FD-11601 Specifications

2025-07-07

Contents

FD-11601 Specifications

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These specifications apply to the FD-11601.

Revision History

Version	Date changed	Description
377532B-01	June 2025	Added pinout.
377532A-01	April 2019	Initial release.

Looking For Something Else?

For information not found in the specifications for your product, such as operating instructions, browse ***Related Information***.

Related information:

- FD-11601 User Manual
- FD-11601 Calibration Procedure
- NI-DAQmx User Manual
- Software and Driver Downloads
- Release Notes
- License Setup and Activation
- Dimensional Drawings
- Product Certifications
- Letter of Volatility
- Discussion Forums
- NI Learning Center

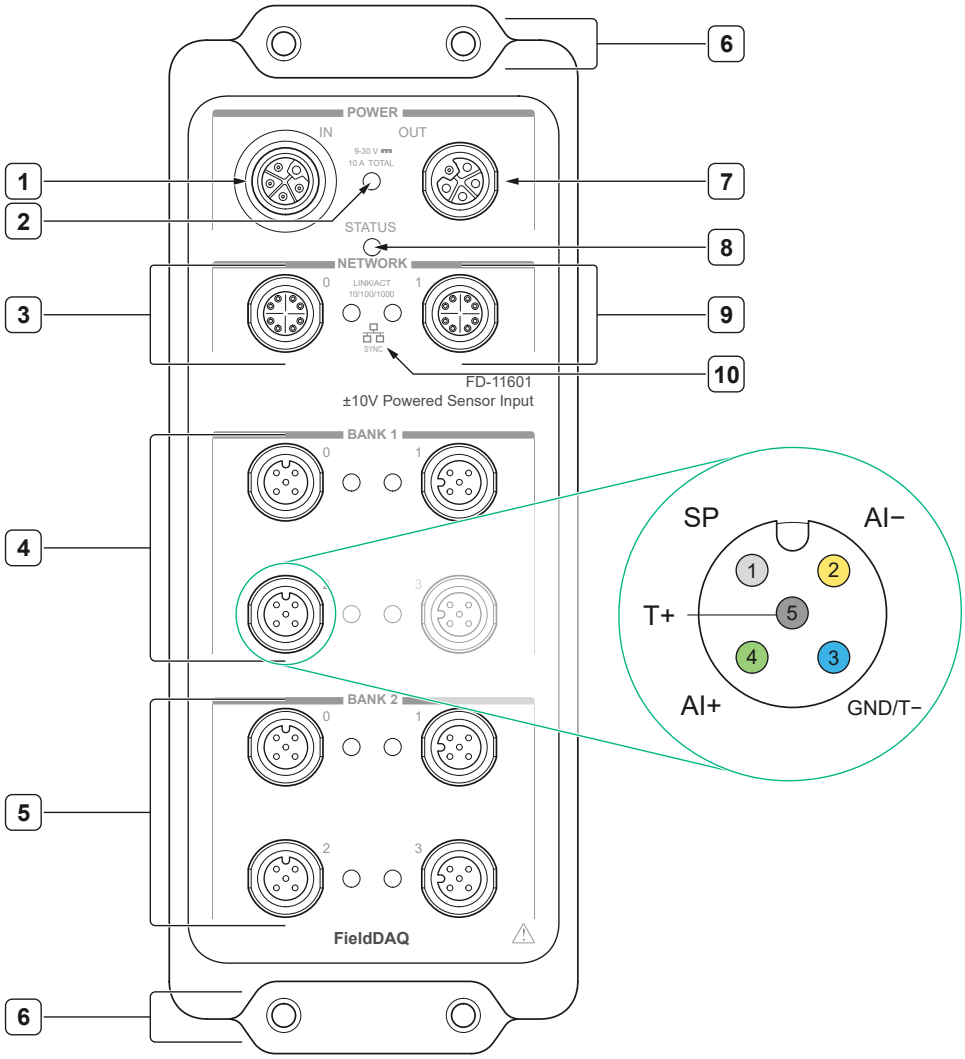
Conditions

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

FD-11601 Front Panel

Use the front panel to locate the connectors, LEDs, and mounting holes on the FD-11601.

Figure 1. FD-11601 Front Panel



1. Power IN Connector
2. Power LED
3. Ethernet Port 0 and LED
4. Bank 1 Voltage Input Connectors 0 through 3 and LEDs
5. Bank 2 Voltage Input Connectors 0 through 3 and LEDs
6. Mounting Holes
7. Power OUT Connector
8. STATUS LED

9. Ethernet Port 1 and LED
10. SYNC Logo

Voltage Input Connectors Pinout

The FD-11601 features eight 5-pin A-coded M12 connectors: Bank 1 connectors 0 through 3 and Bank 2 connectors 0 through 3. The following figure shows the pinout of a voltage input connector.

Figure 2. FD-11601 Pinout

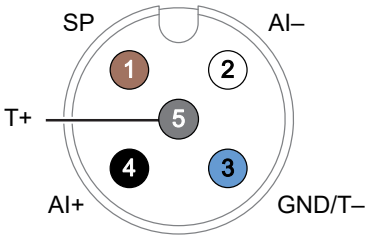


Table 1. Signal Descriptions

Pin Number	Wire Color*	Signal	Description
1	Brown	SP	Sensor power
2	White	AI-	Negative analog input voltage signal
3	Blue	GND/T-	Sensor power ground and TEDS return
4	Black	AI+	Positive analog input voltage signal
5	Gray	T+	TEDS data

* Wire color pertains to SHM125M I/O cables sold through NI. Other manufacturers' cable wire colors may vary.

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 whenever water, dust, or dirt are present.

Power Connector Pinout

The following figure shows the pinout of the Power IN connector.

Figure 3. Power Connector Pinout

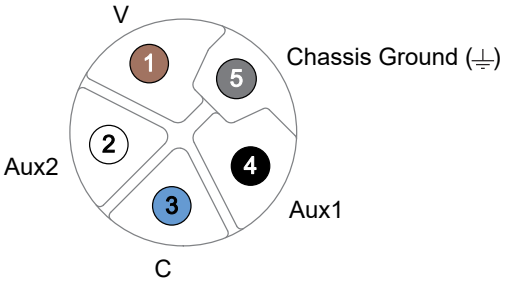


Table 2. Signal Descriptions

Pin Number	Wire Color*	Signal	Description
1	Brown	V	Positive voltage line
2	White	Aux2	Optional line for powering non-FieldDAQ devices
3	Blue	C	Common. Negative voltage line
4	Black	Aux1	Optional line for powering non-FieldDAQ devices
5	Gray	⏚	Chassis Ground. This terminal is internally connected to the C terminal.

* Wire color pertains to M125F power cables sold through NI. Other manufacturers' cable wire colors may vary.

Ethernet Ports

The FD-11601 has two 8-pin X-coded M12 Ethernet ports—0 and 1.

You can use a shielded straight-through Ethernet or an Ethernet crossover cable with either of the Ethernet ports to network your device to a computer host, NI Linux Real-Time controller, another FieldDAQ device, or any network connection on the same subnet. Refer to ***Topology Options*** for more information about using these ports in various topologies.

Figure 4. Ethernet Connector Pinout

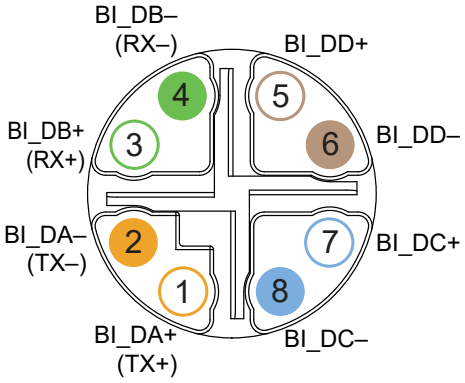


Table 3. Signal Descriptions

Pin Number	Wire Color	Gigabit Ethernet Signal	Fast Ethernet Signal
1	Orange/White	BI_DA+	TX+
2	Orange	BI_DA-	TX-
3	Green/White	BI_DB+	RX+
4	Green	BI_DB-	RX-
5	Brown/White	BI_DD+	No Connect
6	Brown	BI_DD-	No Connect
7	Blue/White	BI_DC+	No Connect
8	Blue	BI_DC-	No Connect

You can use the Ethernet ports to reset the FieldDAQ device to factory-default settings. Refer to ***Resetting the FieldDAQ to Factory-Default Settings*** for more information.

Cap the Ethernet ports when not in use.

Related information:

- Topology Options
- Resetting the FieldDAQ to Factory-Default Settings

Input Characteristics

Number of channels	8 analog input channels
Isolation	Galvanic isolation between channels and to chassis
Input voltage range (AI+ to AI-)	±10.5 V
ADC resolution	24 bits
Type of ADC	Delta-Sigma (with analog prefiltering)
Sample mode	Simultaneous
TEDS support	IEEE 1451.4 TEDS Class 2

Table 4. Timebases (f_M)

Frequency	13.1072 MHz, 12.8 MHz, 12.288 MHz, 10.24 MHz
Accuracy	±30 ppm maximum

Base clocks can be synchronized with other FieldDAQ devices using the network synchronization feature.

Table 5. Sampled data rate range (f_S)

Minimum	500 Samples/s
Maximum	102.4 kSamples/s

Sampled data rates (f_S)	Refer to the following table for sample data rates supported for each timebase

Table 6. Timebases (f_M) and Supported Sampled Data Rates (f_S), (kSamples/s)

13.1072 MHz	12.8 MHz	12.288 MHz	10.24 MHz
102.4	100.0	96.0	80.0
51.2	50.0	48.0	40.0
34.133	33.333	32.0	26.667

13.1072 MHz	12.8 MHz	12.288 MHz	10.24 MHz
25.6	25.0	24.0	20.0*
20.48	20.0	19.2	16.0
17.067	16.667	16.0*	13.333
12.8	12.5	12.0	10.0*
10.24	10.0	9.6	8.0
8.533	8.333	8.0*	6.667
6.4	6.25	6.0	5.0*
5.12	5.0	4.8	4.0
4.267	4.167	4.0*	3.333
3.2	3.125	3.0	2.5*
2.56	2.5	2.4	2.0
2.133	2.083	2.0*	1.667
1.6	1.563	1.5	1.25*
1.28	1.25	1.2	1.0
1.067	1.042	1.0*	0.833
0.8	0.781	0.75	0.625
0.64	0.625	0.6	0.5

Note For sample rates that can be obtained using two different timebases, the lowest noise (highest resolution) option is indicated with an asterisk (*).

Input impedance (AI+ to AI-)	>1 GΩ
Input capacitance (AI+ to AI-)	440 pF

Table 7. Accuracy

Temperature	Gain Error (% of Reading)	Offset Error (% of Range, mV)[1]
5 °C to 40 °C, typical	0.013%	0.001%, 0.105 mV

1. Range equals 10.5 V.

Temperature	Gain Error (% of Reading)	Offset Error (% of Range, mV)
5 °C to 40 °C, maximum	0.037%	0.01%, 1.05 mV
-40 °C to 85 °C, maximum	0.062%	0.02%, 2.1 mV

Table 8. Sampled data rate noise

1 kSample/s	7 µV RMS
10 kSamples/s	20 µV RMS
102.4 kSamples/s	40 µV RMS

Table 9. Stability

Gain drift	±4 ppm/°C
Offset drift	±5 µV/°C

Gain mismatch (channel-to-channel, 40 kHz)	0.035 dB maximum
Phase mismatch (channel-to-channel)	0.03°/kHz maximum
Phase nonlinearity (f_S = 102.4 kSamples/s)	0.1° maximum
Crosstalk (1 kHz)	-110 dB
CMRR to chassis/earth (f_{in} = 60 Hz)	130 dB
Spurious Free Dynamic Range (SFDR), (1 kHz, -60 dBFS)	130 dBFS
Total Harmonic Distortion (THD), (1 kHz, -1 dBFS)	-102 dB
MTBF	864,132 hours at 25 °C; Bellcore Issue 6, Method 1, Case 3, Limited Part Stress Method

Powered Sensor Excitation

Nominal output voltage range	5 V to 24 V
Power-on output state	Channels off[2]

2. During the power down of the FD-11601, the sensor power excitation output may experience a glitch of up to 1.5 V.

Settling time to 1% of final value	100 ms

Figure 5. Tolerance vs Output Voltage (5 °C to 40 °C, 1 mA Output)

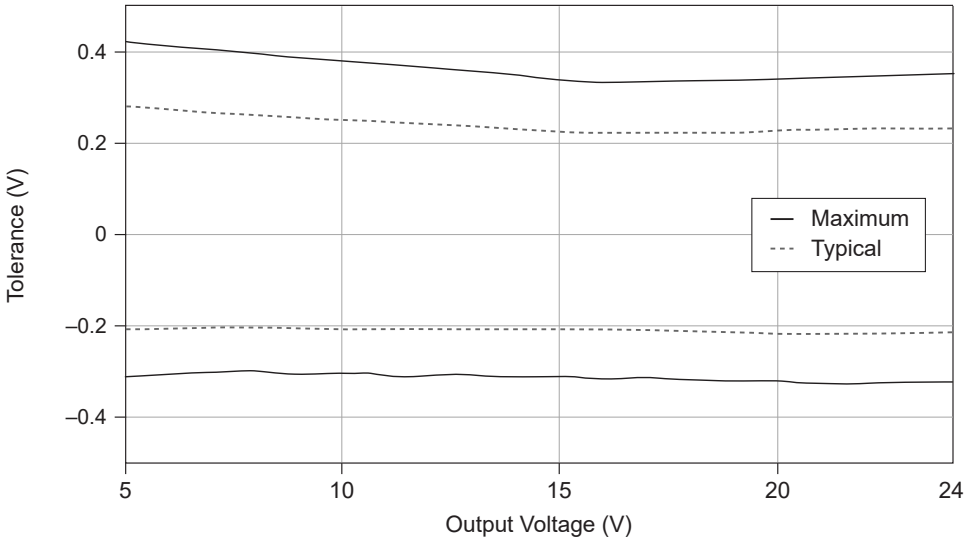


Table 10. Temperature Coefficient

Typical	-2.5 mV/°C
Maximum	-5.2 mV/°C to +3.5 mV/°C

Load regulation	-2.2 mV/mA
Resolution	10 bits
Voltage noise, RMS, 100 kHz BW	3 mV

Figure 6. Maximum Output Current vs Output Voltage

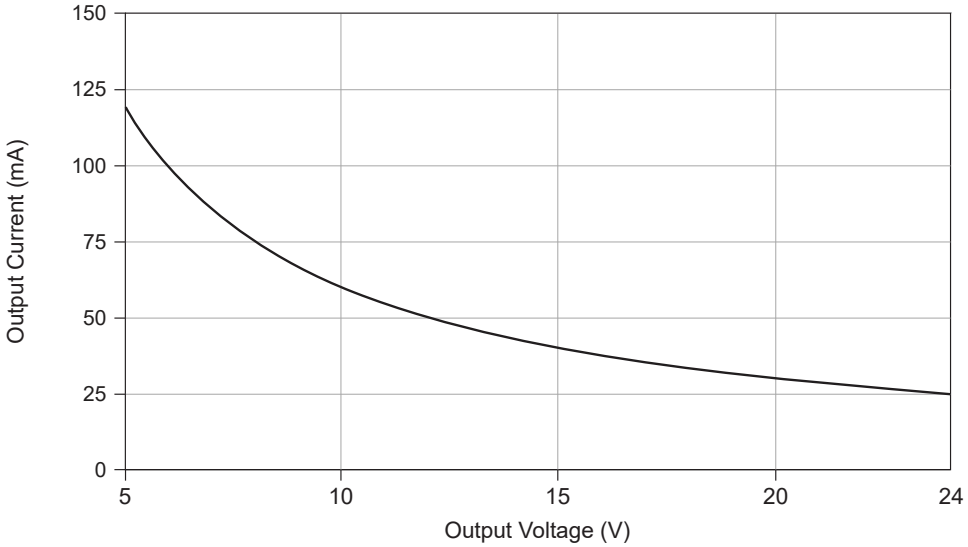
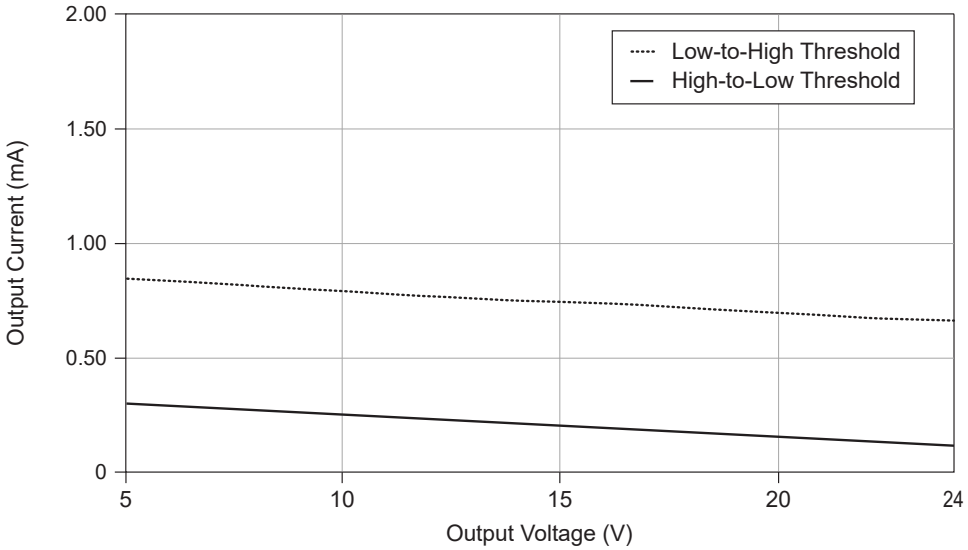


Figure 7. Sensor Detection Threshold



Filtering

Brickwall Filter (Default)

Input delay	$36/f_S + 1.65\ \mu s$
Input delay tolerance	±150 ns

Table 11. Brickwall Filter Passband Frequency and Flatness

Frequency	DC to $0.4 \cdot f_S$

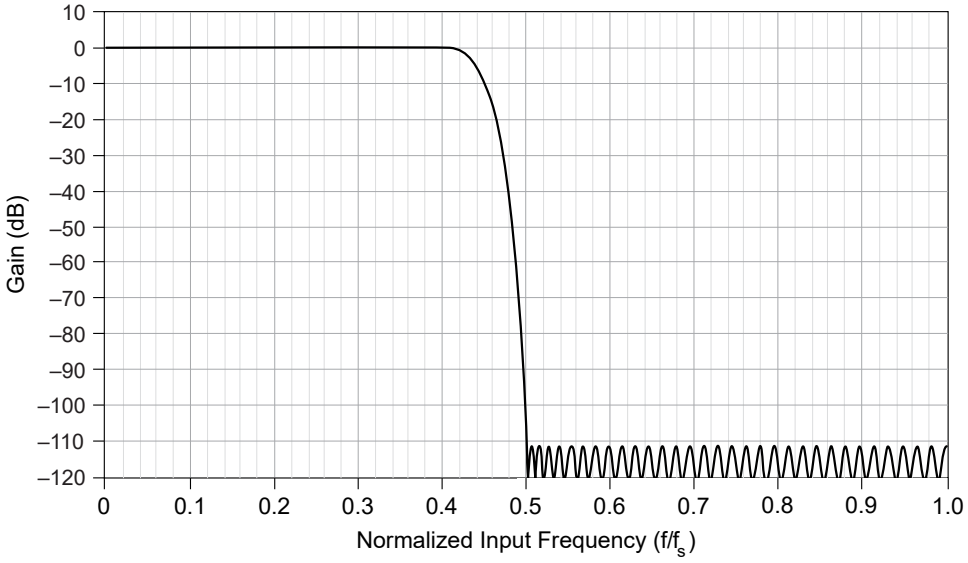
Flatness	-0.02 dB maximum at 0 kHz to 10 kHz
	-0.03 dB maximum at 0 kHz to 20 kHz
	-0.075 dB maximum at 0 kHz to 40 kHz

Table 12. Brickwall Filter Stopband Frequency and Rejection

Frequency	At or above 0.5 · f_S
Rejection	100 dB

Alias-free bandwidth	0.5 · f_S

Figure 8. Brickwall Filter Magnitude Response



Butterworth Filter

Butterworth filtering is supported in NI-DAQmx 18.6 and later. Previous versions of NI-DAQmx support only brickwall filtering

Input delay tolerance	±150 ns
Filter order	2nd or 4th order

Table 13. Butterworth Filter Cutoff Frequencies (-3 dB Point) for Available Timebases

13.1072 MHz	12.8 MHz	12.288 MHz	10.24 MHz
4,096 Hz	4,000 Hz	3,840 Hz	3,200 Hz
2,048 Hz	2,000 Hz	1,920 Hz	1,600 Hz
1,024 Hz	1,000 Hz	960 Hz	800 Hz
512 Hz	500 Hz	480 Hz	400 Hz
256 Hz	250 Hz	240 Hz	200 Hz
128 Hz	125 Hz	120 Hz	100 Hz

Table 14. Butterworth Filter Input Delay for Available Timebases (f_M)

Timebase	Cutoff	4th Order		2nd Order	
		Input Delay	Maximum Input Delay	Input Delay	Maximum Input Delay
13.1072 MHz	4,096 Hz	436.2 µs	457.5 µs	398.8 µs	405.2 µs
	2,048 Hz	537.2 µs	580.5 µs	453.5 µs	466.5 µs
	1,024 Hz	740.5 µs	827.5 µs	563.2 µs	589.3 µs
	512 Hz	1.1466 ms	1.3209 ms	783.0 µs	835.0 µs
	256 Hz	1.9585 ms	2.3047 ms	1.2226 ms	1.3264 ms
	128 Hz	3.5833 ms	4.2771 ms	2.0826 ms	2.2925 ms
12.8 MHz	4,000 Hz	446.6 µs	468.5 µs	408.3 µs	414.9 µs
	2,000 Hz	550.1 µs	594.4 µs	464.3 µs	477.6 µs
	1,000 Hz	758.2 µs	847.4 µs	576.7 µs	603.4 µs
	500 Hz	1.1741 ms	1.3526 ms	801.8 µs	855.0 µs
	250 Hz	2.0055 ms	2.3600 ms	1.2519 ms	1.3582 ms
	125 Hz	3.6693 ms	4.3797 ms	2.1326 ms	2.3475 ms
12.288 MHz	3,840 Hz	465.2 µs	487.9 µs	425.3 µs	432.1 µs
	1,920 Hz	572.9 µs	619.1 µs	483.6 µs	497.5 µs
	960 Hz	789.8 µs	882.6 µs	600.7 µs	628.5 µs
	480 Hz	1.2229 ms	1.4089 ms	835.1 µs	890.5 µs

Timebase	Cutoff	4th Order		2nd Order	
		Input Delay	Maximum Input Delay	Input Delay	Maximum Input Delay
	240 Hz	2.0889 ms	2.4582 ms	1.3040 ms	1.4147 ms
	120 Hz	3.8221 ms	4.5621 ms	2.2213 ms	2.4453 ms
10.24 MHz	3,200 Hz	557.9 µs	585.2 µs	510.0 µs	518.2 µs
	1,600 Hz	687.2 µs	742.5 µs	580.0 µs	596.6 µs
	800 Hz	947.4 µs	1.0588 ms	720.5 µs	753.9 µs
	400 Hz	1.4672 ms	1.6903 ms	1.0018 ms	1.0683 ms
	200 Hz	2.5064 ms	2.9496 ms	1.5644 ms	1.6974 ms
	100 Hz	4.5861 ms	5.4742 ms	2.6653 ms	2.9340 ms

Figure 9. Butterworth Filter Magnitude Response (4th Order, with 12.8 MHz Timebase)

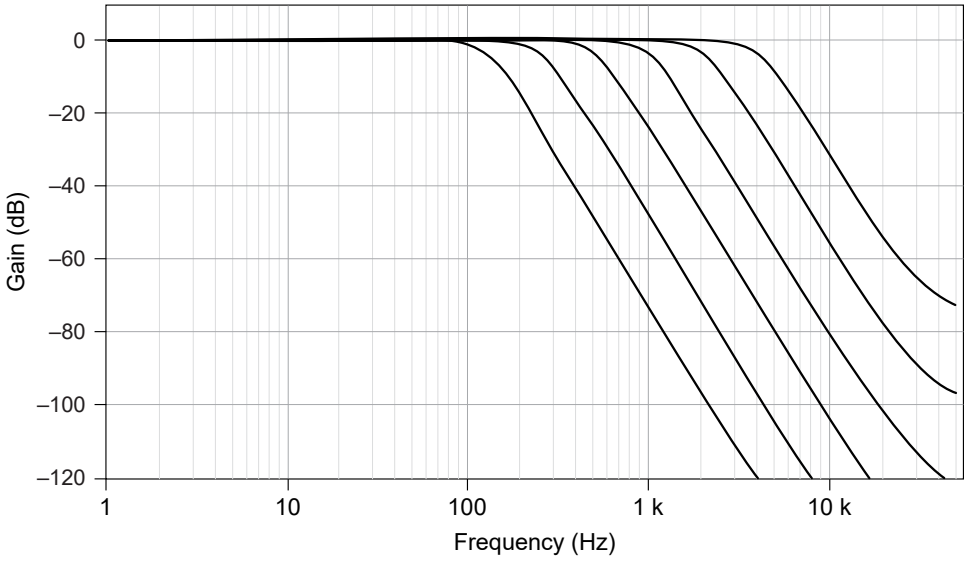


Figure 10. Butterworth Filter Magnitude Response (2nd Order, with 12.8 MHz Timebase)

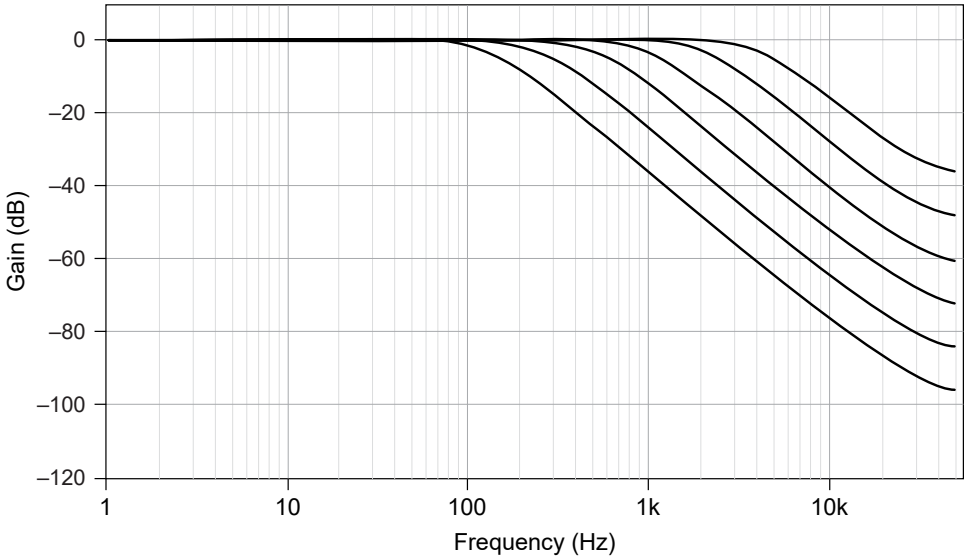


Figure 11. Butterworth Filter Input Delay (4th Order, with 12.8 MHz Timebase, 4 kHz, 2 kHz, 1 kHz Filter)

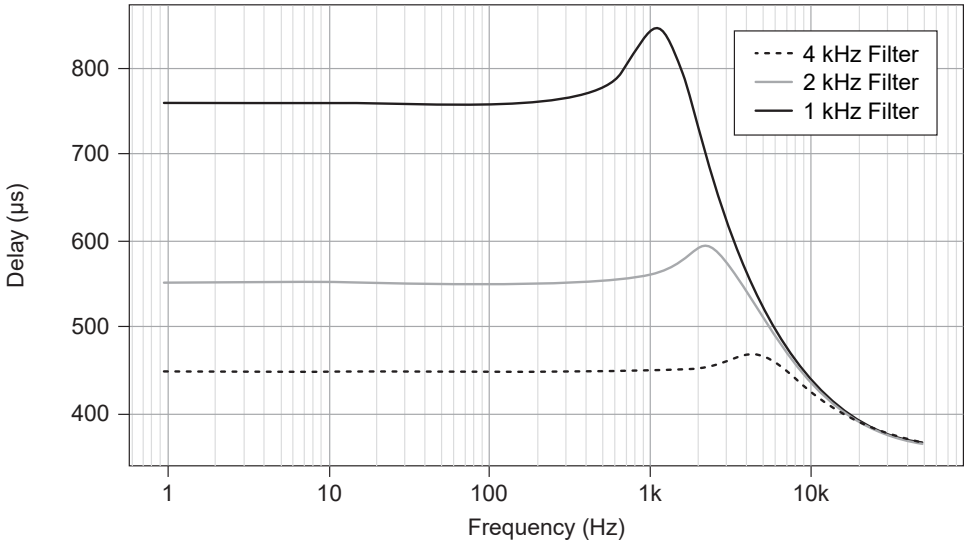


Figure 12. Butterworth Filter Input Delay (4th Order, with 12.8 MHz Timebase, 500 Hz, 250 Hz, 125 Hz

Filter)

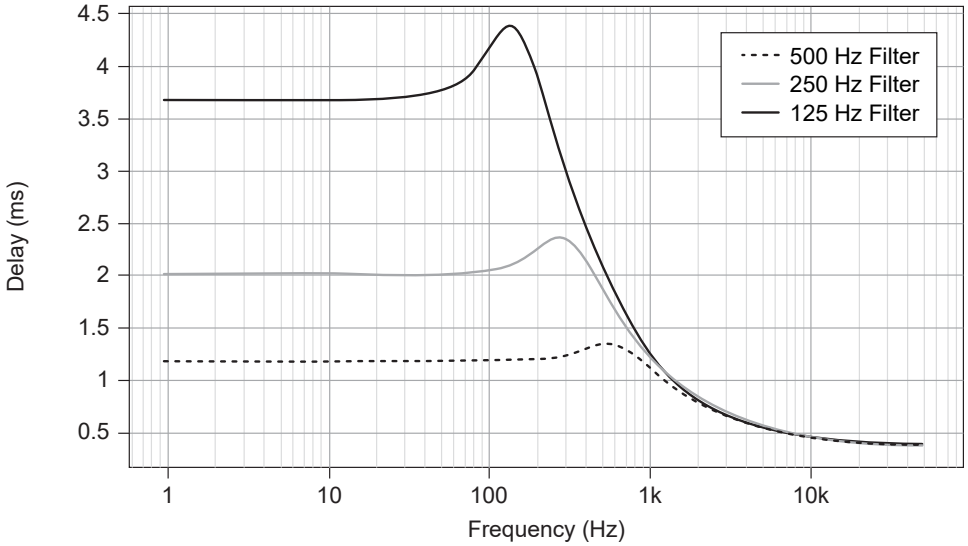


Figure 13. Butterworth Filter Input Delay (2nd Order, with 12.8 MHz Timebase,4 kHz, 2 kHz, 1 kHz Filter)

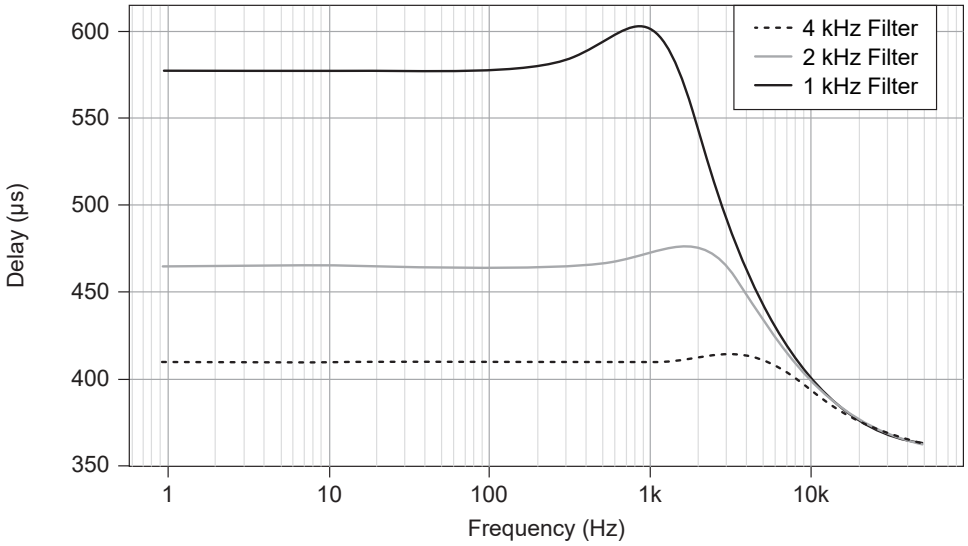
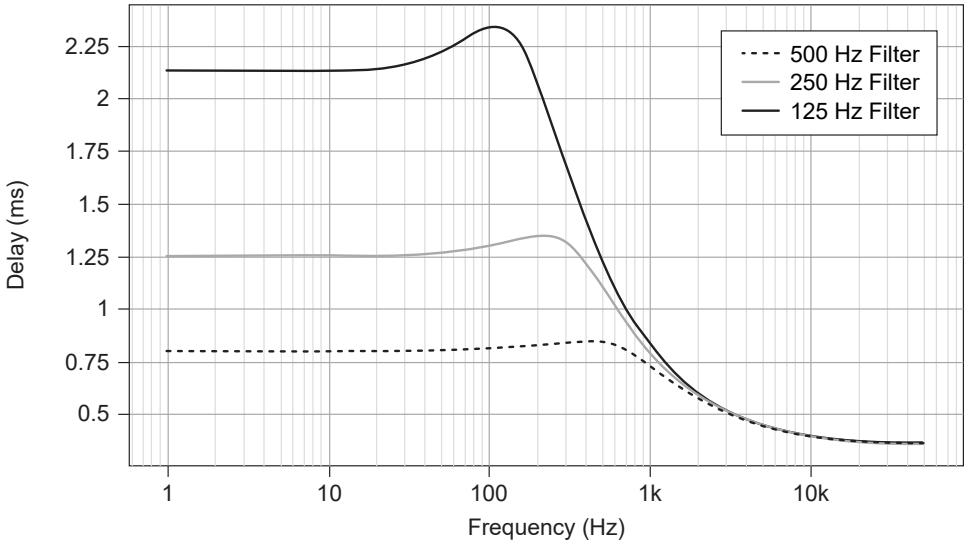


Figure 14. Butterworth Filter Input Delay (2nd Order, with 12.8 MHz Timebase, 500 Hz, 250 Hz, 125 Hz

Filter)

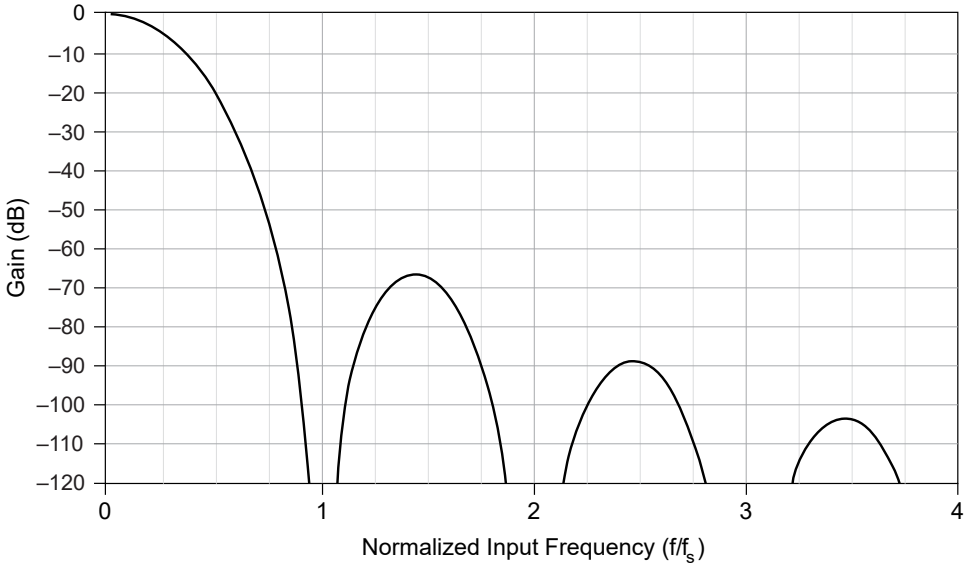


Comb Filter

Comb filtering is supported in NI-DAQmx 18.6 and later. Previous versions of NI-DAQmx support only brickwall filtering.

Input delay	$5/f_S + 1.65\ \mu s$
Input delay tolerance	±150 ns
Notches	$f_S, 2f_S, 3f_S, \ldots$

Figure 15. Comb Filter Magnitude Response



Time-Based Triggers

Type	Start Trigger, Sync Pulse

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.

For information about network synchronization accuracy, refer to ***NI-DAQmx-Based TSN Synchronization Accuracy Explained***. For information about achieving high-accuracy synchronization, refer to ***How to Achieve High-Accuracy Measurements With NI-DAQmx-Based TSN Devices***.

Related information:

- NI-DAQmx-Based TSN Synchronization Accuracy Explained
- How to Achieve High-Accuracy Measurements With NI-DAQmx-Based TSN Devices

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

3. I/O synchronization is system-dependent. Assumes the devices are connected in a line topology.
4. I/O synchronization is system-dependent. Assumes a system containing one hop.

	only)
Network IP configuration	DHCP + Link-Local, DHCP, Static, Link-Local
Default MTU size	1,500 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	10/100/1,000 Mbps, auto-negotiated
Maximum cabling distance	100 m/segment
Maximum hops per line[6]	15

For information about creating reliable Ethernet-based systems, refer to ***Designing Distributed TSN Ethernet-Based Measurement Systems***.

Related information:

- Designing Distributed TSN Ethernet-Based Measurement Systems

Power Requirements

Table 15. Voltage Input Range

V_{in}	9 V DC to 30 V DC
V_{aux}	Up to 30 V DC

Table 16. Device Power Consumption

Nominal	With sensor power excitation off	7.0 W

5. This allows for line topologies or network redundancy.
6. With default software configuration.

	With sensor power excitation on[7]	13.5 W
Maximum with sensor power excitation on[8]		16.0 W

Current Limits

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

Table 17. 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

Table 18. Dimensions and Weight

Dimensions	198.5 mm × 77.4 mm × 47.1 mm (7.8 in. × 3.0 in. × 1.9 in.)
Weight	1.2 kg (42 oz)

Table 19. Input Connection

Number	8
Type	5-pin A-coded M12 connectors

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

7. The total amount of power drawn by the device from the power input connector, including power delivered to external sensors.
8. The total amount of power drawn by the device from the power input connector, including power delivered to external sensors.

Calibration

Calibration interval	1 year

Environmental Characteristics

Refer to the ***FD-11601 User Manual*** for more information about meeting these specifications.

Table 20. Temperature

Operating	-40 °C to 85 °C
Storage	-40 °C to 100 °C

Table 21. Humidity

Operating	Up to 100% relative humidity, condensing or noncondensing
Storage	Up to 100% relative humidity, condensing or noncondensing

Ingress protection	IP65/IP67
Pollution Degree	4
Maximum altitude	5,000 m

Notice Failure to follow the mounting instructions in the ***FD-11601 User Manual*** can cause temperature derating.

Notice To meet shock and vibration specifications in this document, you must panel mount the system.

Notice 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.

Notice Avoid long periods of exposure to sunlight.

Shock and Vibration

Table 22. Operating Vibration

Random	10 g RMS, 5 Hz to 2,000 Hz
Sinusoidal	10 g, 5 Hz to 2,000 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

Related information:

- FD-11601 User Manual

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 vibration
- IEC 60068-2-27 Shock
- IEC 60068-2-30 Damp heat, cyclic (12 h + 12 h cycle)
- IEC 60068-2-64 Broadband random vibration

Safety Voltages

The FD-11637 is rated for use in DRY or WET LOCATIONS. Do not connect hazardous

voltages to the FD-11601. A ***hazardous voltage*** is a voltage greater than 30 V RMS, 42.4 V peak, or 60 V DC in DRY LOCATIONS and 22.6 V peak or 35 V DC in WET LOCATIONS.

Rated Voltages

Connect only voltages that are within the following limits:

Between any two pins	60 V DC (Dry Locations); 35 V DC (Wet Locations)

Temporary Overvoltage Protection

Product has been designed to withstand power frequency overvoltage of relatively long duration as specified below. Voltages beyond these levels may cause permanent damage.

Between any two pins on the connector	±30 V DC

Isolation Voltages

- **Working Voltage**—The highest RMS value of the AC or DC voltage across the insulation that can continuously occur when the equipment is supplied at rated voltage.
- **Transient Overvoltage (Vpk)**—An overvoltage condition of a relatively short duration, a few milliseconds or less, oscillatory or non-oscillatory, usually highly damped.
- **Withstand**—The highest RMS value of AC or DC voltage to which the isolation barrier has been tested in order to verify the insulation can handle the working voltage electrical and mechanical stresses in normal use, verified with a 1 min. duration.

Table 23. Channel-to-Channel Isolation

Working Voltage	60 V DC (Dry Locations); 35 V DC (Wet Locations) Non-Mains
Withstand	1,000 V RMS, verified by 5 s withstand

Table 24. Channel-to-Earth Ground Isolation

Working Voltage	60 V DC (Dry Locations); 35 V DC (Wet Locations) Non-Mains
Withstand	1,000 V RMS, verified by 5 s withstand

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.

Hazardous Voltage Do not connect the product 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.

Tension dangereuse Ne pas connecter le produit à des signaux dans les catégories de mesure II, III ou IV et ne pas l'utiliser pour des mesures dans ces catégories, ou des mesures sur secteur ou sur des circuits dérivés de surtensions de catégorie II, III ou IV pouvant présenter des surtensions transitoires supérieures à ce que le produit peut supporter. Le produit ne doit pas être raccordé à des circuits ayant une tension maximale supérieure à la tension de fonctionnement continu, par rapport à la terre ou à d'autres voies, sous peine d'endommager et de compromettre l'isolation. Le produit peut

tomber en panne et son isolation risque d'être endommagée si les tensions transitoires dépassent la surtension transitoire nominale. Une analyse des tensions de fonctionnement, des impédances de boucle, des surtensions temporaires et des surtensions transitoires dans le système doit être effectuée avant de procéder à des mesures.

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
- ICES-001: Class A emissions

Note Group 1 equipment 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 Europe, Australia, New Zealand, and Canada (per CISPR 11) Class A equipment is intended for use in non-residential locations.

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

Notice Operate this product only with shielded cables and accessories.

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

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.