

FieldPoint™ Operating Instructions

FP-AIO-600 and cFP-AIO-600

Four-Channel Analog Input, Four-Channel Analog Output, 12-Bit Module

These operating instructions describe how to install and use the National Instruments FP-AIO-600 and cFP-AIO-600 (referred to inclusively as the [c]FP-AIO-600). For more information about configuring and accessing the [c]FP-AIO-600 over a network, refer to the user manual for the FieldPoint network module you are using.

Features

The [c]FP-AIO-600 is a FieldPoint analog input and output module with the following features:

- Four analog voltage or current input channels with 11 input ranges up to ± 36 V or ± 24 mA with overranging
- Four analog current output channels with 0–20 or 4–20 mA ranges without overranging
- 1.7 kHz hardware update rate
- 12-bit resolution
- –40 to 70 °C operation
- Onboard diagnostics including open current loop indicators
- Current inputs protected up to ± 100 mA or ± 10 V
- Hot swappable
- 2,300 V_{rms} transient overvoltage protection

Installing the FP-AIO-600

The FP-AIO-600 mounts on a FieldPoint terminal base (FP-TB-*x*), which provides operating power to the module. Installing the FP-AIO-600 onto a powered terminal base does not disrupt the operation of the bank.

To install the FP-AIO-600, refer to Figure 1 and complete the following steps:

1. Slide the terminal base key to position X.
2. Align the FP-AIO-600 alignment slots with the guide rails on the terminal base.
3. Press firmly to seat the FP-AIO-600 on the terminal base. When the module is firmly seated, the terminal base latch locks it into place.

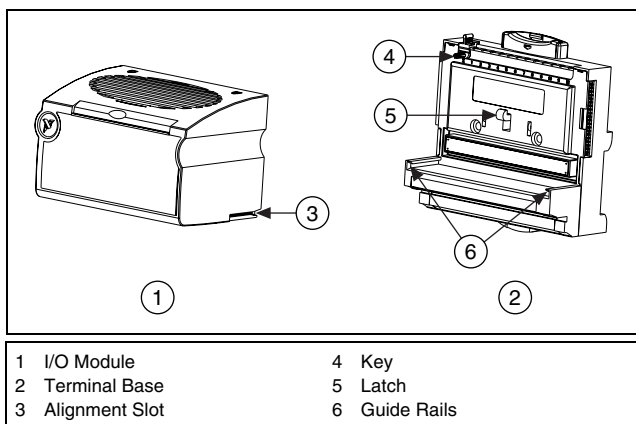


Figure 1. Installing the FP-AIO-600

Installing the cFP-AIO-600

The cFP-AIO-600 mounts on a Compact FieldPoint backplane (cFP-BP-*x*), which provides operating power to the module. Installing the cFP-AIO-600 onto a powered backplane does not disrupt the operation of the bank.

To install the cFP-AIO-600, refer to Figure 2 and complete the following steps:

1. Align the captive screws on the cFP-AIO-600 with the holes on the backplane. The alignment keys on the cFP-AIO-600 prevent backward insertion.
2. Press firmly to seat the cFP-AIO-600 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.

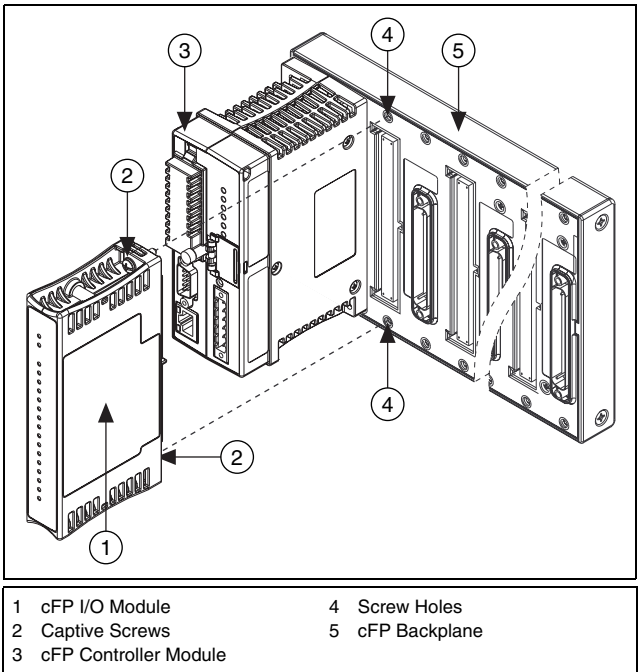


Figure 2. Installing the cFP-AIO-600

Wiring the [c]FP-AIO-600

The FP-TB- x terminal base has connections for each input channel and each output channel, and for an external power supply to power the current output channels and field devices. The cFP-CB- x connector block provides the same connections. Each input channel has one input terminal for voltage (V_{IN}) and one input terminal for current (I_{IN}). Only one of these input terminals should be connected on each channel. Each output channel has one output terminal for current (I_{OUT}). All four input channels and all four output channels are referenced to the COM terminals. The V and V_{SUP} terminals are all internally connected, as are the C and COM terminals.

Use a 10–30 VDC external power supply that provides at least 125 mA for the output channels. The power supply must provide more current if you use it to power transducers or field devices. Connect the external power supply to multiple V and V_{SUP} terminals and to multiple C and COM terminals as needed to ensure that the maximum current through any terminal is 2 A or less.

Install a 125 mA minimum, 2 A maximum, fast-acting fuse at each connected V and V_{SUP} terminal. Select a fuse value suitable for the device connected to each channel to protect the module and connected devices. Install a 63 mA, fast-acting fuse at each connected I_{IN} terminal. The detailed wiring diagrams in this document show fuses where appropriate.

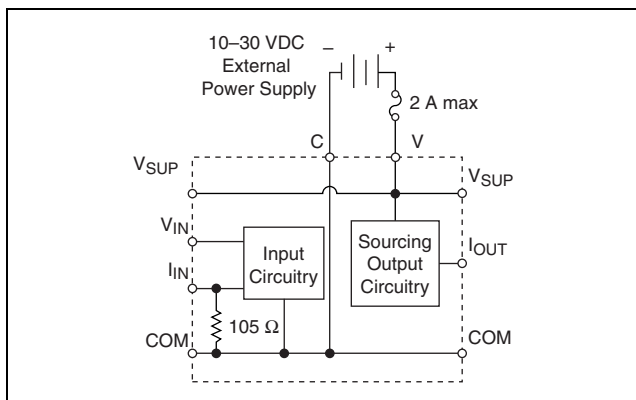


Figure 3. Basic Field Connection



Caution Do *not* connect both current and voltage inputs to the same channel.

Table 1 lists the terminal assignments for the signals of each input channel.

Table 1. Input Terminal Assignments

Channel	Inputs			
	V_{IN}	I_{IN}^1	V_{SUP}^2	COM
In 0	1	2	17	18
In 1	3	4	19	20
In 2	5	6	21	22
In 3	7	8	23	24

¹ Install a 63 mA fast-acting fuse on each I_{IN} terminal.
² Install a 2 A maximum fast-acting fuse on each V_{SUP} terminal.

Table 2 lists the terminal assignments for the signals of each output channel.

Table 2. Output Terminal Assignments

Channel	Outputs		
	I_{OUT}	V_{SUP}^1	COM
Out 0	9	25	26
Out 1	11	27	28
Out 2	13	29	30
Out 3	15	31	32

¹ Install a 2 A maximum fast-acting fuse on each V_{SUP} terminal.



Caution Cascading power between two modules defeats isolation between those modules. Cascading power from the network module defeats all isolation between modules in the FieldPoint bank.

Connecting Signals to the [c]FP-AIO-600

The [c]FP-AIO-600 has four single-ended input channels. All four input channels share a common ground reference that is isolated from other modules in the FieldPoint system.



Note The input and output channels of the [c]FP-AIO-600 are *not* electrically isolated from each other.

Figure 4 shows the input circuitry on a single input channel.

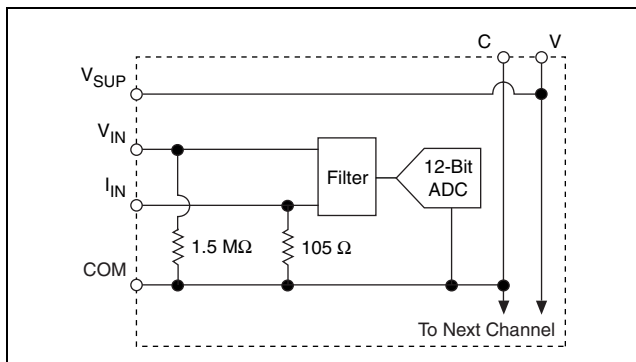


Figure 4. Input Circuitry on One Channel of the [c]FP-AIO-600

Voltage Inputs

The input ranges for voltage signals are ± 5 , ± 10 , ± 15 , ± 30 , 0–5, 0–10, 0–15, and 0–30 V. FieldPoint software accounts for the 20% overranging feature and shows the ranges accordingly.

Figure 5 shows how to connect a voltage source without an external power supply to one input channel of the [c]FP-AIO-600.

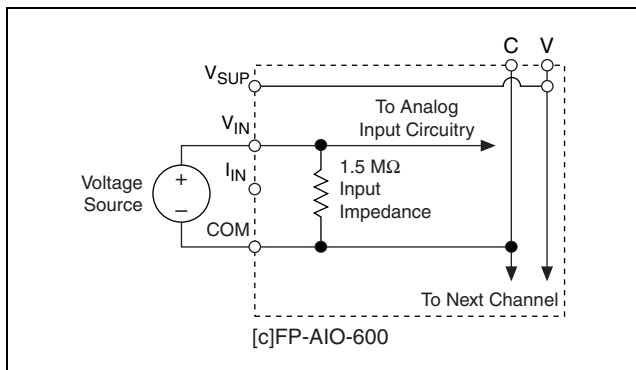


Figure 5. Voltage Input without an External Power Supply

Figure 6 shows how to connect a voltage source with an external power supply to one input channel of the [c]FP-AIO-600.

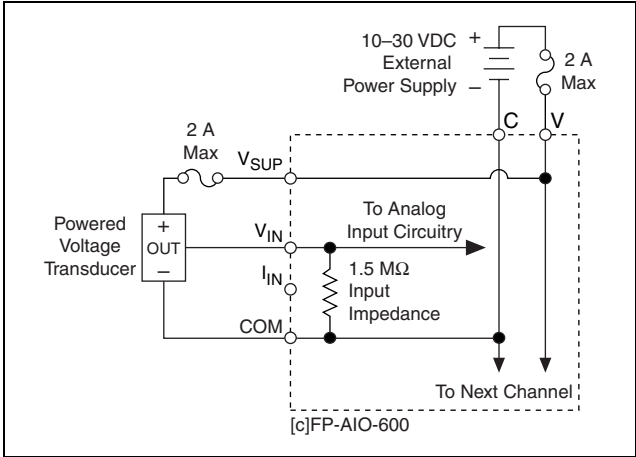


Figure 6. Voltage Input with an External Power Supply

Current Inputs

The input ranges for current sources are ± 20 , $0-20$, and $4-20$ mA. FieldPoint software accounts for the 20% overranging feature and shows the ranges accordingly. Figure 7 shows how to connect a current source without an external power supply to one input channel of the [c]FP-AIO-600.

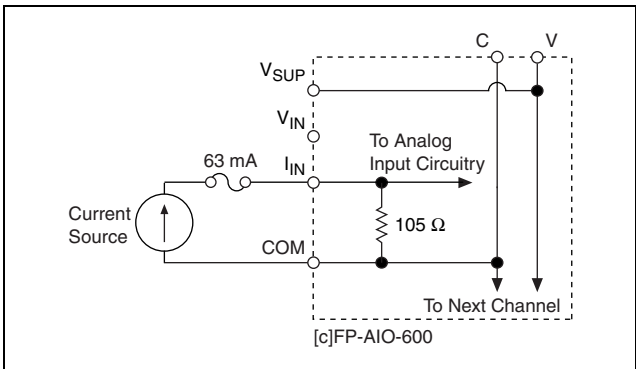


Figure 7. Current Input without an External Power Supply

Figure 8 shows how to connect a current source with an external power supply to one input channel of the [c]FP-AIO-600.

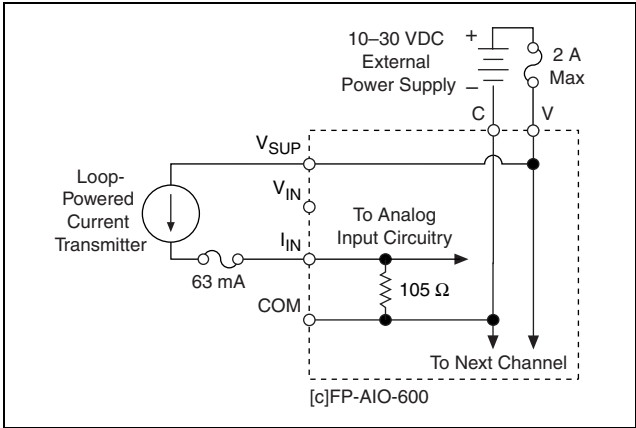


Figure 8. Current Input with an External Power Supply

Input Ranges

To prevent inaccurate readings, select an input range such that the signal you are measuring does not exceed either end of the range.

Overranging

The [c]FP-AIO-600 has an overranging feature that measures 20% beyond the nominal values of each range. For example, the actual measurement limit of the ± 5 V range is ± 6.0 V. The overranging feature enables the [c]FP-AIO-600 to compensate for field devices with span errors of up to 20% of full scale. Also, with the overranging feature, a noisy signal near the nominal full scale does not create rectification errors.

Connecting the [c]FP-AIO-600 to a Load

The [c]FP-AIO-600 has four single-ended current output channels that *source* current from a 10–30 VDC, 125 mA external power supply. Sourcing current means that current flows out of the I_{OUT} terminal into the load. All four output channels and their common are isolated from the other modules in the FieldPoint system. The four output channels are not isolated from the four input channels.



Note Add a 2 A max fuse to any V_{SUP} terminal in use.

Figure 9 shows the output circuitry of a single channel.

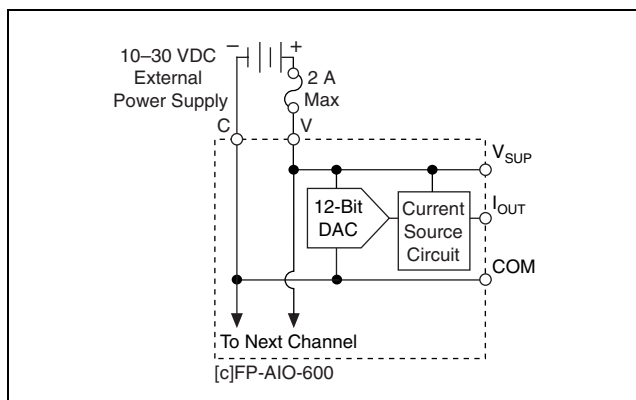


Figure 9. [c]FP-AIO-600 Analog Output Circuit

Output Ranges

You can configure each channel independently for an output range of 0–20 mA or 4–20 mA. The default power-up setting for each channel is 0–20 mA, with the output set to 0 mA. The [c]FP-AIO-600 has overranging in each of these ranges, so the full-scale ranges available are 0–21 mA and 3.5–21 mA. Overranging enables the [c]FP-AIO-600 to compensate for span and offset errors in field devices.

Open-Loop Detection

Each channel has a monitoring circuit that compares the actual output current to the specified output current. If the [c]FP-AIO-600 cannot source the specified output current for one or more channels, the monitoring circuits turn on a red **STATUS** LED for each affected channel and report the error condition to the network module. Generally, the error condition is caused by an open current loop—either the load device or the external power supply is disconnected. However, the monitoring circuit also detects errors caused by load impedances that are too high and by external power supply voltages that are too low. For more information, refer to the *Specifications* section.

If the output of a [c]FP-AIO-600 channel is set to 0 mA, the monitoring circuit does not register an error condition because the [c]FP-AIO-600 can always source zero current, even to an open loop. Leave any unused and unwired channels in the default state to avoid error conditions.

Short-Circuit Protection

Each I_{OUT} terminal of the [c]FP-AIO-600 is protected against short circuits. One or more channel outputs can be short-circuited indefinitely without causing damage or improper operation to the channel, as long as the maximum loop supply does not exceed 30 VDC.

Status Indicators

Figure 10 shows the [c]FP-AIO-600 status indicators.



Figure 10. Status Indicators

The [c]FP-AIO-600 has two green status LEDs, **POWER** and **READY**. After you install the [c]FP-AIO-600 onto a terminal base or backplane and apply power to the connected network module, the green **POWER** indicator lights and the [c]FP-AIO-600 informs the network module of its presence. When the network module recognizes the [c]FP-AIO-600, it sends initial configuration information to the [c]FP-AIO-600. After the [c]FP-AIO-600 receives this initial information, the green **READY** indicator lights and the module is in normal operating mode.

In addition to the green **POWER** and **READY** indicators, each output channel has a red, numbered error status indicator. For more information, refer to the *Open-Loop Detection* section.

Upgrading the FieldPoint Firmware

You may need to upgrade the FieldPoint firmware when you add new I/O modules to the FieldPoint system. For information on determining which firmware you need and how to upgrade the firmware, go to ni.com/info and enter `fpmatrix`.


Isolation and Safety Guidelines



Caution Read the following information before attempting to connect the [c]FP-AIO-600 to any circuits that may contain hazardous voltages.

This section describes the isolation of the [c]FP-AIO-600 and its compliance with international safety standards. The field wiring connections are isolated from the backplane and the inter-module communication bus. The isolation is provided by the module, which has optical and galvanic isolation barriers designed and tested to protect against transient fault voltages of up to 2,300 V_{rms}.

Follow these guidelines to ensure a safe total system:

- The [c]FP-AIO-600 has a safety isolation barrier between the I/O channels and the inter-module communication bus. There is no isolation between channels unless otherwise noted. If any of the channels on a module are wired at a hazardous potential, make sure that all other devices or circuits connected to that module are properly insulated from human contact.
- Do *not* share the external supply voltages (the V and C terminals) with other devices (including other FieldPoint devices), unless those devices are isolated from human contact.
- For Compact FieldPoint, 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.
- As with any hazardous voltage wiring, make sure that all wiring and connections meet applicable electrical codes and commonsense practices. Mount terminal bases and backplanes in an area, position, or cabinet that prevents accidental or unauthorized access to wiring that carries hazardous voltages.
- Operate the [c]FP-AIO-600 only at or below Pollution Degree 2. Pollution Degree 2 means that only nonconductive pollution occurs in most cases. Occasionally, however, a temporary conductivity caused by condensation must be expected.

- Refer to the FieldPoint product label for regulatory certification under hazardous location standards. If the FieldPoint product is not certified for operation in hazardous locations, do not operate it in an explosive atmosphere or where there may be flammable gases or fumes.

Specifications

The following specifications are typical for the range -40 to 70 °C unless otherwise noted.

Input and Output Characteristics

Number of input channels.....	4
Number of output channels.....	4
ADC resolution.....	12 bits
Type of ADC.....	Successive approximation
DAC resolution	12 bits
Type of DAC	R-2R
Hardware update rate (all 8 channels).....	1.7 kHz (588 μ s)

Voltage Inputs

Effective resolution	11.3 bits
Input impedance.....	1.5 M Ω
Signal input bandwidth (-3 dB).....	350 Hz
Gain error at 15 to 35 °C	0.03% typ, 0.04% max
Gain error at -40 to 70 °C	
Unipolar input ranges	0.11% typ, 0.16% max
Bipolar input ranges	0.13% typ, 0.19% max

Voltage Input Range	Offset Errors at 15 to 35 °C	Offset Errors at -40 to 70 °C
0–5 V	4 mV typ, 9 mV max	6 mV typ, 15 mV max
0–10 V	6 mV typ, 14 mV max	8 mV typ, 20 mV max
0–15 V	8 mV typ, 18 mV max	10 mV typ, 24 mV max
0–30 V	13 mV typ, 32 mV max	15 mV typ, 37 mV max
±5 V	6 mV typ, 14 mV max	8 mV typ, 20 mV max
±10 V	10 mV typ, 23 mV max	12 mV typ, 29 mV max
±15 V	14 mV typ, 32 mV max	16 mV typ, 38 mV max
±30 V	25 mV typ, 59 mV max	28 mV typ, 64 mV max

Current Inputs

Effective resolution 11.3 bits

Input impedance 105 Ω

Overcurrent protection ±100 mA

Overvoltage protection ±10 V

Signal input bandwidth (-3 dB) 350 Hz

The FieldPoint software shows these ranges with 20% overranging.

Current Input Range	Gain Errors at 15 to 30 °C	Gain Errors at -40 to 70 °C
0–20 mA	0.04% typ, 0.07% max	0.19% typ, 0.29% max
4–20 mA	0.04% typ, 0.07% max	0.19% typ, 0.29% max
±20 mA	0.05% typ, 0.07% max	0.21% typ, 0.32% max

Current Input Range	Offset Errors at 15 to 30 °C	Offset Errors at -40 to 70 °C
0–20 mA	9 μA typ, 20 μA max	9 μA typ, 20 μA max
4–20 mA	9 μA typ, 20 μA max	9 μA typ, 20 μA max
±20 mA	17 μA typ, 38 μA max	17 μA typ, 38 μA max

Current Outputs

Output range	0–20 or 4–20 mA, programmable (0–21 or 3.5–21 mA with overranging)
Type	Current source, external power required
External power supply	10–30 VDC, 125 mA for 4 output channels
Internal voltage drop.....	3 V
Resistive load.....	Up to 1 k Ω with 24 V power supply ¹
Protection.....	Short-circuit and open-circuit
Default power-up state.....	0 mA
Gain error at 15 to 35 °C	0.02% max
Gain error at –40 to 70 °C	0.12% max
Offset error at 15 to 35 °C	26 μ A max
Offset error at –40 to 70 °C	41 μ A max

Dynamic Characteristics

Hardware update rate	1,700 updates/s
Slew rate	0.4 mA/ μ s

Physical Characteristics

Indicators	Green POWER and READY indicators, and 4 red output indicators
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Weight

FP-AIO-600.....	141 g (4.9 oz)
cFP-AIO-600.....	111 g (3.9 oz)

Power Requirements

Power from network module	600 mW
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¹ *Maximum load resistance = (Supply voltage – Internal voltage drop)/0.021 A*

Isolation Voltage

Channel-to-channel isolation	No isolation between channels
Transient overvoltage.....	2,300 V _{rms}

Environmental

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

Operating temperature	-40 to 70 °C
Storage temperature	-55 to 85 °C
Humidity	10 to 90% RH, noncondensing
Maximum altitude.....	2,000 m; at higher altitudes the isolation voltage ratings must be lowered
Pollution Degree	2

Shock and Vibration

These specifications apply only to the cFP-AIO-600.

NI recommends Compact FieldPoint if your application is subject to 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
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 3121-1, UL 61010C-1
- CAN/CSA C22.2 No. 1010.1



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

Electromagnetic Compatibility

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

Emissions.....	EN 55011 Class A at 10 m FCC Part 15A above 1 GHz
Immunity.....	EN 61326:1997 + A2:2001, Table 1



Note For EMC compliance, you *must* 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/hardref.nsf, search by model number or product line, and click the appropriate link in the Certification column.

Mechanical Dimensions

Figure 11 shows the mechanical dimensions of the FP-AIO-600 installed on a terminal base. If you are using the cFP-AIO-600, refer to your Compact FieldPoint controller user manual for the dimensions and cabling clearance requirements of the Compact FieldPoint system.

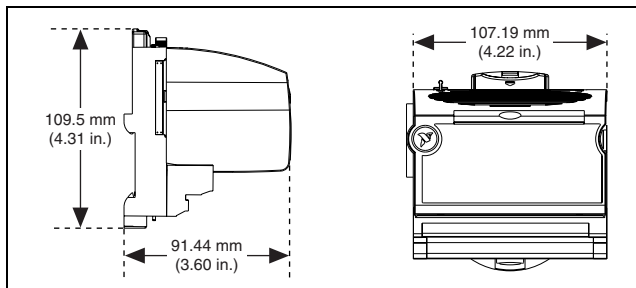


Figure 11. FP-AIO-600 Mechanical Dimensions

Where to Go for Support

For more information about setting up the FieldPoint system, refer to these National Instruments documents:

- FieldPoint network module user manual
- Other FieldPoint I/O module operating instructions
- FieldPoint terminal base and connector block operating instructions

Go to ni.com/support for the most current manuals, examples, and troubleshooting information.

For telephone support in the United States, create your service request at ni.com/ask and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

Australia 1800 300 800, Austria 43 0 662 45 79 90 0,
Belgium 32 0 2 757 00 20, Brazil 55 11 3262 3599,
Canada (Calgary) 403 274 9391,
Canada (Montreal) 514 288 5722,
Canada (Ottawa) 613 233 5949, Canada (Québec) 514 694 8521,
Canada (Toronto) 905 785 0085,
Canada (Vancouver) 514 685 7530, China 86 21 6555 7838,

Czech Republic 420 2 2423 5774, Denmark 45 45 76 26 00,
Finland 385 0 9 725 725 11, France 33 0 1 48 14 24 24,
Germany 49 0 89 741 31 30, Greece 30 2 10 42 96 427,
India 91 80 51190000, Israel 972 0 3 6393737,
Italy 39 02 413091, Japan 81 3 5472 2970,
Korea 82 02 3451 3400, Malaysia 603 9131 0918,
Mexico 001 800 010 0793, Netherlands 31 0 348 433 466,
New Zealand 0800 553 322, Norway 47 0 66 90 76 60,
Poland 48 0 22 3390 150, Portugal 351 210 311 210,
Russia 7 095 783 68 51, Singapore 65 6226 5886,
Slovenia 386 3 425 4200, South Africa 27 0 11 805 8197,
Spain 34 91 640 0085, Sweden 46 0 8 587 895 00,
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