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Find the *National Instruments CF-6004* at our website: ***Click HERE***

USER GUIDE AND SPECIFICATIONS

NI CF-6004

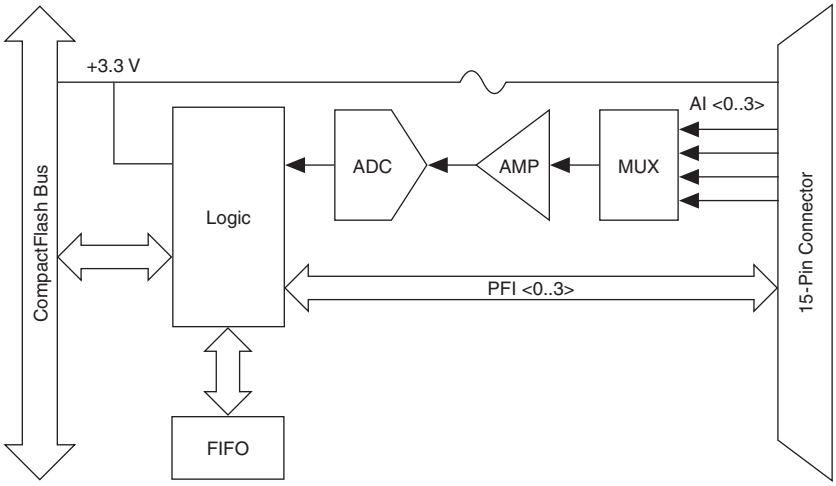
This user guide describes how to use the National Instruments CF-6004 data acquisition (DAQ) device and lists specifications. The NI CF-6004 provides connection to four analog input (AI) channels and four digital input/output (DIO) channels, with a type II CompactFlash interface.

Figure 1. NI CF-6004



Figure 2 shows key functional components of the NI CF-6004.

Figure 2. NI CF-6004 Block Diagram



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Safety Guidelines

Caution Operate the hardware only as described in these operating instructions.

The following section contains important safety information that you must follow when installing and using the NI CF-6004.

Do not operate the NI CF-6004 in a manner not specified in this document. Misuse of the device can result in a hazard. You can compromise the safety protection built into the device if the device is damaged in any way. If the device is damaged, contact National Instruments for repair.

Do not substitute parts or modify the device except as described in this document. Use the device only with the chassis, modules, accessories, and cables specified in the user guide. You must have all covers and filler panels installed during operation of the device.

Do not operate the device in an explosive atmosphere or where there may be flammable gases or fumes. If you must operate the device in such an environment, it must be in a suitably rated enclosure.

If you need to clean the device, use a dry cloth. Make sure that the device is completely dry and free from contaminants before returning it to service.

Operate the device only at or below Pollution Degree 2. Pollution is foreign matter in a solid, liquid, or gaseous state that can reduce dielectric strength or surface resistivity. The following is a description of pollution degrees:

- Pollution Degree 1 means no pollution or only dry, nonconductive pollution occurs. The pollution has no influence.
- Pollution Degree 2 means that only nonconductive pollution occurs in most cases. Occasionally, however, a temporary conductivity caused by condensation must be expected.
- Pollution Degree 3 means that conductive pollution occurs, or dry, nonconductive pollution occurs that becomes conductive due to condensation.

You must insulate signal connections for the maximum voltage for which the device is rated. Do not exceed the maximum ratings for the device. Do not install wiring while the device is live with electrical signals. Do not remove or add connector blocks when power is connected to the system. Avoid contact between your body and the connector block signal when hot swapping modules. Remove power from signal lines before connecting them to or disconnecting them from the device.

Operate the device at or below the Measurement Category I[1]. Measurement circuits are subjected to working voltages[2] and transient stresses (overvoltage) from the circuit to which they are connected during measurement or test. Measurement categories establish standard impulse

[1] Measurement Category as defined in electrical safety standard IEC 61010-1. Measurement Category is also referred to as Installation Category.

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withstand voltage levels that commonly occur in electrical distribution systems. The following is a description of measurement categories:

- Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS[1] voltage. This category is 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.
- Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet (for example, 115 V for U.S. or 230 V for Europe). Examples of Measurement Category II are measurements performed on household appliances, portable tools, and similar devices.
- Measurement Category III is for measurements performed in the building installation at the distribution level. This category refers to measurements on hard-wired equipment such as equipment in fixed installations, distribution boards, and circuit breakers. Other examples are wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and stationary motors with permanent connections to fixed installations.
- Measurement Category IV is for measurements performed at the primary electrical supply installation (<1,000 V). Examples include electricity meters and measurements on primary overcurrent protection devices and on ripple control units.

Electromagnetic Compatibility Guidelines

This product was tested and complies with the regulatory requirements and limits for electromagnetic compatibility (EMC) stated in the product specifications. These requirements and limits provide reasonable protection against harmful interference when the product is operated in the intended operational electromagnetic environment.

This product is intended for use in industrial locations. However, harmful interference may occur in some installations, when the product is connected to a peripheral device or test object, or if the product is used in residential or commercial areas. To minimize interference with radio and television reception and prevent unacceptable performance degradation, install and use this product in strict accordance with the instructions in the product documentation.

Furthermore, any modifications to the product not expressly approved by National Instruments could void your authority to operate it under your local regulatory rules.

Caution To ensure the specified EMC performance, operate this product only with shielded cables and accessories.

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[2] Working Voltage is the highest rms value of an AC or DC voltage that can occur across any particular insulation.

[1] MAINS is defined as a hazardous live electrical supply system that powers equipment. Suitably rated measuring circuits may be connected to the MAINS for measuring purposes.

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Caution To ensure the specified EMC performance when using the SH-15-15-B cable to implement a custom, user-defined connection, the cable shield must be connected to the chassis of the user-provided shielded enclosure in which the custom connection is mounted.

Caution To ensure the specified EMC performance when using the CB-15 DIN-mountable connector block, the connector block must be installed in a shielded enclosure.

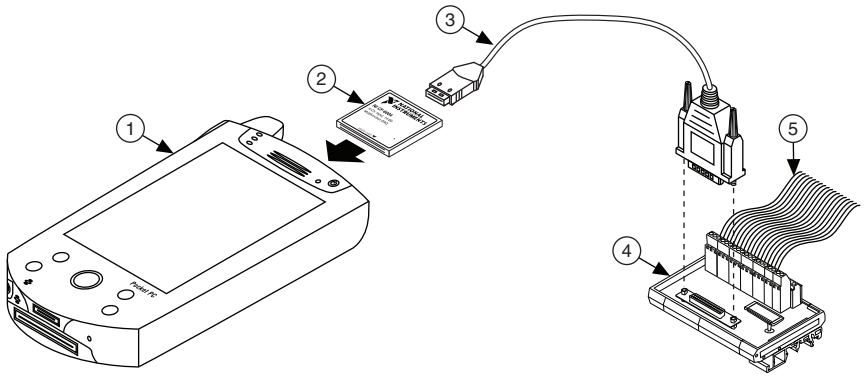
Installing the Software and Hardware

Software support for the NI CF-6004 for Windows is provided by NI-DAQmx Base.

Note For non-Windows operating support, refer to `ni.com/info` and enter `BaseGSGML`.

Figure 3 shows the NI CF-6004 installation.

Figure 3. NI CF-6004 Installation



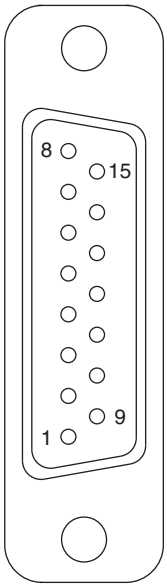
1	PDA with Type II CompactFlash Slot	4	Accessory
2	NI CF-6004	5	Input/Output Cable
3	I/O Cable		

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I/O Connector and Signal Descriptions

Table 1 lists the terminal assignments for the CF-6004 adapter cables. Table 2 describes the signals available on the I/O connectors.

Table 1. Terminal Assignments

SH-15-15 DSUB Connector	Terminal	Signal	SH-15-15-B Cable Wire Color
	1	AI GND	White or Red
	2	AI 0	White/Black
	3	AI 1	Red/Black
	4	AI 2	Yellow/Black
	5	AI 3	Green/Black
	6	RSRVD	Green or Blue
	7	RSRVD	Blue/Black
	8	+3.3 V	Brown/White
	9	NC	—
	10	D GND	Orange or Gray
	11	PFI 0	Orange/Black
	12	PFI 1	Gray/Black
	13	PFI 2	Purple/White
	14	PFI 3	Pink/Black
	15	D GND	Purple or Pink

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Table 2. Signal Descriptions

Signal Name	Reference	Direction	Description
AI GND	—	—	**Analog Ground**—These terminals are the reference point for single-ended AI measurements. The AI GND and D GND ground references are connected on the device.
AI <0..3>	AI GND	Input	**Analog Input Channels 0 to 3**—For single-ended measurements, each signal is an analog input voltage channel.
+3.3 V	D GND	Output	**+3.3 V Power Source**—Provides +3.3 V power up to 10 mA.
D GND	—	—	**Digital Ground**—D GND supplies the reference for PFI <0..3> and +3.3 V. The AI GND and D GND ground references are connected on the device.
PFI <0..3>	D GND	Input or Output	**Programmable Function I/O 0 to 3**—Each of these terminals are configurable as a PFI terminal or a digital I/O terminal. You can individually configure each digital I/O signal as an input or output. You can configure any of the terminals as a PFI input for a digital AI trigger.

Cables and Accessories

Refer to Table 3 for a list of recommended cables and accessories. Additional accessories are available for custom cable and DIN-rail applications. For more information, visit the CF-6004 product page at ni.com.

Table 3. Cables and Accessories

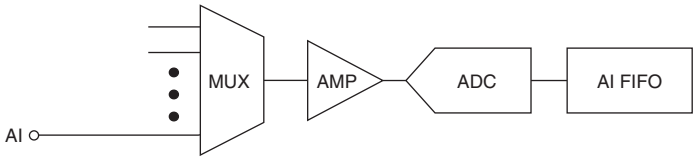
Part Number	Cable/Accessory
191067-0R5	**SH-15-15**—Shielded cable with DSUB connector for use with two connector blocks
191070-0R5	**SH-15-15-B**—Shielded bare-wire adapter cable for user-defined connection
779197-01	**SCB-15**—Shielded compact connector block accessory
779198-01	**CB-15***—Unshielded DIN rail-mountable accessory
* The CB-15 *must* be mounted on a DIN rail and installed in a shielded enclosure.	

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Analog Input

You can connect analog input signals to the NI CF-6004 through the I/O connector. AI GND is the ground-reference signal for the AI ports. Refer to Table 2 for more information about connecting analog input signals. Figure 4 illustrates the analog input circuitry of the NI CF-6004.

Figure 4. Analog Input Circuitry



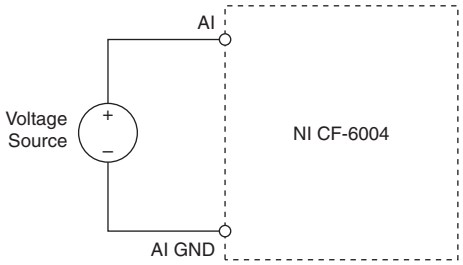
The main blocks featured in the NI CF-6004 analog input circuitry are as follows:

- **MUX**—The NI CF-6004 has one analog-to-digital converter (ADC). The multiplexer (MUX) routes one AI channel at a time to the ADC.
- **AMP**—The amplifier provides an effective input gain of 1.
- **ADC**—The analog-to-digital converter (ADC) digitizes the AI signal by converting the analog voltage into a digital code.
- **AI FIFO**—The NI CF-6004 can perform both single and multiple A/D conversions of a fixed or infinite number of samples. A first-in-first-out (FIFO) buffer holds data during AI acquisitions to ensure that no data is lost.

Connecting Single-Ended Voltage Signals

To connect single-ended voltage signals to the NI CF-6004, connect the positive voltage signal to the desired AI terminal, and the ground signal to an AI GND terminal.

Figure 5. Connecting a Single-Ended Voltage Signal



Digital Trigger

You can configure PFI <0..3> as a digital trigger input for analog input tasks. Refer to the *Using PFI <0..3> as a Digital AI Trigger* section for more information.

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PFI

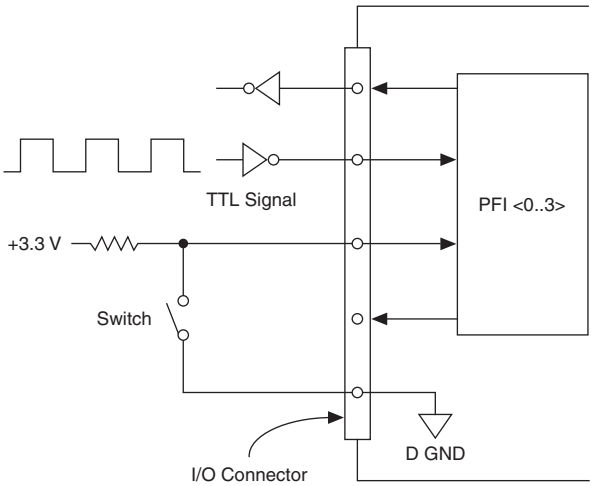
The four PFI lines are configurable as either digital input/output ports or digital trigger inputs for AI tasks.

Digital I/O

The NI CF-6004 has four digital lines, PFI <0..3>, which comprise the DIO port. D GND is the ground-reference signal for the DIO port.s You can individually program all lines as inputs or outputs.

Figure 6 shows PFI <0..3> configured for digital input and digital output. Digital input applications include receiving TTL signals and sensing external device states, such as the state of the switch shown in Figure 6. Digital output applications also include sending TTL signals and driving external devices.

Figure 6. Example of Connecting a Load



Caution Exceeding the maximum input voltage ratings, which are listed in the *Specifications* section, can damage the DAQ device and the computer. National Instruments is not liable for any damage resulting from such signal connections.

Source/Sink Info

The NI CF-6004 DIO ports are push-pull, allowing 3.3 V operation.

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I/O Protection

To protect the NI CF-6004 against overvoltage, undervoltage, and overcurrent conditions as well as ESD events, use the following guidelines:

- If you configure a DIO line as an output, do not connect it to any external signal source, ground signal, or power supply.
- If you configure a DIO line as an output, understand the current requirements of the load connected to these signals. Do not exceed the specified current output limits of the DAQ device.
- If you configure a DIO line as an input, do not drive the line with voltages outside of its normal operating range. The DIO lines have a smaller operating range than the AI signals.
- Treat the DAQ device as you would treat any static-sensitive device. Always properly ground yourself and the equipment when handling or connecting to the DAQ device.

Power-On States

At system startup and reset, the hardware sets all DIO lines to high-impedance inputs. The DAQ device does not drive the signal high or low.

Static DIO

Each of the NI CF-6004 DIO lines can be used as a static DI or DO line. You can use static DIO lines to monitor or control digital signals. All samples of static DI lines and updates of DO lines are software-timed.

Using PFI <0..3> as a Digital AI Trigger

When an AI task is defined, you can configure any one of the PFI inputs as a digital trigger input. When the digital trigger is enabled, the AI task waits for either a rising or falling edge on any PFI before starting the acquisition. To use AI Start Trigger with a digital source, specify the desired PFI input as the source and select the desired edge.

+3.3 V Power Source

The NI CF-6004 supplies a 3.3 V, 10 mA output. This source can be used to power external components.

Specifications

The following specifications are typical at 25 °C, unless otherwise noted.

Analog Input

Number of channels ..... 4 single-ended
ADC type ..... Successive approximation
ADC resolution ..... 14 bits
DNL ..... No missing codes
INL ..... ±1 LSB

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Sample rate (might be system-dependent)
- Single-channel, finite acquisition
  - Up to 8 kS total, raw or calibrated ..... 200 kS/s
  - Up to 1 MS, raw data ..... 200 kS/s
- Multi-channel, finite acquisition
  - Up to 8 kS total, raw or calibrated ..... 132 kS/s, aggregate
  - Up to 1 MS total, raw data ..... 132 kS/s, aggregate
- Continuous acquisition, single- and multi-channel
  - Calibrated data, monitoring ..... 18 kS/s, typical
  - Calibrated data, graphing ..... 1 kS/s, typical
- Minimum hardware-timed ..... 195 S/s

Timing accuracy ..... 50 ppm

Timing resolution ..... 78.125 ns

Settling time ..... 20 ppm at 7.6 µs, 0.1 Ω source impedance

Input coupling ..... DC

Input range ..... ±5 V

Maximum working voltage ..... ±5 V

Input impedance ..... 100 MΩ, in parallel with 20 pF

Input bias current ..... 75 pA

Crosstalk (at 1 kHz)
- Adjacent channels ..... –104 dB typical
- Non-adjacent channels ..... –104 dB typical

Small signal bandwidth –3 dB ..... 497 kHz

System noise ..... 0.75 LSB_{rms}

Input FIFO size ..... 8,192 samples

Data transfers ..... Programmed I/O

Overvoltage protection ..... ±8 V

Input current during overvoltage condition
- Single channel ..... 8 mA maximum
- Four channels ..... 32 mA maximum

Accuracy over the operating range
- Typical ..... ±3.1 mV
- Maximum ..... ±21 mV

Calibration

Recommended warm-up time ..... 15 minutes

Calibration interval ..... 1 year

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Digital I/O

Number of channels ..... 4 lines, PFI <0..3>
Direction control ..... Each channel individually programmable as input or output
Output driver type ..... Push-pull
Compatibility ..... 3.3 V LVCMOS and LVTTL
Power-on state ..... Input (high-impedance)
Data transfers ..... Programmed I/O
Absolute maximum voltage range ..... –0.5 V to 4 V
Digital logic levels

Level	Minimum	Maximum
Input low voltage Input high voltage Input leakage current	–0.3 V 2 V –1 µA	0.8 V 3.9 V 1 µA
Output low voltage (I = 2 mA) Output high voltage (I = 2 mA)	— 2.5 V	0.8 V —
Input current (0 < Vin < 3.3 V)	–1 µA	1 µA

External Voltage References

+3.3 V output (10 mA maximum)
- Minimum ..... 0.97 V
- Typical ..... 3.3 V

Power Requirements

+3.3 V from PDA host
- Idle maximum ..... 2 mA
- Typical (continuous acquisition) ..... 50 mA
- Maximum (all outputs loaded) ..... 68 mA

Physical Characteristics

Dimensions ..... Type II CompactFlash Card
Weight ..... 9 g (0.3 oz)
I/O connectors 15-pin

Safety Voltages

Connect only voltages that are within the absolute maximum limits of the connection point. Refer to the *External Voltage References* and *Power Requirements* specifications sections for the appropriate limits.

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Environmental

Temperature (IEC 60068-2-1 and IEC 60068-2-2)

Operating ..... 0 to 40 °C

Storage ..... –20 to 70 °C

Humidity (IEC 60068-2-56)

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

Storage ..... 5 to 90% RH, noncondensing

Pollution Degree (IEC 60664) 2

Maximum altitude ..... 2,000 m

Indoor use only.

Safety

This product meets 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 the *Online Product Certification* section.

Electromagnetic Compatibility

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; Basic 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

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.

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 For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

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CE Compliance CE

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

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

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and 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.

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 *NI and the Environment* 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.

Waste Electrical and Electronic Equipment (WEEE)



EU Customers At the end of the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste and Electronic Equipment, visit ni.com/environment/weee.

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Where to Go from Here

This section lists where you can find example programs for the NI CF-6004 and relevant documentation.

Example Programs

NI-DAQmx Base software include example programs to help you get started programming with the NI CF-6004. Modify example code and save it in an application, or use examples to develop a new application, or add example code to an existing application. NI-DAQmx Base examples are accessible from **Start»All Programs»National Instruments» NI-DAQmx Base» Examples**.

Note For information about non-Windows operating system support, refer to ni.com/info and enter BaseGSGML.

Related Documentation

The *NI-DAQmx Base Getting Started Guide* describes how to install your NI-DAQmx Base software, your NI-DAQmx Base-supported DAQ device, and how to confirm that your device is operating properly. In Windows, select **Start»All Programs»National Instruments» NI-DAQmx Base» Documentation»NI-DAQmx Base Getting Started Guide**.

The *Getting Started with NI-DAQmx Base for Linux and Mac OS X Users* document describes how to install your NI-DAQmx Base software, your NI-DAQmx Base-supported DAQ device, and how to confirm that your device is operating properly on your Linux or Mac machine.

The *NI-DAQmx Base Readme* lists which devices are supported by a version of NI-DAQmx Base. In Windows, select **Start»All Programs»National Instruments»NI-DAQmx Base» DAQmx Base Readme**.

The *NI-DAQmx Base VI Reference Help* contains VI reference and general information about measurement concepts. In LabVIEW, select **Help»NI-DAQmx Base VI Reference Help**.

The *NI-DAQmx Base C Function Reference Help* contains C reference and general information about measurement concepts. In Windows, select **Start»All Programs»National Instruments» NI-DAQmx Base»Documentation»C Function Reference Help**.

Note All NI-DAQmx Base documentation for Linux is installed at `/usr/local/natinst/nidaqmxbase/documentation`.

Note All NI-DAQmx Base documentation for Mac OS X is installed at `/Applications/National Instruments/NI-DAQmx Base/documentation`.

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Training Courses

If you need more help getting started developing an application with NI products, NI offers training courses. To enroll in a course or obtain a detailed course outline, refer to ni.com/training.

Technical Support on the Web

For additional support, refer to ni.com/support or zone.ni.com.

Where to Go for Support

The National Instruments Web site is your complete resource for technical support. At ni.com/support you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting ni.com/certification. If your product supports calibration, you can obtain the calibration certificate for your product at ni.com/calibration.

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