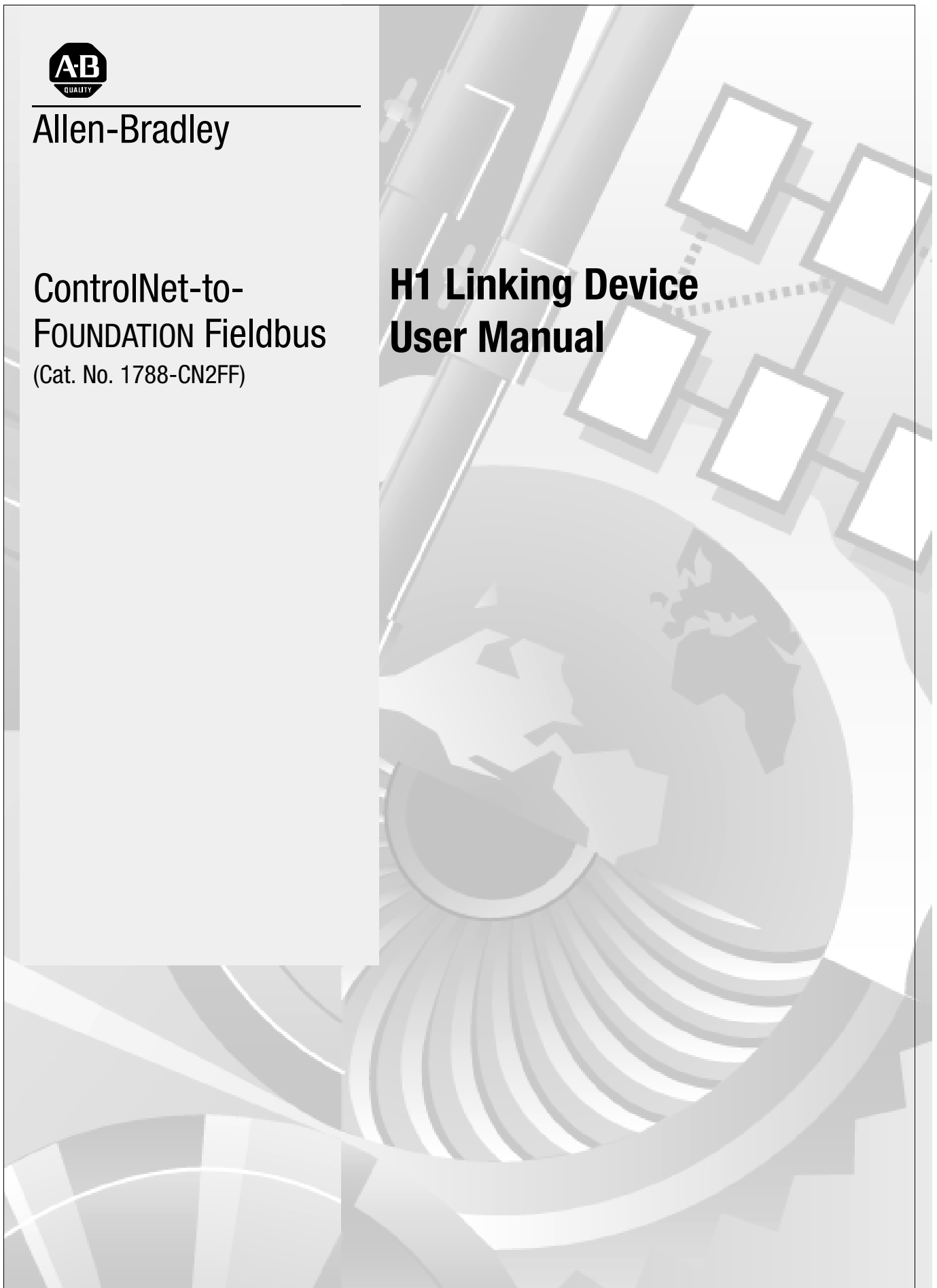




Allen-Bradley

ControlNet-to-  
FOUNDATION Fieldbus  
(Cat. No. 1788-CN2FF)

# H1 Linking Device User Manual



## Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Allen-Bradley office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

Reproduction of the contents of this copyrighted publication, in whole or part, without written permission of Rockwell Automation, is prohibited.

Throughout this manual we use notes to make you aware of safety considerations:



**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss

---

Attention statements help you to:

- identify a hazard
- avoid a hazard
- recognize the consequences

**Important:** Identifies information that is critical for successful application and understanding of the product.

Allen-Bradley is a trademark of Rockwell Automation.

<b>Introduction</b>	Product Overview . . . . .	1-1
	Closed-loop Control . . . . .	1-1
	Configuration and Monitoring . . . . .	1-2
	System Requirements . . . . .	1-3
	Hardware . . . . .	1-3
	Software . . . . .	1-3
	Compatibility Information . . . . .	1-4
	Linking Device Hardware Description . . . . .	1-4
	NI-FBUS Configurator Software Description . . . . .	1-5
<b>Hardware Installation and Configuration</b>	Handling the Linking Device . . . . .	2-1
	Installing the Linking Device . . . . .	2-1
	Removing the Linking Device . . . . .	2-2
	Connecting Power . . . . .	2-2
	Connecting to the ControlNet Network . . . . .	2-3
	Connecting to the Fieldbus Network . . . . .	2-4
	Setting the ControlNet Network Address . . . . .	2-5
	Interpreting the LEDs . . . . .	2-6
	Module STATUS LED . . . . .	2-6
	ControlNet Network Status LEDs . . . . .	2-7
	Fieldbus Network Status LEDs . . . . .	2-7
<b>Software Installation and Configuration</b>	Installing the NI-FBUS Configurator Software . . . . .	3-1
	Configuring the NI-FBUS Configurator Software . . . . .	3-3
	Configuring the Interface Address . . . . .	3-3
	Configuring the Interface Name . . . . .	3-4
	Installing Device Descriptions . . . . .	3-5
	Configuring Fieldbus Communication Parameters . . . . .	3-6
	Using the NI-FBUS Interface Configuration Utility After Installation . . . . .	3-6
	Testing the Installation . . . . .	3-7
<b>Using the ControlNet-to-FOUNDATION Fieldbus H1 Linking Device</b>	Blocks in the Linking Device . . . . .	4-1
	Analog Inputs . . . . .	4-2
	Configuration of Analog Inputs . . . . .	4-2
	ControlNet Analog Input Objects . . . . .	4-4
	Alarm Handling for Analog Inputs . . . . .	4-4
	Analog Outputs . . . . .	4-5
	Configuration of Analog Outputs . . . . .	4-5
	ControlNet Analog Output Objects . . . . .	4-8
	Discrete Inputs . . . . .	4-8
	Configuration of Discrete Inputs . . . . .	4-9
	ControlNet Discrete Input Objects . . . . .	4-10
	Alarm Handling for Discrete Inputs . . . . .	4-10
	Discrete Outputs . . . . .	4-12
	Configuration of Discrete Outputs . . . . .	4-12
	ControlNet Discrete Output Objects . . . . .	4-13

Alarm Handling by the HMI.....	4-14
Assembly Objects .....	4-14
MAI Blocks.....	4-15
MAO Blocks.....	4-15
MDI Blocks.....	4-16
MDO Blocks.....	4-16
Viewing Object Information in the NI-FBUS Configurator.....	4-16
Changing the Linking Device Configuration .....	4-17
Trends and Alarms .....	4-18

## **Specifications**

## Introduction

### Product Overview

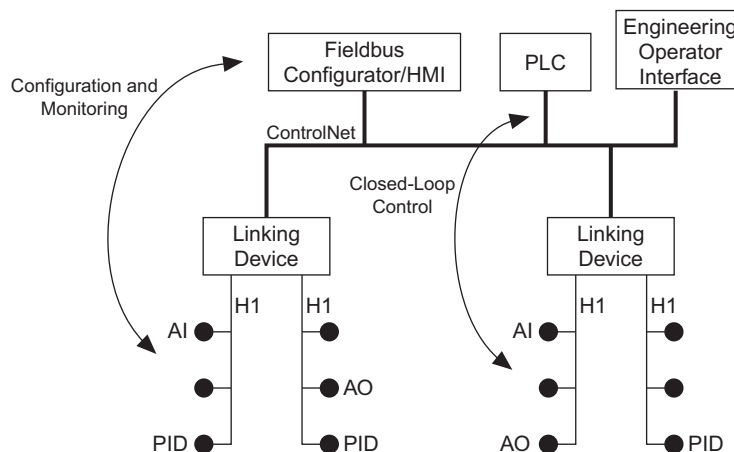
The ControlNet-to-FOUNDATION Fieldbus linking device connects a ControlNet™ network with one or more FOUNDATION Fieldbus H1 (Fieldbus) networks. Each H1 network consists of multiple Fieldbus devices. Each field device has one or more function blocks. Each function block performs an elementary control 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 linking device has two broad functions, supporting the following:

- closed-loop control
- configuration and monitoring

Figure 1.1 shows these functions within a simple ControlNet system.

**Figure 1.1 Linking Device Function within a Simple ControlNet System**



### Closed-loop Control

The linking device basically permits closed-loop control between the Fieldbus devices and ControlNet controllers. ControlNet PLC processors can access data and control Fieldbus devices such as pressure transmitters and valves. As an example, a PID executing on a ControlNet PLC processor can get process values from a Fieldbus pressure transmitter and control the position of a Fieldbus valve.

The linking device is similar to an I/O subsystem. An I/O subsystem typically contains several I/O modules. Each module has a number of channels. The channels perform one of these functions:

- analog input (AI)
- analog output (AO)
- discrete input (DI)
- discrete output (DO)

The linking device models the I/O modules in software. The linking device has four types of custom function blocks:

- multiple AI block
- multiple AO block
- multiple DI block
- multiple DO block

Each of these function blocks has multiple channels. These function blocks are similar to the I/O modules in the I/O subsystem. Each channel of these custom blocks is associated with an analog/discrete input or output value in a Fieldbus device. You establish the association when you configure the system.

The linking device creates a ControlNet object (analog input, analog output, discrete input, or discrete output) for every channel that is associated with a Fieldbus device. In summary the linking device makes the function blocks in Fieldbus devices visible as ControlNet objects on the ControlNet. ControlNet devices and controllers can access the Fieldbus devices as though they are ControlNet devices.

The function blocks in Fieldbus devices have contained parameters and I/O parameters. Contained parameters are mainly used to configure the function blocks. I/O parameters are used in distributed control of the process. These parameters are made visible as attributes of the ControlNet objects. The linking device publishes and subscribes to the I/O parameters on the Fieldbus network, and consumes and produces the corresponding ControlNet object attributes on the ControlNet as assembly objects. The linking device can be Link Active Scheduler (LAS) on all of the connected Fieldbus networks.

## **Configuration and Monitoring**

The linking device permits the NI-FBUS Fieldbus Configurator on a PC connected to ControlNet to configure Fieldbus devices as if the configurator were directly connected to the Fieldbus network. Fieldbus devices have a physical address, a physical device tag, and function block tags. They also have schedules for function block execution, information on connections between function blocks, and so on. All of these are configurable.

The Fieldbus devices have View objects that are a collection of dynamic process data. Fieldbus devices broadcast alarms, collect trend data, and broadcast trend data. An HMI typically accesses the view objects, collects trends from different Fieldbus devices, processes alarms, and acknowledges alarms. The linking device permits a Fieldbus HMI on a PC connected to ControlNet to access and monitor Fieldbus devices as if the HMI were directly connected to the Fieldbus network.

The NI-FBUS Fieldbus Configurator generates the information about the layout or structure of the ControlNet assembly objects produced and consumed by the linking devices. It provides the offset within the assembly objects for every Fieldbus function block parameter being published or subscribed by the linking device. You can use this information to program your PLC processors. Therefore, you configure your Fieldbus network before you obtain linking device assembly object information to program your PLC processor.

## System Requirements

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

### Hardware

- ControlNet-to-Fieldbus linking device
- PC ControlNet interface: 1784-KTC15 or 1784-PCC
- ControlNet and Fieldbus cabling

### Software

- Windows NT® 4.0 with service pack 3 or higher
- NI-FBUS Configurator version 2.3 or higher

These are necessary to configure the Fieldbus devices and the linking device using ControlNet.

- RSLinx™ 2.0 or RSLinx OEM™ 2.0 or later; this is the driver for the Allen-Bradley PC interfaces

RSLinx Lite™ is not sufficient.

- RSNetWorx™ for ControlNet version 1.8 or later; this is the ControlNet configuration tool

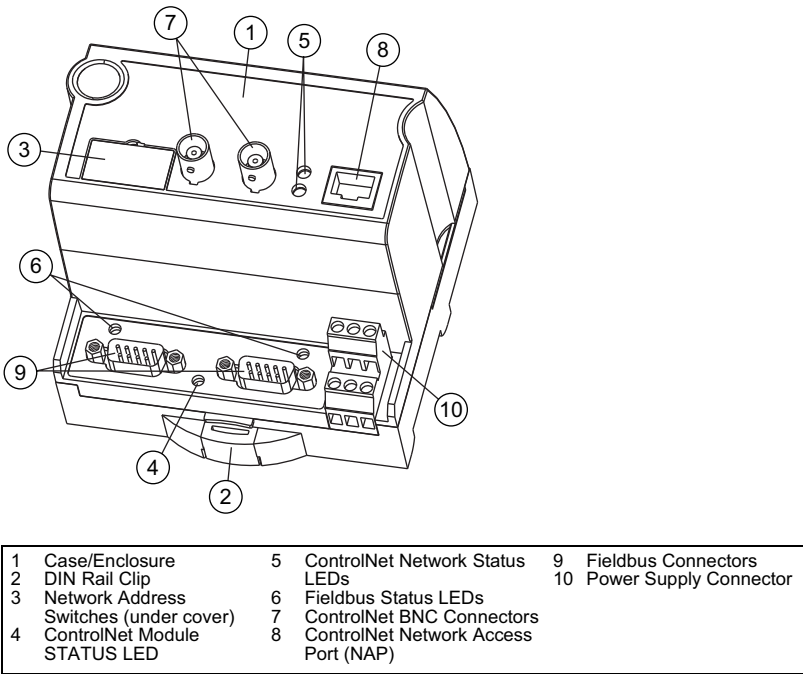
Compatibility Information

The linking device is compatible with ControlNet specification version 1.03 (or later) and Fieldbus specification version 1.3.

Linking Device Hardware Description

Figure 1.2 shows the components of the linking device.

Figure 1.2 ControlNet-to-FOUNDATION Fieldbus Linking Device



The linking device is designed to be mounted on a 35 mm DIN rail. It has one ControlNet port with support for redundant media and a network access port. The ControlNet status LEDs on the front of the linking device 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 linking device has two separate Fieldbus ports. Next to each port is an LED to display the current status of the port. The status LED indicates if the device is powered on and operating properly. The power connections are used to supply power to the linking device.

For more information on connecting and configuring the linking device see chapter 2, Hardware Installation.

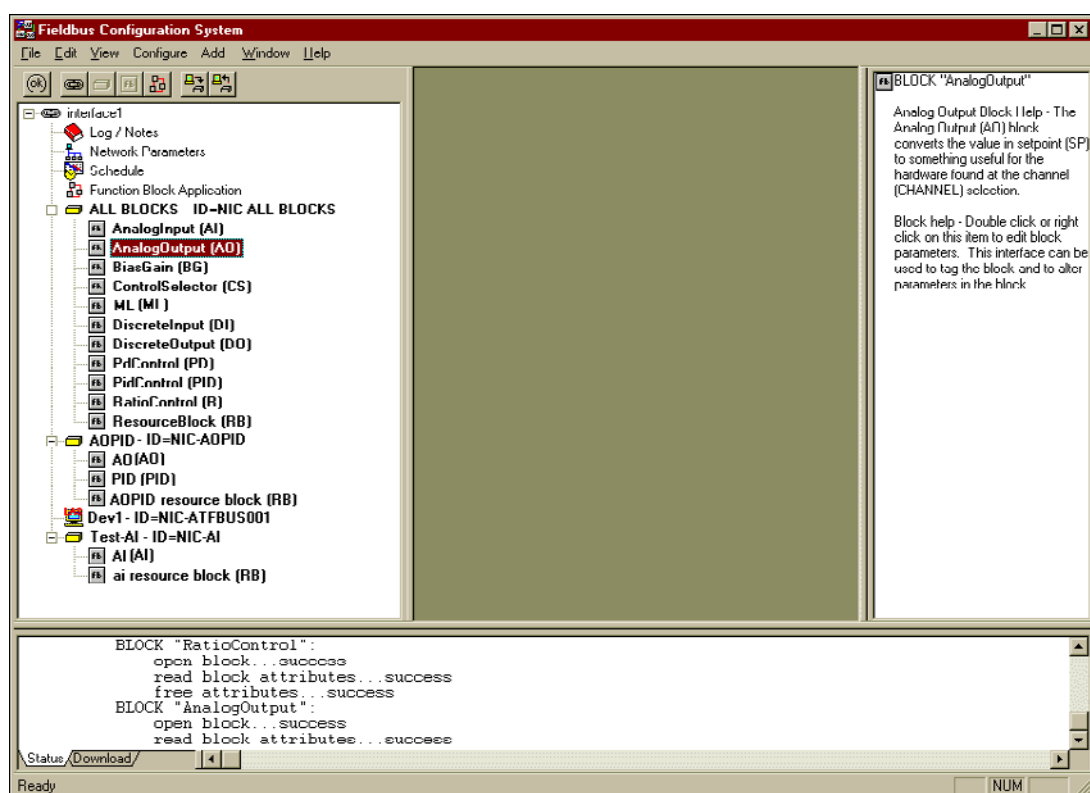


## NI-FBUS Configurator Software Description

Use the NI-FBUS Fieldbus Configurator to configure a Fieldbus network and keep track of your configurations. The Configurator is an easy-to-use graphical environment for creating Fieldbus linkages, loops, and schedules.

Figure 1.3 shows the Configurator Main window. For more information, refer to the NI-FBUS Configurator User Manual, publication 1788-6.5.2.

**Figure 1.3 NI-FBUS Configurator Main Window**



**Notes:**

## Hardware Installation and Configuration

### Handling the Linking Device

We recommend that you adhere to this precautionary information.

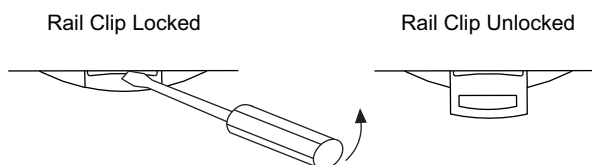


**ATTENTION:** This module contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing or testing this assembly. Component damage may result if these procedures are not followed.

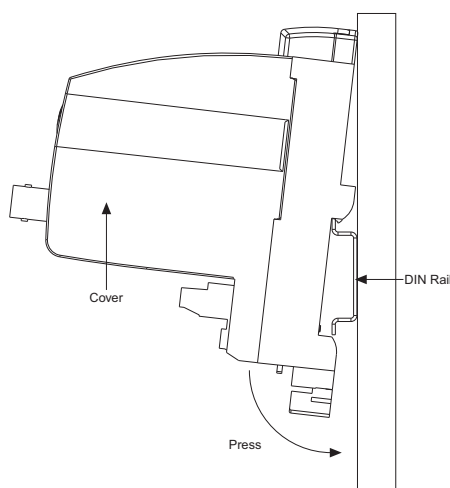
### Installing the Linking Device

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

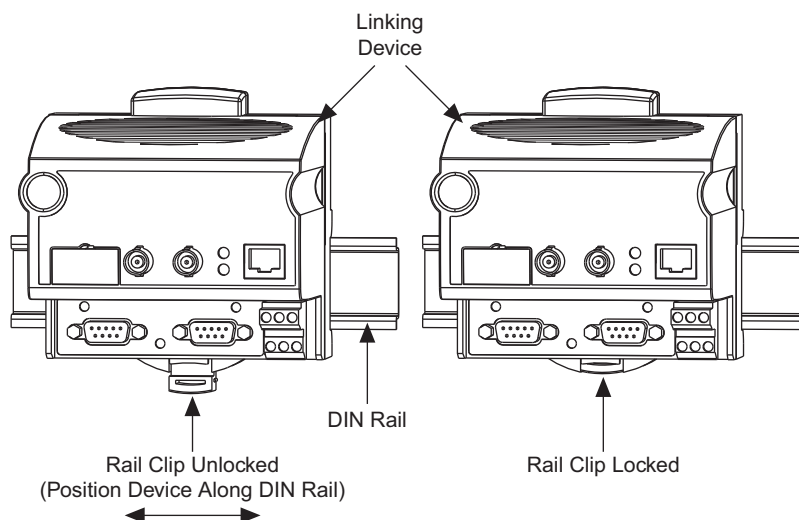
1. Use a flat-bladed screwdriver to open the DIN rail clip to the unlocked position.



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



- Slide the linking device to the desired position on the DIN rail. After it is in position, push the rail snap into the locked position to lock it in place on the DIN rail.



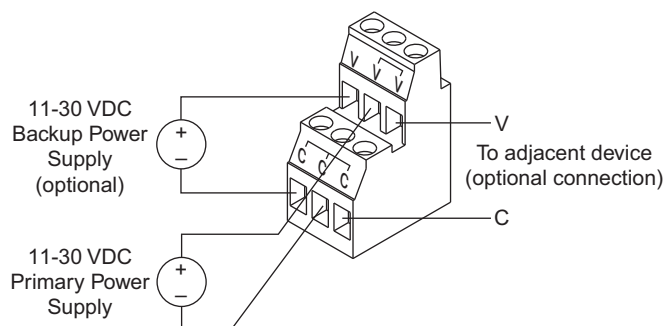
## Removing the Linking Device

To remove a linking device, unlock it from the DIN rail by placing a screwdriver in the slot on the rail snap and opening the rail snap to the unlocked position as shown in step 1 on page 2-1. Then lift the device off of the rail.

## Connecting Power

An 11-30V dc power supply is required by each linking device. The linking device filters and regulates this supplied power. The power connector is a 6-pin screw terminal connector. The pinout for the power connector is shown in Figure 2.1.

**Figure 2.1 Power Connector Pinout**



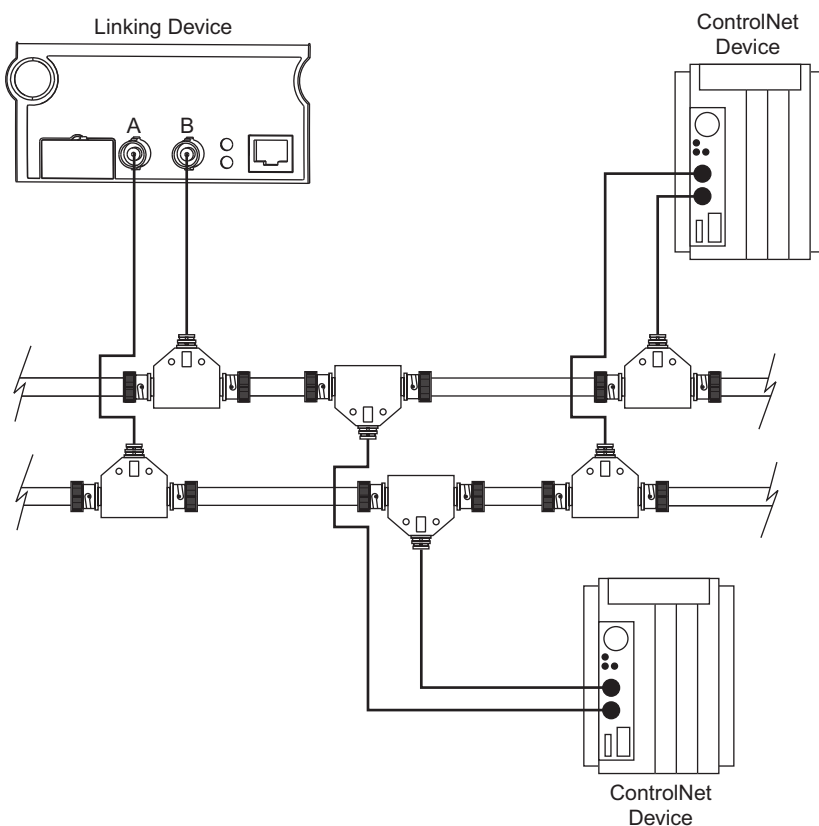
Connect the primary power supply to the center V and C pair. An optional backup power supply may be connected to the left V and C pair. The right V and C pair may be used to chain the primary power supply to other devices. All three terminals labeled C are connected in the linking device. The right two V terminals are connected in the linking device. 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 linking device. The BNC connectors are for direct connection to a ControlNet network through a tap. The BNC connectors must be used to connect the linking device to the ControlNet network. The RJ-45 connector is a network access port (NAP). This port is only for temporary connections to a ControlNet network. Figure 2.2 shows an example of a typical network connection.

**Important:** Do not connect the linking device to more than one ControlNet network at a time. Attempting to connect to a second network will cause the linking device to operate erratically.

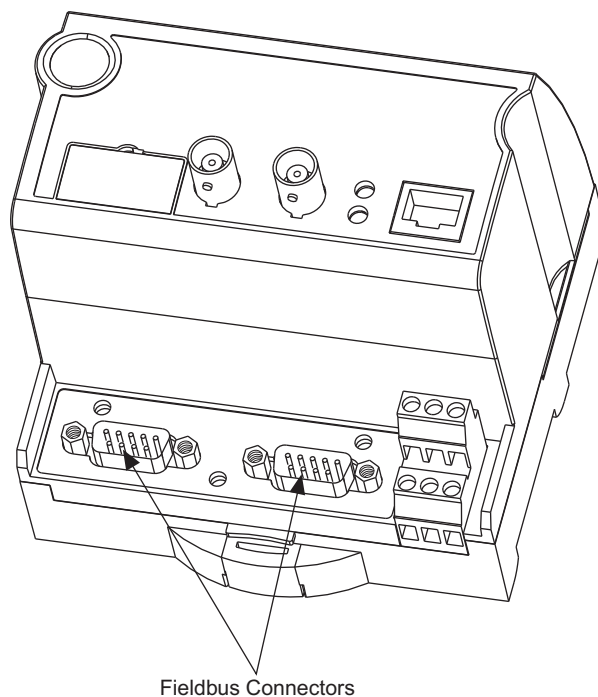
**Figure 2.2 .Typical Linking Device Connections to a ControlNet Network**



## Connecting to the Fieldbus Network

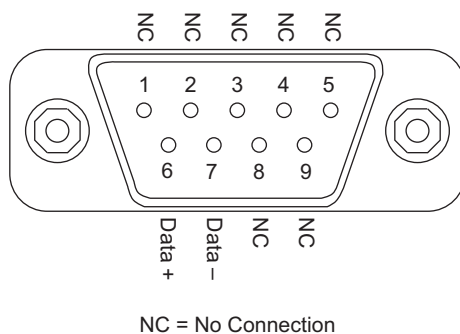
The location of the Fieldbus connectors is shown in Figure 2.3.

**Figure 2.3 Fieldbus Connectors on the Linking Device**



If you want to make your own Fieldbus cable, make sure that it uses 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 2.4 for the connector pinout of the linking device.

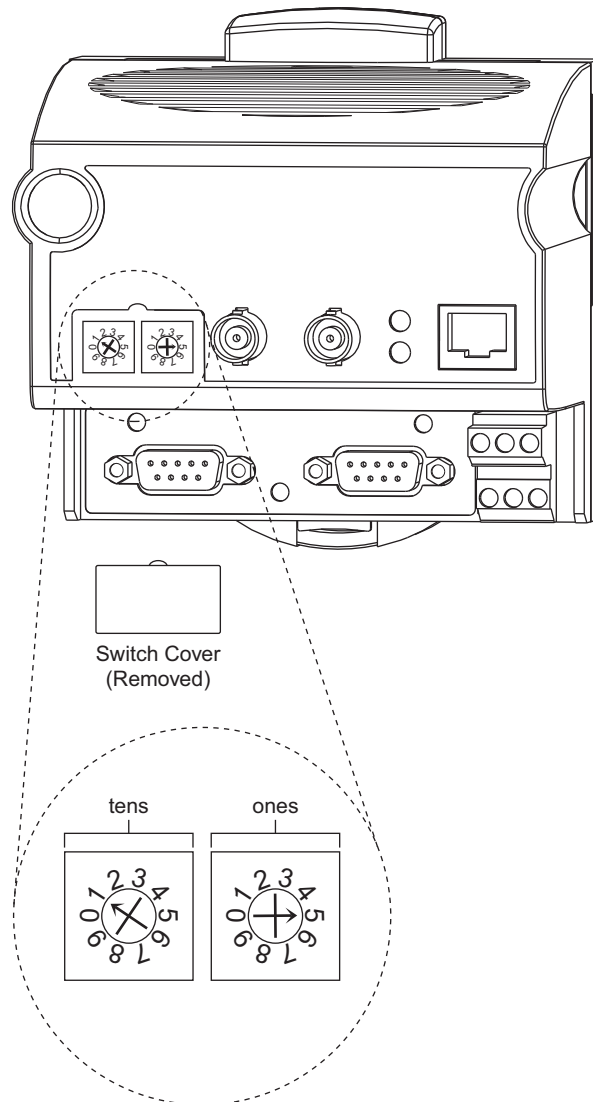
**Figure 2.4 Fieldbus Connector Pinout for the Linking Device**



## 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 2.5 shows the location of the network address switches and an example of switch settings for a network address of 15.

**Figure 2.5 ControlNet Network Address Switches Set to 15**



Follow these steps to set the ControlNet network address for the linking device.



For optimum throughput, assign network addresses to your ControlNet nodes in a sequential order starting with 01 for the PC running the configuration software.

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

## Interpreting the LEDs

### Module STATUS LED

The STATUS LED is located on the front of the linking device, between the two Fieldbus connectors, as shown in Figure 1.2. It indicates whether the linking device is powered, configured, and operating properly. Table 2.A shows how to interpret the STATUS LED states.

**Table 2.A Interpretation of ControlNet Module STATUS LED**

LED State	Meaning
Off	No power to linking device
Flashing red and green	Linking device self testing
Flashing green	Standby state
Solid green	Operational state
Flashing red	Major recoverable fault
Solid red	Major unrecoverable fault

Standby state indicates the linking device has passed all self tests and is ready to operate. Yet, it is not functioning because of a lack of configuration.

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



## ControlNet Network Status LEDs

The ControlNet network status LEDs are located on the front of the linking device, beside the ControlNet BNC connectors, as shown in Figure 1.2. They indicate the state of the ControlNet connected to the BNC connectors. These LEDs do not reflect anything about the status of the network if the linking device is connected to the network through 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 2.B describes the LED states and the priority of each status.

**Table 2.B Description of ControlNet Network Status LED States**

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

## Fieldbus Network Status LEDs

Each Fieldbus port on the linking device has an LED to indicate the functional states of the port. Table 2.C describes each state.

**Table 2.C Description of Fieldbus Network Status LED States**

LED State	Meaning
Off	Fieldbus port not receiving packets
Steady green	Fieldbus port is alive as Link Active Scheduler
Flashing red and green	Fieldbus port is seeing traffic, but is at a default or visitor address
Flashing red	Fieldbus port encountered transient, non-fatal network error
Steady red	Fieldbus port encountered fatal network error

**Notes:**

## Software Installation and Configuration

### Installing the NI-FBUS Configurator Software

After you have configured and installed the linking device, you are ready to install the NI-FBUS Configurator software.

Complete the following steps to install the NI-FBUS Configurator software:

1. Determine the ControlNet network address of the linking device or devices from rotary address switches. Refer to Figure 2.5.
2. Using Windows NT, log in as Administrator or as a user that has administrator privileges.
3. Insert installation diskette 1 into an unused drive.
4. Run Add/Remove Programs from the control panel or select Start—>Run, and type:

`x:\setup`

where *x* is the letter of the drive containing the installation diskette (usually a or b).

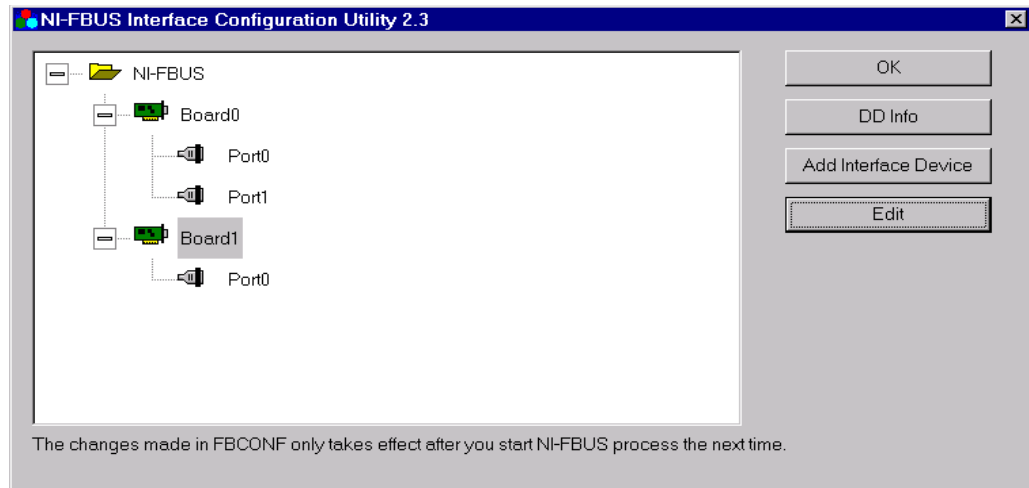
The interactive setup program takes you through the necessary steps to install the software.

By default, the installation program installs the software in the `nifbus` directory. You can change the directory if you want to install the NI-FBUS software into a different directory.

The installation program copies `nifb.dll` and `drvintf.dll` into your Windows directory and adds information to the Windows NT registry.

After installing the software components to the appropriate directories, the installer starts the NI-FBUS Interface Configuration Utility as shown in Figure 3.1. To reach this program after initial installation, click on the Windows Start icon, point to Programs, point to National Instruments FBUS, and select Interface Config.

**Figure 3.1 Interface Configuration Utility**



## Configuring the NI-FBUS Configurator Software

### Configuring the Interface Address

To add, view, or change the interface address of the linking device, complete the following steps:

1. In the NI-FBUS Interface Configuration Utility window, select the icon for the linking device you want to change and click on the **Edit** button. If you are adding a linking device, click on the **Add Interface Device** button. The Interface dialog box appears.

The screenshot shows the 'Interface' dialog box. It has a title bar with the text 'Interface' and a close button. The main area contains several fields and buttons. On the left, a vertical list of numbered circles (2 through 7) corresponds to the fields. Field 2 is 'InterfaceType' with three radio buttons: 'ISA', 'PCMCIA', and 'CONTROLNET' (which is selected and has a dashed border). To the right of these are 'Add' and 'Cancel' buttons, with a circled number 8 next to the 'Cancel' button. Field 3 is 'Driver' with a text box containing 'AB\_KTC-1'. Field 4 is 'Network Address' with an empty text box. Field 5 is '# of Ports' with a dropdown menu showing '1'. Field 6 is 'Path' with a text box containing '02'. Field 7 is 'Timeout (ms)' with a text box containing '6000'.

2. In the Interface Type field, choose the ControlNet radio button. The utility displays the ControlNet network address and path to the selected linking device.
3. In the Driver field, type the driver name that RSLinx uses to communicate with your ControlNet PC interface. The default driver, AB\_KTC-1, uses an Allen-Bradley 1784-KTC15 interface card.
4. In the Network Address field, enter the ControlNet node number of the linking device you are configuring.
5. In the # of Ports field, select the number of Fieldbus ports that matches the linking device.

6. In the Path field, enter 02, the default path, indicating NI-FBUS uses the ControlNet port on an Allen-Bradley PC ControlNet interface card. The path is comprised of ASCII encoded hexadecimal bytes, separated by spaces, required to reach the destination linking device.
7. In the Timeout field, specify a timeout (in milliseconds) for communication with the linking device. The default value is most likely adequate. However, if you encounter communication errors, increasing the timeout may solve the problem.
8. If you want to accept these settings to communicate with the listed linking device, choose Add; if you want to abort these settings, choose Cancel.
9. Repeat steps 1 through 8 for each linking device in your system.

### Configuring the Interface Name

To configure the interface name, follow these steps:

1. To change the interface name of a Fieldbus in a linking device, click on the port icon and click on the **Edit** button. The interface configuration utility displays the current port configuration.

The screenshot shows a Windows-style dialog box titled "Port". It has a standard title bar with a close button (X). The dialog is divided into several sections. The "Interface Name" section has a text box containing "interface0-0" and an "OK" button. The "Device Tag" section has an empty text box and a "Cancel" button. The "Device Address" section includes a "type" label and three radio buttons: "Fixed" (which is selected), "Default", and "Visitor". Next to these radio buttons is an empty text box. The "Usage" section has two radio buttons: "NI-FBUS" (selected) and "Bus Monitor". To the right of the "Device Address" section is an "Advanced ..." button.

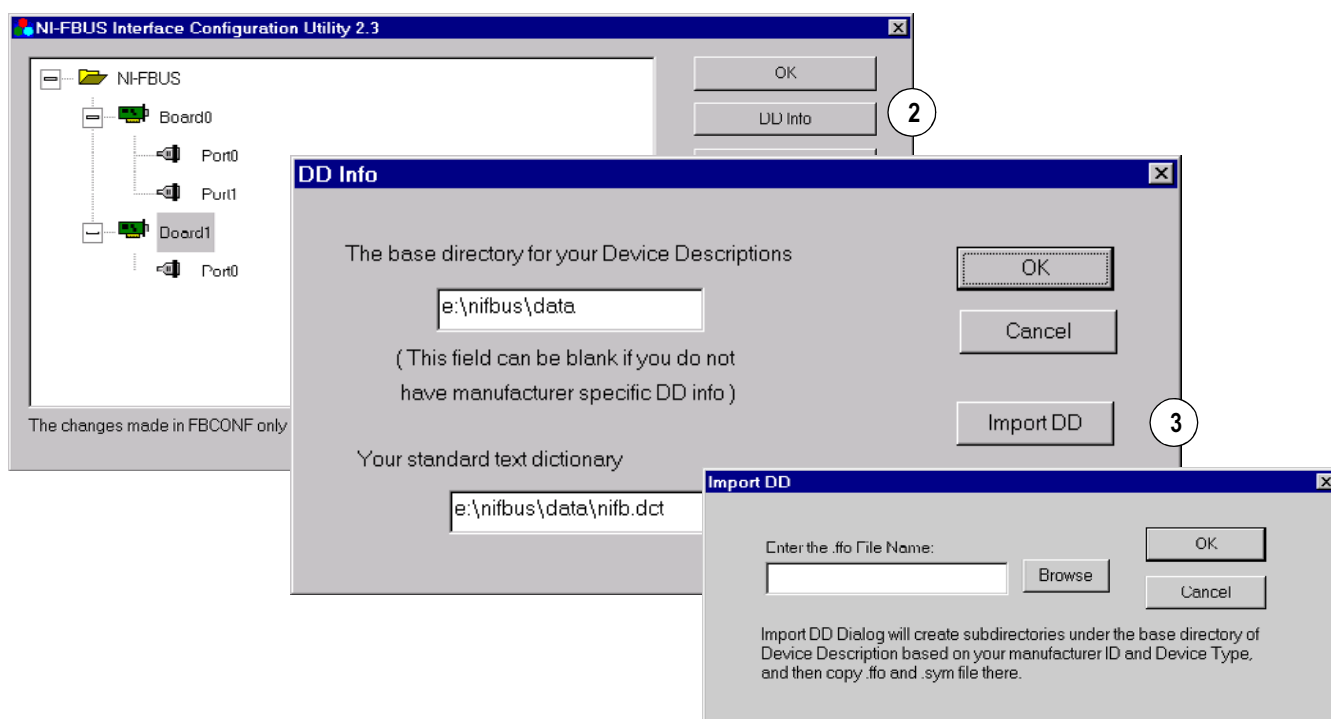
2. Enter the logical interface name for the port in this dialog. The logical interface name must be unique within a PC, but the same linking device may be referenced by different interface names in different PCs.

## Installing Device Descriptions

Device descriptions describe functionality of Fieldbus devices using the Fieldbus Device Description Language. Device Descriptions must be provided to NI-FBUS for all attached Fieldbus devices. NI-FBUS includes many standard DDs. Most devices contain custom functionality; therefore, you should install the DD for all attached Fieldbus devices.

The linking device is shipped with the “Linking Device Setup” disk containing its device description. To install device descriptions, follow these steps:

1. Insert the disk in an unused drive.
2. Click on the **DD Info** button in the NI-FBUS Interface Configuration Utility screen..



The DD Info dialog box appears. If this is the first time you have installed a device description, the base directory edit box will be empty. We recommend that you enter the same directory as the location of your standard text dictionary—in this example, e:\nifbus\data.

3. Click on **Import DD**.

The Import DD dialog box appears. The path to the DD typically uses a hierarchy of directories indicating vendor ID, product code, and product revision. Select the DD (.ffo file) path from the support disk of the Fieldbus device. NI-FBUS installs the DD in the base directory that you specified.

## Configuring Fieldbus Communication Parameters

Each Fieldbus device must have a unique address within one Fieldbus network. It must also have a unique physical device tag. Each Fieldbus port of the linking device is considered a Fieldbus device. Therefore, each Fieldbus port must have its own address and tag. The linking device is shipped with all the Fieldbus ports set to the default address and without any physical device tag.

You must assign a tag and address to a port before using it to communicate with other Fieldbus devices connected to the Fieldbus network. Use the NI-FBUS Configurator to do this. See the sections on setting tags and addresses in the NI-FBUS Configurator User Manual, publication 1788-6.5.2.

## Using the NI-FBUS Interface Configuration Utility After Installation

You should use the NI-FBUS interface configuration utility after installation to:

- add or remove a linking device
- change the software settings to match the linking device settings
- view or change the software settings

The NI-FBUS interface configuration utility prompts you to provide the following information:

- Hardware information
  - number of linking devices
  - ControlNet network address of each linking device
  - path to each linking device
- Logical name for each Fieldbus port; you can use this information to access the port using the logical name
- Device Description (DD) information
  - base directory to store your DD information
  - location of the standard text dictionary

If you change the base directory or location of the standard text dictionary, you must copy all the DDs from the old base directory to the new one. To install a new device description, click on **Import DD** and follow the instructions.



---

## Testing the Installation

Make sure that you have installed and configured the RSLinx software and an Allen-Bradley PC ControlNet interface. The NI-FBUS Configurator requires these components to interact with the linking device.

To make sure that your NI-FBUS software is correctly installed and is working properly, follow these steps:

1. Restart Windows NT.
2. Start the NI-FBUS Communications Manager by selecting the NIFB icon in the NI-FBUS menu.

On successful startup, NI-FBUS displays a message saying that NIFB started up successfully, and the title bar of the window changes to NIFB (running).

**Notes:**

## **Using the ControlNet-to-FOUNDATION Fieldbus H1 Linking Device**

This chapter describes:

- the blocks in the linking device
- configuring the linking device to access the AI, AO, DI, DO function blocks on the Fieldbus network from ControlNet
- attributes of the created ControlNet objects, assembly objects, alarm handling
- ControlNet connection details

### **Blocks in the Linking Device**

The linking device is similar to an I/O subsystem. An I/O subsystem typically contains several I/O modules. Each module has a number of channels. The channels perform either analog input, analog output, discrete input, or discrete output functions. The linking device models the I/O modules in software. The linking device has four types of function blocks:

- Multiple Analog Input (MAI)
- Multiple Analog Output (MAO)
- Multiple Discrete Input (MDI)
- Multiple Discrete Output (MDO)

Each of these function blocks has eight channels. Each channel is a combination of a value and Fieldbus status.

You can connect an analog input function block on the Fieldbus network to a channel on the MAI block, just as you would wire a 4-20ma analog input to an analog channel in your I/O subsystem. The main difference is that the Fieldbus function blocks do considerable processing. The channel value represents a scaled value in engineering units. Each value has an associated status. The status is more than a boolean of good or bad. It has four major status values of Good or Bad, with 16 sub-status values for each major status, and four limits.

## Analog Inputs

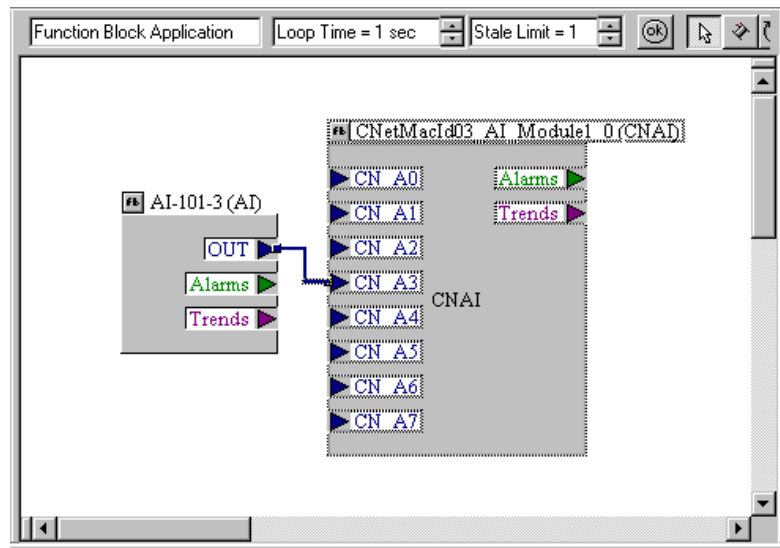
This section describes configuration of the linking device to access any analog value (and status) in a Fieldbus device. It also describes the attributes of the created ControlNet analog input object.

The linking device contains a number of MAI block instances. Each instance of the MAI block is the software equivalent of an analog input module in an I/O subsystem. Each MAI block has eight channels, with each channel containing a float and a status pair. The linking device assigns a tag to each MAI block in the form CNetMacIdxx\_AI\_Module*i*-*j*, where *xx* is the ControlNet network address, *i* is the Fieldbus channel number, and *j* is the module or instance number.

### Configuration of Analog Inputs

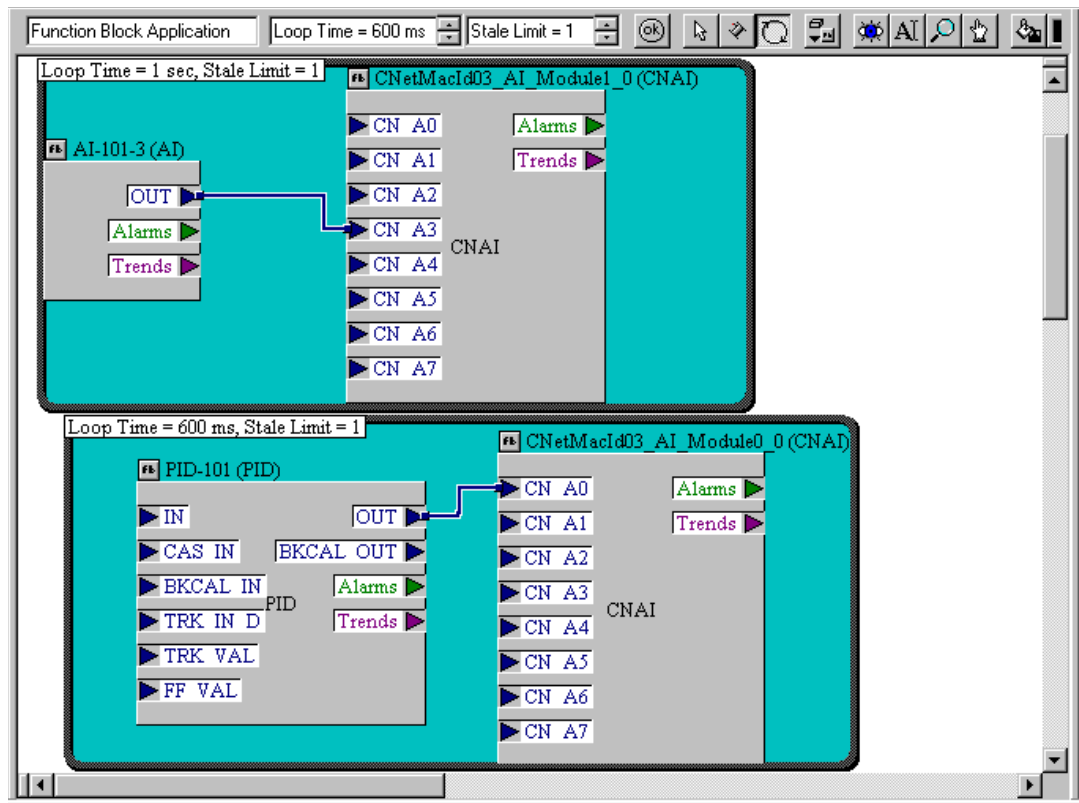
When the NI-FBUS Configurator is started, and continuously thereafter, it lists all the devices and the function blocks in each device in its browse window. This includes the AI function blocks in the Fieldbus devices and the MAI function blocks in the linking device. You must connect the Fieldbus AI function blocks that will be accessed by ControlNet controllers (or devices) to the MAI channels, as shown in Figure 4.1.

**Figure 4.1 Sample Single Macrocycle MAI Configuration**



The NI-FBUS Configurator sets up the analog input devices to publish their data on Fieldbus. The linking device MAI block subscribes to these values and produces them on ControlNet. Each MAI block has its own schedule of subscribing on Fieldbus and producing on ControlNet. For different rates (macrocycle) of production on ControlNet, you must choose different MAI blocks as shown in the Figure 4.2.

**Figure 4.2 Sample Multiple Macrocycle MAI Configuration**



You do not have to connect to all the channels in an MAI block instance before using another instance. You do not have to use the channels in order. That is, you may use channels CN\_A0 and CN\_A5 and not use any of the others.

As shown in the lower loop of Figure 4.2, you can connect any parameter that is a float value and status combination to the MAI block. In other words, you can bring values from any function block to the PLC processor. The MAI block is not limited to interfacing with AI function blocks.

## ControlNet Analog Input Objects

The linking device creates an instance of a ControlNet AI object for every wired channel in the MAI block instances. Each instance of the ControlNet AI object has the attributes and access rules shown in Table 4.A.

**Table 4.A ControlNet Analog Input Object Attributes**

Attribute Number	Name	Type	Access	Initial Value	Remarks
3	Value	Float	Get	0	
4	CNStatus	Boolean	Get	Bad	ControlNet status. 0-Good; 1-Bad.
107	LoFlag	uint8	Get/Set	0	See Alarm Handling for Analog Inputs
108	HiFlag	uint8	Get/Set	0	See Alarm Handling for Analog Inputs
109	LoLoFlag	uint8	Get/Set	0	See Alarm Handling for Analog Inputs
110	HiHiFlag	uint8	Get/Set	0	See Alarm Handling for Analog Inputs
150	FFstatus	uint8	Get	Bad:Out of Service	Fieldbus status of the value; obtained from the Fieldbus device.
151	TagDesc	String	Get	As configured	Tag of the Fieldbus function block that is represented by this object instance.

All attributes in Table 4.A are created if a standard Fieldbus AI function block is connected to a channel of an MAI block. Otherwise, only Value, CNStatus, TagDesc, and FFstatus are created.

## Alarm Handling for Analog Inputs

You can configure Fieldbus AI function blocks to detect and report alarms.

Four process alarms (HI\_HI\_ALM, HI\_ALM, LO\_LO\_ALM, and LO\_ALM) are exposed through the ControlNet AI object. When you connect an AI function block to an MAI block, the NI-FBUS Configurator configures the field device to send the four alarms to the linking device.

In Fieldbus terminology, confirming an alarm means that the alarm has been received by an operator, and acknowledging an alarm means that the operator has taken the necessary action.

When an alarm condition is detected by a Fieldbus function block, the alarm is said to be ACTIVE. An active alarm should be Acknowledged and Confirmed after the condition causing the alarm is corrected. When the function block detects the alarm condition is no longer present, the alarm is said to be CLEARED. The CLEARED state must be Confirmed when it is detected. Users of the LD use the alarm attributes to process Fieldbus alarms.

Each attribute corresponding to a process alarm has the three alarm-related bits as shown in Figure 4.3.

**Figure 4.3 Alarm Attribute Definition**

Bit Position	7	6	5	4	3	2	1	0
Value	X	X	X	X	X	Acknowledge	CLEARED	ACTIVE

Bits 7-3, DON'T CARE, are undefined when read and should be ignored when performing a GET. The DON'T CARE bits should be written as 0 when performing a SET. Bit 2, Acknowledge, is undefined when read and should be ignored when performing a GET. When a user wants to Acknowledge an alarm, this bit should be written as a 1 when performing a SET. Each time the LD detects a 1 in the Acknowledge position, a Fieldbus Acknowledge will be generated. Therefore, users must be careful not to set the Acknowledge bit more than once per alarm. Bits 1 and 0, CLEARED and ACTIVE respectively, are read/write bits. When an alarm condition is ACTIVE or CLEARED, these bits are read as a 1 when performing a GET. The user must Confirm each of these states by writing them to a 0 by a SET. Once an alarm has occurred (become ACTIVE), alarm processing is NOT complete until the user intervenes to remove the alarm condition, Acknowledges the alarm (writing a 1 in the Acknowledge bit position), Confirms the alarm (writing a 0 to the ACTIVE bit position once it is read as a 1), and Confirms the alarm condition being CLEARED (writing a 0 to the CLEARED bit position once it is read as a 1).

## Analog Outputs

This section describes configuration of the linking device to control any analog value (and status) in a Fieldbus device, such as in a Analog Output (AO) function block. It also describes the attributes of the created ControlNet analog output object.

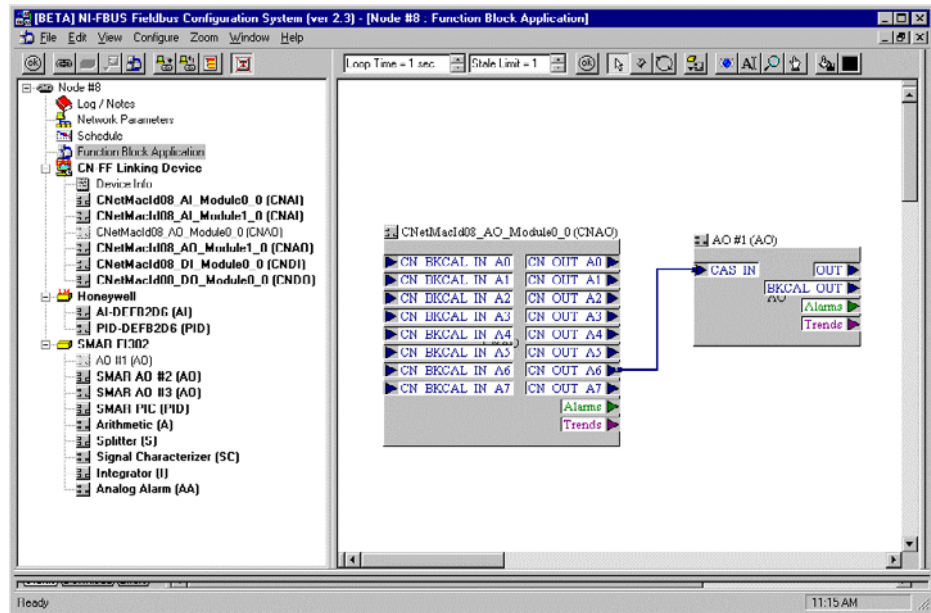
The linking device contains a number of MAO block instances. Each instance of the MAO block is the software equivalent of an analog output module in an I/O subsystem. Each MAO block also has eight channels or outputs, with each channel containing a float and a status pair. Each MAO block has eight inputs to provide for the BKCAL or readback from the analog output function blocks. The linking device assigns a tag to each MAO block in the form CNetMacId $_{xx}$ \_AO\_Module $_{i-j}$ , where  $xx$  is the ControlNet network address,  $i$  is the Fieldbus channel number, and  $j$  is the module or instance number.

### Configuration of Analog Outputs

The NI-FBUS Configurator lists all the devices and the function blocks in each device in its browse window. This includes the AO function blocks in the Fieldbus devices and the MAO function blocks in the linking device. You must connect the Fieldbus AO function blocks that will be controlled by the ControlNet controllers (or devices) to the MAO channels.

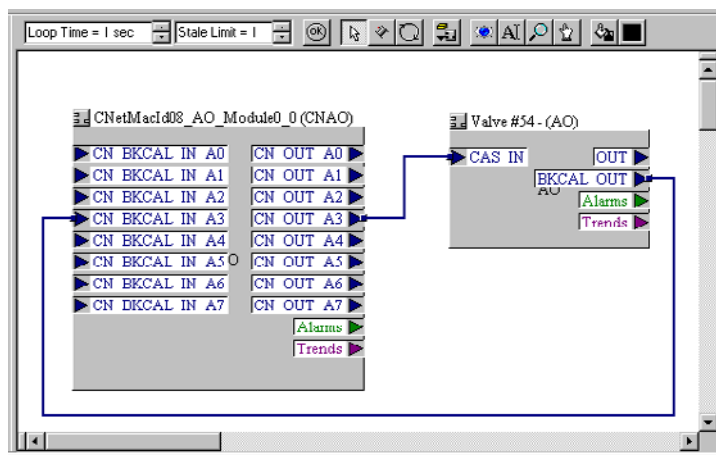
The MAO function block has two valid configurations. In the first configuration the BKCAL\_OUT parameter of the AO is not connected back to the controller. In this case, there is no mode handshake provided by the upstream controller for cascade initialization of the AO. You connect only the CN\_OUT\_Ax parameter from the MAO to the CAS\_IN of the AO block as shown in Figure 4.4. In this case, you must not connect the BKCAL\_OUT parameter of the AO to the BKCAL\_INx parameter of the MAO block.

**Figure 4.4 Sample Non-Cascade AO Configuration**

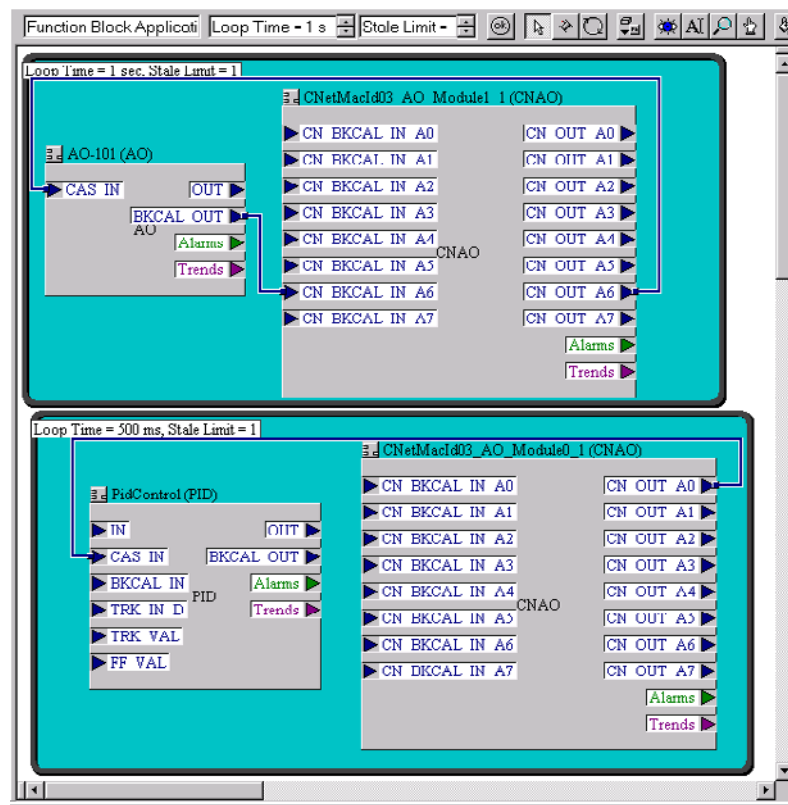


In the second configuration the controller provides the necessary mode handshake for cascade initialization of the AO block. In this case, you must connect CN\_OUT\_Ax of the MAO block to CAS\_IN of the AO block, and BKCAL\_OUT of the AO block to BKCAL\_IN\_Ax of the MAO block, as shown in Figure 4.5. Note that there is a strict ordering relationship between CN\_OUT\_Ax and CN\_BKCAL\_IN\_Ax parameters of the MAO block. That is, CN\_BKCAL\_IN\_A0 is associated with CN\_OUT\_A0, CN\_BKCAL\_IN\_A1 with CN\_OUT\_A1, and so on.



**Figure 4.5 Sample Cascaded AO Configuration**

The linking device consumes analog values produced by the controller on ControlNet and publishes these values on Fieldbus. The NI-FBUS Configurator sets up the analog output devices to subscribe to their data on Fieldbus. Each MAO block has its own schedule to consume data on ControlNet and publish it on Fieldbus. For different rates of publishing on Fieldbus, you must choose different MAO blocks as shown in Figure 4.6.

**Figure 4.6 Sample Multiple Macrocycle AO Configuration**

You do not have to connect to all the channels in an MAO block instance before using another instance. You do not have to use the channels in order.

That is, you may use channels CN\_OUT\_A3 and CN\_OUT\_A5 and not use any of the others.

As shown in the lower loop of Figure 4.6, you can connect the MAO block to any parameter that is a float value and status combination. In other words, you can bring values from a PLC processor to any function block. The MAO block is not limited to interfacing with AO function blocks.

## ControlNet Analog Output Objects

The linking device creates an instance of a ControlNet AO object for every wired channel in the MAO block instances. Each instance of the ControlNet AO object has the attributes and access rules shown in Table 4.B.

**Table 4.B ControlNet Analog Output Object Attributes**

Attribute Number	Name	Type	Access	Initial Value	Remarks
3	Value	Float	Set	0	This is written from the ControlNet side.
4	CNStatus	Boolean	Set	Bad	ControlNet status. 0-Good; 1-Bad.
11	FailStateValue	Float	Set	0	The linking device writes the value to the AO block when this attribute is changed by the controller.
151	TagDesc	String	Get	As configured	Tag of the Fieldbus function block that this object instance represents.
152	FailstateTime	Float	Set	0	The linking device writes the value to the AO block when this attribute is changed by the controller.
153	ReadBack	Float	Get	0	This represents the BKCAL_OUT value from the AO block.
154	BkCalStatus	uint8	Get	Bad:Not-Connected	This represents the status of the Readback attribute.
155	casInstatus	uint8	Set	Bad:Not-connected	This represents the status of the CAS_IN to the AO block.

Note that BkCalStatus is created only when the controller is capable of participating in the CAscade initialization handshake and when the BKCAL\_OUT of the AO block is wired to a BKCAL\_INx parameter of the MAO block.

Only Value, CNStatus, casInstatus, ReadBack, and TagDesc are created when an MAO is connected to something other than an AO function block CAS\_IN parameter.

## Discrete Inputs

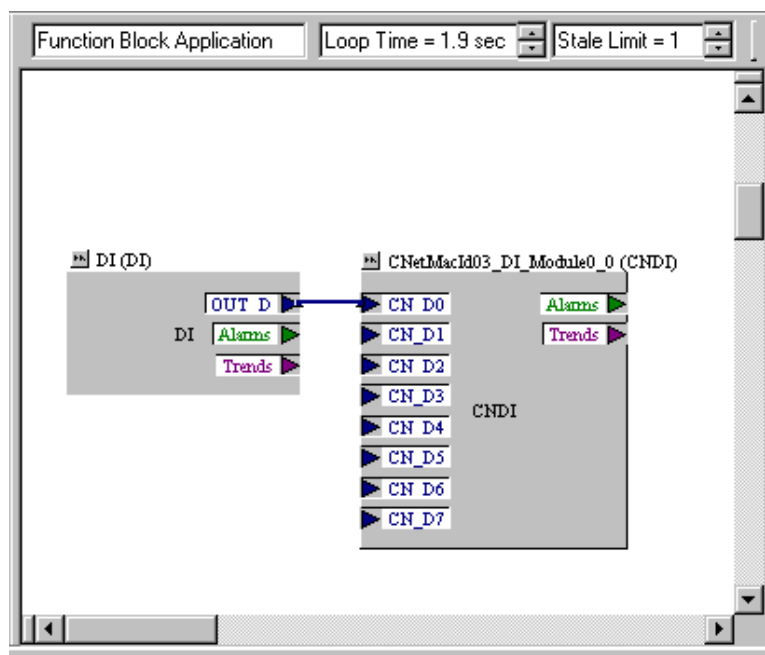
This section describes configuration of the linking device to access any discrete value (and status) in a Fieldbus device. It also describes the attributes of the created ControlNet discrete input object.

The linking device contains a number of MDI block instances. Each instance of the MDI block is the software equivalent of a discrete input module in a I/O subsystem. Each MDI block has eight channels, with each channel containing a byte and a status pair. The linking device assigns a tag to each MDI block in the form CNetMacId $xx\_DI\_Modulei-j$ , where  $xx$  is the ControlNet network address,  $i$  is the Fieldbus channel number, and  $j$  is the module or instance number.

## Configuration of Discrete Inputs

The NI-FBUS Configurator lists all the devices and the function blocks in each device in its browse window. This includes the DI function blocks in the Fieldbus devices and the MDI function blocks in the linking device. You must connect the Fieldbus DI function blocks that will be accessed by the ControlNet controllers (or devices) to the MDI channels as shown in Figure 4.7. The remaining configuration is similar to that for the analog inputs.

**Figure 4.7 Sample Single Macrocycle MDI Configuration**



## ControlNet Discrete Input Objects

The linking device creates an instance of a ControlNet DI object for every wired channel in the MDI block instances. Each instance of the ControlNet DI object has the attributes and access rules shown in Table 4.C.

**Table 4.C ControlNet Discrete Input Object Attributes**

Attribute Number	Name	Type	Access	Initial Value	Remarks
3	Value	Boolean	Get	0	
4	CNStatus	Boolean	Get	Bad	ControlNet status. 0-Good; 1-Bad.
150	Ffstatus	uint8	Get	Bad: Out of Service	Fieldbus status of the value; obtained from the Fieldbus device.
151	TagDesc	String	Get	As configured	Tag of the Fieldbus function block that is represented by this object instance.
156	DiscAlmFlag	uint8	Get/Set	0	See Alarm Handling for Discrete Inputs

All attributes in Table 4.C are created if a standard Fieldbus DI function block is connected to a channel on an MDI block. Otherwise, DiscAlmFlag is not created.

## Alarm Handling for Discrete Inputs

You can configure Fieldbus DI function blocks to detect and report alarms.

The process alarm (DISC\_ALM) are exposed through the ControlNet DI object. When you connect a DI function block to an MDI block, the NI-FBUS Configurator configures the field device to send the alarm to the linking device.

In Fieldbus terminology, confirming an alarm means that the alarm has been received by an operator, and acknowledging an alarm means that the operator has taken the necessary action.

When an alarm condition is detected by a Fieldbus function block, the alarm is said to be ACTIVE. An active alarm should be Acknowledged and Confirmed after the condition causing the alarm is corrected. When the function block detects the alarm condition is no longer present, the alarm is said to be CLEARED. The CLEARED state must be Confirmed when it is detected. Users of the LD use the alarm attributes to process Fieldbus alarms.

Each attribute corresponding to a process alarm has the three alarm-related bits as shown in Figure 4.8.

**Figure 4.8 Alarm Attribute Definition**

Bit Position	7	6	5	4	3	2	1	0
Value	X	X	X	X	X	Acknowledge	CLEARED	ACTIVE

Bits 7-3, DON'T CARE, are undefined when read and should be ignored when performing a GET. The DON'T CARE bits should be written as 0 when performing a SET. Bit 2, Acknowledge, is undefined when read and should be ignored when performing a GET. When a user wants to Acknowledge an alarm, this bit should be written as a 1 when performing a SET. Each time the LD detects a 1 in the Acknowledge position, a Fieldbus Acknowledge will be generated. Therefore, users must be careful not to set the Acknowledge bit more than once per alarm. Bits 1 and 0, CLEARED and ACTIVE respectively, are read/write bits. When an alarm condition is ACTIVE or CLEARED, these bits are read as a 1 when performing a GET. The user must Confirm each of these states by writing them to a 0 by a SET. Once an alarm has occurred (become ACTIVE), alarm processing is NOT complete until the user intervenes to remove the alarm condition, Acknowledges the alarm (writing a 1 in the Acknowledge bit position), Confirms the alarm (writing a 0 to the ACTIVE bit position once it is read as a 1), and Confirms the alarm condition being CLEARED (writing a 0 to the CLEARED bit position once it is read as a 1).

## Discrete Outputs

This section describes configuration of the linking device to control any discrete value (and status) in a Fieldbus device, such as in a Discrete Output (DO) function block. It also describes the attributes of the created ControlNet discrete output object.

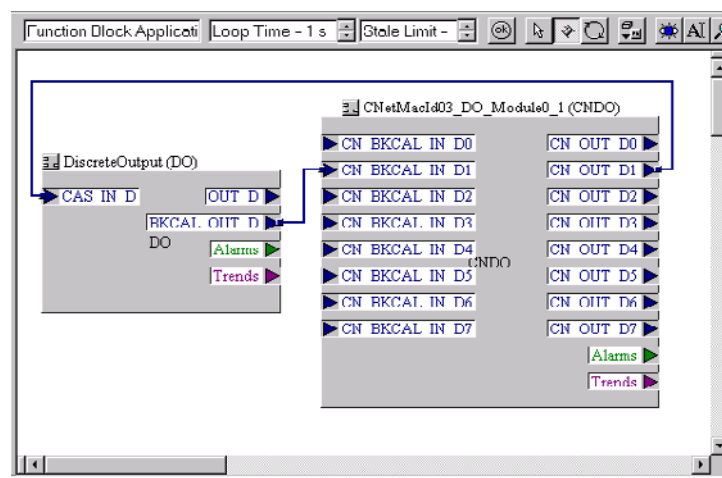
The linking device contains a number of MDO block instances. Each instance of the MDO block is the software equivalent of a discrete output module in a I/O subsystem. Each MDO block also has eight channels or outputs, with each channel containing a byte and a status pair. Each MDO block has eight inputs to provide for the BKCAL or readback from the discrete output function blocks. The linking device assigns a tag to each MDO block in the form CNetMacIdxx\_DO\_Module*i*-*j*, where *xx* is the ControlNet network address, *i* is the Fieldbus channel number, and *j* is the module or instance number.

### Configuration of Discrete Outputs

The NI-FBUS Configurator lists all the devices and the function blocks in each device in its browse window. This includes the DO function blocks in the Fieldbus devices and the MDO function blocks in the linking device. You must connect the Fieldbus DO function blocks that will be controlled by the ControlNet controllers (or devices) to the MDO channels.

The MDO function block has two valid configurations. In the first configuration the BKCAL\_OUT\_D parameter of the DO is not connected back to the controller. In this case, there is no mode handshake provided by the upstream controller for cascade initialization of the DO. You connect only the CN\_OUT\_Dx parameter from the MDO to the CAS\_IN\_D of the DO block. In this case, you must not connect the BKCAL\_OUT\_D parameter of the DO to the BKCAL\_INn parameter of the MDO block.

**Figure 4.9 Sample Cascade DO Configuration**



In the second configuration, shown in Figure 4.9, the controller provides the necessary mode handshake for cascade initialization of the DO block. In this case, you connect CN\_OUT\_Dx of the MDO block to the CAS\_IN\_D parameters of the DO block, and the BKCAL\_OUT\_D parameter of the DO block to BKCAL\_INn of the MDO block. Note that there is a strict ordering relationship between the CN\_OUT\_Dx and CN\_BKCAL\_IN\_Dx parameters of the MDO block, that is, CN\_BKCAL\_IN\_D0 is associated with CN\_OUT\_D0, CN\_BKCAL\_IN\_D1 with CN\_OUT\_D1, and so on.

You can connect the MDO block to any parameter that is a byte value and status combination. In other words, you can bring values from a PLC processor to any function block. The MDO block is not limited to interfacing with DO function blocks.

### ControlNet Discrete Output Objects

The linking device creates an instance of a ControlNet DO object for every wired channel in the MDO block instances. Each instance of the ControlNet DO object has the attributes shown in Table 4.D.

**Table 4.D ControlNet Discrete Output Object Attributes**

Attribute Number	Name	Type	Access	Initial Value	Remarks
3	Value	Boolean	Set	0	This is written from the ControlNet side.
4	CNStatus	Boolean	Set	Bad	ControlNet status. 0-Good; 1-Bad.
6	FailStateValue	uint8	Set	0	The linking device writes the value to the DO block when this attribute is changed by the controller.
151	TagDesc	String	Get	As configured	Tag of the Fieldbus function block that this object instance represents.
152	FailstateTime	Float	Set	0	The linking device writes the value to the DO block when this attribute is changed by the controller.
153	ReadBack	uint8	Get	0	This represents the BKCAL_OUT_D value from the DO block.
154	BkCalStatus	uint8	Get	Bad:Not-Connected	This represents the status of the Readback attribute.
155	casInstatus	uint8	Set	Bad:Not-connected	This represents the status of the CAS_IN_D to the DO block.

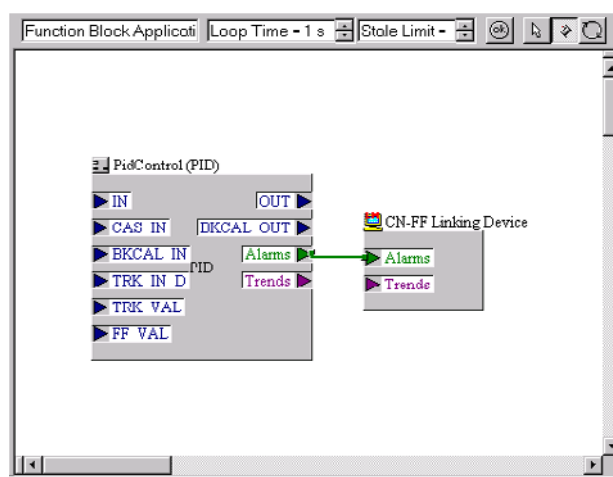
Note that BkCalStatus is created only when the controller is capable of participating in the CAScade initialization handshake, that is, when the BKCAL\_OUT\_D of the DO block is wired to a BKCAL\_INx parameter of the MDO block.

Only Value, CNStatus, casInstatus, ReadBack, and TagDesc are created when an MDO channel is connected to something other than a DO function block CAS\_IN\_D parameter.

## Alarm Handling by the HMI

The linking device makes the process alarms from AI and DI function blocks visible as attributes of the created ControlNet objects, as discussed in the previous sections. Fieldbus devices generate other types of alarms; for example, they send out an alarm whenever their static configuration changes. Other function block types also generate alarms. In general all alarms, except the AI and DI process alarms, must be handled by a Fieldbus HMI. You must configure the linking device to receive such alarms and forward them to a PC-based HMI on ControlNet. You set up the linking device as shown in Figure 4.10.

**Figure 4.10 Setting Up an Alarm**



If you connect the AI and DI alarms to the linking device, the linking device forwards all alarms from these to the HMI. The process alarms are also visible to your PLC processor through the ControlNet objects. You must ensure, through your application design, that either the HMI or the PLC processor acknowledges the process alarms.

## Assembly Objects

For each channel that you connect on the MAI, MAO, MDI, and MDO blocks, the linking device creates an instance of a ControlNet object corresponding to the type of channel. These individual instances are useful for unscheduled querying and setting object information. For scheduled communications on ControlNet, the linking device takes specific attributes from the corresponding object instances and combines them into input and output assembly objects.

The linking device uses input assembly objects to produce data on ControlNet and output assembly objects to consume data from ControlNet. The definition of assembly objects is determined after you configure the MAI, MAO, MDI and MDO blocks on the linking device. Assembly offsets are 0 based and increment by the size of data placed into them.



Table 4.E describes the attributes placed into the input and output assembly for each object type.

**Table 4.E Attributes in Input and Output Assemblies**

Object Type	Attributes in Input Assembly	Attributes in Output Assembly
AI	3, 4, 150	
AO (CASCade initialization)	153, 154	3, 4, 155
AO (NO CASCade initialization)	153	3, 4, 155
DI	3, 4, 150	
DO (CASCade initialization)	153, 154	3, 4, 155
DO (NO CASCade initialization)	153	3, 4, 155

## MAI Blocks

For each MAI block configured in the linking device beginning with the lowest numbered module, each channel that is connected to a Fieldbus function block has attributes 3, 4, and 150 placed into the required input assembly object. Each MAI channel requires 6 bytes in the input assembly object.

## MAO Blocks

For each MAO block configured in the linking device beginning with the lowest numbered module, each channel that is connected to a Fieldbus function block has attributes 3, 4, and 155 placed into the required output assembly object. Additionally, if your controller participates in cascade initialization for a specific channel (wiring BKCAL\_OUT from AO), attribute 154 is placed into the required input assembly. Each MAO channel requires 6 bytes in the output assembly object and 6 bytes in the input assembly, if cascade initialization is performed—4 bytes in the input assembly if cascade initialization is *not* performed.

## MDI Blocks

For each MDI block configured in the linking device beginning with the lowest numbered module, each channel that is connected to a Fieldbus function block has attributes 3, 4, and 150 placed into the required input assembly object. Each MDI requires 4 bytes in the input assembly object.

## MDO Blocks

For each MDO block configured in the linking device beginning with the lowest numbered module, each channel that is connected to a Fieldbus function block has attributes 3, 4, and 155 placed into the required output assembly object. Additionally, if your controller participates in cascade initialization for a specific channel (wiring BKCAL\_OUT\_D from DO), attribute 154 is placed into the required input assembly. Each MDO channel requires 2 bytes in the input assembly object, and 4 bytes in the output assembly object, if cascade initialization is performed—2 bytes if cascade initialization is *not* performed.

## Viewing Object Information in the NI-FBUS Configurator

The NI-FBUS Configurator can display information about the ControlNet objects created inside the linking device. This information contains the layouts and instance numbers of the input and output assembly objects as well as instance numbers of the base ControlNet objects created. To display this information, view the Device Info for the linking device in question. You can view the Device information in the NI-FBUS Configurator from the browse window. A sample Device Info display is shown in Figure 4.11.

To print the Device Info, put the cursor on the display of the Device Info that is shown in Figure 4.11, and click on Print, under the File menu. Note, if the cursor is not on the Device Info display, when you click on Print, you will be given an extensive menu of other items that you may print, but no listing for the Device Info.

Figure 4.11 Sample NI-FBUS Configurator View of ControlNet Object Information

**[BETA] NI-FBUS Fieldbus Configuration System (ver 2.3) - [CN-FF Linking Device : Device Info]**

File Edit View Device Info Configure Window Help

CN-FF Linking Device - ID=NIC\_CN-FF/2\_00ACD5FA\_0:

INPUT Assembly

FieldbusTag	Module/Channel	Instance	Handshake	Attribute	Offset	Length	Data Type
Pot 3 TEMP	AI_Module0_0	0	2	VALUE	6	4	CNFLOAT
				CNSTATUS	10	1	CNBOOL
				FFSTATUS	11	1	CNUSINT
Pot 3 Press	AI_Module0_0	7	1	VALUE	0	4	CNFLOAT
				CNSTATUS	4	1	CNBOOL
				FFSTATUS	5	1	CNUSINT
Valve #54 -	AO_Module0_0	0	1	TRUE	FFREADBCK	12	4
					FFBKCALSTATUS	16	1
Valve #7	AO_Module0_0	1	2	TRUE	FFREADBCK	18	4
					FFBKCALSTATUS	22	1
Drive #11	AO_Module0_0	2	3	TRUE	FFREADBCK	24	4
					FFBKCALSTATUS	28	1

OUTPUT Assembly

FieldbusTag	Module/Channel	Instance	Handshake	Attribute	Offset	Length	Data Type
Valve #54 -	AO_Module0_0	0	1	VALUE	0	4	CNFLOAT
				CNSTATUS	4	1	CNBOOL
				FFCASINSTATUS	5	1	CNUSINT
Valve #7	AO_Module0_0	1	2	VALUE	6	4	CNFLOAT
				CNSTATUS	10	1	CNBOOL
				FFCASINSTATUS	11	1	CNUSINT
Drive #11	AO_Module0_0	2	3	VALUE	12	4	CNFLOAT
				CNSTATUS	16	1	CNBOOL
				FFCASINSTATUS	17	1	CNUSINT

Status\Download\Errors

Ready

1:14 PM

## Changing the Linking Device Configuration

Once a configuration is created in the linking device and a PLC processor or PC is using the offsets previously defined, an addition to the configuration should not require you to change functioning code in your application. For this reason, once a configuration has been stored into the linking device, if the user wires more Fieldbus devices with NI-FBUS, additional object instances are created and additional offsets are *appended* to the assembly objects; the existing instances of ControlNet objects and assembly offsets are unchanged. The individual instances increment from the last one used in the category. The offsets within the assembly objects are assigned in the same order as described previously, but are placed after existing offsets. For example, assume you have two MAI channels and one MDO channel with cascade initialization. The instances and offsets are created. Sometime later, you need to add an additional MAI channel and two MAO channels to your configuration. These additions are placed *after* the final MDO from the previous configuration.

Because existing programs may be using a configuration, the deletion of a linkage from a Fieldbus network does not result in a renumbering of ControlNet objects or a reordering of the assembly object offsets. If the Fieldbus device is no longer present, Fieldbus and ControlNet status indicates an error condition, and the object and assembly offset resources continue to be in use. In order to remove existing objects from a configuration, you must remove the existing configuration. To accomplish this, select Download Configuration in the NI-FBUS Configurator, enable the **Clear Devices** checkbox in the dialog box that appears, and download a new configuration.



## Trends and Alarms

The linking device can receive trends and alarms from connected Fieldbus devices.

Use NI-FBUS configurator to connect trends and alarms to the linking device. Within the function block application, drag the linking device icon from the browse window. Connect trends and alarms as necessary from Fieldbus devices to the trends or alarms inputs. Refer to the NI-FBUS Configurator User Manual, publication 1788-6.5.2, for additional information.

## Specifications

**Table A.A Linking Device Specifications**

Type	Specifications
Environmental	Operating Temperature: 0 to 60° C (32 to 140° F) Storage Temperature: -40 to 85° C (-40 to 185° F) Relative Humidity: 5 to 90% (non-condensing)
Vibration	Operating - 2Gs each axis Tested 2Gs @ 10 - 500 Hz per IEC 68-2-6
Communication	ControlNet - redundant media and network access port FOUNDATION Fieldbus H1, 2 independent channels LAS on both channels Time Master on both channels
Power Requirements	11-30V dc; 270 mA @ 24V dc (typical)
Indicators	Module Status Fieldbus Status, 1 each channel ControlNet Status, 1 each connection
Connectors	ControlNet - BNC connectors Network Access Port - RJ45 Fieldbus - 9-pin sub-D connectors
Conductors/Wire Size/Category	Category 2 <sup>1</sup>
Mounting	35 mm DIN rail
ControlNet Channel Selection	two 10-position rotary switches
Agency Certification (when product is marked)	 <ul style="list-style-type: none"> <li>Information Technology Equipment</li> <li>Industrial Control Equipment</li> <li>Class I, Div. 2, Groups A, B, C, D Hazardous Location</li> </ul>  <ul style="list-style-type: none"> <li>EN 50082-1, 2</li> <li>EN 55022, Radiated Emission Class B</li> <li>EN 61131-2</li> </ul> FCC Part 15, SubPart B

<sup>1</sup> Refer to the Industrial Automation Wiring and Grounding Guidelines for Noise Immunity, publication 1770-4.1.

## **Compliance to European Union Directives**

If this product has the **CE** marking, it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

### **EMC Directive**

This product is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2 EMC - Generic Emission Standard, Part 2 - Industrial Environment
- EN 50082-2 EMC - Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

### **Low Voltage Directive**

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 - Equipment Requirements and Tests.

For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- Industrial Automation Wiring and Grounding Guidelines for Noise Immunity, publication 1770-4.1
- Automation Systems Catalog, publication B111

This equipment is classified as open equipment and must be installed (mounted) in an enclosure as a means of providing safety protection.

---

**Hazardous Location Approval**

This product may be certified for general use as well as for use in hazardous locations. **Actual agency certification is indicated by the product label** as shown below, and not by statements in any user documentation.

Example of the certification product label:

CL I, DIV 2  
GP A,B,C,D  
TEMP



---

To comply with certification for use in hazardous locations, the following information becomes a part of the product literature for this certified industrial control product.

- This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D, or non-hazardous locations only.
- The products having the appropriate markings (that is, Class I, Division 2, Groups A, B, C, D) are certified for use in other equipment where the suitability of combination (that is, application or use) is determined by the local authority having jurisdiction.

---

**Important:** Due to the modular nature of a programmable control system, the product with the highest temperature rating determines the overall temperature code rating of a programmable control system in a Class I, Division 2, location. The temperature code rating is marked on the product label as shown.

Temperature code rating:

CL I, DIV 2  
GP A,B,C,D  
TEMP



Look for temperature  
code rating here.

---

The following warnings apply to products having certification for use in hazardous locations.



**ATTENTION:** Explosion hazard -

- Substitution of components may impair suitability for Class I, Division 2.
  - Do not replace components unless power has been switched off or the area is known to be non-hazardous.
  - Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
  - Do not disconnect connectors unless power has been switched off or the area is known to be non-hazardous. Secure any user-supplied connectors that mate to external circuits on this equipment by using screws, sliding latches, threaded connectors, or other means such that any connection can withstand a 15 Newton (3.4 lb.) separating force applied for a minimum of one minute.
-

### Approbation d'utilisation en environnements dangereux

Ce produit est certifié pour une utilisation générale aussi bien que pour une utilisation en environnements dangereux. **La certification en vigueur est indiquée par l'étiquette produit** et non par des indications dans la documentation utilisateur.

Exemple d'étiquette de certification d'un produit :

CL I, DIV 2  
GP A,B,C,D  
TEMP

Pour satisfaire à la certification en environnements dangereux, les informations suivantes font partie intégrante de la documentation des produits de commande industrielle certifiés.

- Cet équipement ne convient qu'à une utilisation en environnements de Classe 1, Division 2, Groupes A, B, C, D, ou non dangereux.
- Les produits portant le marquage approprié (c'est-à-dire, Classe 1, Division 2, Groupes A, B, C, D) sont certifiés pour une utilisation avec d'autres équipements, les combinaisons d'applications et d'utilisation étant déterminées par le bureau local d'inspection qualifié.

**Important :** De par la nature modulaire des systèmes de commande programmables, le produit ayant le code de température le plus élevé détermine le code de température global du système dans un environnement de Classe 1, Division 2. Le code de température est indiqué sur l'étiquette produit.

Code de température :

CL I, DIV 2  
GP A,B,C,D  
TEMP

Le code de température  
est indiqué ici

Les avertissements suivants s'appliquent aux produits certifiés pour une utilisation en environnements dangereux.

#### **DANGER :** Risque d'explosion



- La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe 1, Division 2.
- Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de remplacer des composants.
- Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement.
- Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs fournis par l'utilisateur pour se brancher aux circuits externes de cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres, de sorte que les connexions résistent à une force de séparation de 15 newtons (1,5 kg - 3,4 lb) appliquée pendant au moins une minute.



We use these abbreviations, acronyms, and initialisms throughout the document.

**AI**

Analog Input

**AO**

Analog Output

**CH**

Channel

**DD**

Device Description

**DI**

Discrete Input

**DO**

Discrete Output

**Fieldbus**

FOUNDATION Fieldbus H1

**H1**

31.25 Kbps Fieldbus

**HMI**

Human-Machine Interface

**MAI**

Multiple Analog Input

**MAO**

Multiple Analog Output

**MDI**

Multiple Discrete Input

**MDO**

Multiple Discrete Output

**PID**

Proportional Integral Derivative

**PLC**

Programmable Logic Controller

**Notes:**

**Numerics**

11-30V dc power supply 2-2  
1784-KTCX15 1-3  
1784-PCC 1-3

**A**

Alarm Handling by the HMI 4-14  
Alarm Handling for Analog Inputs 4-4  
Alarm Handling for Discrete Inputs 4-10  
Analog Inputs 4-2  
Analog Outputs 4-5  
Assembly Objects 4-14  
Attributes in Input and Output  
Assemblies 4-15

**B**

Blocks in the Linking Device 4-1

**C**

Changing the Linking Device  
Configuration 4-17  
Closed-loop Control 1-1  
Compatibility Information 1-4  
Configuration and Monitoring 1-2  
Configuration of Analog Inputs 4-2  
Configuration of Analog Outputs 4-5  
Configuration of Discrete Input 4-9  
Configuration of Discrete Outputs 4-12  
Configuring Fieldbus Communication  
Parameters 3-6  
Configuring the Interface Address 3-3  
Configuring the Interface Name 3-4  
Configuring the NI-FBUS Configurator  
Software 3-3  
Connecting Power 2-2  
Connecting to the ControlNet Network  
2-3  
Connecting to the Fieldbus Network 2-4  
ControlNet 2-5  
ControlNet Analog Input Object  
Attributes 4-4  
ControlNet Analog Input Objects 4-4  
ControlNet Analog Output Object  
Attributes 4-8  
ControlNet Analog Output Objects 4-8  
ControlNet Discrete Input Object  
Attributes 4-10  
ControlNet Discrete Input Objects 4-10

ControlNet Discrete Output Object  
Attributes 4-13  
ControlNet Discrete Output Objects 4-13  
ControlNet Network Address Switches  
Set to 15 2-5  
ControlNet Network Status LEDs 2-7  
custom function blocks 1-2

**D**

Description of ControlNet Network  
Status LED States 2-7  
Description of Fieldbus Network Status  
LED States 2-7  
Discrete Inputs 4-8  
Discrete Outputs 4-12

**F**

Fieldbus Connector Pinout for the  
Linking Device 2-4  
Fieldbus Connectors on the Linking  
Device 2-4  
Fieldbus Network Status LEDs 2-7

**G**

Glossary G-1

**H**

Handling the Linking Device 2-1  
Hardware 1-3  
Hardware Installation and Configuration  
2-1

**I**

Installing Device Descriptions 3-5  
Installing the Linking Device 2-1  
Installing the NI-FBUS Configurator  
Software 3-1  
Interface Configuration Utility 3-2  
Interpretation of ControlNet Module  
STATUS LED 2-6  
Interpreting the LEDs 2-6  
Introduction 1-1

**L**

Linking A-1

## **M**

MAI Blocks 4-15  
MAO Blocks 4-15  
MDI Blocks 4-16  
MDO Blocks 4-16  
Module STATUS LED 2-6

## **N**

network access port (NAP) 2-3  
NI-FBUS Configurator version 2.3 1-3

## **P**

Power Connector Pinout 2-2  
Product Overview 1-1

## **R**

Removing the Linking Device 2-2  
RJ-45 connector 2-3  
RSLinx Lite 1-3  
RSLinx OEM™ 2.0 1-3  
RSLinx™ 2.0 1-3  
RSNetWorx 1-3  
RSNetWorx™ for ControlNet 1-3

## **S**

Sample Cascaded AO Configuration 4-7  
Sample Multiple Macrocycle AO Configuration 4-7  
Sample Multiple Macrocycle MAI Configuration 4-3  
Sample NI-FBUS Configurator View of ControlNet Object Information 4-17  
Sample Non-Cascade AO Configuration 4-6  
Sample Single Macrocycle MAI Configuration 4-2  
Sample Single Macrocycle MDI Configuration 4-9  
service pack 3 1-3  
Setting the ControlNet Network Address 2-5  
Setting Up an Alarm 4-14  
Specifications A-1  
System Requirements 1-3

## **T**

Testing the Installation 3-7  
Trends and Alarms 4-18  
Typical Linking Device Connections to a ControlNet Network 2-3

## **U**

Using the  
ControlNet-to-FOUNDATION  
Fieldbus Linking Device 4-1  
Using the NI-FBUS Interface  
Configuration Utility After  
Installation 3-6

## **V**

Viewing Object Information in the  
NI-FBUS Configurator 4-16

## **W**

Windows NT® 4.0 1-3



# Allen-Bradley Publication Problem Report

If you find a problem with our documentation, please complete and return this form.

Pub. Name ControlNet-to-Foundation Fieldbus H1 Linking Device User Manual

Cat. No. 1788-CN2FF

Pub. No. 1788-6.5.1

Pub. Date January 1999

Part No. 955133-78

Check Problem(s) Type:	Describe Problem(s)	Internal Use Only
<input type="checkbox"/> Technical Accuracy	<input type="checkbox"/> text <input type="checkbox"/> illustration	
<input type="checkbox"/> Completeness What information is missing?	<input type="checkbox"/> procedure/step <input type="checkbox"/> illustration <input type="checkbox"/> definition <input type="checkbox"/> example <input type="checkbox"/> guideline <input type="checkbox"/> feature <input type="checkbox"/> explanation <input type="checkbox"/> other	<input type="checkbox"/> info in manual (accessibility) <input type="checkbox"/> info not in
<input type="checkbox"/> Clarity What is unclear?		
<input type="checkbox"/> Sequence What is not in the right order?		
<input type="checkbox"/> Other Comments Use back for more comments.		

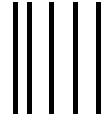
Your Name \_\_\_\_\_ Location/Phone \_\_\_\_\_

Return to: Marketing Communications, Allen-Bradley, 1 Allen-Bradley Drive, Mayfield Hts., OH 44124-6118 Phone: (440) 646-3176  
FAX: (440) 646-4320

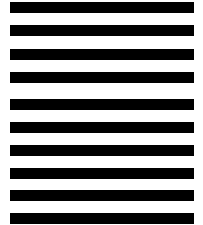
Other Comments

PLEASE FOLD HERE

PLEASE REMOVE



NO POSTAGE  
NECESSARY  
IF MAILED  
IN THE  
UNITED STATES



# BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 18235 CLEVELAND OH

POSTAGE WILL BE PAID BY THE ADDRESSEE



**Allen-Bradley**

1 ALLEN BRADLEY DR  
MAYFIELD HEIGHTS OH 44124-9705





**[www.rockwellautomation.com](http://www.rockwellautomation.com)**

---

**Power, Control and Information Solutions Headquarters**

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444

Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640

Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 1788-6.5.1 - January 1999

PN 955133-78

©1999 Rockwell International Corporation. Printed in the U.S.A.