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Compact FieldPoint™

cFP-21*xx* and cFP-BP-*x* User Manual

February 2005
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The following conventions appear in this manual:

»	The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.
	This icon denotes a note, which alerts you to important information.
	This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash. When this symbol is marked on the product, refer to the *Read Me First: Safety and Radio-Frequency Interference* document, shipped with the product, for precautions to take.
bold	Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names and LED names.
cFP-21*xx*	cFP-21*xx* refers to the cFP-2100, cFP-2110, and cFP-2120.
italic	Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.
`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.
`monospace italic`	Italic text in this font denotes text that is a placeholder for a word or value that you must supply.

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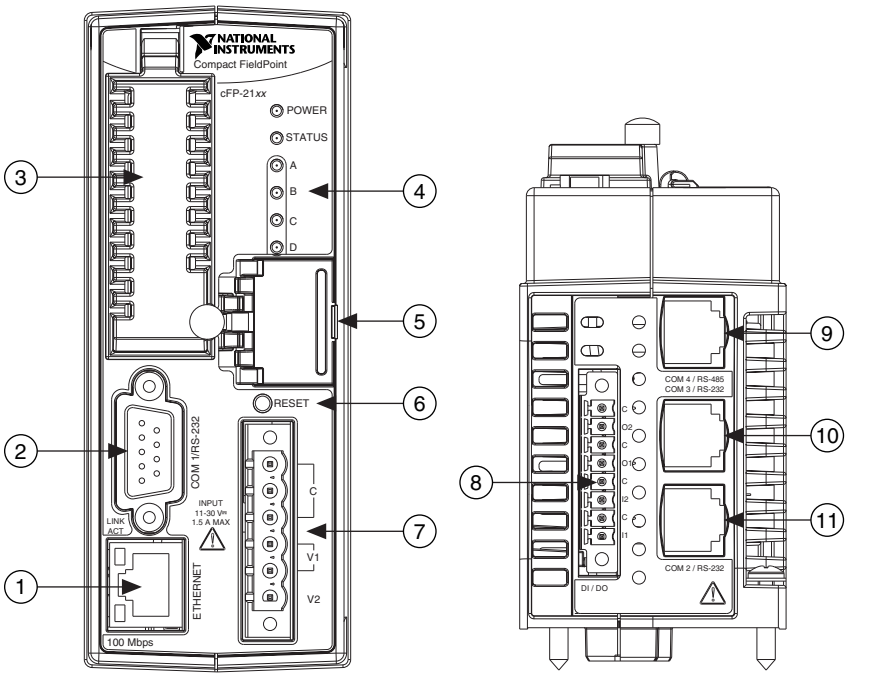
Overview of Compact FieldPoint

This chapter provides an overview of the cFP-21*xx* Compact FieldPoint controller and FieldPoint software.

cFP-21*xx* Compact FieldPoint Controller Overview

Using the cFP-21*xx* controller with LabVIEW Real-Time provides an easy-to-use system for real-time embedded applications. When you run the LabVIEW Real-Time Engine on a cFP-21*xx*, the controller can run applications without a host PC. If you connect the cFP-21*xx* to an Ethernet network, you can use a separate host PC running Windows to display measurement results and status information and change the settings of the controller. Refer to the *LabVIEW Help* for more information about the LabVIEW Real-Time Engine.

Besides the Ethernet port, the cFP-21*xx* has one or more RS-232 serial ports accessible through software. It also has LED indicators to communicate status information and DIP switches that perform various functions. The cFP-2120 also has a software-accessible RS-485 port and switch input/LED output for connecting to external devices such as LED status indicators and start/stop buttons. Figure 1-1 shows where all of these features are located on the cFP-21*xx*. The figure indicates which features are available only on specific models such as the cFP-2120.



1	Ethernet Port	7	Power Connector
2	RS-232 Serial Port	8	Switch Input/LED Output Terminals (cFP-2120 Only)
3	Removable Compact Flash (cFP-2120 Only)	9	RS-485 Serial Port (cFP-2120 Only)
4	LED Indicators	10	RS-232 Serial Port (cFP-2120 Only)
5	DIP Switches	11	RS-232 Serial Port (cFP-2110 and cFP-2120)
6	Reset Switch		

Figure 1-1. cFP-21*xx* Parts Locator Diagram

A Compact FieldPoint system consists of one cFP-BP-*x* backplane, one cFP-21*xx* controller, one or more I/O modules, and one or more connector blocks or accessories. Each Compact FieldPoint system can be accessed by an unlimited number of PCs and controllers, forming a distributed computing system. The maximum number of cFP-21*xx* controllers that you can install on an Ethernet network is limited only by network topology.

The cFP-21*xx* controller connects directly to a 10 or 100 Mbps Ethernet network. The cFP-21*xx* auto-detects the speed of the connection and configures itself accordingly.

For detailed hardware specifications and cabling information, refer to Appendix B, *Specifications*.

FieldPoint Software Overview

FieldPoint software includes NI Measurement & Automation Explorer (MAX) as well as server and driver software for easy integration into application software packages. These software components manage the low-level communications and hardware details, simplifying programmatic access to I/O channels. FieldPoint software runs on Windows 2000/NT 4.0 Service Pack 6+/XP and includes the following components:

- MAX
- LabVIEW VIs
- LabWindows™/CVI™ Functions
- Measurement Studio instrument drivers
- OPC Server
- VI Logger support

You can download a current version of FieldPoint software from the National Instruments Web site. Using your Web browser, go to `ni.com`, select **Support»Drivers and Updates»Current Software Versions» Distributed I/O—FieldPoint**, then select the latest version of NI-FieldPoint.

cFP-21*xx* Setup Overview

The following list is an overview of the steps required to get started with the cFP-21*xx* and LabVIEW Real-Time.

1. Install hardware as described in Chapter 2, *Installing Compact FieldPoint Hardware and Software*.
   a. Mount backplane on a panel, DIN rail, or standard 19-in. rack.
   b. Mount cFP-21*xx* and I/O modules on backplane.
   c. Connect cFP-21*xx* to network.

2. Install software as described in Chapter 2, *Installing Compact FieldPoint Hardware and Software*.
   a. Install programming software (LabVIEW Real-Time).
   b. Install FieldPoint software.
3. Configure Compact FieldPoint system and verify configuration as described in the *Measurement & Automation Explorer Help for FieldPoint*.
   a. Configure cFP-21*xx* network settings.
   b. Configure I/O module ranges and settings.
   c. Configure security.
   d. Connect input signals and loads to I/O modules.
   e. Test channels.
   f. Save settings.
4. Configure optional settings as described in Chapter 3, *Feature Descriptions*.
5. Develop application as described in Chapter 4, *LabVIEW Real-Time Programming*.
   a. Launch LabVIEW Real-Time.
   b. Build basic application.
   c. Switch execution target to test application on cFP-21*xx*.
   d. Embed application by building `.exe` with LabVIEW Real-Time targeted to cFP-21*xx*.
   e. Test embedded application.
6. Deploy system.

2

Installing Compact FieldPoint Hardware and Software

This chapter explains how to install the Compact FieldPoint hardware and software.

What You Need to Get Started

To set up and use LabVIEW Real-Time with the cFP-21*xx*, you need the following:

- ❑ cFP-21*xx* Compact FieldPoint controller
- ❑ cFP-BP-*x* backplane
- ❑ Mounting hardware (DIN rail, panel-mount, or rack-mount accessory)
- ❑ cFP I/O module(s)
- ❑ Wiring accessories such as cFP-CB-*x* connector block(s) or cables
- ❑ 11–30 VDC power supply (20 W recommended)
- ❑ Ethernet cable
- ❑ 1/8 in. flathead and number 2 Phillips screwdrivers
- ❑ NI-FieldPoint software version 4.1.1
- ❑ A host PC running Windows 2000/NT 4.0[1]/XP
- ❑ LabVIEW Real-Time software

[1] Using FieldPoint software with Windows NT 4.0 requires Service Pack 6 or later.

- ❑ Optional accessories
  - 37-pin I/O cables
  - Serial cables
  - DIN-rail terminal blocks

Compact FieldPoint Safety Information

The following section contains important safety information that you *must* follow when installing and using Compact FieldPoint products.

Do *not* operate the Compact FieldPoint product in a manner not specified in the user manual or operating instructions. Misuse of the product can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way. If the product is damaged, return it to National Instruments for repair.

Do *not* substitute parts or modify the Compact FieldPoint product. Use the product only with the modules, accessories, and cables specified in the installation instructions.

You *must* connect the protective earth (PE) ground terminal on the cFP-BP-*x* backplane to the system safety ground. The backplane PE ground terminal has the following symbol stamped beside it: ⏚. Connect the backplane PE ground terminal to the system safety ground using 14 AWG (1.6 mm) wire with a ring lug. Use the 5/16 in. panhead screw shipped with the backplane to secure the ring lug to the backplane PE ground terminal.

Do *not* operate Compact FieldPoint products in an explosive atmosphere or where there may be flammable gases or fumes. If you need to operate Compact FieldPoint products in such an environment, the Compact FieldPoint products *must* be in a suitably rated enclosure.

If you need to clean a Compact FieldPoint product, use a soft nonmetallic brush. The product *must* be completely dry and free from contaminants before you return it to service.

Operate the product only at or below Pollution Degree 2. Pollution is foreign matter in a solid, liquid, or gaseous state that can reduce dielectric strength or surface resistivity. The following is a description of pollution degrees:

- Pollution Degree 1 means no pollution or only dry, nonconductive pollution occurs. The pollution has no influence.

- Pollution Degree 2 means that only nonconductive pollution occurs in most cases. Occasionally, however, a temporary conductivity caused by condensation must be expected.
- Pollution Degree 3 means that conductive pollution occurs, or dry, nonconductive pollution occurs which becomes conductive due to condensation.

Caution You *must* insulate signal connections for the maximum voltage for which the Compact FieldPoint product is rated. Do *not* exceed the maximum ratings for the product. Do *not* install wiring while the product is live with electrical signals. Do *not* remove or add connector blocks when power is connected to the Compact FieldPoint system. Avoid contact between your body and the connector block signal wiring when hot-swapping modules.

Operate Compact FieldPoint products at or below the *installation category*[1] marked on the hardware label. Measurement circuits are subjected to *working voltages*[2] and transient stresses (overvoltage) from the circuit to which they are connected during measurement or test. Installation categories establish standard impulse withstand voltage levels that commonly occur in electrical distribution systems. The following is a description of installation categories:

- Installation Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS[3] voltage. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.
- Installation Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet (for example, 115 V for U.S. or 230 V for Europe). Examples of Installation Category II are measurements performed on household appliances, portable tools, and similar products.
- Installation Category III is for measurements performed in the building installation at the distribution level. This category refers to measurements on hard-wired equipment such as equipment in fixed

[1] Installation categories, also referred to as *measurement categories*, are defined in electrical safety standard IEC 61010-1.

[2] Working voltage is the highest rms value of an AC or DC voltage that can occur across any particular insulation.

[3] MAINS is defined as a hazardous live electrical supply system that powers equipment. Suitably rated measuring circuits may be connected to the MAINS for measuring purposes.

installations, distribution boards, and circuit breakers. Other examples are wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and stationary motors with permanent connections to fixed installations.

- Installation Category IV is for measurements performed at the primary electrical supply installation (<1,000 V). Examples include electricity meters and measurements on primary overcurrent protection devices and on ripple control units.

Mounting the Compact FieldPoint Backplane

You can mount the cFP-BP-*x* backplane on a panel or in a standard 19 in. rack. You can mount the cFP-BP-4 on a 35 mm DIN rail. The following sections contain instructions for all three mounting methods. Before using any of these mounting methods, record the serial number from the back of the backplane. You will be unable to read the serial number after you have mounted the backplane.

To ensure maximum cooling efficiency, mount the Compact FieldPoint system so that the I/O module vents are at the top and bottom.

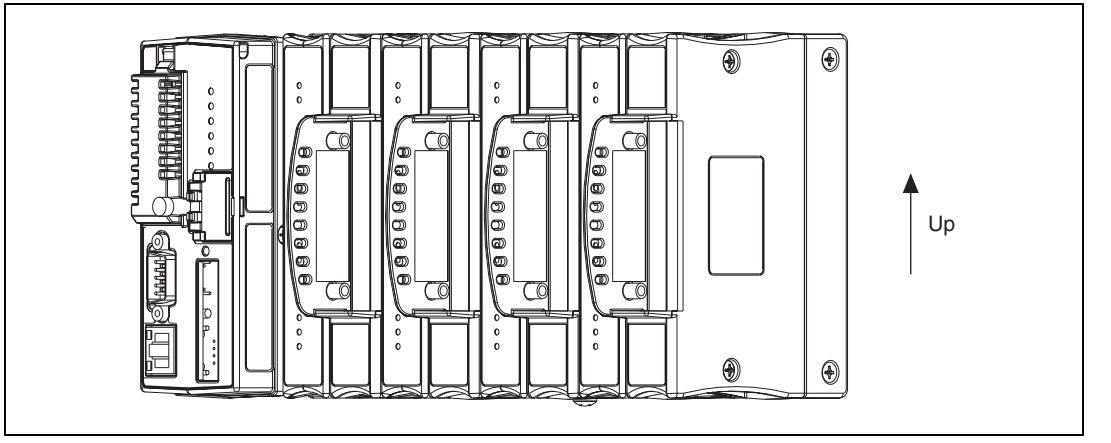


Figure 2-1. cFP-BP-4 Backplane Properly Mounted

Caution As you mount the backplane, keep in mind the following requirements for space and cabling clearance:

- Allow 51–76 mm (2–3 in.) all around the backplane for air circulation.
- Allow 76 mm (3 in.) in front of the controller and 38 mm (1.5 in.) below the controller for cabling clearance.

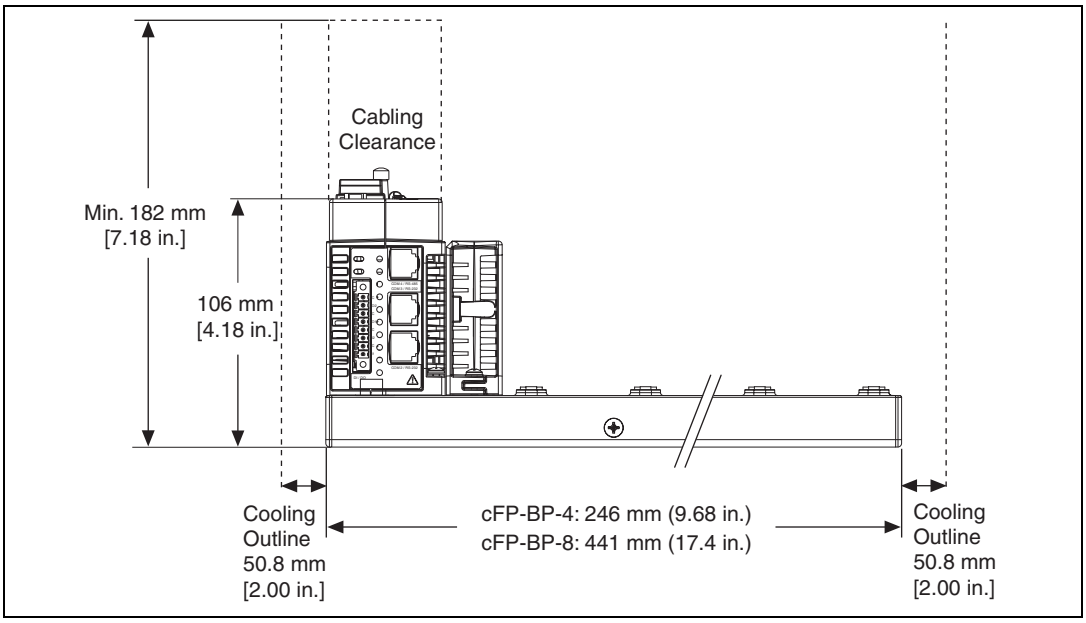


Figure 2-2. cFP-BP-*x* Backplane with cFP-21*xx* Installed, Bottom View with Dimensions

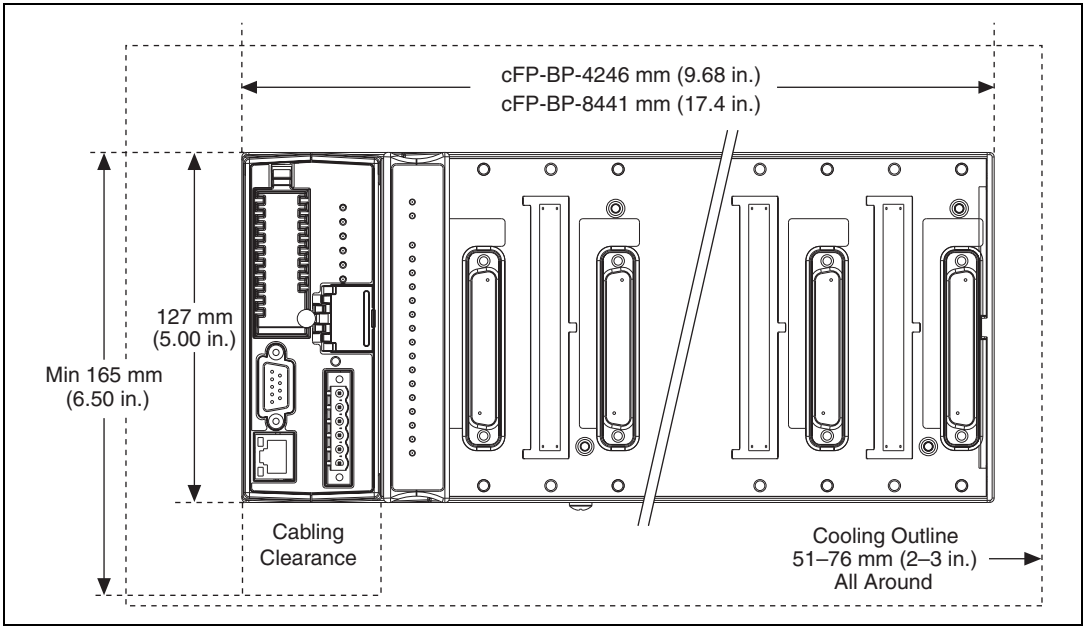


Figure 2-3. cFP-BP-*x* Backplane with cFP-21*xx* Installed, Front View with Dimensions

Caution NI recommends that you use one of the mounting systems described in this document. If you decide to use a custom mounting solution, make sure that the screws you use are short enough to fit in the holes in the backplane. The screw holes are 5 mm (0.2 in) deep.

Mounting the Backplane on a Panel

The cFP-BP-*x* backplane is shipped with a panel-mount kit. Complete the following steps to mount the backplane on a panel:

1. Fasten the two plates of the panel-mount kit to the back of the cFP-BP-*x* using a number 2 Phillips screwdriver and the 8-32 × 5/16 in. countersink screws shipped with the kit. These screws have a nylon coating to prevent them from loosening. Refer to Figures 2-4 and 2-5.

Caution Do *not* use screws longer than 5/16 in. to fasten the panel-mount plates to the backplane.

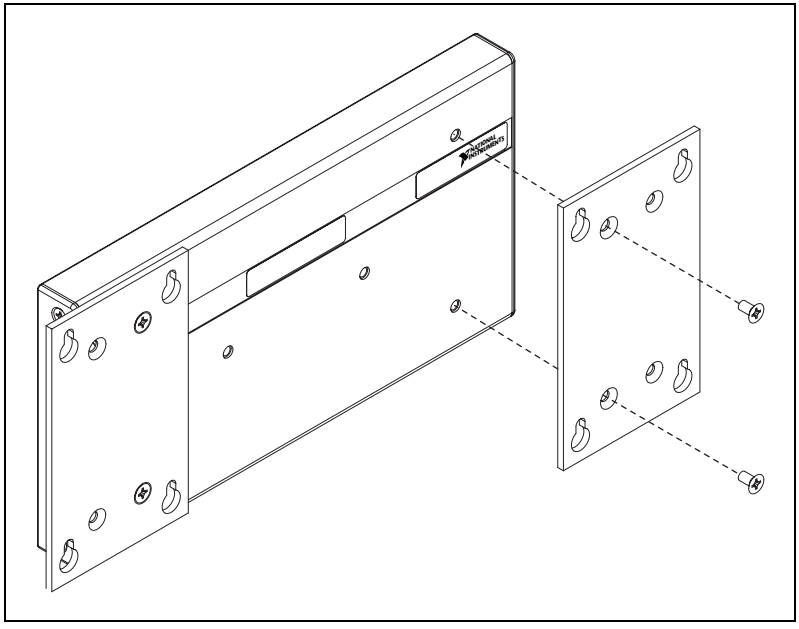


Figure 2-4. Fastening the Panel-Mount Plates to the cFP-BP-4 Backplane

2. Bolt or screw the panel-mount accessory to a panel using 8-32 or M4 screws.

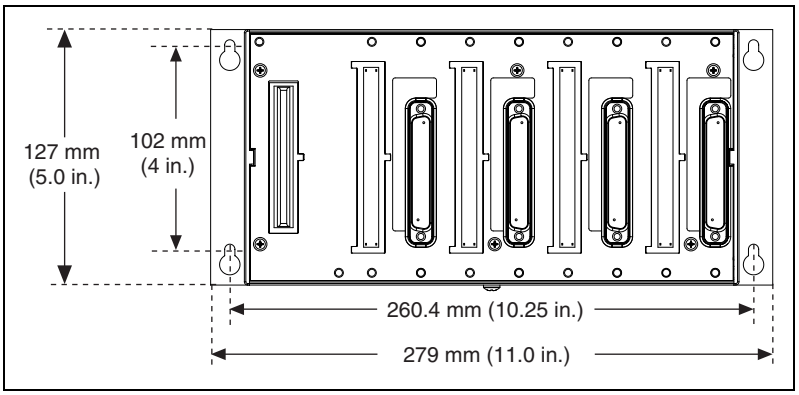


Figure 2-5. The cFP-BP-4 Backplane with Panel-Mount Accessory

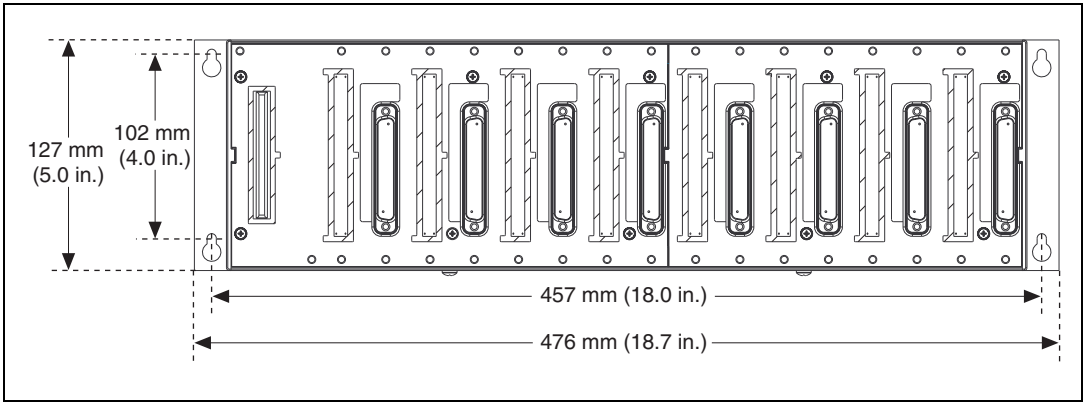


Figure 2-6. The cFP-BP-8 Backplane with Panel-Mount Accessory

3. Connect the safety ground as explained in the *Compact FieldPoint Safety Information* section.

Caution Disconnect power before removing the backplane from the panel.

Note As shown in Figures 2-5 and 2-6, the horizontal panel-mount kit shipped with the backplane extends about 3/4 in. from each side of the backplane. NI also offers a vertical panel-mount kit that extends from the top and bottom of the backplane and is flush with the sides. The vertical panel-mount kit is part number 778688-01.

Mounting the Backplane in a Standard 19-in. Rack

In order to mount the cFP-BP-*x* backplane in an EIA standard 19-in. rack, you need the rack-mount kit. You can order the kit, part number 778615-01, from NI.

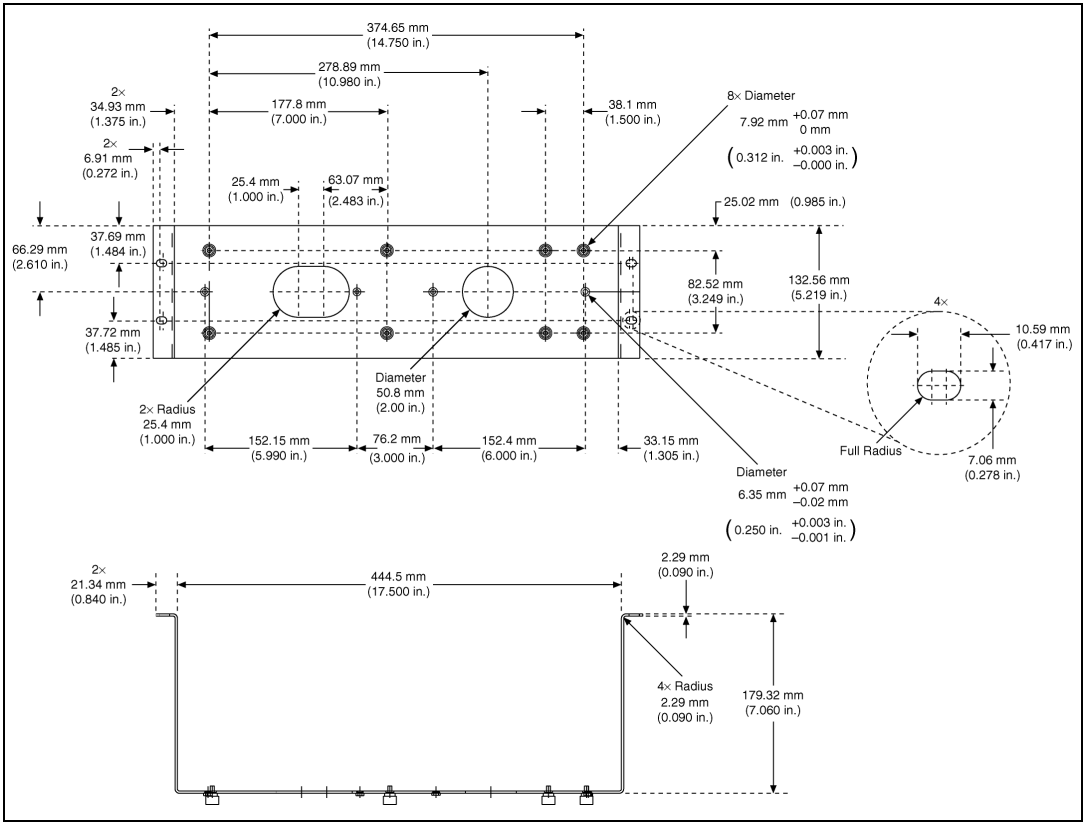


Figure 2-7. Dimensions of Compact FieldPoint Rack-Mount Kit, Part Number 778615-01

Complete the following steps to mount the backplane in a rack:

1. Fasten the rack-mount bracket to the back of the cFP-BP-*x* using the captive screws on the bracket. Refer to Figures 2-8 and 2-9.

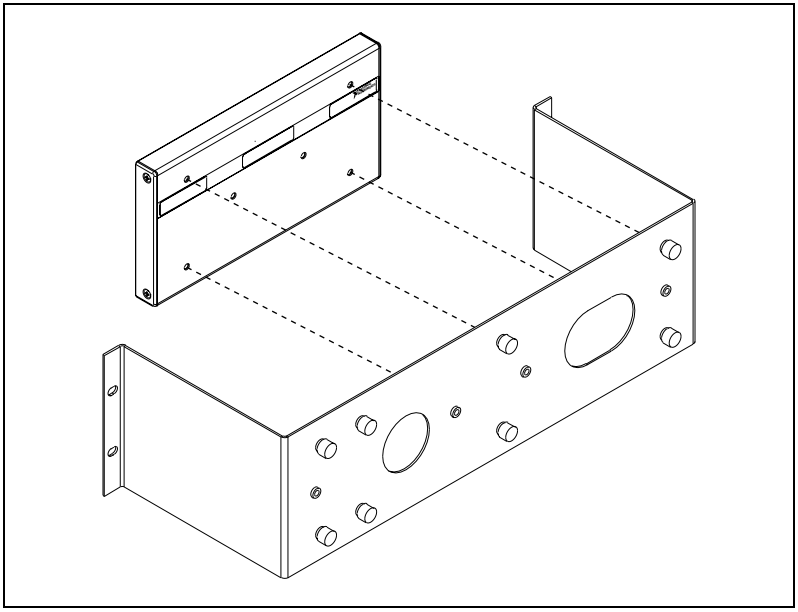


Figure 2-8. Fastening the Rack-Mount Accessory to the cFP-BP-4 Backplane

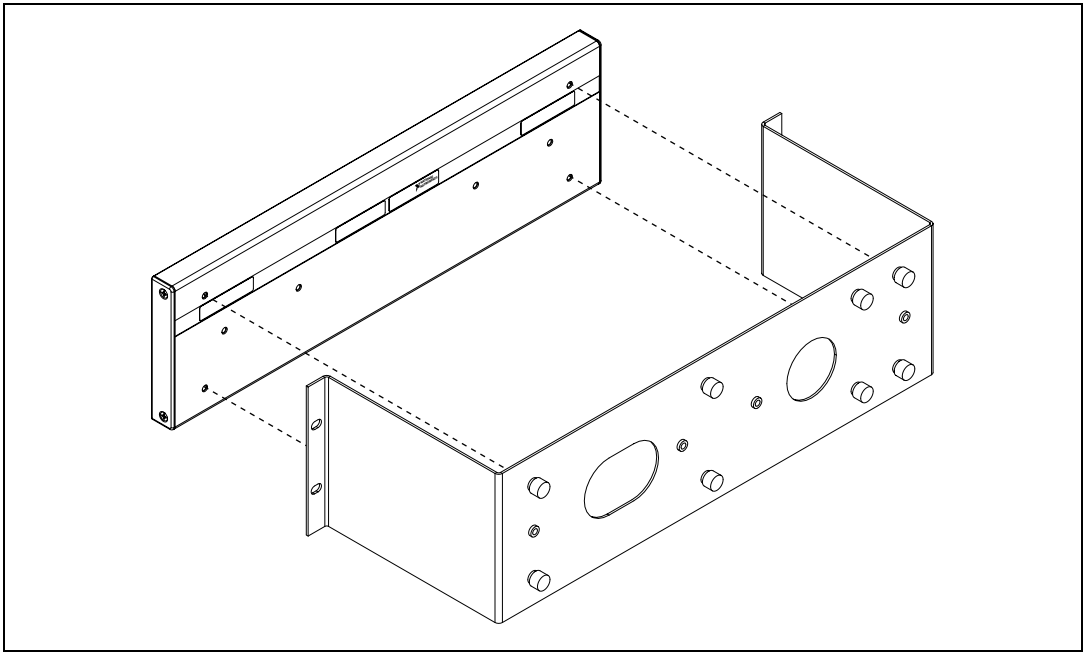


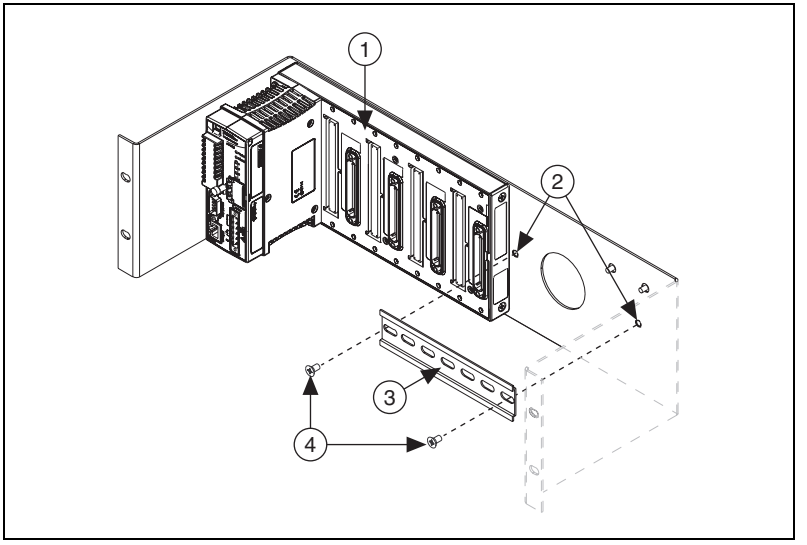
Figure 2-9. Fastening the Rack-Mount Accessory to the cFP-BP-8 Backplane

2. Bolt the rack-mount accessory to a standard 19 in. rack.
3. Connect the safety ground as explained in the *Compact FieldPoint Safety Information* section.

Caution Disconnect power before removing the backplane from the rack.

Installing a DIN Rail in the Rack-Mount Accessory

If you are using a rack-mounted cFP-BP-4, you can install a short (approximately 8 in.) DIN rail to the right of the backplane for mounting power supplies, terminal blocks, or other accessories. Refer to Figure 2-10.



1	cFP-BP-4 Backplane	3	Short DIN Rail for Power Supply
2	Screw Holes	4	#10-32 Screws, 3/8–1/2 in.

Figure 2-10. Installing a Small DIN Rail in the Rack-Mount Accessory

You can install a 16 in. DIN rail in another rack-mount accessory if you need more DIN rail space.

Mounting the cFP-BP-4 on a DIN Rail

You can mount the cFP-BP-4 backplane on a standard 35 mm DIN rail using the DIN rail clip, NI part number 778614-01. NI does not recommend mounting the cFP-BP-8 on a DIN rail. Complete the following steps to mount the cFP-BP-4 on a DIN rail:

1. Fasten the DIN rail clip to the cFP-BP-4 using a number 2 Phillips screwdriver and the 8-32 × 5/16 in. countersink screws shipped with the DIN rail clip(s). These screws have a nylon coating to prevent them from loosening. Refer to Figure 2-11.

Caution Do *not* use screws longer than 5/16 in. to fasten the DIN rail clip to the backplane.

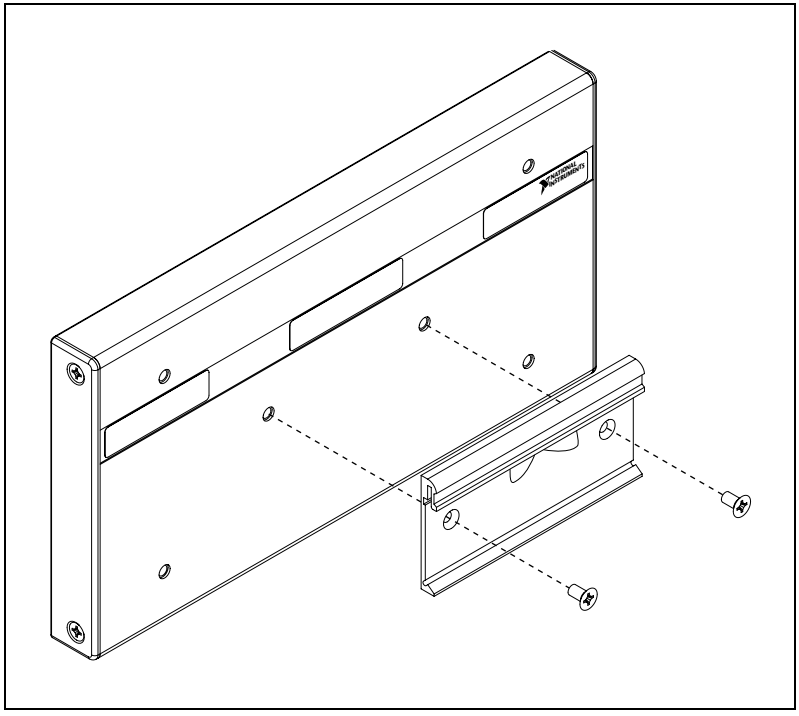
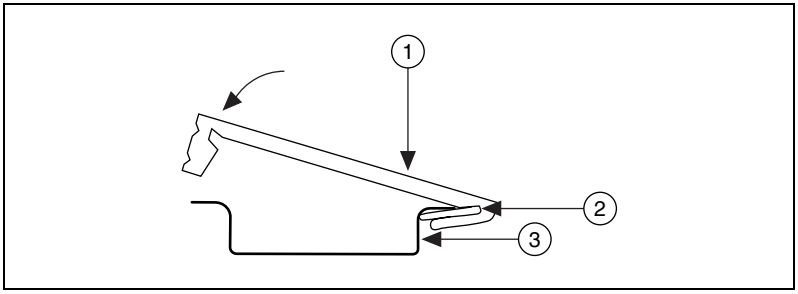


Figure 2-11. Fastening the DIN Rail Clip to the cFP-BP-4 Backplane

2. Insert one edge of the DIN rail into the deeper opening of the DIN rail clip, as shown in Figure 2-12.



1 DIN Rail Clip 2 DIN Rail Clip Spring 3 DIN Rail

Figure 2-12. One Edge of DIN Rail Inserted in Clip

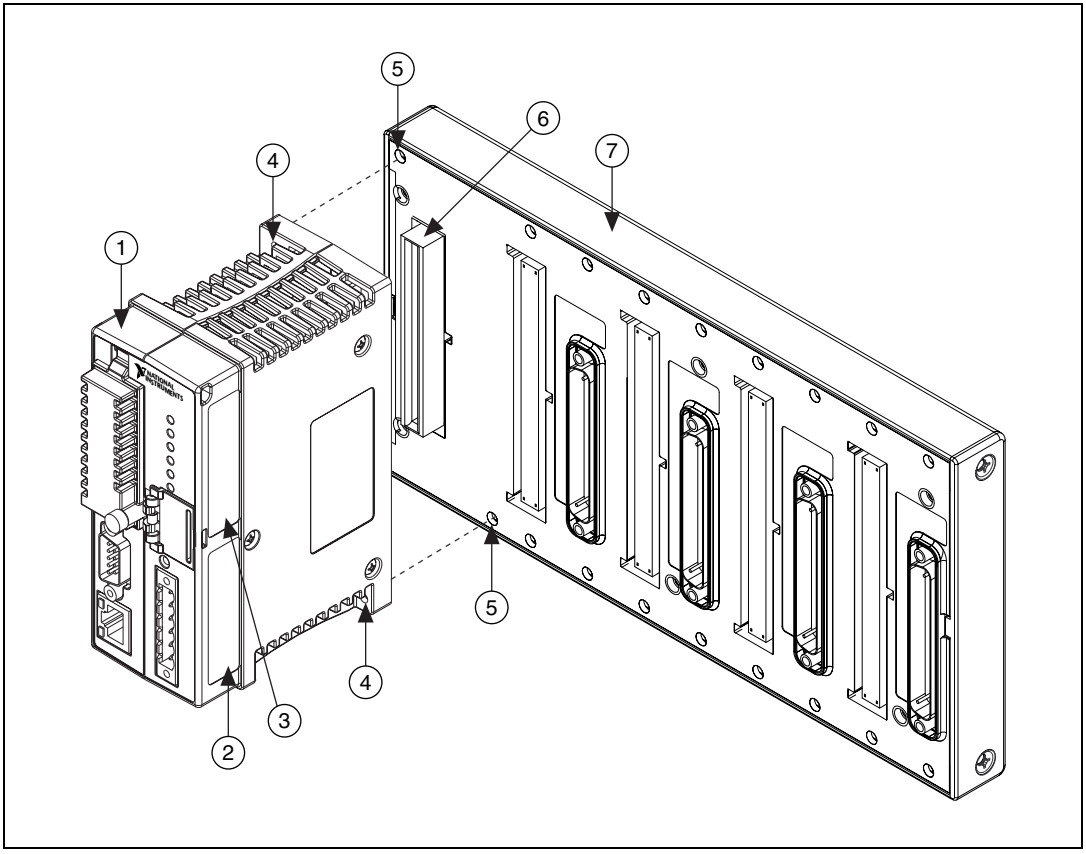
3. Press down firmly on the backplane to compress the spring until the clip locks in place on the DIN rail.
4. Connect the safety ground as explained in the *Compact FieldPoint Safety Information* section.

Caution Disconnect power before removing the backplane from the DIN rail.

Installing the cFP-21*xx* Controller on a Compact FieldPoint Backplane

Make sure that no power is connected to the controller or the backplane. Refer to Figure 2-13 and follow these steps:

1. Make sure that the cFP-21*xx* controller is right side up, with the NI logo at the top, and align the captive screws on the controller with the holes on the backplane.
2. Seat the card edge at the back of the controller in the card-edge connector on the backplane.
3. Press the controller firmly to seat it on the backplane.
4. Using a number 2 Phillips screwdriver with a shank of at least 64 mm (2.5 in.) length, tighten the captive screws to 1.1 N · m (10 lb · in.) of torque. The nylon coating on the screws prevents them from loosening.

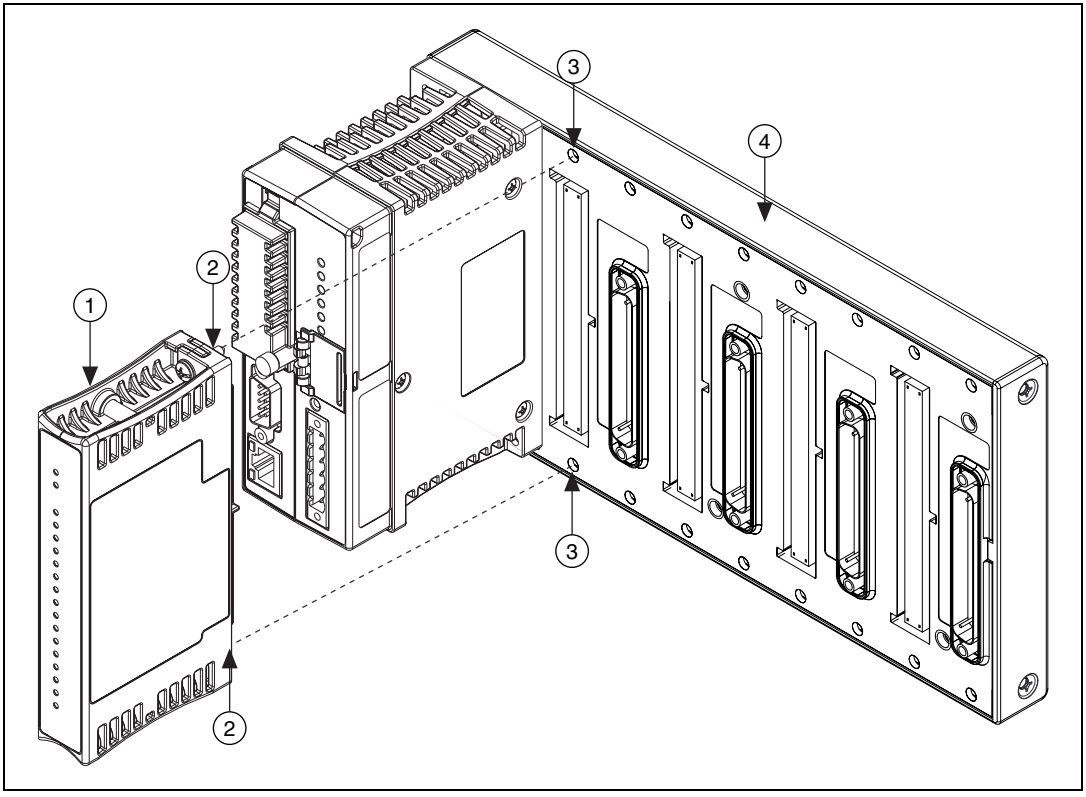


1	cFP-21*xx* Controller	5	Screw Holes
2	Serial Number Label	6	Card-Edge Connector
3	Write-On Address Label	7	cFP-BP-4 Backplane
4	Captive Screws		

Figure 2-13. Installing the cFP-21*xx* Controller on the Backplane (cFP-BP-4 Shown)

Installing I/O Modules on the Backplane

1. Align the captive screws on the I/O module with the holes on the backplane. Alignment keys on the I/O module prevent backward insertion.
2. Press firmly to seat the I/O module on the backplane.
3. Using a number 2 Phillips screwdriver with a shank of at least 64 mm (2.5 in.) length, tighten the captive screws to 1.1 N · m (10 lb · in.) of torque. The nylon coating on the screws prevents them from loosening.



1 cFP I/O Module	3 Screw Holes
2 Captive Screws	4 cFP-BP-4 Backplane

Figure 2-14. Installing an I/O Module on the Backplane (cFP-BP-4 Shown)

4. Repeat this procedure to install additional I/O modules on the backplane.

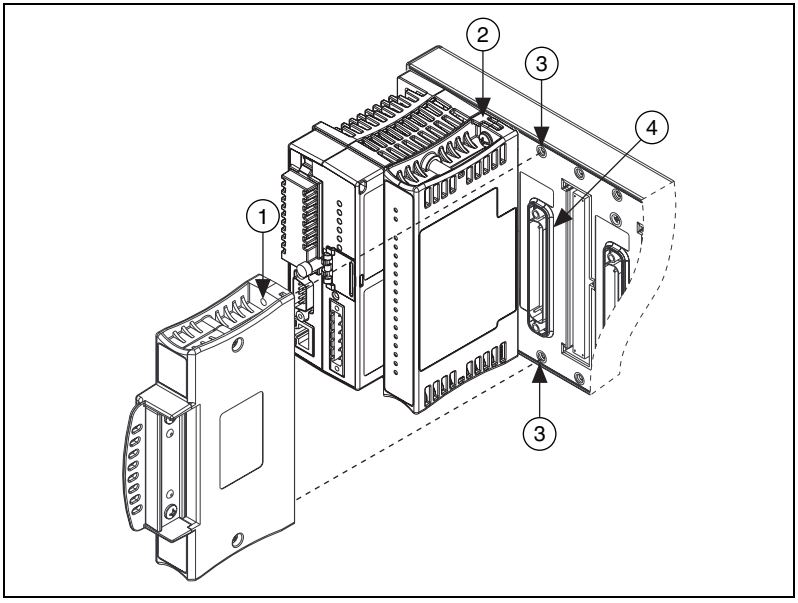
Connecting to Field Devices

Use cFP-CB-*x* connector blocks or Compact FieldPoint cabling accessories to connect the I/O modules to field devices. Refer to the operating instructions for the I/O modules, connector blocks, and cabling accessories.

Installing Connector Blocks on the Backplane

In order to connect I/O modules to input signals or to external loads, you need to install a cFP-CB-*x* connector block or other connectivity accessory for each I/O module on the backplane. Use the connector socket to the right of each I/O module socket.

1. Align the captive screws on the connector block with the holes on the backplane. The shape of the I/O connector on the connector block prevents backward insertion.
2. Press firmly to seat the connector block on the backplane.
3. Using a number 2 Phillips screwdriver with a shank of at least 64 mm (2.5 in.) length, tighten the captive screws to 1.1 N · m (10 lb · in.) of torque. The nylon coating on the screws prevents them from loosening.



1	cFP-CB-*x* Connector Block	3	Screw Holes
2	cFP I/O Module	4	Connector Slot

Figure 2-15. Installing a cFP-CB-*x* Connector Block

4. Repeat this procedure to install additional connector blocks on the backplane.

Connecting the cFP-21*xx* to a Network

Connect the cFP-21*xx* controller to an Ethernet network using the RJ-45 Ethernet port on the module. Use a standard Category 5 Ethernet cable to connect the cFP-21*xx* to an Ethernet hub, or use an Ethernet crossover cable to connect the module directly to a computer.

Caution To prevent data loss and to maintain the integrity of your Ethernet installation, do *not* use a cable longer than 100 m. If you are using a 100 Mbps Ethernet, NI recommends using a Category 5 shielded twisted-pair Ethernet cable.

The host PC communicates with the cFP-21*xx* over a standard Ethernet connection. If the host PC is already configured on a network, you must configure the cFP-21*xx* on the same network. If neither is connected to a network, you can connect the two directly using a CAT-5 crossover cable. If you need to build your own cable, refer to the *Cabling* section of Appendix B, *Specifications*, for more information about Ethernet cable wiring connections.

In order to configure the cFP-21*xx*, it must reside on the same subnet as the host PC. If you want to use the cFP-21*xx* on a subnet other than the one the host PC is on, first connect and configure it on the same subnet as the host PC, then reassign a static IP address for the subnet where you want it to be and physically move it to the other subnet. Contact your network administrator if you need assistance configuring the host PC and cFP-21*xx* on the same subnet.

Wiring Power to the Compact FieldPoint System

Each cFP-21*xx* on your network requires an 11–30 VDC power supply. NI recommends the PS-5 power supply for most Compact FieldPoint applications.

The cFP-21*xx* filters and regulates the supplied power and provides power for all the I/O modules on the backplane. Refer to the documentation for the individual I/O modules to determine whether they require any additional power in your applications.

Figure 2-16 shows the 6-pin screw-terminal power connector on the cFP-21*xx*.

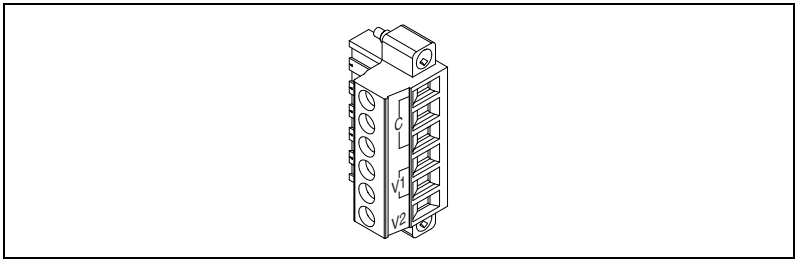


Figure 2-16. cFP-21*xx* Power Connector

1. Connect the positive lead of the primary power supply to one of the V1 terminals and the negative lead to one of the C terminals.
2. If you are using a backup power supply, connect the positive lead to V2 and the negative lead to one of the C terminals. The cFP-21*xx* generally uses the power supply with the higher voltage level. V2 is isolated from the other V terminals.
3. If module-to-module isolation is important in your application, use a separate power supply for each module that needs external power. If your application does not require module-to-module isolation, you can *cascade* power, using the same power supply for all modules that require external power.

Caution Cascading power defeats isolation between the cascaded modules.

4. Refer to the operating instructions for the power requirements of each I/O module. If a module requires external power, connect a power supply to the appropriate input terminals on the connector block. If you want to power field I/O devices from a connector block, supply power to the connector block, and then connect the connector block output terminals to the field device.

Powering Up the cFP-21*xx*

Check the DIP switches on the controller, making sure that the RESET IP switch is not enabled. Refer to Chapter 3, *Feature Descriptions*, for a description of the DIP switches. Plug in each power supply to the Compact FieldPoint system. The cFP-21*xx* runs a power-on self test (POST) that takes several seconds. You should see the **POWER** and **STATUS** LEDs come on. After about five seconds, the **STATUS** LED begins flashing. The cFP-21*xx* is ready to be configured, and you can install the FieldPoint software.

If you have already assigned an IP address to the cFP-21*xx*, the **STATUS** LED turns off, the I/O module **READY** LEDs come on, and the cFP-21*xx* is ready for use. The total boot time for a configured system is 15–20 seconds.

If the **STATUS** LED does not light up as described here, refer to the *STATUS LED Error Indications* section of Appendix A, *Troubleshooting*.

Installing Software on the Host PC

The cFP-21*xx* has the embedded LabVIEW Real-Time Engine and FieldPoint software pre-installed, but you must install the necessary software on the host PC. Follow these steps to install the FieldPoint software on the host PC.

1. Install the software packages you plan to use, such as LabVIEW, LabVIEW Real-Time, Lookout, Measurement Studio, VI Logger, or LabWindows/CVI, *before* you install the FieldPoint software. The FieldPoint software installation installs the LabVIEW VIs and examples and the LabWindows/CVI instrument driver only if it finds the corresponding development software installed.
2. Close all other applications.
3. Insert the FieldPoint software CD into the CD-ROM drive on your computer.
4. Follow the onscreen instructions to complete the installation.

Note If the setup does not launch automatically, select **Start»Run** from Windows, enter either `d:\setup` or `d:\autorun`, where `d` is the letter of your CD-ROM drive, and select **OK**.

Configuring the Compact FieldPoint System in MAX

Refer to the *Measurement & Automation Explorer Help for FieldPoint* for information about configuring the Compact FieldPoint system in MAX.

3

Feature Descriptions

Guarding against Network Failures (Network Watchdog)

The network watchdog feature of the cFP-21*xx* enables you to guard your system against failures in the network connection, cables, or host computer. If the network watchdog is enabled and the cFP-21*xx* loses communication with all hosts or clients over the network, the cFP-21*xx* sets output channels to predefined values (the watchdog state). The network watchdog is disabled by default.

Note National Instruments recommends leaving the network watchdog disabled when you are running embedded applications on the cFP-21*xx*. Refer to the section of this chapter for information about the hardware watchdog for embedded applications.

Network watchdog output values can be different than power-up output values. For example, you may want to turn an output value on when you power up, but turn it off if network communication is lost.

Refer to the *Measurement & Automation Explorer Help for FieldPoint* for information about enabling and configuring the network watchdog.

Guarding against Other System Failures (Hardware Watchdog)

In addition to the network watchdog, the cFP-21*xx* controller supports a hardware watchdog that you can set up in LabVIEW Real-Time. The hardware watchdog enables the controller to respond in predetermined ways to failures in the system. The VIs to control the hardware watchdog are on the LabVIEW Real-Time palette.

Storing a Custom Power-Up Configuration

Setting a Power-Up State with the Snapshot Feature

The Snapshot feature stores the current state of the Compact FieldPoint hardware for use as the power-up state of the system.

Caution Using the Snapshot feature overwrites any power-up values you have specified for individual channels.

Refer to the *Measurement & Automation Explorer Help for FieldPoint* for information about using the Snapshot feature.

Configurable Power-Up States

With the configurable power-up state feature, you can define the power-up configuration on a module-by-module basis. You do not need to set any of the channels to the desired power-up state as you would with the Snapshot feature. However, you can use configurable power-up states to adjust previously stored Snapshot information. In this way, you can make incremental changes to the power-up values of individual channels.

Refer to the *Measurement & Automation Explorer Help for FieldPoint* for information about using configurable power-up states.

Inserting, Removing, and Replacing I/O Modules

You can remove and insert I/O modules while the system is operating. You do not need to power down the Compact FieldPoint system. I/O modules already working in the system remain fully operational and accessible on the network. Commands sent to a missing module return an error response, but the cFP-21*xx* stores the commands and applies the effects of the commands if a suitable replacement module is inserted.

Caution Do *not* add or remove connector blocks while power is applied to the system.

When you remove an I/O module and insert a new one, the cFP-21*xx* first verifies that the replacement I/O module is compatible with the one that was removed. If the I/O module is the same as, or is compatible with, the one removed, the cFP-21*xx* configures the replacement I/O module with its predecessor's configuration and output value settings.

Table 3-1 shows how modules are configured after hot swapping.

Table 3-1. Module Configuration Results After Hot Swapping

Replacement Module	Factory Configuration Checked?[1]	Replacement Module Configuration after Hot Swapping
Compatible with the removed module	Yes or No	Same as the removed module
Incompatible with the removed module but compatible with the stored configuration	No	Same as the stored configuration
	Yes	Factory default configuration
Incompatible with the removed module and incompatible with the stored configuration	Yes or No	Factory default configuration

[1] The factory configuration checkbox is on the Bank Configuration tab in MAX.

LED Indicators

The cFP-21*xx* has several LEDs to indicate status information.

POWER LED

The green **POWER** LED is lit while the cFP-21*xx* is powered on. This LED indicates that the power supply connected to the cFP-21*xx* is acceptable, and that the cFP-21*xx* is supplying power to the I/O modules.

STATUS LED

The red **STATUS** LED is off in normal operation mode. The cFP-21*xx* indicates specific error conditions by flashing **STATUS** a specific number of times. Refer to the *STATUS LED Error Indications* section of Appendix A, *Troubleshooting*, for more information about **STATUS** LED error indications.

LINK ACT LED

The yellow **LINK ACT** LED blinks when the cFP-21*xx* receives data from or transmits data to the Ethernet. Unrelated network activity causes this LED to blink occasionally even when the cFP-21*xx* is inactive.

100 Mbps LED

The green **100 Mbps** LED is lit when the cFP-21*xx* is communicating at 100 megabits per second. If the **100 Mbps** LED is not lit, the cFP-21*xx* is communicating at 10 megabits per second.

User-Configurable LEDs A–D

LEDs **B**, **C**, and **D** can be sent values of 0, 1, or 2. LED **A** should be sent only 0 or 1. LED **A** handles a 2 as a 1. The values sent to these LEDs manifest as 0 = off, 1 = green, and 2 = red.

Power-On Self Test (POST)

The cFP-21*xx* runs a power-on self test (POST) at power-up to verify its operational status. The test takes several seconds, does not affect the operation of the network, and does not affect any of the field wiring on connector blocks installed on the backplane.

If the power-on self test fails, the cFP-21*xx* does not participate in network communication, eliminating potential conflicts with other controllers on the network.

When you power up the cFP-21*xx* and it has already been configured for use, the **POWER** and **STATUS** LEDs turn on for about five seconds, then the **STATUS** LED turns off. When the I/O module **READY** LEDs turn on, the controller is ready for use.

The cFP-21*xx* indicates POST failure through the **STATUS** LED. If the LEDs do not follow the sequence described here, refer to the *STATUS LED Error Indications* section of Appendix A, *Troubleshooting*, for information about possible reasons.

DIP Switches

The following figure shows the DIP switches on the front of the cFP-21*xx*.

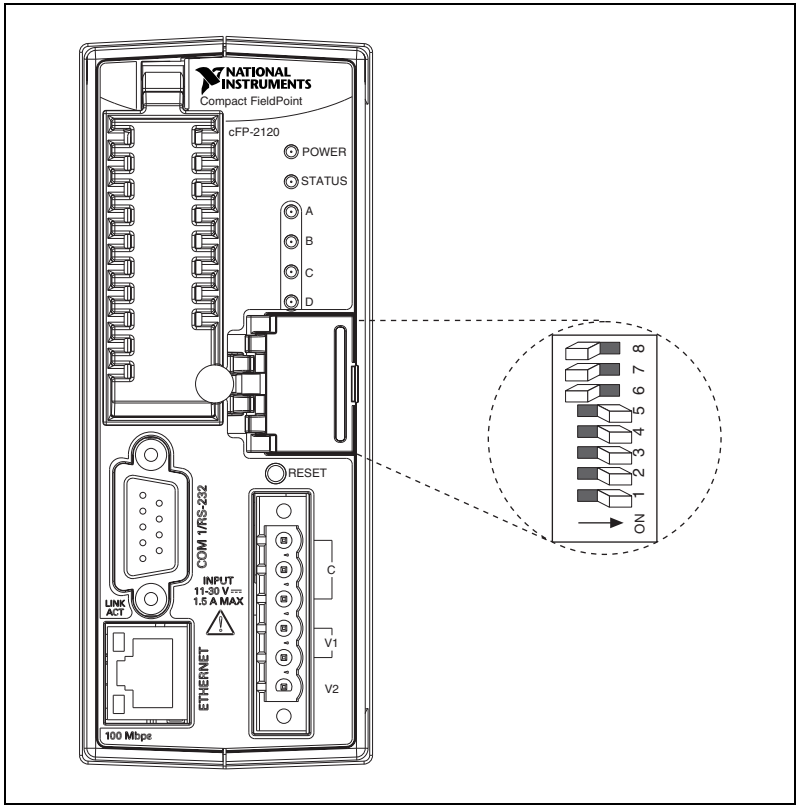


Figure 3-1. cFP-21*xx* DIP Switches

DIP switches 3 and 4 are user configurable on the cFP-21*xx*. Switches 1 and 2 are user configurable on the cFP-2100 and cFP-2110 but are disabled on the cFP-2120. FieldPoint LabVIEW VIs, CVI, OPC, Lookout, and other applications can read these switches, but the switches have no default functionality.

DIP switches 5, 6, 7, and 8 are the CONSOLE OUT, DISABLE VI, SAFE MODE, and RESET IP switches. The cFP-21*xx* reads these switches only when powering up or rebooting. You must reboot the module with one of these switches ON for its setting to take effect.

CONSOLE OUT Switch

With a serial-port terminal program, you can use the Console Out switch to read the IP address and BIOS version of the controller. Connect the serial port on the controller to a computer. Push the switch to the ON position.

Make sure that the serial-port terminal program is configured to the following settings:

- 9,600 bits per second
- Eight data bits
- No parity
- One stop bit

The serial-port terminal program displays the IP address and BIOS version. Keep this switch in the OFF position during normal operation.

DISABLE VI Switch

The position of the DISABLE VI switch determines whether any VIs run at startup. You can instruct the cFP-21*xx* controller to run a VI when it starts up, but if this VI consumes all of the cFP-21*xx* CPU resources for any reason, it can make the module inaccessible on the network. If you reboot the cFP-21*xx* with the DISABLE VI switch in the ON position, the module does not run any VIs at startup.

SAFE MODE Switch

The position of the SAFE MODE switch determines whether the cFP-21*xx* controller starts up in safe mode. Safe mode disables all LabVIEW functions and communication with I/O modules. If the software or configuration information on the controller becomes corrupt or cannot be read correctly, the system may hang after being rebooted or become inaccessible over the network. Safe mode enables you to reconfigure network settings and reinstall software on the controller.

Reboot the controller with the SAFE MODE switch in the ON position and reinstall software using MAX. Then reboot the controller with the SAFE MODE switch in the OFF position.

If reinstalling software does not work and you still cannot communicate with the controller over the network, use the Format Disk function in MAX to reformat the controller. Then reconfigure the TCP/IP settings, download new software to the controller using MAX, and reboot the cFP-21*xx* with the SAFE MODE switch in the OFF position.

RESET IP Switch

Push the RESET IP switch to the ON position and reboot the controller to reset the IP address of the controller to `0.0.0.0`. If the controller is on your local subnet and the RESET IP switch is in the ON position, the controller appears in MAX with IP address `0.0.0.0`. You can configure a new IP address for the controller in MAX. Refer to the *Remote Systems Help* in MAX for more information about resetting the IP address.

Serial Ports

Refer to the *cFP-21xx Compact FieldPoint Controller Overview* section of Chapter 1, *Overview of Compact FieldPoint*, to find the serial ports on the controller. If you are not running an embedded application, you must target the cFP-21*xx* in order to access the serial ports. Refer to the *LabVIEW Help* for more information about targeting the cFP-21*xx*.

COM 1

COM 1 is an RS-232 DTE serial port with a standard DB-9 connector. The Serial Port VIs access COM 1 as port 0. Figure 3-2 shows the locations of the DB-9 connector pins and Table 3-2 lists the signals on the pins.

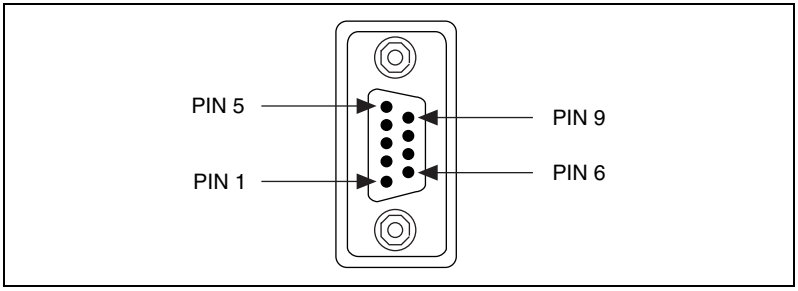


Figure 3-2. DB-9 Connector Pin Locations

Table 3-2. DB-9 Pin Descriptions

DB-9 Pin	RS-232 Signal
1	DCD
2	RXD
3	TXD
4	DTR
5	GND

Table 3-2. DB-9 Pin Descriptions (Continued)

DB-9 Pin	RS-232 Signal
6	DSR
7	RTS
8	CTS
9	RI

COM 2 (cFP-2110 and cFP-2120 Only)

COM 2 is an RS-232 DTE serial port with a 10-position modular jack. The Serial Port VIs access COM 2 as port 1. Refer to Figure 3-3 and Table 3-3 for pin locations and signal descriptions.

COM 3 (cFP-2120 Only)

COM 3 is an RS-232 DTE serial port with a 10-position modular jack. The Serial Port VIs access COM 3 as port 2. Refer to Figure 3-3 and Table 3-3 for pin locations and signal descriptions.

COM 4 (cFP-2120 Only)

COM 4 is an RS-485 serial port with a 10-position modular jack. The Serial Port VIs access COM 4 as port 3. COM 4 has 100 V_{rms} of operational isolation. Use an external RS-485 isolator if your application requires more isolation. Refer to Figure 3-3 and Table 3-3 for pin locations and signal descriptions.

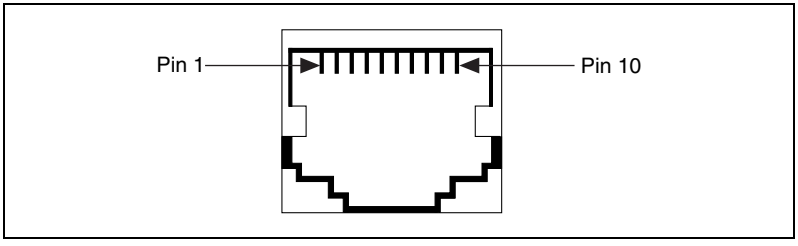


Figure 3-3. 10-Position Modular Jack Pin Locations

Table 3-3. 10-Position Modular Jack Pin Descriptions

10-Position Modular Jack Pin	RS-232 Signal	RS-485 Signal
10	DCD	GND
9	RXD	CTS+ (HSI+)
8	TXD	RTS+ (HSO+)
7	DTR	RXD+
6	GND	RXD–
5	DSR	CTS– (HSI–)
4	RTS	RTS– (HSO–)
3	CTS	TXD+
2	RI	TXD–
1	No Connect	No Connect

Figure 3-4 shows how to wire several FP-1001 banks in an RS-485 network controlled by the cFP-2120. Only two FP-1001 banks are shown, but the cFP-2120 can control up to 24 FP-1001 banks. Install 120 Ω termination resistors at each end of the network as shown in Figure 3-4.

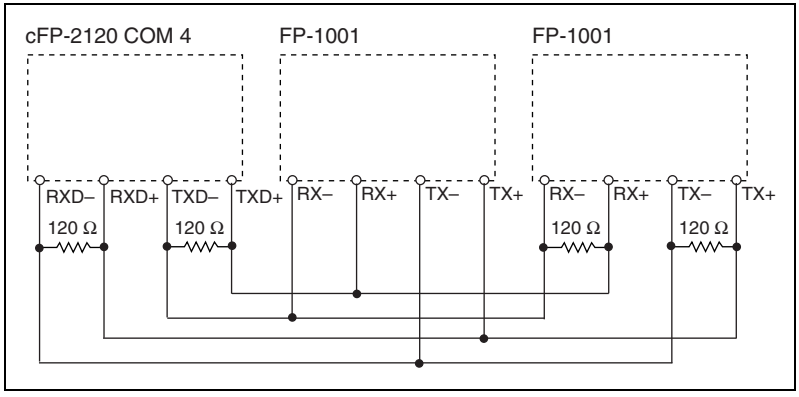


Figure 3-4. Wiring for an RS-485 Network Controlled by the cFP-2120

COM 4 is designed to operate in four-wire mode as shown in Figure 3-4. You can use COM 4 in two-wire mode, but you must design your application so that it filters out the writes that echo back over the read channels. NI does not recommend this method.

NI offers a DIN rail–mountable screw terminal adapter that you can use to connect termination resistors to COM 4. The adapter is part number 778674-01.

Cable adapters for the 10-position modular jacks are available from NI. Part numbers 182845-01, -02, and -03 are 1, 2, and 3 m cable adapters for connecting the 10-position modular jack to a 9-position D-Sub plug.

External Switch Inputs and LED Outputs (cFP 2120 Only)

The cFP-2120 has two switch inputs and two LED outputs that you can use to connect a simple operator interface to the controller. Refer to Figure 1-1 for the location of the input and output terminals. The inputs and outputs appear in software as Input 1, Input 2, LED A, and LED B. Logic high for the DIO ports is +5 V. Logic low is 0 V. The DIO ports are not isolated and are not intended for field connections. Use them only for simple VI controls and indicators.

Outputs 1 and 2 are tied to LEDs A and B, respectively, on the cFP-2120 front panel. When LED A has a value of 1 or 2, Output 1 is ON and sources +5 V. When LED A has a value of 0, Output 1 is OFF and does not source voltage. When LED B has a value of 1, Output 2 is ON and sources +5 V. When LED B has a value of 0 or 2, Output 2 is OFF and does not source voltage. You can use the outputs to provide status or alarm indicators to operators. For example, if the Compact FieldPoint bank is mounted in a sealed enclosure, you can connect the outputs to external LEDs so that operators can see status information without opening the enclosure.

You can use the two switch inputs to control the cFP system from LabVIEW. For example, one switch input could be a START/STOP switch, and the other could determine which of two VIs should run at startup. NI recommends connecting a single-pole single-throw (SPST) switch between the input terminal and one of the C terminals. The switch inputs have a value of 1 when the switch is closed and 0 when the switch is open.

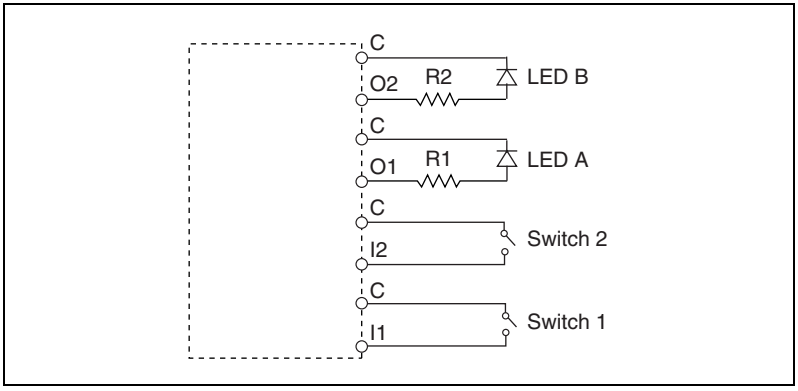


Figure 3-5. Wiring the cFP-2120 External Input and Output Terminals

Power Source (Isolated Power Connector)

The cFP-21*xx* power connector is a 6-pin screw-terminal connector that accommodates both primary and backup power supplies. The cFP-21*xx* uses the power supply with the higher voltage level, indicating which supply it is using on the channel called Power Source in software. A value of 0 indicates the primary supply, and a value of 1 indicates the backup supply. If the output voltages of the two power supplies are within 0.1–0.6 V of each other, the cFP-21*xx* can use either supply.

Removable Compact Flash (cFP-2120 Only)

You can use compact flash for removable data storage with the cFP-2120. The controller takes Type I and Type II compact flash up to 512 MB. With the power off, open the compact flash cover and plug a compact flash into the slot, then power up the controller. You can access the removable compact flash by using LabVIEW file I/O VIs running embedded on the controller. To read from or write to the removable compact flash, point the VI to the D drive on the controller.

Caution You must power down the controller before installing or removing a compact flash. Removing the compact flash without powering down the controller can cause data corruption. In order to get data from the compact flash while the controller is operating, use an FTP client or a LabVIEW remote front panel and download the data from the D drive on the controller.

File Transfer Capability

When running on a cFP-21*xx*, the Real-Time Engine has a File Transfer Protocol (FTP) server. The FTP server gives you the ability to use any standard FTP utility for transferring files to and from the hard drive of the cFP-21*xx*. You must provide the correct password when opening a connection to the cFP-21*xx* if the configuration is locked in MAX.

For programmatic file transfer control in LabVIEW or LabVIEW Real-Time, use the Internet Developers Toolkit, included in the LabVIEW Enterprise Connectivity Toolset. Refer to `ni.com` for more information about the LabVIEW Enterprise Connectivity Toolset.



Note Contact NI to determine whether the version of the toolkit you are using can be downloaded onto the cFP-21*xx*.

Remote Front Panels

You may need to monitor and control an embedded VI remotely. The cFP-21*xx* supports multiple remote front panels for embedded VIs. Users can view the remote front panel using either LabVIEW or a Web browser.

Users accessing the remote front panels with a Web browser need to have either Internet Explorer 5.5 Service Pack 2 or later, or Netscape 4.7 or later.

If you plan to use remote front panels to control the VI, keep the front panel simple and do not use property nodes. Complex front panels can cause slight control latency when users operate them remotely. Users cannot programmatically change the value of a control remotely.

The cFP-2100 can support up to five remote connections, and the cFP-2110 and cFP-2120 can support 20.

4

LabVIEW Real-Time Programming

This chapter contains specific information about targeting LabVIEW Real-Time to the cFP-21*xx* module, network options for restricting access to the module, embedding LabVIEW Real-Time applications on the module, and launching embedded applications when the module starts up. For general LabVIEW Real-Time programming information, refer to the *LabVIEW Help*.

Targeting LabVIEW Real-Time to a Platform

You can target LabVIEW Real-Time to the cFP-21*xx* or to the host PC. When you select a target platform other than the host PC, the Real-Time Development System downloads any LabVIEW Real-Time application you subsequently run to the selected target platform. Refer to the *LabVIEW Help* for more information about the Real-Time Development System.

Targeting LabVIEW Real-Time to the cFP-21*xx*

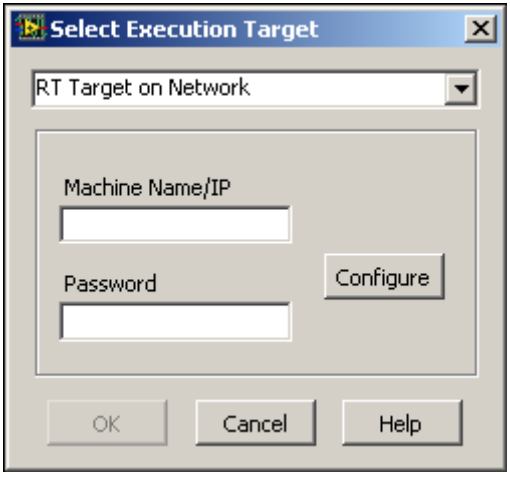
When you target LabVIEW Real-Time to the cFP-21*xx*, you can run LabVIEW Real-Time applications on the controller. However, when targeted to the cFP-21*xx*, LabVIEW Real-Time lacks some features found in LabVIEW for Windows because the controller does not have all the software of a PC. The following LabVIEW functions are *not* supported in LabVIEW Real-Time when targeted to the cFP-21*xx*:

- ActiveX
- Front panel datalogging
- Dialog boxes
- Printing
- Programmatic menus
- Front panel Web publishing
- NI driver software for non-FieldPoint hardware

LabVIEW Real-Time applications that have any of the unsupported functionality previously listed may or may not work as expected on the cFP-21*xx*.

Complete the following steps on the host PC to target LabVIEW Real-Time to the cFP-21*xx*:

1. Start LabVIEW.
2. Open a new VI.
3. Select **Operate»Switch Execution Target** to open the Select Target Platform dialog box, shown in the following figure.



4. Select the target platform from the pull-down menu.
5. Select **RT Target on Network** to target the cFP-21*xx*.

Note The module need not reside on the same subnet as the host PC.

6. Enter the IP address and password you specified for the cFP-21*xx* in MAX. If no password is specified for the cFP-21*xx*, leave the password field blank.

   Refer to the *RT Target: Access* section for more information.
7. Click **OK**.

Targeting LabVIEW Real-Time to the Host PC

When you target LabVIEW Real-Time to the host PC, you can use LabVIEW Real-Time as you would use LabVIEW for Windows.

Complete the following steps to target LabVIEW Real-Time to the host PC:

1. Complete steps 1 through 4 of the *Targeting LabVIEW Real-Time to the cFP-21xx* section.
2. Select **Host PC (LabVIEW for Windows)**.
3. Click **OK**.

Note Applications running on the host PC communicate with FieldPoint I/O channels. However, serial communication is routed to the host PC serial port rather than to the cFP-21*xx* serial port. VIs that use the serial port communicate using the host PC serial port. Also, when an application runs on the host, deadbands apply to FieldPoint I/O channels.

RT Target Options

When you target LabVIEW Real-Time to a networked cFP-21*xx*, select **Tools»Options** to access LabVIEW options. The options in the **Options** menu apply only to the Real-Time Development System running on the host PC.

You also can set options for the Real-Time Engine on the cFP-21*xx* when you target LabVIEW Real-Time to the controller. With LabVIEW Real-Time targeted to the cFP-21*xx*, select **Tools»RT Target Options** to access Real-Time Engine options. Real-Time Engine options apply to LabVIEW Real-Time applications running on the cFP-21*xx*. The **VI Server** and **Web Server** option dialog boxes are identical to the normal LabVIEW option dialog boxes. However, the settings are applied to the cFP-21*xx*. Refer to the *LabVIEW Help* for more information about the **VI Server** and **Web Server** options.

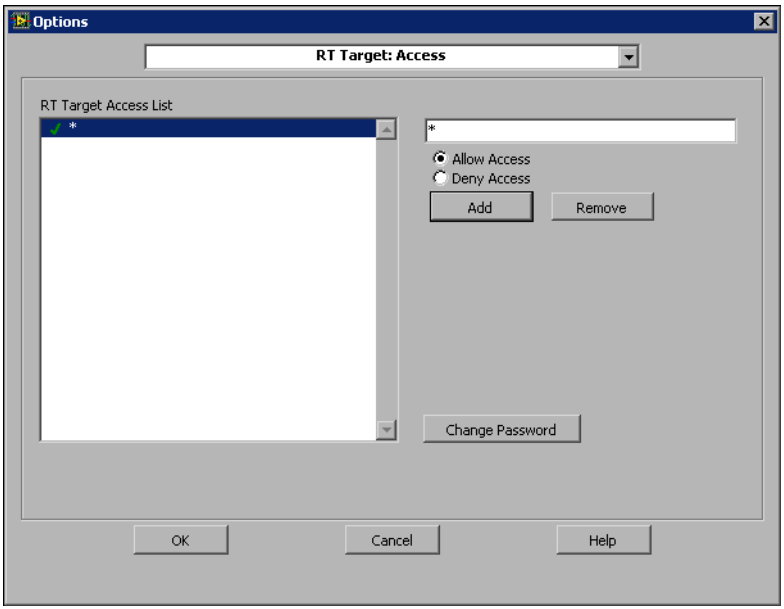
You also can use the following two additional groups of options for LabVIEW Real-Time applications on networked cFP-21*xx* modules: **RT Target: Access** and **RT Target: Miscellaneous**.

RT Target: Access

Use **RT Target: Access** options to limit which host PCs can target the Real-Time Engine on the cFP-21*xx*.

Complete the following steps to open the RT Target: Access dialog box:

1. Target LabVIEW Real-Time to the cFP-21*xx*. Refer to the *Targeting LabVIEW Real-Time to the cFP-21xx* section for more information.
2. Select **Tools»RT Target: *x.x.x.x*:Options**, where ***x.x.x.x*** is the IP address of the cFP-21*xx*.
3. Select **RT Target: Access** from the pull-down menu to see the following dialog box.



If the IP address of the host PC matches an entry that allows access, you can target the cFP-21*xx* without providing a password, even if the module configuration is locked. If the host IP address does not match any entry or matches an entry that denies access, you must provide the correct password to target the cFP-21*xx*.

When you try to target the Real-Time Engine on a cFP-21*xx* from a host PC through the Real-Time Development System, the Real-Time Engine compares the host PC's IP address to the entries in the RT Target Access List to determine if the host PC is permitted access. You define the RT Target Access List entries to indicate whether or not a host PC is

permitted or denied access. If an entry in the list matches the host PC address, the Real-Time Engine either allows or denies access based on what you define for the entry. If a subsequent entry also matches the host PC address, that permission is used in place of the previous permission. For example, in the RT Target: Access dialog box shown, `a.test.site.com` and `b.test.site.com` are permitted access even though the list indicates by the * wildcard that all addresses ending in `.test.site.com` are denied access. A checkmark next to a list entry denotes that access is permitted, while an `X` denotes that access is denied. If no entry matches the host PC address, access is denied unless you supply a password.

Table 4-1 shows examples of RT Target Access List entries and provides information about the * wildcard and permitting matching access entries.

To specify an Internet host address, enter its domain name or IP address. Use the * wildcard when specifying Internet host addresses. For example, you can specify all hosts within the domain `site.com` with the entry `*.site.com`. You can specify all hosts in the subnet whose first two numbers are 130.164 with the entry `130.164.*`. The entry * matches all addresses.

Table 4-1. Example RT Target Access List Entries

Access String	Matches
*	All hosts
`test.site.com`	The host whose domain name is `test.site.com`
`*.site.com`	All hosts whose domain names end with `.site.com`
`130.164.123.123`	The host with the IP address `130.164.123.123`
`130.164.123.*`	All hosts whose IP addresses start with `130.164.123`

In the RT Target: Access dialog box previously shown, all hosts in the `site.com` domain can target the Real-Time Engine, with the exception of all hosts in the `test.site.com` domain. Additionally, the hosts `a.test.site.com`, `b.test.site.com`, and `130.164.123.123` also can target the Real-Time Engine. The host `public.site.com` does not have access, even though it is in the `site.com` domain.

The default RT Target: Access settings permit any host machine to target the Real-Time Engine on the cFP-21*xx* without a password.

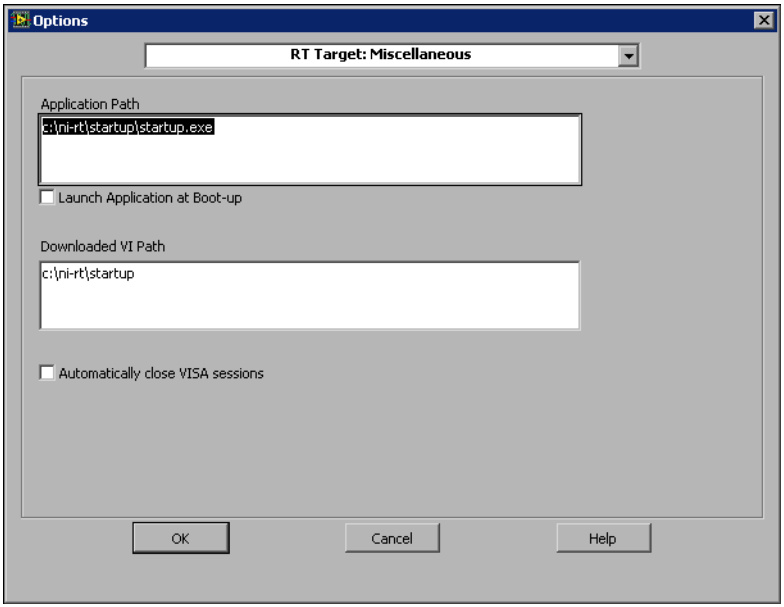
Note If the cFP-21*xx* does not have access to a Domain Name Server (DNS), do not use domain name entries in the RT Target Access List. Requests to resolve domain names to IP addresses fail and slow down the system. Place frequently matched entries toward the bottom of the RT Target Access List to improve system performance.

RT Target: Miscellaneous

Use **RT Target: Miscellaneous** options to launch LabVIEW Real-Time applications at system startup and to specify the **Downloaded VI Path**.

Complete the following steps to open the RT Target: Miscellaneous dialog box:

1. Target LabVIEW Real-Time to the cFP-21*xx*. Refer to the *Targeting LabVIEW Real-Time to the cFP-21xx* section for more information about targeting LabVIEW Real-Time to the cFP-21*xx*.
2. Select **Tools»Network Options**.
3. Select **RT Target: Miscellaneous** from the pull-down menu to see the following dialog box.



Use the **Application Path** and **Launch Application at Boot-up** settings to automatically launch a built LabVIEW Real-Time application when you start up the cFP-21*xx*. The LabVIEW Real-Time Engine launches the built application specified by **Application Path** when you start up the cFP-21*xx*. The specified path also determines the path and application name that appear when you target LabVIEW Real-Time to the cFP-21*xx* and create an embedded LabVIEW Real-Time application. Refer to the *Embedding Applications on the cFP-21xx* and *Launching Embedded Applications at Startup* sections for more information about embedding and launching LabVIEW Real-Time applications on the cFP-21*xx*.

Select **Launch Application at Boot-up** to launch the application specified in **Application Path** when you start up the cFP-21*xx*. You must first create the application using the Application Builder before you select this option. Refer to the *LabVIEW Application Builder Release Notes* and to the *LabVIEW Help* for more information about the Application Builder. Refer to the *Embedding Applications on the cFP-21xx* section for more information about creating LabVIEW Real-Time applications.

By changing the **Application Path**, you can create multiple LabVIEW Real-Time applications on the cFP-21*xx*. However, if you select **Launch Application at Boot-up**, only the application you specify in the **Application Path** launches at startup.

Use **Downloaded VI Path** to specify the default path for the Real-Time Engine VIs downloaded by the Real-Time Development System. VIs are stored on the host PC hard drive and are opened in the host Real-Time Development System. Therefore, the Real-Time Engine does not know the actual path of the downloaded VIs. The Real-Time Engine uses the path specified in **Downloaded VI Path** for operations that require the VI path. For example, the file constant **Current VI's Path** normally returns the path of the VI in which the constant is used. This constant may be used in a VI that reads or writes data to a file on the disk. When you run this VI in the LabVIEW Real-Time Engine on the cFP-21*xx*, **Current VI's Path** returns the path specified in the **Downloaded VI Path** option, appended with the name of the VI.

Embedding Applications on the cFP-21*xx*

LabVIEW Real-Time applications built on the host PC with the Application Builder can be embedded on the cFP-21*xx*. This section explains how to embed LabVIEW Real-Time applications on the cFP-21*xx* by using the Application Builder while LabVIEW Real-Time is targeted to the controller.

Refer to the *LabVIEW Help* for more information about building LabVIEW Real-Time applications on the host PC. Refer to the *LabVIEW Application Builder Release Notes* and to the *LabVIEW Help* for more information about using the Application Builder on the host PC.

Command Line Arguments

Use command line arguments for applications built on the host PC to disable the Select Target Platform dialog box and to explicitly specify a target for the application. You can use these command line arguments in a shortcut from the Windows Startup folder to automatically launch Real-Time Engine applications and/or host PC applications when you start up the host PC.

For example, create a shortcut with the following shortcut target:

```
c:\mybuiltapp.exe -target 127.127.44.108 -quithost
```

To disable the Select Target Platform dialog box, specify a target, such as the IP address of the cFP-21*xx*, in the command line argument of your application using `-target`. For example,

```
c:\mybuiltapp_rtengine.exe -target 127.127.44.108
```

or

```
c:\mybuiltapp_host.exe -target host
```

To disconnect the host PC from the Real-Time Engine after all applications are downloaded, use `-quithost`. For example,

```
c:\mybuiltapp_rtengine.exe -target 127.127.44.108
-quithost
```

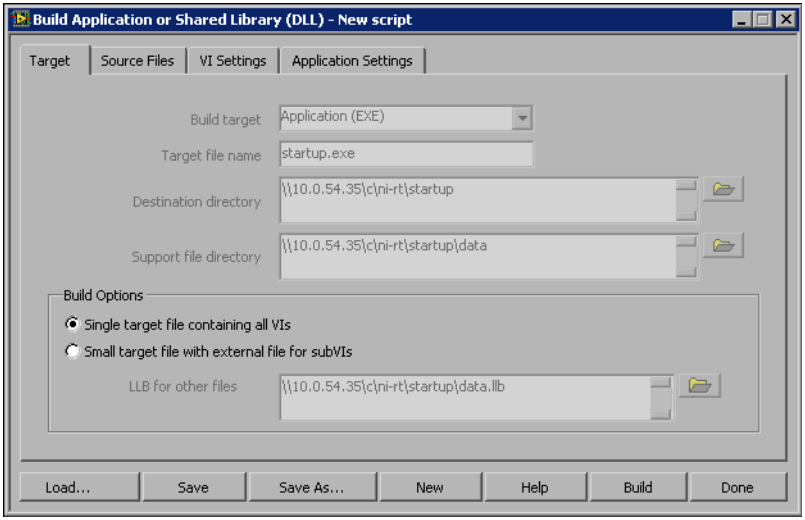
Using Application Builder

When you target LabVIEW Real-Time to the cFP-21*xx*, use the Application Builder to embed LabVIEW Real-Time applications on the cFP-21*xx*.

Complete the following steps to embed LabVIEW Real-Time applications on the cFP-21*xx* using the Application Builder:

1. Target LabVIEW Real-Time to the cFP-21*xx*. Refer to the *Targeting LabVIEW Real-Time to the cFP-21xx* section for more information.
2. Open a new VI.

3. Select **Tools»Build Application or Shared Library (DLL)** to open the Build Application or Shared Library (DLL) dialog box, shown in the following figure.



4. Select **Application (EXE)** from the **Build target** pull-down menu.
5. Click the **Source Files** tab.
6. Click **Add Top-Level VI**.
7. Navigate to the location of the VI to be added.
8. Select the VI to be added.
9. Click **OK**.
10. Click **Build**.

Target Tab

On the **Target** tab, the Application Builder determines the Target file name, Destination directory, and Support file directory from the **Application Path** setting in **RT Target Options**. You cannot change the Application name, Destination directory, and Support file directory settings in the Application Builder when you target LabVIEW Real-Time to the cFP-21*xx*. Refer to the *RT Target Options* section for more information about accessing and using **RT Target Options**.

If you select **Small target with external file for subVIs** in the Build Options pane, you cannot change the **LLB for other files** path because this path is determined from the **Application Path** setting in **Network Options**. Refer to the *LabVIEW Help* for more information about the **Small target with external file for subVIs** option. Refer to the *RT Target Options* section for more information about accessing and using **RT Target Options**.

Source Files and VI Settings Tabs

Use the **Source Files** and **VI Settings** tabs the same way you do to build a LabVIEW Real-Time application when LabVIEW Real-Time is targeted to the host PC. Refer to the *LabVIEW Help* for more information about the **Source Files** and **VI Settings** tabs.

Application Settings and Installer Settings Tabs

The **Application Settings** and **Installer Settings** tabs are disabled when you target LabVIEW Real-Time to the cFP-21*xx* because these settings do not apply to applications embedded on the controller.

Launching Embedded Applications at Startup

The Real-Time Engine can launch your embedded application each time you start up the cFP-21*xx*. Complete the following steps to launch the embedded application each time the cFP-21*xx* starts up:

1. Target LabVIEW Real-Time to the cFP-21*xx*. Refer to the *Targeting LabVIEW Real-Time to the cFP-21xx* section for more information about targeting LabVIEW Real-Time to the cFP-21*xx*.
2. Select **Tools»RT Target Options**.
3. Select **RT Target: Miscellaneous** from the pull-down menu.
4. Select **Launch Application at Boot-up**.
5. Click **OK**.

5

Accessing cFP-21*xx* Channels from PC Applications

This chapter describes how to access channels on the cFP-21*xx* from other software running on a PC after you configure the system in MAX. For information about configuring the Compact FieldPoint system in MAX, refer to the *Measurement & Automation Explorer Help for FieldPoint*.

Using the cFP-21*xx* from PC Applications

The primary intended use for the cFP-21*xx* is to run LabVIEW Real-Time, but you can use the controller with other software on a PC, even while the controller is running LabVIEW Real-Time. The following sections explain how to access the channels on the cFP-21*xx* from software running on a PC.

LabVIEW VIs and the cFP-21*xx*

When you install the FieldPoint software, a library of FieldPoint VIs is created if LabVIEW has already been installed on your computer. The FieldPoint VIs directly access I/O items configured in MAX. For help using these VIs, refer to the FieldPoint LabVIEW Interface Help accessible from the LabVIEW help menu, or to the FieldPoint examples in `LabVIEW\examples\FieldPoint`. You can use this same set of VIs to access the cFP-21*xx* by Ethernet from the host PC or to run an embedded application. For more information about programming embedded applications for the cFP-21*xx*, refer to Chapter 4, *LabVIEW Real-Time Programming*.

LabWindows/CVI Functions and the cFP-21*xx*

When you install the FieldPoint software, a LabWindows/CVI instrument driver for FieldPoint is installed if LabWindows/CVI has already been installed on your computer. This instrument driver includes function panels to call C functions that directly access I/O items you configured in MAX. In addition, a set of sample projects is placed in your `LabWindows/CVI Samples` directory. Using these examples is the best way to get familiar with these functions. The *FieldPoint LabWindows/CVI Interface*

Help describes each function in the instrument driver with a description of the C syntax, a description of each parameter, and a list of possible error codes.

Note FieldPoint CVI Interface Compatibility Modes—The FieldPoint software ships with object (`.obj`) files to support the different compiler compatibility modes that LabWindows/CVI supports (Microsoft Visual C/C++, and Borland). When the FieldPoint software is installed, the `.obj` file corresponding to the configured compatibility mode is installed.

FieldPoint OPC Server and the cFP-21*xx*

The FieldPoint OPC server conforms to the OPC Data Access 2.0 standard. OPC (OLE for Process Control) is an industry-standard device interface specification that provides interoperability between field devices such as FieldPoint and application software packages. The FieldPoint OPC server imports I/O items that you configured in MAX and makes them available as OPC items to any *OPC client*. Therefore, if two computers are networked together, it is possible for an OPC client on one computer to access FieldPoint hardware connected to the OPC server on another computer.

OPC clients differ in the features they offer and in their presentation of the OPC interface for the FieldPoint OPC server. Refer to the documentation on using the OPC client features of your application for detailed instructions on how to access an OPC server. However, the basic steps involved are similar for most OPC client applications.

Follow these steps to use the FieldPoint OPC server:

1. Launch your OPC client.
2. Open the FieldPoint OPC server, `National Instruments.OPCFieldPoint`, from the OPC client.

   This server was registered with Windows when you installed the FieldPoint software. OPC clients should be able to show you a list of available registered servers, but you may have to type this name in yourself. The OPC client may automatically connect to the server when you select it, but if you are given the option to connect to the FieldPoint OPC server, you should do so.
3. Create a group.

   Groups are a collection of I/O items. Some OPC clients might not give you the option of creating groups, or they might be created for you.

4. The OPC server loads the last saved `.iak` file on startup. Select the I/O items you configured in MAX that you want to read or write as a part of this group.

   Many OPC clients can use the Browse Address Space feature of the FieldPoint OPC server to show you a list of all the I/O items you configured in MAX. However, if the OPC client you are using does not support this feature, you may need to type the item IDs of the I/O items directly. The naming convention of the FieldPoint item IDs is *Comm resource name*`\`*Device Name*`\`*I/O item name*, where the values are the names given in MAX. For example, an item ID associated with one of the I/O items might be the following:

   ```
   FP Res\cFP-TC-120 @1\Channel 0
   ```

In most cases, the preceding steps are all that is required to configure an OPC client to read from I/O items of the FieldPoint OPC server. In some cases, the OPC client might require more information about the FieldPoint OPC server. The following list contains additional information about the FieldPoint OPC server, which you may find helpful.

- The FieldPoint OPC server does not require an access path. Some OPC clients expect the access path to be included in the item ID name or might request the access path when you select I/O items. You should be able to leave the access path blank (empty string).
- The FieldPoint OPC interface is an out-of-process server.
- The FieldPoint OPC server supports both synchronous and asynchronous reads and writes.
- The FieldPoint OPC server uses the GetErrorString method to return error and diagnostic messages from the FieldPoint server and hardware. OPC clients that do not support this method might give you error messages like “Bad, non-specific” along with an error code. Some OPC clients that do not support this GetErrorString method still provide a way for you to manually look up the FieldPoint message corresponding to the error code using the method.

Data Communications

The cFP-21*xx* network module provides several methods for communicating and sharing data with other FieldPoint systems, computers, and devices. The most common methods are to use DataSocket, serial VIs, TCP VIs, UDP VIs, or Data Publishing VIs, as described in the following sections.

DataSocket

DataSocket, a programming technology based on TCP/IP, simplifies live data exchange between different applications on one computer or between computers connected on a network. DataSocket was designed as an easy-to-use, high-performance programming interface for sharing and publishing live data in measurement and automation applications. You can use DataSocket VIs to obtain data from other DataSocket servers, Lookout or LabVIEW DSC module applications, and data published by the Publish Data VIs.

DataSocket uses uniform resource locators (URLs) to specify absolute paths to data items. A URL consists of three separate components: protocol, network address, and locator. You are probably most familiar with URLs from using a Web browser. For example, `http://www.ni.com/support/fieldpoint` is a URL in which `http` is the protocol, `www.ni.com` is the network address, and `support/fieldpoint` is the locator.

In LabVIEW, select **NI Measurements»FieldPoint»Advanced» DataSocket»DataSocket Select URL**. Run the VI. Enter the IP address of the FieldPoint network module in the **Browse host** field, then click **Refresh**. Browse to the data item. Copy the URL of the item and paste it into a string control or a constant in your LabVIEW VI. Wire the control or the constant to the DataSocket VI URL terminal.

DataSocket URLs for Compact FieldPoint I/O Modules

The following is an example of a DataSocket URL that points to a specific channel of a Compact FieldPoint I/O module:

```
fieldpoint:\\130.164.44.8\FP\1AI\01
```

In this URL, `fieldpoint` is the protocol, `130.164.44.8` is the IP address of the Compact FieldPoint controller, and `FP\1AI\01` is the locator. You can use `fieldpoint`, `lookout`, or `logos` as the protocol.

The FieldPoint Process part of a URL provides the parent folder from which you access all data items in a Compact FieldPoint system. The FieldPoint Process part of a URL has the following format:

`\\[`*`machine`*`]\FP`

where `[`*`machine`*`]` is the IP address or hostname of the Compact FieldPoint controller.

The I/O Module Folder part of a URL provides the sub-folder from which you access all data items from a specific FieldPoint I/O module. The I/O Module Folder part of a URL has the following format:

`\\[machine]\FP\[n]`

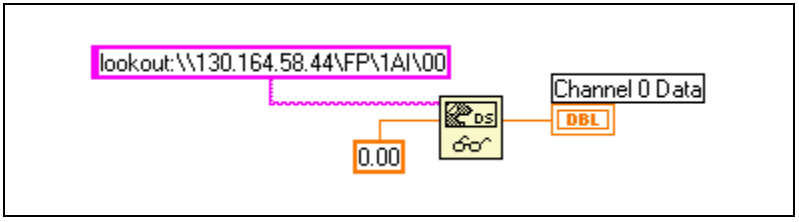
where `[n]` consists of the numeric address and name of the I/O module. The address of the I/O module is an integer from 1 to 8, where 1 represents the I/O module closest to the network module and 8 represents the I/O module farthest from the network module. The folder `\\130.164.44.8\FP\1AI` indicates the I/O module closest to the network module, and the AI means that it is an analog input module.

The Channel Data part of a URL provides the scaled data value of the input or output value for a specific channel. The Channel Data part of a URL has the following format:

`\\[machine]\FP\[n]\[channel]`

where `[channel]` is a two-digit decimal number between 00 and 15.

The following figure shows a DataSocket URL with Channel Data.



The locator is read as channel 0 (00) of the analog input module in slot 1 (the slot closest to the controller) of the backplane.

Publish Data VI

You can use the Publish Data VI on the FieldPoint palette to create items and groups that are published using the National Instruments Ethernet (Logos) protocol. A host computer or cFP-21*xx* can link to these items using DataSocket or using the native connection capabilities of Lookout or the LabVIEW DSC module. The Publish Data VI creates data that other VIs and applications can browse and read, write, or read/write from the cFP-21*xx*. These items are accessible in MAX and the FieldPoint OPC server.

Serial VIs

You can use the LabVIEW Serial VIs to communicate with other serial devices through the serial port(s) on the cFP-21*xx*. For more information about the cFP-21*xx* serial port(s), refer to the *Serial Ports* section of Chapter 3, *Feature Descriptions*.

TCP and UDP VIs

You can use the LabVIEW TCP VIs to publish data from the cFP-21*xx* to computers or devices on the network using TCP-based protocols. You can use the LabVIEW UDP VIs to publish data from the cFP-21*xx* to computers on the network using UDP (User Datagram Protocol).



Note The TCP and UDP VIs provide low-level access to your network. Use them only when the supplied protocols do not fit into your application.

A

Troubleshooting

This appendix gives troubleshooting instructions for the cFP-21*xx* and FieldPoint software. For more troubleshooting information, refer to the *Measurement & Automation Explorer Help for FieldPoint* and the *Measurement & Automation Explorer Remote Systems Help*.

Runaway Startup Application

If a runaway startup application causes the cFP-21*xx* to become unresponsive, you must power down the cFP-21*xx*, then reboot it with either the DISABLE VI switch or the SAFE MODE switch in the ON position. Rebooting the controller with the DISABLE VI switch ON prevents any VIs from running at startup. Rebooting with the SAFE MODE switch ON starts the cFP-21*xx* in safe mode, and the embedded LabVIEW Real-Time engine is not launched. Refer to the *DIP Switches* section of Chapter 3, *Feature Descriptions*, for more information about these DIP switches.

STATUS LED Error Indications

The cFP-21*xx* indicates specific error conditions by flashing the red **STATUS** LED a specific number of times. Table A-1 describes the **STATUS** LED flashing sequences and the corresponding error condition.

Table A-1. STATUS LED Flashes and Corresponding Error Conditions

Number of Flashes	Error Condition
0 (stays lit)	The cFP-21*xx* did not power on correctly. Contact National Instruments for assistance.
1	The cFP-21*xx* is in reset mode or is unconfigured. Make sure the RESET IP switch is in the OFF position and restart the controller. Refer to the *Measurement & Automation Explorer Help for FieldPoint* for more information about configuration.

Table A-1. STATUS LED Flashes and Corresponding Error Conditions (Continued)

Number of Flashes	Error Condition
2	The cFP-21*xx* has detected an error in software. This usually occurs when an attempt to upgrade the software is interrupted. Repeat the software upgrade process.
3	The cFP-21*xx* is in safe mode. Either the controller is ready for software installation or the SAFE MODE switch is in the ON position.
4 (or more)	The cFP-21*xx* has detected an unrecoverable error. Contact National Instruments for assistance.

Other Indications of Trouble with the Controller

- Red status LED stays lit when controller is in normal mode
- Cannot detect controller in MAX unless it is in safe mode
- After youset the IP address, the controller reboots unconfigured or with the old IP address
- Red status LED error code greater than 3
- Red status LED error code 2 during normal operation
- Controller incorrectly reports that the disk is full
- I/O module ready LEDs off in normal mode but on in safe mode
- Unusual file or folder names when you FTP to the controller

First, use MAX to reinstall software on the controller. If that does not solve the problem, you may have to reformat the internal memory of the controller.

Reformatting the Internal Memory

1. Reboot the controller into safe mode by flipping DIP switch 7 and cycling the power.
2. Open MAX and expand Remote Systems to find the FieldPoint bank.
3. Right-click the FieldPoint bank and select **Format Disk**.

If the Format Disk option is not available, there are three possible issues. Either the OS has not been updated, MAX 3.1 or later has not been installed, or MAX has not been rebooted since the controller OS was upgraded.

After formatting, you must reconfigure network settings and reinstall software. Remember to install LabVIEW Real-Time 6.1.3 or later on the controller, because previous versions do not work with the controller.

B

Specifications

The following specifications are typical for the range –40 to 70 °C unless otherwise noted. Specifications are subject to change without notice.

Network

Network interface ..... 10BaseT and 100BaseTX Ethernet

Compatibility IEEE802.3

Communication rates ..... 10 Mbps, 100 Mbps, auto-negotiated

Maximum cabling distance ..... 100 m/segment

Maximum power to connected I/O modules ..... 9 W

Maximum number of banks ..... Determined by network topology

Memory

cFP-2100 ..... 64 MB nonvolatile
64 MB DRAM

cFP-2110 ..... 64 MB nonvolatile
128 MB DRAM

cFP-2120 ..... 128 MB nonvolatile
128 MB DRAM

Memory lifetime (nonvolatile) ..... 300,000 writes per sector

Serial Ports

cFP-2100 ..... One RS-232 serial port

cFP-2110 ..... Two RS-232 serial ports

cFP-2120.....Three RS-232 serial ports, one RS-485 serial port

RS-232 (DTE) serial ports

- Baud rate.....110–115,200 bps
- Data bits.....5, 6, 7, 8
- Stop bits.....1, 1.5, 2
- Parity.....Odd, Even, Mark, Space
- Flow control.....RTS/CTS, XON/XOFF, DTR/DSR

RS-485 (DTE) ports

- Baud rate.....110–115,200 bps
- Data bits.....5, 6, 7, 8
- Stop bits.....1, 1.5, 2
- Parity.....Odd, Even, Mark, Space
- Flow control.....XON/XOFF
- Wire mode.....4-wire
- Isolation voltage
  - Maximum continuous isolation voltage.....100 V_{rms}
  - Dielectric withstand.....740 V_{rms}, 1 minute

Power Requirements

Power supply range.....11–30 VDC

Recommended power supply

- cFP system with cFP-BP-4 backplane.....24 VDC, 15 W
- cFP system with cFP-BP-8 backplane.....24 VDC, 20 W

Power consumption

- cFP-2100.....4.8 W + 1.1(*Total Power Consumption of All I/O Modules*)
- cFP-2110.....5.0 W + 1.1(*Total Power Consumption of All I/O Modules*)
- cFP-2120.....6.1 W + 1.1(*Total Power Consumption of All I/O Modules*)

Physical Characteristics

Screw-terminal wiring ..... 16–26 AWG copper conductor wire with 7 mm (0.28 in.) of insulation stripped from the end

Torque for screw terminals ..... 0.5–0.6 N · m (4.4–5.3 lb · in.)

Weight ..... 278 g (9.8 oz)

Environmental

FieldPoint modules are intended for indoor use only. For outdoor use, they must be placed inside a suitable enclosure.

Operating temperature ..... –40 to 70 °C in correct orientation; –40 to 60 °C in other orientations

Storage temperature ..... –40 to 85 °C

Humidity ..... 10 to 90% RH, noncondensing

Maximum altitude ..... 2,000 m

Pollution Degree 2

Shock and Vibration

Operating vibration, random
(IEC 60068-2-64) ..... 10–500 Hz, 5 g_{rms}

Operating vibration, sinusoidal
(IEC 60068-2-6) ..... 10–500 Hz, 5 g
(IEC 60068-2-64) ..... 10–500 Hz, 5 g_{rms}

Operating shock
(IEC 60068-2-27) ..... 50 g, 3 ms half sine, 18 shocks at 6 orientations; 30 g, 11 ms half sine, 18 shocks at 6 orientations

Safety

This product is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1
- CAN/CSA-C22.2 No. 61010-1

Note For UL and other safety certifications, refer to the product label, or visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Electromagnetic Compatibility

Emissions.....EN 55011 Class A at 10 m
FCC Part 15A above 1 GHz

Immunity .....EN 61326:1997 + A2:2001,
Table 1 (Industrial Levels)

CE, C-Tick, and FCC Part 15 (Class A) Compliant

Note For EMC compliance, operate this device with shielded cabling.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

Low-Voltage Directive (safety).....73/23/EEC

Electromagnetic Compatibility
Directive (EMC) 89/336/EEC

Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Cabling

Table B-1 shows the standard Ethernet cable wiring connections for both normal and crossover cables.

Table B-1. Ethernet Cable Wiring Connections

Pin	Connector 1	Connector 2 (Normal)	Connector 2 (Crossover)
1	white/orange	white/orange	white/green
2	orange	orange	green
3	white/green	white/green	white/orange
4	blue	blue	blue
5	white/blue	white/blue	white/blue
6	green	green	orange
7	white/brown	white/brown	white/brown
8	brown	brown	brown

Figure B-1 shows the connector pinouts for FieldPoint Ethernet cables.

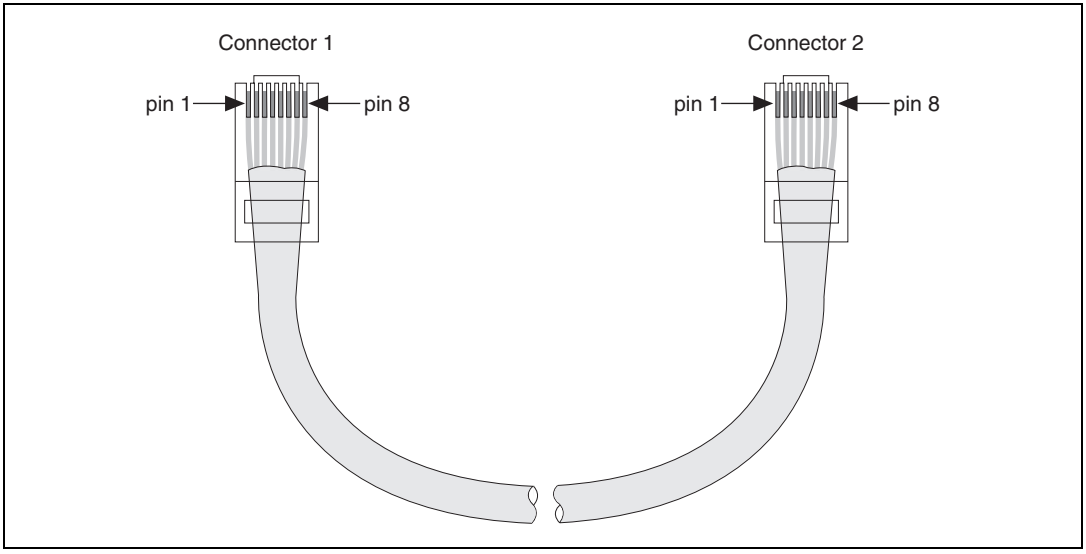


Figure B-1. Ethernet Cable Pinout

C

Technical Support and Professional Services

Visit the following sections of the National Instruments Web site at ni.com for technical support and professional services:

- **Support**—Online technical support resources at ni.com/support include the following:
  - **Self-Help Resources**—For answers and solutions, visit the award-winning National Instruments Web site for software drivers and updates, a searchable KnowledgeBase, product manuals, step-by-step troubleshooting wizards, thousands of example programs, tutorials, application notes, instrument drivers, and so on.
  - **Free Technical Support**—All registered users receive free Basic Service, which includes access to hundreds of Application Engineers worldwide in the NI Developer Exchange at ni.com/exchange. National Instruments Application Engineers make sure every question receives an answer.

    For information about other technical support options in your area, visit ni.com/services or contact your local office at ni.com/contact.
- **Training and Certification**—Visit ni.com/training for self-paced training, eLearning virtual classrooms, interactive CDs, and Certification program information. You also can register for instructor-led, hands-on courses at locations around the world.
- **System Integration**—If you have time constraints, limited in-house technical resources, or other project challenges, National Instruments Alliance Partner members can help. To learn more, call your local NI office or visit ni.com/alliance.
- **Declaration of Conformity (DoC)**—A DoC is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electronic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting ni.com/certification.

- **Calibration Certificate**—If your product supports calibration, you can obtain the calibration certificate for your product at `ni.com/calibration`.

If you searched `ni.com` and could not find the answers you need, contact your local office or NI corporate headquarters. Phone numbers for our worldwide offices are listed at the front of this manual. You also can visit the Worldwide Offices section of `ni.com/niglobal` to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

Glossary

Symbol	Prefix	Value
m	milli	10^{-3}
k	kilo	10^{3}
M	mega	10^{6}

%	Percent.
°	Degrees.
Ω	Ohms.
0x	Precedes a hexadecimal number.
b	Bits.
B	Bytes.
bank	The combination of one FieldPoint network module and one or more terminal bases and I/O modules.
C	Celsius.
DIP switch	Dual inline package switch.
DNS	Domain name server.
FTP	File Transfer Protocol.
HotPnP	Hot plug-and-play.
I/O	Input/output.
IEC	International Electrotechnical Commission.
LED	Light-emitting diode.
m	Meters.
OPC	OLE for Process Control.
PG	Pulse generation.
POST	Power-on self test.

PWM	Pulse-width modulation. Generation of a pulse waveform with fixed frequency and variable pulse width (duty cycle). PWM is used to control discrete devices such as DC motors and heaters by varying the pulse width (the ration of on time to off time).
subnet	A set of systems whose IP addresses are configured such that they can communicate directly with one another. Data will not flow through an intermediate router.
TCP	Transmission Control Protocol. A set of standard protocols for communicating across a single network or interconnected set of networks. TCP is for high-reliability transmissions.
UDP	User Datagram Protocol. A set of standard protocols for communicating across a single network or interconnected set of networks. UDP is for low-overhead transmissions.
V	Volts.
VDC	Volts direct current.
VI	Virtual Instrument. A combination of hardware and/or software elements, typically used with a PC, that has the functionality of a classic stand-alone instrument.
W	Watts.

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