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.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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

| ![Warning Icon] | **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 Icon] | **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 Icon] | **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 Icon] | **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 Icon] | **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 Icon] | **ARC FLASH HAZARD**: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE). |

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Trademarks not belonging to Rockwell Automation are property of their respective companies.
# Table of Contents

## Preface

- Introduction ............................................. 5
- About the Linking Devices ............................... 5
- Network Diagrams ....................................... 6
  - 1788-EN2FFR EtherNet/IP Network ..................... 6
  - 1788-CN2FFR ControlNet Network ...................... 7
- Features .................................................. 7
- Safety Precautions ...................................... 8
  - Prevent Electrostatic Discharge ....................... 8
  - Environment and Enclosure ............................ 9
- European Hazardous Location Approval ................. 10
- North American Hazardous Location Approval .......... 11
- Additional Resources ................................... 12

## Chapter 1

### Installation

- Hardware ................................................. 13
  - Dimensions ........................................... 13
  - Power Connection .................................... 13
  - H1 Network Connections ............................... 14
  - ControlNet and EtherNet/IP Connections ............... 16
  - Shielding ............................................. 16
- Set the Linking Device Network Address ................. 17
  - Hardware Switches Location .......................... 17
  - Set the ControlNet Node Address ...................... 17
  - Set the EtherNet/IP Address ........................... 18
  - Ethernet Switch Settings ............................. 19
- Software Installation ................................... 20
  - Firmware Version .................................... 20

## Chapter 2

### Set Up in the Studio 5000

- Logix Designer Application ............................
  - Add the 1788-EN2FFR Linking Device to the I/O Tree ........ 21
  - Add the 1788-CN2FFR Linking Device to the I/O Tree ........ 22
  - RSNetWorx for ControlNet Configuration ............... 23
- Linking Device Configuration Using the AOP ............ 26
  - Master Configuration .................................. 28
  - Add and Manage Device Description Files ............... 31
  - Field Device Configuration ............................ 32
  - Field Device Block Configuration ....................... 36
  - Field Device Class .................................... 42
- Scheduling and the LAS .................................. 43
- Redundant Master Setup .................................. 43
  - Redundant Master Mismatch ............................ 45
  - Redundant Master Disabled ............................. 45
- MultiMaster Connecting Procedures ...................... 46
## Table of Contents

Connect Safe Mode .......................................................... 46
Start the Back-up LAS Master (Already Configured) .......... 46
Reconnect Two Separate Running LAS Devices ............... 47
Swap Out Linking Devices ................................................. 47

### Chapter 3

**Logix Assemblies**

Input .................................................................................. 49
  - Master Device Tag Structure ........................................ 49
  - Field Device Tag Structure ........................................... 51
Output ................................................................................. 53
  - Field Device Output Values ......................................... 53

### Chapter 4

**Diagnostics**

Status Screen ................................................................. 55
PV Data Screen ............................................................... 57
Oscilloscope Screen ......................................................... 57
The Web Server ............................................................... 58
Device Type Manager (DTM) ............................................. 59

### Appendix A

**Linking Device Display Status**

Main Page ........................................................................ 61
H1 Master Page ............................................................... 62
Field Device Page ............................................................ 62

### Appendix B

**HSProcessUtility**

Use the HSProcessUtility .................................................. 65

### Appendix C

**Field Device Block Configuration Examples**

Overview ............................................................................ 69
AO Function Block Example ................................................ 70
DO Function Block Example .............................................. 80

### Appendix D

**H1 Topology**

Master Mode 0 .................................................................. 85
Master Mode 1 .................................................................. 85
Master Mode 2 .................................................................. 85
Master Mode 3 .................................................................. 86
Master Mode 4 .................................................................. 86
Master Mode 5 .................................................................. 86
Master Mode 6 .................................................................. 86
Master Mode 7 .................................................................. 87
Master Mode 8 .................................................................. 87
Master Mode 9 .................................................................. 87
Master Mode 10 .................................................................. 87
| Master Mode 11 | 88 |
| Master Mode 12 | 88 |
| Master Mode 13 | 88 |
| Master Mode 14 | 88 |
| Master Mode 15 | 89 |
| Master Mode 16 | 89 |
Introduction

This user manual describes the installation and operation of the 1788-EN2FFR and 1788-CN2FFR linking devices.

About the Linking Devices

The 1788-EN2FFR linking device provides a gateway between an EtherNet/IP network and a single segment FOUNDATION Fieldbus H1 layer.

The 1788-CN2FFR linking device provides a gateway between a ControlNet network and a FOUNDATION Fieldbus network.

In this manual, both modules are referred to as the linking device.

The linking device can support up to 16 field devices. It is configurable through the Studio 5000® Logix Designer™ application by use of a dedicated Add-on Profile (AOP). Multiple levels of media redundancy are supported, including ring, split, and redundant trunk, plus options for H1 media, redundant linking devices, redundant controllers, and redundant ControlNet media.

The linking device has full FOUNDATION fieldbus host capability, including link active scheduler (LAS) capability.
Network Diagrams

1788-EN2FFR EtherNet/IP Network

The diagram below is an example of how a 1788-EN2FFR linking device could be used with an EtherNet/IP network.
1788-CN2FFR ControlNet Network

This diagram shows an example of how a 1788-EN2FFR linking device could be used with a ControlNet network.

Features

The AOP provides an intuitive graphical interface to configure devices. A predefined data structure for each field device provides eight input process variables (PVs), eight output PVs, and eight PVs for inter-device communication for full distributed control.

The linking device uses four controller connections. The data for the 16 field devices is distributed over the four CIP connections. Connection A has the data for the linking device and four field devices. Connection B, C, and D have the data of four field devices each. The minimum requested packet interval (RPI) is 100 ms, and the maximum is 3,000 ms.

The HSProcessUtility is used to manage and register the field device description (DD) files. The utility is launched from the AOP in the Studio 5000 Logix Designer application, or directly in the Microsoft Windows operating system.

Field Device Tool/Device Type Manager (FDT/DTM) technology is supported. This allows access to field device configuration and diagnostics via FDT Frames such as FactoryTalk® AssetCentre. In addition, the Rockwell Automation FDT ThinFrame (read only) can be launched from a FactoryTalk View or via the AOP providing access to each field devices status and extended diagnostics.
Built-in power conditioners and protection are provided, which helps to minimize installation space requirements. The H1 segment is divided between two physical ports (A and B) with individual protection and a supply of 500 mA per port. See H1 Network Connections on page 14.

The basic diagnostics of the linking device and the field devices, is found in the input assemblies. Advanced configuration is found only through the AOP.

To assist with troubleshooting, a 128 x 128 pixel display provides access to the status of the linking device. Information available includes network voltages and currents, internal temperature, and communication quality to each field device.

A built-in web server provides remote access to network and field device data.

Safety Precautions

Read and understand all precautions before using the linking device.

Prevent Electrostatic Discharge

ATTENTION: Prevent Electrostatic Discharge

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.
Environment and Enclosure

**ATTENTION: Environment and Enclosure**

- 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 nonmetallic. 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.

**ATTENTION:** Do not place the module in direct sunlight. Prolonged exposure to direct sunlight could degrade the LCD.
European Hazardous Location Approval

The following applies when the product bears the ☥ 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.

ATTENTION: This equipment is not resistant to sunlight or other sources of UV radiation.

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.

WARNING: This equipment shall be used within its specified ratings defined by Rockwell Automation.

WARNING: Should the unit be installed in an environment where induced transients could exceed 44V, then external transient/surge arrestors should be installed.

WARNING: Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.

WARNING: Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.

WARNING: Devices shall be used in an environment of not more than Pollution Degree 2.
North American Hazardous Location Approval

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

**WARNING:** 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.

**WARNING:** If you connect or disconnect the communications 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.

**WARNING:** Temperature rating of conductors must be higher than 82 °C (179.6 °F).

**WARNING:** If you connect or disconnect wiring while the field-side power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.
# Additional Resources

These documents contain more information about related products from Rockwell Automation®.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOUNDATION Fieldbus Linking Devices Technical Data, publication 1788-TD001</td>
<td>Provides technical data and specifications for the FOUNDATION Fieldbus linking devices.</td>
</tr>
<tr>
<td>FOUNDATION Fieldbus Junction Boxes Installation Instructions, publication 1788-IN006</td>
<td>Provides installation instructions and technical information about the FOUNDATION Fieldbus junction boxes (1788-FBJJB4R, 1788-FBJJB6).</td>
</tr>
<tr>
<td>ControlLogix® Enhanced Redundancy System User Manual, publication 1756-UM535</td>
<td>Provides information specific to enhanced redundancy systems including design and planning considerations, installation procedures, configuration procedures, and maintenance and troubleshooting methods.</td>
</tr>
<tr>
<td>ControlLogix EtherNet/IP Module Installation Instructions, publication 1756-IN603</td>
<td>Provides hardware installation instructions for the ControlLogix EtherNet/IP module.</td>
</tr>
<tr>
<td>EtherNet/IP Network Configuration User Manual, publication ENET-UM001</td>
<td>Describes how you can use EtherNet/IP communication modules with your Logix5000 controller and communicate with various devices on the Ethernet network.</td>
</tr>
<tr>
<td>RSNetWorx™ for ControlNet Getting Results Guide, publication CNET-GR001</td>
<td>Provides information on how to install and navigate the RSNetWorx for ControlNet software. It explains how to use RSNetWorx for ControlNet software and how to access and navigate the online help.</td>
</tr>
<tr>
<td>RSNetWorx for EtherNet/IP Getting Results Guide, publication ENET-GR001</td>
<td>Provides information on how to install and navigate the RSNetWorx for EtherNet/IP software. It explains how to use the RSNetWorx for EtherNet/IP software and how to access and navigate the online help.</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>
</tbody>
</table>

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

### Hardware

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

### Dimensions

![Dimensions Diagram]

### Power Connection

To comply with the CE Low Voltage Directive (LVD), this equipment must be powered from a source compliant with Safety Extra Low Voltage (SELV) or Protected Extra Low Voltage (PELV).

To comply with UL restrictions, this equipment must be powered from a source compliant with Class 2 or Limited Voltage/Current.
We recommend a 24…32V DC power supply for the linking device to operate correctly. No additional power supplies or power conditioners are required. The power supply connection is described here. Tighten DC Power connections to a torque of 0.22…0.25Nm (2…2.2 lb-in).

**IMPORTANT** Do not use additional power supplies or power conditioners with the 1788-EN2FFR and 1788-CN2FFR linking devices.

### H1 Network Connections

The H1 network must be connected via the H1 terminal on the linking device. The H1 network connection and pinout is described here.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right/Top (red)</td>
<td>FF +</td>
</tr>
<tr>
<td>Middle (green)</td>
<td>FF -</td>
</tr>
<tr>
<td>Left/Bottom</td>
<td>Shield</td>
</tr>
</tbody>
</table>

Make Fieldbus connections to a torque of 0.5…0.6 Nm (4.4…5.3 lb-in)

The H1 Segment is split between two physical ports, A and B.
ControlNet and EtherNet/IP Connections

Two BNC connectors on the base of the 1788-CN2FFR linking device provide connections for single or dual ControlNet media. The 1788-EN2FFR linking device uses an RJ45 connector to connect to an EtherNet/IP network. The dual port EtherNet/IP switch on the 1788-EN2FFR linking device provides connections for multiple Ethernet topologies, including device level ring (DLR). The EtherNet/IP port can also be used as a connection point in the field to access the web server or asset management tools.

Shielding

Ground the linking device shield connection to a clean earth connection.

Connect the shield to the H1 media so that connectivity runs through all junction boxes, but is not connected to the field device shield or grounded at the device.

Do not attach the H1 media shield to the field device. Tape the media shield back to avoid accidental contact with other conductors or ground.
Set the Linking Device
Network Address

This section describes the network address switches.

**Hardware Switches Location**

The hardware switches are located under the front cover of the linking device. Use the Page button to toggle between different diagnostics on the display.

Set the ControlNet Node Address

To set the ControlNet node address of the 1788-CN2FFR linking device, use the hardware switches behind the front cover.
Set the EtherNet/IP Address

The linking device ships with BOOTP enabled. To set the IP address of the 1788-EN2FFR linking device, use a BOOTP server or use the hardware switches.

IMPORTANT

Power down the linking device before changing the Ethernet switch settings. The IP address is set during powerup.
# Ethernet Switch Settings

This table describes the Ethernet switch settings.

<table>
<thead>
<tr>
<th>Ethernet Switch Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="#" alt="Switch Setting" /></td>
<td>To set the IP address of the linking device to the 192.168.1.xxx sub net, set the switches to the required last three digits. In this example, the linking device will start up with IP address: 192.168.1.123.</td>
</tr>
<tr>
<td><img src="#" alt="Switch Setting" /></td>
<td>To set the IP address of the linking device via a BOOTP server, set the switches to 888 (factory default setting). Power up the linking device and set the IP address by using any BOOTP server. Once the new IP address has been set, power down the linking device, return the switches to 000, and power up the linking device.</td>
</tr>
<tr>
<td><img src="#" alt="Switch Setting" /></td>
<td>Normal setting after setting IP address with BOOTP. The 000 setting disables BOOTP and holds the IP address.</td>
</tr>
<tr>
<td><img src="#" alt="Switch Setting" /></td>
<td>The linking device can run the firmware with which it was originally shipped. If power was cycled while upgrading the firmware, the firmware can be corrupted and prevent the linking device from starting up. Set the switches to 777 to set the linking device into Safe mode and upgrade the firmware again.</td>
</tr>
</tbody>
</table>
Software Installation

You need the AOP for the Studio 5000 Logix Designer application to configure and manage the linking device. The installation of the AOP includes the HSProcessUtility that is used to manage DTMs and DD service libraries. See Appendix B.

For the latest compatible software information and to download the AOP, see the Product Compatibility and Download Center at http://www.rockwellautomation.com/rockwellautomation/support/pcdc.page#/tab2.

The AOP version of the linking device is located on the display during the start up process, or via the web server.

Firmware Version

The firmware version is printed on the linking device and displayed on the screen during power-up.
Set Up in the Studio 5000
Logix Designer Application

Add the 1788-EN2FFR Linking Device to the I/O Tree

The 1788-EN2FFR linking device must be added to the I/O tree of the Logix controller. The linking device must be added to an Ethernet bridge, such as an Allen-Bradley® 1756-EN2T or 1756-EN2TR module.

Follow these steps to add the linking device to the I/O tree of the Logix controller. This example uses the 1756-EN2TR module.

1. Right-click the Ethernet bridge and choose New Module.

2. Select the linking device that you want to add to the Ethernet bridge.

3. Click the General tab and set the name, description, and IP address.
4. Set the RPI for the linking device.

**IMPORTANT** The recommended RPI is 1/2 the macrocycle time. Calculate the macrocycle by calculating the total response time of all field devices on the segment and then add 100...200 ms for class 2 (DTM message) data. If the RPI is too low, class 1 data (PVs and status) does not update each cycle, and class 2 data responses can be slow.

5. Click OK to add the linking device to the I/O tree.

**Add the 1788-CN2FFR Linking Device to the I/O Tree**

The 1788-CN2FFR linking device must be added to the I/O tree of the Logix controller. The linking device must be added to a ControlNet bridge, such as an Allen-Bradley 1756-CNB or 1756-CNBR module.

Follow these steps to add the linking device to the I/O tree of the Logix controller. This example uses the 1756-CNBR/A module.

1. Right-click the ControlNet bridge and choose New Module.

2. Select the linking device to add to the ControlNet bridge.

3. Click the General tab and set the name, description, and ControlNet node address.
4. Set the RPI for the linking device.

**IMPORTANT** The recommended RPI is 1/2 the macrocycle time. Calculate the macrocycle by calculating the total response time of all field devices on the segment and then add 100...200 ms for class 2 (DTM message) data. If the RPI is too low, class 1 data (PVs and status) does not update each cycle, and class 2 data responses can be slow.

5. Click OK to add the linking device to the I/O tree.

**RSNetWorx for ControlNet Configuration**

See the RSNetWorx for ControlNet Getting Results Guide, publication CNET-GR001, for more details.

Follow these steps to configure the ControlNet network.

1. Launch RSNetWorx™ for ControlNet and create a file.

2. Click the Online button.

The Browse for Network window appears with the drivers you have installed on your system.
3. Select the communication path to the ControlNet network, select the ControlNet port, and click OK.

The following pop-up window appears while RSNetWorx browses the network.

Once complete, all devices on the network are displayed in the graphic window on the right side of the window.

4. Right-click any white space around the graphics and select Enable Edits.

5. Right-click any white space around the graphics and select Properties.
6. On the Networks Parameters Tab, update the Max Unscheduled Address if you are sure that the allocated range is less than 99.

7. Click OK.

8. Right-click any white space around the graphics and choose Download to Network.

9. Select the correct save option for your configuration and click OK.

10. Enter a suitable file name.

11. Click Yes to download the configuration.

The ControlNet network is now scheduled and the graphics display green plus signs.
Chapter 2  Set Up in the Studio 5000 Logix Designer Application

Linking Device Configuration Using the AOP

Once the linking device has been added to the config tree, you can access the property settings. Right-click the linking device and select Properties. Then click the Configuration tab as shown in Figure 1.

Once the linking device is connected to the controller, you can see the linking device in the Configuration tab.

- **Master green** in the config tree = linking device is **online**
- **Master gray** in the config tree = linking device is **offline**

The layout of the Configuration tab is shown in Figure 1.

**Figure 1 - Module Properties Configuration Tab**

![Configuration Tab Diagram]

**Live List**

Once a field device is found and has an address between 16 (0x10) and 247 (0xF7), the device appears in the live list. You can configure this device.

**Visitor List**

Once a field device is found and has an address above 247 (0xF7), the device appears in the visitor list. You cannot configure this device until an address between 16 (0x10) and 247 (0xF7) is given to the field device. See Live List.
LAS

The LAS icon indicates if the master is the LAS that requests and receives live data from each field device, or if the master is the back-up LAS. (The back-up LAS has a red X over the icon.) See Redundant Master Setup on page 43 for more information.

Config Tree

Once you have configured the slot for a device (even if not downloaded yet), the device appears in the config tree. Use the config tree to navigate between configuration and status pages for each master and field device.

Shortcuts

These shortcuts are located above the live list on the configuration tab.

Table 1 - Configuration Tab Shortcuts

<table>
<thead>
<tr>
<th>Shortcut Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image]</td>
<td>Used to open the HSProcessUtility, or to refresh the device catalog.</td>
</tr>
<tr>
<td>![Image]</td>
<td>The Overview page displays a list of configured and attached field devices.</td>
</tr>
<tr>
<td>![Image]</td>
<td>Export configuration for entire linking device, (including all field devices that are configured under linking device).</td>
</tr>
<tr>
<td>![Image]</td>
<td>Import configuration for entire linking device, (including all field devices that are configured under linking device).</td>
</tr>
<tr>
<td>![Image]</td>
<td>Used to synchronize the back-up link active scheduler (LAS) to the current LAS. You must first export the project from the LAS AOP. Note that this button is only available to the back-up LAS and is disabled on the LAS.</td>
</tr>
</tbody>
</table>

You can export or import the configuration for either a field device or linking device (with all field devices connected).

**TIP** If you want to replicate the configuration to many devices, the synchronize shortcut can speed up the process.
Master Configuration

1. Open the master configuration page from the config tree to access the linking device master configuration settings.
2. Choose the Topology for the master linking device.
3. Enter the configuration values.
4. Click the Download Config button to download the settings to the linking device.

The settings are stored in nonvolatile memory in the linking device.
5. Click the Apply button to store the configuration in the project file.

Topology

Choose the correct Topology mode for the application. The graphical representation must be used to match the topology. See Appendix D for available options. Use this setting to configure redundant linking devices, redundant H1 media, and the internal H1 segment terminators.

FF Master Node

The H1 Master (linking device) needs a node number to operate on the H1 network. The default is node number 16 (0x10).

IMPORTANT  Do not modify the default node number; doing so can result in loss of communication.
Max Scan Address

When the linking device is operating, a background scan constantly probes each
unused node number to see if any new field devices were connected. The
background scan runs to the max scan address, then restarts at one.

Slave Retry Limit

The slave retry limit sets the number of times the H1 Master re-requests data
before dropping the connection. The default setting is 5.

---

**IMPORTANT**  Do not modify the default setting. A limit above 5 can slow down
communication.

MacroCycle (ms)

The amount of time between data compels (process variables). Too low a number
can cause poor performance when downloading and going online with a field
device.

Auto Reset Trip

Selects the option to reset H1 bus trips due to over-current.

- If the checkbox is selected, the trip automatically resets. The linking device
  resets the trip each 5 seconds. If the trip is still persistent, the bus will trip
  again.
- If the checkbox is not selected, reset the bus via the reset button on the
  master status page.

Fail Status in Prog/Fault Mode

The fail status is used when field devices use output blocks (AO or DO) that are
receiving data from the Logix controller via the linking device. When the linking
device loses connection to the Logix controller, or the Logix controller goes into
Program mode or Fault mode, you can choose one of two operations:

- If the checkbox is selected, the linking device detects that there is a comms
  fault on the Ethernet network and forces all output PV status to
  Bad:NoComms. If the field device is configured correctly, the field device
  goes to fail-safe value.
- If the checkbox is not selected, the linking device continues to send the last
  received data.

**TIP**  When Logix is in Prog/Fault mode, you can still go into the tags and
change values as the linking device is still connected.

Upload Config

Uploads the configuration store on the attached linking device.
Auto MacroCycle

Calculates the Macro Cycle based on the configured field devices and the number of PVs configured. A window is also added for class II data communication.

Advanced

Opens the Advanced Settings window.

Load Defaults

Resets the configuration settings to their default values.

Update Master Time

Update the master time to local computer time.

Download Schedule

Download schedule to linking device.

TIP

This task is performed automatically when field devices are added or edited.

Enable Schedule

The default is enabled. Used only when the Disable Schedule Function disables the schedule.

Clear Schedule

Clear the schedule from the linking device and the AOP.

IMPORTANT

This action causes the module to stop compelling data.

Disable Schedule

Disable the schedule from executing in the linking device.

Advanced

The Advanced button on the master configuration page launches the Master Advanced configuration dialog box (see Master Configuration on page 28).

IMPORTANT

We recommend that you do not alter these settings; doing so can cause loss of communication.
**Auto MacroCycle**

Click the Auto MacroCycle button on the master configuration page to calculate the recommended MacroCycle for the current linking device (see *Master Configuration* on page 28).

**Auto MacroCycle Calculation**

\[
\text{Macrocycle} = [(\text{time for request + receive}) \times (\text{configured field devices}) \times (\text{configured PVs for each field device})] + [(\text{configured field devices}) \times (\text{time for one token exchange})] + [\text{fixed amount of unscheduled time}].
\]

**IMPORTANT** The Auto MacroCycle only takes effect after you download it to the master and field devices.

**Add and Manage Device Description Files**

Before field devices can be added to the 1788-CN2FFR/1788-EN2FFR linking device, add a copy of the DD file to the field device catalog by using the HSProcessUtility as described in Appendix B.

The DD file defines the capabilities and configuration parameters of the field device.
Field Device Configuration

The overview page on the configuration tab displays the field device live list with colored icons that depict the status of each field device (see page 26). If the Studio 5000 Logix Designer application is online with the 1788-CN2FFR/1788-EN2FFR link master correctly configured, the attached field devices appear in the live list.

The field device index (00→15) provides a unique index for each of the 16 field devices that can be connected to the linking device. This index corresponds with the index in the linking device data structure that is located in the controller tags.

The H1 node address and physical tag are also displayed together with the device ID and serial number of the field device.

A right-click menu in the overview page displays functions for addition, configuration, and diagnostics of field devices.

Figure 3 - Overview Page on the Configuration Tab

Field Device Status

The icon color indicates the status of the field device.

Table 2 - Field Device Status Icons

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Green Icon" /></td>
<td>Green – Field device is online, allocated to a field device index and configured, producing process variables.</td>
</tr>
<tr>
<td><img src="image" alt="Yellow Icon" /></td>
<td>Yellow – Field device is online, not allocated to a field device index and not configured.</td>
</tr>
<tr>
<td><img src="image" alt="Blue Icon" /></td>
<td>Blue – Field device is online, allocated but not configured or producing process variables.</td>
</tr>
<tr>
<td><img src="image" alt="Red Icon" /></td>
<td>Red – Field device is not online.</td>
</tr>
<tr>
<td><img src="image" alt="Light Blue Icon" /></td>
<td>Light blue – Field device identification mismatch (occurs when the field device identity [ident] that is downloaded to the linking device is different than the actual field device).</td>
</tr>
</tbody>
</table>
The color of the text indicates if the online device has the same node address and tag as the offline configured device.

- If the text is black, the online and offline node address and tag name match.
- If the text is red, the online and offline node address and tag name do not match.

**Add New**

Use this function to add field devices when the linking device is not connected to the field device. The Select Device dialog box displays a list of devices from the field device catalog. Set the H1 Node Address and Tagname.

**Figure 4 - Select Device Dialog Box**
Configure

Launches the field device block configuration screen that is used to configure each field device.

Auto Configure Online

**IMPORTANT** Requires the field device to be online.

You can right-click on a device (of which the DD files are registered) and choose the Auto Configure Online option. A configuration is applied for basic operation of the field device.

- The AOP adds a resource block and sets the target mode to auto.
- A transducer block is added and the mode block is set to auto.
- An analog input block (if available) is added with the target mode set to auto.
- The channel is set to 1 (in most cases the primary value).

**Figure 5 - Field Device Configuration Screen**

Advanced Configuration

Used to assign DTM to the field device and to launch the Thin-Frame DTM viewer.

Oscilloscope

Displays an oscilloscope trace of the response message from the field device.
Copy and Paste

After the device configuration is done, you can copy and paste the configuration to speed up the configuration process.

Move

You can move a device in the live list to another field device index even if the devices have been configured and are providing process variables.

Remove

A device configuration can also be removed (deleted).

IMPORTANT If a configuration is stored in the linking device at the specific field device index, it is also removed (deleted).

Set H1 Node Address

Used to change the H1 node address on the field device. We recommend that you set the node address from 17 through 247. The linking device uses 16, and node addresses above 247 are placed in the visitor List.

Set H1 Physical Tag

Use to change the tag name that is stored in the field device.

Merge Online and Offline

The device merge option is used when you want to merge an online device with the offline configuration of a certain device index. Use this option when performing a device exchange for a faulty device.

Mapping Report

Produces a report that describes in detail the configuration of the field device.

Export Device and Import Device

A device configuration can be exported to a file which can later be imported again. This option helps when you have multiple devices with the same configuration.
Field Device Block Configuration

You can configure the field device blocks from the block configuration view. Choose the Configuration option of the device in the config tree, or from the right-click menu in the live list.

Configuration is device-centric and performed in a graphical view using blocks, wires, and connectors (see Figure 5 on page 34). The graphical interface also provides access to parameters for each block for detailed configuration of each device.

See Appendix C, Field Device Block Configuration Examples on page 69 for detailed information about how to configure AO and DO function blocks.

Table 3 - Field Device Configuration Tools

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Select and move objects." /></td>
<td>Select and move objects.</td>
</tr>
<tr>
<td><img src="image" alt="Draw wire." /></td>
<td>Draw wire.</td>
</tr>
<tr>
<td><img src="image" alt="Go online with device." /></td>
<td>Go online with device.</td>
</tr>
<tr>
<td><img src="image" alt="Download configuration to device." /></td>
<td>Download configuration to device.</td>
</tr>
<tr>
<td><img src="image" alt="Print." /></td>
<td>Print.</td>
</tr>
</tbody>
</table>
Add a Block

Blocks are defined by the field device manufacturer and described in the DD files.

There are three classes of blocks:

R – Resource Block
T – Transducer Block
F – Function Block

Only function blocks have ports that are used to transfer data to and from the block:
- Ports on the left of the function blocks are inputs.
- Ports on the right of the function blocks are outputs.

For detailed descriptions and uses of each block, refer to the user manual of the field device.

Follow these steps to add a block.

1. To add (instantiate) a block, right-click in the window and choose New Block.
   A list of all available blocks for the specific device appears.
2. Choose the block that you want to use.
   The block appears on the screen.
Adjust Block Parameters

To change the parameters of a block, right-click the title portion of the block and choose Parameters.

To enable a parameter for editing, click the box in the En column. A green check mark indicates the parameter is enabled for editing. Different parameters will have different classes as shown in Table 4.

Table 4 - Parameter Class Descriptions

<table>
<thead>
<tr>
<th>Icon</th>
<th>Parameter Class Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Icon" /></td>
<td>Configurable parameter but non output</td>
</tr>
<tr>
<td><img src="image2.png" alt="Icon" /></td>
<td>Input port</td>
</tr>
<tr>
<td><img src="image3.png" alt="Icon" /></td>
<td>Read-only</td>
</tr>
<tr>
<td><img src="image4.png" alt="Icon" /></td>
<td>Tune</td>
</tr>
<tr>
<td><img src="image5.png" alt="Icon" /></td>
<td>Output port</td>
</tr>
<tr>
<td><img src="image6.png" alt="Icon" /></td>
<td>Alarm</td>
</tr>
<tr>
<td><img src="image7.png" alt="Icon" /></td>
<td>Parameter help (provides information about the parameter)</td>
</tr>
</tbody>
</table>

1. Click a parameter that is enabled for editing to display a list of options to choose from.
2. Select a new value in the pop-up dialog box and click OK.
Add a Connector

A connector enables transfer of data between the block of the field device and the data structure in the controller, or between field device blocks on the same segment. Data transfers between segments are performed via the controller.

Follow these steps to add a connector.

1. To add a connector, right-click in the window and choose New Connector.
2. Set the desired options in the Add Connector dialog box to configure the connector, and click OK.

Table 5 describes the four types of connectors.

Table 5 - Connector Types

<table>
<thead>
<tr>
<th>Connector Type</th>
<th>Data Transfer Use</th>
<th>Icon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input : I.PV</td>
<td>From a field device to the controller.</td>
<td>![PV.1.1]</td>
</tr>
<tr>
<td>Output : O.PV</td>
<td>From the controller to the field device.</td>
<td>![PV.0.3]</td>
</tr>
<tr>
<td>Network Publication</td>
<td>From a field device to another field device on the same segment.</td>
<td>![LinkTag]</td>
</tr>
<tr>
<td>Network Subscription</td>
<td>From another field device on the same segment to the field device.</td>
<td>![LinkTag]</td>
</tr>
</tbody>
</table>
The field device index, PV slot, and data type define where the connector points to in the data structure of the controller tags.

**Figure 6 - Example of a Field Device Index**

<table>
<thead>
<tr>
<th>ENSTFA</th>
<th>Field Device Index 00</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVReal0</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVReal1</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVReal2</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVReal3</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVReal4</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVReal5</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVReal6</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVReal7</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVBinary0</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVBinary1</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVBinary2</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVBinary3</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVBinary4</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVBinary5</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVBinary6</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVBinary7</td>
</tr>
<tr>
<td>ENSTFA</td>
<td>Field Device00.Data PVBinary8</td>
</tr>
</tbody>
</table>

- For **Input**: I.PV connectors, the data types of float and integer both connect to PVReal in the input image, while binary data types connect to PVBinary.

- For **Output**: O.PV connectors, the output image of the linking device provides separate data types for float, integer, and binary.

- **Network Publication** and **Network Subscription** are used for control in the field where data is sent from one field device to another without any intervention from the LAS (master).

Each Network Publication connector must be given a unique name that is used as the reference for the Network Subscription connectors.

**IMPORTANT** Network Publication connectors must be defined first.
Add Wires

Wires are used to connect input and output ports on the blocks to other ports or connectors.

Follow these steps to add a wire.

1. To add a wire, right-click in the window and choose New Wire.
2. Drag the ends of the wires to the docking points on the block and the connectors.

Download the Configuration

When the configuration is complete, click the Download button to download the configuration to the field device. The download status is displayed in the progress bar.

IMPORTANT

The first configuration download for a device requires more time than subsequent downloads due to extra data required for configuring the communication links (virtual communication relationship [VCR]). After the communication links are created, configuration downloads are quicker.
Once the download is done and the device is providing process variables, the device will be green in the configuration tree and the live list.

If the device is not producing data (for example, incorrect configuration) the device will be blue in the configuration tree and the live list.

**Go Online**

Click the Go Online button to see process variables and change parameters in real time.

Click a parameter to change it in real time. If the block is in Auto mode, you are prompted to change the mode to Out of Service (OOS). Some parameters cannot be changed while the block is in Auto mode.

See Appendix C, Field Device Block Configuration Examples on page 69 for detailed information about how to configure AO and DO function blocks.

**Field Device Class**

A field device can have one of two classes. It can be a basic device (normal operation) or it can be a link master (LAS capability). Choose Basic or Link Master on the block configuration screen. Power cycle the field device for the changes to take effect.

**IMPORTANT** We recommend that you set up all field devices as basic (default).
**Scheduling and the LAS**

The 1788-CN2FFR/1788-EN2FFR linking device generates the LAS schedule, which determines when each function block executes and transmits data. Newly added field devices are automatically added to the schedule, and removed from the schedule when removed from the live list.

**Figure 7 - Master Configuration Dialog Box**

The Download Schedule function is only needed when the 1788-CN2FFR/1788-EN2FFR linking device has been replaced.

**Redundant Master Setup**

You can configure a second 1788-CN2FFR/1788-EN2FFR linking device to act as a backup. You can choose from various architectures (see Appendix D). The figure shows an example of MultiMaster architecture, A bus only, with a shared termination.

**IMPORTANT**

When connecting to running linking devices, you must follow the procedures in MultiMaster Connecting Procedures on page 46 to avoid losing the connection to certain devices.

**IMPORTANT**

You must not have any additional LAS devices. Be sure that the field devices have been configured with the class set to basic. See Field Device Class on page 42.

**IMPORTANT**

Test and verify that the specific field devices that are connected to the MultiMaster operate correctly when one of the linking devices fails.
We recommend you use the given AOI when using redundant masters. The AOI swaps between masters when one fails and automatically updates the destination PV with the back-up master data.

Only one of the masters is the LAS that requests and receives live data from each field device.

- If the device is the LAS, the device icon is displayed without a cross (see page 26).
- If the device is the back-up LAS, the device icon is displayed with a cross.

Follow these steps to configure one master to take priority as the primary master.

1. Set the back-up master Primary Link Master to No in the Master Advanced options (see Figure 2 on page 31).

2. Create the network on the LAS.

3. Click the Export button to export the bridge configuration.

4. On the back-up LAS, click the Sync Masters button and choose the file that was exported.

All scheduled configurations are downloaded to the back-up LAS. Once this download is done, the status indicates Active - Backup LAS as shown.
Redundant Master Mismatch

If the two masters are not synchronized (for example, there is a configuration mismatch) one of the following errors on the back-up LAS is displayed.

- **Master + Device Config Mismatch** indicates that there is a difference between the LAS and back-up LAS master configuration.
- **Device Config Mismatch** indicates that there is a difference in at least one of the field devices between the LAS and back-up LAS configuration.

Redundant Master Disabled

If a redundant master is not in use, the Multi-Master status is disabled.
MultiMaster Connecting Procedures

To avoid communication loss, or a field device going to the visitor address range, follow the MultiMaster connection procedures in this section.

Connect Safe Mode

The Connect Safe mode is used in the Reconnect Two Separate Running LAS Devices on page 47 and Swap Out Linking Devices on page 47 procedures.

To enter the Connect Safe mode, hold the Page button for at least 5 seconds. The LCD displays the time until communication is re-established to the linking device (10 seconds).

Start the Back-up LAS Master (Already Configured)

Follow these steps to start the Back-up LAS master.

1. Plug in all communication connectors (H1, EtherNet/IP or ControlNet cables), but not the power.
2. Once all communication connectors are plugged in, connect the power to the linking device.
   The linking device starts in Back-up LAS mode and does not disturb communication.
Reconnect Two Separate Running LAS Devices

If two masters are configured on a network (one on each end) and the cable between them is broken, some devices will be connected to one master, and the remaining devices will be connected to the other master.

See master modes 9, 12, and 15 in Appendix D.

Follow these steps to connect the two H1 segments.

1. Hold the Page button for 5 seconds to put one of the masters into Connect Safe mode (see Connect Safe Mode on page 46).
   You have 10 seconds to reconnect the segments.

   IMPORTANT  Failure to enter Connect Safe mode can result in a loss of communication, or devices going to the visitor range.

2. Reconnect the cable between the masters.

Swap Out Linking Devices

Follow these steps to swap out a linking device.

1. Plug in all communication and power connectors, but not the H1 segment.

2. Once the linking device is connected to Logix, change the node address to anything other than the node address of the running master.

3. Hold the Page button for 5 seconds to put the linking device into Connect Safe mode (see Connect Safe Mode on page 46).
   You have 10 seconds to reconnect the segments.

   IMPORTANT  Failure to enter Connect Safe mode can result in a loss of communication, or devices going to the visitor range.

4. Click the Master Sync button in the overview window to synchronize the new master with the current running master (see Redundant Master Setup on page 43)
The linking device uses four CIP connections for the 16 field devices. Connection A has the master instance and four field devices. The other connections (B, C, and D) have only the four field devices. All device assemblies are identical.

Figure 9 - Example of Linking Device Connections Tag Data Structure

Master Device Tag Structure

This section describes the values on the elements in the master device status tag structure.
Bus A/BTripped

If too much current (> 500 mA) is drawn on Bus A or Bus B, a trip occurs and the bus is no longer functional. The trip is indicated in the input image.

NewFieldDevice

If a new field device is found which is not in the configuration of the H1 master, a new field device bit is set.

LinkActiveScheduler

This bit indicates if the current device is the LAS or the back-up LAS (set indicating that the linking device is the LAS).

MasterMode

N/A

LinkingDeviceStatus

This is currently reserved.

ConnectionStatus

If a field device is online and running (exchanging cyclic data), its field device index bit (in the connection status) is set. If the device goes offline, the bit is cleared.

FFBusVoltageA/B

The voltage on the H1 bus as measured at port A and port B on the linking device.

FFBusCurrentA/B

The current being drawn by the H1 bus through port A and port B.

ExternalVoltage

The voltage of the external power supply.

Temperature

The internal temperature of the linking device.

BusA/BEnabled

The master mode setting enables and disables the H1 ports A and B. For example, if the master mode setting is Master Mode 0 - Single Master, A Bus Only, then A is enabled and B is disabled (see page 85).
BusA/B Terminated

The master mode setting sets the termination for H1 ports A and B. For example, if the mode setting is Master Mode 0 - Single Master, A Bus Only, then A is enabled and terminated (see page 85).

Field Device Tag Structure

This section describes the elements of the field device tag structure.

<table>
<thead>
<tr>
<th>FFNode</th>
<th>Allocate</th>
<th>Compel</th>
<th>Live</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN2H1R01: IA.FieldDevice00</td>
<td>24</td>
<td>1</td>
<td>1</td>
<td>{\ldots}</td>
</tr>
</tbody>
</table>
| EN2H1R01: IA.FieldDevice00.Allocate | Decimal | Deciml | Deciml | Tag
| EN2H1R01: IA.FieldDevice00.Compel | \{\ldots\} | \{\ldots\} |
| EN2H1R01: IA.FieldDevice00.Live | Deciml | Deciml | Live |

FFNode

The node value specifies the number of the field device.

Allocate

Indicates that this field device index has been allocated for a specific field device and another device cannot use it.

Compel

If this bit is set, the linking device is requesting process variable data from the field device.

Live

A connection has been established to the field device and the linking device is receiving live data.

Tag

This element specifies the tag name of the field device.
**PVReal1…PVReal8**

This element contains the process variable (PV) float or integer value from the field device. Each field device can have a maximum of eight real PVs.

| EN2H1R01 JA FieldDevice00 Data PVReal1 | 50.0 | Float |
| EN2H1R01 JA FieldDevice00 Data PVReal2 | 0.0  | Float |
| EN2H1R01 JA FieldDevice00 Data PVReal3 | 0.0  | Float |
| EN2H1R01 JA FieldDevice00 Data PVReal4 | 0.0  | Float |
| EN2H1R01 JA FieldDevice00 Data PVReal5 | 0.0  | Float |
| EN2H1R01 JA FieldDevice00 Data PVReal6 | 0.0  | Float |
| EN2H1R01 JA FieldDevice00 Data PVReal7 | 0.0  | Float |
| EN2H1R01 JA FieldDevice00 Data PVReal8 | 0.0  | Float |

**PVBinary1…PVBinary8**

This element contains the process variable (PV) Boolean value from the field device. Each field device can have a maximum of eight binary PVs.

| EN2H1R01 JA FieldDevice00 Data PVBinary1 | 0   | Decimal |
| EN2H1R01 JA FieldDevice00 Data PVBinary2 | 0   | Decimal |
| EN2H1R01 JA FieldDevice00 Data PVBinary3 | 0   | Decimal |
| EN2H1R01 JA FieldDevice00 Data PVBinary4 | 0   | Decimal |
| EN2H1R01 JA FieldDevice00 Data PVBinary5 | 0   | Decimal |
| EN2H1R01 JA FieldDevice00 Data PVBinary6 | 0   | Decimal |
| EN2H1R01 JA FieldDevice00 Data PVBinary7 | 0   | Decimal |
| EN2H1R01 JA FieldDevice00 Data PVBinary8 | 0   | Decimal |

**PVStatus**

The PV status indicates these quality values:
- Bad
- Uncertain
- GoodNonCascade
- GoodCascade

The PV status indicates these limit values:
- NotLimited
- LowLimited
- HighLimited
- Constant

| EN2H1R01 JA FieldDevice00 Data PV1_Bad          | 0   | Decimal |
| EN2H1R01 JA FieldDevice00 Data PV1_Uncertain   | 0   | Decimal |
| EN2H1R01 JA FieldDevice00 Data PV1_GoodNonCascade | 1 | Decimal |
| EN2H1R01 JA FieldDevice00 Data PV1_GoodCascade  | 0   | Decimal |
| EN2H1R01 JA FieldDevice00 Data PV1_NotLimited   | 0   | Decimal |
| EN2H1R01 JA FieldDevice00 Data PV1_LowLimited   | 0   | Decimal |
| EN2H1R01 JA FieldDevice00 Data PV1_HighLimited  | 0   | Decimal |
| EN2H1R01 JA FieldDevice00 Data PV1_Constant    | 1   | Decimal |
PV Diagnostics

This tag contains the diagnostics information that is associated with each PV.

<table>
<thead>
<tr>
<th>FieldDeviceID</th>
<th>Data/PV/Diagnostics</th>
<th>xx</th>
<th>xx</th>
<th>RT-178</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.Error_Bad_Parameters</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.ConfigurationError</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.BusConnected</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.BusError</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.BusOff</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.BusTransducerManual</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.BusTransducerManualAndFault</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.BusTransducerManualAndFaultAndRelative</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.BusTransducerManualAndFaultAndRelativeAndAbsolute</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.BusTransducer_4-20mA</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.BusTransducer_4-20mAAndFault</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.BusTransducer_4-20mAAndFaultAndRelative</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.BusTransducer_4-20mAAndFaultAndRelativeAndAbsolute</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
<tr>
<td>FTDO.A.FieldDeviceID.Data.PV.Diagnostics.BusTransducer_4-20mAAndFaultAndRelativeAndAbsoluteAndRelativeAndAbsolute</td>
<td>0</td>
<td>Decimal</td>
<td>00DL</td>
<td></td>
</tr>
</tbody>
</table>

Output

This section describes the values on the field device output status screen.

Field Device Output Values

PVReal1…PVReal8

For a field device that requires an output, the data must be updated in the output image of that field device. If the data type for the connector is set to Float, then the data for that connector is read from the real value in the output image.

PVInt1…PVInt8

For a field device that requires an output, the data must be updated in the output image of that field device. If the data type for the connector is set to Integer, then the data for that connector is read from the integer value in the output image.
PVBinary1…PVBinary8

For a field device that requires an output, the data must be updated in the output image of that field device. If the data type for the connector is set to Boolean, then the data for that connector is read from the binary value in the output image.

PVStatus1…PVStatus8

If the connector for the PV output is set to have a status, you must put a status in the output image that will be sent with the process variable.

<table>
<thead>
<tr>
<th>PV Status</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVStatus ≥ 0x80</td>
<td>Green = good</td>
</tr>
<tr>
<td>0x40 ≤ PVStatus &lt; 0x80</td>
<td>Orange = uncertain</td>
</tr>
<tr>
<td>PVStatus &lt; 0x40</td>
<td>Red = bad</td>
</tr>
</tbody>
</table>

Figure 10 - Example of Field Device Output Screen
Chapter 4

Diagnostics

The diagnostic status provides basic device data and statistics. Click Status in the config tree to view basic data and statistics for the device.

### Status

The connectivity status of the linking device.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>80...100</td>
<td>Good</td>
</tr>
<tr>
<td>41...79</td>
<td>Uncertain</td>
</tr>
<tr>
<td>0...40</td>
<td>Bad</td>
</tr>
</tbody>
</table>

### Tag

The tag name that is stored in the field device.

### Ident

The identity of field device.

### Device

The field device type.

### Vendor

The field device vendor.

### Good Packets

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>80...100</td>
<td>Good</td>
</tr>
<tr>
<td>41...79</td>
<td>Uncertain</td>
</tr>
<tr>
<td>0...40</td>
<td>Bad</td>
</tr>
</tbody>
</table>
Chapter 4   Diagnostics

The count of good quality reply packets that are received from the field device. (Cyclic Redundant Code [CRC] check passed.)

Bad CRC Packets

The count of reply packets that are received from the field device that were rejected because the CRC check failed.

No Replies

The count of communication request to which the field device did not respond.

Success Rate

The rate of good replies to the number of requests for the last 100 requests.

Signal Quality

Displays the quality of the waveform for the field device by evaluating slew rate, amplitude, distortion, noise, and balance.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0…33</td>
<td>Bad</td>
</tr>
<tr>
<td>34…66</td>
<td>Poor</td>
</tr>
<tr>
<td>67…100</td>
<td>Good</td>
</tr>
</tbody>
</table>

Allocated

True if the field device has been allocated a field device index of 00 through 15. If a field device is in the visitor list, it has not been allocated.

Compel

True if the field device has been allocated and configured to compel data. The field device is also included in the schedule.

Live Data

True if the field device is allocated and configured, and is currently producing live data.
PV Data Screen

If a field device has been configured and scheduled, its scheduled PV values are displayed here. The name of the function block parameter that produces or consumes the data is also displayed.

Table 6 - PV Status Colors

<table>
<thead>
<tr>
<th>PV Status</th>
<th>Status Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVStatus ≥ 0x80</td>
<td>Green = good</td>
</tr>
<tr>
<td>0x40 ≤ PVStatus &lt; 0x80</td>
<td>Orange = uncertain</td>
</tr>
<tr>
<td>PVStatus &lt; 0x40</td>
<td>Red = bad</td>
</tr>
</tbody>
</table>

Click PV Data in the config tree to view the PV data for the device.

Oscilloscope Screen

The last packet received (good or bad) is displayed in the oscilloscope trace. Click Oscilloscope in the config tree to view the last packet that is received for the device.
## The Web Server

To view detailed status and diagnostic information for the device in the web server, enter the IP address of the device into the address field of a web browser and press Enter.

![Web Server Screenshot](image)

**IMPORTANT** If data is not being updated, turn off page caching or try a different web browser.
Device Type Manager (DTM) Use the HSThinFrame to open the device DTM in the Studio 5000 Logix Designer application. The DTM is read-only when opened in the Studio 5000 Logix Designer application.

**IMPORTANT** The correct DTM must be installed and the HSProcessUtility DTM Catalog must be updated for the correct DTM to display in the pull-down list.

Follow these steps to open the DTM.

1. Click Advanced in the config tree.
2. Choose the DD revision from the pull-down list.
3. Click Open DTM.
4. Choose the device information that you want to view.
5. View the selected device information.
Linking Device Display Status

The display of the linking device provides status and diagnostic data in one of three page formats: main page, H1 master page, or field device page. Use the display Page button behind the front cover to scroll through the pages (see Figure 8 on page 46 for location of the Page button).

Main Page

The main page is the default display, and the linking device returns to this page after 10 seconds.

H1Bus A/B: Displays the bus voltages on each port.

IP: Displays the current IP address or BOOTP if enabled.

STS: Displays the status (see Table 7).

Table 7 - STS Status Descriptions

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ok</td>
<td>No events</td>
</tr>
<tr>
<td>New device found</td>
<td>New device on the bus</td>
</tr>
<tr>
<td>Redundancy ok</td>
<td>Masters are synchronized</td>
</tr>
<tr>
<td>Redundancy err</td>
<td>Masters out of sync</td>
</tr>
<tr>
<td>Bus A Tripped</td>
<td>Bus A over current trip</td>
</tr>
<tr>
<td>Bus B Tripped</td>
<td>Bus B over current trip</td>
</tr>
<tr>
<td>SAFE MODE</td>
<td>linking device set to Safe mode</td>
</tr>
</tbody>
</table>

The lower portion of the main page shows the communication quality to each field device as the percentage of data packets sent compared to data packets received for each field device index (see Table 8).

Table 8 - Field Device Communication Quality

<table>
<thead>
<tr>
<th>Display</th>
<th>Communication Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;&gt;&gt;&gt;</td>
<td>95+</td>
</tr>
<tr>
<td>&gt;&gt;</td>
<td>80+</td>
</tr>
<tr>
<td>&gt;</td>
<td>60+</td>
</tr>
<tr>
<td>XXX</td>
<td>Below 60</td>
</tr>
</tbody>
</table>

H1 Bus: A: 24.4V B: 24.7V
IP: 192.168.1.203
STS: Ok
00 ➔ >
01 ➔ >>>
02 ➔ >>
03 ➔ XXX
04 ➔ ???
05 ➔ OOS
06 ➔ Off
07 ➔ Err
Appendix A  Linking Device Display Status

H1 Master Page

The next page that is accessed by the Page button is the H1 Master page.

**Bus A/B:** Displays the bus voltages, currents, and bus status.

**Temperature:** Displays the internal temperature of the linking device.

**External Pwr:** Displays the power supply voltage.

**FF Node:** Displays the H1 node address for the master (default 16).

**BusA/B Enabled:** H1 Bus A or H1 Bus B is enabled for communication.

**BusA/B Tripped:** H1 Bus A or H1 Bus B has tripped indicating that there was an over-current on either port.

**BusA/B Term:** The linking device is configured to terminate H1 Bus A or H1 Bus B.

Field Device Page

The next 16 FF Field Device pages display the status of each of the field device indices.

**FF Node:** Displays the H1 node address.

**Device Tag Name:** The tag name of the device.

**Status:** Displays the field device status (see Table 9.)

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Connected</td>
<td>Device cannot be seen</td>
</tr>
<tr>
<td>Online</td>
<td>Online - not configured</td>
</tr>
<tr>
<td>ConfigRunning</td>
<td>Device is configured and running</td>
</tr>
</tbody>
</table>

**Success:** Displays the data packets that are received as a percentage of packets that are sent for the previous 100 packets.

**Pckt Send:** Displays the total number of data packets that are sent from the field device.
**Pckt Recv:** Displays the total number of data packets that are received from the field device.

**Bad CRC:** Displays the total number of bad CRC packets received.

**No Reply:** Displays the total number of data requests to which the field device did not respond.

**Signal Quality:** Displays the quality of the waveform for the field device by evaluating slew rate, amplitude, distortion, noise, and balance.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0…33</td>
<td>Bad</td>
</tr>
<tr>
<td>34…66</td>
<td>Poor</td>
</tr>
<tr>
<td>67…100</td>
<td>Good</td>
</tr>
</tbody>
</table>
Notes:
HSProcessUtility

Follow these steps to use the HSProcessUtility to add a device description to a field device.

1. Click the HSProcessUtility icon in the AOP and click Launch HSProcessUtility.

   TIP You can also click the refresh catalog option to refresh the device catalog once a DD file has been added.

The HSProcessUtility opens. Because the same utility is used to register GSD files (PROFIBUS PA) and DTMs, these options are still in the menu bar.

2. Select the FOUNDATION Fieldbus option and choose Add Device Description. Three files are required to update the library:
   - Binary file (.ffo)
   - Symbol file (.sym)
   - Capability file (.cff)
3. Select the binary file, the appropriate symbol file, and the correct version of the capability file.

A new file is generated and the library directory is updated.

**TIP**  
Before the field device can be configured in the AOP, the catalog must be refreshed.

4. Click the HSProcessUtility icon and choose Refresh Catalog.
5. Install the device DTMs from the vendors, then go to the DTM tab in HSProcessUtility and click Update Catalog.
Notes:
Field Device Block Configuration Examples

Overview

This appendix provides examples of how to use field bus output devices with the linking device.

Each example starts from an empty live list, adds the device to the network, and configures an analog output (AO) or discreet output (DO) function.

The purpose of these examples is to place the AO or DO function block in the Cas mode, so the values entered in CAS_IN are processed into the SET_POINT value.

See Field Device Block Configuration on page 36 for general field device block configuration information.

Figure 11 - Empty Live List
AO Function Block Example

This example describes the steps that are used to configure an AO function block for the linking device. The linking device tag name in this example is SMAR FI302.

1. Add the linking device to the field bus network.

2. Right-click the linking device and choose Auto Configure Online.
3. Click the Go Online button.

4. Right-click the resource function block and choose Parameters. Verify that the correct DD files were enabled.

5. Scroll down to Index rows 10, 11, 12, and 13.

6. Check the En column for Index rows 10, 11, 12, and 13. A green check displays in the box.
7. Verify that the Dev_Rev and DD_REV in the Parameters screen matches the Rev and DDRev revisions in the HSProcessUtility (compare Figure and Figure 7).

8. Use the tools in the Configuration screen to build the configuration as shown in Figure.

See Field Device Block Configuration on page 36 for general field device block configuration information.
9. Click the download button to download the AO function block to the linking device.

The download operation completes without errors.

10. Click OK.
11. Click the Go Online button.

12. Right-click the Analog Output function block.

13. Choose Parameters.

The linking device parameters are displayed.
14. Under MODE_BLK > PERMITTED, right-click the Value column and select Cas.
15. Click OK to add the Cas mode.

16. Under MODE_BLK > TARGET, right-click the Value column and select Cas and Auto.
17. Click OK to add the Cas+Auto mode.
18. Verify that the MODE_BLK > TARGET value is Cas + Auto and the MODE_BLK > ACTUAL value is Auto.

19. In the parameter screen, scroll down to parameters CAS_IN and BKCAL_OUT.

20. Verify that the BKCAL_OUT > STATUS in the Live column indicates a NotInvited condition.

Before the output control loop can be initialized, the NotInvited condition must be cleared.
21. Set the value of the controller tag that is associated with the quality of CAS_IN (connector PV:O.1) status parameter (PVx_GoodCascade) to the value 1.

22. Verify that the NotInvited status has been replaced by the new status, InitializationRequest.

The InitializationRequested must receive a response.

23. Set the value of the Controller Tag associated with the substatus of CAS_IN (connector PV:O.1) status parameter (PV1_SubStatus) to the value 1, which is InitializationAcknowledge.
The InitializationRequested status in BKCAL_OUT > STATUS > Live column is cleared and replaced by the value, NonSpecific.

The CAS_IN > STATUS > Live column displays a status of InitializationAcknowledge.
24. Verify that the AO function block MODE_BLK > ACTUAL > Live column displays Cas.

25. Set the CAS_IN (PV:O.1) value to 50%.

26. Verify that the BKCAL_OUT (PV:I.1) and OUT (PV:I.2) values change as required (50% equals 12 mA at the OUT parameter).

The AO function block is now created, initialized, and operating correctly.
DO Function Block Example

This example describes the how to configure a DO function block for the linking device. The device that is used in this example is FPAC_2.

1. Add the linking device to the field bus network.

2. Add a DO function block to the configuration.

TIP You can delete other function blocks and connections.
3. Make connections to CAS_IN_D, OUT_D, and BKCAL_OUT_D.
4. Click the Download button to download the DO function block to the linking device.

The download operation completes without errors.
5. Click OK.
6. Click the Go Online button.
7. Right-click the Discreet Output function block.
8. Choose Parameters.

The linking device parameters are displayed.

9. In the Parameters screen, scroll down to parameters CAS_IN_D and BKCAL_OUT_D.
10. Verify that the BKCAL_OUT_D > STATUS in the Live column indicates a NotInvited condition.

Before the output control loop can be initialized, the NotInvited condition must be cleared.

11. Set the value of the controller tag that is associated with the quality of BKCAL_OUT_D (connector PV:O.1) status parameter (PVx_GoodCascade) to the value 1.

12. Verify that the NotInvited status has been replaced by the new status, InitializationRequest.

The InitializationRequest must receive a response.
13. Set the value of the Controller Tag associated with the substatus of CAS_IN_D (connector PV:O.1) status parameter (PV1_SubStatus) to the value 1, which is InitializationAcknowledge.

14. Verify that the DO function block MODE_BLK > ACTUAL > Live column displays Cas.

The DO function block is now created, initialized, and operating correctly.
Appendix D

H1 Topology

**Master Mode 0**
- Single Master
- A Bus Only
- Terminated at the linking device.

**Master Mode 1**
- Single Master
- A Bus Only
- Not terminated at the linking device.

**Master Mode 2**
- Single Master
- B Bus Only
- Terminated at the linking device.
**Master Mode 3**  
Single Master  
B Bus Only  
Not terminated at the linking device.

**Master Mode 4**  
Single Master  
Dual Bus  
Terminated at the linking device.

**Master Mode 5**  
Single Master  
Dual Bus  
Not terminated at the linking device.

**Master Mode 6**  
Single Master  
Split Bus  
Terminated at the linking device.
Master Mode 7

- Single Master
- Split Bus
- Not terminated at the linking device.

Master Mode 8

- Single Master
- Ring Bus

Master Mode 9

- MultiMaster
- A Bus Only
- Terminated at the linking devices.

Master Mode 10

- MultiMaster
- A Bus Only
- Shared termination at the linking devices.
### Master Mode 11

MultiMaster  
A Bus Only  
Not terminated at the linking devices.

### Master Mode 12

MultiMaster  
B Bus Only  
Terminated at the linking devices.

### Master Mode 13

MultiMaster  
B Bus Only  
Shared termination at the linking devices.

### Master Mode 14

MultiMaster  
B Bus Only  
Not terminated at the linking devices.
**Master Mode 15**

- MultiMaster
- Dual Bus
- Terminated at the linking devices.

**Master Mode 16**

- MultiMaster
- Dual Bus
- Shared termination at the linking devices.
Notes:
The following terms and abbreviations are used throughout this manual. For definitions of terms not listed here, refer to the Allen-Bradley Industrial Automation Glossary, publication AG-7.1.

**1788-EN2FFR linking device** Provides a gateway between EtherNet/IP and a single segment FOUNDATION Fieldbus H1 layer.

**1788-CN2FFR linking device** Provides a gateway between ControlNet and FOUNDATION Fieldbus (FF).

**AO** Abbreviation for an analog output; signal is generated by the host system and transmitted to a field device.

**AOP** Abbreviation for Add-on Profile; provides an intuitive graphical interface for configuring devices.

**Basic device** A device that can communicate on the fieldbus, but cannot become the LAS.

**block** See function block, resource block (RES), and transducer block.

**BOOTP** A protocol to boot a diskless workstation and receive the boot information from a server.

**bridge** An interface in a fieldbus network that interconnects two or more H1 networks.

**bus** An H1 fieldbus cable between a Host and field devices connected to multiple segments, sometimes through the use of repeaters.

**CAS** Abbreviation for Cascade.

**channel** A path for a signal.

**CIP** Acronym for Common Industrial Protocol; a communication protocol, or language, between industrial devices. CIP provides seamless communication for devices on DeviceNet, ControlNet, and EtherNet/IP networks.

**configurable** Capability to select and connect standard hardware modules to create a system; or the capability to change functionality or sizing of software functions by changing parameters without having to modify or regenerate software.

**configuration** Physical installation of hardware modules to satisfy system requirements; or the selection of software options to satisfy system requirements.

**connector** Coupling device used to connect the wire medium to a fieldbus device or to another segment of wire.

**control loop** Group of function blocks that execute at a specified rate within a FOUNDATION Fieldbus device or distributed across the fieldbus network.
ControlNet network  An open control network that uses the producer/consumer model to combine the functionality of an I/O network and peer-to-peer network, while providing high-speed performance for both functions.

cycle  Scanning of inputs, execution of algorithms and transmission of output values to devices.

device description (DD)  Abbreviated as DD, this is a set of files (CFF, SYM, and FFO) that describes the parameter capabilities of a fieldbus device. The file information on these block parameters includes names, data types, and specifications.

device  The term in this manual refers to the instruments that make up the fieldbus system.

device ID  An identifier for a device that the manufacturer assigns. Device IDs must be unique to the device; no two devices can have the same device ID.

device tag  A character string name that uniquely identifies a device on a fieldbus network.

DO  Abbreviation for discrete output; signal is generated by the host system and transmitted to a field device.

Ethernet  Physical and data link layer defined by IEEE 802 standards used by EtherNet/IP.

EtherNet/IP  An open, industrial networking standard that supports both real-time I/O messaging and message exchange.

fieldbus  A digital, two-way, multi-drop communication link among intelligent measurement and control devices. It serves as a Local Area Network (LAN) for advanced process control, remote input/output, and high-speed factory automation applications.

FOUNDATION Fieldbus  The communication network that the Fieldbus Foundation created.

function block  A named block consisting of one or more input, output, and contained parameters. The block performs some control function as its algorithm. Function blocks are the core components with which you control a system. The Fieldbus Foundation defines standard sets of function blocks.

gateway  Translates another protocol to FOUNDATION fieldbus or vice versa, for example HART to FOUNDATION fieldbus or Modbus to FOUNDATION fieldbus.

H1  A FOUNDATION fieldbus segment that operates at 31.25 Kbps.
**host**  Control system that has FOUNDATION fieldbus capabilities to configure and operate FOUNDATION fieldbus segments. There are several classes of Host systems:

- Class 61 - Integrated Host - Primary, or process Host that manages the communication and application configuration of all devices on the network.
- Class 62 - Visitor Host - Temporary, on process Host with limited access to device parameterization.
- Class 63 - Bench Host - Primary, off process Host for configuration and setup of a non-commissioned device.
- Class 64 - Bench host - Primary, off process Host with limited access to device parameterization of an off-line, commissioned device.
- Class 71 - Safety Integrated Host - Primary, on-process Host that manages the communication and application configuration of all safety and control and monitoring devices on a network.

**LAS**  See link active scheduler.

**link**  A logical link is a connection between function blocks; a physical link is a connection between fieldbus devices.

**linking device**  As a bridge, enables peer-to-peer communication between H1 devices without the need for host system intervention. As a gateway, connects the H1 network to other plant control and information networks, such as EtherNet/IP and ControlNet.

**link active scheduler**  Abbreviated as LAS, this scheduler is responsible for coordinating all communication on the fieldbus; maintaining a list of transmission times for all data buffers in all devices that need to be cyclically transmitted. The LAS circulates tokens, distributes time, probes for new devices, and removes non-responsive devices from the link.

**link master**  An LM is a device that contains LAS functionality that can control communication on a FOUNDATION fieldbus H1 fieldbus link. There must be at least one LM on the H1 link; one of those LM devices is chosen as the LAS.

**macrocycle**  A calculated time for a fieldbus device to send and receive data. The AOP can automatically generate the value, or the value can be manually entered. The LAS is responsible for scheduling of the segment macrocycle.

**mode**  Control block operational condition, such as manual, automatic, or cascade.

**network**  A network as applied in this document is the termination of one or more fieldbus segments into an interface card of the Host system.

**node**  The connection point at which media access is provided.

**offline**  Perform tasks while the Host system is not communicating with the field devices.
online Perform tasks, such as configuration, while the Host system is communicating with the field devices.

PV Acronym for Process Variable, which is the primary value.

resource block (RES) This block controls the linking device. It contains data specific to the linking device’s hardware. All data is modeled as contained, so there are no links in this block.

redundancy The duplication of devices for the purpose of enhancing the reliability or continuity of operations in the event of a failure without loss of a system function.

ring bus A network where signals are transmitted from one station and replayed through each subsequent station in the network. Signal can travel in either direction of the ring so it creates network redundancy; if the ring breaks in one place the nodes can still communicate.

RSLogix Software that provides a programming environment for sequential, process, drive, and motion control programming. The RSLogix environment provides an IEC 61131-3 compliant interface for controls programming.

segment A physical link (cable) between fieldbus devices and a pair of terminators on an H1 channel. Segments can be linked by repeaters to form a longer H1 fieldbus. A fully loaded (maximum number of connected devices) 31.25 Kbps voltage-mode fieldbus segment should have a total cable length, including spurs, between any two devices of up to 1900 m. There cannot be a non-redundant segment between two redundant systems.

signal The event or electrical quantity that conveys information from one point to another.

tag Unique alphanumeric code assigned to inputs, outputs, equipment items, and control blocks.

terminator Impedance-matching module used at or near each end of a transmission line that has the same characteristic impedance of the line. Terminators are used to minimize signal distortion, which can cause data errors. H1 terminators convert the current signal transmitted by one device to a voltage signal that can be received by all devices on the network.

topology The shape and design of the fieldbus network.

transducer block The transducer block decouples function blocks from the local input/output (I/O) function required to read sensors and command output hardware. Transducer blocks contain information, such as calibration date and sensor type. There is usually one transducer block for each input or output of a function block.

trunk The main communication highway between devices on an H1 fieldbus network. The trunk acts as a source of main supply to spurs on the network.
VCR  Acronym for Virtual Communication Relationship. Configured application layer channels that provide for the transfer of data between applications. FOUNDATION Fieldbus describes three types of VCRs: Publisher/Subscriber, Client/Server, and Source/Sink.
Index

Numerics
1756-CNB ControlNet bridge 22
1756-CNBR ControlNet bridge 22
1756-EN2T Ethernet bridge 21
1756-EN2TR Ethernet bridge 21
1788-CN2FFR ControlNet network 7
1788-EN2FFR EtherNet/IP network 6

A
add linking device to I/O tree 22, 23
add new field device 33
add-on-profile 20
advanced configuration 8
advanced settings 30
AO function block example 70
AOP
install file 20
version 20
Auto MacroCycle 30, 31
Auto MacroCycle calculation 31
auto reset trip 29

B
background scan 29
backup linking device 43
backup master 44
backup-LAS mode 46
bad CRC packets received 63
binary file (.ffo) 65
block classes
F – function block 37
R – resource block 37
T – transducer block 37
block configuration
block classes 37
block parameters 38
connectors 39
download configuration to device 36
draw wire 36
go online with device 36
input I.PV connectors 40
network publication 40
network subscription 40
output O.PV connectors 40
print 36
select and move objects 36
wires 41
block parameters 38
block ports
input 41
output 41
bridge
ControlNet 22
Ethernet 21
bridge configuration, export 44
bus voltages, currents, and bus status 62

C
capability file (.cff) 65
catalog
refresh 66
update 67
change parameters in real time 42
class description
alarm 38
configurable parameter but non-output 38
input port 38
output port 38
read-only 38
tune 38
clear schedule 30
cfg 27
configuration replication 27
configuration shortcuts
display list of configured and attached field devices 27
export configuration 27
import configuration 27
synchronize the backup LAS 27
configure
internal H1 segment terminators 28
redundant H1 media 28
redundant linking devices 28
Connect Safe mode 46, 47
ControlNet
connections 16
network 7, 23
node address 17
port 24
ControlNet bridge
1756-CNB 22
1756-CNBR 22

data compels 29
data packets sent from field device 62
data requests not responded to by field device 63
default node number 28
determine the RPI 22, 23
device
cfg mismatch 45
description (DD) files 7
statistics 55
diagnostic and status information 58
diagnostic data 61
diagnostic status 55
diagnostics
Device Type Manager (DTM) 59
oscilloscope screen 57
PV data screen 57
status screen 55
Web server 58
dimensions 13
disable schedule 30
Index

display status
field device page
bad CRC 63
data packet transfer success rate 62
device tag name 62
FF node 62
field device status 62
no reply 63
pckt recv 63
pckt send 62
signal quality 63
status 62
H1 master page
bus A/B 62
busA/B enabled 62
busA/B term 62
busA/B tripped 62
external pwr 62
FF node 62
temperature 62
main page
bus A tripped 61
bus B tripped 61
bus voltages 61
communication quality 61
H1Bus A/B 61
IP address or BOOTP 61
new device found 61
Ok 61
redundancy err 61
redundancy ok 61
SAFE MODE 61
STS 61
D0 function block example 80
download schedule 30, 43
download settings to linking device 28
downloading the field device configuration 41

E
earth ground 16
enable schedule 30
Ethernet bridge
1756-EN2T 21
1756-EN2TR 21
Ethernet switch settings 19
EtherNet/IP address 18
EtherNet/IP network 6
export and import device configuration 35
export bridge configuration 44

F
FactoryTalk AssetCentre 7
fail status in prog/fault mode 29
FF master node 28
FF node 62
field device
adding 32
configuring 32
diagnosing 32
index 32
status 62
status icons 32
status, viewing 32
field device block configuration
download configuration to device 36
draw wire 36
go online with device 36
print 36
select and move objects 36
field device catalog 31, 33
field device class
basic device (normal operation) 42
link master (LAS capability) 42
field device configuration
add new field device 33
advanced configuration 34
auto configure online 34
configure 34
copy and paste 35
export and import device configuration 35
mapping report 35
merge online and offline 35
move device 35
oscilloscope 34
remove device configuration 35
set H1 node address 35
set H1 physical tag 35
field device output image
boolean 54
float 53
integer 53
field device tool (FDT) 7
fieldbus host capability 5
firmware version 20
firmware, flashing 19
function block configuration example
AO 70
DO 80

G
grounding 16

H
H1 network connection 14
H1 node
address 62
address and physical tag 32
H1 node address 35
H1 physical tag 35
H1 segment ports 8
H1 topology, multi-master
A bus only
not terminated 88
shared termination 87
Index

terminated 87
B bus only
not terminated 88
shared termination 88
terminated 88
dual bus
shared termination 89
terminated 89
H1 topology, single master
A bus only
mon-terminated 85
terminated 85
B bus only
non-terminated 86
terminated 85
dual bus
non-terminated 86
terminated 86
ring bus 87
split bus
non-terminated 87
terminated 86
HSProcessUtility 20, 31
HSThinFrame 59

I
I/O tree 21
add linking device 22, 23
import and export device configuration 35
input and output ports on blocks 41
input I.PV connectors 39, 40
instantiate a block 37
IP address
setting via BOOTP 19
setting via Ethernet switches 19

L
LAS 27
LAS device icon
LAS 44
LAS backup 44
LAS errors
device config mismatch 45
master + device config mismatch 45
LAS schedule 43
library directory 66
linking device
add to I/O tree 22, 23
non-volatile memory 28
offline status indicator 26
online status indicator 26
linking device property settings 26
live list 26
load defaults 30
Logix assemblies, input
field device
allocate 51
compel 51
FFNode 51
live 51

PVBinary1...PVBinary8 52
PVDiagnostics 53
PVRreal1...PVRreal8 52
PVStatus 52
tag 51
master
bus A/B tripped 50
BusA/BEnabled 50
BusA/BTerminated 51
ConnectionStatus 50
ExternalVoltage 50
FFBusCurrentA/B 50
FFBusVoltageA/B 50
LinkActiveScheduler 50
LinkingDeviceStatus 50
MasterMode 50
NewFieldDevice 50
Temperature 50
Logix assemblies, output
field device
PVBinary1...PVBinary8 54
PVInt1...PVInt8 53
PVRreal1...PVRreal8 53
PVStatus1...PVStatus8 54
Logix controller 21

M
MacroCycle 29
master
backup 44
primary 44
master + device config mismatch 45
master advanced configuration screen 30
master configuration
advanced 30
Auto MacroCycle 30
auto reset trip 29
clear schedule 30
disable schedule 30
download schedule 30
enable schedule 30
fail status in prog/fault mode 29
FF master node 28
load defaults 30
MacroCycle 29
max scan address 29
slave retry 29
topology mode 28
update master time 30
upload config 29
max scan address 29
media redundancy supported
redundant controllers 5
redundant Ethernet media 5
redundant linking devices 5
redundant trunk 5
ring 5
split 5
memory, non-volatile 28
module properties, configuration tab
  config tree 27
  LAS 27
  live list 26
  shortcuts 27
  visitor list 26

N
network
  publication connectors 39
  subscription connectors 39
network connection, H1 14
network diagrams
  ControlNet network 7
  EtherNet/IP network 6
network subscriptions 40
node address
  ControlNet 17
node address and tag name
  online and offline do not match 33
  online and offline match 33
node number
  default 28
  non-volatile memory 28

O
oscilloscope trace 57
output and input ports on blocks 41
output image
  boolean 54
  float 53
  integer 53
output O.PV connectors 39, 40

P
parameter class description
  alarm 38
  configurable parameter but non-output 38
  input port 38
  output port 38
  read-only 38
  tune 38
parameter help 38
ports, H1 segment 8
power
  additional supplies 14
  conditioners 6, 14
  connection 13
  supply 14
  supply connection 14
  supply voltage 62
primary master 44
process variables 7
property settings
  linking device 26
publication connectors 39
PV data 57
PV status
  bad 57
  good 57
  limit values
    constant 52
    HighLimited 52
    LowLimited 52
    NotLimited 52
  quality values
    bad 52
    good_cascade 52
    good_noncascade 52
    uncertain 52
  uncertain 57

R
refresh catalog 66
remote access 8
replicate configuration 27
request packet interval 22, 23
  minimum and maximum 7
RJ45 connector 16
RPI
  determining 22, 23
  minimum and maximum 7
RSNetWorx for ControlNet 23

S
Safe mode 19
set the H1 node address and tag name 33
shielding 16
slave retry 29
status and diagnostic information 58
status icons
  field device 32
store configuration in project file 28
subscription connectors 39
symbol file (sym) 65

T
temperature of linking device 62
topology mode 28
troubleshooting 8, 55

U
update catalog 67
update master time 30
upload config 29

V
visitor list 26
Rockwell Automation Support

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

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

Installation Assistance

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

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

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

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