



ControlNet-to-Foundation Fieldbus H1 Linking Device

Catalog 1788-CN2FF

Product Overview

ATTENTION

The 1788-CN2FF module ships from the factory with configuration switches set to “ON (RESET)”. With switches “ON”, any configuration data would be reset on Power interruption. Set the switches to “OFF (NORMAL)” after initial power-up (to clean any Factory test configurations) but before you configure the module with your application.

Remove power to the module before resetting configuration switches. For more information on configuration refer to Configuring the 1788-CN2FF Linking Device on page 9.

The ControlNet-to-Foundation Fieldbus H1 linking device (1788-CN2FF) connects a ControlNet™ network with one or two FOUNDATION Fieldbus H1 (Fieldbus) networks. Each H1 network consists of multiple Fieldbus devices. Each field device has one or more function blocks. Each function block performs an elementary control function such as analog input, analog output, discrete input, or discrete output. The ControlNet network consists of controllers, such as PLC® processors, HMIs, drives, I/O devices, and so on. The 1788-CN2FF has three broad functions, supporting the following:

- closed-loop control
- configuration
- a redundant ControlNet network design

Use this document as a guide when you install the 1788-CN2FF module.

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Additional Information

Refer to the following publications for additional information on the NI-FBUS Configurator, the 1788-CN2FF Linking Device, and general fieldbus solutions information.

Pub Number	Publication Title	Scope	Source
AG-140	Wiring and Installation 31.25 kbit/s, Voltage Mode, Wire Medium Application Guide	Overview of what you need to know to wire, power, and layout network components	Fieldbus Foundation 9005 Mountain Ridge Dr., Bowie - Suite 190 Austin, TX 78759 USA 512.794.8890 www.fieldbus.org
AG-163	31.25 kbit/s Intrinsically Safe Systems	Complements the previous document, introduces you to the principles of intrinsic safety, and outlines how to apply approved devices in a hazardous area.	
AG-165	Fieldbus Installation and Planning Guide	Outlines things to consider before installing a Fieldbus network	
1788-UM052	NI-FBUS Configurator User Manual	Provides the information you need to use the NI-FBUS Configurator software.	Rockwell Automation www.theautomationbookstore.com
1788-6.5.1	ControlNet to Foundation Fieldbus User Manual	Provides the information about the 1788-CN2FF module.	
1757-UM006	Fieldbus Solutions for Rockwell Automation's Integrated Architecture	Overview of integrating fieldbus into ProcessLogix, ControlLogix and PLC5.	

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at <http://www.ab.com/manuals/gi>) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.





In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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 we use notes to make you aware of safety considerations.

<p>WARNING</p> 	<p>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.</p>
<p>IMPORTANT</p>	<p>Identifies information that is critical for successful application and understanding of the product.</p>
<p>ATTENTION</p> 	<p>Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you:</p> <ul style="list-style-type: none"> • identify a hazard • avoid a hazard • recognize the consequence
<p>SHOCK HAZARD</p> 	<p>Labels may be located on or inside the drive to alert people that dangerous voltage may be present.</p>
<p>BURN HAZARD</p> 	<p>Labels may be located on or inside the drive to alert people that surfaces may be dangerous temperatures.</p>

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 publication 60664-1), at altitudes up to 2000 meters without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.

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 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.

See NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure. Also, see the appropriate sections in this publication, as well as the Allen-Bradley publication 1770-4.1 (“Industrial Automation Wiring and Grounding Guidelines”), for additional installation requirements pertaining to this equipment.

Handling the 1788-CN2FF Module

ATTENTION



Preventing 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.
 - If available, use a static-safe workstation.
 - When not in use, store the equipment in appropriate static-safe packaging.
-

System Requirements

This section describes the required hardware and software components you need before you can use the 1788-CN2FF. You should also review the README.TXT file on the setup disk for the latest information.

Hardware

- ControlNet-to-Foundation Fieldbus H1 linking device, 1788-CN2FF module
- PC ControlNet interface: 1784-KTCX15, 1784-PCC, 1784-PCIC
- ControlNet and Fieldbus cabling

Software

The following software is necessary to configure the Fieldbus devices and the 1788-CN2FF using ControlNet.

- Windows NT 4.0, service pack 6 or Windows 2000, service pack 3 or higher
- NI-FBUS Configurator, 1788-FFCT version 2.6.0 or higher
- RSLinx OEM 2.40.00 (build 16) or later, RSLinx Lite is not sufficient.

Other Software

To use the 1788-CN2FF module with RSLogix 5000 and a ControlLogix controller you will need:

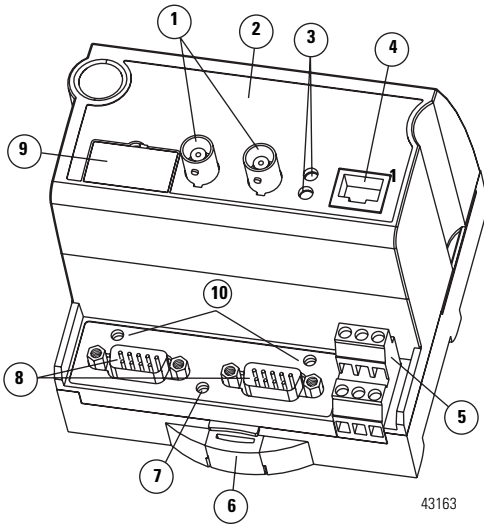
- RSLogix 5000 version 11.11 or later
- RSNetWorx for ControlNet version 4.01.00 (build 04) or later

To use the 1788-CN2FF module with ProcessLogix, refer to:

- The ProcessLogix Installation and Upgrade Guide.
- Knowledge Builder

1788-CN2FF Hardware Description

Figure 1 ControlNet-to-Foundation Fieldbus Linking Device



1. ControlNet A and B BNC Connectors, to support single or redundant network topologies.
2. Case/Enclosure
3. ControlNet Network Status LEDs
4. Non-isolated ControlNet Network Access Port (NAP)
5. Power Supply Connector
6. DIN Rail Clip
7. ControlNet Module STATUS LED
8. Fieldbus Connectors
9. Network Address Switches (under cover)
10. Not Used

Installation Considerations

The 1788-CN2FF is designed to be mounted on a 35 mm DIN rail. The device dimensions are 4.375 x 4.375 and is 4.5 inches high. ControlNet connectors are on top of the unit, allow 1.5 inches for the connectors.

IMPORTANT

Make sure that the power to the network is **off** when connecting the module.

The CN2FF supports redundant media and a ControlNet network access port (NAP). There are 2 (A, B) BNC ControlNet connectors. We recommend using the “A” BNC connector when setting up a single network and then using the “B” connector for the second (redundant) network. It does not matter, but when you are working with redundant networks, the industry tends to refer to the primary network as A and the secondary network as B.

The ControlNet status LEDs on the front of the module display the current status of each of the redundant media channels. The rotary switches are used to set the ControlNet network address. You can write the network address in the space provided on front of the device.

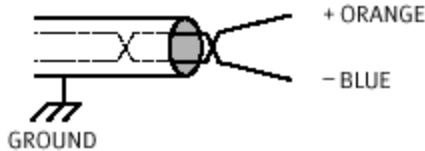
The module has two separate Fieldbus ports which supports 2 Fieldbus networks. The power connections are used to supply power to the CN2FF.

Power Conditioning

You must use a power conditioner between your Fieldbus power supply and the Fieldbus network. You can use a power supply designed for Foundation Fieldbus operation which has the proper power conditioning elements. If you are using an ordinary power supply, a separate power conditioner must also be used. If an ordinary power supply is connected directly to the Fieldbus, the power supply would absorb signals on the cable because it would try to maintain a constant voltage level. The power conditioner puts an inductor between the power supply and the Fieldbus wiring. The inductor connects the DC power to the Fieldbus wiring but prevents signals from going into the power supply.

In practice, a real inductor is not used in the power conditioner but an electronic equivalent. The electronic inductor circuit has the added advantage of limiting the current provided to the network segment if the cable is shorted.

The voltage supplied to the Fieldbus cable can be as high as 32 V. The voltage at any device can be as low as 9 V for the device to operate correctly. A typical Fieldbus device takes about 20 mA of current from the cable. The Fieldbus is configured so that one of the wires has a (+) voltage, the other wire has a (-) voltage and the shield is grounded.



A cable with the orange wire as plus and the blue wire as minus is shown above. This type of cable is available from Fieldbus cable manufacturers. Other cables or existing plant wiring conventions may be different. Regardless of the color convention, keep the sense of Fieldbus polarity consistent throughout the plant.⁽¹⁾

IMPORTANT

We suggest that you not use White/Black or White/Red pairs since they may be mistaken for 115 volt power wiring.

Be sure to follow the wiring and installation requirements in the Foundation Fieldbus publications listed in the section Additional Information on page 3.

⁽¹⁾ RELCOM inc., Fieldbus Wiring Design and Installation Guide (2221 Yew Street, Forest Grove, OR 97116) p. 5. Reprinted by permission.

Configuring the 1788-CN2FF Linking Device

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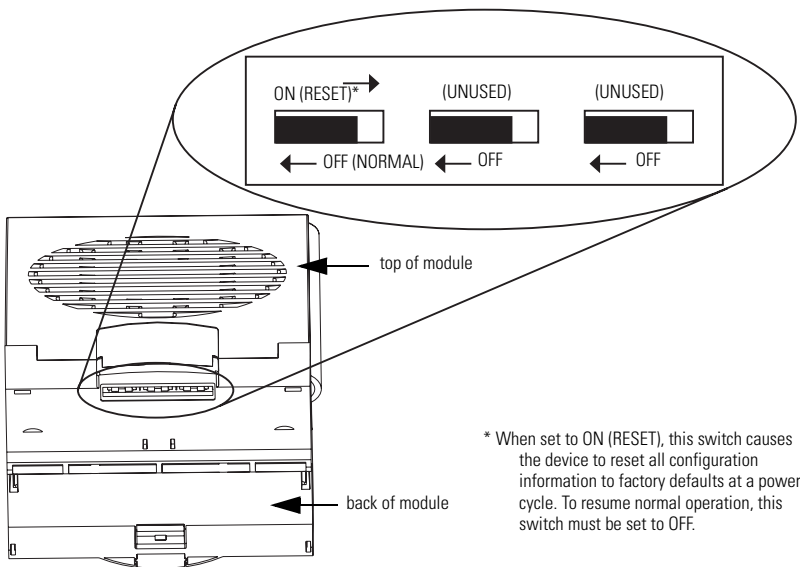


The 1788-CN2FF module ships from the factory with configuration switches set to “ON (RESET)”. With switches “ON”, any configuration data would be reset on Power interruption. Set the switches to “OFF (NORMAL)” after initial power-up (to clean any Factory test configurations) but before you configure the module with your application.

Remove power to the module before resetting configuration switches.

The CN2FF has three configuration switches accessible from an opening in the bottom of the module. These switches are illustrated in Figure 2.

Figure 2 The 1788-CN2FF Configuration Switches

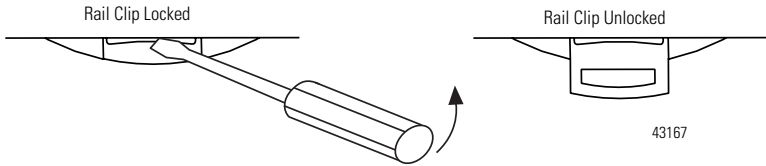


* When set to ON (RESET), this switch causes the device to reset all configuration information to factory defaults at a power cycle. To resume normal operation, this switch must be set to OFF.

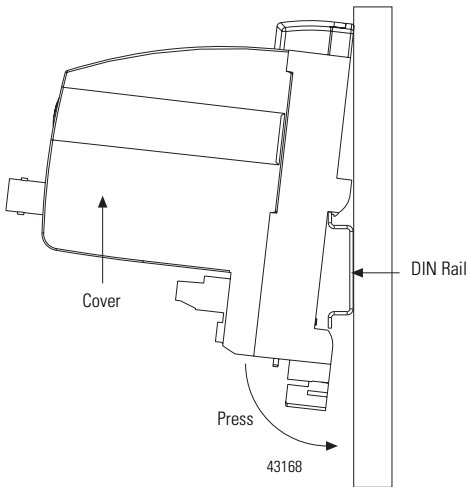
Installing the 1788-CN2FF

The CN2FF has a rugged, simple clip for mounting reliably on a standard 35mm DIN rail. Follow these steps to mount the module onto a DIN rail.

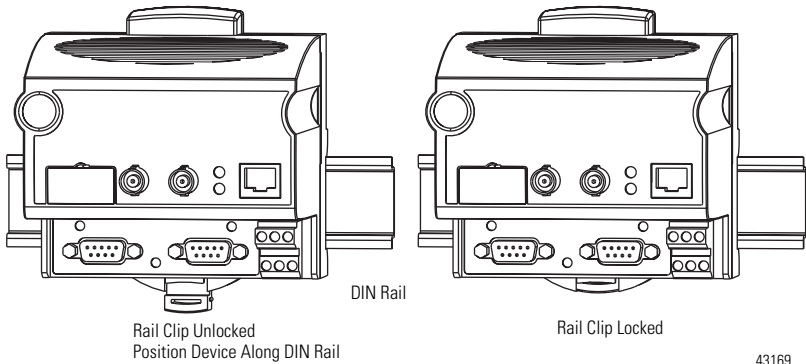
1. Use a flat-bladed screwdriver to open the DIN Rail Clip to the unlocked position.



2. Hook the lip on the rear of the module onto the top of a 35mm DIN rail and press the module down onto the DIN rail.



3. Slide the module to the desired position on the DIN rail. After it is in position, push the rail clip into the locked position to lock it in place on the DIN rail.

Figure 3 Install the 1788-CN2FF on to the DIN Rail

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Removing the 1788-CN2FF

To remove a module, unlock it from the DIN rail by placing a screwdriver in the slot on the rail clip and opening the rail clip to the unlocked position as shown in step 1 on page 10. Then lift the device off of the rail.

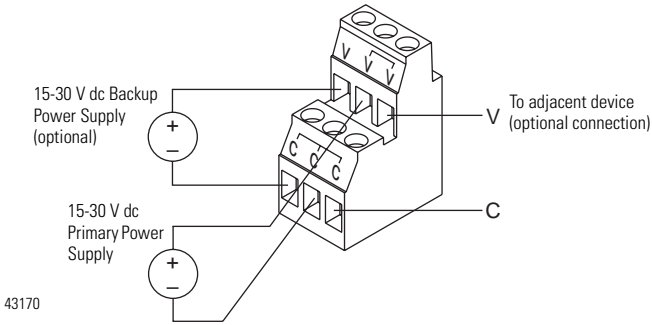
Connecting Power

The 1788-CN2FF requires 15-30V dc power and the cable is limited to a maximum of 3m in length. One power supply can support several CN2FFs. The power connector is a 6-pin screw terminal connector. The pinout for the power connector is shown in Figure 4.

IMPORTANT

Make sure that the power to the network is **off** when connecting the module.

Figure 4 Power Connector Pinout



Connect the primary power supply to the center V and C pair. An optional backup power supply may be connected to the left V and C pair. The right V and C pair may be used to chain the primary power supply to other devices. All three terminals labeled C are connected in the CN2FF. The right two V terminals are connected in the CN2FF. These connections are indicated on the power connector by the lines over the V and C terminals.

Connecting to the ControlNet Network

There are two types of ControlNet connectors on the CN2FF, the BNC and the RJ-45. Using the BNC:

- BNC connectors are for direct connection to a ControlNet network through a tap.
- BNC connectors must be used to connect the CN2FF to the ControlNet network.

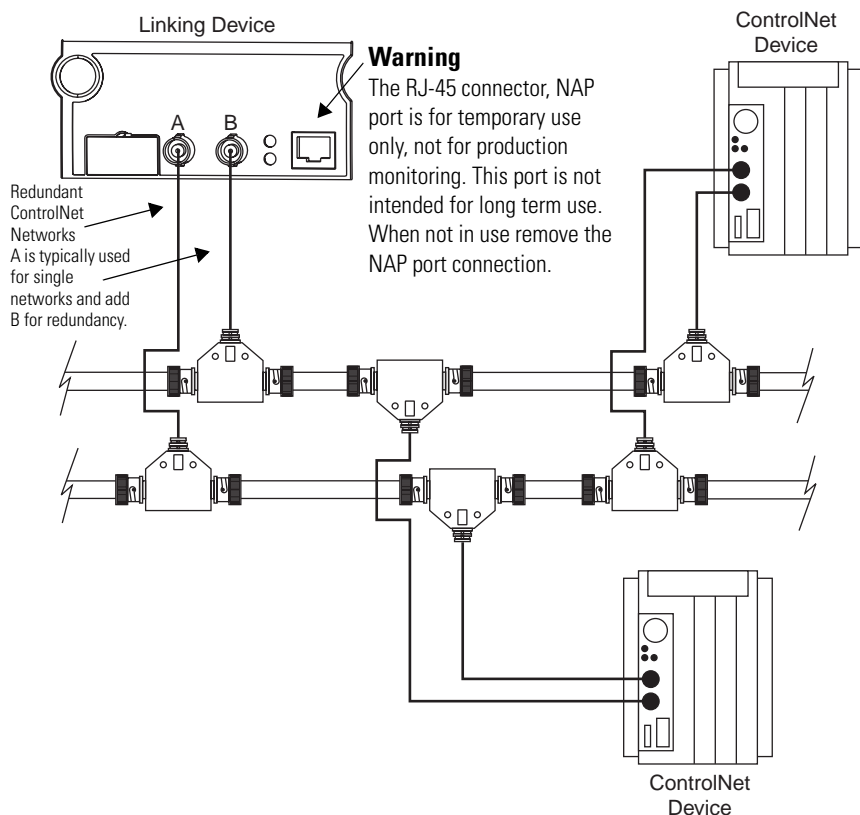
Using the RJ-45:

- The RJ-45 connector is a network access port (NAP).
- This port is provided for configuration and development use only and it is not intended for long term use.
- Maximum length of the cable connecting the NAP to the CN2FF is limited to 30m.
- When not in use remove the NAP port connection.

IMPORTANT

Do not connect the 1788-CN2FF to more than one ControlNet network at a time. Attempting to connect to a second network will cause the CN2FF to operate erratically.

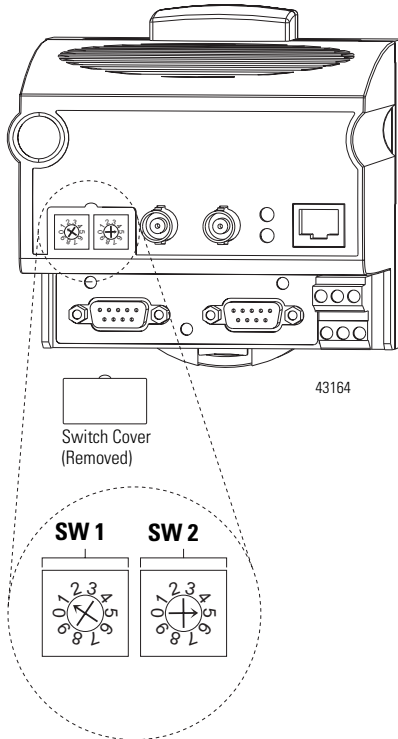
Figure 5 Typical 1788-CN2FF Connections to a Redundant ControlNet Network



Setting the ControlNet Network Address

Valid ControlNet network addresses are 1-99. Network address zero is reserved. Switch 1 controls the most significant decimal digit (the tens). Switch 2 controls the least significant decimal digit (the ones). Figure 6 shows the location of the network address switches and an example of switch settings for a network address of 15.

Figure 6 ControlNet Network Address Switches Set to 15



Follow these steps to set the ControlNet network address for the 1788-CN2FF.

1. Choose and set a network address.
2. Write the network address setting in the space provided on the CN2FF label.
3. Apply (or cycle) power to the CN2FF to enable the new network address.
4. Make the same address changes in your NI-FBUS configuration software.

Interpreting the LEDs: ControlNet Network Status

The ControlNet network status LEDs are located on the front of the 1788-CN2FF, beside the ControlNet BNC connectors, as shown in Figure 1, Item 3. They indicate the state of the ControlNet connected to the BNC connectors. These LEDs do not reflect anything about the status of the network access port (NAP). If more than one state is present, the LEDs always reflect the highest priority status present on the network. Table 7 describes the LED states and the priority of each status.

Table 7 ControlNet Network LED Status Descriptions

LED State	Priority	How to View	Cause
Both steady off	1 (highest)	View together	Reset or no power
Both steady red	2		Failed to link interface to ControlNet
Alternating red & green	3		Self testing
Alternating red	4		Bad node configuration (such as duplicate ControlNet network address)
Steady off	5	View independently	Channel disabled or not supported
Flashing red & green	6		Invalid link configuration
Flashing red	7		Link fault or no frames received
Flashing green	8		Temporary channel error or listen only
Steady green	9 (lowest)		Normal operation

Interpreting the LEDs: Module Status

The STATUS LED is located on the front of the 1788-CN2FF, between the two Fieldbus connectors, as shown in Figure 1, Item 7. It indicates whether the CN2FF is powered, configured, and operating properly. Table 8 shows how to interpret the STATUS LED states.

Table 8 Module Status LED State Descriptions

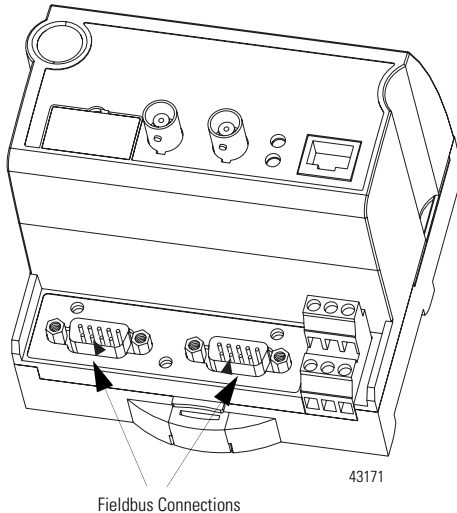
LED State	Description
Off	No power to the CN2FF
Flashing red and green	CN2FF self testing
Flashing green	Standby state ⁽¹⁾
Solid green	Operational state ⁽²⁾
Flashing red	Major recoverable fault
Solid red	Major unrecoverable fault

⁽¹⁾ Standby state indicates the CN2FF has passed all self tests and is ready to operate. Yet, it is not functioning because it is not been configured.

⁽²⁾ Operational state indicates the CN2FF has left standby state because the necessary network configuration (if any) has occurred.

Connecting to the Fieldbus Network

Figure 9 Fieldbus Connector Locations on the 1788-CN2FF

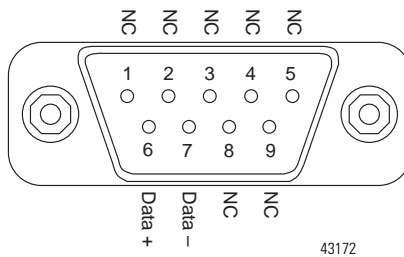


Use pins 6 and 7 for the Fieldbus signals, as specified in the *Fieldbus Standard for Use in Industrial Control Systems, Part 2, ISA-S50.02.1992*. Refer to Figure 10 for the connector pinout of the 1788-CN2FF.

IMPORTANT

Make sure that the power to the network is **off** when connecting the module.

Figure 10 Fieldbus Connector Pinout for the 1788-CN2FF



Device vs. Connection Clarifications

This section describes the functional relationship and differences between 1788-CN2FF Connections and Foundation Fieldbus™ Devices. A connection does not always equal a device.

ATTENTION



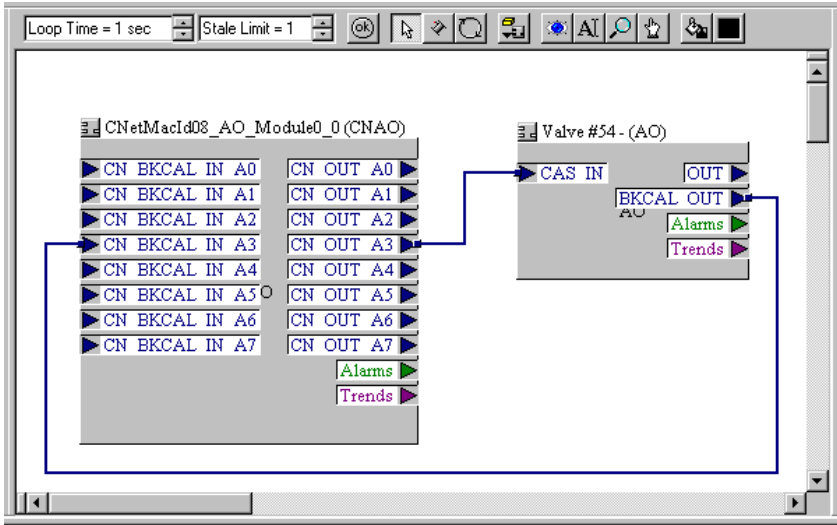
The maximum number of “connections” is 30 per CN2FF. The recommended number of “devices” is 8 per H1 port on the CN2FF. If you exceed the maximum number of connections or the recommended number of devices, system performance could be compromised.

- A connection is considered any link (wire connection) to:
 - CNAI, ControlNet ANALOG INPUT
 - CNAO, ControlNet ANALOG OUTPUT
 - CNDI, ControlNet DIGITAL INPUT
 - CNDO, ControlNet DIGITAL OUTPUT
- A device is considered a specific Foundation Fieldbus device such as a transmitter.

For each different network configuration, you must account for all connections and devices toward the maximum recommendations.

1788-CN2FF Connections

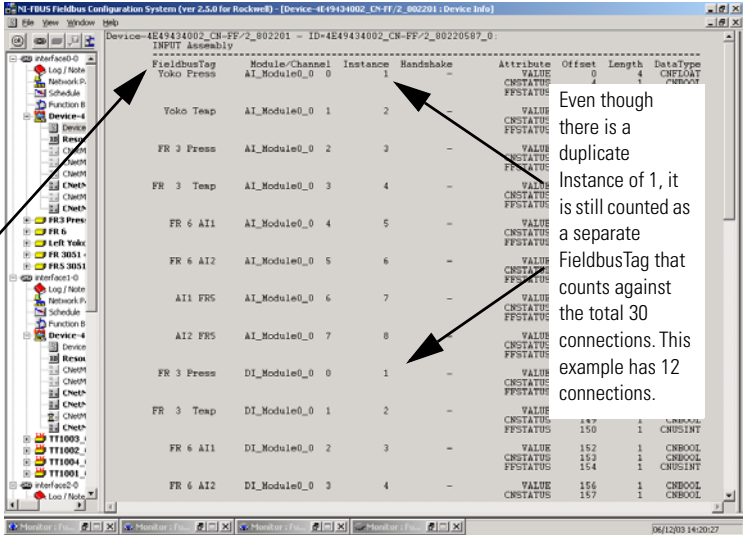
A connection is considered any link (wire connection) to a CNAI, CNAO, CNDI, and CNDO. When using the CNAO, refer to the graphic below that illustrates there are two connections for each CNAO.



For help in determining the number of connections on a port, refer to the Device Info screen once you have downloaded the function block applications to the CN2FF.

To locate the Device Info, expand the CN2FF tree and double-click on Device Info.

When accounting for the number of connections, you need to count the number of Tags in the FieldbusTag column and not the number identifying the Instances.



Each tag in the FieldbusTag column counts as a fieldbus connection. There can be duplicate Instance numbers for different types of modules (e.g. DI vs. AI).

On any one port you can have up to a maximum of 18 connections. If you are using 18 connections on one port, the second port would only be allowed 12 connections for a total of 30 per CN2FF.

1788-CN2FF and Foundation Fieldbus Devices

Devices do not equate to connections. The current recommended number of devices per H1 port is 8 and the maximum number of devices per 1788-CN2FF module is 16 for any type of bus power used.

ATTENTION



The maximum number of “connections” is 30 per CN2FF. The recommended number of “devices” is 8 per H1 port on the CN2FF. If you exceed the maximum number of connections or the recommended number of devices, system performance could be compromised.

These numbers are for Non-IS (Intrinsically Safe) class devices only. IS device maximums are even lower, depending on all the configuration constraints of a particular application.

Understanding the 1788-CN2FF Connection and Device Relationship

One connection does not equal one device. The maximum recommended number of devices per each H1 port is 8 for a total 16. That maximum takes into account that you have an optimal sized network, the correct number of connections, followed wiring guidelines and you don't have 16 devices that exceed the current limitation of your systems' power supply.

Many devices require 2 connections (e.g. an AO) and some devices that can require 3 or more connections (e.g. a PID). The number of connections needs be considered when counting devices. You may have 8 devices that exceed the connection limits of the module. For example: AIs take one connection, AOs will require two, and PIDs will need at least 2 but could use more depending on how it is wired.

The maximum number of connections (30) is specified as a combination for BOTH channels. In addition, you need to account for other process aspects such as loop time and stale limits for your network segments. You need to take into account the length of your cables and spurs, the number of devices per spur, power consumption of each device, etc.

ATTENTION



Be sure to follow the wiring and installation requirements in the Foundation Fieldbus publications listed in the section Additional Information on page 3.

Specifications

Type	Specifications
Operating Temperature	0 to 60°C (32 to 140°F) IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)
Storage Temperature	-40 to 85°C (-40 to 185°F) IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold), IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat), IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock)
Relative Humidity	5 to 95% non-condensing IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat)
Vibration	IEC60068-2-6 (Test Fc, Operating): 2g @ 10-500Hz
Physical Dimensions	4.375 in. x 4.375 in x 4.5 in <ul style="list-style-type: none"> • ControlNet connectors are on top of the unit • Allow 1.5 inches for the connectors.
Shock	IEC60068-2-27 (Test Ea, Unpackaged shock): Operating 30g Non-operating 50g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity	IEC 61000-4-2: 4kV contact discharges 8kV air discharges
Radiated RF Immunity	IEC 61000-4-3: 10V/m with 1kHz sine-wave 80%AM from 30MHz to 1000MHz 10V/m with 200Hz 50% Pulse 100%AM at 900Mhz
EFT/B Immunity	IEC 61000-4-4: ±2kV at 5kHz on signal ports
Surge Transient Immunity	IEC 61000-4-5: ±1kV line-line(DM) and ±2kV line-earth(CM) on signal ports
Conducted RF Immunity	IEC 61000-4-6: 10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz
Magnetic Field Immunity	IEC 61000-4-8: 30A/m at 50Hz
Enclosure Type Rating	None (open-style)
Communication	<ul style="list-style-type: none"> • ControlNet - redundant media • NAP, network access port • FOUNDATION Fieldbus H1, 2 independent channels • LAS on both channels • Time Master on both channels
Mounting	35 mm DIN rail
Power Requirements	Class 2 power supply 24V dc 15-30V dc 270 mA @ 24V dc (typical)

Type		Specifications
Indicators		<ul style="list-style-type: none"> • Module Status • ControlNet Status, 1 each connection
Connectors		<ul style="list-style-type: none"> • ControlNet - BNC connectors, provides redundancy • two 10-position rotary switches • Network Access Port - RJ45 (non-isolated) • Fieldbus - 9-pin sub-D connectors • Power Input Terminals: <ul style="list-style-type: none"> -Torque 5-7 in.-lb. -Not to be used with combination of solid and stranded 16 GA wire
Conductors	Wire Size	#22 AWG (0.355 SQmm) Copper Stranded wire to #14 AWG (2.08 SQmm) Copper Stranded wire
	Category	60° C minimum 2 ^{(1) (2)}
Certifications (when product is marked)		c-UL-us UL Listed Industrial Control Equipment, certified for US and Canada FCC North American EMI Verification Part 15-Class A-ICES003 C-Tick ⁽³⁾ Australian EMC Compliance AS/NZS CISPR 11; Industrial Emissions CE ⁽³⁾ European Union 89/336/EEC EMC Directive, compliant with: EN 61000-6-4; Industrial Emissions EN 50082-2; Industrial Immunity EN 61326; Meas./Control/Lab., Industrial Requirements EN 61000-6-2; Industrial Immunity

⁽¹⁾ Use this Conductor Category information for planning conductor routing. Refer to Publication 1770-4.1, "Industrial Automation Wiring and Grounding Guidelines".

⁽²⁾ Appropriate shielded cable is *required* for Electromagnetic compatibility (EMC) standards.

⁽³⁾ See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

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RSLinx, RSLinx OEM, RSNetWorx are trademarks of Rockwell Software.
Foundation Fieldbus is a trademark of the Fieldbus Foundation.
Windows NT and 2000 are trademarks of the Microsoft Corporation.

Rockwell Automation Support

Rockwell Automation provides technical information on the web to assist you in using our products. At <http://support.rockwellautomation.com>, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration and troubleshooting, we offer TechConnect Support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit <http://support.rockwellautomation.com>.

Installation Assistance

If you experience a problem with a hardware module within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your module up and running:

United States	1.440.646.3223 Monday – Friday, 8am – 5pm EST
Outside United States	Please contact your local Rockwell Automation representative for any technical support issues.

New Product Satisfaction Return

Rockwell tests all of our products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned:

United States	Contact your distributor. You must provide a Customer Support case number (see phone number above to obtain one) to your distributor in order to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for return procedure.

www.rockwellautomation.com

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