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NI CompactDAQ

USB Data Acquisition Systems

- Mix sensor measurements with analog and digital I/O in the same instrument
- Acquire from analog input modules at different rates with multiple timing engines
- Run up to seven I/O tasks simultaneously
- Windows 7/XP support
- Hi-Speed USB communication with NI Signal Streaming technology
- LabVIEW SignalExpress LE data-logging software included
- Four 32-bit general-purpose counters built into chassis (access through digital module or BNC triggers)
- BNC trigger connections on the cDAQ-9178 for up to 1 MHz clocks and triggers

Overview

The NI cDAQ-9178 is an eight-slot NI CompactDAQ chassis designed for small, portable, mixed-measurement test systems. Combine the cDAQ-9178 with up to eight NI C Series I/O modules for a custom analog input, analog output, digital I/O, and counter/timer measurement system.

Modules are available for a variety of sensor measurements including thermocouples, RTDs, strain gages, load and pressure transducers, torque cells, accelerometers, flow meters, and microphones. NI CompactDAQ systems combine sensor measurements with voltage, current, and digital signals to create custom, mixed-measurement systems with a single, simple USB cable back to the PC, laptop, or netbook.

The cDAQ-9178 has four 32-bit general-purpose counter/timers built in. You can access these counters through an installed, hardware-timed digital module such as the NI 9401 or NI 9402 for applications that involve quadrature encoders, PWM, event counting, pulse train generation, and period or frequency measurement.

Use the two built-in BNC connections to share clocks or triggers up to 1 MHz.

The cDAQ-9178 chassis is shipped with the following:
- AC/DC converter that plugs directly into the chassis
- USB cable with a thumbscrew lock for strain relief

Power cord sold separately.

The NI-DAQmx driver shipped with every chassis includes the following:
- LabVIEW SignalExpress LE for simple data-logging applications
- API for NI LabVIEW, ANSI C/C++, C#, Visual Basic .NET
- DAQ Assistant code generation for NI LabVIEW, LabWindows™/CVI, and Measurement Studio
- Example programs for all supported languages
- NI Measurement & Automation Explorer (MAX) for system configuration and test

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Comparison Tables

Model	Slots	Counters	Number of Simultaneous Tasks	Number of AI Timing Engines
cDAQ-9178	8	4	7	3
cDAQ-9174	4	4	7	3

Application and Technology

Mix Analog, Digital, and Sensor Measurements in the Same System

Many devices can measure temperature, voltage, or bridge-based sensors, but NI CompactDAQ can integrate all of these measurements and more into a single device that outputs all of the data via the same bus interface, such as USB. An NI CompactDAQ system can mix multiplexed voltage input signals, simultaneously sampled accelerometers, low-speed thermocouples, and TTL digital I/O all in the same 4- or 8-slot chassis using the same driver, NI-DAQmx. NI CompactDAQ makes programming easier because the same driver is used for all measurements. This solution saves space and simplifies service and support. With NI CompactDAQ, there is only one box on your lab bench, and, if there are problems with any of the measurements or equipment, award-winning National Instruments support is your contact for all your instrumentation needs.

Figure 1. NI cDAQ-9174 with Three Analog and One Digital Module Connected to a Laptop

C Series Modules

You have more than 50 C Series modules, most of which work with NI CompactDAQ, to choose from for different measurements including thermocouple, voltage, resistance temperature detector (RTD), current, resistance, strain, digital (TTL and other), accelerometers, and microphones. Channel counts on the individual modules range from three to 32 channels to accommodate a wide range of system requirements. C Series modules combine signal conditioning, connectivity, and data acquisition into a small module for each specific measurement type. You can insert these modules into any of the C Series chassis to create a variety of systems. You can create a mix of channel counts and measurement types within one system by selecting the desired modules and installing them into one of several C Series systems. For this reason, systems built on the C Series platform are highly customizable. See ni.com/crio/cseries for the C Series compatibility table.

Figure 2. Three High-Speed Analog Input Modules

Rugged Design

NI CompactDAQ and all C Series modules are constructed from A380 cast aluminum for a rugged system that can withstand operating temperatures from -20 to 55 °C, and up to 30 g of shock. NI CompactDAQ was built to be used in the lab but not to necessarily stay there. With a rugged, flexible system such as NI CompactDAQ, you can reconfigure and move a single test system from place to place without having to purchase different equipment for every lab or test stand. C Series modules are equally rugged and designed with spring loaded latches to lock into place when installed in the chassis. The shock and vibration specifications are all tested on an NI CompactDAQ system with modules installed, so modules do not fall out or come undocked under the specified conditions. For cable strain relief, a locking USB cable with thumbscrew is included to prevent accidental disconnection during use. The rugged features of NI CompactDAQ help you quickly begin testing because you need less time to prepare the instrumentation for the rigors of field testing. For added system portability, or to help track multiple systems around the lab, purchase the CASE-0750 rugged carrying case that has room for chassis, modules, power supplies, and signal wire.

Figure 3. The carrying case has removable foam blocks for further customization.

Multiple Timing Engines to Acquire from Different Modules at Different Rates

With the cDAQ-9174/78 chassis, you can install a thermocouple module next to an accelerometer measurement module and acquire from both simultaneously at different rates. The cDAQ-9174/78 chassis have multiple analog input timing engines, which means you can group all of your analog input modules in up to three sets of modules. These sets, known as tasks, can all run at different rates because each one has its own timing engine in the chassis backplane. This alleviates the need to decimate or parse lower-speed data from the higher-speed data as you need to do in the original cDAQ-9172 chassis.

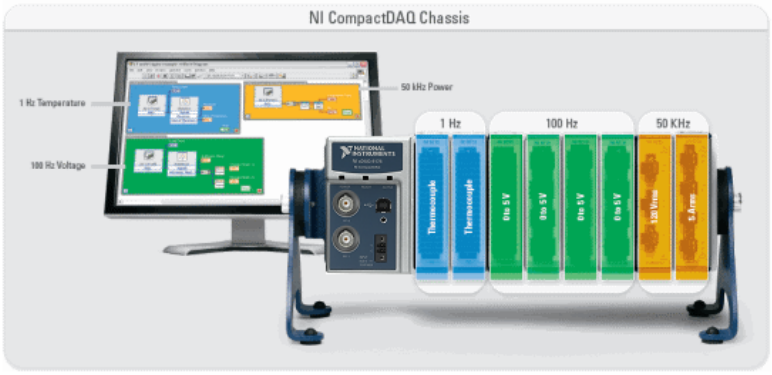

Figure 4. Run analog input modules at different rates with multiple AI timing engines.

Four 32-Bit General-Purpose Counters Built In

The cDAQ-9174/78 chassis both have four 32-bit counters built in. These counters are accessed through an installed hardware-timed digital I/O module (sold separately) such as the NI 9401 or NI 9402. Once you have installed the digital module, you can create a counter task in software for operations such as quadrature encoder, period and frequency measurement, or finite pulse train and PWM generation. For some operations, you can access the counters in the cDAQ-9178 chassis through the built-in BNC connectors on the chassis.

Flexible Power Options

The upgraded chassis features a new physical connection for power supplies. Each chassis is shipped with an AC/DC converter that plugs directly into the chassis. (Note that the power cord to go from the AC/DC converter to the wall is sold separately.) For other power options, such as a power supply with leads for V/C, an automotive electrical system, or an off-the-shelf battery pack, purchase the screw-terminal accessory for the chassis to enable easy connection of a V and C lead to the chassis. NI CompactDAQ requires a 9 to 30 VDC power supply and uses a maximum load 15 W of power.

Figure 5. NI cDAQ-9178 Connections Showing BNC Triggers, Flexible Power Connector, and USB Port with Threaded Hole for Cable Strain Relief

Included Data-Logging Software

NI ships NI CompactDAQ, and every other NI data acquisition (DAQ) device, with a driver kit that includes the following:

- Measurement & Automation Explorer (MAX) – This configuration utility is for quick measurement debugging or system diagnostic test via the device self-test.

- NI-DAQmx – Driver and API for all NI data acquisition devices. This installer includes interfaces to LabVIEW, ANSI C/C++, C#, Visual Basic .NET, and hundreds of example programs for LabVIEW and text-based languages.
- LabVIEW SignalExpress LE – With configuration-based data logging, you can get up and running out of the box without programming. Using LabVIEW SignalExpress LE, you can acquire data from the hardware, build a custom user interface, and log data to Technical Data Management Streaming (TDMS) files or to Microsoft Excel for graphing and postprocessing. LabVIEW SignalExpress is available for purchase and includes analysis and processing blocks for use within the data-logging environment.

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Ordering Information

For a complete list of accessories, visit the product page on ni.com.

Products	Part Number	Recommended Accessories	Part Number
NI CompactDAQ Chassis			
cDAQ-9178 8 slot chassis	781156-01	No accessories required.	
cDAQ-9174 4 slot chassis	781157-01	No accessories required.	
Accessories			
Desktop Mounting Kit (as seen in images)	779473-01	No accessories required.	
Replacement/Spare Power Supply	780703-01	No accessories required.	
Filler Module for Empty Slots	196917-01	No accessories required.	
Rugged Carying Case (CASE-0750)	780315-01	No accessories required.	
Screw Terminals for Alternate Power Supply	780702-01	No accessories required.	
Power Cords			
US 120VAC	763000-01	No accessories required.	
North America, 240 VAC	763068-01	No accessories required.	
UK, 240 VAC	763064-01	No accessories required.	
Australia, 240 VAC	763066-01	No accessories required.	
Switzerland, 220 VAC	763065-01	No accessories required.	
Japan, 100VAC	763634-01	No accessories required.	
Europe, 240 VAC	763067-01	No accessories required.	

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Support and 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.

Calibration

NI measurement hardware is calibrated to ensure measurement accuracy and verify that the device meets its published specifications. To ensure the ongoing accuracy of your measurement hardware, NI offers basic or detailed recalibration service that provides ongoing ISO 9001 audit compliance and confidence in your measurements. To learn more about NI calibration services or to locate a qualified service center near you, contact your local sales office or visit ni.com/calibration.

Technical Support

Get answers to your technical questions using the following National Instruments resources.

- **Support** - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
- **Discussion Forums** - Visit forums.ni.com for a diverse set of discussion boards on topics you care about.
- **Online Community** - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

- **Classroom training in cities worldwide** - the most comprehensive hands-on training taught by engineers.
- **On-site training at your facility** - an excellent option to train multiple employees at the same time.
- **Online instructor-led training** - lower-cost, remote training if classroom or on-site courses are not possible.
- **Course kits** - lowest-cost, self-paced training that you can use as reference guides.
- **Training memberships** and training credits - to buy now and schedule training later.

Visit ni.com/training for more information.

Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 700 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

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Detailed Specifications

These specifications are for the NI cDAQ-9171/9174/9178 chassis only.
These specifications are typical at 25 °C unless otherwise noted. For the C Series I/O module specifications, refer to the documentation for the C Series I/O module you are using.

Analog Input	
Input FIFO size	127 samples per slot
Maximum sample rate [1]	Determined by the C Series I/O module(s)
Timing accuracy [2]	50 ppm of sample rate
Timing resolution [2]	12.5 ns
Number of channels supported	Determined by the C Series I/O module(s)
Analog Output	
Numbers of channels supported	
Hardware-timed task	
Onboard regeneration	16
Non-regeneration	Determined by the C Series I/O module(s)
Non-hardware-timed task	Determined by the C Series I/O module(s)
Maximum update rate	
Onboard regeneration	1.6 MS/s (multi-channel, aggregate)
Non-regeneration	Determined by the C Series I/O module(s)
Timing accuracy	50 ppm of sample rate
Timing resolution	12.5 ns
Output FIFO size	
Regeneration	8,191 samples shared among channels used
Non-regeneration	127 samples per slot
AO waveform modes	Non-periodic waveform, periodic waveform regeneration mode from onboard memory, periodic waveform regeneration from host buffer including dynamic update
Digital Waveform Characteristics	
Waveform acquisition (DI) FIFO	127 samples per slot
Waveform generation (DO) FIFO	

NI cDAQ-9171	2,047 samples
NI cDAQ-9174	
Slots 1-4	2,047 samples
NI cDAQ-9178	
Slots 1-4	2,047 samples
Slots 5-8	1,023 samples

Note (NI cDAQ-9178) When modules are installed in slots 1 through 4, FIFO is 2,047 samples per slot for all slots. When any module is installed in slots 5 through 8, FIFO is 1,023 samples per slot for all eight slots.

Digital input sample clock frequency	
Streaming to application memory	System-dependent
Finite	0 to 10 MHz
Digital output sample clock frequency	
Streaming from application memory	System-dependent
Regenerate from FIFO	0 to 10 MHz
Finite	0 to 10 MHz
Digital output or digital input sample clock source	Any PFI, analog sample or convert clock, analog output sample clock, Ctr *n* Internal Output, and many other sources
General-Purpose Counter/Timers	
Number of counter/timers	4
Resolution	32 bits
Counter measurements	Edge counting, pulse, semi-period, period, two-edge separation, pulse width
Position measurements	X1, X2, X4 quadrature encoding with Channel Z reloading; two-pulse encoding
Output applications	Pulse, pulse train with dynamic updates, frequency division, equivalent time sampling
Internal base clocks	80 MHz, 20 MHz, 100 kHz
External base clock frequency	0 to 20 MHz
Base clock accuracy	50 ppm
Output frequency	0 to 20 MHz
Inputs	Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down
Routing options for inputs	Any module PFI, chassis PFI BNC, analog trigger, many internal signals
FIFO	Dedicated 127-samples FIFO
Frequency Generator	
Number of channels	1
Base clocks	10 MHz, 20 MHz, 100 kHz
Divisors	1 to 16 (integers)
Base clock accuracy	50 ppm
Output	
NI cDAQ-9171/9174	Available on module PFI terminals
NI cDAQ-9178	Available on any chassis PFI BNC terminal or module PFI terminals
Module PFI Characteristics	
Functionality	Static digital input, static digital output, timing input, and timing output
Timing output sources	Many analog input, analog output, counter, digital input, and digital output timing signals
Debounce filter settings	Selectable per input: 125 ns, 6.425 µs, 2.56 ms, disable, high and low transitions
Timing input frequency	0 - 20 MHz
Timing output frequency	0 - 20 MHz
Chassis PFI Characteristics (NI cDAQ-9178 Only)	

Max input or output frequency	1 MHz
Cable length	3 m (10 ft)
Cable impedance	50 Ω
TRIG 0 (PFI 0), TRIG 1 (PFI 1) connectors	BNC
Power-on state	High impedance

Input/output voltage protection

Voltage	Minimum	Maximum
Input	–20 V	25 V
Output	–15 V	20 V

Maximum operating conditions

Level	Minimum	Maximum
I_{OL} output low current	--	8 mA
I_{OH} output high current	--	–8 mA

DC input characteristics

Level	Minimum	Maximum
Positive going threshold	1.43 V	2.28 V
Negative going threshold	0.86 V	1.53 V
Hysteresis	0.48 V	0.87 V

DC output characteristics - Level High

Conditions	Minimum	Maximum
--	--	5.25 V
Sourcing 100 µA	4.65 V	--
Sourcing 2 mA	3.60 V	--
Sourcing 3.5 mA	3.44 V	--

DC output characteristics - Level Low

Conditions	Minimum	Maximum
Sinking 100 µA	--	0.10 V
Sinking 2 mA	--	0.64 V
Sinking 3.5 mA	--	0.8 V

Digital Triggers

Source

NI cDAQ-9171/9174	Any module PFI terminal
NI cDAQ-9178	Any chassis PFI BNC terminal or module PFI terminal
Polarity	Software-selectable for most signals
Analog input function	Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase
Analog output function	Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase
Counter/timer functions	Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down

Module I/O States

At power-on	Module-dependent. Refer to the documentation included with the C Series I/O module(s).

Note The chassis may revert the input/output of the modules to its power-on state when the USB cable is removed.

Power Requirements

Caution You must use a National Electric Code (NEC) Class 2 power source with the NI cDAQ-9178/9174 chassis.

Note Some I/O modules have additional power requirements. For more information about C Series I/O module(s) power requirements, refer to documentation included with the C Series I/O module(s).

Note Sleep mode for C Series I/O modules is not supported in the NI cDAQ-917x.

NI cDAQ-9171

Power consumption from USB, 4.75 to 5.25 V	500 mA maximum
Suspend mode	2.5 mA maximum

NI cDAQ-9174/9178

Input voltage range	9–30 V

Maximum required input power	15 W
Power input connector	2 positions 3.5 mm pitch pluggable screw terminal with screw locks similar to Sauro CTMH020F8-0N001
Power input mating connector	Sauro CTF020V8, Phoenix Contact 1714977, or equivalent
Power consumption from USB, 4.10 to 5.25 V	500 µA maximum

Bus Interface

USB specification	USB 2.0 Hi-Speed
High-performance data streams	
NI cDAQ-9171	6
NI cDAQ-9174/9178	7
Data stream types available	Analog input, analog output, digital input, digital output, counter/timer input, counter/timer output

Note If you are connecting the NI cDAQ-917x to a USB hub, the hub must be externally powered.

Physical Characteristics

NI cDAQ-9171 chassis	
Weight (unloaded)	Approx. 353 g (12.5 oz)
Dimensions (unloaded)	131.4 mm × 88.6 mm × 33.3 mm (5.17 in. × 3.49 in. × 1.31 in.)
NI cDAQ-9174 chassis	
Weight (unloaded)	Approx. 574 g (20.2 oz)
Dimensions (unloaded)	15.9 cm x 8.81 cm x 5.89 cm (6.28 in. x 3.5 in. x 2.3 in.)
NI cDAQ-9178 chassis	
Weight (unloaded)	Approx. 878 g (31.0 oz)
Dimensions (unloaded)	25.4 cm x 8.81 cm x 5.89 cm (10.0 in. x 3.5 in. x 2.3 in.)

If you need to clean the chassis, wipe it with a dry towel.

Safety

Safety Standards

If you need to clean the chassis, wipe it with a dry towel.

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

Environmental

Temperature	
Operating	–20 °C to 55 °C (IEC-60068-2-1 and IEC-60068-2-2)
Storage	–40 °C to 85 °C (IEC-60068-2-1 and IEC-60068-2-2)
NI cDAQ-9174/9178 ingress protection	IP 30
Humidity	
Operating	10 to 90% RH, noncondensing (IEC-60068-2-56)
Storage	5 to 95% RH, noncondensing (IEC-60068-2-56)
Maximum altitude	2,000 m
Pollution Degree (IEC 60664)	2

Indoor use only.

Shock and Vibration

To meet these specifications, you must panel mount the NI cDAQ-917x system, use an NI locking USB cable, and affix ferrules to the ends of the terminal lines.

Operating shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.)

Random vibration	
Operating	5 to 500 Hz, 0.3 grms
Non-operating	5 to 500 Hz, 2.4 grms (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

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

- EN 61326 EMC requirements; Minimum Immunity
- EN 55011 Emissions; Group 1, Class A
- 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 generates 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..

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)

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 module number or product line, and click the appropriate link in the Certification column.

Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also 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 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.

电子信息产品污染控制管理办法 （中国 RoHS）

中国客户 National Instruments 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 National Instruments 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.)

[1] Performance dependent on type of installed C Series I/O modules and number of channels in the task.

[2] Does not include group delay. Refer to C Series I/O module documentation for more information

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Technical Sales

(866) 531-6285
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Ordering Information | Detailed Specifications

For user manuals and dimensional drawings, visit the product page resources tab on ni.com.

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NI 9205

±200 mV to ±10 V, Analog Input, 250 kS/s, 32 Ch Module

- 32 single-ended or 16 differential channels, 250 kS/s sample rate
- ±200 mV, ±1 V, ±5 V, and ±10 V programmable measurement ranges; 16-bit resolution
- 250 Vrms channel-earth, CAT II (spring-terminal), or 60 VDC channel-earth, CAT I (D-SUB), isolation
- 36-position spring-terminal or 37-pin D-SUB connectors available
- -40 °C to 70 °C operating, 5 g vibration, 50 g shock

Overview

The NI 9205 is a C Series module for use with NI CompactDAQ and CompactRIO chassis. It features 32 single-ended or 16 differential analog inputs, 16-bit resolution, and a maximum sample rate of 250 kS/s. Each channel has programmable input ranges of ±200 mV, ±1 V, ±5 V, and ±10 V. To protect against signal transients, the NI 9205 includes up to 60 V of overvoltage protection between input channels and common (COM). In addition, the NI 9205 features a channel-to-earth ground double isolation barrier for safety, noise immunity, and high common-mode voltage range. It is rated for 1,000 Vrms transient overvoltage protection.

You can choose from two connector options for the NI 9205: a 36-position spring-terminal connector for direct connectivity or a 37-position D-SUB connector.

Recommended Accessories

-NI 9940 strain relief operator protection (for spring-terminal variant)
-NI 9923 front-mount D-SUB to screw-terminal connector (for D-SUB variant)

Box Contents

-1 NI 9205 C Series module
-1 NI 9205 Operating Instructions and Specifications manual
-1 NI 9974 36-position spring-terminal connector (for spring-terminal variant)

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Comparison Tables

Product Name	Signal Ranges	Channels	Sample Rate	Simultaneous	Resolution	Isolation	Connectivity
NI 9201	±10 V	8 single-ended	500 kS/s	No	12-Bit	250 Vrms Ch-Earth (Screw Terminal), 60 VDC Ch-Earth (D-SUB)	Screw Terminal, 25-Pin D-SUB
NI 9205	±200 mV, ±1 V, ±5 V, ±10 V	32 single-ended, 16 differential	250 kS/s	No	16-Bit	250 Vrms Ch-Earth (Spring Terminal), 60 VDC Ch-Earth (D-SUB)	Spring Terminal, 37-Pin D-SUB
NI 9206	±200 mV, ±1 V, ±5 V, ±10 V	32 single-ended, 16 differential	250 kS/s	No	16-Bit	600 VDC Ch-Earth	Spring Terminal
NI 9215	±10 V	4 differential	100 kS/s/ch	Yes	16-Bit	250 Vrms Ch-Earth (Screw Terminal), 60 VDC Ch-Earth (BNC)	Screw Terminal, BNC
NI 9220	±10 V	16 differential	100 kS/s/ch	Yes	16-Bit	250 Vrms Ch-Earth (Spring Terminal), 60 VDC Ch-Earth (D-SUB)	Spring Terminal, 37-Pin D-SUB

Product Name	Signal Ranges	Channels	Sample Rate	Simultaneous	Resolution	Isolation	Connectivity
NI 9221	±60 V	8 single-ended	800 kS/s	No	12-Bit	250 Vrms Ch-Earth (Screw Terminal), 60 VDC Ch-Earth (D-SUB)	Screw Terminal, 25-Pin D-SUB
NI 9222	±10 V	4 differential	500 kS/s/ch	Yes	16-Bit	60 VDC Ch-Ch	Screw Terminal
NI 9223	±10 V	4 differential	1 MS/s/ch	Yes	16-Bit	60 VDC Ch-Ch	Screw Terminal
NI 9229	±60 V	4 differential	50 kS/s/ch	Yes	24-Bit	250 Vrms Ch-Ch (Screw Terminal), 60 VDC Ch-Ch (BNC)	Screw Terminal, BNC
NI 9239	±10 V	4 differential	50 kS/s/ch	Yes	24-Bit	250 Vrms Ch-Ch (Screw Terminal), 60 VDC Ch-Ch (BNC)	Screw Terminal, BNC

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Application and Technology

NI C Series Overview

NI C Series modules are designed to provide high-accuracy measurements to meet the demands of advanced DAQ and control applications. Each module contains measurement-specific signal conditioning to connect to an array of sensors and signals, bank and channel-to-channel isolation options, and support for wide temperature ranges to meet a variety of application and environmental needs all in a single rugged package. You can choose from more than 100 C Series modules for measurement, control, and communication to connect your applications to any sensor on any bus.

Most C Series I/O modules work with both the NI CompactDAQ and CompactRIO platforms. The modules are identical, and you can move them from one platform to the other with no modification.

NI CompactRIO Platform

Powered by the NI LabVIEW reconfigurable I/O (RIO) architecture, NI CompactRIO combines an open embedded architecture with small size, extreme ruggedness, and hot-swappable industrial I/O modules. Each system contains an FPGA for custom timing, triggering, and processing with a wide array of modular I/O to meet any embedded application requirement.

Configure Your Complete NI CompactRIO System

NI CompactDAQ Platform

NI CompactDAQ is a portable, rugged data acquisition platform that integrates connectivity and signal conditioning into modular I/O to directly interface with any sensor or signal. Using NI CompactDAQ with LabVIEW, you can easily customize how you acquire, analyze, present, and manage your measurement data. From research to development to validation, NI provides programmable software, high-accuracy measurements, and local technical support to help ensure you meet your exact measurement application requirements.

Configure Your Complete NI CompactDAQ System

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Ordering Information

For a complete list of accessories, visit the product page on ni.com.

Products	Part Number	Recommended Accessories	Part Number
NI 9205 Voltage			
NI 9205 with Spring Terminals Requires: 1 Connectivity Accessories ;	779519-01	**Connectivity Accessories:** screwTerminal - NI 9940 Extra Strain relief, operator protection (qty 1)	779567-01

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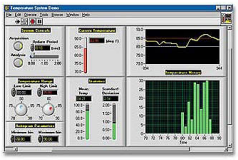
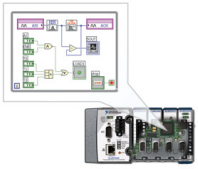
Software Recommendations

LabVIEW Professional Development System for Windows



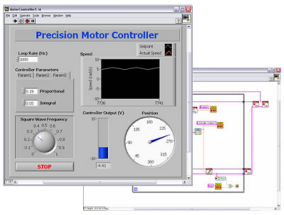
- Advanced software tools for large project development
- Automatic code generation using DAQ Assistant and Instrument I/O Assistant
- Tight integration with a wide range of hardware
- Advanced measurement analysis and digital signal processing
- Open connectivity with DLLs, ActiveX, and .NET objects
- Capability to build DLLs, executables, and MSI installers

NI LabVIEW FPGA Module



- Design FPGA applications for NI reconfigurable I/O (RIO) hardware targets
- Program with the same graphical environment used for desktop and real-time applications
- Execute control algorithms with loop rates up to 300 MHz
- Implement custom timing and triggering logic, digital protocols, and DSP algorithms
- Incorporate existing HDL code and third-party IP including Xilinx CORE Generator functions
- Included in the LabVIEW Embedded Control and Monitoring Suite

NI LabVIEW Real-Time Module



- Design deterministic real-time applications with LabVIEW graphical programming
- Download to dedicated NI or third-party hardware for reliable execution and a wide selection of I/O
- Take advantage of built-in PID control, signal processing, and analysis functions
- Automatically take advantage of multicore CPUs or set processor affinity manually
- Includes real-time OS, development and debugging support, and board support
- Purchase individually or as part of a LabVIEW suite

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Support and 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.

Calibration

NI measurement hardware is calibrated to ensure measurement accuracy and verify that the device meets its published specifications. To ensure the ongoing accuracy of your measurement hardware, NI offers basic or detailed recalibration service that provides ongoing ISO 9001 audit compliance and confidence in your measurements. To learn more about NI calibration services or to locate a qualified service center near you, contact your local sales office or visit ni.com/calibration.

Technical Support

Get answers to your technical questions using the following National Instruments resources.

- **Support** - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
- **Discussion Forums** - Visit forums.ni.com for a diverse set of discussion boards on topics you care about.
- **Online Community** - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

- **Classroom training in cities worldwide** - the most comprehensive hands-on training taught by engineers.
- **On-site training at your facility** - an excellent option to train multiple employees at the same time.
- **Online instructor-led training** - lower-cost, remote training if classroom or on-site courses are not possible.
- **Course kits** - lowest-cost, self-paced training that you can use as reference guides.
- **Training memberships** and training credits - to buy now and schedule training later.

Visit ni.com/training for more information.

Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 700 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

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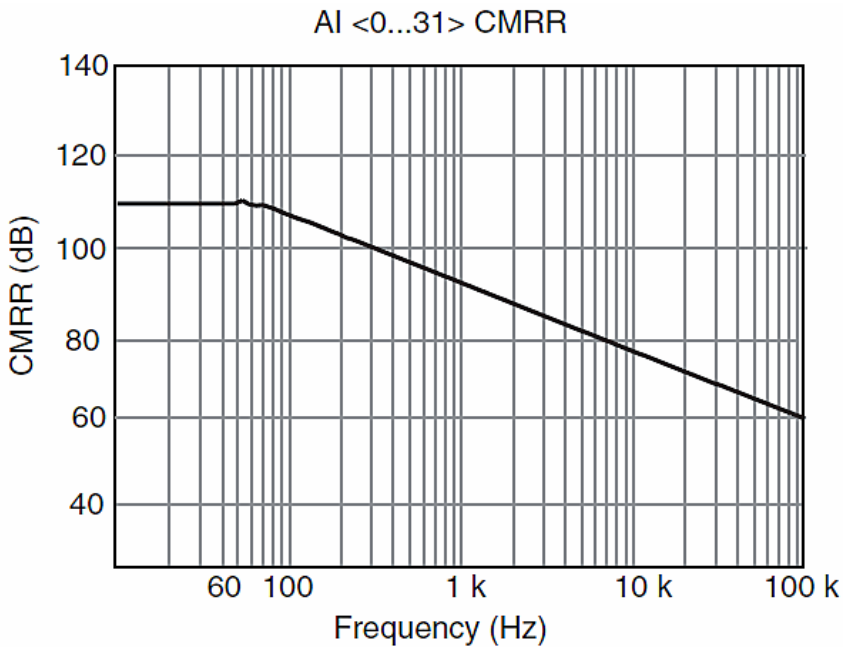
Detailed Specifications

The following specifications are typical for the range –40 to 70 °C unless otherwise noted. All voltages are relative to COM unless otherwise noted.

Analog Input Characteristics	
Number of channels	32 single-ended or 16 differential analog input channels, 1 digital input channel, and 1 digital output channel
ADC resolution	16 bits
DNL	No missing codes guaranteed
INL	Refer to the *AI Absolute Accuracy Tables and Formulas*
MTBF	775,832 hours at 25 °C; Bellcore Issue 6, Method 1, Case 3, Limited Part Stress Method

Note Contact NI for Bellcore MTBF specifications at other temperatures or for MIL-HDBK-217F specifications.

Conversion time	
R Series Expansion chassis	4.50 µs (222 kS/s)
All other chassis	4.00 µs (250 kS/s)
Input coupling	DC
Nominal input ranges	±10 V, ±5 V, ±1 V, ±0.2 V
Minimum overrange (for 10 V range)	4%
Maximum working voltage for analog inputs (signal + common mode)	Each channel must remain within ±10.4 V of common
Input impedance (AI-to-COM)	
Powered on	>10 GΩ in parallel with 100 pF
Powered off/overload	4.7 kΩ min
Input bias current	±100 pA
Crosstalk (at 100 kHz)	
Adjacent channels	–65 dB
Non-adjacent channels	–70 dB
Analog bandwidth	370 kHz
Overvoltage protection	
AI channel (0 to 31)	±30 V (one channel only)
AISENSE	±30 V
CMRR (DC to 60 Hz)	100 dB
Typical AI+ to AI– CMRR graph	



Settling time for multichannel measurements, accuracy, all ranges	
±120 ppm of full-scale step (±8 LSB)	4 µs convert interval
±30 ppm of full-scale step (±2 LSB)	8 µs convert interval
Analog triggers	
Number of triggers	1
Resolution	10 bits, 1 in 1,024
Bandwidth (–3 dB)	370 kHz
Accuracy	±1% of full scale

Scaling coefficients	
Nominal Range (V)	**Typical Scaling Coefficient (µV/LSB)**
±10	328
±5	164.2
±1	32.8
±0.2	6.57

AI Absolute Accuracy Tables and Formulas

The values in the following tables are based on calibrated scaling coefficients, which are stored in the onboard EEPROM.

Accuracy summary			
Nominal Range (V)	**Absolute Accuracy at Full Scale [1] (µV)**	**Random Noise, σ (μV_{rms})**	**Sensitivity [2] (µV)**
±10	6,230	240	96.0
±5	3,230	116	46.4
±1	690	26	10.4
±0.2	174	10	4.0

Accuracy details						
Nominal Range (V)	**Residual Gain Error (ppm of Reading)**	**Gain Tempco (ppm/°C)**	**Reference Tempco**	**Residual Offset Error (ppm of Range)**	**Offset Tempco (ppm of Range/°C)**	**INL Error (ppm of Range)**
±10	115	11	5	20	44	76
±5	135	11	5	20	47	76
±1	155	11	5	25	66	76
±0.2	215	11	5	40	162	76

Absolute accuracy formulas

AbsoluteAccuracy = *Reading* · *GainError* + *Range* · *OffsetError* + *NoiseUncertainty*
GainError = *ResidualGainError* + *GainTempco* · *TempChangeFromLastInternalCal* + *ReferenceTempco* · *TempChangeFromLastExternalCal*
OffsetError = *ResidualOffsetError* + *OffsetTempco* · *TempChangeFromLastInternalCal* + *INL_Error*
NoiseUncertainty = (*RandomNoise* · 3) /√100 for a coverage factor of 3 σ and averaging 100 points.

Absolute accuracy at full scale on the analog input channels is determined using the following assumptions:

TempChangeFromLastExternalCal = 70 °C
TempChangeFromLastInternalCal = 1 °C
NumberOfReadings = 100
CoverageFactor = 3 σ

For example, on the 10 V range, the absolute accuracy at full scale is as follows:

GainError = 115 ppm + 11 ppm · 1 + 5 ppm · 70
GainError = 476 ppm

OffsetError = 20 ppm + 44 ppm · 1 + 76 ppm
OffsetError = 140 ppm

NoiseUncertainty = (240 µV · 3) /√100
Noise Uncertainty = 72 µV

AbsoluteAccuracy = 10 V · 476 ppm + 10 V · 140 ppm + 72 µV
AbsoluteAccuracy = 6,232 µV (rounds to 6,230 µV)

Digital Characteristics

Digital input logic levels		
Level	**Min**	**Max**
Input high voltage (V_{IH})	2.0 V	3.3 V
Input low voltage (V_{IL})	0 V	0.34 V

Digital output logic levels		
Level	**Min**	**Max**
Output high voltage (V_{OH}), sourcing 75 µA	2.1 V	3.3 V
Output low voltage (V_{OL}), sinking 250 µA	0 V	0.4 V

Overvoltage protection	±30 V
External digital triggers	
Source	PFI0
Delay	100 ns max

Note The digital output channel is supported only in CompactRIO systems.

Power Requirements

Power consumption from chassis	
Active mode	625 mW max
Sleep mode	15 mW
Thermal dissipation (at 70 °C)	
Active mode	625 mW max
Sleep mode	15 mW

Physical Characteristics

Spring-terminal wiring	18 to 28 AWG copper conductor wire with 7 mm (0.28 in.) of insulation stripped from the end
Weight	
NI 9205 with spring terminal	158 g (5.8 oz)
NI 9205 with DSUB	148 g (5.3 oz)

Safety

If you need to clean the module, wipe it with a dry towel.

Maximum Voltage [3]

Connect only voltages that are within the following limits.

AI, PFI0, and DO-to-COM	±30 VDC

NI 9205 with Spring Terminal Isolation Voltages

Channel-to-channel	None
Channel-to-earth ground	
Continuous	250 V_{rms}, Measurement Category II
Withstand	2,300 V_{rms}, verified by a 5 s dielectric withstand test

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 (e.g., 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 products.

Caution Do *not* connect the NI 9205 with spring terminal to signals or use for measurements within Measurement Categories III or IV.

NI 9205 with DSUB Isolation Voltages

Channel-to-channel	None
Channel-to-earth ground	
Continuous	60 VDC, Measurement Category I
Withstand	1,000 V_{rms}, verified by a 5 s dielectric withstand test

Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS [4] 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.

Caution Do *not* connect the NI 9205 with DSUB to signals or use for measurements within Measurement Categories II, III, or IV.

Safety Standards

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 the *Online Product Certification* section.

Hazardous Locations	
U.S. (UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nC IIC T4
Canada (C-UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nC IIC T4
Europe (DEMKO)	EEx nC IIC T4

Environmental

National Instruments C Series modules are intended for indoor use only but may be used outdoors if installed in a suitable enclosure. Refer to the manual for the chassis you are using for more information about meeting these specifications.

Operating temperature (IEC 60068-2-1, IEC 60068-2-2)	–40 to 70 °C
Storage temperature (IEC 60068-2-1, IEC 60068-2-2)	–40 to 85 °C
Ingress protection	IP 40
Operating humidity (IEC 60068-2-56)	10 to 90% RH, noncondensing
Storage humidity (IEC 60068-2-56)	5 to 95% RH, noncondensing
Maximum altitude	2,000 m
Pollution Degree (IEC 60664)	2

Shock and Vibration

To meet these specifications, you must panel mount the system and use a backshell kit or shielded cable to protect the connections. Use the NI 9940 backshell for the NI 9205 with spring terminal and a 37-pin shielded cable or the NI 9933 backshell for the NI 9205 with DSUB.

Operating vibration	
Random (IEC 60068-2-64)	5 g_{rms}, 10 to 500 Hz
Sinusoidal (IEC 60068-2-6)	5 g, 10 to 500 Hz
Operating shock (IEC 60068-2-27)	30 g, 11 ms half sine, 50 g, 3 ms half sine, 18 shocks at 6 orientations

Electromagnetic Compatibility

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

- EN 61326 EMC requirements; Industrial Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

Note For EMC compliance, operate this device with shielded cables.

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 For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.

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 module number or product line, and click the appropriate link in the Certification column.

Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also 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 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.

电子信息产品污染控制管理办法 （中国 RoHS）

中国客户 National Instruments 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 National Instruments 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.)

Calibration (Analog Input)

You can obtain the calibration certificate and information about calibration services for this device at ni.com/calibration.

Calibration interval	2 years

[1] Absolute accuracy values at full scale on the analog input channels assume the device is operating within 70 °C of the last external calibration and are valid for averaging 100 samples immediately following internal calibration. Refer to the *Absolute accuracy formulas* for more information.

[2] Sensitivity is the smallest voltage change that can be detected. It is a function of noise.

[3] The maximum voltage that can be applied or output between AI and COM without creating a safety hazard.

[4] MAINS is defined as the (hazardous live) electrical supply system to which equipment is designed to be connected for the purpose of powering the equipment. Suitably rated measuring circuits may be connected to the MAINS for measuring purposes.

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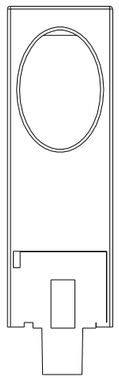
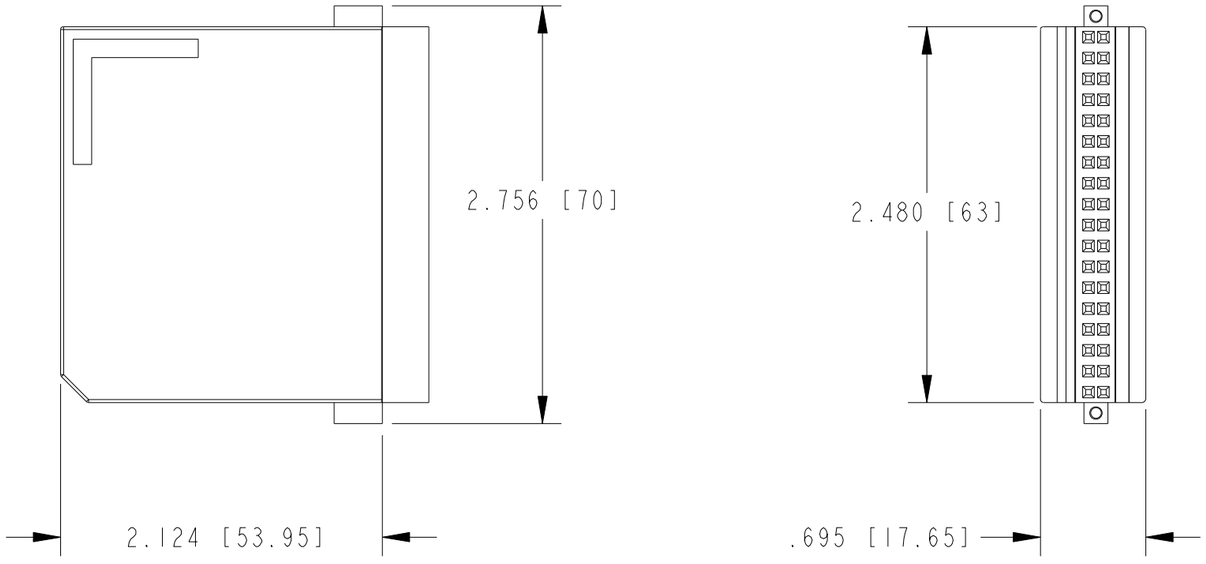




CUSTOMER DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND [MILLIMETERS].

DO NOT SCALE DRAWING

THIRD ANGLE PROJECTION

NATIONAL INSTRUMENTS®

AUSTIN, TEXAS

TITLE

CONNECTOR BLOCK 36 PIN WEIDMULLER

SIZE	CODE IDENT NO.	MM/DD/YYYY
B	7U296	06/11/2007

SCALE: 1/1 | SHEET 1 OF 1

CU_CONN_CRIO_36_POS_WEID_TB

LI-210SA Photometric Sensor

LI-COR, Inc. Toll Free: 1-800-447-3576 (U.S. & Canada) • Phone: 402-467-3576 • FAX: 402-467-2819 • E-mail: envsales@env.licor.com • Internet: http://www.licor.com

Measures Illuminance as Related to the CIE Standard Observer Curve

The LI-210SA Photometric Sensor utilizes a filtered silicon photodiode to provide a spectral response that matches the CIE curve within ± 5% with most light sources. This photodiode and filter combination is placed within a fully cosine-corrected sensor head to provide the proper response to radiation at various angles of incidence.

Some of the applications for the LI-210SA Photometric Sensor include interior and industrial lighting, outdoor illuminance, passive solar energy, architecture and lighting models, illumination engineering, and biological sciences that require illuminance measurements. The LI-210SA is a research grade photometric sensor that is very reasonably priced.

Photometric Sensors

Photometry refers to the measurement of visible radiation (light) with a sensor having a spectral responsivity curve equal to the average human eye. This curve is known as the CIE Standard Observer Curve (photopic curve).

Photometric sensors are used to measure lighting conditions where the eye is the primary receiver, such as illumination of work areas, interior lighting, television screens, etc. Although photometric measurements have been used in the past in plant science, PPFD and irradiance are the preferred measurements.

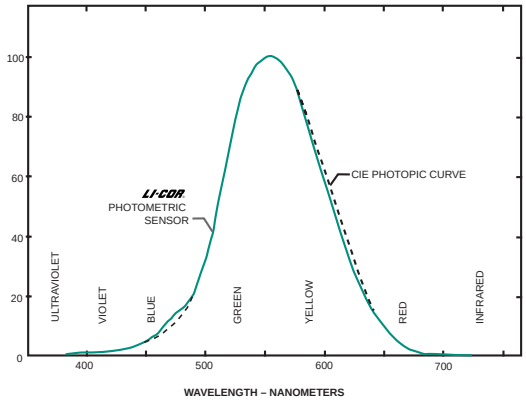


Figure 1. Typical spectral response of LI-COR Photometric Sensors vs. Wavelength and the CIE Standard Observer Curve.

LI-210SA Specifications

Absolute Calibration: ± 5% traceable to NBS.

Sensitivity: Typically 30 µA per 100 klux.

Linearity: Maximum deviation of 1% up to 100 klux.

Stability: < ± 2% change over a 1 year period.

Response Time: 10 µS.

Temperature Dependence: ± 0.15% per °C maximum.

Cosine Correction: Cosine corrected up to 80° angle of incidence.

Azimuth: < ± 1% error over 360° at 45° elevation.

Tilt: No error induced from orientation.

Operating Temperature: -20 to 65 °C.

Relative Humidity: 0 to 100%.

Detector: High stability silicon photovoltaic detector (blue enhanced).

Sensor Housing: Weatherproof anodized aluminum case with acrylic diffuser and stainless steel hardware.

Size: 2.38 Dia. × 2.54 cm H (0.94" × 1.0").

Weight: 28 g (1 oz.).

Cable Length: 10 ft. standard.

LI-210SA Photometric Sensor

Ordering Information

The LI-210SA Photometric Sensor cable terminates with a BNC connector that connects directly to the LI-250 Light Meter or LI-1400 DataLogger. The 2290 Millivolt Adapter should be ordered if the LI-210SA will be used with a strip chart recorder or datalogger that measures millivolts. The 2290 uses a 604 Ohm precision resistor to convert the LI-210SA output from microamps to millivolts. The Photometric Sensor can also be ordered with bare leads (without the connector) and is designated LI-210SZ. The 2003S Mounting and Leveling Fixture is recommended for each sensor unless other provisions for mounting are made. Other accessories are described on the Accessory Sheet.

LI-210SA Photometric Sensor
(with BNC connector)
LI-210SZ Quantum Sensor
(with bare leads)
2003S Mounting and Leveling Fixture
2222SB-50 Extension Cable (50 ft.)
2222SB-100 Extension Cable (100 ft.)
2290 Millivolt Adapter

LI-COR®
ENVIRONMENTAL DIVISION

4421 Superior Street • P.O. Box 4425 • Lincoln, NE 68504. U.S.A.
Toll Free: 1-800-447-3576 (U.S. & Canada) • Phone: 402-467-3576 • FAX: 402-467-2819
E-mail: envsales@env.licor.com • Internet: http://www.licor.com

Universal Voltage Output Amplifier for LI-COR™ Sensors
(Amplifies LI-COR sensor current to voltage-logger level)

The UTA is a special purpose amplifier that converts the microamp-level current output of LI-COR[1] light sensors to a corresponding signal voltage. The UTA can be configured at EME Systems or by the end user for any one of the three standard LI-COR sensors, and for any one of four popular output voltage ranges, through the manipulation of two plug-in jumpers. The UTA provides a simple interface between LI-COR sensors and voltage input data loggers, chart recorders, HVAC, and greenhouse control systems.

LI-COR sensor	Typical full sun response	UTA output (user selectable)
LI-190 PAR sensor	10µA @ 2000 µE/m^2s^2	1, 2, 5, 10 Volts out @ 12.5µA in
LI-200 Pyranometer	100µA @ 1000 W/m^2	1, 2, 5, 10 Volts out @ 125µA in
LI-210 Photometer	40µA @ 100 klux (=9290 ftcd)	1, 2, 5, 10 Volts out @ 50µA in

Alternate gain settings are available on special order. NEW: special 2.5 volt operation and calibration available for use with ONSET HOBO [2] data loggers. The calibration tag provided by LI-COR with each sensor, in conjunction with the preset amplifier gain factor can be used to compute the light levels incident on the sensor with a high degree of accuracy. Instructions and re-calibration information are included with each shipment.

Specifications:
- Supply Voltage: 5–24 VDC
  (supply volts > full scale output volts + 2)
- Supply Current: less than 1mA
- Gain accuracy:± 0.5% all ranges
  ± 0.2% on factory preset range
- Voltage output in darkness: <0.2% FSO
- Supply Voltage variation effect:
  less than 0.01% per Volt
- Operating Temperature: -30°C to +70°C
- Tempco: less than 0.01% per °C
- Output impedance: 1000Ω ±1%
- NEMA 4 gasketed white polycarbonate
  enclosure: 1.37" x 1.96" x 2.55" (4.15" w/glands)
  gland nut or BNC at input, gland nut at output
  Phoenix® beryllium/copper i/o terminals.

Order item	description	price ea.
UTA	base price, standard UTA with i/o cord grips, polycarbonate enclosure	$105
Options:		
/BNC	BNC connector on input	add $10
/input preset	preset input for LI-190, LI-200 or LI-210	no charge
/output preset	preset output for 1, 2 5 or 10 volts	no charge
/special output	preset output range for special value	add $15
/HOBO	special to run from 2.5 volts supply, 0-2.5 volt fs output.	add $10
/NE	no enclosure; amplifier electronics only.	subtract $15

Example 1: **UTA/200/5** UTA pre-configured for 0 to 5 volt output from LI-200 Pyranometer, price $105ea
Example 2: **UTA/BNC/190/1** UTA pre-configured for 0 to 1 volt output from an LI-190 Quantum PAR sensor with BNC input termination, price $115ea.

[1] LI-190,LI-200,LI-210 and part designations are trademarks and the exclusive property of LI-COR Lincoln, Nebraska
[2] HOBO is a trademark of ONSET Computer Corporation, Bourne, MA., U.S.A. (www.onset.com)

The following instructions are provided to assist you in the installation and operation of your amplifier. While we have made every effort to protect the amplifier from faults, improper installation or misuse may result in incorrect readings, or at worst, failure of the amplifier. Please read the manual in its entirety before connecting power to the UTA. If you have questions about the UTA or any portion of this manual please contact EME Systems technical support between the hours of 9:00 AM to 5:00 PM PST at: (510) 848-5725, or
(510) 848-5748 fax. You may also post your questions to us by e-mail on Internet at address: www.emesystems.com

Configuring your UTA:

The first step in using the UTA is to configure it for the LI-COR sensor and output voltage scaling you wish to use. You may have ordered your UTA pre-configured for the appropriate sensor and full scale output voltage you need. The preset value is marked on a label outside the UTA enclosure. If so, please skip to "connections" on the next page. This section explains how to configure the UTA for different sensors and output ranges.

1) UTA amplifiers are enclosed in a protective enclosure. To gain access to the connection terminals and jumper blocks, remove the two corner screws using a standard screwdriver and lift up on the top.

2) Refer to the diagram below for the position of jumper blocks JP1 and JP2. Each jumper block should have only one jumper in place. Choose the jumper position on JP1 that corresponds to the type of LI-COR sensor you will be using. Choose the jumper position on JP2 that corresponds to your desired full scale output voltage. To move the jumpers, pull them up and off the posts, and plug them back into the desired position. A copy of this diagram is attached on a label on the inside the lid of the UTA enclosure.

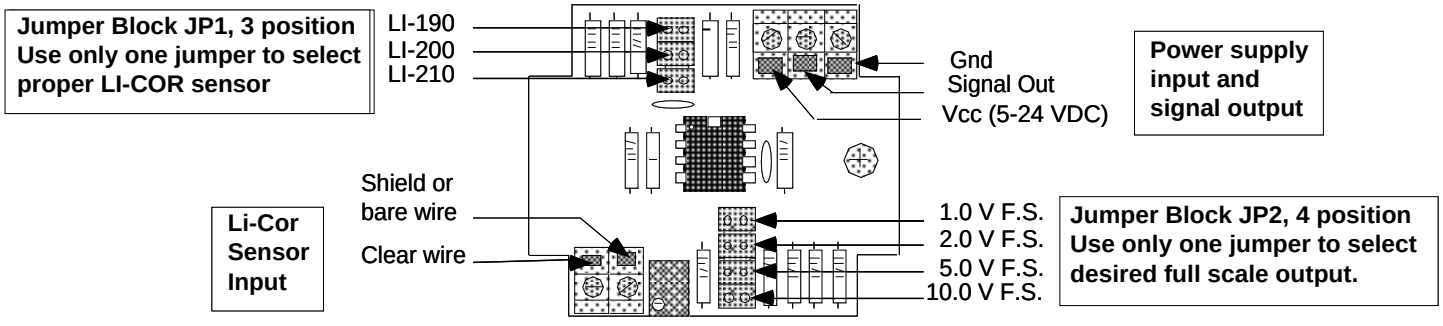


Figure 2: UTA jumper and connections diagram

Notes:

• Choose a full scale output voltage less than or equal to your logger's input capability -but not too much less. For example, if your logger has a full scale input range of 2.5 volts, you should choose the 2 volt position.

• If you select too low a setting, you will lose resolution and your logger will not register subtle changes and may fail to register the lowest light levels of interest.

• If you select too high a setting, the amplifier may overdrive or saturate the input circuit on your meter or even damage its inputs. The highest light levels will all register as one value: off scale!

• You may wish to purposely select a higher output setting to achieve greater sensitivity at low light levels. This might be useful in studies of indoor lighting where full-sun intensities will never be attained.

• The UTA power supply must always be greater than or equal to the full scale output voltage.

• Use alcohol to rub off the old mark on the calibration label, and a Sharpie™ marker for the new one.

Connections:

1) UTA amplifiers are enclosed in a protective cabinet. To gain access to the connection terminals and jumper blocks, remove the two corner screws using a standard screwdriver and lift up on the top.

2) Refer to figure 2. The UTA has connections for the LI-COR sensor input at one end of the circuit board and for the power supply and signal output at the other end. The input connections may be either a pair of black and white color coded screw terminals or a BNC connector. The UTA power supply and output signal is always terminated with a strip of three screw terminals, color-coded red, green and black.

a) LIXXX-**SZ** (bare wire termination): LI-COR part numbers ending with "SZ" are terminated with a stripped and tinned bare coaxial cable. These sensors should be used with a standard UTA amplifier. Connect the inner conductor (green, white, or clear) to the white colored terminal on the UTA board and connect the outer wire (shield or tinned copper wire) to the neighboring black terminal.

or

LIXXX-**SA** (BNC termination): LI-COR part numbers ending with a "SA" are terminated with a BNC connector and should be used with the UTA-BNC amplifier. Simply align the connector with its mate on the outside of the UTA-BNC and twist the two halves together. The BNC connectors should lock together when they are properly seated.

b) Connect the power supply from your data logger between the black (common) and red (+ DC voltage) terminals on the opposite end of the circuit board. The power supply voltage must be at least 5 volts, and must be greater than or equal to the full-scale output voltage you select for the UTA (ie, if using the 10.0 V F.S setting, your power supply must provide at least 10 volts, or it must provide 5 volts power for a 1, 2 or 5 volt output. The UTA draws less than 1mA of current, making a battery a viable option for a power supply.

c) The signal from the UTA should be taken between the green and black terminals. Green is signal and black is common (ground). The green terminal should be connected to the signal input of your logger and the black terminal should be connected to the power supply ground. Note that the black terminal is common to both the power supply and signal line.

3) Check all connections for proper polarity and be sure all wires are clamped solidly in place. Replace the top cover on the enclosure and tighten the corner screws. Take care not to over tighten the cover screws as this may cause the cover to deform or “saddle” which can compromise the seal.

Note:
The amplifier should be placed as close to the LI-COR sensor as possible. If the sensor and the meter or logger are spaced far apart (greater than 50 feet) the bulk of the distance should be between the UTA and the logger or meter, not between the sensor and the UTA. This will minimize the effect of noise and electro-magnetic interference. For long runs in the presence of halide lamps or other noise sources, you should consider using shielded, three-wire cable for the power and signal connections between the logger and the UTA, with the shield tied to common at one end only.

Calculations:
In order to convert the UTA's output voltage into the appropriate units of light, you will have to program your equipment to multiply the UTA output voltage times the multiplier printed on the calibration tag that accompanies each individual LI-COR sensor, divided by the UTA's transconductance gain (Volts per µAmp). Refer to the calibration tag on your LI-COR sensor for the multiplier for your particular LI-COR sensor. Drop the minus sign from the multiplier. This is your sensor conversion factor.

$$\textbf{Light level} = \frac{\textbf{(UTA output)*(sensor conversion factor)}}{\textbf{(UTA tranconductance gain)}}$$

If you configure the UTA jumpers yourself, please refer to the table below to find the UTA transconductance gain corresponding to their positions.

Table of LI-COR sensor types Vs. Transconductance gain for various jumper settings				
	JP2-1) **1 Volt fs**	JP2-2) **2 Volts fs**	JP2-3) **5 Volts fs**	JP2-4) **10 Volts fs**
JP1-1) **LI-190**	**0.08** V/µA	**0.16** V/µA	**0.4** V/µA	**0.8** V/µA
JP1-2) **LI-200**	**0.008** V/µA	**0.016** V/µA	**0.04** V/µA	**0.08** V/µA
JP1-3) **LI-210**	**0.02** V/µA	**0.04** V/µA	**0.1** V/µA	**0.2** V/µA

Example calculations:

Example 1: Suppose you will be using your UTA in conjunction with a **Quantum PAR sensor (LI-190)** , and that the Quantum sensor calibration tag states a multiplier of -187.5µE/m2s per µA. Suppose your data logger has a full scale input of 1.28 volts. You choose the 1.0 volt output setting for your UTA, with a transconductance gain of 0.08 V/µA (1st column, 1st row in the table). The conversion is:

light level in µE/m2s = (UTA volts) * (187.5 / 0.08) = (UTA volts) * (2343.75 µE/m2s per volt)

A 0.836 volt output signal would indicate 1959.4 µE/m2s.

Example 2: Suppose you will be using your UTA in conjunction with a **Pyranometer sensor (LI-200)**, and that the Pyranometer sensor calibration tag states a multiplier of -9.8 W/m2 per µA. Suppose your meter has a full scale input of 5.0 volts You choose the 5.0 volt output setting for your UTA, with a transconductance gain of 0.04 V/µA. (3rd column, 2nd row in table). The conversion is:

light level in W/m2 = (UTA volts) * (9.8 / 0.04) = (UTA volts) * (245 W/m2 per volt)

A 5.0 volt output signal would indicate 1225 W/m2

Example 3: Suppose you will be using your UTA in conjunction with a **Photometer sensor (LI-210)**, and that the Photometer calibration tag states a multiplier of -2.63 klux/µA. Suppose your recorder has a full scale input of 2.5 volts You choose the 2.0 volt output setting for your UTA, with a transconductance gain of 0.04 V/µA (2nd column, 3rd row in table). The conversion is:

light level in klux = (UTA volts) * (2.63 / 0.04) = (UTA volts) * (65.75 klux per volt)

A 1.25 volt output signal would indicate 83.4 klux. If you need units in footcandles, 1 footcandle=10.764 lux.

Note: If you need more sensitivity at low light levels, choose a higher UTA transconductance gain.

Troubleshooting:

1) UTA appears to be dead; the output voltage is stuck at zero or full scale regardless of light level:

Things to check:

1a) Check supply voltage and polarity at the red and black terminals of the UTA circuit board.

1b) Check the sensor polarity, make sure that the center conductor on the sensor wire is connected to the white terminal and the outer shield wire is connected to the black terminal on the UTA input.

1c) Check the screw terminal connections, make sure all of the wires are clamped solidly in place. The sensor wire should be clamped in the terminal, not loose underneath it. The center conductor of the sensor wire is delicate; be sure it is not broken.

1d) If you are testing the unit on a bench indoors you may have to move it very close to an artificial light source to get a response. Light levels indoors are much, much weaker than sunlight. Be sure the protective red cap is removed from the sensor.

1e) Check if the sensor and gain selecting jumpers are in place, oriented properly and seated firmly.

1f) Has there been a lightning strike in close proximity? Although the UTA is protected against excess or reversed power supply voltages, it can not be expected to survive catastrophic extremes.

1g) Check for evidence of water entry into the cabinet. In regions of extreme humidity or precipitation it may be wise to place a dessicant, such as silica gel, inside the UTA's cabinet.

2) Amplifier seems to be responding to light, but the output seems too low or too high:

Things to check:

2a) Check the position of the jumpers on JP1 and on JP2 against the diagram attached to the inside of the lid of the enclosure and the calibration label. Is the setting correct?

2b) Place sensor in full unobstructed sunlight, you should see a significant increase in output voltage. Indoor lighting is much, much weaker than full sunlight. The standard amplification factors are designed to accommodate full tropical sunlight conditions. If you will be using your sensor in generally low-light conditions, say indoors or in the arctic or under a plant canopy, you may wish to select a higher output voltage setting to bring the signal into the dynamic range of your data logger. Please consult the LI-COR literature and references, or contact EME Systems for assistance.

2c) The power supply must be at least 2 volts greater than the desired full scale output voltage.

3) The amplifier output is unstable and readings fluctuate too much under constant lighting conditions:

Things to check:

3a) Check all of the connections to the screw terminals. Make sure all connections are tight and secure.

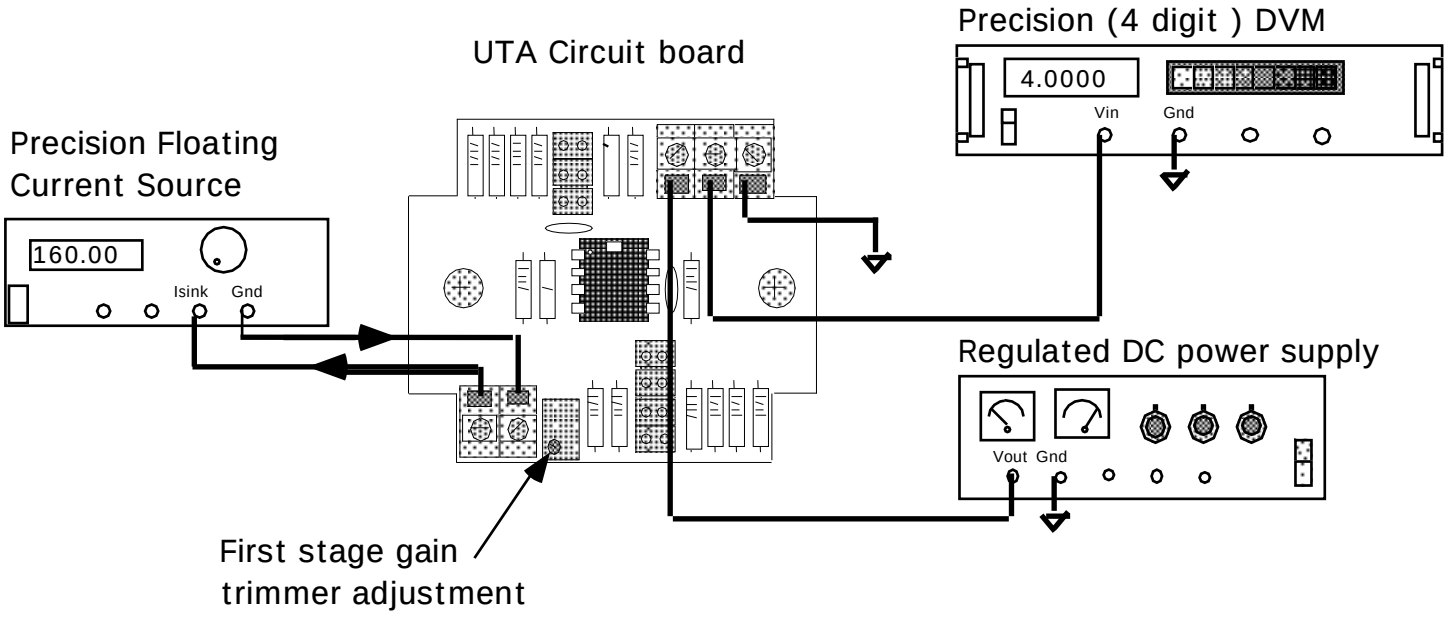
3b) Check for an AC component in the power supply voltage. The power supply should be filtered direct current and should stay at least 1.5 volts above the full scale output voltage.

3c) Is the sensor is close to a strong electromagnetic field, such as a halide lamp or a refrigerator motor or other AC power equipment? If so, try to reroute the sensor cable, or run the sensor cable inside a grounded metal conduit. Avoid running the sensor cable in the same conduit as AC power lines.

3d) Occasionally, oscillations can arise due to reactive loading on the signal cable. Placing a 0.1µF capacitor between the signal terminal and the common terminal at your data logger input will usually suppress the oscillation.

UTA re-calibration:

The jumpers in the UTA select certain popular values for the transconductance gain. If you want to set an intermediate value of gain, it is possible to do so. The diagram below shows the location of the gain adjustment trimmer. Use a precision current sink as the input signal for the amplifier and an accurate (4digit) DVM to read the amplifier output voltage. Set the output of the precision current sink to the desired the full scale sink current. Adjust the first stage gain trimmer to give the corresponding full scale output. For example, to calibrate for a Quantum PAR sensor, we standardize with a 12.5 microamp input current, and a 5.0 volt output voltage. The adjustment range is ± 20% of the fixed gain value.



Notes:

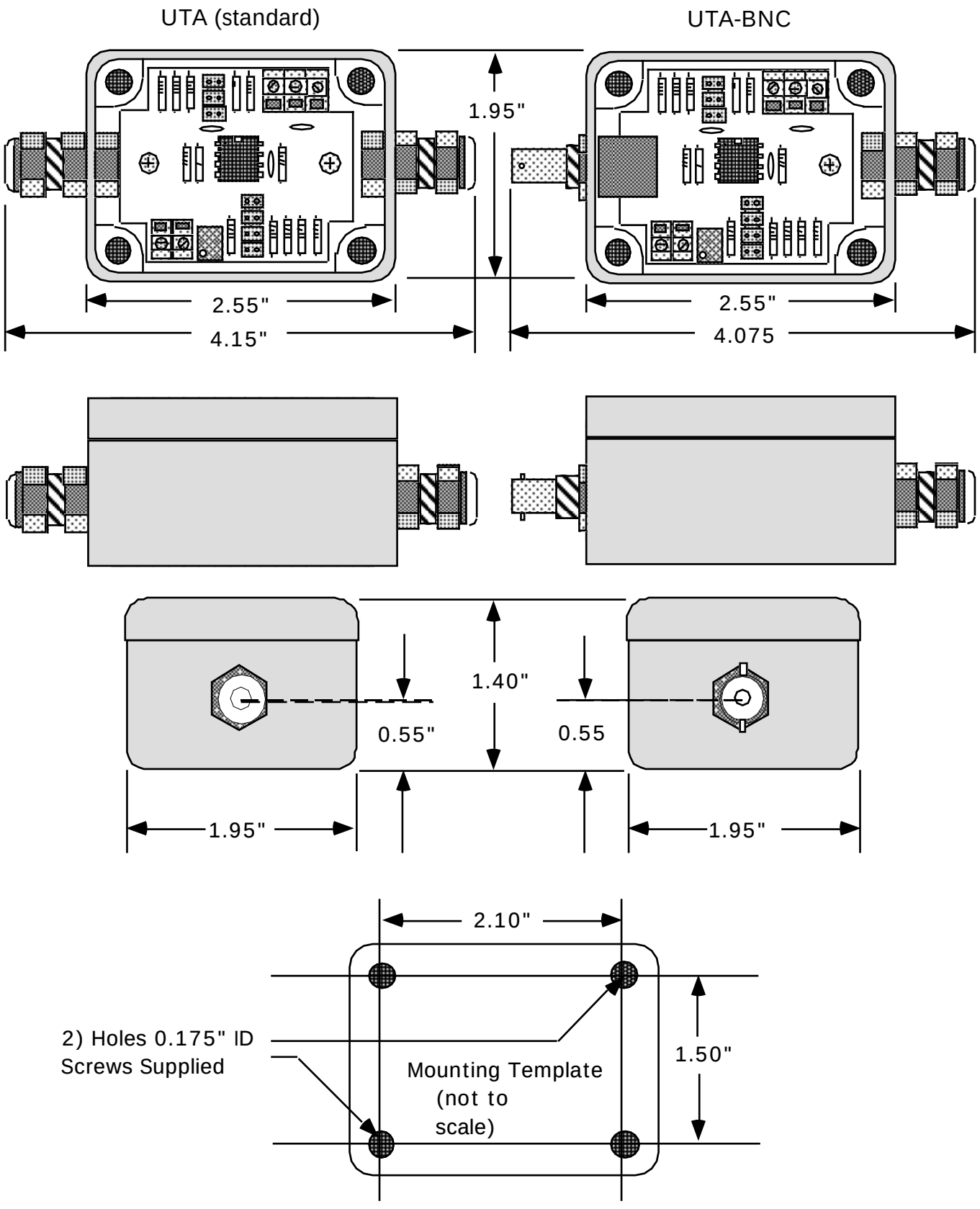
• Each LICOR sensor has an individual calibration tag. The standard calibration of the UTA requires that the calibration constant be entered in software. Alternatively, a UTA can be calibrated to match an individual LI-COR sensor, so that, say, 1000 watts/meter2 intput will give 4.00 volts output. That UTA then stays with that particular LICOR sensor. In effect the calibration is done in the hardware, rather than in the software. The advantage is that it simplifies the software, particularly where a low-resolution converter will be used, or where calibration constants can not be entered in software, or where several light sensors must be interchangeable without reprogramming. The disadvantage is that if the LICOR sensor needs to be replaced or recalibrated, then so must its attached UTA.

For example, suppose you have a Quantum PAR sensor (LI-190), and that its calibration tag states a multiplier of -187.5 µE/m2s per µA. Suppose you want to calibrate the UTA to have an output of exactly 4.0 volts when the solar input is 2000 µE/m2s. Note that the sensor output when the solar radiation is 2000µE/m2s will be 10.667 microamps (=2000/187.5). One way to do the calibration would be to apply a current of exactly 10.6667 microamps to the UTA input and then adjust the trimmer in the UTA to give an output of 4.0 volts. It may be more convenient to use a standard current sink, say 10 microamps, and then set the output to 3.750 volts. (=4*10/10.667).

Alternatively, a calibrated light source such as LI-COR's 1800-02 Optical Radiation Calibrator can be used to match a LI190 and LI210 sensor to the UTA. Place the sensor in the calibrator and adjust the first stage gain trimmer to match the desired voltage output.

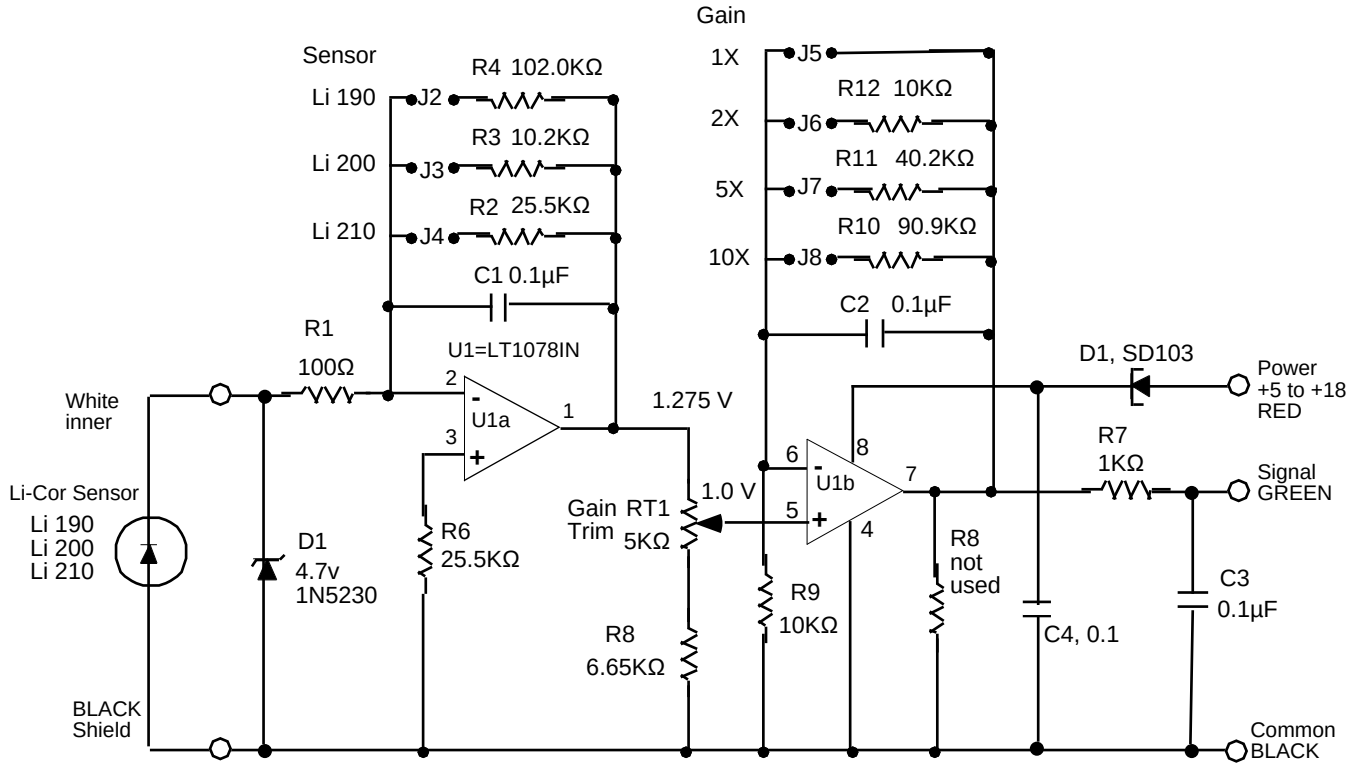
• LI-COR recommends that all LI-XXX series sensors be returned for re-calibration every two years. This will ensure proper calibration and compensate for the effects of aging and degradation on the sensor.

UTA, Polycarbonate Enclosure, Physical Dimensions:



UTA Schematic:

The information contained herein is provided as an aid to resolving questions about the amplifier and its application. It is not meant for general distribution and remains the exclusive property of EME Systems.



UTA — Universal Transconductance Amplifier

- Special for faster response, 1 millisecond settling, C1=C2=C3=0.01µF or 0.001µF
- Special for HOBO, Remove C2,C3; replace C1 w/ 0.001 µF, short D1, U1=LT1490A.

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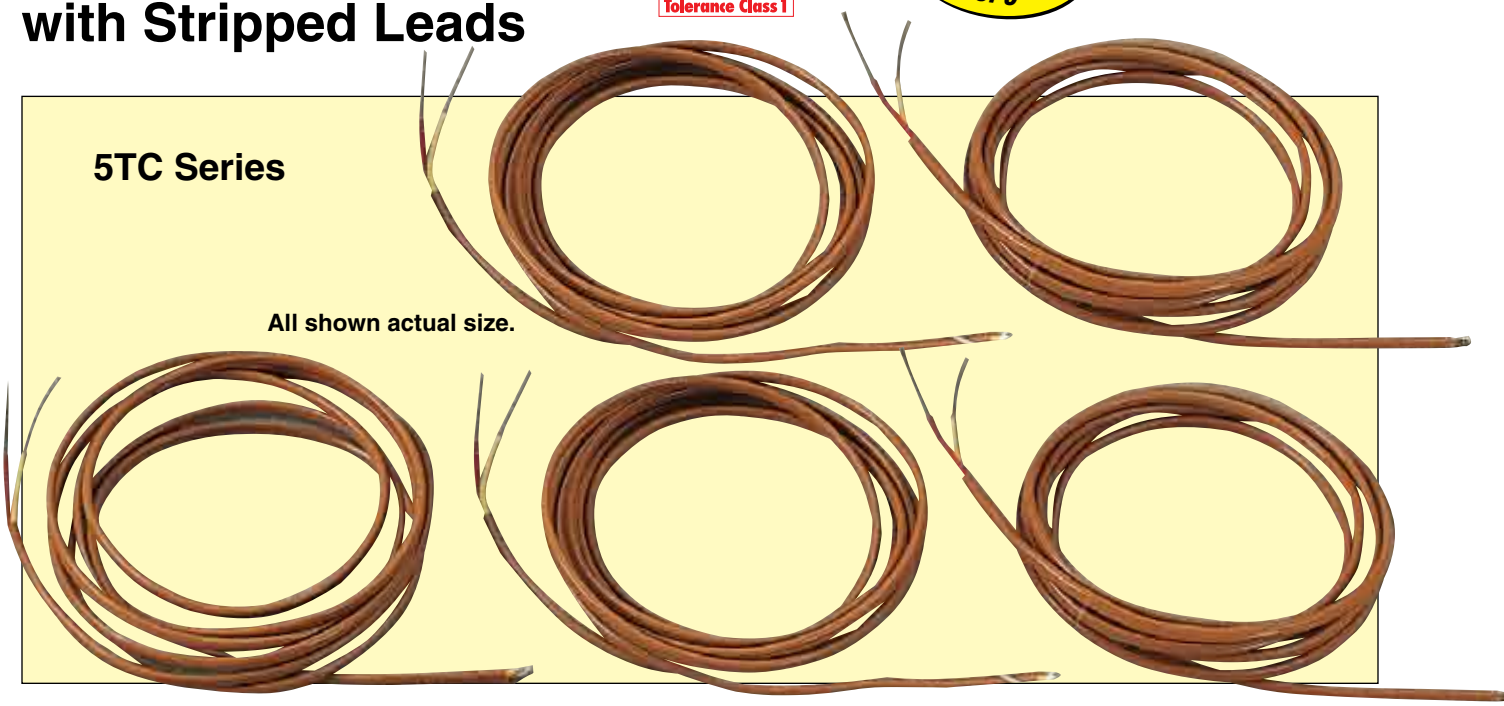

- Available from Stock in Convenient 5-Packs
- PFA, Kapton®, or Glass Braid Insulation
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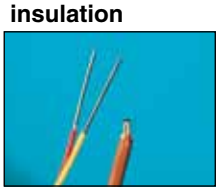
- 1 and 2 m (40 and 80") Lengths Standard
- NIST Calibration Available
- OEM Quantities Available

"TT" PFA insulation



"GG" Glass braid insulation

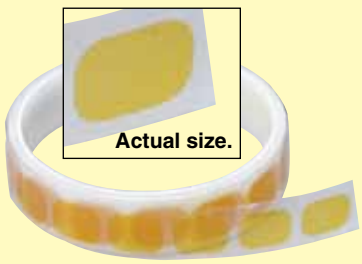
Fine 40-Gage PFA Wire

KAPTON® Insulation

Also Available TAP Adhesive Labels

Thermocouple Adhesive Labels secure wire probes to surfaces. **TAP** adhesive labels have a thickness of 0.064 mm (0.0022") and can be used at a maximum temperature of 180°C (356°F). They are made of a polymide film with a silicone pressure sensitive adhesive.

Visit us online for details and ordering information.



Model TAP, roll of 100 adhesive labels, shown smaller than actual size.

To Order

Model No. ANSI Color Code	AWG Gage	Diameter mm (in)	Insulation
5TC-GG-(*)-20-(**)	20	0.81 (0.032)	Glass Braid
5TC-GG-(*)-24-(**)	24	0.51 (0.020)	Glass Braid
5TC-GG-(*)-30-(**)	30	0.25 (0.010)	Glass Braid
5TC-GG-(*)-36-(**)	36	0.13 (0.005)	Glass Braid
5TC-TT-(*)-20-(**)	20	0.81 (0.032)	PFA
5TC-TT-(*)-24-(**)	24	0.51 (0.020)	PFA
5TC-TT-(*)-30-(**)	30	0.25 (0.010)	PFA
5TC-TT-(*)-36-(**)	36	0.13 (0.005)	PFA
5TC-TT-(*)-40-(**)	40	0.08 (0.003)	PFA
5TC-KK-(*)-20-(**)	20	0.81 (0.032)	Kapton®
5TC-KK-(*)-24-(**)	24	0.51 (0.020)	Kapton®
5TC-KK-(*)-30-(**)	30	0.25 (0.010)	Kapton®

** Insert calibration **J, K, T,** or **E.** ** Specify length, insert **"36"** for 1 m or **"72"** for 2 m length.*

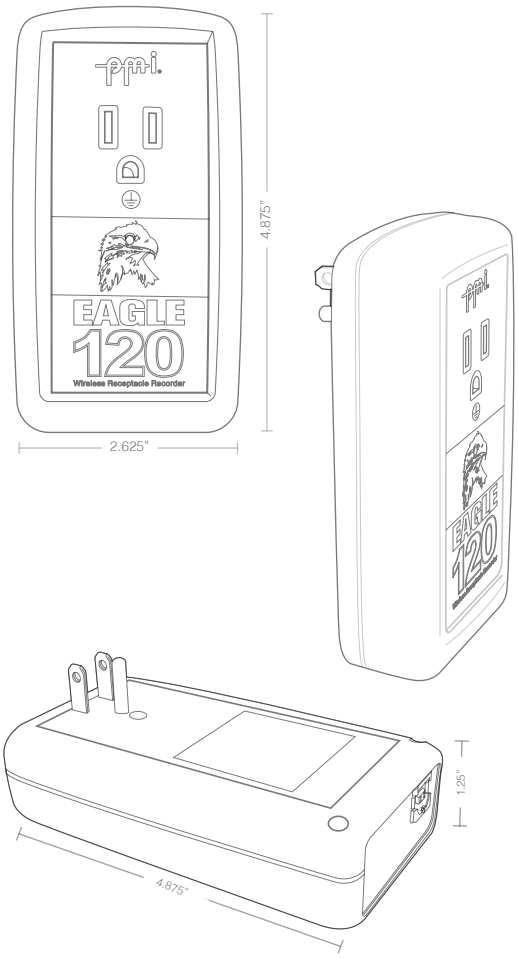
***Note:** For GG or TT wire, additional cost per additional 300 mm (12") per package of 5.*
For KK wire, additional cost per additional 300 mm (12") per package of 5.
*For a male straight M8 plug add **"M8-S-M"** to the model number for additional cost, for a male straight M12 plug add **"M12-S-M"** to the model number for additional cost.*
*For a male right-angled M8 plug add **"M8-R-M"** to the model number for additional cost, for a male right-angled M12 plug add **"M12-S-M"** to the model number for additional cost.*

***Ordering Example:** **5TC-TT-K-30-36**, 5 pack, PFA insulated thermocouples, Type K calibration (CHROMEGA®-ALOMEGA®), 30 AWG, 1 m (40") long, stripped lead termination.*

EAGLE

EAGLE 120

INPUTS	AC Voltage	60 to 140 VAC RMS Continuous, 0 to 240 VAC Peak, Neutral-Ground 0-75 VAC RMS
	AC Current	0 to 80 amps RMS (15 amps continuous)
	Sample Rate	256 samples/cycle/channel
CHANNELS	Voltage	2 channels
	Current	1 channel
MEASURED QUANTITIES PER CYCLE	RMS Voltage	Volts
	RMS Current	Amps
	Real Power	Watts
	Apparent Power	VAs
	Reactive Power	VARs
	Phase Angle	Degrees
	Power Factor	Watts/VA
	Displacement PF	cos (phase angle)
	Power Usage	kWh, kVARh, kVAh
COMMUNICATIONS	Type	USB, Bluetooth® Wireless (optional)
INFORMATION STORAGE	Interval Graphs	1.2 MB (Standard) 6.9 MB (with memory option)
	Significant Change	1000 records
	Flicker	1000 records
	Waveform Capture	256 KB (standard) 1.7 MB (with memory option)
RECORD SETTINGS	Interval Graphs	1 cycle to 4 hour interval. User selected, stop-when-full, or wrap around memory modes
	Significant Change	1V to 8V in 1V steps
	Flicker	User-defined, or conform to IEEE1453/ IEC61000-4-15, and IEEE Std. 141
	Waveform Capture	Voltage and current threshold, periodic capture
ENVIRONMENTAL	Operating Temp	-20°F to +135° F
	Shock	60 Hz to 2 KHz, acceleration 25G
	Vibration	10Hz to 60Hz, amplitude 1.8mm
ACCURACY	Voltage	0.33% of full scale
	Current	1.0% of full scale
	Power	1.0% of full scale
	Phase Angle	1.0°
	Power Factor	±0.02
	Displacement PF	±0.02
PHYSICAL DIMENSIONS	Size	4.9" L x 2.7" W x 1.25" H
	Weight	0.5 lbs
HARMONICS	Voltage	to the 51st
	Current	to the 51st
	Measures	magnitude, phase, THD



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Last Revised: 2014-11-06 07:14:12.0

Low-Cost, Bus-Powered Multifunction DAQ for USB

12- or 14-Bit, Up to 48 kS/s, 8 Analog Inputs

- 8 analog inputs at 12 or 14 bits, up to 48 kS/s
- 2 analog outputs at 12 bits, software-timed
- 12 TTL/CMOS digital I/O lines
- One 32-bit, 5 MHz counter
- Digital triggering
- Bus-powered
- 1-year warranty

Overview

With recent bandwidth improvements and new innovations from National Instruments, USB has evolved into a core bus of choice for measurement applications. The NI USB-6008 and USB-6009 are low-cost DAQ devices with easy screw connectivity and a small form factor. With plug-and-play USB connectivity, these devices are simple enough for quick measurements but versatile enough for more complex measurement applications.

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Requirements and Compatibility

OS Information

- Mac OS X
- Windows 2000/XP
- Windows 7
- Windows CE
- Windows Mobile
- Windows Vista 32-bit
- Windows Vista 64-bit

Driver Information

- NI-DAQmx
- NI-DAQmx Base

Software Compatibility

- ANSI C/C++
- LabVIEW
- LabWindows/CVI
- Measurement Studio
- SignalExpress
- Visual Basic .NET
- Visual C#

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Comparison Tables

Product	Analog Inputs	Input Resolution	Max Sampling Rate (kS/s)	Analog Outputs	Output Resolution	Output Rate (Hz)	Digital I/O Lines	32-Bit Counter	Triggering
USB-6008	8 single-ended/4 differential	12	10	2	12	150	12	1	Digital
USB-6009	8 single-ended/4 differential	14	48	2	12	150	12	1	Digital

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Application and Technology

The USB-6008 and USB-6009 are ideal for applications where a low-cost, small form factor and simplicity are essential. Examples include the following:

- Data logging—quick and easy environmental or voltage data logging
- Academic lab use—student ownership of data acquisition hardware for completely interactive lab-based courses (Academic pricing available. Visit the academic product page for details.)
- OEM applications as I/O for embedded systems

Recommended Software

National Instruments measurement services software, built around NI-DAQmx driver software, includes intuitive application programming interfaces, configuration tools, I/O assistants, and other tools designed to reduce system setup, configuration, and development time. National Instruments recommends using the latest version of NI-DAQmx driver software for application development in NI LabVIEW, SignalExpress, LabWindows™/CVI, and Measurement Studio software. To obtain the latest version of NI-DAQmx, visit ni.com/support/daq/versions.

NI measurement services software speeds up your development with features including the following:

- A guide to create fast and accurate measurements with no programming using the DAQ Assistant
- Automatic code generation to create your application in LabVIEW
- LabWindows/CVI; SignalExpress; and C#, Visual Studio .NET, ANSI C/C++, or Visual Basic using Measurement Studio
- Multithreaded streaming technology for 1,000 times performance improvements
- Automatic timing, triggering, and synchronization routing to make advanced applications easy
- More than 3,000 free software downloads at ni.com/zone to jump-start your project
- Software configuration of all digital I/O features without hardware switches/jumpers
- Single programming interface for analog input, analog output, digital I/O, and counters on hundreds of multifunction DAQ hardware devices; M Series devices are compatible with the following versions (or later) of NI application software—LabVIEW, LabWindows/CVI, or Measurement Studio versions 7.x; and SignalExpress 2.x

Every National Instruments DAQ device includes a copy of SignalExpress LE data-logging software, so you can quickly acquire, analyze, and present data without programming. The NI-DAQmx Base driver software is provided for use with Linux, Mac OS X, Windows Mobile, and Windows CE OSs.

Recommended Accessories

The USB-6008 and USB-6009 have removable screw terminals for easy signal connectivity. For extra flexibility when handling multiple wiring configurations, NI offers the USB-600x Connectivity Kit, which includes two extra sets of screw terminals, extra labels, and a screwdriver. In addition, the USB-600x Prototyping Kit provides space for adding more circuitry to the inputs of the USB-6008 or USB-6009.

NI USB DAQ for OEMs

Shorten your time to market by integrating world-class National Instruments OEM measurement products into your embedded system design. Board-only versions of NI USB DAQ devices are available for OEM applications, with competitive quantity pricing and available software customization. The NI OEM Elite Program offers free 30-day trial kits for qualified customers. Visit ni.com/oem for more information.

Information for Student Ownership

To supplement simulation, measurement, and automation theory courses with practical experiments, NI has developed the USB-6008 and USB-6009 student kits, which include the LabVIEW Student Edition and a ready-to-run data logger application. These kits are exclusively for students, giving them a powerful, low-cost, hands-on learning tool. Visit ni.com/academic for more details.

Information for OEM Customers

For information on special configurations and pricing, call (800) 813-3693 (United States only) or visit ni.com/oem. Go to the Ordering Information section for part numbers.

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Ordering Information

For a complete list of accessories, visit the product page on ni.com.

Products	Part Number	Recommended Accessories	Part Number
NI USB-6009			
NI USB-6009 with NI-DAQmx software, LabVIEW SignalExpress LE, and a USB cable.	779026-01	No accessories required.	
NI USB-6009 Student Kit with NI-DAQmx software, LabVIEW SignalExpress LE, and a USB cable. Includes LabVIEW Student Edition.	779321-22	No accessories required.	
NI USB-6009 OEM (no enclosure)	193132-01	No accessories required.	
Prototyping Kit			
NI USB-600x Prototyping Kit	779511-01	No accessories required.	
NI USB-6008			
NI USB-6008 with NI-DAQmx software, LabVIEW SignalExpress LE, and a USB cable.	779051-01	No accessories required.	
NI USB-6008 OEM (no enclosure)	193132-02	No accessories required.	
NI USB-6008 Student Kit with NI-DAQmx software, LabVIEW SignalExpress LE, and a USB cable. Includes LabVIEW Student Edition.	779320-22	No accessories required.	
Connectivity Kit			
NI USB-600x Connectivity Kit	779371-01	No accessories required.	

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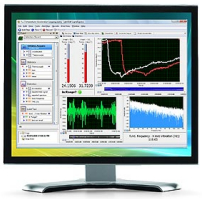
Software Recommendations

NI LabVIEW Full Development System for Windows

- Fully integrated graphical system design software
- Support for a wide range of measurement hardware, I/O, and buses
- Custom, event-driven user interfaces for measurement and control
- Extensive signal processing, analysis, and math functionality
- Advanced compiler to ensure high-performance execution and code optimization
- Includes SSP for professional technical support, online training, and software upgrades

SignalExpress for Windows

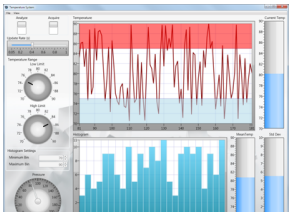


- Quickly configure projects without programming
- Control over 400 PC-based and stand-alone instruments
- Log data from more than 250 data acquisition devices
- Perform basic signal processing, analysis, and file I/O
- Scale your application with automatic LabVIEW code generation
- Create custom reports or easily export data to LabVIEW, DIAdem or Microsoft Excel

NI LabWindows™/CVI for Windows

- Real-time advanced 2D graphs and charts
- Complete hardware compatibility with IVI, VISA, DAQ, GPIB, and serial
- Analysis tools for array manipulation, signal processing statistics, and curve fitting
- Simplified cross-platform communication with network variables
- Measurement Studio .NET tools (included in LabWindows/CVI Full only)
- The mark LabWindows is used under a license from Microsoft Corporation.

NI Measurement Studio Standard Edition



- Customizable graphs and charts for WPF, Windows Forms, and ASP.NET Web Forms UI design
- Analysis libraries for basic signal generation
- Hardware integration support with data acquisition and instrument control libraries
- Project setup wizards to speed up development
- Support for Microsoft Visual Studio .NET 2012/2010/2008

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Support and 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.

Technical Support

Get answers to your technical questions using the following National Instruments resources.

- **Support** - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
- **Discussion Forums** - Visit forums.ni.com for a diverse set of discussion boards on topics you care about.
- **Online Community** - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

- **Classroom training in cities worldwide** - the most comprehensive hands-on training taught by engineers.
- **On-site training at your facility** - an excellent option to train multiple employees at the same time.
- **Online instructor-led training** - lower-cost, remote training if classroom or on-site courses are not possible.
- **Course kits** - lowest-cost, self-paced training that you can use as reference guides.
- **Training memberships** and training credits - to buy now and schedule training later.

Visit ni.com/training for more information.

Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 700 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

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Detailed Specifications

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

Analog Input	
Converter type	Successive approximation
Analog inputs	8 single-ended, 4 differential, software selectable
Input resolution	
NI USB-6008	12 bits differential, 11 bits single-ended
NI USB-6009	14 bits differential, 13 bits single-ended
Max sampling rate (aggregate) [1]	
NI USB-6008	10 kS/s
NI USB-6009	48 kS/s
AI FIFO	512 bytes
Timing resolution	41.67 ns (24 MHz timebase)
Timing accuracy	100 ppm of actual sample rate
Input range	
Single-ended	±10 V
Differential	±20 V [2] , ±10 V, ±5 V, ±4 V, ±2.5 V, ±2 V, ±1.25 V, ±1 V
Working voltage	±10 V
Input impedance	144 kΩ
Overvoltage protection	±35
Trigger source	Software or external digital trigger
System noise [3]	
Single-ended	
±10 V range	5 mVrms
Differential	
± 20 V range	5 mVrms
±1 V range	0.5 mVrms

Absolute accuracy at full scale, single-ended		
Range	**Typical at 25 °C (mV)**	**Maximum over Temperature (mV)**
±10	14.7	138

Absolute accuracy at full scale, differential [4]		
Range	**Typical at 25 °C (mV)**	**Maximum over Temperature (mV)**
±20	14.7	138
±10	7.73	84.8

Absolute accuracy at full scale, differential [4]		
Range	**Typical at 25 °C (mV)**	**Maximum over Temperature (mV)**
±5	4.28	58.4
±4	3.59	53.1
±2.5	2.56	45.1
±2	2.21	42.5
±1.25	1.70	38.9
±1	1.53	37.5

Analog Output

Analog outputs	2
Output resolution	12 bits
Maximum update rate	150 Hz, software-timed
Output range	0 to +5 V
Output impedance	50 Ω
Output current drive	5 mA
Power-on state	0 V
Slew rate	1 V/µs
Short circuit current	50 mA
Absolute accuracy (no load)	7 mV typical, 36.4 mV maximum at full scale

Digital I/O

Digital I/O	
P0.<0..7>	8 lines
P1.<0..3>	4 lines
Direction control	Each channel individually programmable as input or output
Output driver type	
NI USB-6008	Open collector (open-drain)
NI USB-6009	Each channel individually programmable as active drive (push-pull) or open collector (open-drain)
Compatibility	TTL, LVTTL, CMOS
Absolute maximum voltage range	–0.5 to 5.8 V with respect to GND
Pull-up resistor	4.7 kΩ to 5 V
Power-on state	Input

Digital logic levels			
Level	**Min**	**Max**	**Units**
Input low voltage	–0.3	0.8	V
Input high voltage	2.0	5.8	V
Input leakage current	—	50	µA
Output low voltage (I = 8.5 mA)	—	0.8	V
Output high voltage			
Active drive (push-pull), I = –8.5 mA	2.0	3.5	V
Open collector (open-drain), I = –0.6 mA, nominal	2.0	5.0	V
Open collector (open-drain), I = –8.5 mA, with external pull-up resistor	2.0	—	V

External Voltage

+5 V output (200 mA maximum)	+5 V typical, +4.85 V minimum
+2.5 V output (1 mA maximum)	+2.5 V typical
+2.5 V accuracy	0.25% max
Reference temperature drift	50 ppm/°C max

Counter

Number of counters	1
Resolution	32 bits
Counter measurements	Edge counting (falling-edge)
Counter direction	Count up
Pull-up resistor	4.7 kΩ to 5 V
Maximum input frequency	5 MHz
Minimum high pulse width	100 ns
Minimum low pulse width	100 ns
Input high voltage	2.0 V
Input low voltage	0.8 V

Power Requirements

USB	
4.10 to 5.25 VDC	80 mA typical, 500 mA max
USB suspend	300 µA typical, 500 µA max

Physical Characteristics

Dimensions	
Without connectors	6.35 cm × 8.51 cm × 2.31 cm (2.50 in. × 3.35 in. × 0.91 in.)
With connectors	8.18 cm × 8.51 cm × 2.31 cm (3.22 in. × 3.35 in. × 0.91 in.)
I/O connectors	USB series B receptacle, (2) 16 position terminal block plug headers
Weight	
With connectors	84 g (3 oz)
Without connectors	54 g (1.9 oz)
Screw-terminal wiring	16 to 28 AWG
Torque for screw terminals	0.22–0.25 N · m (2.0–2.2 lb · in.)

Safety

If you need to clean the module, wipe it with a dry towel.

Safety Voltages

Connect only voltages that are within these limits.

Channel-to-GND	±30 V max, Measurement Category I

Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS voltage. MAINS is a hazardous live electrical supply system that powers equipment. 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.

Caution Do not use this module for connection to signals or for measurements within Measurement Categories II, III, or IV.

Safety Standards

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.

Hazardous Locations

The NI USB-6008/6009 device is not certified for use in hazardous locations.

Environmental

The NI USB-6008/6009 device is intended for indoor use only.

Operating temperature	
(IEC 60068-2-1 and IEC 60068-2-2)	0 to 55 °C
Operating humidity	
(IEC 60068-2-56)	5 to 95% RH, noncondensing
Maximum altitude	2,000 m (at 25 °C ambient temperature)
Storage temperature	
(IEC 60068-2-1 and IEC 60068-2-2)	–40 to 85 °C
Storage humidity	
(IEC 60068-2-56)	5 to 90% RH, noncondensing
Pollution Degree (IEC 60664)	2

Electromagnetic Compatibility

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

- EN 61326 EMC requirements; Minimum Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

Note For EMC compliance, operate this device with double-shielded cables.

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 module number or product line, and click the appropriate link in the Certification column.

Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also 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 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.

电子信息产品污染控制管理办法 （中国 RoHS）

中国客户 National Instruments 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 National Instruments 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.)

[1] System dependent.

[2] ±20 V means that |AI+ – (AI–)| ≥ 20 V. However, AI+ and AI– must both be within ±10 V of GND.

[3] System noise measured at maximum sample rate.

[4] Input voltages may not exceed the working voltage range.

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