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Find the *National Instruments cFP-AI-118* at our website: ***Click HERE***

FIELDPOINT™ OPERATING INSTRUCTIONS

cFP-AI-118

8-Channel, 16-Bit Analog Input Module

日本語　한국어

ni.com/manuals

These operating instructions describe how to install and use the cFP-AI-118 analog input module. For information about configuring and accessing the cFP-AI-118 over a network, refer to the user manual for the FieldPoint network module you are using.

Features

The cFP-AI-118 is a FieldPoint analog input module with the following features:

- Eight differential analog voltage input channels
- Eight voltage input ranges: 0–1 V, 0–5 V, 0–10 V, 0–15 V, ±1 V, ±5 V, ±10 V, and ±15 V
- 16-bit resolution
- Simultaneous sampling on all channels
- 10 Hz digital sinc filter configurable per channel
- 750 V_{rms} channel-to-channel isolation, verified by 5 s dielectric withstand test
- 250 V_{rms} CAT II continuous channel-to-ground isolation, verified by 2,300 V_{rms}, 5 s dielectric withstand test
- –40 °C to 70 °C operation
- Hot-swappable

Installing the cFP-AI-118

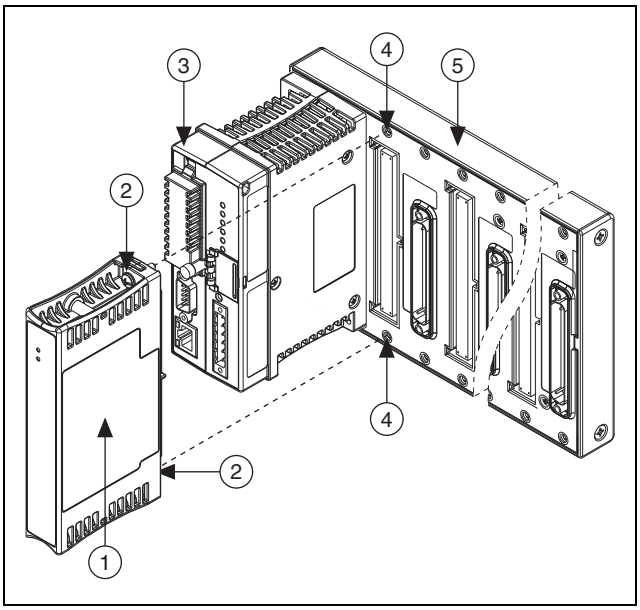
The cFP-AI-118 mounts on a Compact FieldPoint backplane (cFP-BP-*x*), which provides operating power to the module. Installing the cFP-AI-118 onto a powered backplane does not disrupt the operation of the FieldPoint bank.

NATIONAL INSTRUMENTS

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To install the cFP-AI-118, refer to Figure 1 and complete the following steps:

1. Align the captive screws on the cFP-AI-118 with the holes on the backplane. The alignment keys on the cFP-AI-118 prevent backward insertion.
2. Press firmly to seat the cFP-AI-118 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-AI-118	4	Screw Holes
2	Captive Screws	5	cFP Backplane
3	cFP Controller Module		

Figure 1. Installing the cFP-AI-118

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Wiring the cFP-AI-118

The cFP-CB-1 has connections for each of the eight input channels. Each channel has two input terminals, V+ and V–.

Table 1 lists the terminal assignments for each channel.

Table 1. Terminal Assignments

Channel	Terminal Numbers	
	V+	V–
0	1	18
1	3	20
2	5	22
3	7	24
4	9	26
5	11	28
6	13	30
7	15	32

NI does not recommend using the V and C terminals with the cFP-AI-118.

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.

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Measuring Voltage with the cFP-AI-118

Figure 2 shows how to connect a voltage source to one channel of the cFP-AI-118.

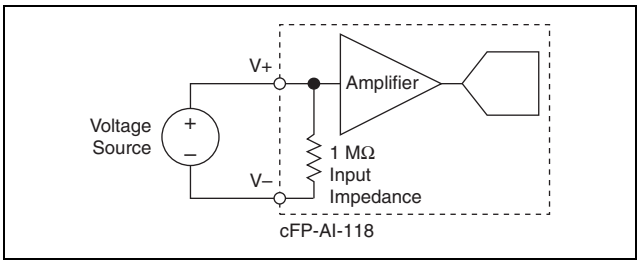
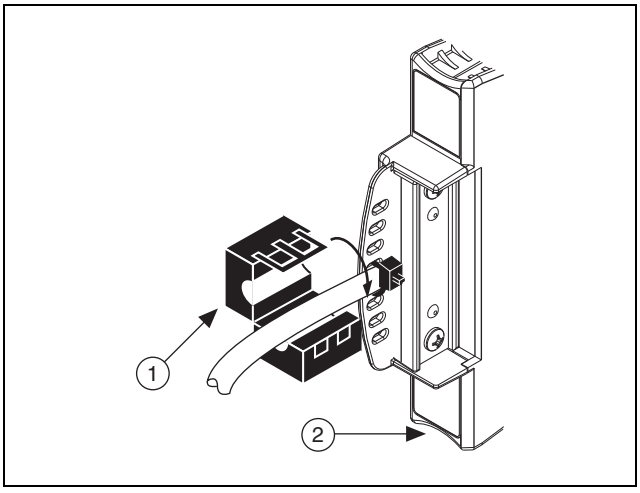


Figure 2. Voltage Source without External Power Supply

Installing the Ferrite on Signal Wires

In order to suppress radiated emissions from the Compact FieldPoint system, you must install the ferrite shipped with the cFP-AI-118. Install the ferrite 2–3 in. from the ends of the I/O signal wires, as shown in Figure 3.

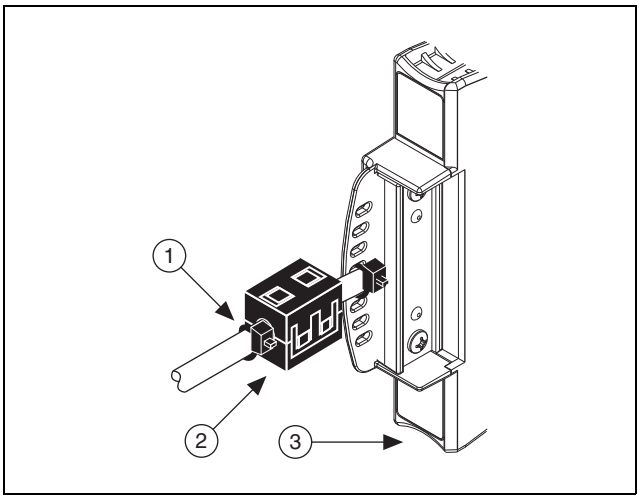


1	Ferrite	2	cFP-CB-*x* Connector Block

Figure 3. Installing the Ferrite on Signal Wires

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Install a tie wrap or other device to secure the ferrite in place, as shown in Figure 4.



1 Ferrite 2 Tie Wrap 3 cFP-CB-*x* Connector Block

Figure 4. Ferrite Installed on Signal Wires and Secured with Tie Wrap

Note Figures 3 and 4 show signal wires connected to a cFP-CB-*x* connector block, but the ferrite is required with any connection method.

Input Ranges

The input ranges for voltage signals are 0–1 V, 0–5 V, 0–10 V, 0–15 V, ±1 V, ±5 V, ±10 V, and ±15 V. FieldPoint software shows these input ranges with overranging. To prevent inaccurate readings, choose an input range such that the signal you are measuring does not exceed either end of the range.

Measurements on a channel may be invalid for up to two update periods after you change the input range.

Overranging

The cFP-AI-118 has an overranging feature that measures 5% beyond the nominal values of each range. For example, the actual measurement limit of the ±15 V range is ±15.75 V. The

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overranging feature enables the cFP-AI-118 to compensate for field devices with span errors of up to +5% of full scale. Also, the overranging feature helps prevent errors caused by clipping.

Filter Settings

The cFP-AI-118 has a 10 Hz digital sinc filter that provides 55 dB of rejection at every multiple of 10 Hz ±0.01%. You can configure each channel separately in software for 10 Hz filtering or no rejection. The filter can greatly reduce 50/60 Hz noise from nearby AC power lines.

Update Rate

The all-channel update rate of the cFP-AI-118 is 10.42 kHz with no filtering. If you enable filtering on any channel, the all-channel update rate is 3.45 kHz.

Status Indicators

The cFP-AI-118 has two green status LEDs, **POWER** and **READY**. After you insert the cFP-AI-118 into a backplane and apply power to the connected network module, the green **POWER** indicator lights up and the cFP-AI-118 informs the network module of its presence. When the network module recognizes the cFP-AI-118, it sends initial configuration information to the cFP-AI-118. After the cFP-AI-118 receives this initial information, the green **READY** indicator lights up and the module is in normal operating mode.

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 about determining which firmware you need and how to upgrade your firmware, go to `ni.com/info` and enter `fpmatrix`.

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Isolation and Safety Guidelines

Caution Read the following information before attempting to connect the cFP-AI-118 to any circuits that may contain *hazardous voltages*.[1]

This section describes the isolation of the cFP-AI-118 and its compliance with international safety standards. The field wiring connections are isolated from the backplane and the inter-module communication bus. The isolation barriers in the module provide 250 V_{rms} Measurement Category II continuous isolation, verified by 2,300 V_{rms}, 5 s dielectric withstand test. The cFP-AI-118 provides *double insulation* (compliant with IEC 61010-1) for working voltages of 250 V_{rms}[2]. Safety standards (such as those published by UL and IEC) require the use of double insulation between hazardous voltages and any human-accessible parts or circuits.

Never try to use any isolation product between human-accessible parts (such as DIN rails or monitoring stations) and circuits that can be at hazardous potentials under normal conditions, unless the product is specifically designed for such an application, as is the cFP-AI-118.

Even though the cFP-AI-118 is designed to handle applications with hazardous potentials, follow these guidelines to ensure a safe total system:

- 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.
- 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.

[1] A hazardous voltage is a voltage greater than 42.4 V_{peak} or 60 VDC.

[2] *Working voltage* is defined as the signal voltage plus the common-mode voltage. *Common-mode voltage* is the voltage of the module with respect to ground.

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- The cFP-AI-118 is a UL Recognized component. The entire Compact FieldPoint system must be installed in a UL Listed, suitably rated NEMA or IP enclosure for safe use.

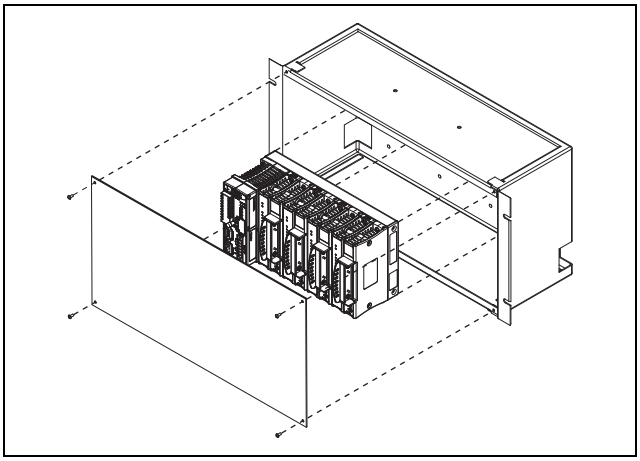


Figure 5. Installing the Compact FieldPoint System in an Enclosure

- 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.
- Do *not* use the cFP-AI-118 as the only isolating barrier between human contact and working voltages higher than 250 V_{rms}.
- Operate the cFP-AI-118 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.
- Do *not* operate FieldPoint products in an explosive atmosphere or where there may be flammable gases or fumes. If you need to operate FieldPoint products in such an environment, the FieldPoint products *must* be in a suitably rated enclosure.
- Operate the cFP-AI-118 at or below Measurement Category II. Measurement Category II is for measurements performed on circuits directly connected to the low-voltage installation. This category refers to local-level distribution, such as that provided by a standard wall outlet.

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Specifications

The following specifications are typical for the –40 °C to 70 °C temperature range, and for operation with the 10 Hz filter enabled, unless otherwise noted.

Input Characteristics

Number of channels ..... 8 differential

Maximum signal input range ..... ±15 V (±15.75 V with overranging)

Maximum voltage (V+ or V– to earth)[1,2] ..... 250 V_{rms}, Measurement Category II

ADC resolution ..... 16 bits (refer to table)

Type of ADC ..... Delta-sigma

Effective resolution by input range and filter setting

Nominal Input Range	With Overranging	Effective Resolution* (No Filtering)	Effective Resolution* with 10 Hz Filter
±1 V	±1.05 V	100 µV	32 µV
±5 V	±5.25 V	160 µV	160 µV
±10 V	±10.5 V	320 µV	320 µV
±15 V	±15.75 V	480 µV	480 µV
0–1 V	0–1.05 V	100 µV	16 µV
0–5 V	0–5.25 V	100 µV	80 µV
0–10 V	0–10.5 V	160 µV	160 µV
0–15 V	0–15.75 V	240 µV	240 µV

*Includes quantization errors and typical rms noise.

[1] The maximum voltage that can be applied continuously between any terminal and earth without creating a safety hazard.

[2] When a hazardous voltage (>42.4 V_{peak} or 60 VDC) is present on any channel, all of the channels must be considered to be carrying hazardous voltages. Ensure that all circuits connected to the module are inaccessible to human touch.

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All-channel update rate

With 10 Hz filter ..... 3.45 kHz

Without filtering ..... 10.42 kHz

Input bandwidth (–3 dB) ..... 3 kHz minimum

Common-mode rejection at 60 Hz, with 50 Ω source impedance and no filtering

Channel-to-channel ..... 100 dB

Channel-to-ground ..... 100 dB

Crosstalk attenuation ..... >100 dB

RMS noise ..... 100 µV

Peak-to-peak noise ..... 700 µV

Settling time[1] to 1 LSB

Full-scale step (–15 V to 15 V) ..... 2.1 ms

1% step ..... 1.6 ms

Semaphore acquisition jitter ..... None

Monotonicity[2] ..... Warranted over the operating temperature range

Input resistance ..... 1 MΩ

Input capacitance ..... <50 pF

Overvoltage protection ..... ±250 V

Accuracy by input range and temperature range

Nominal Input Range	Typical Accuracy at 15 °C to 35 °C (% of Reading; % of Full Scale)	Warranted Accuracy at 15 °C to 35 °C (% of Reading; % of Full Scale)
±1 V	±0.037%; ±0.0130%	±0.086%; ±0.0640%
±5 V	±0.037%; ±0.0050%	±0.066%; ±0.0152%
±10 V	±0.037%; ±0.0040%	±0.064%; ±0.0091%
±15 V	±0.037%; ±0.0037%	±0.063%; ±0.0071%

[1] In this document, *settling time* denotes the time it takes for a change in signal level to be available to the Compact FieldPoint controller.

[2] A characteristic of an ADC in which the digital code output always increases as the value of the analog input to it increases.

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Nominal Input Range	Typical Accuracy at 15 °C to 35 °C (% of Reading; % of Full Scale)	Warranted Accuracy at 15 °C to 35 °C (% of Reading; % of Full Scale)
0–1 V	±0.037%; ±0.0115%	±0.111%; ±0.0624%
0–5 V	±0.037%; ±0.0035%	±0.071%; ±0.0137%
0–10 V	±0.037%; ±0.0025%	±0.066%; ±0.0076%
0–15 V	±0.037%; ±0.0022%	±0.065%; ±0.0056%

Input Range with Overranging	Typical Accuracy at –40 °C to 70 °C (% of Reading; % of Full Scale)	Warranted Accuracy at –40 °C to 70 °C (% of Reading; % of Full Scale)
±1.05 V	±0.081%; ±0.0345%	±0.168%; ±0.1437%
±5.25 V	±0.081%; ±0.0093%	±0.148%; ±0.0312%
±10.5 V	±0.081%; ±0.0062%	±0.145%; ±0.0171%
±15.75 V	±0.081%; ±0.0051%	±0.144%; ±0.0124%
0–1.05 V	±0.081%; ±0.0329%	±0.193%; ±0.1422%
0–5.25 V	±0.081%; ±0.0078%	±0.153%; ±0.0297%
0–10.5 V	±0.081%; ±0.0047%	±0.148%; ±0.0156%
0–15.75 V	±0.081%; ±0.0036%	±0.146%; ±0.0109%

Note Full scale is the maximum value of the nominal input range.

Gain error drift ..... 7.4 ppm/°C

Offset error drift ..... 3 µV/°C

Physical Characteristics

Indicators ..... Green **POWER** and **READY** indicators

Weight ..... 117 g (4.1 oz)

Warm-up time ..... 30 minutes

Power Requirements

Power from network module ..... 1.125 W

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Isolation Voltage

Isolation voltage is verified by a 5 s dielectric withstand test.

Channel-to-channel ..... 750 V_{rms}[1]

Channel-to-backplane ..... 2,300 V_{rms}

Channel-to-ground ..... 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 °C to 70 °C

Storage temperature ..... –40 °C 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

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 meets 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, CSA 61010-1

[1] When a hazardous voltage is present on a channel, all of the channels must be considered to have a hazardous voltage. Ensure that all circuits connected to the module are inaccessible to human touch.

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Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Industrial immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Caution When operating this product, use shielded cables and accessories.

Note For EMC declarations and certifications, refer to the *Online Product Certification* section.

CE Compliance CE

This product meets the essential requirements of applicable European Directives as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

To obtain product certifications and the Declaration of Conformity (DoC) for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

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NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

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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.

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