

# FieldPoint™ Operating Instructions

## FP-AIO-610 and cFP-AIO-610

### 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-610 and cFP-AIO-610 (referred to inclusively as the [c]FP-AIO-610). For more information about configuring and accessing the [c]FP-AIO-610 over a network, refer to the user manual for the FieldPoint network module you are using.

## Features

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The [c]FP-AIO-610 is a FieldPoint analog input and output module with the following features:

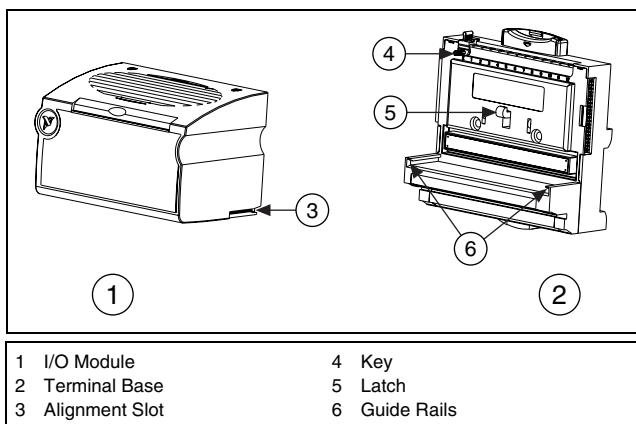
- Four analog voltage or current input channels with 11 input ranges up to  $\pm 30$  V or  $\pm 20$  mA ( $\pm 36$  V or  $\pm 24$  mA with 20% overranging)
- Four analog voltage output channels with  $\pm 10$  or 0–10 V ranges ( $\pm 10.2$  or 0–10.2 V with 2% overranging)
- 1.4 kHz hardware update rate
- 12-bit resolution
- –40 to 70 °C operation
- Voltage outputs sink or source up to 10 mA per channel
- Onboard diagnostics including one out-of-range indicator for all inputs and one overcurrent indicator for each output
- Current inputs protected up to  $\pm 10$  V
- Voltage outputs short-circuit protected up to  $\pm 30$  V
- Hot swappable
- 2,300 V<sub>rms</sub> transient overvoltage protection
- 250 V<sub>rms</sub> isolation voltage rating

# Installing the FP-AIO-610

The FP-AIO-610 mounts on a FieldPoint terminal base (FP-TB-*x*), which provides operating power to the module. Installing the FP-AIO-610 onto a powered terminal base does not disrupt the operation of the bank.

To install the FP-AIO-610, refer to Figure 1 and complete the following steps:

1. Slide the terminal base key to position X.
2. Align the FP-AIO-610 alignment slots with the guide rails on the terminal base.
3. Press firmly to seat the FP-AIO-610 on the terminal base. When the module is firmly seated, the terminal base latch locks it into place.



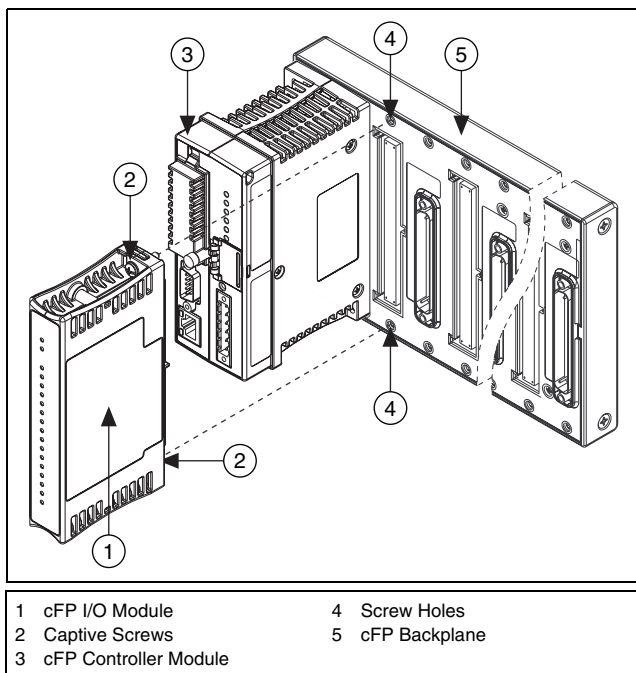
**Figure 1.** Installing the FP-AIO-610

# Installing the cFP-AIO-610

The cFP-AIO-610 mounts on a Compact FieldPoint backplane (cFP-BP-*x*), which provides operating power to the module. Installing the cFP-AIO-610 onto a powered backplane does not disrupt the operation of the bank.

To install the cFP-AIO-610, refer to Figure 2 and complete the following steps:

1. Align the captive screws on the cFP-AIO-610 with the holes on the backplane. The alignment keys on the cFP-AIO-610 prevent backward insertion.
2. Press firmly to seat the cFP-AIO-610 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.



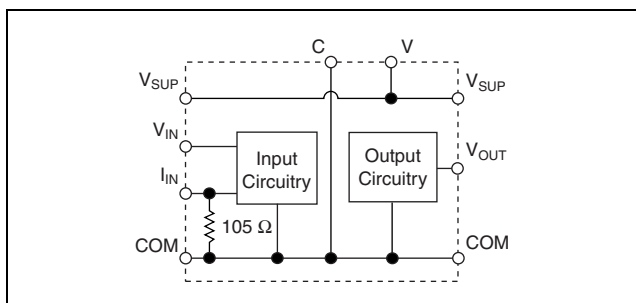
**Figure 2.** Installing the cFP-AIO-610

# Wiring the [c]FP-AIO-610

The FP-TB- $x$  terminal base has connections for each input channel and each output channel, and for an external power supply to power 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,  $V_{OUT}$ . 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.

You can use an external power supply to power field devices. Connect the positive lead of the external power supply to both V terminals and the negative lead to both C terminals. Ensure that the current through both V terminals can never exceed 2 A.

Install 2 A maximum, fast-acting fuses between the external power supply and the V terminals. The 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

<sup>1</sup> Install a 63 mA maximum fast-acting fuse on each connected  $I_{IN}$  terminal.

<sup>2</sup> Install a 125 mA maximum fast-acting fuse on each connected  $V_{SUP}$  terminal.

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

**Table 2.** Output Terminal Assignments

Channel	Outputs		
	$V_{OUT}$	$V_{SUP}^1$	COM
Out 0	9	25	10, 26
Out 1	11	27	12, 28
Out 2	13	29	14, 30
Out 3	15	31	16, 32

<sup>1</sup> Install a 125 mA maximum fast-acting fuse on each connected  $V_{SUP}$  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.

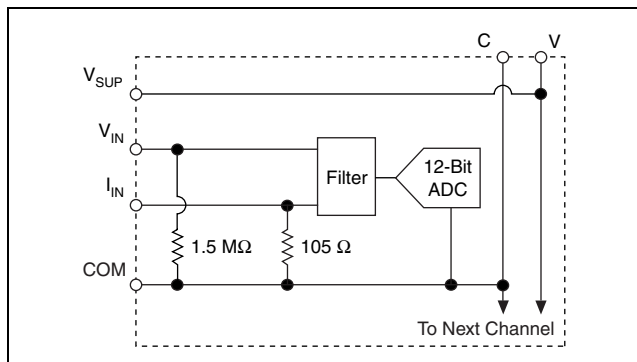
## Connecting Signals to the [c]FP-AIO-610

The [c]FP-AIO-610 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-610 are *not* electrically isolated from each other.

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

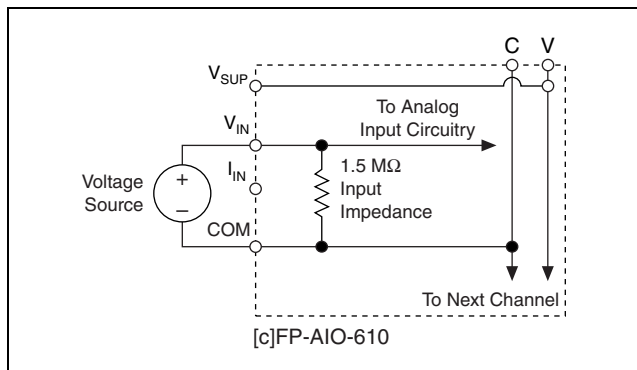


**Figure 4.** Input Circuitry on One Channel of the [c]FP-AIO-610

## Voltage Inputs

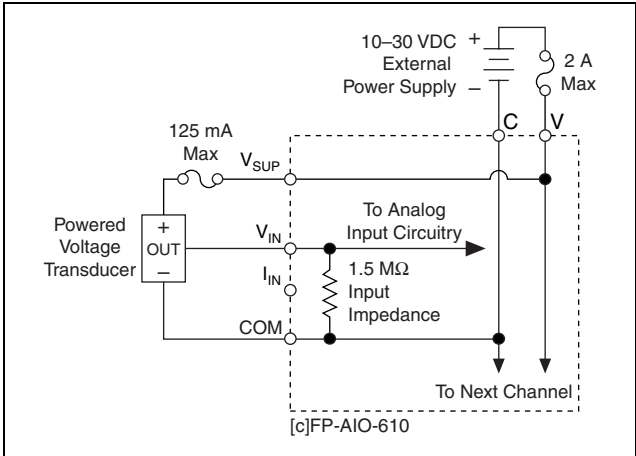
The input ranges for voltage signals are  $\pm 5$ ,  $\pm 10$ ,  $\pm 15$ ,  $\pm 30$ , 0–5, 0–10, 0–15, and 0–30 V. FieldPoint software accounts for the 20% overranging feature and shows the ranges accordingly.

Figure 5 shows how to connect a voltage source without an external power supply to one input channel of the [c]FP-AIO-610.



**Figure 5.** Voltage Input without an External Power Supply

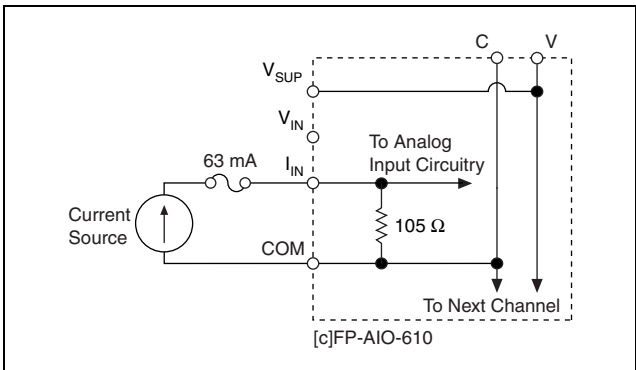
Figure 6 shows how to connect a voltage source with an external power supply to one input channel of the [c]FP-AIO-610.



**Figure 6.** Voltage Input with an External Power Supply

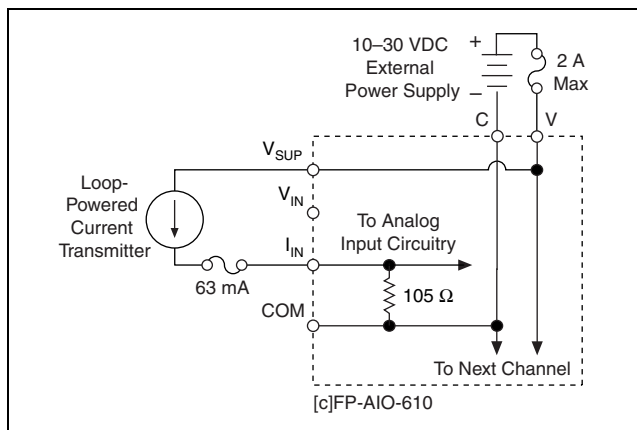
## Current Inputs

The input ranges for current sources are  $\pm 20$ ,  $0-20$ , 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-610.



**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-610.



**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-610 has an overranging feature that measures 20% beyond the nominal values of each range. For example, the actual measurement limit of the  $\pm 5$  V range is  $\pm 6.0$  V. The overranging feature enables the [c]FP-AIO-610 to compensate for field devices with span errors of up to 20% of full scale. Also, the overranging feature helps prevent errors caused by clipping.

## Connecting the [c]FP-AIO-610 to a Load

The [c]FP-AIO-610 has four single-ended voltage output channels that *source* or *sink* up to 10 mA. Sourcing current means that current flows out of the  $V_{OUT}$  terminal into the load. Sinking current means that current flows out of the load into the  $V_{OUT}$  terminal. 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.





## Short-Circuit Protection

Each  $V_{OUT}$  terminal of the [c]FP-AIO-610 is protected against short circuits. One or more output channels can be short-circuited indefinitely without causing damage or improper operation to the channel, as long as the potential to which each channel is shorted does not exceed  $\pm 30$  V.

## Status Indicators

Figure 10 shows the [c]FP-AIO-610 status indicators.



**Figure 10.** Status Indicators

The [c]FP-AIO-610 has two green status LEDs, **POWER** and **READY**. After you install the [c]FP-AIO-610 onto a terminal base or backplane and apply power to the connected network module, the green **POWER** indicator lights and the [c]FP-AIO-610 informs the network module of its presence. When the network module recognizes the [c]FP-AIO-610, it sends initial configuration information to the [c]FP-AIO-610. After the [c]FP-AIO-610 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, the [c]FP-AIO-610 has one **Out of range** indicator for all input channels and one red, numbered error status indicator to indicate current limiting for each output channel. For more information, refer to the [Current Limiting](#) 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](http://ni.com/info) and enter `fpmatrix`.

# Isolation and Safety Guidelines


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**Caution** Read the following information before attempting to connect the [c]FP-AIO-610 to any circuits that may contain hazardous voltages.

This section describes the isolation of the [c]FP-AIO-610 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<sub>rms</sub>.

Follow these guidelines to ensure a safe total system:

- The [c]FP-AIO-610 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-610 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. Specifications are subject to change without notice.

### 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 .....	Resistor string
Hardware update rate (all 8 channels).....	1.4 kHz (714 $\mu$ s)

### Voltage Inputs

Effective resolution.....	11.3 bits
Input impedance.....	1.5 M $\Omega$
Signal input bandwidth ( $-3$ dB).....	350 Hz

Voltage Input Range	Accuracy at 15 to 35 °C (% of Reading; % of Full Scale)	Accuracy at $-40$ to 70 °C (% of Reading; % of Full Scale)
0–5 V	$\pm 0.04\%$ ; $\pm 0.15\%$	$\pm 0.15\%$ ; $\pm 0.25\%$
0–10 V	$\pm 0.04\%$ ; $\pm 0.12\%$	$\pm 0.15\%$ ; $\pm 0.17\%$
0–15 V	$\pm 0.04\%$ ; $\pm 0.1\%$	$\pm 0.15\%$ ; $\pm 0.14\%$
0–30 V	$\pm 0.04\%$ ; $\pm 0.1\%$	$\pm 0.15\%$ ; $\pm 0.11\%$
$\pm 5$ V	$\pm 0.04\%$ ; $\pm 0.12\%$	$\pm 0.2\%$ ; $\pm 0.17\%$
$\pm 10$ V	$\pm 0.04\%$ ; $\pm 0.1\%$	$\pm 0.2\%$ ; $\pm 0.12\%$

<b>Voltage Input Range</b>	<b>Accuracy at 15 to 35 °C (% of Reading; % of Full Scale)</b>	<b>Accuracy at -40 to 70 °C (% of Reading; % of Full Scale)</b>
±15 V	±0.04%; ±0.09%	±0.2%; ±0.11%
±30 V	±0.04%; ±0.08%	±0.2%; ±0.09%

## 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.

<b>Current Input Range</b>	<b>Accuracy at 15 to 35 °C (% of Reading; % of Full Scale)</b>	<b>Accuracy at -40 to 70 °C (% of Reading; % of Full Scale)</b>
0–20 mA	±0.07%; ±0.09%	±0.3%; ±0.09%
4–20 mA	±0.07%; ±0.09%	±0.3%; ±0.09%
±20 mA	±0.07%; ±0.08%	±0.32%; ±0.08%

## Voltage Outputs

Output range ..... ±10 or 0–10 V,  
programmable  
(±10.2 or 0–10.2 V  
with overranging)

Type ..... Voltage source, no external  
power required

Output current..... ±10 mA with 20% tolerance

Protection..... Short-circuit up to ±30 V and  
current limiting to ±10 mA

Default power-up state..... 0 V

Voltage Output Range	Accuracy at 15 to 35 °C (% of Reading; % of Full Scale)	Accuracy at -40 to 70 °C (% of Reading; % of Full Scale)
0–10 V	±0.04%; ±0.05%	±0.15%; ±0.25%
±10 V	±0.04%; ±0.03%	±0.15%; ±0.15%

Slew rate ..... 2 V/μs min, 4 V/μs typ  
 Settling time to within  
 0.001% of new output value ..... 15 μs typ with 2 kΩ load  
 Linearity error ..... ±3 LSB peak to peak

## Physical Characteristics

Indicators ..... Green **POWER** and **READY** indicators, 1 **Out of range** input indicator, and 4 red output indicators

### Weight

FP-AIO-610 ..... 147 g (5.19 oz)  
 cFP-AIO-610 ..... 115 g (4.06 oz)

## Power Requirements

### Power from network module

No or high-impedance load ..... 600 mW  
 All channels sourcing or  
 sinking maximum current ..... 1.5 W

## Isolation Voltage

Isolation voltage rating ..... 250 V<sub>rms</sub>, Installation Category II  
 Channel-to-channel isolation ..... No isolation between channels  
 Transient overvoltage ..... 2,300 V<sub>rms</sub>

## 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-610. 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 <sub>rms</sub>
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](http://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

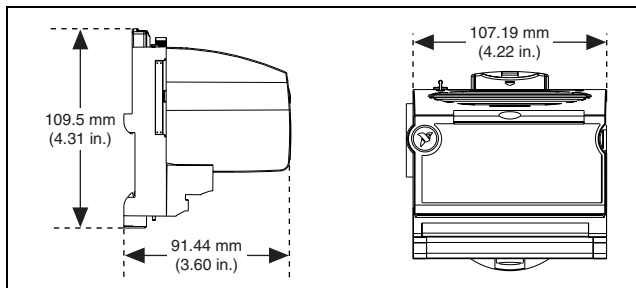


**Note** Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit [ni.com/hardref.nsf](http://ni.com/hardref.nsf), search by model number or product line, and click the appropriate link in the Certification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



## Mechanical Dimensions

Figure 11 shows the mechanical dimensions of the FP-AIO-610 installed on a terminal base. If you are using the cFP-AIO-610, refer to your Compact FieldPoint controller user manual for the dimensions and cabling clearance requirements of the Compact FieldPoint system.



**Figure 11.** FP-AIO-610 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](http://ni.com/support) for the most current manuals, examples, and troubleshooting information.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your service request at [ni.com/support](http://ni.com/support) 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 (Ottawa) 613 233 5949,  
Canada (Québec) 450 510 3055, Canada (Toronto) 905 785 0085,

Canada (Vancouver) 514 685 7530, China 86 21 6555 7838,  
Czech Republic 420 224 235 774, 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 22 3390150, 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,  
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