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Find the *National Instruments cFP-AO-200* at our website: *Click HERE*

FP-AO-200 AND cFP-AO-200

Eight-Channel 20 mA Loop Output Modules

These operating instructions describe how to install and use the National Instruments FP-AO-200 and cFP-AO-200 analog output modules (referred to inclusively as the [c]FP-AO-200). For information about configuring and accessing the [c]FP-AO-200 over a network, refer to the user manual for the FieldPoint network module you are using.

Features

The [c]FP-AO-200 is a FieldPoint analog output module with the following features:

- Eight 0–20 or 4–20 mA outputs
- 0.5 mA overranging
- 12-bit resolution
- Up to 1 kΩ load impedance (with 24 V loop supply)
- Indicators for open current loops
- Short-circuit protection
- 2,300 V_{rms} transient overvoltage protection between the inter-module communication bus and the I/O channels
- –40 to 70 °C operation
- Hot plug-and-play

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NATIONAL INSTRUMENTS™

Installing the FP-AO-200

The FP-AO-200 mounts on a FieldPoint terminal base (FP-TB-*x*). Hot plug-and-play enables you to install the FP-AO-200 onto a powered terminal base without disturbing the operation of other modules or terminal bases. The FP-AO-200 receives operating power from the terminal base. Current loop power is externally supplied.

To install the FP-AO-200, refer to Figure 1 and complete the following steps:

1. Slide the terminal base key to either position X (used for any module) or position 2 (used for the FP-AO-200 module).
2. Align the FP-AO-200 alignment slots with the guide rails on the terminal base.
3. Press firmly to seat the FP-AO-200 in the terminal base. The terminal base latch locks the FP-AO-200 into place when it is firmly seated.
4. Connect a current loop supply for the outputs to the V and C terminals of the terminal base.

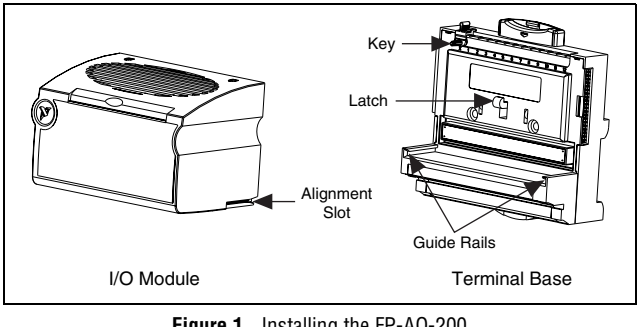


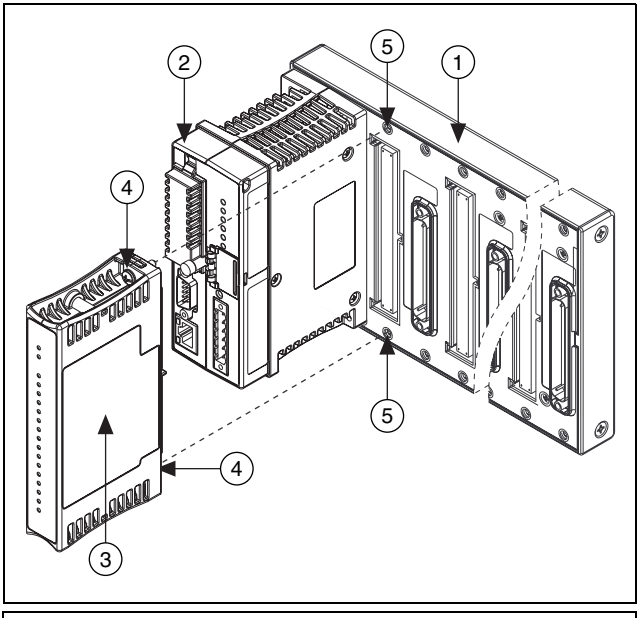
Figure 1. Installing the FP-AO-200

Installing the cFP-AO-200

The cFP-AO-200 mounts on a Compact FieldPoint backplane (cFP-BP-*x*). Hot plug-and-play enables you to install the cFP-AO-200 onto a powered backplane without disturbing the operation of other modules or connector blocks. The cFP-AO-200 receives operating power from the backplane.

To install the cFP-AO-200, refer to Figure 2 and complete the following steps:

1. Align the captive screws on the cFP-AO-200 with the holes on the backplane. The alignment keys on the cFP-AO-200 prevent backward insertion.
2. Press firmly to seat the cFP-AO-200 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 Backplane	3	cFP-AO-200	5	Screw Holes
2	cFP Controller Module	4	Captive Screws		

Figure 2. Installing the cFP-AO-200

Wiring the [c]FP-AO-200

The FP-TB-*x* terminal base provides connections for the eight output channels of the FP-AO-200. The cFP-CB-*x* connector block provides the same connections for the cFP-AO-200.

Table 1 lists the terminal assignments for the signals associated with each channel.

Table 1. Terminal Assignments

Channel	Terminal Numbers		
	I_{out}	COM	V_{sup}
0	1	2, 18	17
1	3	4, 20	19
2	5	6, 22	21
3	7	8, 24	23
4	9	10, 26	25
5	11	12, 28	27
6	13	14, 30	29
7	15	16, 32	31

Each channel has an output terminal, I_{out}; a common terminal, COM; and a supply terminal, V_{sup}. The COM terminals of all the channels are connected internally to each other and to the C terminals, and the V_{sup} terminals are all connected to each other and to the V terminals. Refer to the sections that follow for detailed wiring instructions.

Sourcing Current to a Load

The [c]FP-AO-200 sources current from an external loop supply to a load. The [c]FP-AO-200 can operate with an external loop supply from 5 to 24 VDC. The voltage from the external supply determines the maximum load impedance that the [c]FP-AO-200 can drive. With a 24 VDC loop supply, each output can drive up to 1 kΩ of load impedance. With a 5 VDC loop supply, each output can only drive up to 100 Ω. The [c]FP-AO-200 detects and reports error conditions due to excessive loads or insufficient loop supplies. For more information, refer to the *Open-Loop Detection* section.

The [c]FP-AO-200 updates the output channels as new values are sent to it by the network module. The time it takes to respond to a change on a single channel is between 3 and 6 ms. The response time to changes on all eight channels is 24 to 27 ms.

Figure 3 shows the current output circuit of a single channel.

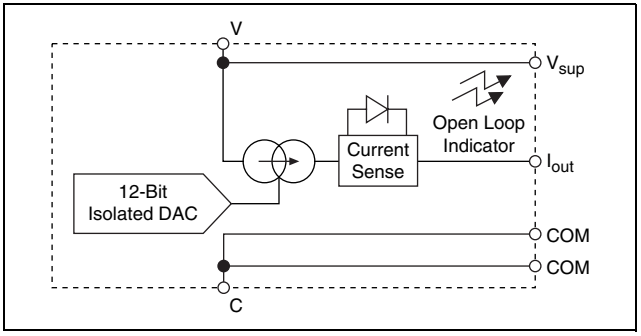


Figure 3. [c]FP-A0-200 Current Output Circuit

Figure 4 shows how to connect loads to two channels of the [c]FP-AO-200.

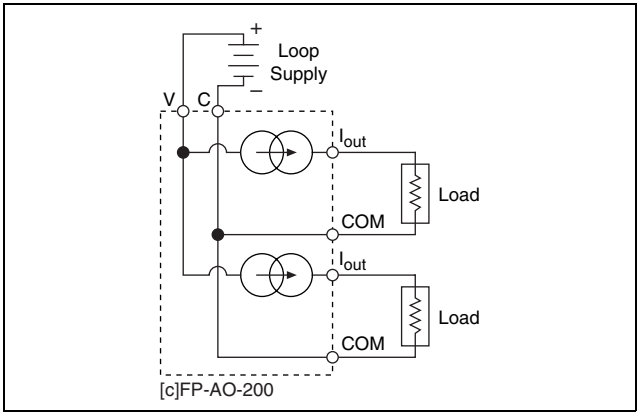


Figure 4. Connecting to Two Channels

Using an external COM connection may be more convenient in your application than using the COM and C terminals on the terminal base or connector block. Figure 5 shows how to connect to two channels using an external COM connection.

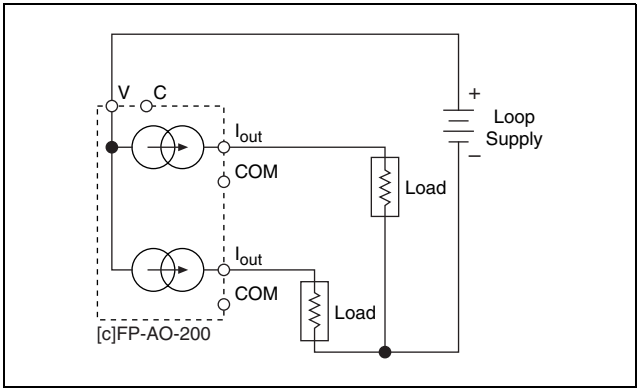


Figure 5. Connecting to Two Channels Using an External COM Connection

Output Ranges

You can configure each channel independently for an output range of either 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-AO-200 has overranging of 0.5 mA in each of these ranges, so that the actual full-scale ranges available are 0–20.5 mA and 3.5–20.5 mA. Overranging enables the [c]FP-AO-200 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-AO-200 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 loop supply is disconnected. However, the monitoring circuit also detects errors caused by load impedances that are too high and by loop supply voltages that are too low.

If the output of a [c]FP-AO-200 channel is set to 0 mA, the monitoring circuit does not register an error condition because the

[c]FP-AO-200 can always source zero current, even to an open loop. Leave any unused and unwired channels in the default state so that they do not generate error conditions.

Short-Circuit Protection

Each I_{out} terminal of the [c]FP-AO-200 is protected against short circuits to any of the other terminals. One or more channel outputs can be short-circuited indefinitely without causing damage or improper operation of other channels, as long as the maximum loop supply does not exceed 24 VDC. The outputs can withstand indefinite short circuits with loop supplies of more than 24 VDC (up to 36 VDC) without damage, but increasing internal temperatures due to such conditions may cause improper operation of other channels on the module.

Status Indicators

Figure 6 shows the [c]FP-AO-200 status indicators.

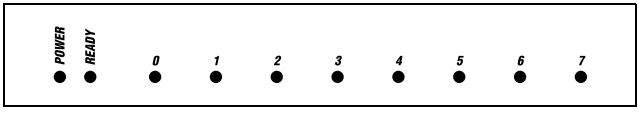


Figure 6. Status Indicators

The [c]FP-AO-200 has two green status LEDs, **POWER** and **READY**. After you insert the [c]FP-AO-200 into a terminal base or backplane and apply power to the connected network module, the green **POWER** indicator lights and the [c]FP-AO-200 informs the network module of its presence. When the network module recognizes the [c]FP-AO-200, it sends initial configuration information to the [c]FP-AO-200. After receiving this initial information, the green **READY** indicator lights and the [c]FP-AO-200 is in normal operating mode.

In addition to the green **POWER** and **READY** indicators, each 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, go to `ni.com/info` and enter `fpmatrix`.

Isolation and Safety Guidelines

Caution Read the following information before attempting to connect the [c]FP-AO-200 to any circuits that may contain hazardous voltages.

This section describes the isolation of the [c]FP-AO-200 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-AO-200 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-AO-200 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

These specifications are typical for the range –40 to 70 °C unless otherwise noted.

Output Characteristics

Number of channels	8 single-ended
Resolution	12 bits, 1 in 4,096 (~6 µA/bit)

Current Output

Output range	0–20 or 4–20 mA, programmable (0–20.5 or 3.5–20.5 mA with overranging)
Type	Current source, external loop power required
External loop power	5–24 VDC
Internal voltage drop	3 V
Resistive load	Up to 1 kΩ with 24 V loop supply, up to 100 Ω with 5 V supply[1]
Protection	Short-circuit and open-circuit
Default power-up state	0 mA

Accuracy

Absolute accuracy	0.1% typ, 0.3% max (calculated as a percentage of full-scale reading)

[1] *Maximum load resistance* = (*Supply voltage – Internal voltage drop*)/0.0205 A

Monotonicity[1] ..... Guaranteed over operating temperature range

Offset temperature coefficient ..... 50 nA/°C

Gain temperature coefficient ..... 40 ppm/°C

Dynamic Characteristics

Max conversion rate..... 200 updates/s

Slew rate ..... 0.4 mA/µs

Physical Characteristics

Indicators ..... Green **POWER** and **READY** indicators, 8 red open-loop indicators

Weight

FP-AO-200 ..... 140 g (4.8 oz)

cFP-AO-200 ..... 110 g (3.7 oz)

Power Requirements

Power from network module ..... 350 mW

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, FieldPoint modules must be mounted inside a sealed enclosure.

Operating temperature ..... –40 to 70 °C

Storage temperature ..... –55 to 100 °C

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

Maximum altitude..... 2,000 m

Pollution Degree 2

[1] A characteristic of a DAC in which the analog output always increases as the value of the digital code input to it increases.

Shock and Vibration

Operating shock (IEC 68-2-27)

cFP-AO-200 ..... 50 g, 3 ms half sine, 3 shocks; 30 g, 11 ms half sine, 3 shocks

Operating vibration, random (IEC 60068-2-34)

FP-AO-200 ..... 10–500 Hz, 2.2 g_{rms}

cFP-AO-200 ..... 10–500 Hz, 5 g_{rms}

Operating vibration, sinusoidal (IEC 60068-2-6)

[c]FP-AO-200 ..... 10–500 Hz, 5 g

Safety

The [c]FP-AO-200 is designed to meet the requirements of the following standards for safety and electrical equipment for measurement, control, and laboratory use.

- EN 61010-1, IEC 61010-1
- UL 3121-1
- CAN/CSA C22.2 No. 1010.1

For certifications under regulatory standards, including hazardous location standards, refer to the product label or to `ni.com`.

Electromagnetic Compatibility

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

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

Electromagnetic immunity..... Evaluated to EN 61326: 1997/A1: 1998, Table 1



Note For full EMC compliance, you must operate this device with shielded cabling. See the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, click **Declaration of Conformity** at `ni.com/hardref.nsf/`.

Mechanical Dimensions

Figure 7 shows the mechanical dimensions of the FP-AO-200 installed on a terminal base. Dimensions are given in millimeters [inches]. If you are using the cFP-AO-200, refer to the Compact FieldPoint controller user manual for the dimensions and cabling clearance requirements of the Compact FieldPoint system.

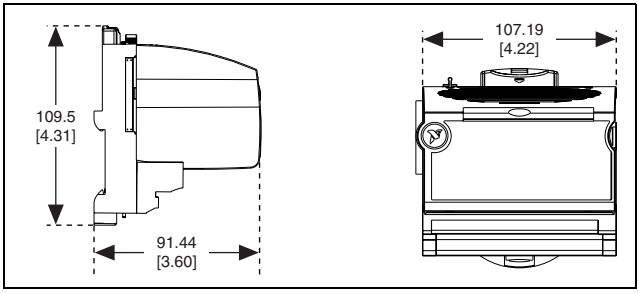


Figure 7. FP-AO-200 Mechanical Dimensions

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 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:

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Portugal 210 311 210, Russia 095 238 7139,
Singapore 65 6 226 5886, Slovenia 3 425 4200,
South Africa 11 805 8197, Spain 91 640 0085,
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