; one bit per channel for channels 0...15:</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Normal</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>INT</td>
<td>Indeterminate diagnostic status; one channel per channel for channels 0...15:</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Normal</td>
</tr>
</tbody>
</table>
## 1715-OB8DE

This section describes the tags that are associated with the 1715-OB8DE module.

### Table 65 - 16-channel Digital Input, Duplex

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timestamps</td>
<td>AB:1715:TIMESTAMP[16]</td>
<td>TIMESTAMP array, one element per channel. NB each timestamp is equivalent DINT[2] representing a 64-bit value (number of microseconds since 1st January 1970). An ADI ‘SystemTime_64bit_Interpreted’ is available to convert such timestamps to a more manageable format with individual values for Day, month, year etc.</td>
</tr>
</tbody>
</table>

### Table 66 - 8-channel Digital Output, Simplex, Output

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>SINT</td>
<td>Output channel commanded data; one bit per channel for channels 0…7: 0 = Off/De-energize 1 = On/Energize</td>
</tr>
<tr>
<td>AlarmUnlatch</td>
<td>SINT</td>
<td>Unlatch alarm; one bit per channel for channels 0…7; rising edge transition (that is, 0&gt;1)</td>
</tr>
<tr>
<td>ResetBlownFuse</td>
<td>SINT</td>
<td>Reset blown electronic fuse, one bit per channel for channels 0…7; rising edge transition (that is, 0&gt;1) resets</td>
</tr>
</tbody>
</table>

### Table 67 - 8-channel Digital Output, Simplex, Input

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault</td>
<td>DINT, Binary</td>
<td>Module fault bit: 0 when a module is present and reporting valid data, OxFFF_FFFF when no module is present, no Logix connection exits, or reported data is invalid.</td>
</tr>
<tr>
<td>ReadBack</td>
<td>SINT</td>
<td>Output channel read-back state, one bit per channel for channels 0…7: 0 = Off/De-energized 1 = On/Energized</td>
</tr>
<tr>
<td>Status</td>
<td>DINT, bit-field</td>
<td>Redundancy and power status:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>PtFault</td>
<td>SINT</td>
<td>Channel fault status; one bit per channel for channels 0 …7: 0 = Normal 1 = Pint is faulted/failed</td>
</tr>
<tr>
<td>NoLoad</td>
<td>SINT</td>
<td>No Load diagnostic status, one bit per channel for channels 0…7: 0 = Normal 1 = Indicates no load detected</td>
</tr>
<tr>
<td>ShortCircuit</td>
<td>SINT</td>
<td>Short Circuit diagnostic status, one bit per channel for 0…7 channels: 0 = Normal 1 = Indicates short circuit detected</td>
</tr>
<tr>
<td>GroupFieldPowerCurrent</td>
<td>DINT</td>
<td>Reports the total current that all the active digital output modules in a group are drawing from the field power supply. Accuracy is ± 10%</td>
</tr>
<tr>
<td>FieldPowerVoltage1</td>
<td>DINT</td>
<td>Reports the voltage from the field power supply for the specified module and field power input. Accuracy is ± 500mV</td>
</tr>
</tbody>
</table>
### Appendix F  I/O Tag Definitions

**FieldPowerVoltage2 DINT**

Reports the voltage from the field power supply for the specified module and field power input. Accuracy is ± 500mV

**Ch AB_1715_ChStatusStruc:I:0[8]**

Current / Voltage Status Array

Each element of the array comprises:

- **Current: REAL**
  - Reports the current for the channel in milliamps and with an accuracy of ± 2 mA and ± 10% of measurement.

- **Voltage: REAL**
  - Reports the channel voltage at the output terminals in units of millivolts and with an accuracy of ± 500 mV. The voltage element cannot report values below 0 mV.

### Table 67 - 8-channel Digital Output, Simplex, Input

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>FieldPowerVoltage2</td>
<td>DINT</td>
<td>Reports the voltage from the field power supply for the specified module and field power input. Accuracy is ± 500mV</td>
</tr>
<tr>
<td>Ch</td>
<td>AB_1715_ChStatusStruc:I:0[8]</td>
<td>Current / Voltage Status Array Each element of the array comprises Current: REAL Reports the current for the channel in milliamps and with an accuracy of ± 2 mA and ± 10% of measurement Voltage: REAL Reports the channel voltage at the output terminals in units of millivolts and with an accuracy of ± 500 mV. The voltage element cannot report values below 0 mV</td>
</tr>
</tbody>
</table>

### Table 68 - 8-channel Digital Output, Duplex, Input

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault</td>
<td>DINT, Binary</td>
<td>Module fault bit: 0 when one module is present and reporting valid data. DxFF_FFFF when no modules are present, no Logix connection exists, or reported data is invalid.</td>
</tr>
<tr>
<td>ReadBack</td>
<td>SINT</td>
<td>Output channel read-back state, one bit per channel for channels 0...7: 0 = Off/de-energized 1 = On/energized</td>
</tr>
<tr>
<td>Status</td>
<td>DINT, bit-field</td>
<td>Redundancy and power status:</td>
</tr>
<tr>
<td></td>
<td>Bit</td>
<td>Name</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>ModAFault</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>ModBFault</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>GroupFault</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>ModAGroupFault</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>ModBGroupFault</td>
</tr>
<tr>
<td>PtfFault</td>
<td>SINT</td>
<td>Channel fault status; one bit per channel for channels 0 ...7: 0 = Normal 1 = Pint is faulted/failed</td>
</tr>
<tr>
<td>NoLoad</td>
<td>SINT</td>
<td>No Load diagnostic status; one bit per channel for channels 0...7: 0 = Normal 1 = Indicates no load detected</td>
</tr>
<tr>
<td>ShortCircuit</td>
<td>SINT</td>
<td>Short Circuit diagnostic status, one bit per channel for 0...7 channels: 0 = Normal 1 = Indicates short circuit detected</td>
</tr>
<tr>
<td>GroupFieldPowerCurrent</td>
<td>DINT</td>
<td>Reports the total current that all the active digital output modules in a group are drawing from the field power supply. Accuracy is ± 10%.</td>
</tr>
<tr>
<td>ModAFieldPowerVoltage1</td>
<td>DINT</td>
<td>Reports the voltage from the field power supply for the specified module and field power input. Accuracy is ± 500mV</td>
</tr>
<tr>
<td>ModAFieldPowerVoltage2</td>
<td>DINT</td>
<td>Reports the voltage from the field power supply for the specified module and field power input. Accuracy is ± 500mV</td>
</tr>
<tr>
<td>ModBFieldPowerVoltage1</td>
<td>DINT</td>
<td>Reports the voltage from the field power supply for the specified module and field power input. Accuracy is ± 500mV</td>
</tr>
</tbody>
</table>
### 1715-IF16

This section describes the tags that are associated with the 1715-IF16 module.

#### Table 68 - 8-channel Digital Output, Duplex, Input

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ModBFieldPowerVoltage2</td>
<td>DINT</td>
<td>Reports the voltage from the field power supply for the specified module and field power input. Accuracy is ± 500mV</td>
</tr>
<tr>
<td>Ch</td>
<td>AB..1715..ChStatusStruct[0][8]</td>
<td>Current / Voltage Status Array Each element of the array comprises Current: REAL Reports the current for the channel in milliamps and with an accuracy of ± 2 mA and ± 10% of measurement Voltage: REAL Reports the channel voltage at the output terminals in units of millivolts and with an accuracy of ± 500 mV (The voltage element cannot report values below 0 mV)</td>
</tr>
</tbody>
</table>

#### Table 69 - 16-channel Analog Input, Simplex, Input

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault</td>
<td>DINT, Binary</td>
<td>Module fault bit: 0 when one module is present and reporting valid data, OxFFF_FFFF when no modules are present, no Logix connection exits, or reported data is invalid.</td>
</tr>
<tr>
<td>ChSimplex[0 - 15]</td>
<td>Array of structure</td>
<td>Array of 16 structures that represent the data and fault status for channels 0...15:</td>
</tr>
<tr>
<td>Data</td>
<td>REAL</td>
<td>Input data status</td>
</tr>
<tr>
<td>Faults</td>
<td>DINT, bit-field</td>
<td>Channel fault status:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Fault</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Circuit fault for this channel</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Underrange</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Underrange detected</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Overrange</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Overrange detected</td>
</tr>
<tr>
<td>RollingTimestamp</td>
<td>INT</td>
<td>Timestamp data</td>
</tr>
<tr>
<td>Status</td>
<td>DINT, bit-field</td>
<td>Bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Any channel on the module is faulted/failed</td>
</tr>
</tbody>
</table>

#### Table 70 - 16-channel Analog Input, Duplex, Input

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault</td>
<td>DINT, Binary</td>
<td>Module fault bit: 0 when one module is present and reporting valid data, OxFFF_FFFF when no modules are present, no Logix connection exits, or reported data is invalid.</td>
</tr>
<tr>
<td>ChSimplex[0...15]</td>
<td>Array of structure</td>
<td>Array of 16 structures that represent the data and fault status for channels 0...15:</td>
</tr>
<tr>
<td>Data</td>
<td>REAL</td>
<td>Input data</td>
</tr>
<tr>
<td>Faults</td>
<td>DINT, bit-field</td>
<td>Channel fault status:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Fault</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Circuit fault for this channel</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>ModAFault</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = This channel on Module A is faulted/failed</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>ModBFault</td>
</tr>
</tbody>
</table>
### 1715-OF8I

This section describes the tags that are associated with the 1715-OF8I module.

#### Table 70 - 16-channel Analog Input, Duplex, Input

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RollingTimestamp</td>
<td>INT</td>
<td>Timestamp data</td>
</tr>
<tr>
<td>Status</td>
<td>DINT, bit-field</td>
<td>Bit Name</td>
</tr>
<tr>
<td>0</td>
<td>ModAFault</td>
<td>0 = Good</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Fault or module not present</td>
</tr>
<tr>
<td>1</td>
<td>ModBFault</td>
<td>0 = Good</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Fault or module not present</td>
</tr>
<tr>
<td>8</td>
<td>GroupFault</td>
<td>0 = Good</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Any channel on module is faulted/failed</td>
</tr>
<tr>
<td>9</td>
<td>ModAGroupFault</td>
<td>0 = Good</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Any channel on Module A is faulted/failed</td>
</tr>
<tr>
<td>10</td>
<td>ModBGroupFault</td>
<td>0 = Good</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Any channel on Module B is faulted/failed</td>
</tr>
</tbody>
</table>

#### Table 71 - 8-channel Analog Output, Output

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0Ch[0...7]</td>
<td>Array of structure</td>
<td>Array of 8 structures for the output data:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = Data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Faults</td>
</tr>
<tr>
<td>Data</td>
<td>REAL</td>
<td>Commanded output value</td>
</tr>
<tr>
<td>Control</td>
<td>DINT, bit-field</td>
<td>Bit Name</td>
</tr>
<tr>
<td>0</td>
<td>HAAlarmUnlatch</td>
<td>Rising edge transition (that is, 0 &gt; 1) unlashes alarm</td>
</tr>
<tr>
<td>1</td>
<td>LAAlarmUnlatch</td>
<td>Rising edge transition (that is, 0 &gt; 1) unlashes alarm</td>
</tr>
<tr>
<td>2</td>
<td>RateAlarmUnlatch</td>
<td>Rising edge transition (that is, 0 &gt; 1) unlashes alarm</td>
</tr>
</tbody>
</table>

#### Table 72 - 8-channel Analog Output, Simplex, Input

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault</td>
<td>DINT, Binary</td>
<td>Module fault bit:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 when a module is present and reporting valid data. <code>0xFFF_FFFF</code> when no module is present, no Logix connection exits, or reported data is invalid.</td>
</tr>
<tr>
<td>ChDuplex[0...7]</td>
<td>Array of structure</td>
<td>Array of 8 structures that represent the data and fault status for channels 0...7:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = Data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Faults</td>
</tr>
<tr>
<td>ReadBack</td>
<td>REAL</td>
<td>Input data</td>
</tr>
<tr>
<td>Faults</td>
<td>DINT, bit-field</td>
<td>Bit Name</td>
</tr>
<tr>
<td>0</td>
<td>Fault</td>
<td>0 = Good</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Circuit fault for this channel</td>
</tr>
</tbody>
</table>
# Appendix F  I/O Tag Definitions

## Table 72 - 8-channel Analog Output, Simplex, Input

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Status

<table>
<thead>
<tr>
<th>Bit</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>GroupFault</td>
<td>0 = Good; 1 = Any channel on module is faulted/failed</td>
</tr>
</tbody>
</table>

## Table 73 - 8-channel Analog Output, Duplex, Input

<table>
<thead>
<tr>
<th>Tag Name</th>
<th>Data Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Fault

<table>
<thead>
<tr>
<th>Bit</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Fault</td>
<td>0 = Good; 1 = Circuit fault for this channel</td>
</tr>
<tr>
<td>1</td>
<td>ModAFault</td>
<td>0 = Good; 1 = Fault or Module A not present</td>
</tr>
<tr>
<td>2</td>
<td>ModBFault</td>
<td>0 = Good; 1 = Fault or Module B not present</td>
</tr>
<tr>
<td>4</td>
<td>InHold</td>
<td>0 = Good; 1 = Fault or Module not present</td>
</tr>
<tr>
<td>5</td>
<td>NotANumber</td>
<td>0 = Good; 1 = Fault or Module not present</td>
</tr>
<tr>
<td>6</td>
<td>LAAlarm</td>
<td>0 = Good; 1 = Fault or Module not present</td>
</tr>
<tr>
<td>7</td>
<td>HAAlarm</td>
<td>0 = Good; 1 = Fault or Module not present</td>
</tr>
<tr>
<td>8</td>
<td>RateAlarm</td>
<td>0 = Good; 1 = Fault or Module not present</td>
</tr>
<tr>
<td>9</td>
<td>LineFault</td>
<td>0 = Good; 1 = Fault or Module not present</td>
</tr>
</tbody>
</table>

### ChDuplex[0...7]

Array of 8 structures that represent the data and fault status for channels 0...7:

- 0 = Data
- 1 = Faults

### ReadBack

Input data

### ReadBack Faults

Channel fault status:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Fault</td>
<td>0 = Good; 1 = Circuit fault for this channel</td>
</tr>
<tr>
<td>1</td>
<td>ModAFault</td>
<td>0 = Good; 1 = Fault or Module A not present</td>
</tr>
<tr>
<td>2</td>
<td>ModBFault</td>
<td>0 = Good; 1 = Fault or Module B not present</td>
</tr>
<tr>
<td>4</td>
<td>InHold</td>
<td>0 = Good; 1 = Fault or Module not present</td>
</tr>
<tr>
<td>5</td>
<td>NotANumber</td>
<td>0 = Good; 1 = Fault or Module not present</td>
</tr>
<tr>
<td>6</td>
<td>LAAlarm</td>
<td>0 = Good; 1 = Fault or Module not present</td>
</tr>
<tr>
<td>7</td>
<td>HAAlarm</td>
<td>0 = Good; 1 = Fault or Module not present</td>
</tr>
<tr>
<td>8</td>
<td>RateAlarm</td>
<td>0 = Good; 1 = Fault or Module not present</td>
</tr>
<tr>
<td>9</td>
<td>LineFault</td>
<td>0 = Good; 1 = Fault or Module not present</td>
</tr>
</tbody>
</table>

### Status

Redundancy and power status:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>ModAFault</td>
<td>0 = Good; 1 = Fault or module not present</td>
</tr>
<tr>
<td>1</td>
<td>ModBFault</td>
<td>0 = Good; 1 = Fault or module not present</td>
</tr>
<tr>
<td>8</td>
<td>GroupFault</td>
<td>0 = Good; 1 = Any channel on module is faulted/failed</td>
</tr>
<tr>
<td>9</td>
<td>ModAFGroupFault</td>
<td>0 = Good; 1 = Any channel on Module A is faulted/failed</td>
</tr>
<tr>
<td>10</td>
<td>ModuleBGroupFault</td>
<td>0 = Good; 1 = Any channel on Module B is faulted/failed</td>
</tr>
</tbody>
</table>
Appendix G

History of Changes

This appendix contains the new or updated information for each revision of this publication. These lists include substantive updates only and are not intended to reflect all changes. Translated versions are not always available for each revision.

Table 74 - 1715-UM001J-EN-P, December 2020

<table>
<thead>
<tr>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Updated 1715-AENTR firmware version in PFD Calculations with 24-hour MTTR to 3.003</td>
</tr>
<tr>
<td>Applied latest publication template</td>
</tr>
</tbody>
</table>

Table 75 - 1715-UM001I-EN-P, March 2020

<table>
<thead>
<tr>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Updated IEC 61508 edition.</td>
</tr>
<tr>
<td>Updated calculations for 1715 I/O modules.</td>
</tr>
<tr>
<td>Changed the section PFD Calculations with 10-hour MTTR to PFD Calculations with 24-hour MTTR.</td>
</tr>
<tr>
<td>Added Communications Data section.</td>
</tr>
</tbody>
</table>

Table 76 - 1715-UM001H-EN-P, December 2018

<table>
<thead>
<tr>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changed ambient temperature range.</td>
</tr>
<tr>
<td>Added references to ATEX and IECEx UL certificates in the Literature Library.</td>
</tr>
</tbody>
</table>

Table 77 - 1715-UM001G-EN-P, October 2018

<table>
<thead>
<tr>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format changes.</td>
</tr>
<tr>
<td>Added Important table to 1715-C2 Expansion Cable section.</td>
</tr>
</tbody>
</table>

Table 78 - 1715-UM001F-EN-P, July 2017

<table>
<thead>
<tr>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increment ControlFlash tool version..</td>
</tr>
<tr>
<td>Correction to Typographical errors.</td>
</tr>
<tr>
<td>Cross reference &amp; hypertext links.</td>
</tr>
<tr>
<td>Change heading to accommodate table of contents.</td>
</tr>
<tr>
<td>Reformat Cell height and margins in table.</td>
</tr>
<tr>
<td>Reformat instruction numbers.</td>
</tr>
<tr>
<td>Version update to RSLogix 5000 programming software.</td>
</tr>
<tr>
<td>Remove reference to installation from disk and reword section.</td>
</tr>
<tr>
<td>Insertion of Screen-shots for updated version of software.</td>
</tr>
<tr>
<td>Modification of LED behavior.</td>
</tr>
<tr>
<td>Move December 2016 New and Updated Information into Revision History.</td>
</tr>
</tbody>
</table>
Table 79 - 1715-UM001E-EN-P, December 2016

<table>
<thead>
<tr>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addition of Studio 5000 environment to required software. Studio 5000™ Logix Designer application is the rebranding of RSLogix™ 5000 software</td>
</tr>
<tr>
<td>Added sentence &quot;One module in a duplex pair can be removed and replaced without system interruption.&quot; to the Redundancy System Overview section.</td>
</tr>
<tr>
<td>Added detail of the flashing green Network Status LED to identify ‘partner’ adapter during module replacement to a 1715 Redundant I/O operational system. Detail included in an Important statement.</td>
</tr>
<tr>
<td>Inclusion of Figure 4 - “Shield Termination Arrangement to prevent Ground loops” and supporting text</td>
</tr>
<tr>
<td>Added “Timestamping” section</td>
</tr>
<tr>
<td>Added “Attention” statement to detailing how warranty effected by failure to correctly install retaining clips.</td>
</tr>
<tr>
<td>Added drawing detail for removal of adapter coding peg (Reducing number of coding pegs from 3 to 2.</td>
</tr>
<tr>
<td>Added “Attention” statement to “Power Requirements” sub-section</td>
</tr>
<tr>
<td>Added ControlFLASH detail to the new “System Software” section.</td>
</tr>
<tr>
<td>Added “Attention” statement to “Install the Power Supply” section</td>
</tr>
<tr>
<td>Added sub-sub-section detailing the addition of a 120 Ω resistor assembly to facilitate use of HART Secondary Master.</td>
</tr>
<tr>
<td>Added Chapter 3, Security</td>
</tr>
<tr>
<td>Added more detailed explanation to examples of how to upgrade / replace digital I/O modules</td>
</tr>
<tr>
<td>Added sub section Field Power Status Integers</td>
</tr>
<tr>
<td>Added sub-section Field Fault Detection</td>
</tr>
<tr>
<td>Added New Section “HART”</td>
</tr>
<tr>
<td>Modified Firmware Revision Column ot Table 39- 1715 Devices in a SIL 2 System</td>
</tr>
<tr>
<td>Modified Table 40 - SIL 2 Add-On Instructions</td>
</tr>
<tr>
<td>Modified Table 46 - Maximum Scan Rates Measured. Added detail - The L75 Controller was used for taking measurements.</td>
</tr>
<tr>
<td>Added Table 47 - Maximum Scan Rates Measured - The L75 Controller was used for taking measurements</td>
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<tr>
<td>Added detail to sub-section Module Faults</td>
</tr>
<tr>
<td>Added detail to sub-section Channel Faults</td>
</tr>
</tbody>
</table>

Table 80 - 1715-UM001D-EN-P, September 2015

<table>
<thead>
<tr>
<th>Change</th>
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<tbody>
<tr>
<td>Updated European Hazardous Location Approval information and embedded certificates</td>
</tr>
<tr>
<td>Added slew tolerance information</td>
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<tr>
<td>Added Electronic Keying approved text</td>
</tr>
<tr>
<td>Clarification of SIL 2 module reconfiguration</td>
</tr>
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</table>

Table 81 - 1715-UM001C-EN-P, March 2014

<table>
<thead>
<tr>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Updates to include SIL 2 operations with L7 ControlLogix controllers</td>
</tr>
<tr>
<td>Studio 5000 Logix Designer application added throughout document and new information about who can use this system</td>
</tr>
<tr>
<td>Using ControlLogix in SIL 2 Applications Safety Reference Manual added to Additional Resources section</td>
</tr>
<tr>
<td>Added redundant 1715 adapter and status indicator information</td>
</tr>
<tr>
<td>Added information to use a 1715 system in a SIL 2 application</td>
</tr>
<tr>
<td>Corrected drawing; added 1756-L7 controller and 1756-RM2 module; added reference for DLR topologies</td>
</tr>
<tr>
<td>Corrected drawing; added 1756-L7 controller and 1756-RM2 module</td>
</tr>
<tr>
<td>Network status indicator information</td>
</tr>
<tr>
<td>CIP messages</td>
</tr>
<tr>
<td>Required connections for duplex and simplex operation</td>
</tr>
<tr>
<td>Listen Only connections</td>
</tr>
<tr>
<td>Conformal coating is available on all 1715 modules</td>
</tr>
<tr>
<td>1715-A2A adapter base unit fuse graphic and removal and replacement information</td>
</tr>
</tbody>
</table>
### Appendix G          History of Changes

<table>
<thead>
<tr>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital input termination assembly removal and replacement of fuses</td>
</tr>
<tr>
<td>Digital output termination assembly removal and replacement of fuses</td>
</tr>
<tr>
<td>Analog input termination assembly removal and replacement of fuses</td>
</tr>
<tr>
<td>Power requirements</td>
</tr>
<tr>
<td>1715 chassis firmware update; power recycle needed</td>
</tr>
<tr>
<td>ControlFLASH revision number</td>
</tr>
<tr>
<td>Power requirements for PELV/SELV</td>
</tr>
<tr>
<td>Correction to system power graphic</td>
</tr>
<tr>
<td>Digital Input diagram correction-standard inputs</td>
</tr>
<tr>
<td>Short circuit information</td>
</tr>
<tr>
<td>Digital Input diagram correction-line monitored inputs. Added reference for calibration drift checks</td>
</tr>
<tr>
<td>Corrected digital input termination assembly graphics</td>
</tr>
<tr>
<td>Added Attention table for inductive loads</td>
</tr>
<tr>
<td>Added missing arrow on 1715-OB8DE function block diagram, to go from the Control B box to the Output</td>
</tr>
<tr>
<td>Diagram correction-digital outputs</td>
</tr>
<tr>
<td>Damage to pins when inserting/removing I/O modules under power can fault the system</td>
</tr>
<tr>
<td>Corrected analog inputs graphic by removing footnote numbers on voltage</td>
</tr>
<tr>
<td>Added information about analog field loops, input modules and analog input field devices</td>
</tr>
<tr>
<td>Find and record MAC addresses</td>
</tr>
<tr>
<td>Added status indicator labels to the adapter graphic of the locking mechanism</td>
</tr>
<tr>
<td>Changes throughout the Assign an IP Address on the BOOTP/DHCP Server section</td>
</tr>
<tr>
<td>Verify BOOTP network settings Important table added</td>
</tr>
<tr>
<td>Added last step to disable BootP/DHCP</td>
</tr>
<tr>
<td>Module inhibiting when using multiple controllers</td>
</tr>
<tr>
<td>Corrected ohms symbol and added DC on voltage numbers</td>
</tr>
<tr>
<td>Shutdown states</td>
</tr>
<tr>
<td>Removed references to the 1756-IA1B module</td>
</tr>
<tr>
<td>Digital input module tags</td>
</tr>
<tr>
<td>Digital output module tags</td>
</tr>
<tr>
<td>Correction of table header to ControlLogix Analog I/O Modules and Components</td>
</tr>
<tr>
<td>Added performance criteria for the analog input module</td>
</tr>
<tr>
<td>Added performance criteria for the analog output module</td>
</tr>
<tr>
<td>Module inhibiting when using multiple controllers</td>
</tr>
<tr>
<td>Changed Get Support Now website to the Product and Compatibility Download Center website, added Add-on Profile versions for the adapter and I/O modules. Added reference to the release list of approved versions on <a href="http://www.tuvasi.com">www.tuvasi.com</a></td>
</tr>
<tr>
<td>Updated screen shots throughout to reflect Logix Designer version 21 interface and to include SIL 2 operation options</td>
</tr>
<tr>
<td>Connections for Listen Only</td>
</tr>
<tr>
<td>Module definition parameters for 1715-IB16D digital input module in Duplex mode for SIL 2 applications</td>
</tr>
<tr>
<td>Added Important table on how to change Alarms/Limits values</td>
</tr>
<tr>
<td>Added a chapter about SIL 2 safety operation with 1715 redundant I/O</td>
</tr>
<tr>
<td>Added a chapter about SIL 2 Add-On Instruction with 1715 redundant I/O</td>
</tr>
<tr>
<td>Corrected text from 3.9 to 4.3</td>
</tr>
<tr>
<td>Corrected text from 15 to 15.4. Added Calibration Drift Checks section</td>
</tr>
<tr>
<td>SIL 2 safety application online configuration restrictions</td>
</tr>
<tr>
<td>Added appendix for PFD and PFH calculations for a SIL 2 system</td>
</tr>
<tr>
<td>Added appendix for SIL 2 Applications Checklist</td>
</tr>
<tr>
<td>Added appendix for Tag Definitions</td>
</tr>
</tbody>
</table>
Notes:
Index

Numerics

1715-A2A
  adapter base 40, 61
  expansion cable 71

1715-A310
  expansion cable 69
  I/O base 43, 62

1715-AENTR
  adapter 15, 38
  add 165
  Add-on Profile 157
  diagnostic features 241
  install 101
  IP address 165

1715-C2
  expansion cable 49

1715-IB16D 118
  diagnostic features 241
  digital input module 110
  features 118

1715-IF16 135
  analog input module 110
  diagnostic features 242
  features 136
  termination assembly 136

1715-OB8DE
  diagnostic features 242
  digital output module 110

1715-OF8I 135
  analog output module 110, 137
  diagnostic features 242
  features 137

1715-TADIF16 135
1715-TADOF8I 135
1715-TASIF16 135
1715-TASOF8I 135

1756-EN2TR
  add 163

5-year PFD calculations 274

A

adapter 247
  1715-AENTR 15, 38
  configure 165
  cyclic trigger 29
  Ethernet 96
  install 101
  IP address swap 168
  RPY 29
  SIL 2 169
  status indicators 247
  topology 96
  wire 72

adapter base 54
  1715-A2A 40, 61
  install 61

add
  1715-AENTR 165
  1756-EN2TR 163
  analog input module 189
  analog output module 193
  digital input module 177
  digital output module 185

add-on instructions 208

Add-on Profile
  1715-AENTR 157
  I/O module 157

alarms
  disable 196
  latch limit 196
  latch rate 196

analog I/O module 135
  calibration drift checks 267
  cyclic trigger 29
  features 137
  operating modes 139, 141, 145
  shutdown states 141

analog input module
  1715-IF16 110
  add 189
  field loop circuits 88
  field wire 89
  performance criteria 136
  recommended circuits 86
  simplex mode 192
  status indicators 253
  termination assembly 47

analog output module
  1715-OF8I 110, 137
  add 193
  duplex mode 193
  field wire 95
  performance criteria 137
  simplex mode 198
  status indicators 255
  termination assembly 48

architecture
  duplex 21
  mixed 23
  simplex 20

assembly tools
  system 37

assign
  IP address 104

B

base unit 14
before you begin 36
BOOTP 105
button
  change 168
cable
   assembly 67
   Cat5e 97
   shielded twisted pair 97

calculations
   5-year PFD 274
   PFD 273

calibration 267

calibration drift checks
   analog I/O module 267
Cat5e
   cable 97
change
   button 168
change-of-state
   digital module 123
change-of-state trigger
   digital module 29
channel 197
   fault 246
chassis size 169
checklist
   SIL 2 277

CIP
   EtherNet/IP network 28, 241
   SIL 2 14

coding pegs 99
   module 98
commanded values 212
compatibility
   digital output module 120
configuration
   redundant I/O system 157
   tab 166, 191
configuration signature, 1715 216
configure
   adapter 165
   controller 162
connection 169
   data 169
   listen only 169
   power 72
connection reaction time limit
   1715 systems 208, 213, 214
connection wire
   ground 73
connections 28
consumer 222

ControlFLASH software 11
controller 13
   configure 162
controller reaction time limit
   CRTL 277
create new project
   RSLogix 5000 programming software 160
CRTL
   controller reaction time limit 277
cyclic trigger
   adapter 29
   analog I/O module 29
data
   connection 169
   echo output 127
   format connection 29
   transfer 122
d-e-energize-to-trip 131, 209
   power supply 206
DHCP/BOOTP
   IP address 26
diagnostic
   latching 129
diagnostic features 241
   1715-AENTR 241
   1715-IB16D 241
   1715-IF16 242
   1715-OB8DE 242
   1715-OF8I 242
diagnostics
   1715 SIL 2 safety 216
digital input module 118
   1715-IB16D 110
   add 177
   duplex mode 177
   recommended circuits 75
   SIL 2 180
   simplex mode 182
   status indicators 250
   tags 132, 133
   termination assembly 45, 120
   termination assembly wire 78
digital module 117
   change-of-state 123
   change-of-state trigger 29
   features 119
   RIUP 120
   RPI 123
   termination assembly 117
   type 118
digital output module 118
   1715-OB8DE 110
   add 185
   compatibility 120
   duplex mode 185
   features 119
   field loop circuits 86
   field wire 83
   motor starters 120
   recommended circuits 80
   simplex mode 187
   status indicators 252
   termination assembly 46, 120
disable
   alarms 196
DLR
topology 27
dowel pin 103
duplex
   architecture 21
duplex mode
   analog output module 193
   digital input module 177
   digital output module 185
**E**
- electronic keying 169
- emergency stop devices
  - ESD 273
- enclosure 51
- energize-on-communication-failure 131
- energize-to-action 207, 209
- Ethernet 166
  - adapter 96
  - topology 26
- EtherNet/IP network
  - CIP 28, 241
  - expansion cable 67, 68
  - 1715-A2A 71
  - 1715-A3I/O 69
  - 1715-C2 49
  - ferrites 67
  - install 69

**F**
- fail-safe guard 212
- fail-safe state
  - 1715 modules 214
- fault
  - bit 128
  - field 246
  - mode 197
  - value 197
- fault reporting 132
  - standard input modules 132
- fault/program action
  - tab 186, 197
- faults
  - 1715 analog output module 212
  - 1715 digital output modules 210
  - 1715 input modules 209
  - features
    - 1715-IB16D 118
    - 1715-IF16 136
    - 1715-OF8I 137
  - digital module 119
- ferrites
  - expansion cable 67
- field
  - fault 246
  - wire connection 74
- field loop circuits
  - analog input module 88
  - digital inputs 80
  - digital output module 86
- field wire
  - analog input module 89
  - analog output module 95
  - digital output module 83
- format connection
  - datat 29
- fuse
  - termination assembly 46, 47, 48, 247
- fusing 128
  - nondiagnostic
    - output modules 128

**G**
- general tab 178, 184, 188, 192
- ground
  - connection wire 73
  - wire 74

**H**
- hardware
  - layout 17
- heating and cooling requirements 51
- high clamp limit 196
- hold last state 211

**I**
- I/O base 54
  - 1715-A3I0 43, 62
  - install 62
- I/O configuration folder 199
- I/O expansion cable
  - install 67
- I/O module 15, 39
  - Add-on Profile 157
  - install 110
  - partner 15
  - RPI 29
  - termination assembly 44
- IEC 61508 274
- indicators 120
- inhibit
  - module 121
- input module
  - compatibility 119
- install
  - 1715-AENTR 101
  - adapter 101
  - adapter base 61
  - expansion cable 69
  - I/O base 62
  - I/O expansion cable 67
  - I/O module 110
  - power supply 60
  - slot cover 112
  - termination assembly 64
- instrument ground 73
- Internet protocol tab 172
- IP address
  - assign 104
  - DHCP/BOOTB 26
  - obtaining 26
  - primary 25
- IP address swap 26
  - adapter 168

**K**
- keying
  - module 97, 98
latch limit
alarms 196
latch rate
alarms 196
latching
diagnostic 129
layout
hardware 17
system 17
limits configuration tab 195
line monitoring 203
1715 digital output modules 210
listen only
connection 169
locking screw 104

MAC address 106
mean time to repair
MTTR 207
Mean Time to Restoration 277
MTTR 277
mixed
architecture 23
mode
fault 197
module
coding pegs 98
data format 139
definition dialog box 179
fault reporting digital module 121
info A tab 170
info B tab 171
inhibit RSLogix 5000 programming software 138
keying 97, 98
operating modes 139
placement 53
polarization 97
positioning 15
properties 164, 188
resolution 139
scaling 139
module A
module B 27
module B
module A 27
module configuration 109
MTTR
mean time to repair 207
multicast 132

network tab 174

operating modes
analog I/O module 139, 141, 145
output
data echo 127
output fault state 127
overview
system 13
partner
analog input module 15
I/O module 15
parts list 36
performance criteria
analog input module 136
analog output module 137
PES
programmable electronic systems 201
PFD
Probability of Failure on Demand (PFD) 273
PFH
probability of failure 273
Probability of Failure on Demand (PFD)
5-year calculations 274
calculations 273
PFD 273
probability of failure per hour
PFH 273
producer 222
programmable electronic systems
PES 201
ramp 196
rate 198
to program 198
recommended circuits
analog input module 86
digital input module 75
digital output module 80
redundant I/O system
configuration 157
removal and insertion under power (RIUP) 137
remove module 112
requested packet interval
1715 modules 213
reset
1715 SIL 2 216
SIL 2 238
reset button 250
retaining clips
termination assembly 66
RIUP
analog module 137
digital module 120
RPI
adapter 29
digital module 123
I/O module 29
setting 123
RSLinx Classic software 108
RSLogix 5000 programming software 97
create new project 160
project 160
RSWho 108
S
safety application
SIL 2 12
scaling 139
scaling factor 212
shielded twisted pair
cable 97
shutdown mode 210, 211, 212
shutdown states
analog I/O module 141
SIL 2 201
adapter 169
checklist 277
CIP 14
digital input module 180
reset 238
safety application 12
SIL 2 reset status 216
simplex
architecture 20
simplex mode
analog input module 192
analog output module 198
digital input module 182
digital output module 187
slot cover 50
install 112
slot positions 54
software installation 157
solenoids 120
star
topology 19
static configuration 109
status indicators 122, 138, 245
adapter 247
analog input module 253
analog output module 255
digital input module 250
digital output module 252
status reporting 132
standard input modules 132
switchover considerations 25
system
architecture 14
assembly tools 37
configuration 16
connection 28
element 16
example 16
hardware 38
layout 17
overview 13
parts 36
performance 28
power 72
software 51
T
tags
digital input module 132, 133
termination assembly 14
1715-IF16 136
analog input module 47
analog output module 48
digital input module 45, 120
digital module 117
digital output module 46, 120
fuse 46, 47, 48, 247
I/O module 44
install 64
retaining clips 66
termination assembly wire
digital input module 78
topology
adapter 96
DLR 27
Ethernet 26
star 19
troubleshooting
module status indicators 122
type
digital module 118
U
ucer 222
unicast 123
unlatch 196
V
value
fault 197
W
watchdog facility 118
wire
adapter 72
ground 74
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Use these resources to access support information.

<table>
<thead>
<tr>
<th>Technical Support Center</th>
<th>Find help with how-to videos, FAQs, chat, user forums, and product notification updates.</th>
<th>rok.auto/support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledgebase</td>
<td>Access Knowledgebase articles.</td>
<td>rok.auto/knowledgebase</td>
</tr>
<tr>
<td>Local Technical Support Phone Numbers</td>
<td>Locate the telephone number for your country.</td>
<td>rok.auto/phonesupport</td>
</tr>
<tr>
<td>Literature Library</td>
<td>Find installation instructions, manuals, brochures, and technical data publications.</td>
<td>rok.auto/literature</td>
</tr>
<tr>
<td>Product Compatibility and Download Center (PCDC)</td>
<td>Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.</td>
<td>rok.auto/pcdc</td>
</tr>
</tbody>
</table>

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