

# FP-TB-10

## Terminal Base and Dual-channel FieldPoint Modules



These operating instructions describe the installation, features, and characteristics of the FP-TB-10 and the various dual-channel modules. For details on configuring and accessing these modules over a network, refer to the user manual for the particular FieldPoint network module you are using with the dual-channel system.

## Features

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The FP-TB-10 terminal base and the dual-channel FieldPoint modules have the following features:

- High granularity of system design with up to six dual-channel I/O modules per terminal base.
- Any combination of I/O types in each terminal base.
- Each dual-channel I/O module is independently isolated.

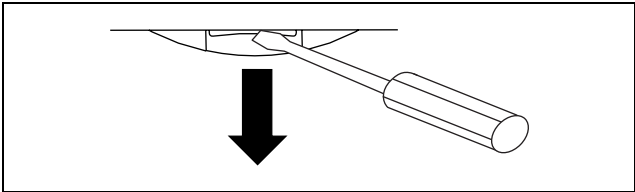
FieldPoint dual-channel modules include a family of two-channel I/O modules for maximum flexibility in configuring I/O systems. You can mount up to six dual-channel modules in any combination on the FP-TB-10 terminal base. You can mix dual-channel modules with standard eight- and 16-channel modules in a single FieldPoint bank. Therefore, you can configure your FieldPoint system to match your specific I/O needs very closely, minimizing the size and cost of your distributed I/O system. In addition, the dual-channel modules provide a flexible solution for applications requiring channel-to-channel isolation.

# DIN Rail Mounting

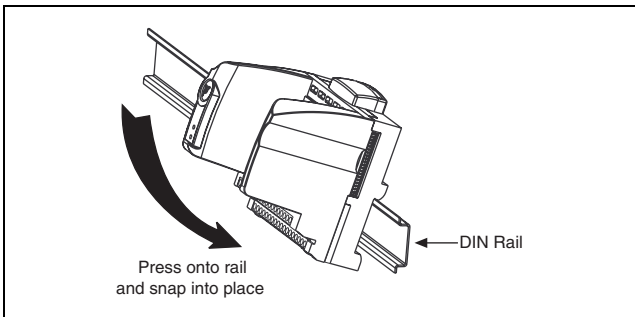


**Note** Before connecting a terminal base to a network module, the network module *must* be powered off.

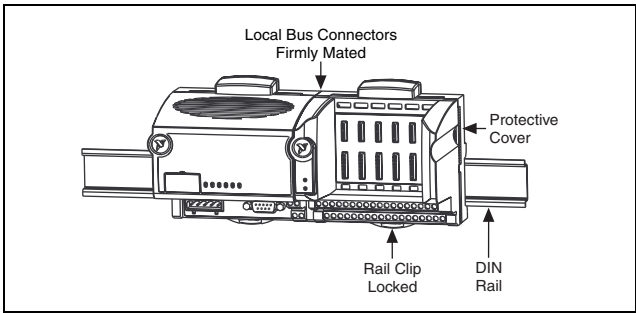
1. With a flat-bladed screwdriver, open the rail clip to the unlocked position as shown in the following figure.



2. Hook the lip on the rear of the terminal base onto the top of a 35 mm DIN rail and rotate the terminal base down onto the DIN rail as shown in the following figure.

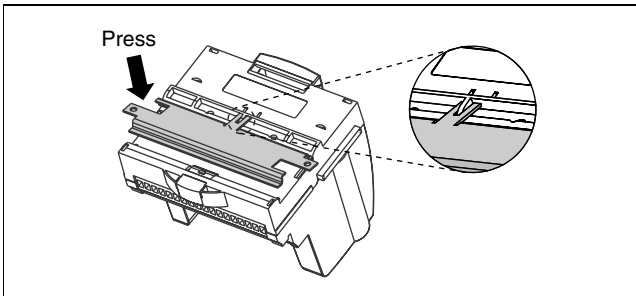


3. Slide the terminal base along the DIN rail until its local bus connector mates with the connector of the terminal base or network module adjacent to it.
4. Lock the terminal base to the DIN rail by pushing in the rail clip.
5. Continue adding as many terminal bases as you need to the DIN rail, making sure to mate the local bus connectors.
6. Place the protective cover over the local bus connector of the last terminal base in the stack. The following figure shows an installed terminal base.



## Panel Mounting

1. With a flat-bladed screwdriver, open the rail clip to the unlocked position.
2. Snap the panel mount accessory onto the terminal base as shown in the following figure.



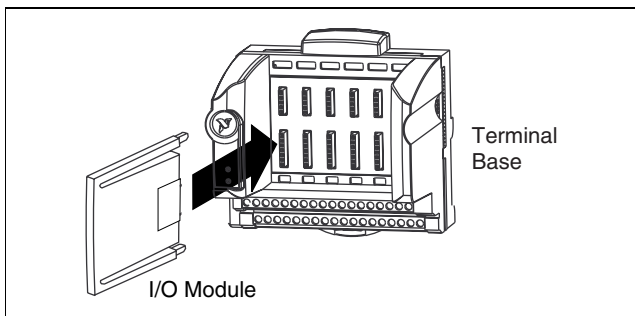
3. Lock the rail clip.
4. Mount the FP-TB-10 and panel mount accessory onto the desired surface. You can drill pilot holes using the directions in the panel mount adapter installation guide.

You should install the network module first, using two bolts/screws, then install the FP-TB-10 module(s) using the right bolt tab. If you use a FieldPoint bus extender cable, the first FP-TB-10 on the new row should use both panel mount bolt tabs.

# Installation

You can install up to six dual-channel modules on each FP-TB-10 terminal base. You can use any combination of modules in any order on the terminal base.

To install a dual-channel module on an FP-TB-10, snap the module onto the terminal base while squeezing the legs of the module inwards. Install the modules with the colored label oriented towards the top. Make sure that both legs of the module are securely snapped into place.



To remove a dual-channel module, squeeze the legs of the module together to unlock, then pull from the terminal base.

## Hot Plug-and-Play Live Insertion and Swapping of Modules

You can install modules while the network module is powered and in operation. Replacing any dual-channel module with another dual-channel module of the same type will not interrupt the FieldPoint system's operation (although during the time a module is missing, it will be reported as having a bad status). The new dual-channel module will be automatically configured with the same settings as the previous module, and if it is an output module, the output value will be automatically updated. However, if a module of a different type replaces a removed dual-channel module, the FP-TB-10 will reset itself and all six of its modules and will request new initial configuration settings from the network module.

## Field Wiring

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The terminal base has four screw terminal connections for each of the six dual-channel modules. These four connections are labeled “1a” and “1b” for channel 1, and “2a” and “2b” for channel 2. The signal connections for each of the different I/O modules are listed in these instructions and are also printed on the sides of each of the I/O modules. In addition to these terminals are six pairs of terminals labeled V and C. These V and C terminals are not directly connected to the dual-channel modules, but all of the V terminals are connected together and all of the C terminals are connected together. These terminals may be useful for connecting terminals of the dual-channel modules to external power supply voltages, or for bussing power to your field devices. You do not need to connect anything to these V and C terminals for proper operation of the dual-channel modules.

Some dual-channel modules may provide for other field wiring connection means on the modules, as opposed to using the screw terminal connections of the FP-TB-10. These include the thermocouple modules and the four-wire RTD module.

## Update Rates

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The FP-TB-10 continuously scans through its six dual-channel modules, updating outputs and reading inputs. The rate of this scan varies depending on the modules in the FP-TB-10. Empty modules and digital modules add 0.2 ms each to the scan time, while analog modules add 1.5 ms each. The sum of these six times is the total scan time. Each I/O module makes its data available to or reads its data from the network module once per scan time. However, the network module makes data available to and receives data from the network at rates that are independent from the operation of the FP-TB-10 and the dual-channel modules. Refer to your network module user manual for more details on the operation and throughput of your particular network.

## Power Requirement (P+)

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The FP-TB-10 and the dual-channel modules are powered through the local backplane bus from the FieldPoint network module. An FP-TB-10 with I/O modules may require more than the nominal power allocated to an I/O module from the network module. In some applications, this could limit the number of I/O modules that you can connect to a single network module. When defining a FieldPoint system that uses an FP-TB-10, you must calculate the total power consumption of the FP-TB-10 with its dual-channel modules, as well as the power consumption of the other I/O modules in the system. The total power consumption of all these modules must be less than 9 Watts. The FP-TB-10 alone requires 0.15 Watts of power; add to this the individual power requirements of the dual-channel modules given in the specifications section.

For example, an FP-TB-10 with three FP-AO-C020 dual-channel modules and two FP-AI-C020 dual-channel modules requires 4.2 Watts of power ( $0.15 \text{ W} + 3 \times 1.1 \text{ W} + 2 \times 0.375 \text{ W}$ ). A bank of FieldPoint modules including two such FP-TB-10 bases uses 8.4 Watts of power—nearly the entire 9 Watt limit.

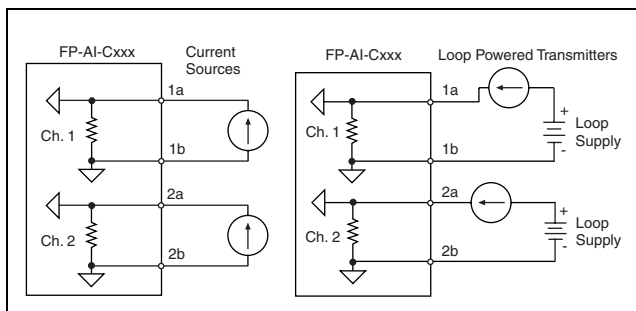
## Dual-Channel I/O Modules

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This section describes the features of the individual dual-channel I/O modules.

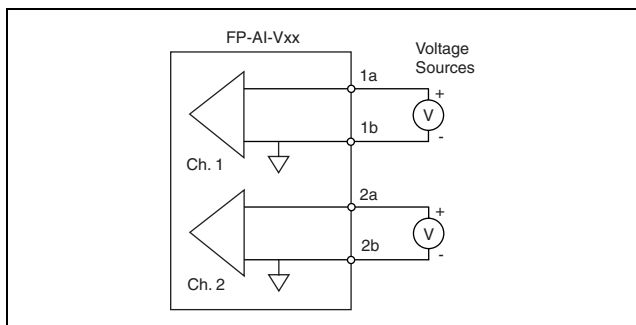
### Analog Current Input Modules (FP-AI-C020 and FP-AI-C420)

The FP-AI-C020 and the FP-AI-C420 are current input modules. They provide 12-bit resolution measurements. Each channel has a programmable filter with two settings, 20 Hz bandwidth or 100 Hz bandwidth. Each module has two channels with a  $133 \Omega$  input impedance that share a common reference point (the “b” terminals). For applications requiring channel-to-channel isolation, you can use only one channel of each module. Field devices should be wired such that current flows into the “a” terminals and returns out through the “b” terminals. The following figure shows an example of this wiring. You may choose to use the V and C terminals to conveniently connect loop power supplies for your current transmitters.



## Analog Voltage Input Modules (FP-AI-V50m, FP-AI-V100m, FP-AI-V1, FP-AI-V5, FP-AI-V5B, FP-AI-V10, and FP-AI-V10B)

The FP-AI-V50m, FP-AI-V100m, FP-AI-V1, FP-AI-V5, FP-AI-V5B, FP-AI-V10, and FP-AI-V10B are analog voltage input modules. They provide 12-bit resolution measurements. Each channel has a programmable filter with two settings, 20 Hz bandwidth or 2 kHz bandwidth. Each module has two channels that share a common reference point (the “b” terminals). The “a” terminal for each channel is the positive input. The following figure shows an example of this wiring. For applications requiring channel-to-channel isolation, you can use only one channel of each module.

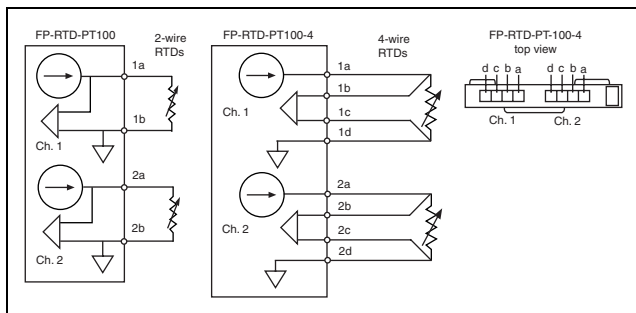


## Analog Thermocouple Input Modules (FP-TC-J, FP-TC-K, FP-TC-T)

The FP-TC-J, FP-TC-K, and FP-TC-T are J-, K-, and T-type thermocouple input modules, respectively. They provide 12-bit resolution measurements. Each channel can be programmed for either the °C or the °F range. Each module has two thermocouple connectors directly on the module and do not use the screw terminals of the FP-TB-10. For applications requiring channel-to-channel isolation, you can use only one channel of each module.

## RTD Input Modules (FP-RTD-PT100 and FP-RTD-PT100-4)

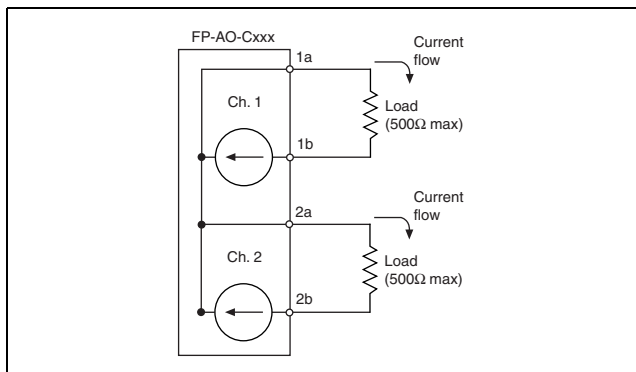
The FP-RTD-PT100 and FP-RTD-PT100-4 are two-wire and four-wire 100 Ω Platinum RTD input modules, respectively. They provide 12-bit resolution measurements. Each is designed with the linearization curves of a DIN 43760 standard RTD ( $\alpha = 0.00385$ ). Each channel can be programmed for either the °C or the °F range. The FP-RTD-PT100-4 four-wire RTD module has two four-terminal connectors directly on the module and does not use the screw terminals of the FP-TB-10. The FP-RTD-PT100 has two terminals per channel, with the negative terminal (the “b” terminal) common for the two channels. For applications requiring channel-to-channel isolation, you can use only one channel of each module. The following figure shows an example of this wiring for both module types.





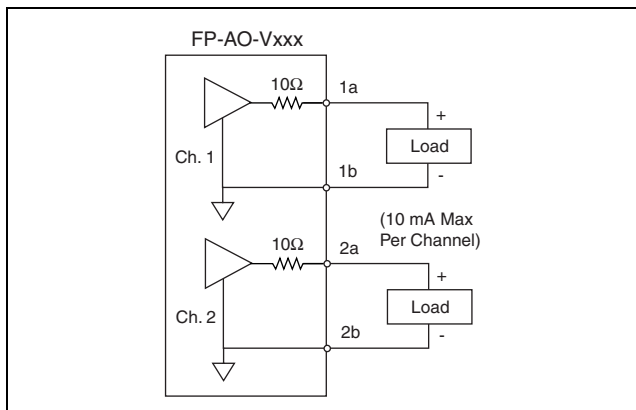
## Analog Current Output Modules (FP-AO-C020, FP-AO-C420, and FP-AO-C024)

The FP-AO-C020, FP-AO-C420, and the FP-AO-C024 are current output modules. They provide 12-bit resolution outputs. All three modules provide internal loop power supplies that can drive loads of up to 500  $\Omega$ . The FP-AO-C024 additionally provides open circuit detection with a status message that is readable from the network module. Each module has two channels that share a common reference point (the “a” terminals). For applications requiring channel-to-channel isolation, you can use only one channel of each module. Field devices should be wired such that current flows out of the common “a” terminals and returns in through the “b” terminals. The following figure shows an example of this wiring.



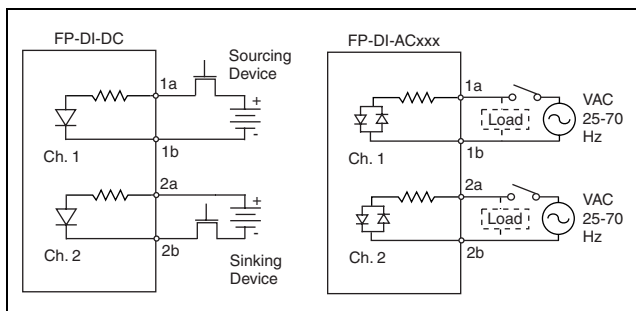
## Analog Voltage Output Modules (FP-AO-V5, FP-AO-V5B, FP-AO-V10, and FP-AO-V10B)

The FP-AO-V5, FP-AO-V5B, FP-AO-V10, and FP-AO-V10B are analog voltage output modules. They provide 12-bit resolution outputs. All three modules provide internal power supplies that can drive loads with up to 10 mA of current; however, each channel has 10  $\Omega$  of output impedance, which adds 10 mV of error for each milliampere that the channel is required to supply. Each module has two channels that share a common reference point (the “b” terminals). For applications requiring channel-to-channel isolation, you can use only one channel of each module. The following figure shows an example of this wiring.



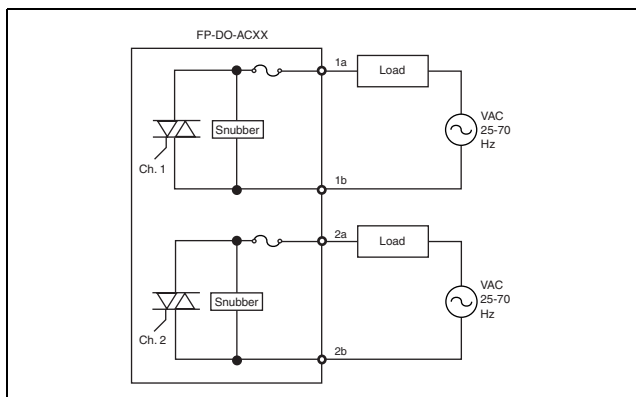
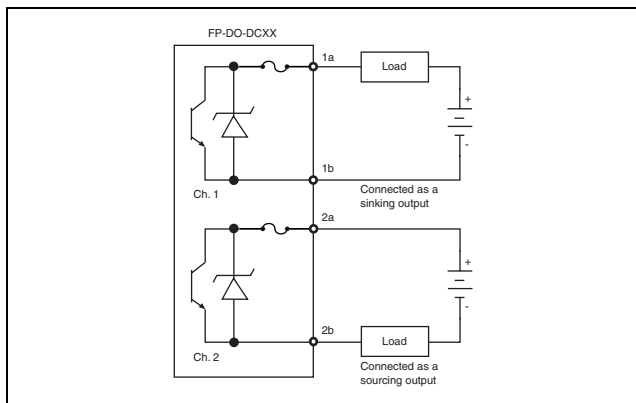
## Discrete Input Modules (FP-DI-DC, FP-DI-AC120, and FP-DI-AC240)

The FP-DI-DC, FP-DI-AC120, and FP-DI-AC240 are discrete input modules. Each module has two isolated channels, so applications requiring channel-to-channel isolation may use both channels on one module. Each module has two green indicator LEDs on the module, one for each channel, to indicate whether the channel is in the ON or OFF state. Each channel is in the ON state when a voltage above the threshold is present between the “a” and “b” terminals. Since each channel of the DC input modules is isolated, each channel may be used with either sinking or sourcing devices. The following figure shows examples of this wiring. You may choose to use the V and C terminals to conveniently bus-connect power supplies for your discrete output field devices if channel-to-channel isolation is not needed.



## Discrete Output Modules (FP-DO-DC60, FP-DO-DC200, FP-DO-AC120, and FP-DO-AC240)

The FP-DO-DC60, FP-DO-DC200, FP-DO-AC120, and FP-DO-AC240 are discrete output modules. Each module has two isolated channels, so applications requiring channel-to-channel isolation may use both channels on one module. Each module has two green indicator LEDs on the module, one for each channel, to indicate whether the channel is in the ON or OFF state. Each module also has two replaceable fuses—one for each channel. The amount of current that each channel can drive without exceeding temperature specifications depends on the ambient temperature and the module type—see the [Specifications](#) section for more details. Since each channel of the DC output modules is isolated, each channel may be used with either sinking or sourcing devices. These modules sink current into the “a” terminals and source current out of the “b” terminals. The following figures show examples of this wiring. The AC output modules have zero-crossing triac style outputs that turn on as the voltage crosses zero and turn off as the current crosses zero. You may choose to use the V and C terminals to conveniently bus-connect power supplies for your loads if channel-to-channel isolation is not needed.



## Isolation and Safety



**Caution** Read the following information before attempting to connect ANY circuits which may contain hazardous voltages to the FP-TB-10.

This section describes the isolation of the FP-TB-10 and its compliance with international safety standards. The field wiring connections of the FP-TB-10 and the dual-channel modules are isolated from the backplane provided by the terminal base with an optical and galvanic isolation barrier designed and tested to provide protection against fault voltages of up to 2500 Vrms.

In addition, the FP-TB-10 and the dual-channel modules provide *double insulation* (compliant to IEC 1010-1) for working common mode voltages of 250 Vrms. 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. You should *never* attempt to use any isolation product between human accessible parts (such as DIN rails or monitoring stations) and circuits which may be at hazardous potentials under normal conditions, unless the product is specifically designed (as the FP-TB-10 and the dual-channel modules are) for such an application. Even when a product like the FP-TB-10 is used in applications with hazardous potentials, follow these guidelines to ensure a safe total system.

- The *safety* isolation of the FP-TB-10 and the dual-channel modules is from input to output, *not* between channels on the same module. If any of the channels on a module are wired at a hazardous potential, ensure that all other devices or circuits connected to that module are properly insulated from human contact.
- Do *not* share the external supply voltages (V and C on the terminal base) with other devices (including other FieldPoint devices) unless those devices are also isolated from human contact.
- As with any hazardous voltage wiring, ensure that all wiring and connections meet with applicable electrical codes or common sense practices. Mount terminal bases in an area, position, or cabinet that prevents accidental or unauthorized access to wiring with hazardous voltages.
- The isolation of the FP-TB-10 and the dual-channel modules is certified as double insulated for normal operating voltages of 250 Vrms. Do *not* use the FP-TB-10 and the dual-channel modules as the sole isolating barrier between human contact and working voltages of more than 250 Vrms.

# Specifications

## Analog Input Modules

### Number of inputs

- Thermocouple modules ..... 2 differential
- Other types ..... 2 single-ended

Measurement resolution..... 12 bits (1 part in 4096)

### Input impedance

- Voltage inputs ..... 2.2 M $\Omega$
- Current inputs ..... 133  $\Omega$

### Excitation current (RTDs)

- Four-wire ..... 100  $\mu$ A
- Two-wire..... 500  $\mu$ A

### Measurement bandwidth

- Voltage inputs ..... 20 Hz or 2 kHz,  
programmable
- Current inputs ..... 20 Hz or 100 Hz
- Thermocouple inputs ..... 20 Hz
- RTD inputs ..... 15 Hz

### Input protection

- Current inputs ..... 45 mA
- Voltage inputs .....  $\pm$ 30 V
- Thermocouple, RTD .....  $\pm$ 6 V

**Table 1.** Analog Input Module Accuracy

Module	Input Range	Resolution	Accuracy (at 25°C)	Temperature Drift*
FP-AI-V50m	0 to 50 mV	12.2 $\mu$ V	0.06%	1.8 $\mu$ V + 75 ppm
FP-AI-V100m	0 to 100 mV	24.4 $\mu$ V	0.06%	3.5 $\mu$ V + 75 ppm
FP-AI-V1	0 to 1 V	244 $\mu$ V	0.05%	35 $\mu$ V + 75 ppm
FP-AI-V5	0 to 5 V	1.22 mV	0.05%	125 $\mu$ V + 75 ppm
FP-AI-V5B	$\pm$ 5 V	2.44 mV	0.06%	250 $\mu$ V + 75 ppm
FP-AI-V10	0 to 10 V	2.44 mV	0.05%	250 $\mu$ V + 75 ppm
FP-AI-V10B	$\pm$ 10 V	4.88 mV	0.06%	500 $\mu$ V + 75 ppm
FP-AI-C020	0 to 20 mA	4.9 $\mu$ A	0.06%	0.5 $\mu$ A + 75 ppm
FP-AI-C420	0 to 20 mA	3.9 $\mu$ A	0.06%	0.5 $\mu$ A + 75 ppm

**Table 1.** Analog Input Module Accuracy (Continued)

Module	Input Range	Resolution	Accuracy (at 25°C)	Temperature Drift*
FP-TC-J	-210 to 1200 °C -346 to 2192 °F	0.34 °C 0.62 °F	1 °C 1.8 °F	0.07 °C + 100 ppm 0.13 °F + 100 ppm
FP-TC-K	-100 to 1372 °C -148 to 2501 °F	0.36 °C 0.65 °F	1 °C 1.8 °F	0.07 °C + 100 ppm 0.13 °F + 100 ppm
FP-TC-T	-240 to 400 °C -400 to 752 °F	0.16 °C 0.28 °F	0.4 °C 0.7 °F	0.03 °C + 100 ppm 0.06 °F + 100 ppm
FP-RTD-PT100	-50 to 350 °C -58 to 662 °F	0.1 °C 0.18 °F	0.2 °C 0.4 °F	0.03 °C + 100 ppm 0.06 °F + 100 ppm
FP-RTD-PT100-4	-50 to 350 °C -58 to 662 °F	0.1 °C 0.18 °F	0.2 °C 0.4 °F	0.03 °C + 100 ppm 0.06 °F + 100 ppm
* Temperature Drift equals (offset + gain) / °C				

## Analog Output Modules

Number of outputs ..... 2 single ended

Output resolution ..... 12 bits (1 part in 4096)

Output impedance

(voltage outputs) ..... 10 Ω

Output drive (voltage outputs) ..... 10 mA

Maximum load (current outputs) ..... 500 Ω

**Table 2.** Analog Output Module Accuracy

Module	Output Range	Resolution	Accuracy (at 25°C)	Temperature Drift*
FP-AO-C020	0 to 20 mA	4.9 μA	0.1%	1 μA + 75 ppm
FP-AO-C420	4 to 20 mA	3.9 μA	0.1%	1 μA + 100 ppm
FP-CO-C024	0 to 24 mA	5.9 mA	0.1%	1.2 μA + 100 ppm
FP-AO-V5	0 to 5 V	1.2 mV	0.08%	125 μV + 100 ppm
FP-AO-V5B	± 5 V	2.4 mV	0.06%	500 μV + 75 ppm
FP-AO-V10	0 to 10 V	2.4 mV	0.06%	250 μV + 100 ppm
FP-AO-V10B	± 10 V	4.9 mV	0.08%	1000 μV + 100 ppm
* Temperature Drift equals (offset + gain) / °C				

## Discrete Input Modules

Number of channels ..... Two isolated inputs

**Table 3.** Discrete Input Characteristics

	FP-DI-DC	FP-DI-AC120	FP-DI-AC240
Nominal input	5 to 24 VDC	120 VAC	240 VAC
Voltage range	0 to 32 VDC	0 to 140 VAC/VDC	0 to 280 VAC/VDC
Voltage level ON state, min OFF state, max	3.0 VDC 0.9 VDC	90 VAC 25 VAC	180 VAC 50 VAC
Current level ON state, min OFF state, max	1.0 mA 0.1 mA	3.7 mA 1.0 mA	2.6 mA 1.0 mA
Input impedance	1.8 k $\Omega$	22 k $\Omega$	64 k $\Omega$
Delay time (max)	0.4 ms	20 ms	20 ms

## Discrete Output Modules

Number of channels ..... Two isolated outputs

Replaceable fuses (5x20 mm, 3.15 A, 250 V, fast-acting)

FP-DO-DC ..... Littlefuse 216315

FP-DO-AC ..... Littlefuse 217315

**Table 4.** Discrete Output Characteristics

	FP-DO-DC60	FP-DO-DC200	FP-DO-AC120	FP-DO-AC240
Voltage range	3 to 60 VDC	4 to 200 VDC	24 to 140 VAC 25 to 70 Hz	24 to 280 VAC 25 to 70 Hz
Voltage drop	1.3 V @ 0.75 A	1.75 V @ 1.0 A	1.0 V @ 0.5 A	1.0 V @ 0.5 A
Current rating (per channel)	0.75 A@25 °C 0.40 A@40 °C 0.20 A@60 °C	0.40 A@25 °C 0.20 A@40 °C 0.10 A@60 °C	0.75 A@25 °C 0.50 A@40 °C 0.30 A@60 °C	0.75 A@25 °C 0.50 A@40 °C 0.30 A@60 °C
Max leakage	1.5 mA	0.01 mA	2 mA rms	4 mA rms
Max output delay	60 ms	0.75 ms	1/2 cycle	1/2 cycle



## Power Requirements

FP-TB-10 .....	150 mW
Analog inputs .....	375 mW
Analog outputs .....	1100 mW
Discrete inputs .....	60 mW
Discrete outputs .....	70 mW

## Physical Characteristics

### Weight

FP-TB-10.....	290 g (10.2 oz)
I/O module.....	60 g (2.1 oz)

### Operating temperature

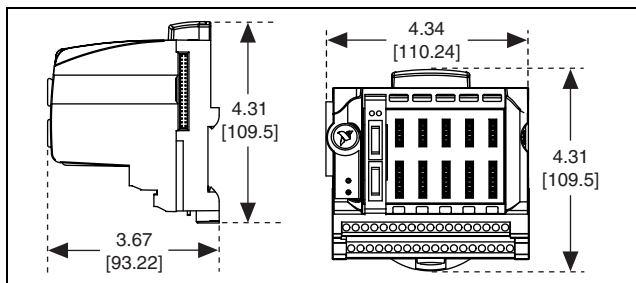
FP-TB-10.....	-40 to +70 °C
Discrete modules .....	-40 to +70 °C
Analog modules.....	-20 to +70 °C

Storage temperature .....

-40 to +100 °C
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## Mechanical Dimensions

The following figure shows the mechanical dimensions of the FP-TB-10. Dimensions are given in inches [millimeters].





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