FD-11614 Specifications

2025-04-07

Contents

FD-11614 Specifications

Conditions

Specifications are typical and valid at -40 °C to 85 °C unless otherwise noted.

Input Characteristics

Number of channels	16 isolated thermocouple channels, 4 CJC
Isolation	Galvanic isolation between channels and to chassis
ADC resolution	24 bits
Type of ADC	Delta-Sigma
Sample mode	Simultaneous
Sample rate	User configurable
Timebases[1]	80 MHz, 20 MHz, 100 kHz
Voltage measurement range	±78.125 mV

Temperature measurement ranges	Works over temperature ranges defined by NIST (J, K, T, E, N, B, R, and S thermocouple types)

Table 1. Conversion Time

Timing Mode	Conversion Time (ms)	Sample Rate (Samples/s)
High resolution	550	1.8
Best 50 Hz rejection	140	7.1
Best 60 Hz rejection	120	8.3
High speed	11.7	85

Common-mode voltage range	
Channel-to-channel	Refer to Safety Voltages for more information
Channel-to-earth ground	Refer to Safety Voltages for more information
Common-mode rejection ratio, channel-to-earth ground voltages (DC to 60 Hz)	
High resolution, best 50 Hz rejection, best 60 Hz rejection	165 dB
High speed	125 dB
Thermocouple signal input bandwidth	
High resolution	1.0 Hz
Best 50 Hz rejection	4.0 Hz
Best 60 Hz rejection	4.7 Hz

High speed	31 Hz
Open thermocouple settling time	1.8 s
Noise rejection	
High resolution (at 50/60 Hz)	78 dB
Best 50 Hz rejection	82 dB
Best 60 Hz rejection	89 dB
Differential input impedance	5.34 MΩ
Input noise	
High resolution	85 nV RMS
Best 50 Hz rejection, best 60 Hz rejection	150 nV RMS
High speed	1 µV RMS

Table 2. Gain Error and Offset Error

Timing Mode	Temperature	Gain Error (% of Reading)	Offset Error (µV)
High resolution, Best 50 Hz rejection, Best 60 Hz rejection	5 °C to 40 °C, typical	0.020%	2.4 µV
	5 °C to 40 °C, maximum	0.062%	5.4 µV
	-40 °C to 85 °C, maximum	0.104%	12.3 µV

Timing Mode	Temperature	Gain Error (% of Reading)	Offset Error (µV)
High speed	5 °C to 40 °C, typical	0.032%	2.4 µV
	5 °C to 40 °C, maximum	0.066%	5.4 µV
	-40 °C to 85 °C, maximum	0.116%	12.3 µV

Gain drift	±7 ppm/°C
Offset drift	±60 nV/°C
Offset error from source impedance	Add 95 nV per Ω
Input bias current	95 nA
Cold-junction compensation accuracy	
5 °C to 40 °C, typical	0.25 °C
5 °C to 40 °C, maximum	0.45 °C
-40 °C to 85 °C, maximum	1.2 °C

Temperature Measurement Accuracy

Measurement sensitivity[2]
High resolution

Types J, K, T, E, N	0.01 °C
Types R, S	0.02 °C
Type B	0.03 °C
Best 50 Hz rejection, best 60 Hz rejection	
Types J, K, T, E, N	0.02 °C
Types R, S	0.04 °C
Type B	0.06 °C
High speed	
Types J, K, T, E	0.05 °C
Type N	0.07 °C
Types R, S	0.18 °C
Type B	0.26 °C

The following thermocouple measurement tables and graphs show the module accuracy for each thermocouple type at 0 V common mode voltage. The tables include all measurement errors of the device including RMS noise. The tables do not include the accuracy of the thermocouple itself.

Table 3. Thermocouple Type K Measurement Accuracy (°C)

Temperature	High Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High Speed		
	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum
-100 °C	0.43	0.83	1.73	0.47	1.02	2.78
0 °C	0.31	0.58	1.33	0.34	0.73	2.14
100 °C	0.32	0.6	1.39	0.36	0.77	2.18
300 °C	0.36	0.72	1.58	0.42	0.92	2.4
400 °C	0.37	0.77	1.65	0.44	0.97	2.47
700 °C	0.43	0.96	1.97	0.54	1.2	2.83
900 °C	0.49	1.13	2.28	0.63	1.41	3.2
1000 °C	0.53	1.22	2.44	0.68	1.52	3.4
1100 °C	0.56	1.32	2.62	0.74	1.65	3.62
1300 °C	0.65	1.56	3.04	0.86	1.93	4.16

Error drift, thermocouple Type K (-100 °C to 1300 °C)	
5 °C to 40 °C	0.1 °C/10 °C
-40 °C to 85 °C	0.16 °C/10 °C

Figure 1. Thermocouple Type K Errors (High Resolution/Best 50 Hz Rejection/Best 60 Hz Rejection)

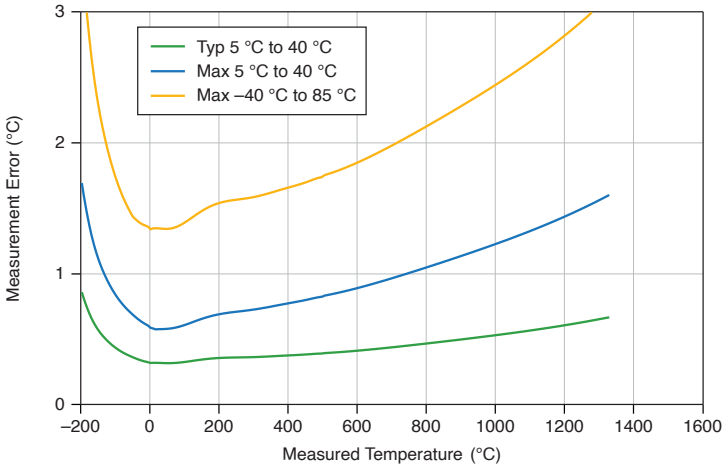


Figure 2. Thermocouple Type K Errors (High Speed)

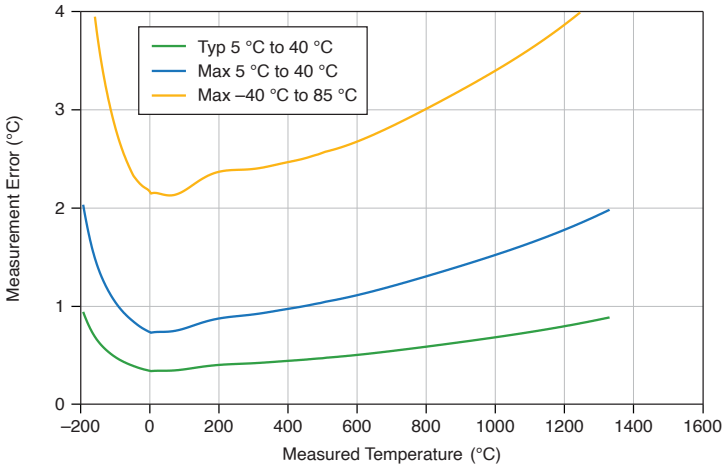


Table 4. Thermocouple Type J Measurement Accuracy (°C)

Temperature	High Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High Speed		
	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum
-100 °C	0.42	0.8	1.57	0.46	0.96	2.57
0 °C	0.32	0.59	1.29	0.34	0.73	2.1
100 °C	0.32	0.59	1.29	0.35	0.76	2.07
300 °C	0.35	0.71	1.48	0.41	0.9	2.26
400 °C	0.37	0.78	1.58	0.45	0.98	2.38
700 °C	0.39	0.87	1.68	0.49	1.09	2.43

Temperature	High Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High Speed		
	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum
900 °C	0.43	1.0	1.89	0.56	1.24	2.65
1000 °C	0.48	1.12	2.09	0.62	1.39	2.91
1100 °C	0.51	1.22	2.25	0.67	1.5	3.1

Error drift, thermocouple Type J (-100 °C to 1100 °C)	
5 °C to 40 °C	0.07 °C/10 °C
-40 °C to 85 °C	0.15 °C/10 °C

Figure 3. Thermocouple Type J Errors (High Resolution/Best 50 Hz Rejection/Best 60 Hz Rejection)

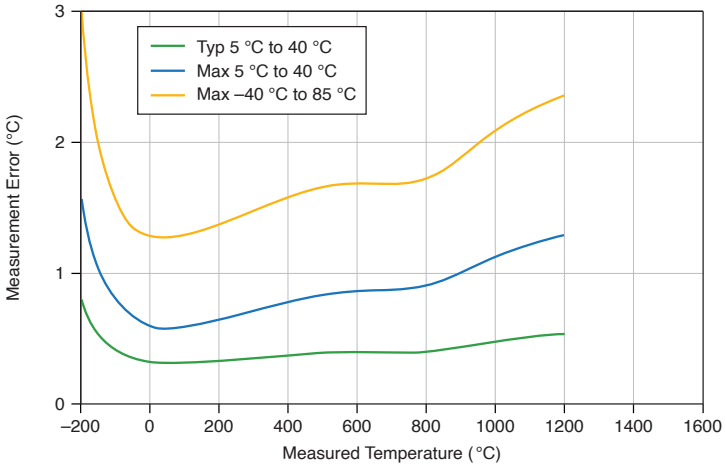


Figure 4. Thermocouple Type J Errors (High Speed)

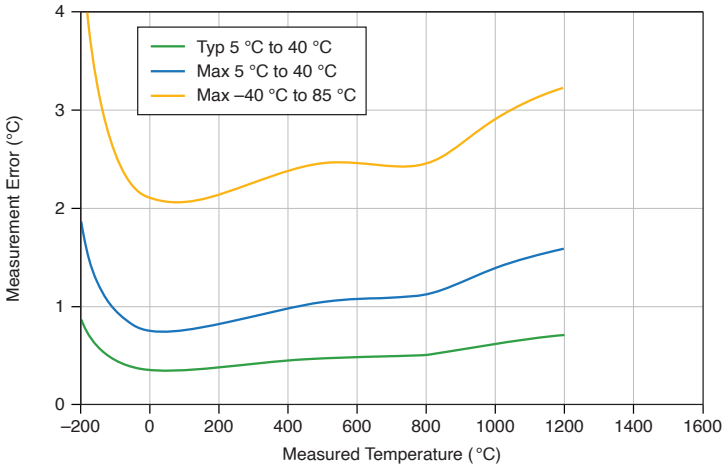


Table 5. Thermocouple Type N Measurement Accuracy (°C)

Temperature	High Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High Speed		
	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum
-100 °C	0.5	1.01	1.92	0.55	1.22	2.99
0 °C	0.39	0.75	1.56	0.42	0.93	2.44
100 °C	0.35	0.69	1.46	0.39	0.88	2.24
300 °C	0.33	0.7	1.41	0.39	0.89	2.08
400 °C	0.34	0.73	1.44	0.41	0.92	2.1
700 °C	0.38	0.88	1.66	0.48	1.1	2.32
900 °C	0.43	1.02	1.88	0.55	1.26	2.57
1000 °C	0.45	1.1	2.0	0.59	1.36	2.71
1100 °C	0.48	1.18	2.14	0.64	1.46	2.87

Error drift, thermocouple Type N (-100 °C to 1100 °C)	
5 °C to 40 °C	0.08 °C/10 °C

-40 °C to 85 °C	0.17 °C/10 °C

Figure 5. Thermocouple Type N Errors (High Resolution/Best 50 Hz Rejection/Best 60 Hz Rejection)

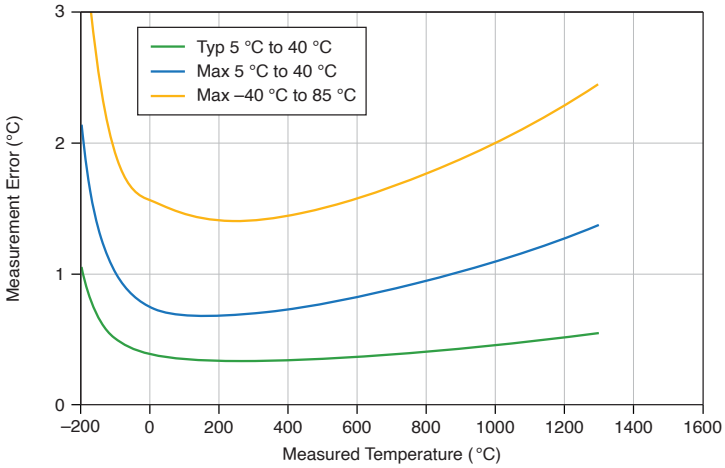


Figure 6. Thermocouple Type N Errors (High Speed)

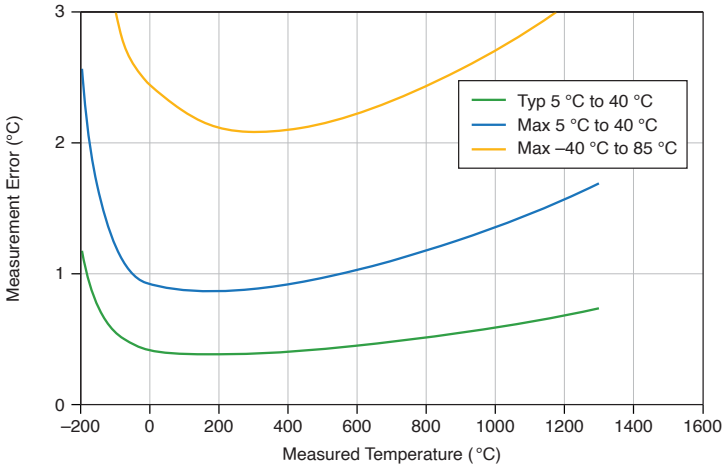


Table 6. Thermocouple Type T Measurement Accuracy (°C)

Temperature	High Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High Speed		
	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum
-100 °C	0.51	0.99	1.91	0.56	1.14	2.85
0 °C	0.36	0.67	1.32	0.38	0.79	2.12
100 °C	0.3	0.56	1.18	0.33	0.72	1.85

Temperature	High Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High Speed		
	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum
300 °C	0.28	0.57	1.14	0.33	0.72	1.7
400 °C	0.28	0.6	1.16	0.34	0.75	1.7

Error drift, thermocouple Type T (-100 °C to 400 °C)	
5 °C to 40 °C	0.09 °C/10 °C
-40 °C to 85 °C	0.19 °C/10 °C

Figure 7. Thermocouple Type T Errors (High Resolution/Best 50 Hz Rejection/Best 60 Hz Rejection)

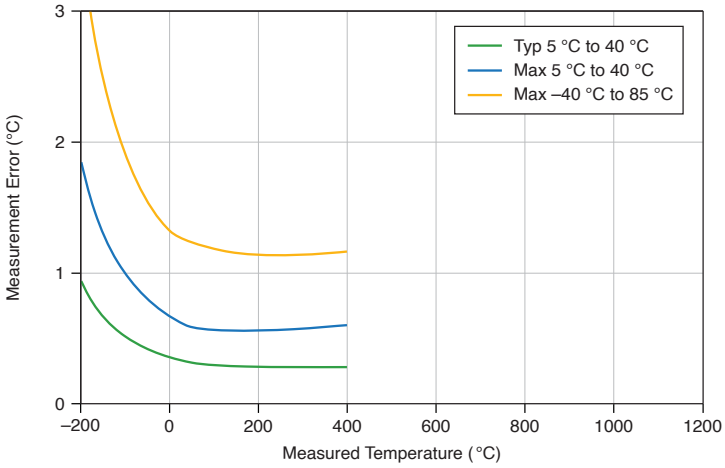


Figure 8. Thermocouple Type T Errors (High Speed)

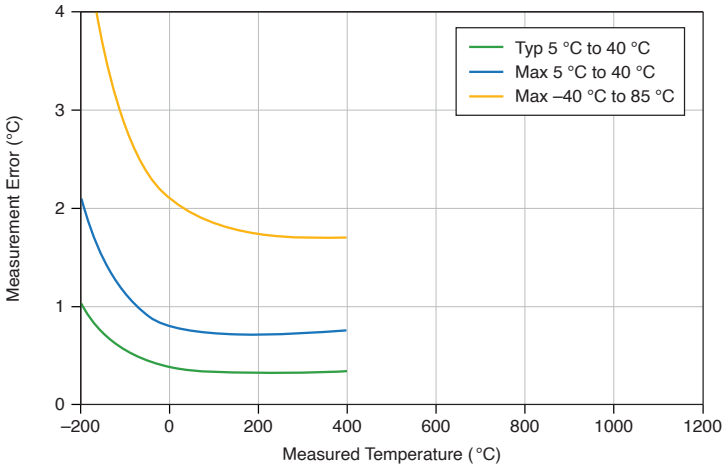


Table 7. Thermocouple Type E Measurement Accuracy (°C)

Temperature	High Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High Speed		
	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum
-100 °C	0.44	0.84	1.61	0.48	0.98	2.59
0 °C	0.32	0.59	1.22	0.34	0.7	2.01
100 °C	0.29	0.53	1.16	0.32	0.68	1.85
300 °C	0.29	0.59	1.19	0.34	0.74	1.82
400 °C	0.3	0.64	1.26	0.37	0.8	1.88
700 °C	0.37	0.84	1.58	0.47	1.04	2.24
900 °C	0.42	1.0	1.84	0.55	1.24	2.56
1000 °C	0.45	1.09	1.98	0.6	1.34	2.73

Error drift, thermocouple Type E (-100 °C to 1100 °C)	
5 °C to 40 °C	0.07 °C/10 °C
-40 °C to 85 °C	0.17 °C/10 °C

Figure 9. Thermocouple Type E Errors (High Resolution/Best 50 Hz Rejection/Best 60 Hz Rejection)

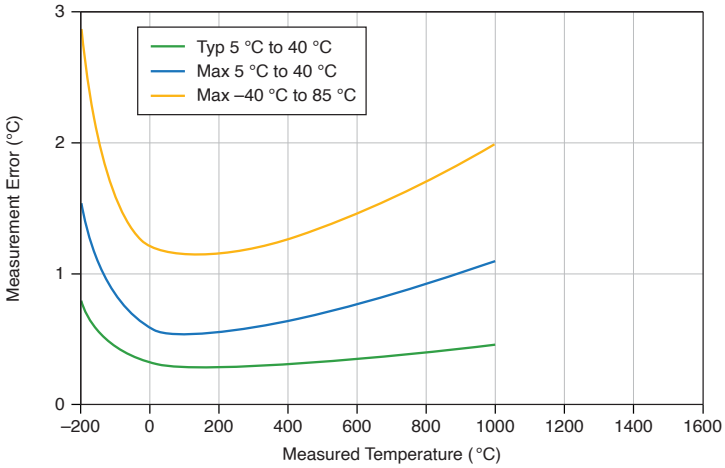


Figure 10. Thermocouple Type E Errors (High Speed)

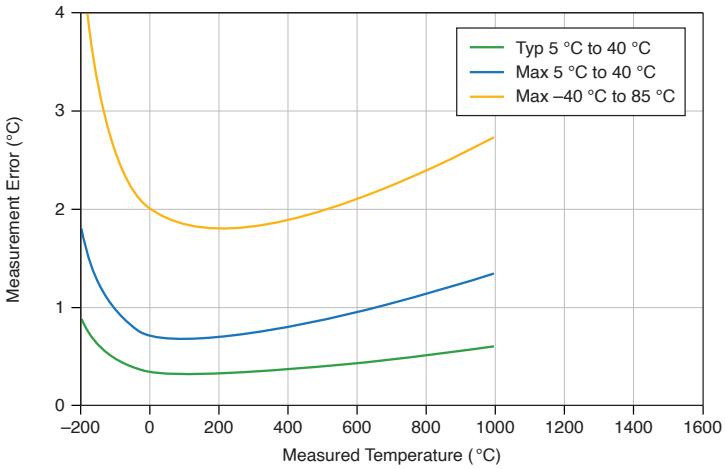


Table 8. Thermocouple Type B Measurement Accuracy (°C)

Temperature	High Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High Speed		
	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum
300 °C	0.98	2.43	4.86	1.16	3.27	5.71
500 °C	0.62	1.57	3.12	0.76	2.1	3.66
700 °C	0.52	1.3	2.51	0.64	1.71	2.93
900 °C	0.44	1.14	2.2	0.56	1.5	2.57
1100 °C	0.41	1.1	2.09	0.54	1.43	2.43
1400 °C	0.41	1.13	2.1	0.56	1.45	2.43

Temperature	High Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High Speed		
	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum
1700 °C	0.46	1.27	2.34	0.64	1.63	2.7

Error drift, thermocouple Type B (500 °C to 1800 °C)	
5 °C to 40 °C	0.12 °C/10 °C
-40 °C to 85 °C	0.13 °C/10 °C

Figure 11. Thermocouple Type B Errors (High Resolution/Best 50 Hz Rejection/Best 60 Hz Rejection)

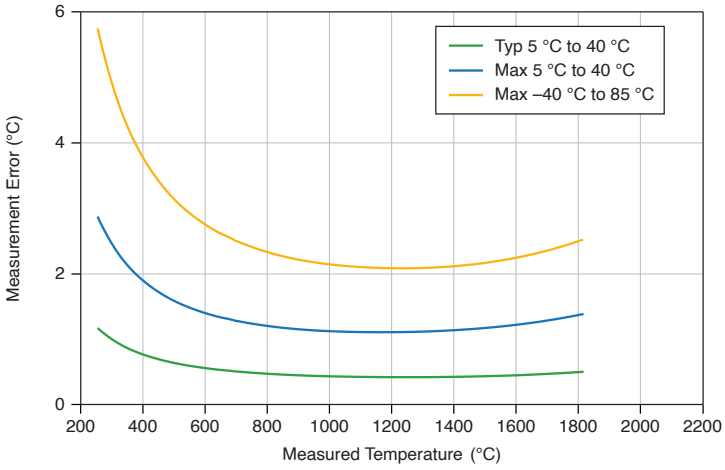


Figure 12. Thermocouple Type B Errors (High Speed)

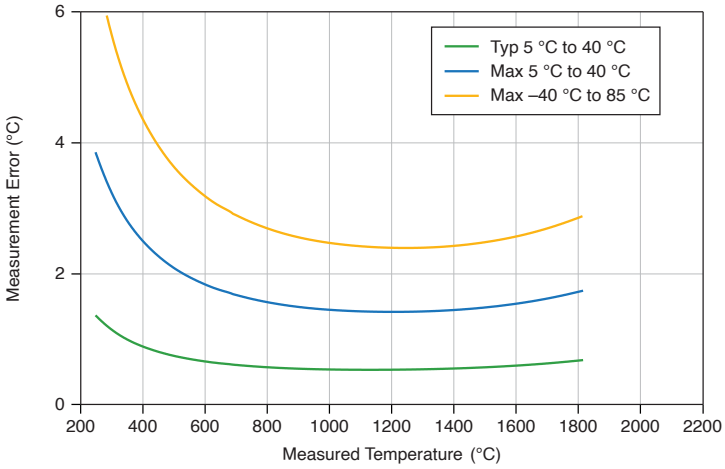


Table 9. Thermocouple Type R/S Measurement Accuracy (°C)

Temperature	High Resolution/Best 50 Hz Rejection/ Best 60 Hz Rejection			High Speed		
	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum	5 °C to 40 °C, Typical	5 °C to 40 °C, Maximum	-40 °C to 85 °C, Maximum
0 °C	0.89	1.99	3.7	1.0	2.48	4.28
100 °C	0.64	1.43	2.58	0.72	1.81	3.27
300 °C	0.55	1.27	2.27	0.64	1.6	2.84
500 °C	0.55	1.28	2.27	0.64	1.6	2.82
700 °C	0.56	1.36	2.36	0.68	1.68	2.89
900 °C	0.57	1.41	2.41	0.71	1.73	2.93
1100 °C	0.58	1.46	2.49	0.74	1.79	3.0
1400 °C	0.63	1.63	2.74	0.82	1.99	3.27

Error drift, thermocouple Type R/S (100 °C to 1400 °C)	
5 °C to 40 °C	0.11 °C/10 °C
-40 °C to 85 °C	0.17 °C/10 °C

Figure 13. Thermocouple Type R/S Errors (High Resolution/Best 50 Hz Rejection/Best 60 Hz Rejection)

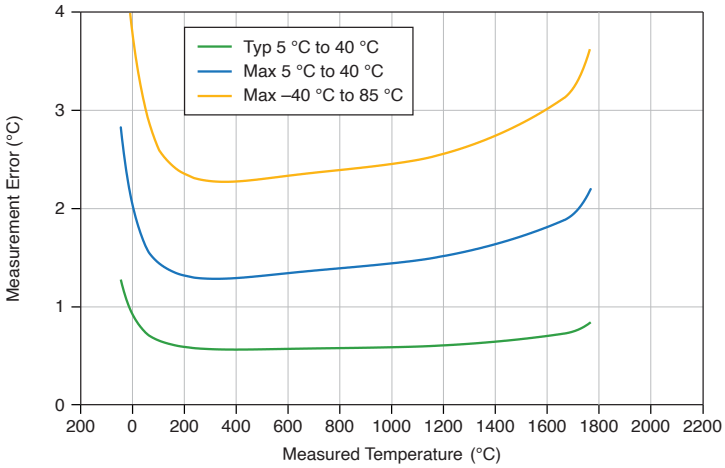
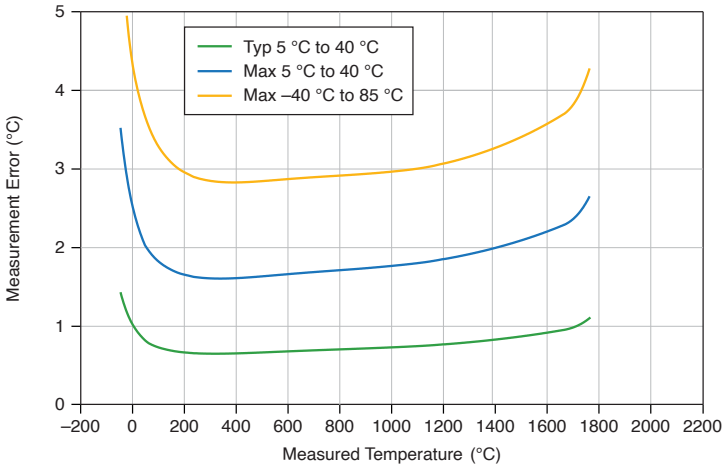


Figure 14. Thermocouple Type R/S Errors (High Speed)



Time-Based Triggers

Type	Start Trigger

Timing and Synchronization

Protocol	IEEE 802.1AS for network synchronization over 1000 Base-TX, full-duplex

Network synchronization accuracy[3]	<1 µs
Network synchronization accuracy with optimized configuration[4]	<100 ns

Note When configured to use IEEE 1588, performance of synchronization may vary from these specifications.

Network Interface

Network protocols	TCP/IP, UDP
Network ports used	HTTP:80 (configuration only), TCP:3580; UDP:5353 (configuration only), TCP:5353 (configuration only); TCP:31415; UDP:7865 (configuration only), UDP:8473 (configuration only)
Network IP configuration	DHCP + Link-Local, DHCP, Static, Link-Local
Default MTU size	1500 bytes

Ethernet

Number of ports	2 8-pin X-coded M12 ports, internally switched[5]

Network interface	1000 Base-TX, full-duplex; 1000 Base-TX, half-duplex; 100 Base-TX, full-duplex; 100 Base-TX, half-duplex; 10 Base-T, full-duplex; 10 Base-T, half-duplex
Communication rates	10/100/1000 Mbps, auto-negotiated
Maximum cabling distance	100 m/segment
Maximum hops per line[6]	15

Power Requirements

Notice The protection provided by the FD-11614 can be impaired if it is used in a manner not described in the ***FD-11614 User Guide***.

Voltage input range	
V_{in}	9 V DC to 30 V DC
V_{aux}	Up to 30 V DC

Maximum device power consumption[7]	5.7 W
Power input connector	5-pin L-coded male M12 connector

Power output connector	5-pin L-coded female M12 connector

Current Limits

Caution Exceeding the current limits may cause damage to the device. Stay below a maximum of 10 A shared between both Input and Aux terminals.

Power IN/OUT terminals	
V_{in}	10 A maximum
V_{aux}	10 A maximum total (combined with V_{in})
Recommended external overcurrent protection	16 A, slow blow fuse

Physical Characteristics

Dimensions	198.5 mm × 77.4 mm × 47.1 mm (7.8 in. × 3.0 in. × 1.9 in.)
Weight	1.18 kg (2 lb 9 oz)
Input connection	
Number	16
Type	Universal miniature thermocouple jack

Torque for M12 connectors (power, Ethernet)	0.6 N · m (5.31 lb · in.)

Calibration

Calibration interval	1 year

Environmental Characteristics

Temperature and Humidity

Refer to the ***FD-11614 User Guide*** for more information about meeting these specifications.

Temperature	
Operating	-40 °C to 85 °C
Storage	-40 °C to 100 °C
Operating and storage humidity	Up to 100% relative humidity, condensing or noncondensing
Ingress protection	IP65/IP67
Pollution Degree	4
Maximum altitude	5,000 m

Note Failure to follow the mounting instructions in the ***FD-11614 User Guide*** can cause temperature derating.

Note To protect against ESD, water, and dirt, install unconnected mini-TC plugs into all unused terminals, and install FD-11940, Mini-TC Connector Protection Boot (Qty 16) (NI part number 786395-01) on all mini-TC plugs.

Note If your application is subject to high vibration or shock, NI recommends 0.5 mm^2 (20 AWG) or larger thermocouple wire. Strain relieve all cables as close to the device as possible.

Note M12 connectors must be mated to cables or have caps installed on them to meet IP65/IP67 requirements. Cover the unused connectors with the included plastic caps or optional metal caps whenever water, dust, or dirt are present.

Note Avoid long periods of exposure to sunlight.

Shock and Vibration

Operating vibration	
Random	10 g RMS, 5 Hz to 2,000 Hz
Sinusoidal	10 g, 20 Hz to 2,000 Hz 12.4 mm minimum pk-pk displacement, 5 Hz to 20 Hz
Operating shock	100 g, 11 ms half sine, 3 shocks at 6 orientations, 18 total 40 g, 6 ms half sine, 4,000 shocks at 6 orientations, 24,000 total

Environmental Standards

This product meets the requirements of the following environmental standards for electrical equipment.

- IEC 60068-2-1 Cold
- IEC 60068-2-2 Dry heat
- IEC 60068-2-6 Sinusoidal operating vibration
- IEC 60068-2-27 Operating shock
- IEC 60068-2-30 Damp heat cyclic (12 + 12h cycle)
- IEC 60068-2-64 Random operating vibration

Note To verify marine approval certification for a product, refer to the product label or visit ni.com/product-certifications and search for the certificate.

Safety Voltages

Connect only voltages that are within the following limits:

Channel-to-channel isolation	
Continuous working voltage[8]	
Transient overvoltage[9]	1,000 V RMS, verified by 5 s withstand
Channel-to-earth ground isolation	
Continuous working voltage	
Transient overvoltage	1,000 V RMS, verified by 5 s withstand

Overvoltage protection[10]	±30 V between TC+ and TC-

These test and measurement circuits are ***not*** rated for measurements performed on circuits directly connected to the electrical distribution system referred to as MAINS.

MAINS is a hazardous live electrical supply system to which equipment is designed to be connected to for the purpose of powering equipment. This product is rated for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.

Warning Do not connect the FD-11614 to signals or use for measurements within Measurement Categories II, III, or IV, or for measurements on MAINs circuits or on circuits derived from Overvoltage Category II, III, or IV which may have transient overvoltages above what the product can withstand. The product must not be connected to circuits that have a maximum voltage above the continuous working voltage, relative to earth or to other channels, or this could damage and defeat the insulation. The product can only withstand transients up to the transient overvoltage rating without breakdown or damage to the insulation. An analysis of the working voltages, loop impedances, temporary overvoltages, and transient overvoltages in the system must be conducted prior to making measurements.

Safety Compliance Standards

This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA C22.2 No. 61010-1

Note For safety certifications, refer to the product label or the Product Certifications and Declarations section.

Electromagnetic Compatibility Standards

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-003: Class A emissions

Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.

Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.

Notice For EMC declarations and certifications, and additional information, refer to the Product Certifications and Declarations section.

Note To ensure the specified EMC performance, operate this product only with shielded Ethernet cables.

CE Compliance CE

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

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)

Product Certifications and Declarations

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI products, visit ni.com/product-certifications, search by model number, and click the appropriate link.

Environmental Management

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.

For additional environmental information, refer to the ***Engineering a Healthy Planet*** web page at ni.com/environment. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

EU and UK Customers

- **Waste Electrical and Electronic Equipment (WEEE)**—At the end of the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit ni.com/environment/weee.

电子信息产品污染控制管理办法（中国RoHS）

- **中国RoHS**— NI符合中国电子信息产品中限制使用某些有害物质指令(RoHS)。关于NI中国RoHS合规性信息，请登录 `ni.com/environment/rohs_china`。(For information about China RoHS compliance, go to `ni.com/environment/rohs_china`.)