Fieldbus

NI-FBUS™ Configurator User Manual

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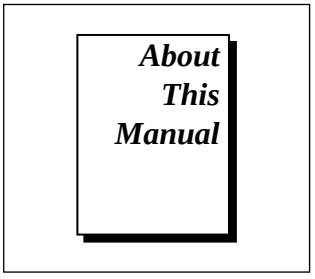


This manual gives an overview of fieldbus, describes the NI-FBUS Configurator, and explains how to use the NI-FBUS Configurator. The NI-FBUS Configurator is intended for use with Microsoft Windows NT. This manual assumes that you are already familiar with the Microsoft Windows NT operating system.

Organization of This Manual

This manual is organized as follows:

- Chapter 1, *Introduction to Fieldbus and the NI-FBUS Configurator,* introduces fieldbus, the parts of a fieldbus network, and the NI-FBUS Configurator.
- Chapter 2, *NI-FBUS Configurator Quick Start,* contains step-by-step instructions with a minimum of explanation for beginning to use the NI-FBUS Configurator.
- Chapter 3, *Using the NI-FBUS Configurator Interface,* describes the details of how to use the NI-FBUS Configurator interface.
- Appendix A, *Error Messages and Warnings,* contains error messages you might receive while using the NI-FBUS Configurator, explanations of the error messages, and solutions to some of the errors.
- Appendix B, *Customer Communication,* contains forms you can use to request help from National Instruments or to comment on our products and manuals.
- The *Glossary* contains an alphabetical list and description of terms used in this manual, including abbreviations, acronyms, metric prefixes, mnemonics, and symbols.

Conventions Used in This Manual

This manual uses the following conventions:

< >	Angle brackets enclose the name of a key on the keyboard—for example, <Enter>.
»	The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options» Substitute Fonts** directs you to pull down the **File** menu, select the **Page Setup** item, select **Options**, and finally select the **Substitute Fonts** options from the last dialog box.
bold	Bold text denotes parameters, menus, menu items, dialog box buttons or options, and error messages.
bold italic	Bold italic text denotes a note, caution, or warning.
`bold monospace`	Bold text in this font denotes the messages and responses that the computer automatically prints to the screen.
italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept. This font also denotes text for which you supply the appropriate word or value.
`monospace`	Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and for statements and comments taken from programs.
NI-FBUS	In this manual, the term *NI-FBUS* refers to the NI-FBUS Communications Manager.

Related Documentation

The following documents contain information that you may find helpful as you read this manual:

- *Foundation Specification: System Architecture*
- *Foundation Specification: Function Block Application Process, Parts 1 and 2*

Customer Communication

National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you to complete. These forms are in Appendix B, *Customer Communication*, at the end of this manual.

Introduction to Fieldbus and the NI-FBUS Configurator

Chapter 1

This chapter introduces fieldbus, the parts of a fieldbus network, and the NI-FBUS Configurator.

This chapter contains fieldbus information that can help you in using the NI-FBUS Configurator, and in solving problems with the configuration of your fieldbus system. Refer to the *Glossary* for more explanation of fieldbus terms and concepts. If you already have a basic knowledge of fieldbus concepts, or want to start using the NI-FBUS Configurator immediately, skip to Chapter 2, *NI-FBUS Configurator Quick Start.*

Introduction to Fieldbus

The term *fieldbus* usually refers to an all-digital, two-way communication system that connects control systems to instrumentation.

The *Fieldbus Foundation* is an organization that developed a fieldbus network based on the work and principles of the ISA/IEC standards committees. The goal of the Fieldbus Foundation and its members is to produce a standard and to help create products that use a robust industrial network based on existing standards and other proven technologies.

FOUNDATION Fieldbus, which is the communications network the Fieldbus Foundation created, is a protocol designed for robust, distributed control in process control environments. Devices connected by FOUNDATION Fieldbus control a fieldbus process by exchanging data. Devices can communicate data using a token-passing scheme controlled by the *Link Active Scheduler* (*LAS*), which is a device used to schedule communication traffic.

Parts of a Fieldbus Network

There are six conceptual parts to a fieldbus network: links, devices, blocks and parameters, linkages, loops, and schedules.

Links

A FOUNDATION Fieldbus network is made up of devices connected by a serial bus. This serial bus is called a *link*. Refer to the *Linkages* section of this chapter to learn the difference between a link and a linkage. Links can be separated by special devices called *bridges*. Figure 1-1 shows a link in a fieldbus network.

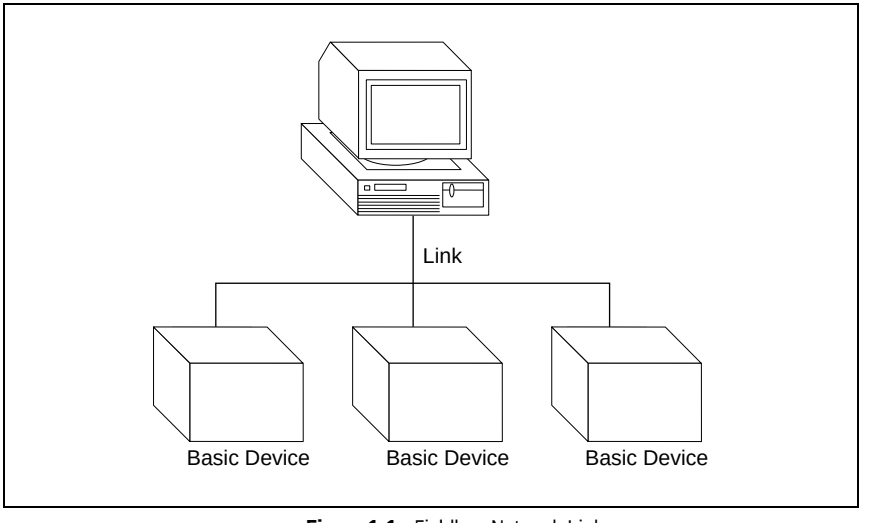


Figure 1-1. Fieldbus Network Link

Devices

There are three types of devices on a fieldbus network: the *link master*, *basic devices*, and *bridges*.

- *Link master*—A link master device controls the communications traffic on a link. A link master prevents multiple devices from communicating data at the same time. A link master can be a Distributed Control System (DCS) or any other device, such as a valve or a pressure transducer. There can be more than one link master per link, but only one at a time can be the Link Active Scheduler.

- *Basic device*—A basic device does not have the ability to become a Link Active Scheduler.
- *Bridge*—A bridge device connects two or more links.

Figure 1-2 shows these three types of devices.

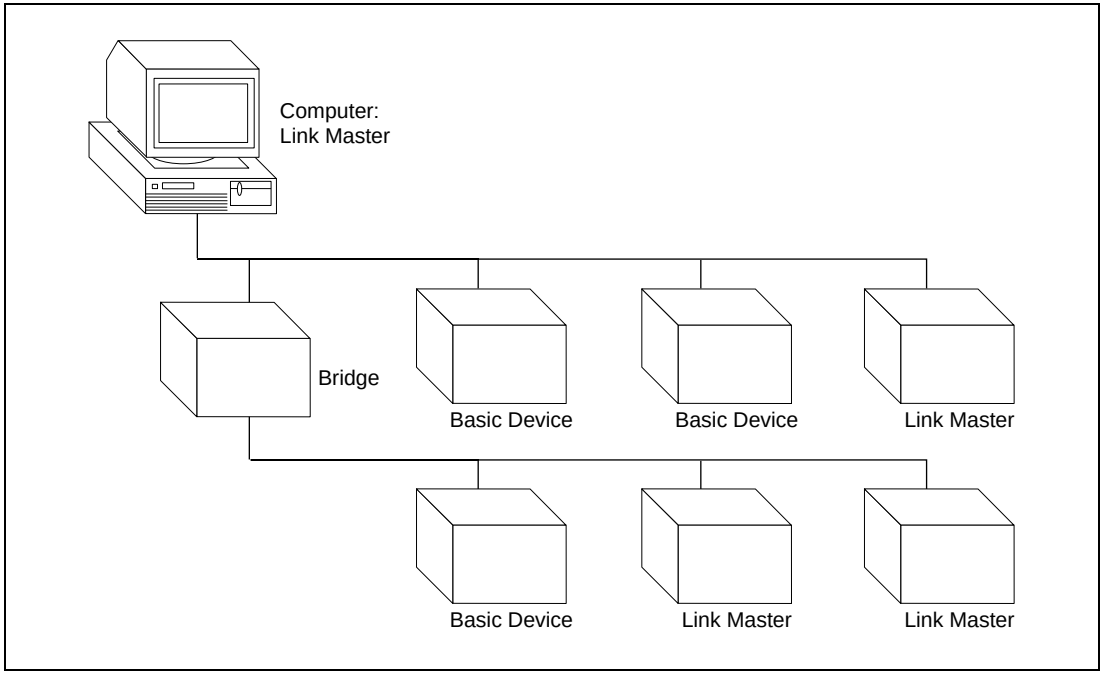


Figure 1-2. Fieldbus Network Devices

Identifying Devices

Devices are uniquely identified on the fieldbus network by character string name, or tag. The *device tag* is a configurable attribute of the device that usually describes the type and location of the device. Device tags are unique on a fieldbus network.

Another unique identifier of a device is the *device ID*, which includes a serial number unique to the device.

Blocks and Parameters

Usually, a device has a set of functions it can perform. These functions are represented as function blocks within the device. Function blocks

contain algorithms and the algorithm-controlling parameters. The FOUNDATION Fieldbus specification defines 10 standard blocks and algorithms as follows:

- Analog Input (AI)
- Analog Output (AO)
- Discrete Input (DI)
- Discrete Output (DO)
- Proportional Integral Derivative (PID)
- Proportional Derivative (PD)
- Bias Gain (BG)
- Ratio Control (RC)
- Control Selector (CS)
- Manual Loader (ML)

You can change or set the action of a block by changing the settings of block parameters. Figure 1-3 shows an example of a function block and its input and output parameters. In addition, the NI-FBUS Configurator recognizes transducer and user-defined function blocks.

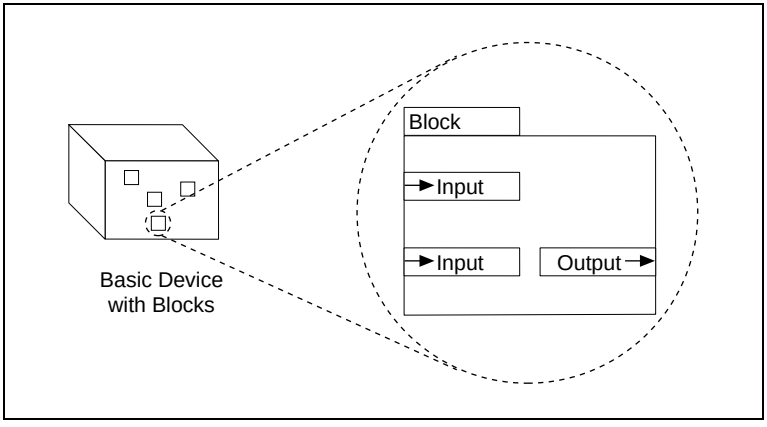


Figure 1-3. Function Block Parameters

Function block parameters are classified as follows:

- *Input* parameters receive data from another block.
- *Output* parameters send data to another block.
- *Contained* parameters do not receive or send data; they are contained within the block.

Function block parameters are also classified as alarm, trend, or tuning parameters. These classifications are independent of the input, output, and contained classifications. For example, an input parameter can also be a trend parameter.

Identifying Blocks

Blocks are uniquely identified on the fieldbus network by a character string name, or tag, similar to the device tag. The *block tag* is an attribute of a block that usually describes the purpose and location of the block. You can change the block tag. Block tags must be unique on a fieldbus network.

Linkages

The function blocks configured to control a process are linked, or connected by configuration objects inside the devices. These *linkages* allow you to send data from one block to the other. A linkage is different from a link, in that a link is a network of devices connected by a serial bus, and a linkage is a connection between function blocks.

A block parameter that is written to the bus is referred to as a *published parameter*. A block parameter that is receiving data is referred to as a *subscribed parameter*. Figure 1-4 shows an example of a linkage between blocks that are linked between devices.

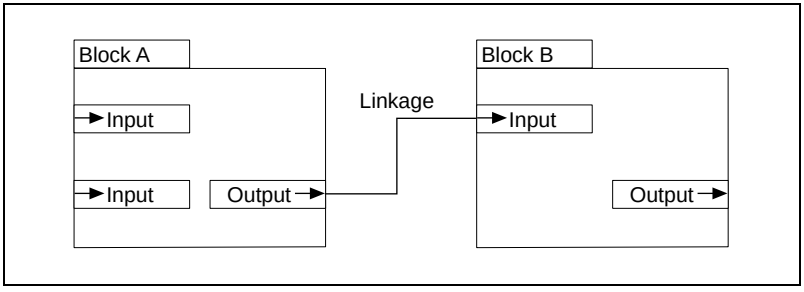


Figure 1-4. Linkage between Blocks

Loops

A *loop* or control loop is a group of function blocks connected by linkages executing at a configured rate. Each block executes at the configured rate and data moves between the blocks at the configured rate. Figure 1-5 shows an example of a control loop.

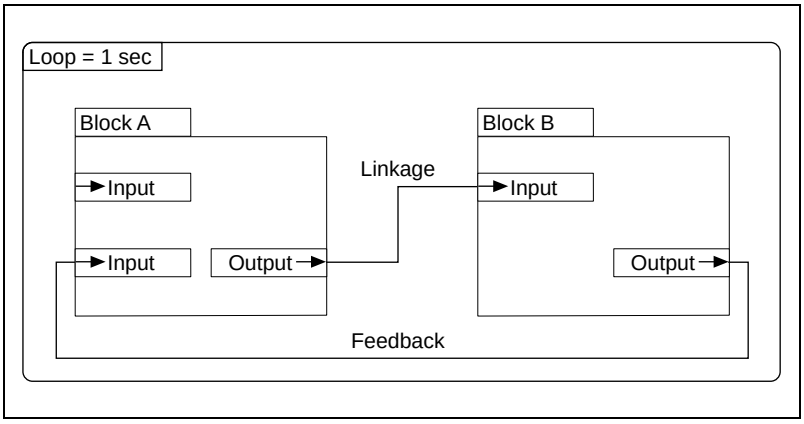


Figure 1-5. Control Loop

Multiple Loops

It is possible to have multiple loops running at different rates on a link. Figure 1-6 shows an example of multiple loops.

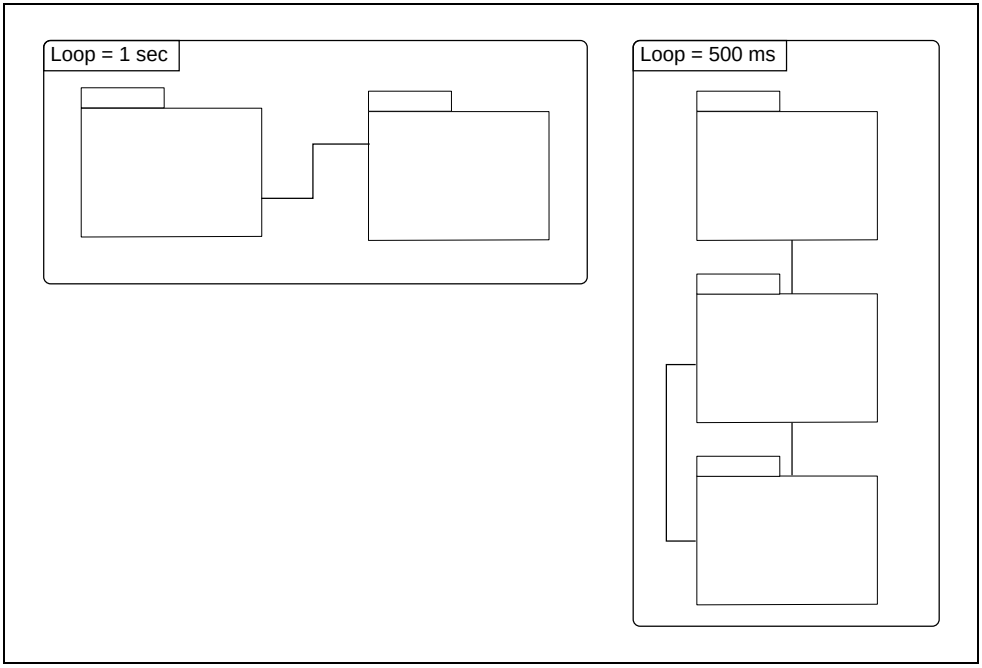


Figure 1-6. Multiple Loops

Even if loops are running at different rates, they can send each other data through linkages. Figure 1-7 shows an example of a linkage between two loops. All loops on a link run within one macrocycle. A *macrocycle* is the least common multiple of all the loop times on a given link.

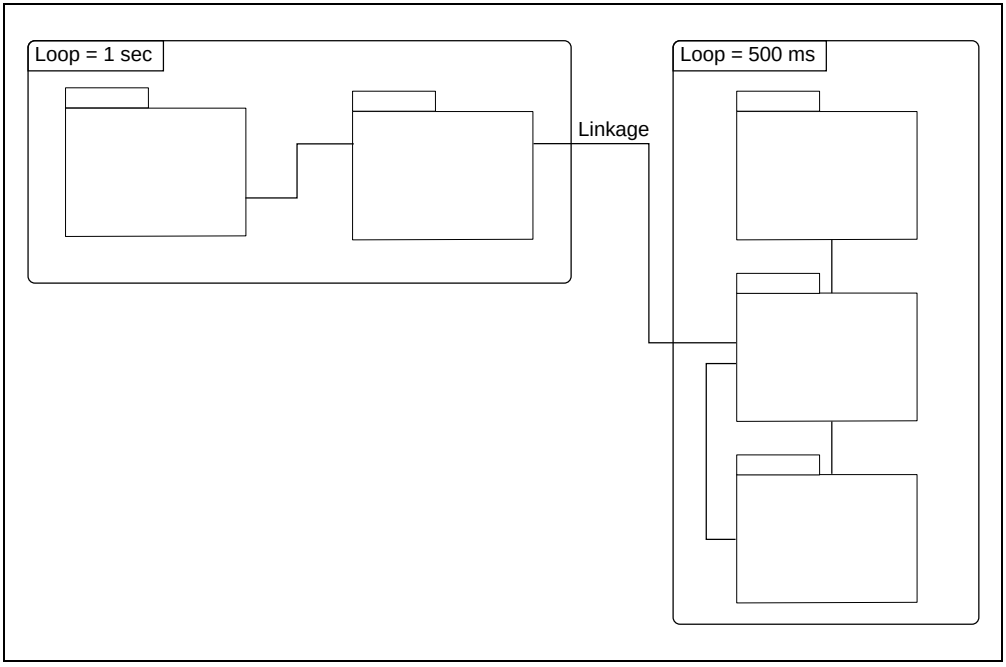


Figure 1-7. Linkage between Two Loops

Schedules

A schedule of data traffic makes it possible for communication to *deterministic*, meaning that data is transferred between a given set of devices at the same time during each loop.

The schedule can be divided into two parts: a function block schedule that determines when a block executes, and a publishing schedule that determines when published data parameters are sent over the fieldbus. The function block schedule is downloaded to the device that contains the function blocks, and the publishing schedule is usually downloaded to a device or devices that have link master capability. The link master running the publishing schedule and thus controlling the process is the LAS.

Downloading the schedule to multiple devices ensures that the process continues to be controlled, even if the LAS fails. If the LAS fails, another device with link master capability takes over the bus and runs the schedule. Figure 1-8 shows the relationship of the two schedules to the device, link, link master, and LAS.

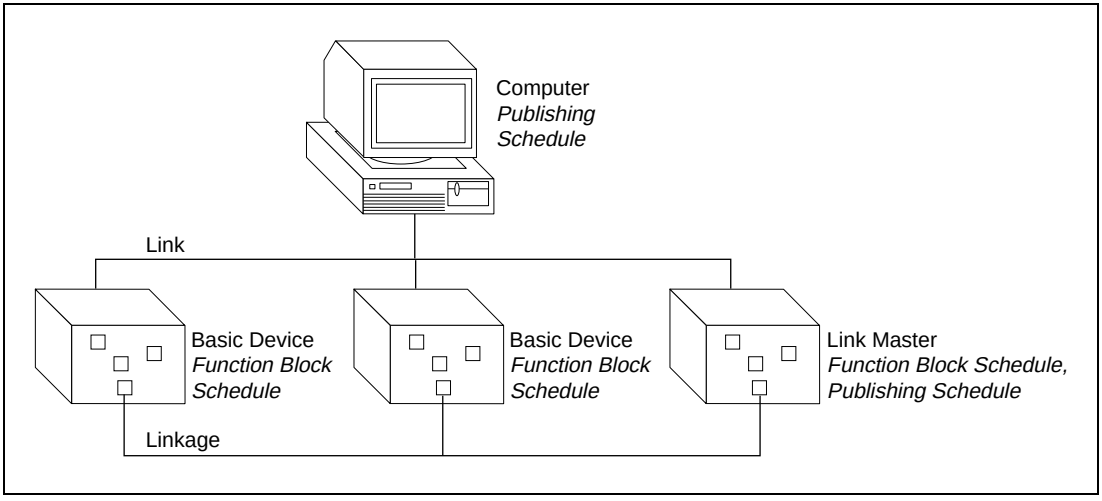


Figure 1-8. Location of Publishing and Function Block Schedules

Introduction to the NI-FBUS Configurator

You should use the NI-FBUS Configurator to configure a fieldbus network and keep track of your configuration changes. The NI-FBUS Configurator is an easy-to-use graphical environment for creating linkages, loops, and a schedule based on the fieldbus concepts discussed in this chapter.

Now that you are acquainted with the basics of fieldbus communication, you are ready to start to use the NI-FBUS Configurator. To get started using the NI-FBUS Configurator immediately, continue to Chapter 2, *NI-FBUS Configurator Quick Start*. To learn details of how the NI-FBUS Configurator user interface works, skip to Chapter 3, *Using the NI-FBUS Configurator Interface*.

Chapter 2

NI-FBUS Configurator Quick Start

This chapter contains step-by-step instructions with a minimum of explanation for beginning to use the NI-FBUS Configurator.

Refer to Chapter 1, *Introduction to Fieldbus and the NI-FBUS Configurator*, or the *Glossary* for explanation of a fieldbus term or concept. Refer to Chapter 3, *Using the NI-FBUS Configurator Interface*, for information about a specific control or window in the NI-FBUS Configurator.

☞ **Note:** ***Before you begin to use the NI-FBUS Configurator, you must install and configure your software and any fieldbus interfaces, as instructed in your Getting Started manual.***

Overview

This section contains a brief overview of the steps that this chapter covers.

1. Start the NI-FBUS process.
2. Start the NI-FBUS Configurator.
3. Select an interface device that is connected to the bus you want to configure. The NI-FBUS Configurator automatically reads all devices and blocks from the network, and assigns addresses to devices that appear at the start-up default addresses.
4. (Optional) Change device and block tags. The NI-FBUS Configurator automatically renames and tags devices and blocks that have duplicate tags.
5. Add/edit function blocks to create a function block application.

6. Connect blocks and define loops. To configure linkages, drop function blocks on the screen and wire the proper outputs to inputs. The NI-FBUS Configurator contains *templates*, which are typical process control loops that are already wired. You can also create and save templates.
7. (Optional) Change block parameter values (for example, setpoints and alarm limits) to suit your configuration.
8. (Optional) Configure trends and alarms.
9. (Optional) Alter the schedule. The NI-FBUS Configurator automatically generates a schedule based on the function block wiring diagram and loop execution times.
10. Download the configuration to the fieldbus network. The NI-FBUS Configurator only downloads changes to your configuration only when you perform this step.

NI-FBUS Configurator Quick Start Steps

To configure your fieldbus network, complete the following steps. For more information about each step, see each corresponding section in this chapter. For more information about a control or window of the NI-FBUS Configurator, refer to Chapter 3, *Using the NI-FBUS Configurator Interface.*

Step 1. Start the NI-FBUS Process

The first time you use the NI-FBUS Configurator, you must start the `nifb` kernel driver manually, as follows:

1. Type the following in a command window:

   ```
   net start nifb
   ```

   You can also start `nifb` by selecting **Start»Settings»Control Panel»System»Device Manager»NIFB»Start** button.

   You can make the `nifb` kernel driver start up automatically the next time you restart by changing the `StartupType` for the `nifb` driver to **Automatic** through the **Devices** window in the **Control Panel**. If you are using Windows NT 4.0, you can also move the NIFB shortcut to the **Start Up** folder to make it start up automatically when your computer restarts or boots.
2. Start the `nifb` process by double-clicking on the **NIFB** icon.

Step 2. Start the NI-FBUS Configurator

To start the NI-FBUS Configurator, double-click on the **NI-FBUS Configurator** icon.

When the NI-FBUS Configurator starts, the Configurator Main window and an **Add Links** dialog box appear.

Step 3. Select a Fieldbus Interface

The **Add Links** dialog appears at start up so you can connect to a fieldbus and automatically scan fieldbus data into a project. Figure 2-1 shows the **Add Links** dialog box.

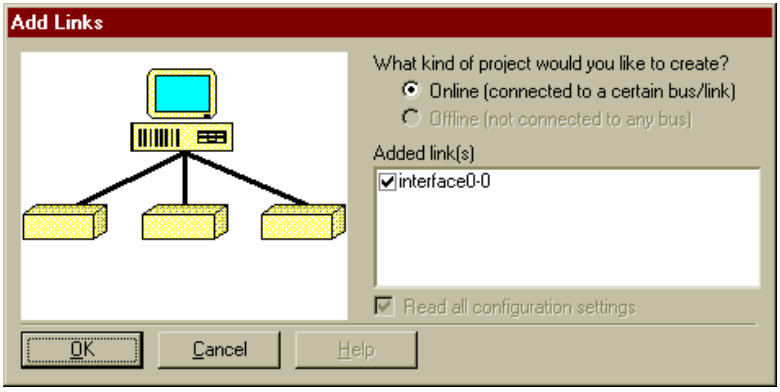


Figure 2-1. Add Links Dialog Box

Complete the following steps to connect to a specific fieldbus interface:

1. Select the interface that you want to connect to from the **Added Link(s)** checklist.
2. Click on the **OK** button to create a new project that is connected to the links you checked.

During the scan of the fieldbus network, the NI-FBUS Configurator checks addresses and object tags. If a device is missing either an address or a tag, or if a block has no tag, the NI-FBUS Configurator assigns one. If the NI-FBUS Configurator detects duplicate tags, it renames the device or block, appending the original device or block tag with a numeric identifier. For example, the duplicate of *tag* becomes *tag*2.

After you complete the preceding steps, the NI-FBUS Configurator creates a new project so you can develop your configuration. The Project View window appears, displaying all of the fieldbus objects on the link or links to which your PC is connected. Figure 2-2 shows the Project View window with an example list of fieldbus objects. For an explanation of the parts of the Project View window, refer to Chapter 3, *Using the NI-FBUS Configurator Interface*.

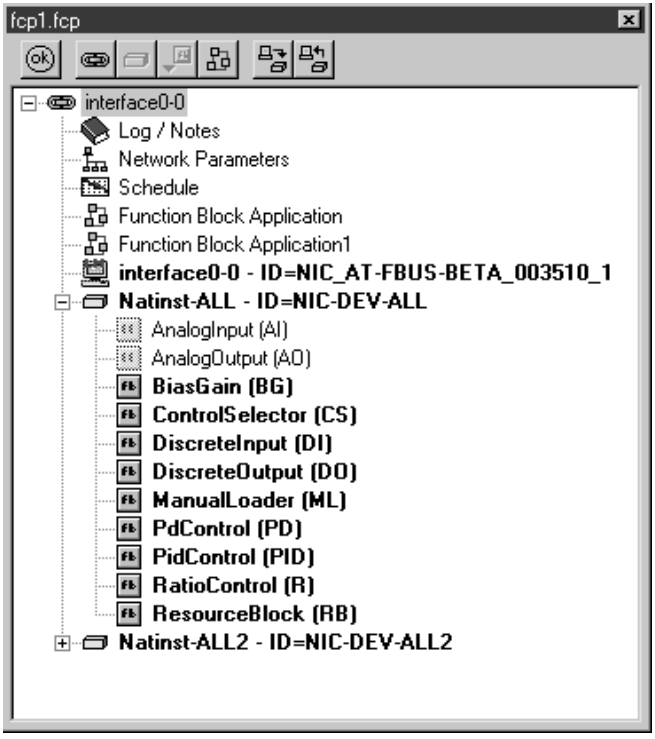


Figure 2-2. Fieldbus Object List in the Project View Window

Step 4. Change Device and Block Tags (Optional)

To change the tag of a device, block, or function block application name, complete the following steps:

1. In the Project View window, click on the object to highlight it.
2. Click on the object again to show the edit box.
3. Enter the new tag name and press enter.

The NI-FBUS Configurator does not write these changes to the objects until you download the configuration to the fieldbus network to configure the link in *Step 10. Download the Configuration to the Fieldbus Network.* However, when you change a tag, the NI-FBUS Configurator places an asterisk (*****) by the changed tag.

There are other methods for changing tags, which are discussed in the Chapter 3, *Using the NI-FBUS Configurator Interface*.

Step 5. Add/Edit Function Blocks

To add function blocks, follow these steps:

1. Open the Function Block Application Editor by double-clicking on the Function Block Application Editor icon ( ) in the Project View window.
2. Drag blocks from the Project View window to the Function Block Application Editor until all the blocks you want to use are in the Function Block Application Editor. Figure 2-3 shows what a block looks like when you drag it from the Project View window.

Figure 2-3. Dragged Block

3. Double-click on a tag or use the **Text** tool ( ) on the Function Block Application Editor toolbar if you want to change the names of the blocks.

Step 6. Connect Blocks and Define Loops

To wire blocks together, complete the following steps:

1. Click on the **Wiring** tool ( ) on the Function Block Application Editor toolbar.
2. Click on an input or output you want to connect.
3. Click on the background of the Function Block Application Editor window to guide the connection around other blocks to the input or output you want to attach to.

4. Click on the input or output you want to attach to. Figure 2-4 shows a sample result of the wiring process.

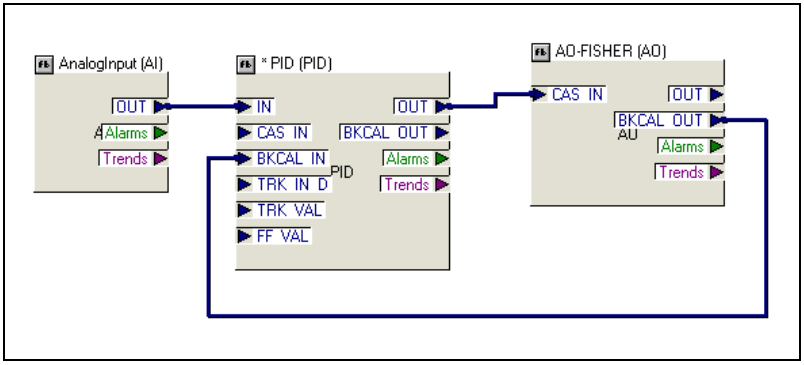


Figure 2-4. Result of the Wiring Process

To isolate loops that run at different rates than the rest of the function block application, complete the following steps:

1. Click on the **Loop** tool ( ) on the Function Block Application Editor toolbar.

2. Click on the background of the Function Block Application Editor and drag a loop around the blocks you want to isolate in a loop. Figure 2-5 shows a loop structure.

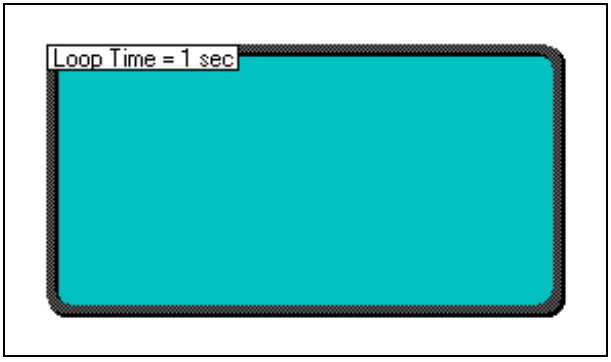


Figure 2-5. Loop Structure

3. Change the execution time for the isolated blocks by typing the new time for the loop in the box at the upper left of the loop.

Step 7. Change Block Parameter Values (Optional)

To change the values of parameters in a block from the default values, complete the following steps:

1. In the Function Block Application Editor, double-click on a function block to open the Block window. Figure 2-6 shows the Block window.

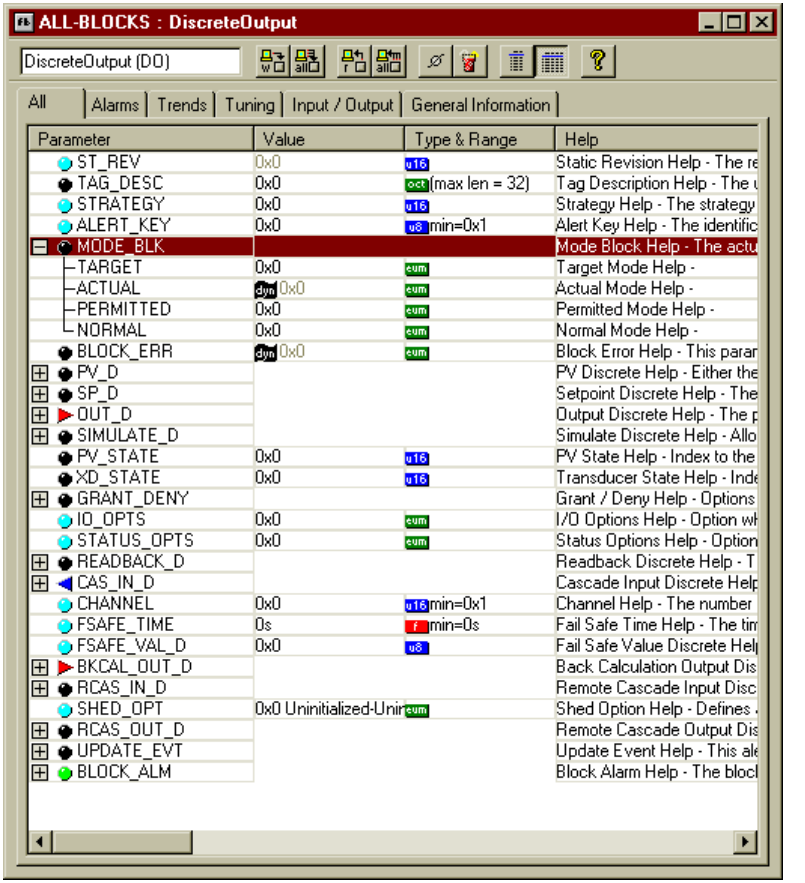


Figure 2-6. Block Window

2. In the Block window, click on the plus signs to see the values of the parameters, if necessary.
3. Use the cursor to select the parameter value you want to change. If a parameter value is grayed out, you cannot change it.
4. Type in the new value.
5. You can make your changes effective immediately by clicking on the **Write changes** button on the Block window toolbar. If you do not click on the **Write changes** button, your changes will take effect after you complete *Step 10. Download the Configuration to the Fieldbus Network.*

Step 8. Configure Trends and Alarms (Optional)

To configure trends and alarms, complete the following steps:

1. Find the icon for the device to which you want to send the trend in the Project View window. Drag this icon from the Project View window to the Function Block Application Editor.
2. In the Function Block Application Editor, double-click on the block you want to send the trend from. The Block window opens. Click on the **Trends** tab. Figure 2-7 shows the Trends tab.

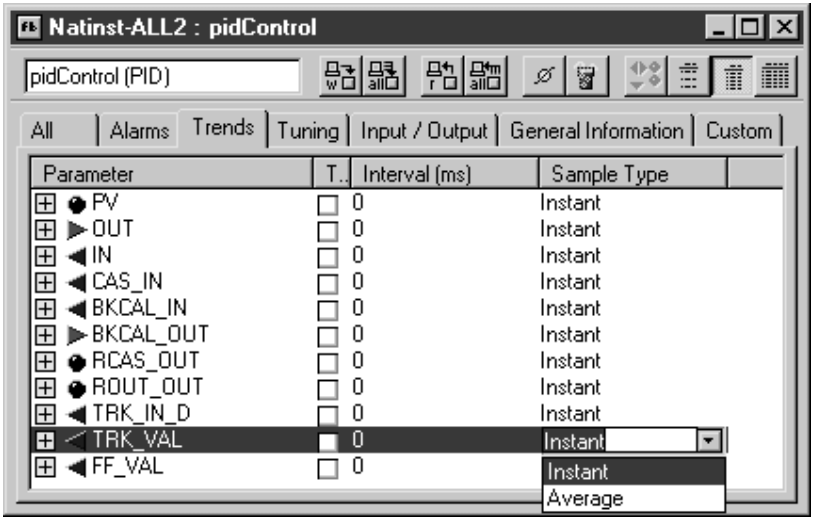


Figure 2-7. Trends Tab of the Block Window

3. Check the parameter to trend by clicking the checkbox in the **Trend** column.
4. Set the sample **Interval** of the trend by typing the interval in the **Interval** field.
5. Set the **Sample Type** by selecting a sample type from the **Sample Type** drop-down list.
6. Wire the **Trends** output of the block to the device to receive the trend. Figure 2-8 shows an example of a configured trend.

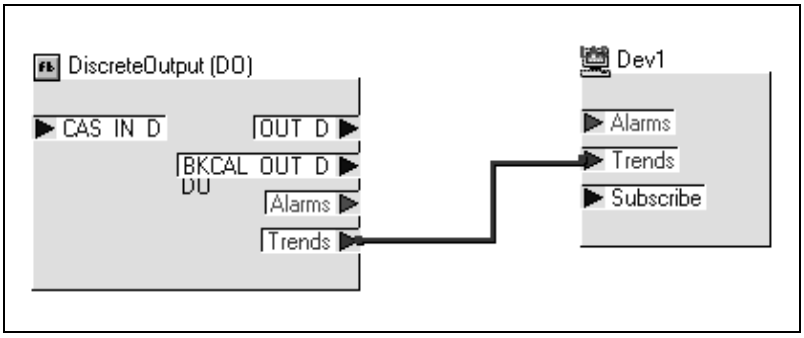


Figure 2-8. Configured Trend

7. In the same way that you connected trends, connect the **Alarm** outputs of the function blocks to the **Alarm** inputs of devices as needed. Figure 2-9 shows a configured alarm.

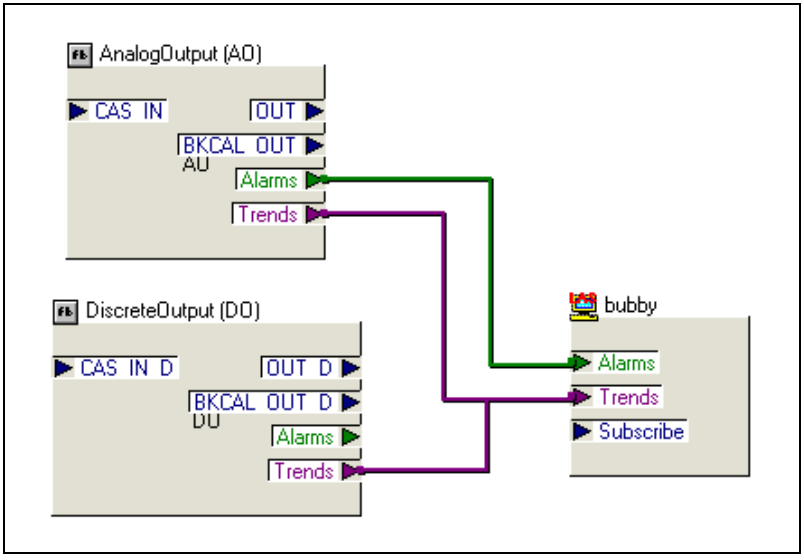


Figure 2-9. Configured Alarm

8. In the Block window for the block that the alarm is coming from, click on the **Alarms** tab, and configure the alarm parameters.

Step 9. Alter the Schedule (Optional)

If the function block execution times in a device are incorrect, or if one device has too many blocks to execute, you might want to change the schedule by completing the following steps:

1. Double-click on the **Schedule** icon in the Project View window. The Schedule window, shown in Figure 2-10, appears.

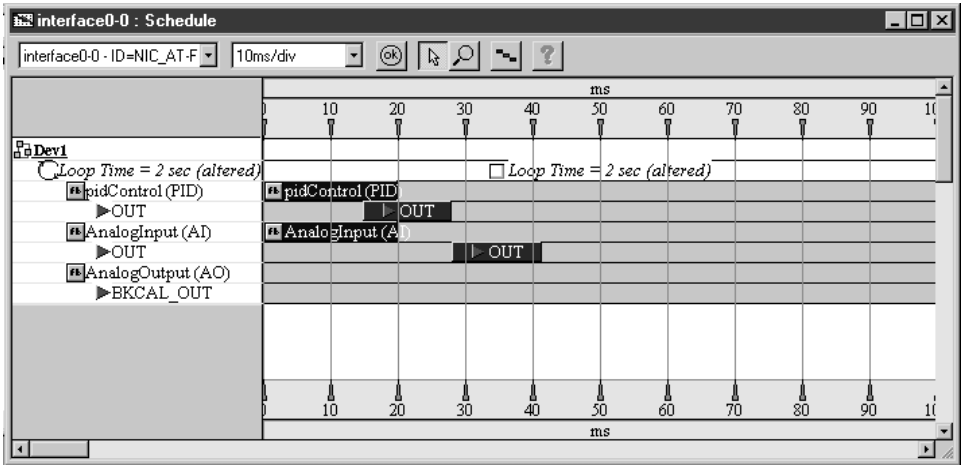


Figure 2-10. Schedule Window

2. Use the cursor to move the function blocks in the schedule as needed.

If you want to change the execution order of the blocks, complete the following steps:

1. In the Function Block Application Editor, click on the **Change Execution Order Button** ( ). Numbers appear on the blocks, indicating their current order.
2. Click on the blocks in the order that you want them to execute.

Step 10. Download the Configuration to the Fieldbus Network

To download your configuration, complete the following steps:

1. Select the **Download** option from the Project View window toolbar or choose **Download Configuration** from the **Configure** menu. The **Download Configuration** dialog box, shown in Figure 2-11, appears.

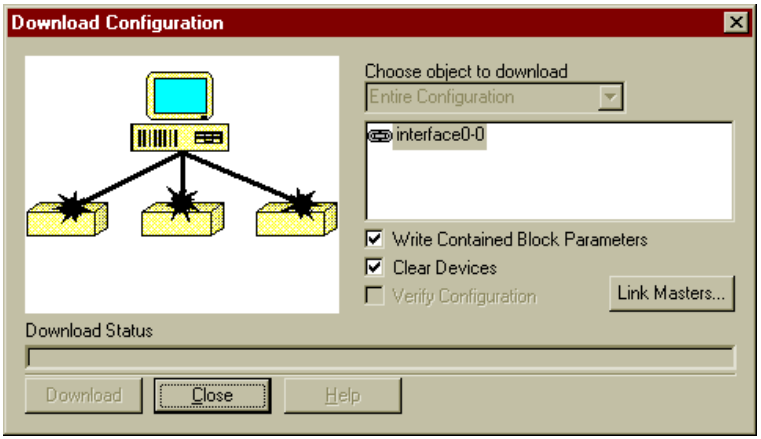


Figure 2-11. Download Configuration Dialog Box

2. Select the configuration object to download.
3. (Optional) Click on the **Link Masters** button to set link masters to receive the Link Active Schedule, the primary Link Active Scheduler, and the primary time master of the link. The **Network Parameters** dialog box appears.
4. (Optional) To write all of the contained parameters of function blocks in the project, check **Write contained block parameters**.
5. (Optional) To reset or clear all of the communication connections of devices on the bus, check **Clear devices**.
6. Click on the **Download** button to download your fieldbus configuration changes to the network. The progress bar shows what percentage of the configuration is complete.

While downloading, the NI-FBUS Configurator displays and updates the **Download** tab in the status window. It shows what devices are being configured, their settings, and whether it is successfully configured.

If you need more detailed information on any of these steps, refer to Chapter 3, *Using the NI-FBUS Interface.*

Chapter 3

Using the NI-FBUS Configurator Interface

This chapter describes the details of how to use the NI-FBUS Configurator interface.

Starting the NI-FBUS Configurator

☞ **Note:** ***Before you begin to use the NI-FBUS Configurator, you must install and configure your software and any fieldbus interfaces, as instructed in your Getting Started manual.***

Complete the following steps to start the NI-FBUS Configurator.

1. Type the following in a command window:

   `net start nifb`

   You can also start `nifb` by selecting **Start»Settings»Control Panel»System»Device Manager»NIFB»Start** button.

   You can make the `nifb` kernel driver start up automatically the next time you restart by changing the `StartupType` for the `nifb` driver to **Automatic** through the **Devices** window in the **Control Panel**. If you are using Windows NT 4.0, you can also move the NIFB shortcut to the **Start Up** folder to make it start up automatically when your computer restarts or boots.
2. Start the `nifb` process by double-clicking on the **NIFB** icon.
3. Double-click on the **NI-FBUS Configurator** icon.
4. Select the interface that you want to connect to from the **Added Link(s)** checklist.
5. Click on the **OK** button to create a new project that is connected to the links you checked.

When you start the NI-FBUS Configurator, three moveable, dockable windows appear within the Configurator Main window, the Help window, the Status window, and the Project View window.

☞ **Note:** ***To move and dock the Help, Status, or Project View windows, hold down the spacebar and drag the window you want to move.***

Configurator Main Window

The Configurator Main window has menus at the top, and contains the windows described in the following paragraphs. Figure 3-1 shows the Help window, Status window, and Project View inside the Configurator Main window.

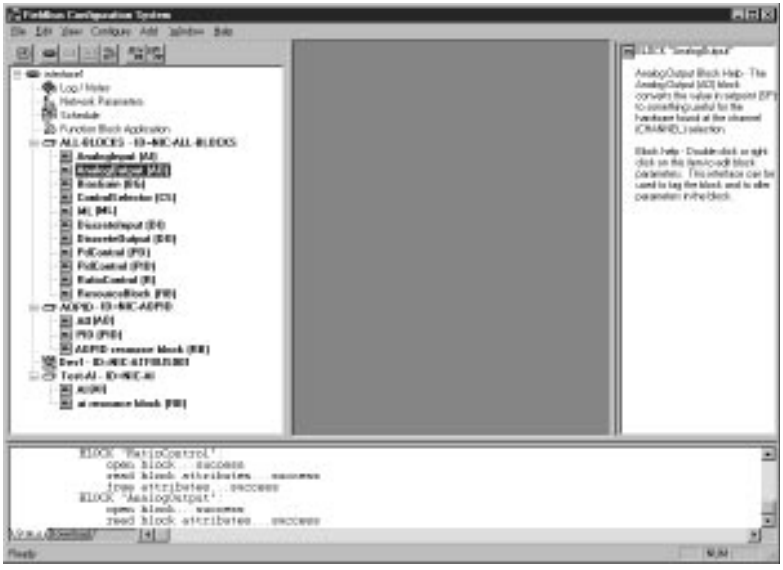


Figure 3-1. Configurator Main Window

Help Window

The Help window, which appears at the right of the Configurator Main window by default, displays help information for the object you put the cursor on. This help is generated from the NI-FBUS Configurator and Device Description (DD) files. You can hide the Help window by unchecking **Help Window** on the **Windows** menu.

Figure 3-2 shows the Help window.

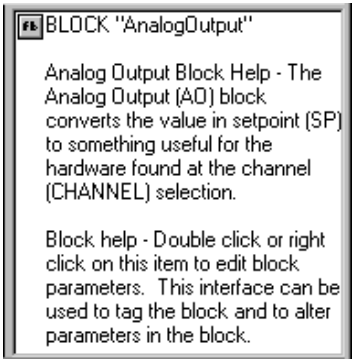


Figure 3-2. Help Window

Status Window

The Status window, which appears at the bottom of the Configurator Main window by default, displays the current status of the NI-FBUS Configurator. When you read, write, scan or download data to the bus, the Status window shows the steps that the NI-FBUS Configurator takes to accomplish the task on the **Status** tab.

The Status window also contains **Download** and **Error** tabs. The **Download** tab is updated only when a configuration is downloaded to the bus. The **Errors** tab shows any errors in the current project. You can hide the Status window by unchecking **Status Window** on the **Windows** menu.

Status Tab

The **Status** tab shows live updates of what the NI-FBUS Configurator is doing on the fieldbus. For example, the **Status** tab shows when the NI-FBUS Configurator is reading, writing and configuring. The **Status** tab automatically appears on top when you start the NI-FBUS Configurator.

Download Tab

The **Download** tab shows all the status information for the last configuration download of the bus. The NI-FBUS Configurator retains this information until the next download. The **Download** tab automatically appears on top when you begin to download your configuration. The status information on the **Download** tab is also in the **Log/Notes** window.

Errors Tab

The **Errors** tab displays all recent I/O errors, project configuration errors, and warnings. To fix an error, double-click on the error to open the window containing the error. Some error messages give hints about how to solve the problem. For a comprehensive list of errors and their explanations, refer to Appendix A, *Error Messages and Warnings.* Figure 3-3 shows the **Errors** tab.

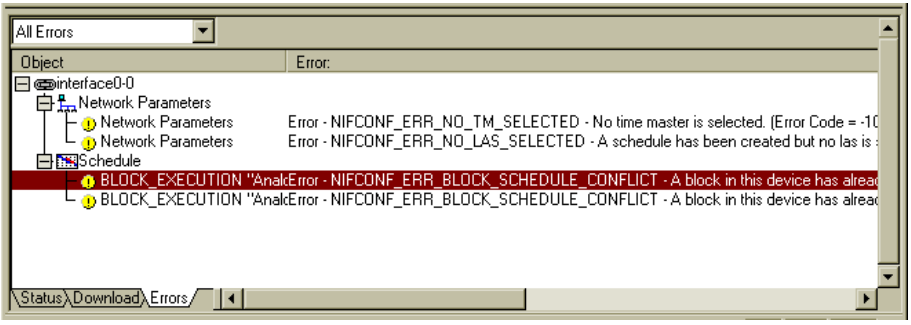


Figure 3-3. Errors Tab

The **Errors** tab has a drop list box attached to the upper left corner of the window. This is used to make a selection in what kind of errors you wish to see. The **All Errors** selection shows all I/O and project errors, and the **Project Errors** selection shows only project errors.

When you download your configuration, the NI-FBUS Configurator checks for errors in your project. If you have a project error, the NI-FBUS Configurator warns you and allows you to cancel the download.

The NI-FBUS Configurator automatically regenerates error information each time you change the project. However, you can force the NI-FBUS Configurator to revalidate the project by clicking on the **OK** toolbar button in any window.

Project View Window

The Project View window, which appears at the left of the Configurator Main window by default, displays the configurable objects of the link that are connected to the NI-FBUS Configurator. Double-click on these icons in the Project View window to configure each object. Figure 3-4 shows the Project View window.

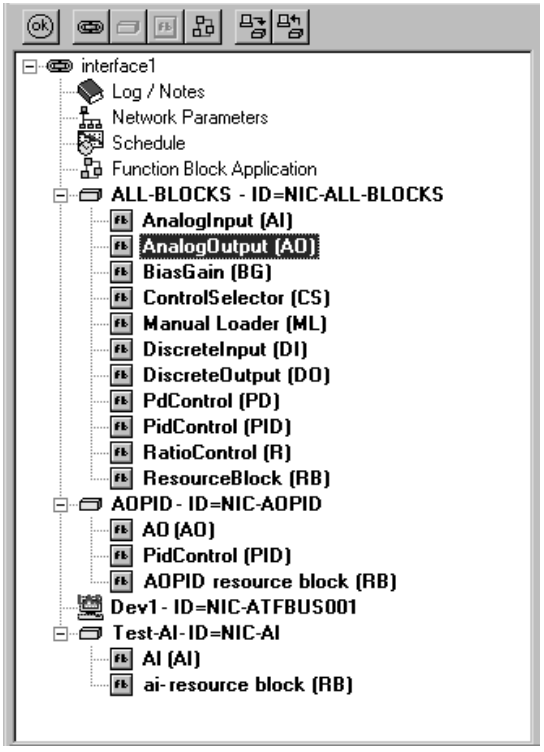


Figure 3-4. Project View Window

Project View Window Icons

Following are descriptions of the project icons that appear in the Project View window:

Link icon—This icon represents the fieldbus segment to which your PC is connected. Double-click on this item to open the Network Parameters window.

Log/Notes icon—Double-click on this icon to see a summary of all the changes you have made to the project link.

Network Parameters icon—Double-click on this icon to open the Network Parameters window and change the low-level configuration parameters for the link.

Schedule icon—Double-click on this icon to see the schedule of function block executions and data transmissions for the entire link.

Function Block Application Editor icon—Double-click on this icon to use the Function Block Application editor to wire function blocks together into a function block application. You can add multiple Function Block Application Editors to your project.

Device icon—This icon represents a fieldbus device, followed by the device tag and its unique serial identifier. Double-click on this icon to open the Device window.

Host Device icon—This icon represents the device (PC) that is hosting the NI-FBUS Configurator. Double-click on this icon to open the Device window.

Function Block icon—This icon represents a fieldbus function block, followed by the block tag and its type (in parentheses). Double-click on this icon to open the Block window.

Project View Window State Icons

During the initial scan of the bus, state icons sometimes overlap the project icons. Following are the meanings of the state icons used in the Project View window:

Updating—Appears when the NI-FBUS Configurator is reading or writing to the object.

Error—Appears when the NI-FBUS Configurator detects or encounters an error with the object.

Invalid—Appears when the indicated object is not responding to the NI-FBUS Configurator's scan.

Project View Window Toolbar

The toolbar at the top of the Project View window helps you perform basic operations on your project. Figure 3-5 shows the Project View window toolbar.

Figure 3-5. Project View Toolbar

Following are descriptions of the buttons on the toolbar in Figure 3-5:

Errors button—Validates the project.

New Link button—Adds another link to the project.

New Device button—Adds another device to the project.

New Block button—Adds another block to the project.

New FBAP button—Adds another Function Block Application Editor window to the project.

Download Project button—Opens the Download Configuration dialog box.

Upload Project button—Rereads the configuration.

Setting Preferences

To set your preferences in the NI-FBUS Configurator, select **Preferences** from the **View** menu. The **Preferences** dialog box appears, containing three tabs: **Fonts**, **Parameter Views**, and **General**.

Fonts tab—Use this tab to change the font types and sizes on the display.

Figure 3-6 shows the **Fonts** tab.

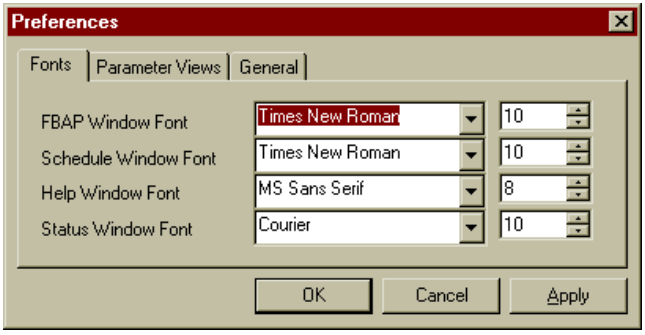


Figure 3-6. Preferences Dialog Box

Parameter Views tab—Use this tab to configure the default view for parameters.

Show Detailed View checkbox—Shows additional type and help strings for the view.

Show Spaced View checkbox—Puts spaces between parameters.

General tab—Use this tab to select which windows appear when you start the NI-FBUS Configurator.

Setting Network Parameters

You can change network parameters such as primary LAS and primary time master from the **Network Parameters** dialog box.

Figure 3-7 shows the **Network Parameters** dialog box.

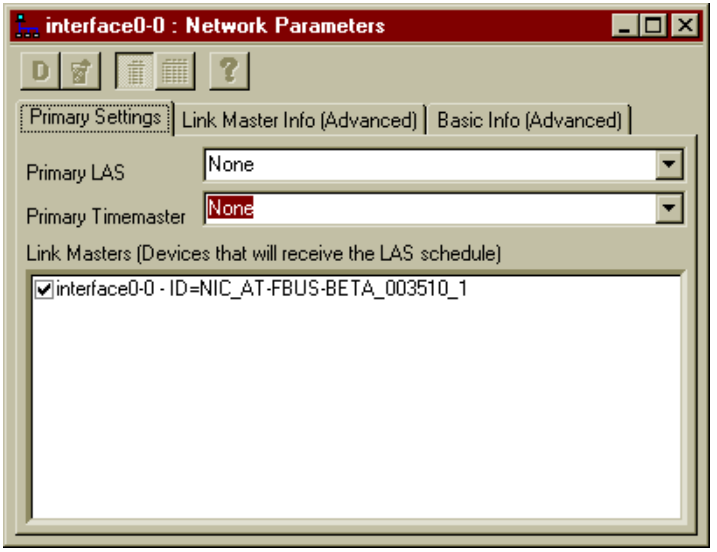


Figure 3-7. Network Parameters Window

This dialog box lists all of the devices capable of being link master for the link. Every link master you select in this dialog box receives the Link Active Schedule when you download your configuration. You can open the **Network Parameters** dialog box by double-clicking on the **Network Parameters** icon in the Project View window, or from the **Download Configuration** dialog box.

Creating a Function Block Application

The Function Block Application Editor is the graphical interface you use to create your fieldbus application in the NI-FBUS Configurator.

Figure 3-8 shows the Function Block Application Editor.

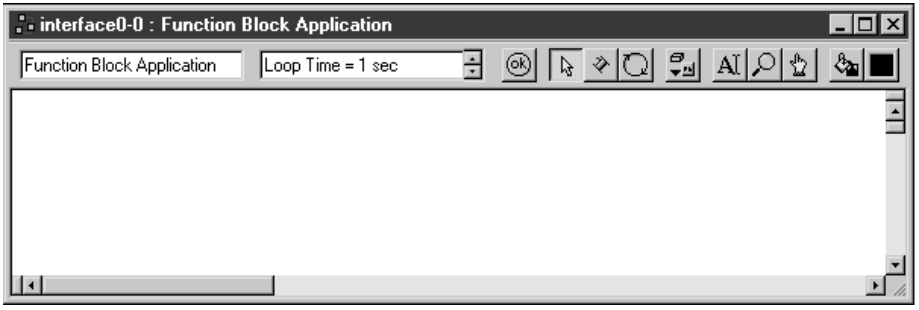


Figure 3-8. Function Block Application Editor

You can open the Function Block Application Editor by double-clicking on its icon ( ) in the Project View window.

The toolbar at the top of the editor displays the various tools used for function blocks. Figure 3-9 shows this toolbar.

Figure 3-9. Function Block Application Editor Toolbar

Following are descriptions of the items on this toolbar:

FBAP Name field—Shows the name of the function block application.

Loop Execution Time field—Shows the default execution rate of the process loop.

Errors button—Performs error checking, regenerates the schedule of the application, and removes bad wires.

Pointer—Drags and highlights objects on the screen.

Wiring tool—Makes connections between valid inputs and outputs. When you try to make a connection, the NI-FBUS Configurator

checks the data type of the input and output you are trying to connect, and highlights the connection if it is valid.

Loop tool—Isolates certain function blocks from the default execution time. The default execution time on the toolbar is the execution rate for all blocks on the Function Block Application Editor. However, you can define multiple loops that run at rates other than the default execution time. The **Loop** tool helps you to assign a special execution rate to a group of function blocks. For more information about running loops at different rates, refer to the *Defining Multiple Loops* section of this chapter.

Block button—Shows the block menu.

Text tool—Types additional information about the application to the screen and changes text in fields.

Zoom tool—Enlarges and shrinks the view. To zoom in, drag a rectangle around the area you want to enlarge. To zoom out, right-click on the background of the Function Block Application Editor window.

Execution Order tool—Chooses the order of execution for blocks. The NI-FBUS Configurator automatically decides the order of the blocks, but you can change the default order by using the **Execution Order** tool to click on the blocks in the order you want them to execute.

Fill tool—Fills objects on the screen with a color.

Fill Color tool—Selects a color to be used with the **Fill** tool.

☞ **Note:** ***To switch between the major tools you are currently using, press <Tab>. To switch between the pointer and the wiring tool, press the spacebar.***

Function Blocks

As stated in the *Blocks and Parameters* section of Chapter 1, *Introduction to Fieldbus and the NI-FBUS Configurator*, function blocks contain an algorithm and several parameters to control a process. The input and output parameters of this function block are displayed on the block, as in Figure 3-10.

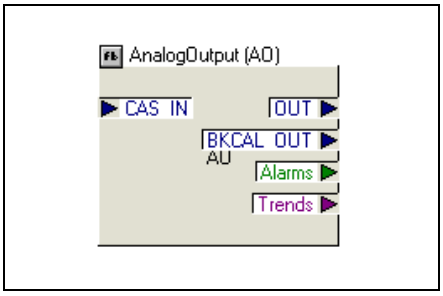


Figure 3-10. Input and Output Parameters on a Function Block

The pointer on the outside of the parameters shows the data flow direction of that parameter. By default, the block tag is at the top, the inputs are on the left, and the outputs are on the right, but you can move them by using the pointer to drag them.

You can re-size the block and move the tag and parameters relative to the block, as shown in Figure 3-11, which is a rearrangement of the block in Figure 3-10.

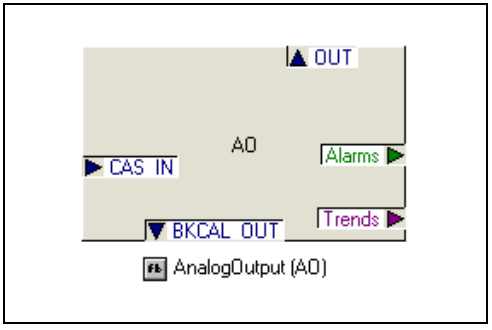


Figure 3-11. Resized Function Block with Parameters Moved

To change a tag, double-click on the block tag to open the edit box shown in Figure 3-12.

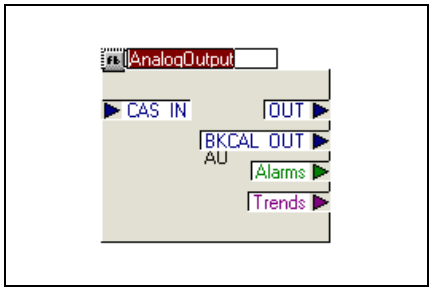


Figure 3-12. Edit Box for a Function Block

Adding Function Blocks

There are two major ways to add function blocks to the Function Block Application Editor. One method is to drag the block directly from the Project View window to the Function Block Application editor, as shown in Figure 3-13.

Figure 3-13. Dragged Block

Another way to add function blocks follows:

1. Right-click on the background of the Function Block Application Editor or click on the **Block** button ( ).
2. Select the device from the menu that appears, and then select the block you want to place on the screen from the menu of function blocks.

☞ **Note:** ***There can only be one instance of a function block on a fieldbus network. After you use a function block in a Function Block Application Editor window, the function block is grayed out on the menu.***

Figure 3-14 shows how the Function Block Application Editor looks with function blocks dragged onto it.

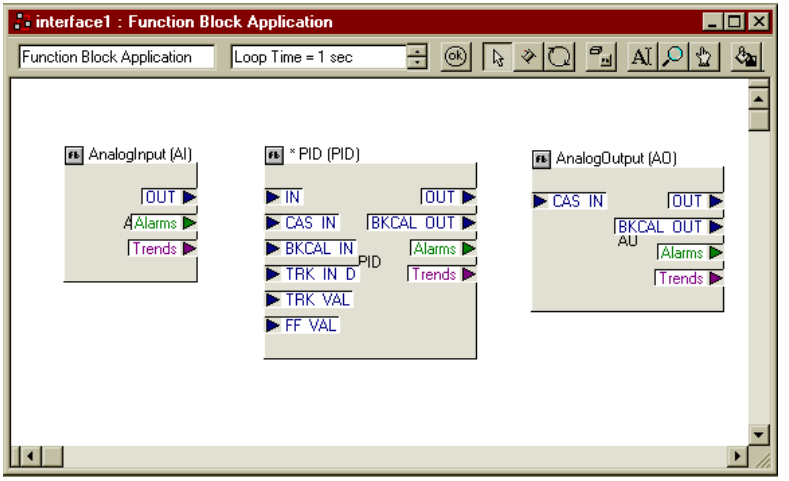


Figure 3-14. Added Function Blocks

Connecting Blocks

To send data from one block to another, you must connect the blocks. There are two ways to link up blocks: manually or using a template.

Wiring Blocks Manually

To wire blocks manually, complete the following steps:

1. Click on the Wiring tool ( ).
2. Click on an input or output you want to connect.
3. Click on the background of the Function Block Application Editor to guide the connection around other blocks to the input or output you want to attach to.
4. Click on the input or output you want to attach to.

When you click on the Wiring tool, the NI-FBUS Configurator performs type checking and highlights valid inputs and outputs.

☞ **Note:** ***Press the spacebar during wiring to toggle the direction of the connection you are dragging.***

Figure 3-15 shows the **BKCAL OUT** output of the **AO** block being connected to the **BKCAL IN** input of the **PID** block.

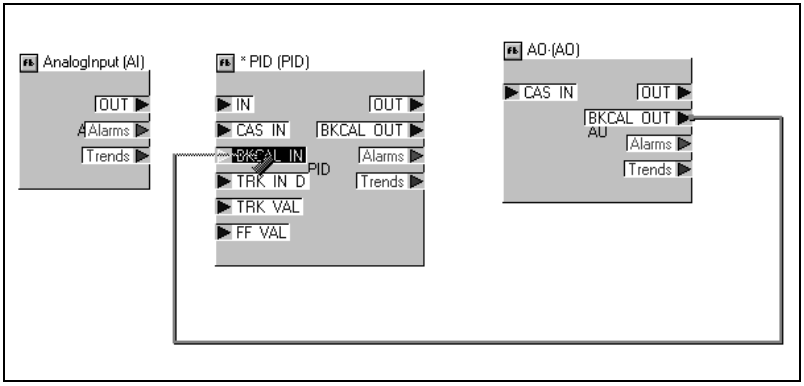


Figure 3-15. Wire Connecting to a Block Input

Figure 3-16 shows an example of the result of the wiring process.

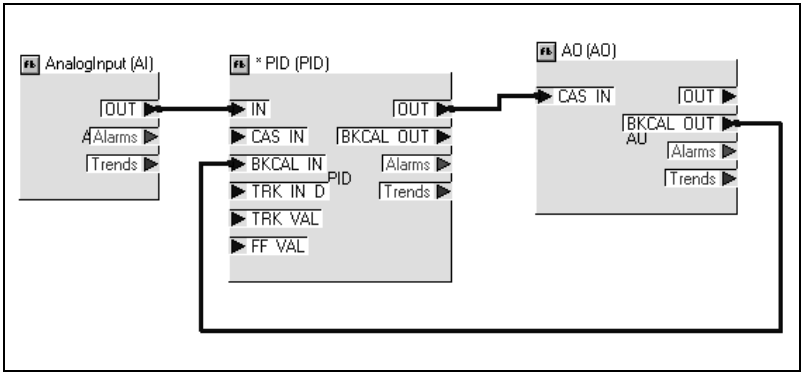


Figure 3-16. Result of the Wiring Process

You can also drag devices from the Project View window into the Function Block Application Editor to configure alarms and trends, as discussed in the following sections.

Using Pre-Wired Templates

Templates are pre-defined, pre-wired control loops that you can drag into the Function Block Application Editor to use as a model for your function block application. The NI-FBUS Configurator is shipped with several types of templates. You can also save your own template as a file by selecting **Save Template** from the **File** menu. The NI-FBUS Configurator saves all templates in the templates directory under the `c:\Nifb\fcs\templates` directory. If a template is in the `c:\Nifb\fcs\templates` directory, it automatically appears in the template menu.

To access templates, do one of the following:

1. Right-click on the background of the Function Block Application Editor.
2. Select **FBAP** Templates.

or Select **Open Template** from the **File** menu.

The following templates come with the NI-FBUS Configurator:

- PID Feedback Control
- Manual Control with PV Indication
- PD Feedback Control
- Track Feedforward Control
- Cascade Control
- Ratio Control
- Override Control

Figure 3-17 shows an example of a template.

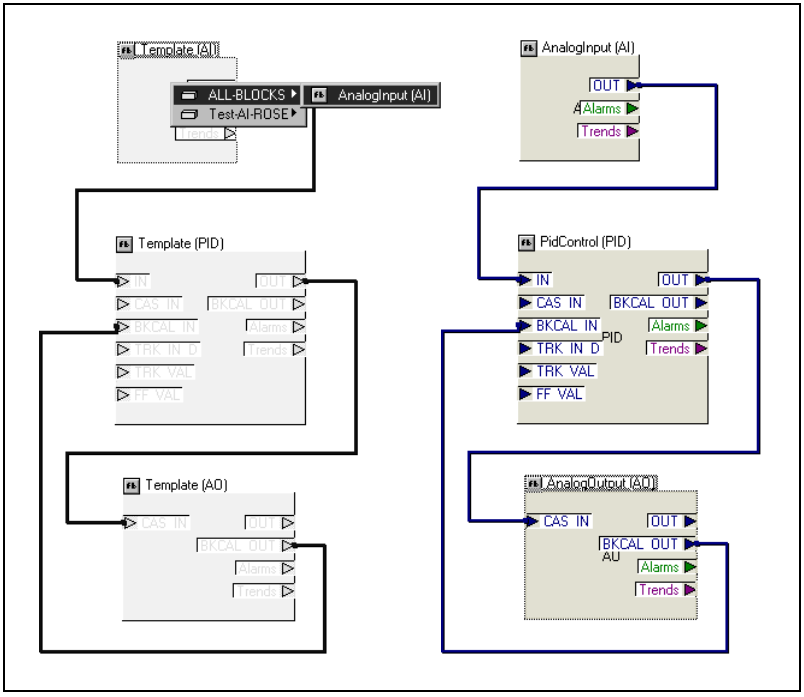


Figure 3-17. Template

If template blocks are grayed out, as the blocks on the left are in Figure 3-17, they are not assigned to any function block in a device. Double-click on the template to view all the blocks that match this block type in your project. Then, select the desired block from the list that appears. Your application is not complete until you have replaced all the template blocks with actual blocks in your project.

Defining Multiple Loops

A *loop* is a group of function blocks that are connected and execute at a specified rate. You can define many loops in one Function Block Application Editor window. However, you might want to add other Function Block Application Editor windows to the project to break up the loops to better organize your project.

Figure 3-18 shows an example of two separate loops running at the same rate.

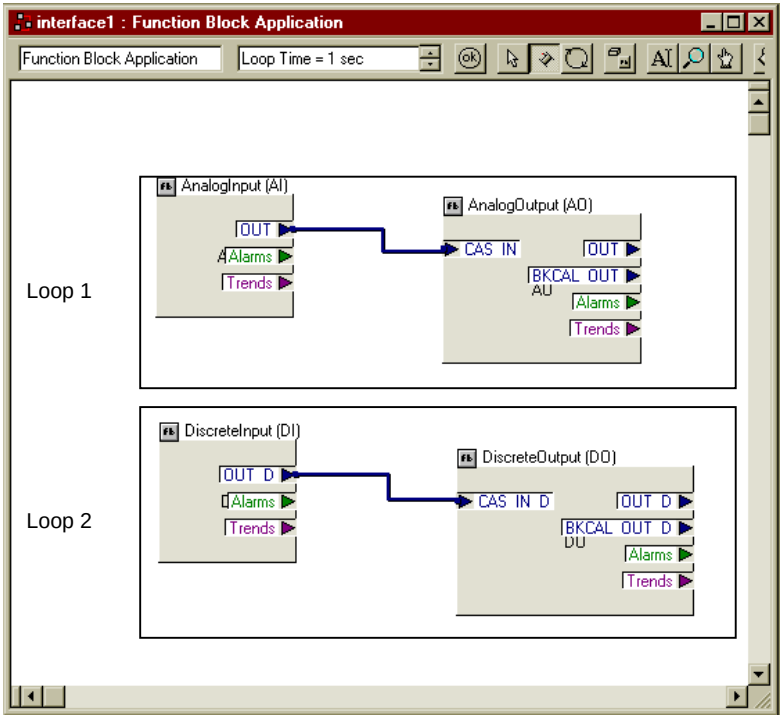


Figure 3-18. Multiple Loops

To add another Function Block Application Editor window to the project, click on the **Function Block Application** button ( ) in the Project View window toolbar.

Defining Multiple Loops Running at Different Rates

The loop execution time shown on the Function Block Application Editor toolbar is the default execution time for all function blocks on the window *not* isolated in a loop structure. For example, the DI and DO blocks in Figure 3-19 execute at a rate of once every second and the AI-PID-AO loop executes once every 500 ms.

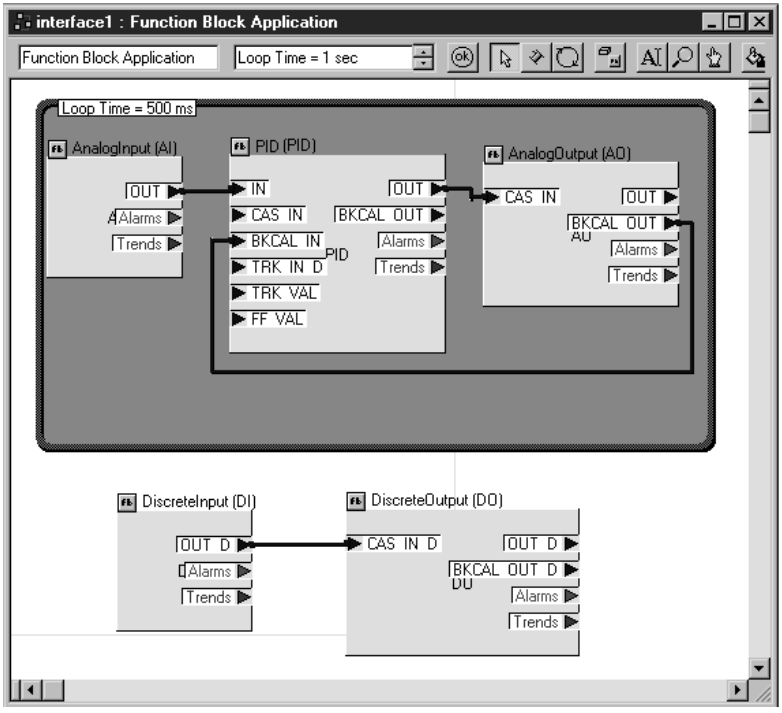


Figure 3-19. Two Loops Running at Different Rates

You can use the loop structure shown in Figure 3-20 to isolate a group of function blocks that runs at a different execution rate than the rate on the toolbar of the Function Block Application Editor.

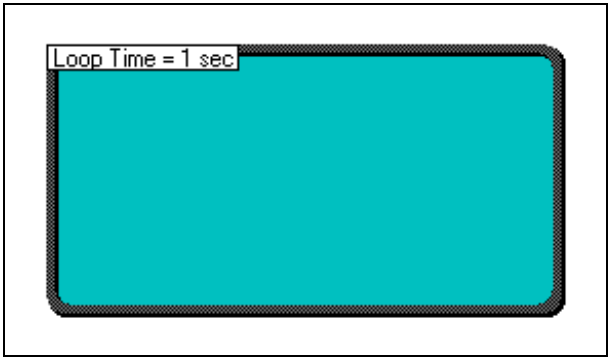


Figure 3-20. Loop Structure

To create a loop structure, complete the following steps:

1. Click on the Define Loops tool ( ) on the Function Block Application Editor toolbar.
2. Click on the background of the Function Block Application Editor and drag a loop around the blocks you want to put in a loop.
3. Change the execution time for the isolated blocks by typing the new time for the loop in the box at the upper left of the loop.

Changing the Block Execution Order

If you want to change the execution order of the blocks, complete the following steps:

1. In the Function Block Application Editor, click on the **Change Execution Order Button** ( ). Numbers appear on the blocks, indicating their current order, as shown in Figure 3-21.

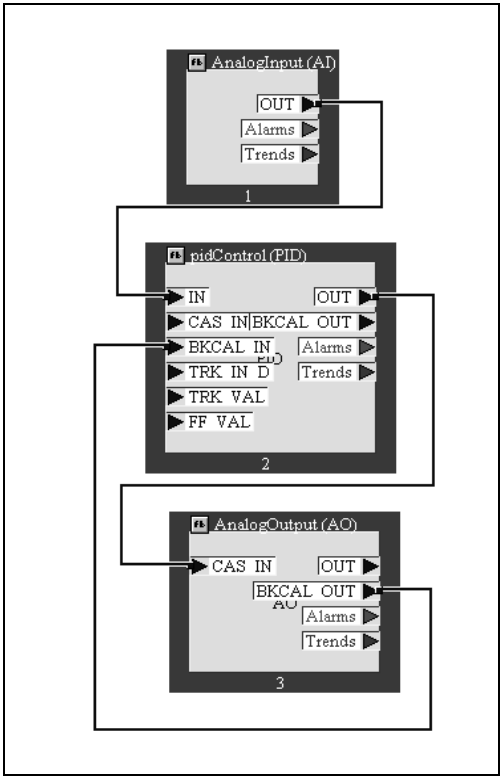


Figure 3-21. Changing the Order of Blocks

2. Click on the blocks in the order that you want them to execute.
3. When you are done, click on the background of the Function Block Application Editor window or select another tool.

Configuring Block Parameters, Trends, and Alarms

Each function block in your function block application has a Block window that you can use to change block parameters and other settings. When you read or write data on a block, the Status window shows the status of the transactions.

Figure 3-22 shows the Block window.

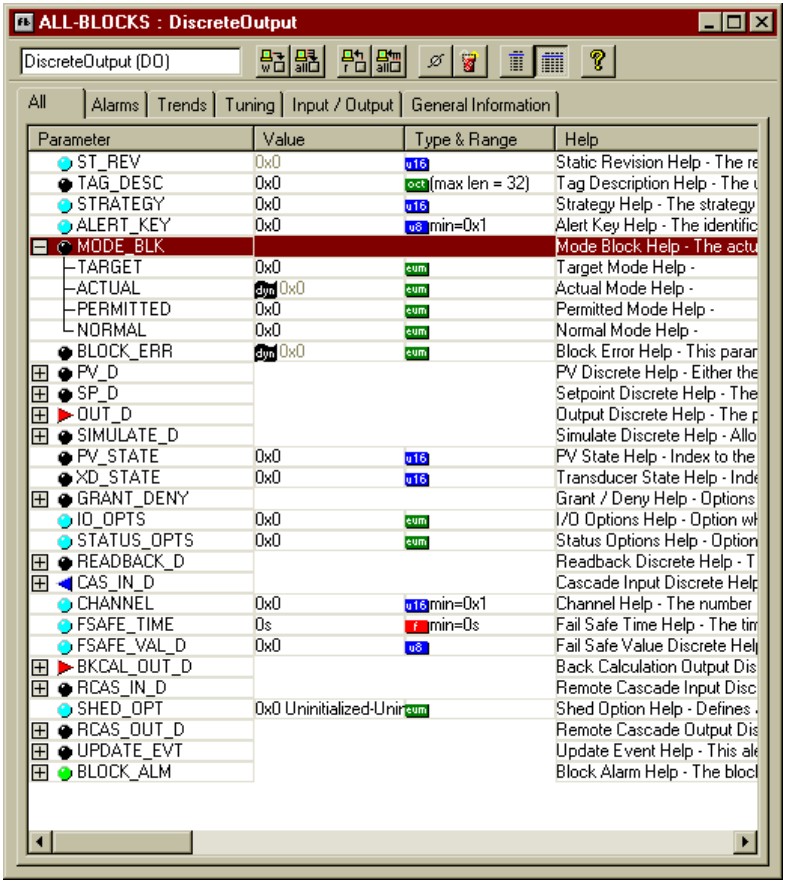


Figure 3-22. All Tab of the Block Window

Block Window Icons

As shown in Figure 3-22, there is an icon to the right of each parameter name that color-codes and symbolically represents the class of the parameter.

Circle—Represents contained parameters. Contained parameters cannot be linked to other parameters; they are contained in the block. There are three types of contained parameters: alarms are green, tuning is light blue, and all others are black.

Right arrow—Represents output and is color-coded red.

Left arrow—Represents input and is color-coded blue.

Tabs of the Block Window

There are seven tabs on the Block window that group the parameters into their various classes:

All—Shows all the parameters. The **All** tab, shown in detail view in Figure 3-22, can show the following columns:

- **Parameter**—Displays the name of the parameter.
- **Value**—Displays the value last read from the block. You can update this value by clicking on the **Read All** or **Read Selected** button on the Block window toolbar.
- **Type & Range**—Displays the data type of the parameter and the range of valid values.
- **Help**—Displays help strings from the Device Description (DD). The help string also appears in the Help window.

Alarms—Shows only alarm parameters and is used to configure alarms. Figure 3-23 shows the **Alarms** tab in simple view.

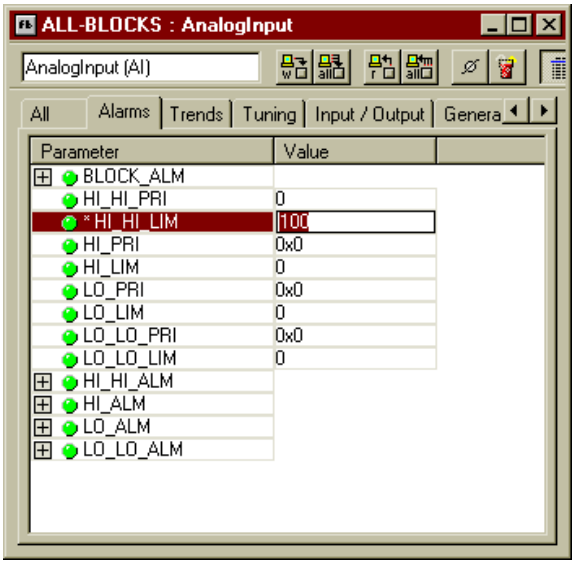


Figure 3-23. Alarms Tab

The **Alarms** tab can show the following columns:

- **Parameter**—Displays the name of the block alarm parameter.
- **Value**—Displays the editable value of the alarm limit and priorities.
- **Type & Range**—Displays the data type of the parameter and the range of valid values.
- **Help**—Displays help strings from the Device Description (DD). The help string also appears in the Help window.

Trends—Shows only trendable parameters and is used to configure trends. Figure 3-24 shows the **Trends** tab.

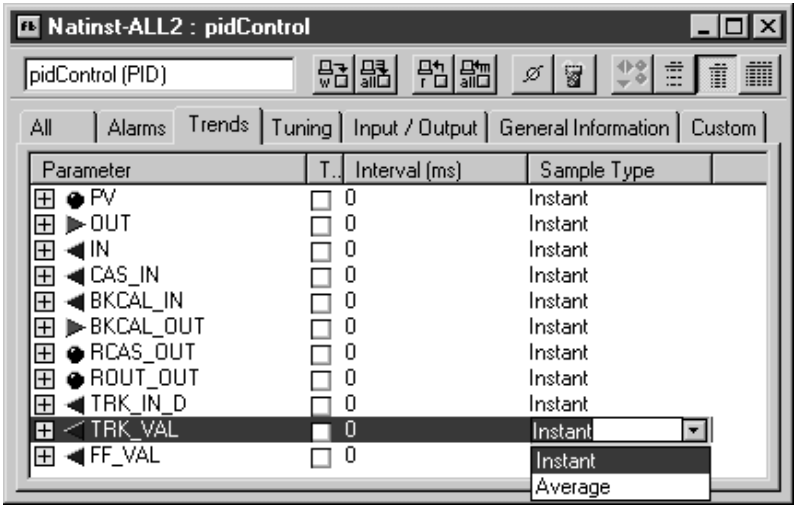


Figure 3-24. Trends Tab of the Block Window

The **Trends** tab has four columns:

- **Parameter**—Displays the name of the parameter.
- **Trend**—Displays the checkbox for trending this value.
- **Interval**—Displays the sample interval of trend.
- **Sample Type**—Displays the type of sample, either **Instant** or **Average**. **Instant** gives an instantaneous reading. **Average** gives an average of previous readings.

Tuning—Shows only tuning parameters and is used to tune the block.

Input/Output—Shows only the I/O parameters.

General Information—Shows basic information about the function block.

Custom—Shows only information you select. To customize this tab, click on the **Customize** button ( ) to display a list of the parameters for the block, and check the boxes next to the parameters you want to view.

Block Window Toolbar

The toolbar at the top of the Block window provides an interface for reading and writing parameters. Figure 3-25 shows this toolbar.

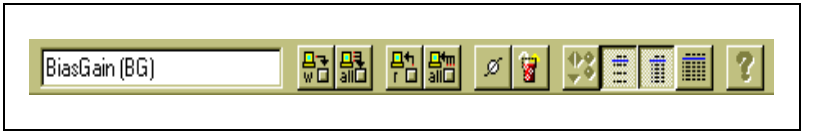


Figure 3-25. Block Window Toolbar

Following are descriptions of the icons on this toolbar:

Device Tag field—Shows the function block tag. Click on this field to change the block tag.

Write Changes button—Writes only changed parameters to the block on the device, including changed block tags.

Write All button—Writes all parameters, including changed block tags, to the block on the device.

Read Selected button—Reads a selected parameter.

Read All button—Reads all parameters.

Clear Selected button—Clears all linkages to this block.

Refresh button—Updates the screen.

Customize button—Selects parameters to add to the custom tab.

Spaced View button—Adds space between parameter listings.

Simple View button—Displays only the **Parameter** and **Value** columns.

Detailed View button—Displays the **Parameter**, **Value**, **Type & Range**, and **Help** columns.

Opening the Block Window

To open the Block window for a block, do one of the following:

Double-click on a function block in the Function Block Application Editor.

or Double-click on the name of the function block in the Project View window.

Changing Parameters

The Block window displays the parameters in the order that they appear in the block. Parameters with a plus sign beside them are records (structures) that contain more than one entry. You can click on the plus sign to expand the structure, or on the minus sign to collapse the structure.

To change a parameter, click on the parameter to display the proper edit control for changing the value of that parameter. If the parameter value is grayed out, you cannot change that parameter. When you change a parameter value, the NI-FBUS Configurator places an asterisk (*****) beside the parameter name.

Configuring Trends

You can connect multiple trends to one device. To configure trends, complete the following steps:

1. Find the icon for the device to which you want to send the trend in the Project View window. Drag this icon from the Project View window to the Function Block Application Editor.
2. Double-click on the function block you want to send a trend from. The Block window appears.
3. In the Block window, switch to the **Trends** tab.
4. Check the parameter to trend by clicking the checkbox in the **Trend** column.
5. Set the sample **Interval** of the trend.
6. Set the **Sample Type**.

7. Wire the **Trends** output of the block to the device to receive the trend. Figure 3-26 shows an example of a configured trend.

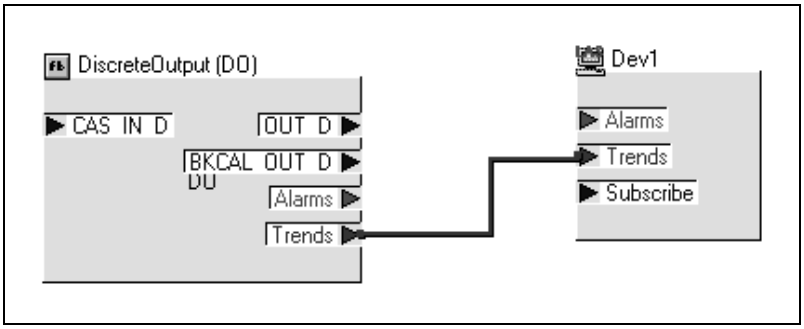


Figure 3-26. Configured Trend

Configuring Alarms

You can connect multiple alarms to one device. To configure alarms, complete the following steps:

1. Find the icon for the device to which you want to send the alarm in the Project View window. Drag this icon from the Project View window to the Function Block Application Editor.
2. If you want to look at the default alarm configuration, double-click on the function block you want to send an alarm from. The Block window appears. In the Block window, switch to the **Alarms** tab to view or change alarm information, such as the high and low limits of an alarm condition.

3. To configure the alarm, wire the alarm output of a function block to an alarm input of a device. Figure 3-27 shows a configured alarm.

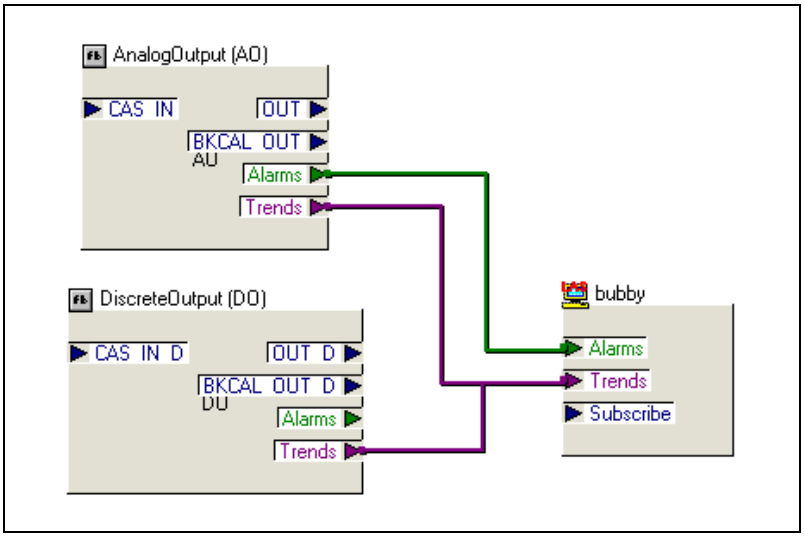


Figure 3-27. Configured Alarm

Viewing or Changing the Schedule

The NI-FBUS Configurator automatically determines the execution order and timing of the schedule based on network and device factors, and on the loop execution you choose. The NI-FBUS Configurator automatically optimizes the schedule. Double-click on the **Schedule** icon in the Project View window to view or edit the link schedule.

Figure 3-28 shows an example of a link active schedule.

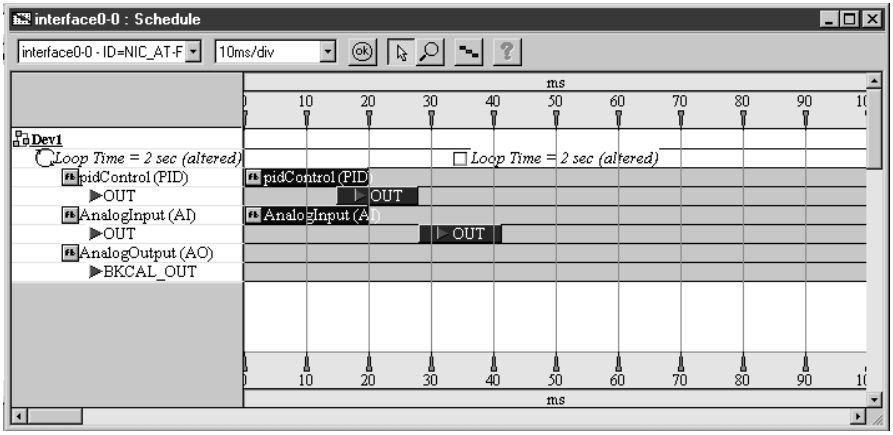


Figure 3-28. Schedule Window

In the Schedule window, a key of the scheduled objects appears on the left. On the right is the timing diagram that displays the execution times of the function blocks, and when data is transmitted on the bus.

The blue bars on the screen correspond to the function block execution times and the red bars correspond to the data transmission times, which consist of LAS notification time and transmission time.

☞ **Note:** ***An optimized schedule can show that the transmission time overlaps the end time for the function block because the transmission time includes the time that the LAS uses to tell the device to send the data.***

To change the execution time for a loop, click on the execution time next to the loop icon ( ) and type in the new time.

Changing the Link Active Schedule

You do not need to alter the schedule if the function block execution times in the device are correct. If the times in the device are incorrect, or if one device has too many blocks to execute, you might have to tune the execution times by dragging the execution time bars on the screen. Dragging bars around in the schedule shuts off the automatic optimization. If you want to reoptimize, click on the **Optimize Schedule** button ( ) on the Schedule window toolbar.

Schedule Window Toolbar

Figure 3-29 shows the toolbar for the Schedule window.

Figure 3-29. Schedule Toolbar

Following are descriptions of the icons on the schedule toolbar:

Primary LAS field—Displays the name of the device that is the primary LAS for the system.

Scale field—Displays the time and divisions on the timing diagram.

Errors button—Validates the schedule.

Pointer—Drags the time bars around on the timing diagram.

Zoom tool—Changes the scale of the view by using smaller or larger units.

Optimize Schedule button—Click on this icon to rerun the optimization routine.

Multiple Loop Representation

The schedule in Figure 3-30 shows how multiple loops are represented.

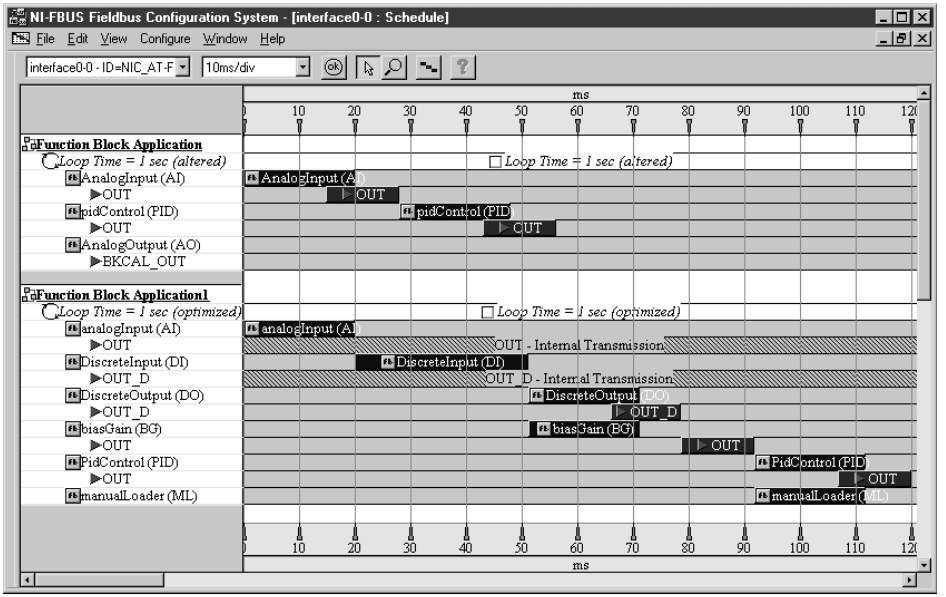


Figure 3-30. Multiple Loops in a Schedule

The loops are separated by white dividers. The loop time shown above the colored bars has a checkbox by it that locks the loop to prevent you and the NI-FBUS Configurator from changing the schedule until you uncheck the box.

Viewing or Adding to the NI-FBUS Configurator Log and Notes

The Log/Notes window in the project keeps track of the last downloaded configuration status output. The Log/Notes window shows the same output as the **Download Log** tab of the **Status** window plus the time and date of the last change and previous downloads of the current project. To open the Log/Notes window, double-click on the Log/Notes icon in the Project View window. Figure 3-31 shows the Log/Notes window.

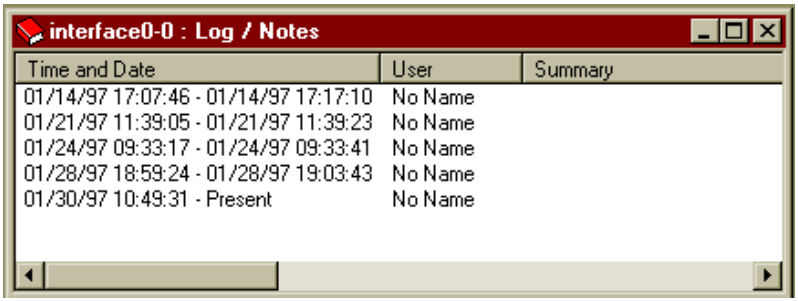


Figure 3-31. Log/Notes

Double-click on a log entry to see the download log for that session. You can also add notes at the bottom of the download log for each session, and the NI-FBUS Configurator automatically saves them with the project for future reference.

Viewing Device and Function Block Settings

Use the Device window to view device and function block settings. The left pane of the Device window shows a tree diagram of the internal fieldbus objects of the device.

Figure 3-32 shows the Device window.

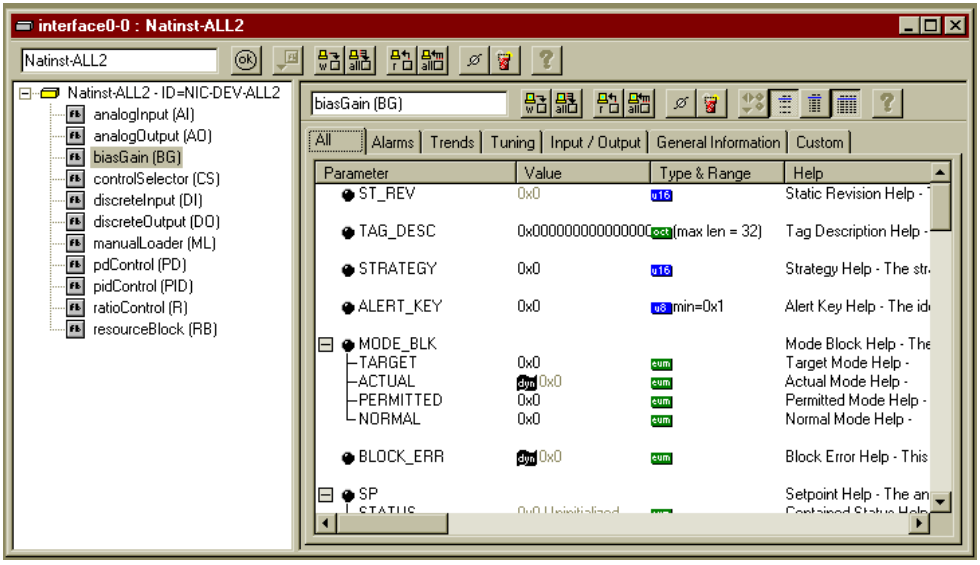


Figure 3-32. Device Window

To edit a block, select it. The Block window for that block appears in the left pane of the Device window. You can edit the block in this Block window just as you normally would. You can use the toolbar at the top of the Device window to rename the device, read or write block parameters, and clear device linkages.

Printing Your Project

You can print your configured project in the form of text, graphical diagrams, and text explanations of the diagrams. From the **Print** dialog box, you can choose to print the complete configuration or only specific objects in the Project View window.

Figure 3-33 shows the **Print** dialog box.

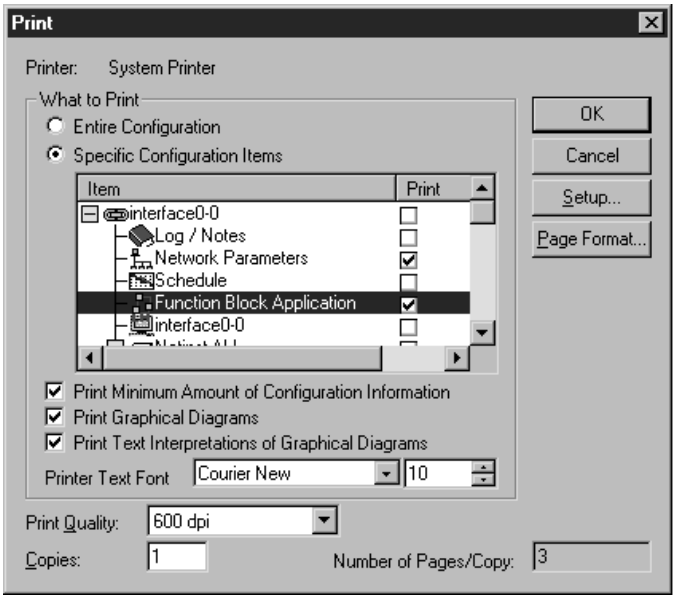


Figure 3-33. Print Dialog Box

Print Minimum Amount of Configuration Information checkbox—Prints only the minimum amount of information necessary to describe the printed items. If you check this item, the NI-FBUS Configurator prints only the function blocks that are used in a function block application of the project, and does not print unused blocks.

Print Graphical Diagrams checkbox—Prints the function block application and graphical representation of the schedule.

Print Text Interpretations of Graphical Diagrams checkbox—Prints a text version of the function block application and schedule.

Page Format button—Use this button to select printing styles for the graphical schematics, page titles, and numbering.

Error Messages and Warnings

Appendix
A

This appendix contains error messages you might receive while using the NI-FBUS Configurator, explanations of the error messages, and solutions to some of the errors.

Schedule Errors

NIFCONF_ERR_COULD_NOT_DETERMINE_SCHEDULE (-1006)	The NI-FBUS Configurator cannot fit the schedule of the loop into the current schedule. Usually, insufficient time or poor choice of loop times cause this error. Use integer multiples such as 1, 2, 4... instead of multiples like 5, 7, 13... to solve this problem.
NIFCONF_ERR_MACROCYCLE_NOT_GOOD_MULTIPLE (-1007)	This macrocycle is a bad choice in comparison to the other macrocycles.
NIFCONF_ERR_INVALID_MACROCYCLE (-1010)	This macrocycle conflicts with previously defined macrocycle.
NIFCONF_ERR_MACROCYCLE_CONFLICT (-1014)	This macrocycle conflicts with a previously defined macrocycle time for a device in this loop. Devices can only schedule one macrocycle time. The best solution is to increase the macrocycle time of the loop that contains the other block(s) for this device.
NIFCONF_ERR_TOO_MANY_FB_SCHEDULE_ENTRIES (-1015)	The schedule for this object contains too many entries for the FB schedule of the device. Normally, bad choices for macrocycle times cause this error. Use macrocycle times that are integer multiples of each other to correct this problem.

NIFCONF_ERR_TOO_MANY_LAS_SCHEDULE_ENTRIES (-1016)	The number of LAS schedule entries exceeds the number of available entries in the LAS device. Choose integer multiple macrocycle values and reduce the number of data links that go between devices to correct this problem.
NIFCONF_ERR_BLOCK_SCHEDULE_CONFLICT (-1017)	A block in this device is already scheduled for this time. Do not schedule more than one block in the device at the same time.
NIFCONF_ERR_PARAMETER_SCHEDULE_CONFLICT (-1018)	A parameter communication has already been scheduled for this time. Do not schedule more than one parameter communication at a time on the fieldbus.
NIFCONF_ERR_NO_UNSCHEDULED_TIME_LEFT (-1019)	The auto scheduler ran out of unscheduled time. Increase the macrocycle time(s) to allow more free time for scheduling.
NIFCONF_ERR_MACROCYCLE_TOO_SHORT (-1020)	There was not enough time in this macrocycle to schedule all of the function blocks and parameters. Increase the macrocycle time of the loop to get more free time.
NIFCONF_ERR_MAXIMUM_LOOPS_EXCEEDED (-1033)	The maximum number of loops that you can configure on this link has been exceeded.
NIFCONF_ERR_UNSCHEDULED_TRAFFIC_CONFLICT (-1042)	The publish time is conflicting with the reserved 128 octet time at the end of a macrocycle. This time is used for unscheduled traffic.

Function Block Application Errors

NIFCONF_ERR_BAD_WIRE (-1021)	This wire is not completely attached to an output and input(s).
NIFCONF_ERR_TEMPLATE_NOT_ASSIGNED (-1022)	The template is not assigned to a valid project object.
NIFCONF_ERR_LOOP_IS_EMPTY (-1023)	This loop does not contain any blocks.

NIFCONF_ERR_CONFUSED_WIRE (-1044)	This wire is not working. The NI-FBUS Configurator has removed it.

General Errors

NIFCONF_ERR_NO_CONVERSION (-1001)	There is no conversion for this data type.
NIFCONF_ERR_BUF_TOO_SMALL (-1003)	The buffer is too small.
NIFCONF_ERR_STRING_NOT_FOUND (-1005)	There is a missing resource string.
NIFCONF_ERR_INCOMPATIBLE_VERSION (-1008)	This file was made with a newer version of the NI-FBUS Configurator. There might be unpredictable problems with the project.
NIFCONF_ERR_OUT_OF_MEMORY (-1009)	Memory is low; the NI-FBUS Configurator cannot allocate objects. Close windows to solve this problem.
NIFCONF_ERR_CORRUPT_FILE (-1011)	The NI-FBUS Configurator found a corrupt file object.
NIFCONF_ERR_INVALID_NUMBER (-1024)	This is an invalid number. A number can use the digits 0-9 and the letters a-f. Hexadecimal numbers can be preceded with `0x`.
NIFCONF_ERR_INVALID_VALUE (-1041)	You have entered an incorrect value. Please check the value or values and the valid ranges for the values.
NIFCONF_ERR_REGISTRY_ERROR (-2000)	Some registry information for your application is missing or corrupt. You might need to reinstall the NI-FBUS software and the NI-FBUS Configurator.
NIFCONF_ERR_STANDARD_DD_MISSING (-2001)	The NI-FBUS Configurator could not find the standard DD file.
NIFCONF_ERR_MISSING_NIFBUS_PATH (-2002)	The install path for NI-FBUS Configurator is not in the Windows registry.

NIFCONF_ERR_NO_PRINTER_DEVICE_CONTEXT (-2003)	The NI-FBUS Configurator cannot draw the document because of an incorrect device context for the selected printer.
NIFCONF_ERR_COULD_NOT_START_THREAD (-2004)	The NI-FBUS Configurator is unable to start a new thread.

I/O Errors

NIFCONF_ERR_DD_SIZE_MISMATCH (-1000)	The actual data size does not match the DD data size.
NIFCONF_ERR_NO_DATA (-1002)	No data.
NIFCONF_ERR_WRONG_TYPE (-1004)	This object has the wrong type.

Configuration Errors

NIFCONF_ERR_DUPLICATE_TAG (-1012)	The tag for this object was found elsewhere in the configuration file. Duplicate tags are not allowed on a fieldbus link.
NIFCONF_ERR_DUPLICATE_ADDRESS (-1013)	The address for this device was found elsewhere in the configuration file. Duplicate addresses are not allowed on a fieldbus link.
NIFCONF_ERR_ADDRESS_OUT_OF_RANGE (-1025)	This address does not fit in the allowable range of addresses.
NIFCONF_ERR_ADDRESS_USED (-1026)	This address is already taken.
NIFCONF_ERR_INVALID_TAG (-1027)	This tag is not valid.
NIFCONF_ERR_OD_SIZE_MISMATCH (-1028)	The size of the actual data object does not match the OD size.
NIFCONF_ERR_TYPE_INFO_UNAVAILABLE (-1029)	The NI-FBUS Configurator cannot read the type information for the object.

NIFCONF_ERR_NO_OBJECT_SELECTED (-1030)	Nothing is selected.
NIFCONF_ERR_DEVICE_NOT_ALIVE (-1031)	The device is not responding.
NIFCONF_ERR_DOWNLOAD_INCOMPLETE (-1032)	The link is only partially configured.
NIFCONF_ERR_NO_LAS_SELECTED (-1034)	A schedule has been created but no LAS is selected.
NIFCONF_ERR_NOT_ON_LINK (-1037)	This object does not belong on this link.
NIFCONF_ERR_MULTI_LAS (-1038)	Multiple primary Link Active Schedulers are defined. Only one primary Link Active Scheduler is allowed on a link.
NIFCONF_ERR_CONFIGURING (-1038)	You are configuring this project. Stop configuring the project to continue.
NIFCONF_ERR_MULTI_TM (-1039)	Multiple time masters are defined. Only one time master per link is allowed.
NIFCONF_ERR_NO_LM_SELECTED (-1040)	A schedule has been created but no link master is selected.
NIFCONF_ERR_NO_TM_SELECTED (-1043)	No time master is selected.

Warnings

NIFCONF_WARN_MEMORY_LOW (-5000)	The system is low on memory.
NIFCONF_WARN_OBJECT_NOT_WIRED (-5001)	This object is not connected by wires to any other object.
NIFCONF_WARN_NO_TREND_SELECTED (-5002)	A trend is wired but no trend is checked.

NIFCONF_WARN_TREND_NOT_WIRED (-5003)	A trend is selected but not wired to device.
NIFCONF_WARN_PROJECT_ERRORS (-5004)	There are errors that might cause problems in the download of the configuration. Look at the error window.

NI-FBUS Errors

NIF_ALARM_ACKNOWLEDGED	The alarm has already been acknowledged.
NIF_BAD_ARGUMENT	A value you gave is not of the correct data type.
NIF_BAD_DEVICE_DATA	The device returned some inconsistent information.
NIF_BUF_TOO_SMALL	The buffer does not contain enough entries to hold all the information for the blocks. If you receive this error, buffer entries that you allocated did not contain valid block information when the call returned.
NIF_COMM_ERROR	An error occurred when NI-FBUS tried to communicate with the device.
NIF_CONFIG_ERROR	Some configuration information, such as registry information or network configuration information, is incorrect.
NIF_DATA_NEVER_WRITABLE	The specified object is read-only.
NIF_DEVICE_NOT_PRESENT	The requested device is not operational.
NIF_ORDINAL_NUM_OUT_OF_RANGE	The ordinal number is out of the device's range.
NIF_EXCEED_LIMIT	The device reported that the value exceeds the allowable limit during a write operation.
NIF_INVALID_DESCRIPTOR	The descriptor you gave is invalid.
NIF_MULTIPLE	There are identical block tags.
NIF_NOT_FOUND	NI-FBUS could not find the specified object.

NIF_OBJECT_ACCESS _UNSUPPORTED	The device does not support write access to this object.
NIF_OBJECT_ACCESS_DENIED	The fieldbus interface does not have the required privileges. The access group you belong to is not allowed to acknowledge the event, or the password you used is wrong.
NIF_OBSOLETE_DESC	The input descriptor is no longer valid. It was closed before a function completed.
NIF_PARAMETER_CHECK	The device reported a violation of parameter-specific checks.
NIF_RESOURCES	NI-FBUS is unable to allocate some system resource; this is usually a memory problem.
NIF_SERVER_CONNECTION_ LOST	The session established with NI-FBUS for this descriptor has been closed or lost.
NIF_SERVER_NOT_RESPONDING	Either the NI-FBUS server has not been started, or the server, in its current state, cannot respond to the request.
NIF_SM_NOT_OPERATIONAL	The device is present, but cannot respond because it is at a default address.
NIF_SYMBOL_FILE_NOT_FOUND	NI-FBUS could not find the symbol file.
NIF_TIMEOUT	The device containing the object is present but did not respond within the timeout period.
NIF_WRITE_IS_PROHIBITED	The device reported that the `WRITE_LOCK` parameter value is set. The `WRITE_LOCK` parameter prohibits writing to the `name` parameter.
NIF_WRONG_MODE_FOR _REQUEST	The device reported that the current function block mode does not allow you to write to the parameter.

Appendix
B

Customer Communication

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve technical problems and a form you can use to comment on the product documentation. When you contact us, we need the information on the Technical Support Form and the configuration form, if your manual contains one, about your system configuration to answer your questions as quickly as possible.

National Instruments has technical assistance through electronic, fax, and telephone systems to quickly provide the information you need. Our electronic services include a bulletin board service, an FTP site, a Fax-on-Demand system, and e-mail support. If you have a hardware or software problem, first try the electronic support systems. If the information available on these systems does not answer your questions, we offer fax and telephone support through our technical support centers, which are staffed by application engineers.

Electronic Services

Bulletin Board Support

National Instruments has BBS and FTP sites dedicated for 24-hour support with a collection of files and documents to answer most common customer questions. From these sites, you can also download the latest instrument drivers, updates, and example programs. For recorded instructions on how to use the bulletin board and FTP services and for BBS automated information, call (512) 795-6990. You can access these services at:

United States: (512) 794-5422
Up to 14,400 baud, 8 data bits, 1 stop bit, no parity

United Kingdom: 01635 551422
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

France: 01 48 65 15 59
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

FTP Support

To access our FTP site, log on to our Internet host, `ftp.natinst.com`, as `anonymous` and use your Internet address, such as `joesmith@anywhere.com`, as your password. The support files and documents are located in the /`support` directories.

Fax-on-Demand Support

Fax-on-Demand is a 24-hour information retrieval system containing a library of documents on a wide range of technical information. You can access Fax-on-Demand from a touch-tone telephone at (512) 418-1111.

E-Mail Support (currently U.S. only)

You can submit technical support questions to the applications engineering team through e-mail at the Internet address listed below. Remember to include your name, address, and phone number so we can contact you with solutions and suggestions.

`support@natinst.com`

Telephone and Fax Support

National Instruments has branch offices all over the world. Use the list below to find the technical support number for your country. If there is no National Instruments office in your country, contact the source from which you purchased your software to obtain support.

	Telephone	Fax
Australia	03 9879 5166	03 9879 6277
Austria	0662 45 79 90 0	0662 45 79 90 19
Belgium	02 757 00 20	02 757 03 11
Canada (Ontario)	905 785 0085	905 785 0086
Canada (Quebec)	514 694 8521	514 694 4399
Denmark	45 76 26 00	45 76 26 02
Finland	09 527 2321	09 502 2930
France	01 48 14 24 24	01 48 14 24 14
Germany	089 741 31 30	089 714 60 35
Hong Kong	2645 3186	2686 8505
Israel	03 5734815	03 5734816
Italy	02 413091	02 41309215
Japan	03 5472 2970	03 5472 2977
Korea	02 596 7456	02 596 7455
Mexico	5 520 2635	5 520 3282
Netherlands	0348 433466	0348 430673
Norway	32 84 84 00	32 84 86 00
Singapore	2265886	2265887
Spain	91 640 0085	91 640 0533
Sweden	08 730 49 70	08 730 43 70
Switzerland	056 200 51 51	056 200 51 55
Taiwan	02 377 1200	02 737 4644
U.K.	01635 523545	01635 523154

Technical Support Form

Photocopy this form and update it each time you make changes to your software or hardware, and use the completed copy of this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

If you are using any National Instruments hardware or software products related to this problem, include the configuration forms from their user manuals. Include additional pages if necessary.

Name _____

Title _____

Company _____

Address _____

_____

Fax (____) _____ Phone (____) _____

Computer brand _____ Model _____ Processor _____

Operating system (include version number) _____

Clock Speed _____ MHz RAM _____ MB Display adapter _____

Mouse ____ yes _____ no Other adapters installed _____

Hard disk capacity _____ MB Brand _____

Instruments used _____

National Instruments hardware product model _____ Revision _____

Configuration _____

National Instruments software product _____ Version _____

Configuration _____

The problem is _____

_____

_____

_____

List any error messages _____

_____

_____

The following steps will reproduce the problem _____

_____

_____

Hardware and Software Configuration Form

Record the settings and revisions of your hardware and software on the line to the right of each item. Complete a new copy of this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

National Instruments Products

Hardware Type and Revision _____

Interrupt Level of Hardware _____

Base I/O Address of Hardware _____

Software Version _____

Other Products

Computer Make and Model _____

Microprocessor _____

Clock Frequency _____

Type of Video Board Installed _____

Operating System _____

Operating System Version _____

Operating System Mode _____

Programming Language _____

Programming Language Version _____

Other Boards in System _____

Base I/O Address of Other Boards _____

DMA Channels of Other Boards _____

Interrupt Level of Other Boards _____

Documentation Comment Form

National Instruments encourages you to comment on the documentation supplied with our products. This information helps us provide quality products to meet your needs.

Title: *NI-FBUS™ Configurator User Manual*

Edition Date: February 1997

Part Number: 321423A-01

Please comment on the completeness, clarity, and organization of the manual.

_____

_____

_____

_____

_____

_____

_____

If you find errors in the manual, please record the page numbers and describe the errors.

_____

_____

_____

_____

_____

_____

_____

Thank you for your help.

Name _____

Title _____

Company _____

Address _____

_____

Phone (____) _____

Mail to: Technical Publications
National Instruments Corporation
6504 Bridge Point Parkway
Austin, TX 78730-5039

Fax to: Technical Publications
National Instruments Corporation
(512) 794-5678

Glossary

Prefix	Meaning	Value
n-	nano-	10^{-9}
µ-	micro-	10^{-6}
m-	milli-	10^{-3}

A

AI	Analog Input.
AO	Analog Output.

B

basic device	A device that can communicate on the fieldbus, but cannot become the LAS.
BG	Bias Gain.
block	A logical software unit that makes up one named copy of a block and the associated parameters its block type specifies. The values of the parameters persist from one invocation of the block to the next. It can be a resource block, transducer block, or function block residing within a VFD.
block tag	A character string name that uniquely identifies a block on a fieldbus network.

bridge	An interface in a fieldbus network between two different protocols.

C

contained parameter	A parameter that does not receive or send data, and is contained within a function block.
control loop	A set of connections between blocks used to perform a control algorithm.
CS	Control Selector.

D

DCS	Distributed Control System.
deterministic communication	Communication in which data is transferred between a given set of devices at the same time during each loop.
device ID	An identifier for a device that the manufacturer assigns. Device IDs must be unique to the device; no two devices can have the same device ID.
device tag	A name you assign to a fieldbus device.
DI	Discrete Input.
DO	Discrete Output.

F

FBAP	See *Function Block Application.*
fieldbus	An all-digital, two-way communication system that connects control systems to instrumentation.
Fieldbus Foundation	The organization that developed a fieldbus network specifically based upon the work and principles of the ISA/IEC standards committees.
FOUNDATION Fieldbus	The communications network specification that the Fieldbus Foundation created.

function block	A named block consisting of one or more input, output, and contained parameters. The block performs some control function as its algorithm. function blocks are the core components you control a system with. The Fieldbus Foundation defines standard sets of function blocks. There are ten function blocks for the most basic control and I/O functions.
Function Block Application	A fieldbus application that you create using FOUNDATION Fieldbus function blocks.

I

IEC Standards Committee	International Electrotechnical Commission Standards Committee. A technical standards committee which is at the same level as the ISO.
input parameter	A block parameter that receives data from another block.
ISA	International Society for Measurement and Control

L

LAS	See *Link Active Scheduler*.
link	A group of fieldbus devices connected across a single wire pair with no intervening bridges.
Link Active Schedule	A schedule of times in the macrocycle when devices must publish their output values on the fieldbus.
Link Active Scheduler	A device that is responsible for keeping a link operational. The LAS executes the link schedule, circulates tokens, distributes time and probes for new devices.
Link Master device	A device that is capable of becoming the LAS.
linkage	A connection between function blocks.
loop	See *control loop.*

M

macrocycle	The least common multiple of all the loop times on a given link.

ML	Manual Loader.

O

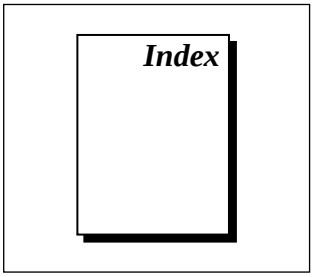
output parameter	A block parameter that sends data to another block.

P

PD	Proportional Derivative.
PID	Proportional Integral Derivative.

R

RC	Ratio Control.



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