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Thermocouple and RTD Modules for Compact FieldPoint

NI cFP-TC-120, NI cFP-TC-125, NI cFP-RTD-122, NI cFP-RTD-124

- 8 temperature inputs
  - Thermocouple or millivolt
  - 2-, 3-, or 4-wire RTD
- Built-in signal conditioning between channels
  - 250 V common-mode isolation on cFP-TC-125
  - 50 and 60 Hz noise rejection
- 16-bit resolution
- Input ranges configurable in software for each channel
- 2,300 V_{rms} bank isolation for transient overvoltage protection
- Hot-swappable with autoconfiguration
- -40 to 70 °C operating range



Module	Input Channels	Resolution (bits)	Input Type	Input Ranges Software-Configurable per Channel	50/60 Hz Noise Filter	All-Channel Update Period	Common-Mode Between Channels	Safety Isolation
cFP-TC-120	8	16	Thermocouple	J,K,R,S,T,N,E, and B ± 25 mV, ±50 mV	✓	1.13 s (0.88 Hz)	–	2,300 V_{rms} bank isolation
			Millivolt	±100 mV, -20 to 80 mV				
cFP-TC-125	8	16	Thermocouple	J,K,R,S,T,N,E, and B	✓	0.22 s (Filter Off) 0.99 s (Filter On)	250 V_{rms}	2,300 V_{rms} bank isolation
			Millivolt	-20 to 80 mV				
cFP-RTD-122	8	16	2-, 3-wire RTD	Pt 100, Pt 1,000	✓	1.08 s (0.93 Hz)	–	2,300 V_{rms} bank isolation
			Resistance	0 to 400, 0 to 4000 Ω				
cFP-RTD-124	8	16	2-, 4-wire RTD	Pt 100	✓	1.08 s (0.93 Hz)	–	2,300 V_{rms} bank isolation
			Resistance	0 to 400 Ω				

Overview

The NI cFP-TC-12x and cFP-RTD-12x are versatile temperature input modules for Compact FieldPoint used to measure thermocouples, millivolt-level voltages, thermistors, and 2-, 3-, and 4-wire RTDs. They are used in applications such as temperature chamber control, device testing, and process control. Thermocouples are low-cost, flexible temperature devices. RTD sensors are used in applications for acquiring temperatures with high accuracy. Two- and 3-wire RTDs work well for applications with short signal wires and low noise levels; 4-wire RTDs are well-suited for applications with long signal wires or high noise levels. All of these I/O modules include overranging and onboard diagnostics to ensure trouble-free installation and maintenance. The modules measure and linearize signals on board to return scaled values to your control or monitoring software. The cFP-TC-12x and cFP-RTD-12x modules have NIST-traceable calibration certificates (available upon request) to ensure accurate and reliable analog measurements.

Compact FieldPoint

Compact FieldPoint is designed for industrial control applications that perform advanced embedded control, data logging, headless operation, and Ethernet connectivity. Compact FieldPoint, a rugged, reliable NI platform, is designed for industrial and mobile environments with high shock, vibration, and temperature extremes.

Isolation

The cFP-TC-125 provides 250 V_{rms} common-mode voltage protection between channels, and all cFP-TC-12x and cFP-RTD-12x modules feature optical bank isolation with 2,300 V_{rms} of breakdown isolation. In addition, the cFP-TC-12x and cFP-RTD-12x offer double insulation for up to 250 V_{rms} of operational isolation. You can safely use Compact FieldPoint with the cFP-CB-1 or cFP-CB-3 connector block in applications where hazardous voltages are present.

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Smart I/O Modules

The cFP-TC-12x and cFP-RTD-12x modules offer 16-bit resolution for high-accuracy measurements, and you can connect directly to industrial sensors or units under test with the safety isolation available. The modules filter, calibrate, and scale raw sensor signals to engineering units, as well as perform self-diagnostics to look for problems such as open thermocouples. With cFP-TC-12x and cFP-RTD-12x modules, your software application reads a linearized, calibrated, scaled value from the I/O module, eliminating the error-prone step of converting binary values to temperature. For increased accuracy and noise rejection, the modules use a16-bit delta-sigma analog-to-digital converter (ADC) with an integrated notch filter on each channel, which is configured for 50 and 60 Hz rejection. With high-accuracy 16-bit delta-sigma ADCs on the I/O modules, you also get instrument-quality measurements on an industrially rugged, distributed, embedded system. The cFP-TC-12x and cFP-RTD-12x modules offer a variety of update rates to fit your application, ranging from 0.22 s with filters off and 1.08 to 1.13 s with filters enabled. Overall data throughput depends on filter settings across all channels, software loop speeds, and network speeds.

cFP-TC-120

The cFP-TC-120 includes eight differential inputs for thermocouples. It also provides cold-junction compensation using a thermistor embedded in the connector block. An onboard microcontroller compensates and linearizes the thermocouple reading to the NIST ITS-90 standard, using an advanced linearization routine for maximum accuracy.

cFP-TC-125

In addition to the thermistor and linearization features of the cFP-TC-120, the cFP-TC-125 provides 250 V_{rms} of common-mode rejection, ideal for applications where differences in voltages might exist between connected thermocouples. The cFP-TC-125 also offers 0.22 s update rates when the 50/60 Hz filter is not enabled.

cFP-RTD-122

The cFP-RTD-122 includes eight inputs for 2- and 3-wire RTDs. The module uses a stable current source for sensor excitation and an onboard microcontroller that linearizes and scales the measurements to temperature units. You can configure each channel of the module to return data scaled to temperature (°C, °F, or °K) or resistance. The 3-wire configuration used with the cFP-RTD-122 eliminates errors caused by lead wire resistance but does not reduce errors caused by noise. If your application involves high noise or long wires, you should use 4-wire RTDs with the cFP-RTD-124.

cFP-RTD-124

The cFP-RTD-124 includes eight inputs for 2- and 4-wire RTDs. The module uses a stable current source for sensor excitation and an onboard microcontroller that linearizes and scales the measurements to temperature units. You can configure each channel of the modules to return data scaled to temperature (°C, °F, or °K) or resistance. Four-wire RTDs used with the cFP-RTD-124 are ideal for applications involving long signal wires or high signal noise. The 4-wire configuration eliminates the voltage drop caused by lead wire resistance and reduces errors caused by noise.

Isothermal Connectivity for cFP-TC-12x Modules

For maximum accuracy, NI recommends using an isothermal connector block with a cFP-TC-12x. The cFP-CB-3 isothermal connector block minimizes the temperature gradient across wiring connections, improving the accuracy of the cold-junction measurement, and, therefore, of thermocouple measurements.

Compact FieldPoint I/O Connections

Compact FieldPoint modules include a built-in power distribution bus that provides multiple power connections on the module. A field-wired power supply connected to the voltage (V) and common (C) terminals is internally connected to a power distribution bus that features additional breakout terminals for voltage supply (VSUP) and common (COM). These terminals offer a convenient way to distribute power to field devices that require external power.

Each cFP-TC-12x input channel has two terminals for differential input:

1. Thermocouple positive input (IN+)
2. Thermocouple negative input (IN-)

Each cFP-RTD-122 input channel has three terminals:

1. Excitation output (EXCITE)
2. Sensing input (SENSE)
3. Common input (COM)

Each cFP-RTD-124 input channel has four terminals:

1. Excitation output (EXCITE)
2. Positive sensing input (SENSE+)
3. Negative sensing input (SENSE-)
4. Common input (COM)

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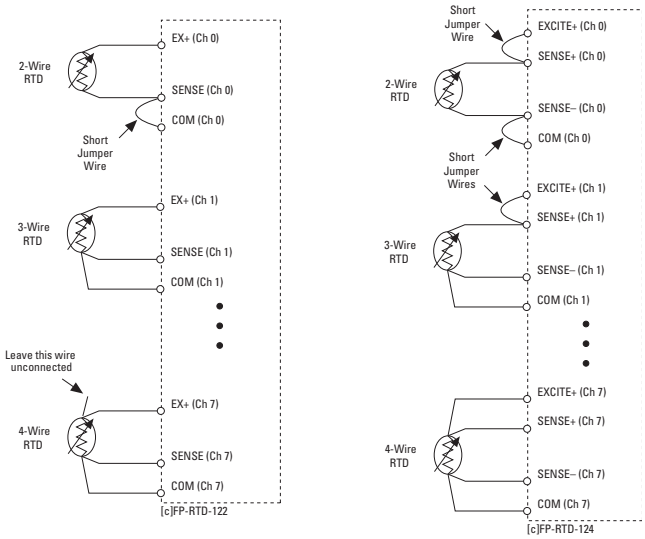


Figure 1. Wiring Diagram for cFP-RTD-12x

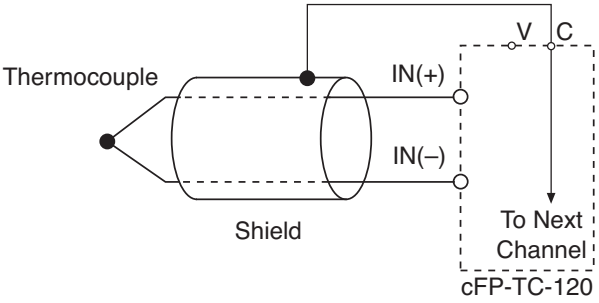


Figure 2. Wiring Diagram for cFP-TC-120

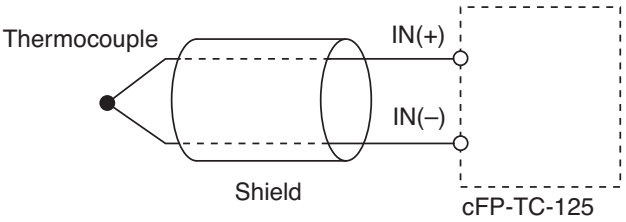


Figure 3. Wiring Diagram for cFP-TC-125
Note: Connections depend on the application.

Ordering Information

NI cFP-TC-120	777318-120
NI cFP-TC-125	777318-125
NI cFP-RTD-122	777318-122
NI cFP-RTD-124	777318-124

Recommended System Products

NI cFP-2120	777317-2120
NI cFP-1804	779490-01
NI cFP-BP-4	778617-04
NI cFP-CB-1	778618-01
NI cFP-CB-3	778618-03
NI PS-5 Power Supply	778805-90

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For complete product specifications, pricing, and accessory information, call 800 813 3693 (U.S.) or go to **ni.com/advisors.**

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Specifications

Typical for -40 to 70 °C unless otherwise noted.

Input Characteristics

Number of inputs	8
ADC resolution	16 bits, 1 in 65,536
Type of ADC	Delta-sigma
Filters	50/60 Hz rejection
Excitation current	
cFP-RTD-122	0.25 mA
cFP-RTD-124	2 mA
Data scaling options	
cFP-TC-120	Temperature (°C, °F, °K) or mV
cFP-RTD-12x	Temperature (°C, °F, °K) or resistance (Ω)
Update period, all channels	
cFP-TC-125	
Filter off	0.22 s
Filter on	0.99 s
cFP-TC-120	1.13 s
cFP-RTD-12x	1.08 s
Signal input bandwidth	
cFP-TC-120	3 Hz
cFP-TC-125	12 Hz
Cold-junction accuracy cFP-TC-12x	
With cFP-CB-3 connector block	0.25 °C typ, 0.5 °C max
Input impedance (cFP-TC-12x)	20 MΩ
Input current (cFP-TC-12x)	35 nA typ, 140 nA max
Input noise	±1 LSB_{pp}
Overvoltage protection	
cFP-TC-120	±40 V
cFP-TC-125	±250 V
Common-mode voltage between channels referenced to isolated ground	
cFP-TC-125	250 V
cFP-TC-120	1 V
cFP-RTD-12x	2 V

Safety Isolation Voltage

Maximum safety isolation voltage	250 V_{rms}, Installation Category II (cFP-TC-12x only)
Channel-to-channel safety isolation	No isolation between channels
Transient overvoltage	2,300 V_{rms}

Physical Characteristics

LED indicators	
POWER (green)	Power on and self-test passed
READY (green)	Module configured and ready
OPEN TC <0..7> (red) (cFP-TC-12x)	Open or broken thermocouple on channel
Dimensions	128 by 88 by 25 mm (5.0 by 3.5 by 1.0 in.)
Weight	
cFP-TC-120	130 g (4.6 oz)
cFP-TC-125	125 g (4.4 oz)
cFP-RTD-12x	110 g (3.7 oz)

Power Requirement

Power from network module	
cFP-TC-120	350 mW
cFP-TC-125	650 mW

Environmental

Operating temperature	-40 to 70 °C
Storage temperature	-55 to 85 °C (cFP-TC-125 -40 to 80 °C)
Relative humidity	10 to 90%, noncondensing
Maximum altitude	2,000 m; at higher altitudes the isolation voltage ratings must be lowered
Pollution degree	2

Shock and Vibration

Operating vibration, random (IEC 60068-2-64)	10 to 500 Hz, 5 g_{rms}
Operating vibration, sinusoidal (IEC 60068-2-6)	10 to 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 and Compliance

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 61010-1, CSA 61010-1

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

Electromagnetic Compatibility

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

- EN 61326 (IEC 61326): 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

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CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

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

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/certification**, search by model number or product line, and click the appropriate link in the Certification column.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers: At the end of their life cycle, all products must be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit **ni.com/environment/weee.htm**.

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Hardware Services

System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deployment services for your NI PXI, CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your system is delivered completely assembled in one box. When you configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and application development environments to create customized, reorderable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled. When you order your system with the standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenance plan, and frequently asked question documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibration service. Use the online product advisors at **ni.com/advisor** to find a system assurance program to meet your needs.

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