Fieldbus

Intel 80188EB-Based Fieldbus Round Card User Manual

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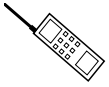

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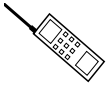

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About This Manual

This manual contains instructions for installing, interfacing to, and programming the National Instruments Fieldbus Round Card. The Round Card software is intended for use with Windows 3.*x*, Windows 95, or Windows NT.

This manual assumes that you are already familiar with the Windows operating system you are using.

How to Use the Manual Set

Use the *Getting Started with Fieldbus* manual to install and configure your Fieldbus hardware, the Fieldbus Stack Interface Library, and the NI-FBUS Function Block Shell software.

Use this *Intel 80188EB-Based Fieldbus Round Card User Manual* manual to install the Intel 80188EB-based Fieldbus Round Card.

Use the *MC68331-Based Fieldbus Round Card User Manual* to install the Motorola MC68331-based Fieldbus Round Card.

Use the *NI-FBUS Function Block Shell Reference Manual* to learn about writing Function Block server applications that are embedded in the Fieldbus Round card.

Use the *NI-FBUS Monitor User Manual* to learn to use the interactive NI-FBUS Monitor utility with your Fieldbus Round Card.

Use the *NI-FBUS Communications Manager User Manual* to learn to use the interactive Fieldbus dialog system with your Fieldbus Round Card.

Use the *NI-FBUS Configurator User Manual* to learn to use the NI-FBUS Configurator to configure your Fieldbus network.

Organization of This Manual

This manual is organized as follows:

- Chapter 1, *Introduction*, lists what you need to get started and includes a brief description of the Fieldbus Round Card hardware and supplied software.
- Chapter 2, *Hardware Installation*, contains instructions to help you install your Fieldbus Round Card.
- Chapter 3, *Software Installation*, contains instructions for installing the software that came with your Fieldbus Round Card.
- Chapter 4, *Interfacing to Your Round Card*, describes how to connect the Fieldbus Round Card to any external electronics, and how to develop your Field Device application to interface to the NI-FBUS Function Block Shell.
- Appendix A, *Data Link Configuration Section Format*, explains how to structure the Data Link Configuration section of your Device Configuration `.ini` file.
- Appendix B, *System Management Configuration Section Format*, explains how to structure the System Management Configuration section of your Device Configuration `.ini` file.
- Appendix C, *Specifications*, describes the characteristics of the Fieldbus Round Card.
- Appendix D, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products and manuals.

Conventions Used in This Manual

The following conventions are used in this manual:

<> Angle brackets enclose the name of a key on the keyboard—for example, <shift>. Angle brackets containing numbers separated by an ellipsis represent a range of values associated with a bit or signal name—for example, DBIO<3..0>.

 This icon to the left of bold italicized text denotes a note, which alerts you to important information.

 This icon to the left of bold italicized text denotes a warning, which advises you of precautions to take to avoid being electrically shocked.

bold	Bold text denotes the names of menus, menu items, parameters, dialog box, dialog box buttons or options, icons, windows, Windows 95 tabs, or LEDs.
bold italic	Bold italic text denotes a note, caution, or warning.
italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept. This font also denotes text from which you supply the appropriate word or value, as in Windows 3.*x*.
`italic monospace`	Italic text in this font denotes that you must supply the appropriate words or values in the place of these items.
`monospace`	Text in this font denotes text or characters that you should literally 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.

Related Documentation

The following document contains information that you may find helpful as you read this manual:

- *Fieldbus Foundation Specification*, which includes the following items:
  - *Fieldbus Foundation System Management Services*
  - *Function Block Application Process, Part 1*
  - *Function Block Application Process, Part 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 D, *Customer Communication*, at the end of this manual.

Chapter 1

Introduction

This chapter lists what you need to get started and includes a brief description of the Fieldbus Round Card hardware and supplied software.

What You Need to Get Started

To install your Fieldbus Round Card Interface Kit, you need the following items:

- Fieldbus Round Card
- Fieldbus Round Card Interface Kit distribution disk
- Windows 3.*x*, Windows 95, or Windows NT installed on your computer

Hardware Overview

The Fieldbus Round Card is a stand-alone card that allows you to interface to a network that complies with the Fieldbus Foundation H1 specification. The Fieldbus Round Card uses the Intel 80188EB embedded processor and a programmable 256 KB × 8 Flash to run the Stack Interface Library, Function Block Shell, and user applications. A 128 KB × 8 SRAM device on the card provides volatile memory.

The Intel 80188EB processor supports two serial ports. You can use one serial port as a debug port and connect it to the COM port of the host running the debugger software. A typical application for the other serial port would be to interface to a device running the serial HART protocol or other proprietary serial protocol. Both serial ports provide 3 V-compatible signals. The Fieldbus Round Card is capable of providing a 3.9 V at 8 mA power supply to power your electronics. The serial ports and the 3.9 V output are accessible from a 2 × 4 female connector.

The Fieldbus Round Card operates under one of two modes: PROG mode and RUN mode. To select PROG mode, place jumper B on the card. To select RUN mode, remove jumper B from the card.

When power is applied to the Fieldbus Round Card, the processor reads the position of jumper B of W1 to check the mode. When the card is in PROG mode, you can download your application from the COM port of the host computer connected to the debug serial port. When the card is in RUN mode, the processor begins executing the application that is loaded in the Flash.

Software Overview

The software supplied with the Fieldbus Round Card Interface Kit includes the NI-FBUS Function Block Shell, which is an Application Programmer's Interface (API) designed to simplify Fieldbus device development by providing a high-level interface to the Fieldbus communications stack. In addition, you can use the serial driver API to make use of the Round Card's interrupt-driven serial port. The serial driver supports standard HART commands, as well as generic access to the serial port to allow any other serial protocols. A linkable library version of the Fieldbus protocol stack is also supplied. Link your Function Block application with the Function Block Shell and the protocol stack before downloading it to your Fieldbus Round Card.

Chapter 2

Hardware Installation

This chapter contains instructions to help you install your Fieldbus Round Card.

Warning: ***Several components on your Fieldbus Round Card can be damaged by electrostatic discharge. To avoid such damage in handling the board, touch the antistatic plastic package to a metal part of your computer chassis before removing the board from the package.***

Install the Hardware

Perform the following steps to install the Fieldbus Round Card.

1. Connect the Fieldbus cable to terminal J2 (see Figure 2-1) on the Round Card. The positive (+) end of the cable should be connected to terminal 0A and the negative (–) end of the cable should be connected to terminal 1A . Ensure that the Fieldbus cable is properly terminated.
2. Press the reset button on the Round Card, S1 (see Figure 2-1), to reset the processor.

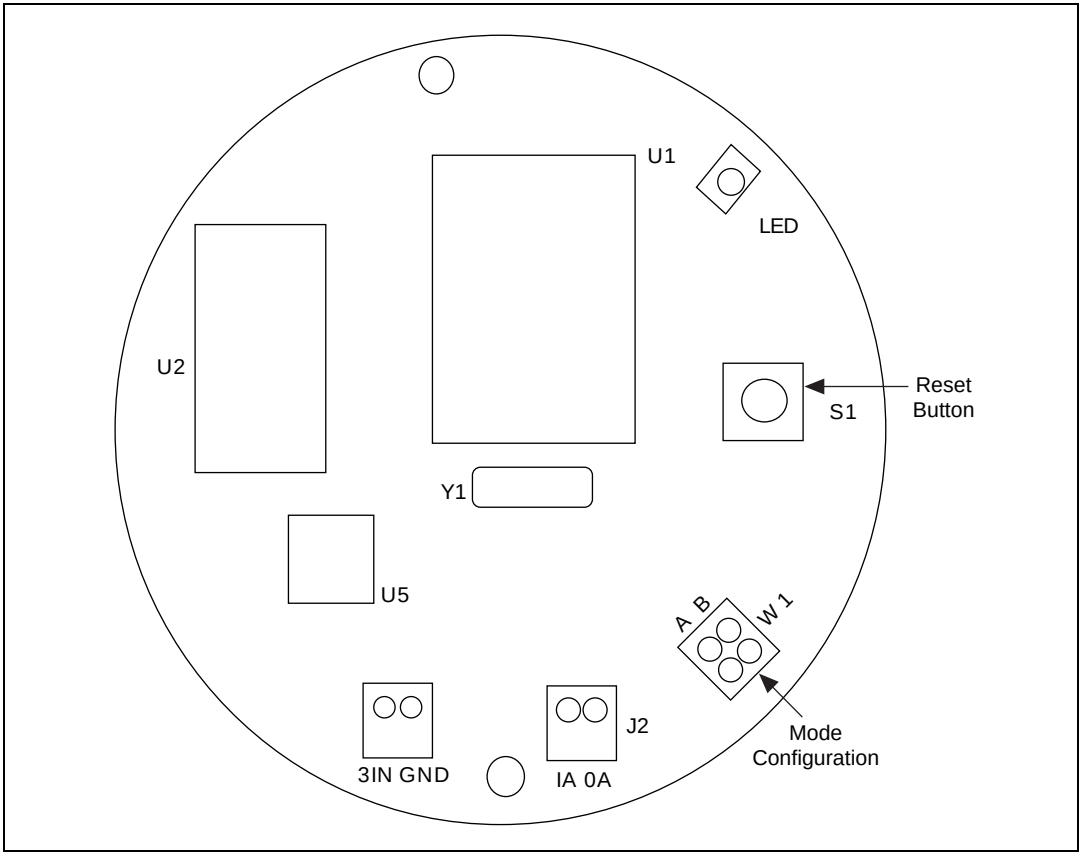

Figure 2-1. Top Side of 80188EB-Based Fieldbus Round Card

In Figure 2-2, W2 shows the pinout of the user electronics connector, and U9 shows where your Flash should be placed after burning. Chapter 4, *Interfacing to Your Round Card*, describes the signals on the user electronics connector and explains how to burn your Flash.

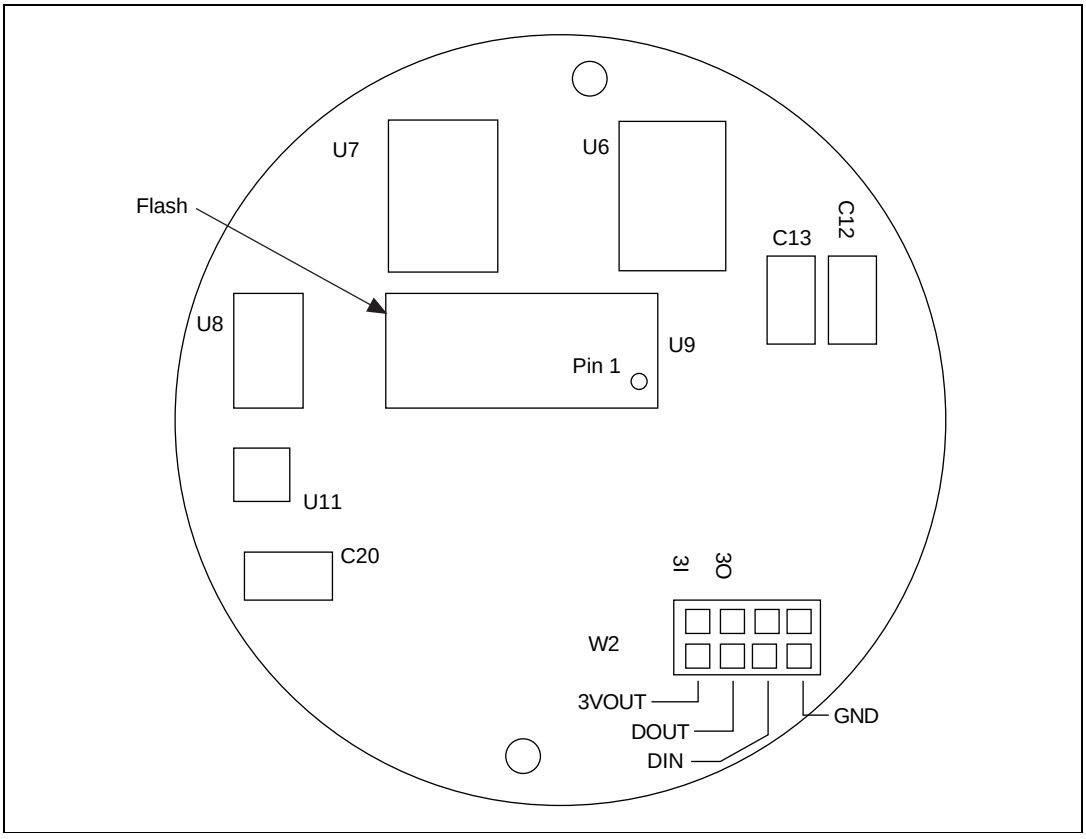

Figure 2-2. Bottom Side of 80188EB-Based Fieldbus Round Card

Your hardware is now installed. Proceed to Chapter 3, *Software Installation*, for instructions on installing the software.

Chapter 3

Software Installation

This chapter contains instructions for installing the software that came with your Fieldbus Round Card.

Fieldbus Round Card Interface Kit Components

The Fieldbus Round Card Interface Kit contains the following software components:

- Function Block Shell Code Generation and Configuration Generation utilities for Windows
- Combined protocol stack, NI-FBUS Function Block Shell, and Serial Driver linkable library for Borland C/C++ 4.5
- Sample function block templates for all standard Foundation Fieldbus function blocks
- Sample function block configuration files
- C language header files for interfacing to the NI-FBUS Function Block Shell

Install the Software

Complete the following steps to run the software installation program.

1. Insert the Fieldbus Round Card Interface Kit distribution disk into an unused drive.
2. Windows 95 or Windows NT 4.*x*: Choose **Run...** from the **Start** menu.

   Windows 3.*x* or Windows NT 3.5 or earlier: Choose **Run...** from the **File** menu in the **Program Manager** window.
3. Type the following command into the dialog box that appears:

   x:\setup

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

4. The interactive installation program installs the software into the directory of your choice.

Your software installation is now complete. Proceed to Chapter 4, *Interfacing to Your Round Card*.

Interfacing to Your Round Card

Chapter 4

This chapter describes how to connect the Fieldbus Round Card to any external electronics, and how to develop your Field Device application to interface to the NI-FBUS Function Block Shell.

Interfacing to the Hardware

The 2×4 female connector on the bottom side of the Fieldbus Round Card, W2, is a user electronics connector that contains signals you can connect to any user-supplied electronics. There are three sets of signals: 3VOUT, Serial Port 0, and Serial Port 1.

The three sets of signals have a common ground pin. See the W2 item in Figure 2-2, *Bottom Side of 80188EB-Based Fieldbus Round Card*, in Chapter 2, *Hardware Installation*, for the pinout of the user electronics connector.

The signals are described as follows:

- 3VOUT—The Fieldbus Round Card has a 3.9 V at 8 mA output that you can use to power the user electronics.

  To activate the 3.9 V output on the W2 connector of the Round Card, place a 0 Ω resistor on R18 and replace R35 with a 0 Ω resistor. Doing this increases the current draw from the Fieldbus to 32 mA in the quiescent state. R18 and R35 are located on the bottom side of the Round Card.
- Serial Port 0—The Transmit and Receive pins of the microprocessor serial port 0 are available at the user electronics connector. You can use this port as an asynchronous serial link to the user electronics board. This port can perform interrupt-driven serial communication. The 3O pin is the Transmit pin and the 3I pin is the Receive pin. Both of these pins provide 3 V-compatible signals.
- Serial Port 1—The Transmit and Receive pins of the processor serial port 1 are available at the user electronics connector. This port *cannot* perform interrupt-driven serial communication. The

DOUT pin is the Transmit pin and the DIN pin is the Receive pin of serial port 1. Both of these pins provide 3 V compatible signals. You can use this port as a debugger port to debug your application. To interface to the COM ports on a host PC computer running a debugger, you should provide means to convert these Fieldbus signals to RS-232 format.

Using the Software

Overview

Most of the code that will be running on your Fieldbus Round Card has already been written for you. It includes the Fieldbus protocol stack, Function Block Shell, and Serial Driver, which are provided in the form of a linkable library with your Fieldbus Round Card Interface Kit. This library provides Fieldbus communications and an API (the Function Block Shell) designed to isolate your application as much as possible from the specifics of the Fieldbus. For more specific information about the Function Block Shell API, consult the *NI-FBUS Function Block Shell Reference Manual*.

In addition, the library contains an API to allow HART or direct serial access to the Round Card's serial port. This API facilitates communications with a HART or serial transducer external to the Round Card. This Serial Driver API is also described in Chapter 8, *Serial Functions*, of the *NI-FBUS Function Block Shell Reference Manual.*

Developing Your Round Card Application

Complete the following steps to develop your application, after you have installed the hardware and software:

1. Write a device template for your device.
2. Convert the device template to C code using the Device Code Generator.
3. Write your Function Block Callbacks, algorithms, and device interface code.
4. Write your `userStart` function to register your callbacks.
5. Write your Device Configuration.
6. Convert your Device Configuration to C code using the Configuration Code Generator.

7. Compile, link, and locate your program on EPROM for installation on the Round Card.
8. Burn your EPROM and place it at U9 on the Round Card. See Figure 2-2, *Bottom Side of 80188EB-Based Fieldbus Round Card*, in Chapter 2, *Hardware Installation.*

These steps are documented in more detail in the following sections.

Writing Device Templates

You must create a device template to describe the network-visible structure of your device and the parameters of your function blocks to the Function Block Shell. The device template is an ASCII file that is divided into various sections containing numerical and string parameters. The `\samples` subdirectory of your installation directory contains sample device templates for devices containing function blocks of the standard types.

The simplest way to create your device template is to modify a copy of one of the sample device templates using a text editor such as MS-DOS Edit or Windows Notepad. Choose the sample device template that most closely matches your device. For example, if the main function of your device is analog input, start with the AI Device Template. If you want your device to contain multiple function blocks, you need to paste several `BLOCK` sections from the sample files into your device template file.

The templates contain information about the device identification, the physical and function blocks in the device, and the device parameters. The device template syntax is described in Chapter 3, *Registration Functions*, of the *NI-FBUS Function Block Shell Reference Manual.*

Your final device templates are converted to C code using the Device Code Generator, described in the next section.

Converting a Device Template to C Code

Before you compile your Function Block device, you must convert the device template to C code using the Device Code Generator. The Device Code Generator resides in the `\utils` subdirectory of your installation directory. The Device Code Generator takes the following command line arguments:

`codegen` *`deviceTemplate outputFile symbolFile`*

where `deviceTemplate` is the name of your device template file, and *`outputFile`* is the name that you want to call the output file. Make sure that *`outputFile`* ends in `.c`.

If there are syntax errors in your device template, `codegen` tells you where they are. When you have corrected all syntax errors, *`outputFile`* is created. *`outputFile`* contains code representing the structure of your device. *`outputFile`* is used again when you compile and link your device application.

`symbolFile` contains a reference to DD information for the parameters defined in your DD and template file. If you are using only the standard function blocks and their parameters, *`symbolFile`* is the standard symbols file, `nifb.sym`, located in the `\samples` subdirectory. If you have defined your own blocks or parameters, *`symbolFile`* must be set to the output of the DD tokenizer.

Writing Function Block Callbacks

The callback functions that you must develop are responsible for the following main functions:

- Handling read and write requests from the network
- Executing your function block algorithm
- Handling alarm confirmations and acknowledgments (if you are using alarms)

The Function Block Shell calls your execution callback whenever your Block is scheduled to execute. This callback performs whatever algorithm you want your function block to perform. The other callbacks, which are called after your device sends an alarm, allow you to perform device-specific processing upon alarm confirmations (notifications that the alarm was received) and alarm acknowledgments (notifications that a user has seen the alarm).

Other optional callbacks are provided for other purposes. See Chapter 4, *Callback Functions*, of the *NI-FBUS Function Block Shell Reference Manual* for more details.

Writing userStart and Registering Callbacks

Your `userStart` function is called by the stack during startup. It is your chance to perform your own initialization tasks. `userStart` also initializes the Function Block Shell and registers your callbacks with

the Function Block Shell. See Chapter 7, *Miscellaneous Functions*, of the *NI-FBUS Function Block Shell Reference Manual* for more details.

Generating Your Device Configuration

The initial configuration of your device includes the configuration of items such as the starting node address, device identification, and, optionally, the function block schedules. You must specify the parameters in the standard Windows `.ini` file format in a configuration `.ini` file. Sample configuration files are included in the `\samples` subdirectory of your installation directory. You might want to start with one of these files and edit it according to your needs. The entries in the data link configuration and system management configuration sections of your configuration `.ini` file are described in are described in Appendix A, *Data Link Configuration Section Format*, and Appendix B, *System Management Configuration Section Format.*

After you have generated your configuration `.ini` file, you must run the Configuration Generator to create a C source file that contains your configuration. This step is described in the next section, *Converting Your Device Configuration to C Code.*

Converting Your Device Configuration to C Code

To convert your Device Configuration to a compilable and linkable `.c` file, you must use the Configuration Generator utility. The Configuration Generator requires the following syntax:

`cfggen` *`iniFile cFile`*

where *`iniFile`* is the name of your configuration file, and *`cFile`* is the name of the C source file for the output C code. If your `.ini` file contains errors, the Configuration Generator halts and informs you where the errors are located. Otherwise, it creates a `.c` source file, which you use in the final step to create your binary file.

Compiling, Linking, and Locating Your Program

The final stage of application development on the Round Card involves creating a binary file suitable for downloading to the EPROM of the Round Card.

☞ **Note:** ***The*** `nistack.lib` ***library file, which your code must link to, was created with Borland C version 4.5. Use either the same compiler or a compatible compiler to ensure that your code works correctly with*** `nistack.lib`***.***

National Instruments recommends that you use Borland C version 4.5 for maximum compatibility with our library file.

The first step in the final stage is compilation. The following files must be successfully compiled to `.obj` format:

- The `.c` file generated by the Device Code Generator.
- The `.c` file generated by the Configuration Generator.
- Your own `.c` file that contains your `userStart` function and your callbacks.

You should compile the files to `.obj` format, using compiler options to meet the following conditions:

- You must use the Medium memory model (near data, far code). For the Borland C 4.5 compiler, this option is `-mm`.
- You must use the default structure alignment, which is a 2-byte structure alignment for Borland C 4.5.
- You must allow single-byte enumeration where possible. For the Borland C 4.5 compiler, this option is `-b-`.

After you have compiled the files, you must link them with the National Instruments Round Card library, `nistack.lib`. This file contains the communications stack and Function Block Shell. You must specify the following linker options when linking to `nistack.lib`:

- Case-sensitive public and external symbols. For the Borland C 4.5 linker, this option is `-c`.
- Ignore default libraries. For the Borland C 4.5 linker, this option is `-n`.
- Set the segment alignment to 16 bytes. For the Borland C 4.5 linker, this option is `-A=16`.

When you have successfully completed linking your application, you are ready to locate it in the physical address space of the Round Card. To complete this step, you need a locator utility such as Paradigm Systems' `locate`.

☞ **Note:** ***The locator file must place the Data Segment so that it covers at least the first 32 bytes of the Frontier-1 memory space. If the Data Segment is not placed correctly, the Round Card will be unable to communicate on the Fieldbus.***

The various hardware components on the Round Card are mapped into processor memory. The memory locations of the EPROM, RAM, and Frontier-1 are shown in Table 4-1.

Table 4-1. Memory Map of Round Card

Component	Size	Memory Window (hex)
SRAM	128 KB × 8	00000–1FFFF
Flash	256 KB × 8	C0000–FFFFF
Frontier-1	1 KB × 8	20000–20400*

* The Frontier-1 needs a 32-byte window for accessing its registers, but the minimum memory window size that can be allocated is 1 kb, so the Frontier-1 registers are aliased within this 1 kb memory space.

Burn Your Flash

After you have run the locator, you are ready to burn your Flash, place it in the Round Card, and test your program.

The Fieldbus Round Card provides a method for you to burn the Flash on the Round Card without an external burner device. This method involves the use of the `niBurn` utility, an RS-232 port on the host, and serial port 1 on the Round Card. This method requires you to build an RS-232 to TTL serial converter cable to connect to the W2 connector on the Round Card.

Complete the following steps to burn the Flash with the `niBurn` utility:

1. Power up the Round Card in PROG Mode (see the *Hardware Overview* section of Chapter 1, *Introduction*, for more information about PROG Mode).
2. Make sure that the user program is located at physical address C0000, because this is the address the `niBurn` utility jumps to when the board is reset in RUN mode, or when `niBurn` has successfully downloaded the user program into the Flash in PROG mode.
3. Launch `niBurn`. The `niBurn` utility is located in the **NI Fieldbus** program group on the host. When you launch the `niBurn` utility, it prompts you for the name of your binary file, and the COM port to use.

Your RS-232 to TTL cable leading to the Round Card must be attached to the COM port you specify. See the *Interfacing to the Hardware* section, earlier in this chapter, for the connections of serial port 1 on the user electronics connector.

The `niBurn` utility contacts the Round Card and downloads your program into the Flash on the Round Card. The utility informs you when it has completed.

4. After the application has downloaded, remove jumper B of W1 before resetting the Round Card.

Data Link Configuration Section Format

Appendix
A

This appendix explains how to structure the Data Link Configuration section of your Device Configuration `.ini` file.

The Data Link Configuration section of your Windows `.ini` Device Configuration file must be converted to C code and linked with your application before the Round Card can communicate on the Fieldbus network. The code generated by running this file through the Configuration Generator automatically configures your board. When a parameter is changed over the Fieldbus, the parameter is updated in nonvolatile memory.

Following is a description of the format of the Data Link Configuration section.

The first line of the Data Link Configuration section is as follows:

```
[Data Link]
```

The general line format for all other lines is as follows:

variable=value

where the valid variable names and values are defined in Table A-1

Table A-1. Valid Variable Names and Values for the Data Link Configuration

Variable Name	Valid Values	Default
`devClass`	BASIC LINKMASTER	none
`nodeAddress`	0x10–0xfb	none

`devClass` indicates whether the device functions as a basic device or a link master device.

`nodeAddress` is the address of the device on the Fieldbus network. It ranges from 0x10 to 0xff. According to the *Fieldbus Foundation Specification*, addresses between 0x10 and 0xf7 are fixed addresses. A device with a fixed address can be in operational state. You will normally configure your device to have a fixed address. Addresses between 0xf8 and 0xfb are temporary addresses. A device with a temporary address on the bus is eventually assigned a fixed address to be operational. Addresses between 0xfc and 0xff are visitor addresses. You should not assign a visitor address to your device.

A Sample Data Link Configuration section follows:

```
[Data Link]
; Comments are allowed on lines starting with a
; semicolon
devClass=BASIC
nodeAddress=0x20
```

If you specify a node address in the range 0xf8 through 0xfb, your device may show up on the bus at any default address. You may use a system configurator such as NI-FBUS Configurator to assign a fixed address to your device.

System Management Configuration Section Format

Appendix
B

This appendix explains how to structure the System Management Configuration section of your Device Configuration `.ini` file.

The System Management Configuration section of your Windows `.ini` Device Configuration file must be converted to C code and linked with your application before the Round Card can communicate on the Fieldbus network. The code generated by running this file through the Configuration Generator automatically configures your card. When a parameter is changed over the Fieldbus, the parameter is updated in nonvolatile memory.

Following is a description of the format of the System Management Configuration section:

The names of the sections in System Management Configuration are as follows:

```
[MIB]
...
[FB Schedule 0]
...
[FB Schedule 1]
...
...
[FB Schedule N]
...
```

The general line format for all other lines is as follows:

`variable=value`

where the valid variable names and values are defined in Table B-1.

☞ **Note:** ***Most of the variables in Table B-1 are optional. In fact, only the*** `devID` ***is required. For other variables, default values are used if other values have not been defined in the configuration file***

Table B-1. Valid Variable Names and Values for the MIB Sections

Variable Name	Valid Values	Implied Units	Default
clockSyncInterval	0–255	seconds	10
macrocycleDuration	32-bit unsigned integer	1/32 ms	0x8000
primaryTimeMaster	0-255	n/a	none
devID	(ASCII string identifier of this device)	n/a	none
pdTag	(ASCII string tag for this device)	n/a	blank tag
T1	0–0xffffffff	1/32 ms	0x40000
T2	0–0xffffffff	1/32 ms	0x40000
T3	0–0xffffffff	1/32 ms	0x8000

Each [FB Schedule] section denotes a single entry in the FB Schedule.

Table B-2. Valid Variable Names and Values for the FB Schedule Sections

Variable Name	Valid Values	Implied Units	Default
offset	32-bit unsigned integer	1/32 ms	none
index	0–65535	n/a	none
vfdRef	32-bit unsigned integer	n/a	none

Specifications

Appendix
C

This appendix describes the characteristics of the Fieldbus Round Card.

Table C-1. Fieldbus Round Card Specifications

Characteristic	Specification
Dimensions	6.2 × 1.52 cm (2.44 × 0.6 in.)
Processor	Intel 80188EB, 8 MHz system clock
Fieldbus Interface	Fuji Electric Frontier-1, bus-powered, 31.25 kb/s
Fieldbus Power Supply	14–32 V at 20 mA at 8 MHz, 50 Ω terminated
Power Supply to External Electronics	3.9 V at 8 mA

Table C-2. Fieldbus Round Card Components

Component	Location on Round Card
Fieldbus Connection	2-position terminal block JI
3 V Output	2-position terminal block J2
Reset Switch	Switch S1
Program Mode Jumper	Jumper B on W1

Customer Communication

Appendix
D

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve your 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 applications 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.

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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.

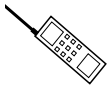
E-Mail Support (currently U.S. only)

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
Brazil	011 288 3336	011 288 8528
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	09 725 725 11	09 725 725 55
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 6120092	03 6120095
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
United Kingdom	01635 523545	01635 523154
United States	512 795 8248	512 794 5678

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 _____

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 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

Interrupt level of hardware _____

DMA channels of hardware _____

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Type of video board installed _____

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 _____

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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: *Intel 80188EB-Based Fieldbus Round Card User Manual*

Edition Date: January 1998

Part Number: 321019C-01

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

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

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Thank you for your help.

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Glossary

Prefix	Meanings	Value
m-	milli-	10^{-3}
c-	centi-	10^{-2}
k-	kilo-	10^{3}
M-	mega-	10^{6}

Ω	Ohms
A	Amperes
AI	Analog input
API	Application Programmer's Interface
ASCII	American Standard Code for Information Interchange
bit	A binary digit; a digit (1 or 0) in the representation of a number in binary notation
byte	Eight related bits of data
DD	Device Description
DMA	Direct-memory access
EPROM	Erasable programmable read-only memory
FB	Function Block
FTP	File Transfer Protocol
HART	HART Field Communications Protocol

hex	Hexadecimal
Hz	Hertz
I/O	Input/Output
KB	Kilobytes of memory
MB	megabytes of memory
OD	Object Dictionary
PC	Personal computer
PROM	Programmable read-only memory
RAM	Random-access memory
s	Seconds
snap	Read from the communications stack
SRAM	Serial random-access memory
TTL	Transistor-transistor logic
V	volts
VCR	Virtual Communication Relationship
VFD	Virtual Field Device
VOUT	Volt output