DI-245 Thermocouple and Voltage Data Acquisition System

Model DI-245
Voltage and Thermocouple DAQ

DATAQ® INSTRUMENTS
www.dataq.com

Download software at dataq.com/245

Event
Power
Active
Remote

DI (±30 V max.)
Evnt/DI0   Rcrd/DI1

Analog Inputs (±50 VFS, ±150 V max.)
Channel 1   Channel 2   Channel 3   Channel 4
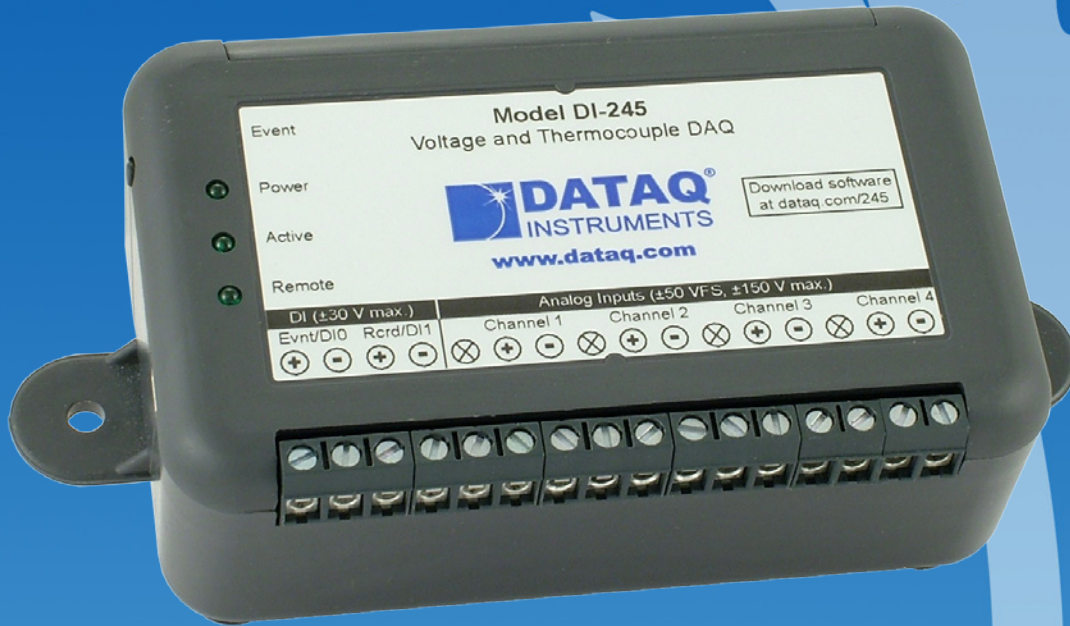
- ✓ **Four differential and isolated analog input channels**
- ✓ **Programmable voltage and thermocouple measurements per channel**
- ✓ **10 mV to 50 V programmable range per channel in 12 steps**
- ✓ **Programmable support for type J,K,T,B,R,S,E,N thermocouples per channel**
- ✓ **Sample rate of 2000 Hz for a single channel and 200 Hz throughput for two or more channels**
- ✓ **USB interface**
- ✓ **Included WinDaq software for ready-to-run measurements**
- ✓ **Included .NET class**
- ✓ **Fully documented protocol supports other operating systems**

DATAQ® INSTRUMENTS

DI-245 Description

Model DI-245 is a low-cost data acquisition system that offers the performance of products many times its price. Four analog input channels adapt to a wide range of measurement types and applications. Each channel can be programmed to make a thermocouple or voltage measurement. Programmed as a voltage channel you can select one of twelve measurement ranges supporting full scale values from ±10 mV to ±50 V. Programmed as a thermocouple channel you can select from eight thermocouple types: J,K,T,B,R,S,E,N.

Virtually any measurement will experience a difference in ground potential between the instrument, the signal source, and even between signal sources. Known as common mode voltages, these potential differences will cause noisy measurements in the best case or damage to the instrument in the worst case unless it's specifically designed to tolerate them. Each analog input of the DI-245 is electrically isolated from other channels and from ground for safe and accurate measurements in the presence of common mode voltages. Channel isolation means that each analog input is free to float to an independent common mode voltage imposed upon it by the signal source, and still provide an accurate and noise-free measurement.

The DI-245 communicates with a PC via a USB interface, which also powers it to eliminate clumsy external power supplies. WinDaq software is included with the DI-245 to provide a ready-to-run solution to acquire, display in real time, record, playback, and export data. Programming support is provided through an included Dot Net Class, ActiveX Control, and documented instruments protocol.

DI-245 Close-up

Remote Event push-button
Trigger events either from the remote event inputs (through WinDaq software) or by pushing this button.

LED Indication
Power LED indicates power is applied
Active LED indicates the device is scanning input data
Digital LED indicates use of a digital input

Bulkhead Mounting Ears

Mini-B **USB** connection

Bulkhead Mounting Ears

Digital In Channels
DI0 and DI1 can be used for Remote Events and Start/Stop control using WinDaq software

Analog In Channels 1-4
(programmable Voltage or Thermocouple)
Voltage Ranges: ±10, 25, 50, 100, 200, 500 mV; ±1, 2.5, 5, 10, 25, 50 V; Thermocouple Types: J, K, T, B, R, S, E, N

⊗ = No Connection

Screw terminals for signal inputs

DI-245 Major Features and Benefits

Four Analog Input Channels

Measure as many as four system variables at once.

Isolated and Differential Input configuration

Noise-free measurements in virtually any application setting.

Programmable Voltage Ranges per Channel

Each DI-245 channel may be programmed for one of the following ranges: ±10, 25, 50, 100, 250, 500 mV; ±1, 2.5, 5, 10, 25, 50 V.

Programmable Thermocouple Types per Channel

The DI-245 supports direct-connected J,K,T,B,R,S,E,N thermocouples without the need for external signal conditioning.

Wide Sampling Rate Range

Sample from minute to millisecond intervals using the supplied software. A single enabled channel can be sampled as fast as 2 kHz.

High Resolution Measurements

Resolve even the smallest changes in applied voltage and temperature (see specifications for details).

Two Digital Inputs

Two reserved digital inputs allow you to remotely stop and start recording, and trigger events.

Protected Inputs

Analog and digital inputs are protected to prevent mishaps from causing damage to the instrument. Analog inputs to ±170 V and digital to ±30 V.
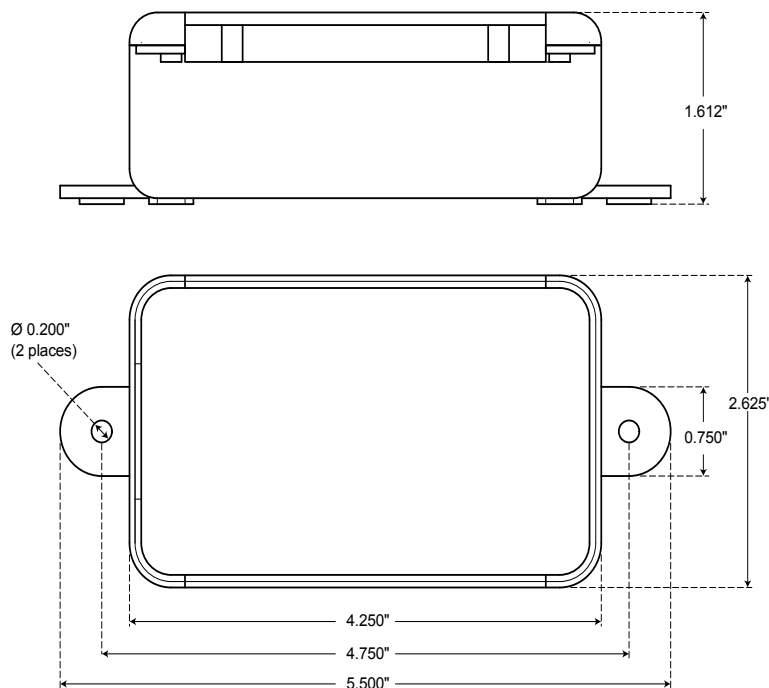
Built-in CJC

Cold junction compensation is automatically enabled for any channel programmed as a thermocouple input.
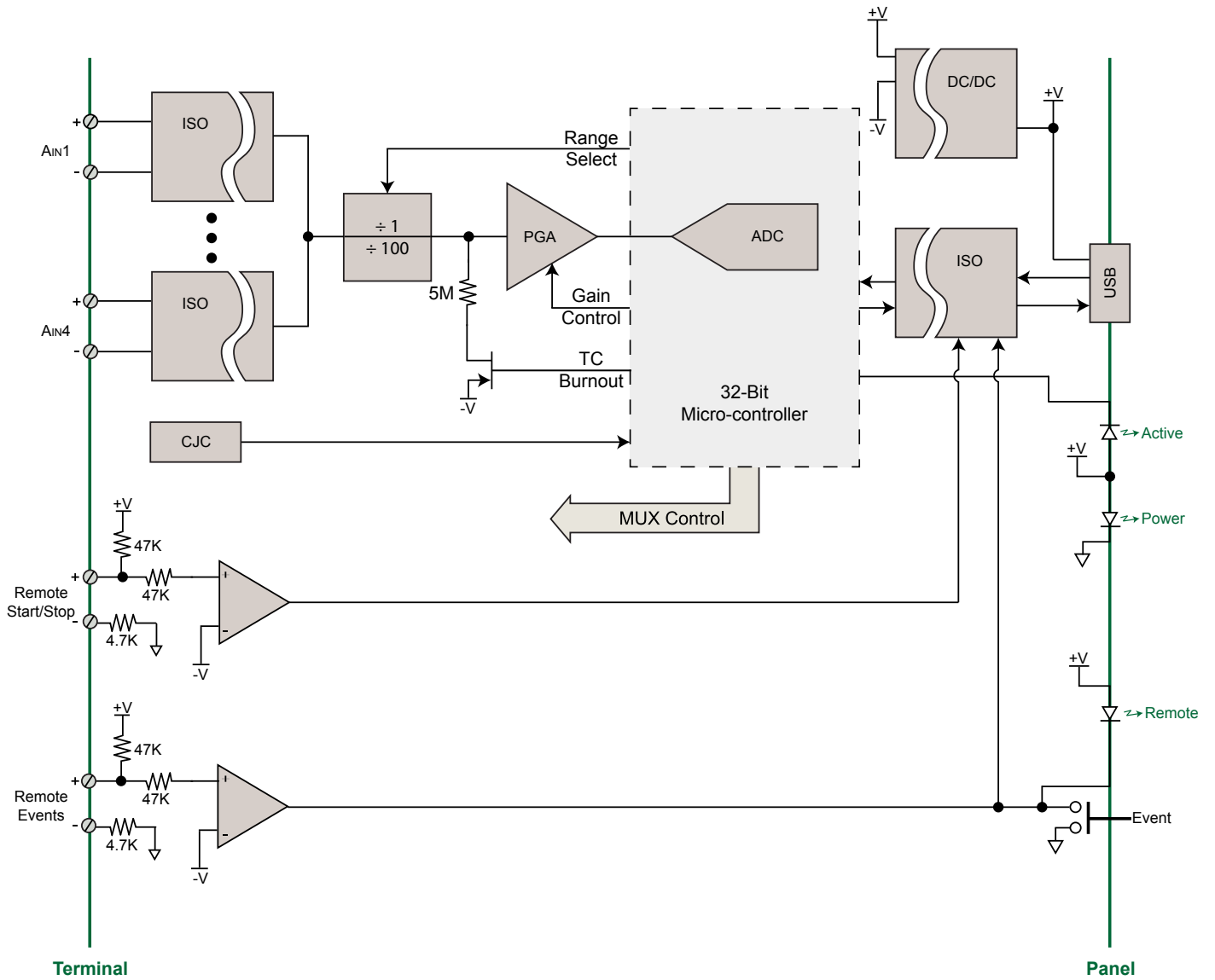
Included Ready-to-run Software

Our WinDaq data acquisition software offers real time display and disk streaming for the Windows environment up to the full sample rate of the DI-245. The real time display can operate in a smooth scroll or triggered sweep mode of operation, and can be scaled into any unit of measure. Event markers with comments allow you to annotate your data acquisition session with descriptive information as you record to disk. Raise your productivity to new heights with WinDaq's unique multitasking feature. Record waveform data to disk in the background while running any combination of programs in the foreground — even WinDaq Playback software to review and analyze the waveform data as it's being stored! Playback supports waveform analysis (Statistics, X-Y plots, frequency analysis) and the ability to export data to Microsoft Excel. WinDaq recording and playback software is provided free with every DI-245 purchase. View the Multimedia Tutorial for more information.

## DI-245 Dimensional Drawing

DI-245 Block Diagram

ISO

A_{IN}1 +
−

ISO

A_{IN}4 +
−

÷ 1
÷ 100

5M

PGA

Range
Select

Gain
Control

TC
Burnout

−V

CJC

ADC

32-Bit
Micro-controller

MUX Control

+V

DC/DC

−V

+V

ISO

USB

⚡→Active
+V

⚡→Power

+V

⚡→Remote

Event

Remote
Start/Stop +
−

+V
47K

47K

4.7K

−V

Remote
Events +
−

+V
47K

47K

4.7K

−V

Terminal

Panel

Setup

Double-click and enter the channels you want to acquire into the WᴉɴDᴀQ scan list. Click to select signal averaging, true RMS, frequency, and peak or valley detection per channel. Click to define a single to 4-channel display — either triggered sweep (oscilloscope-like) or scrolling (chart recorder-like). Click again to define a sample rate ranging from 17 samples per day to 2,000 per second for a single channel, and 200 samples per second for multiple channels..
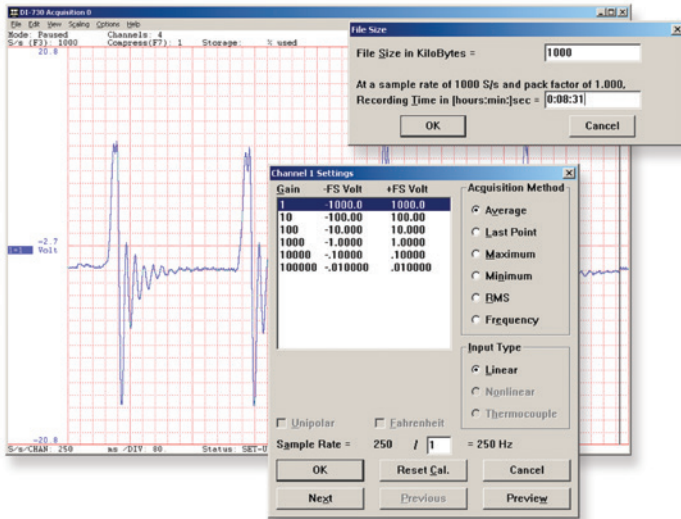
Calibrate

Define calibration per channel to display waveform values in meaningful units such as psi, °F or °C, amps, rpm, watts, horse-power — any unit of measure you need.
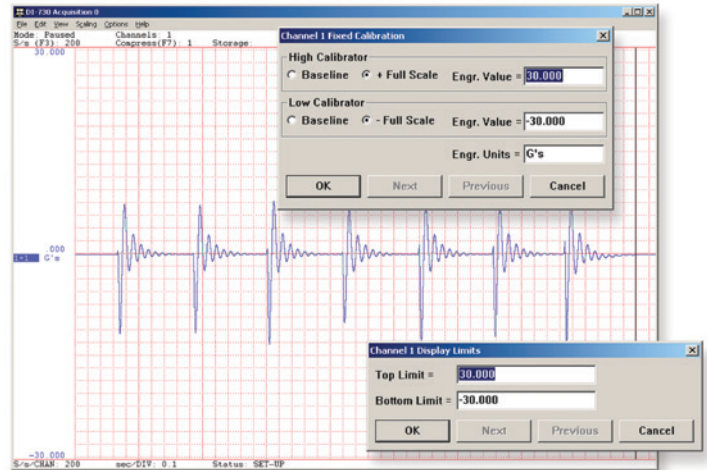
Record

Choose a continuous waveform recording mode or the triggered mode with selectable trigger level, slope, and post-trigger times. WᴉɴDᴀQ automatically time- and date-stamps, then streams acquired data to disk — record as much data as you need. At the same time, WᴉɴDᴀQ supplies a real-time graphical display of any or all channels so you always know where you are and where you're going.
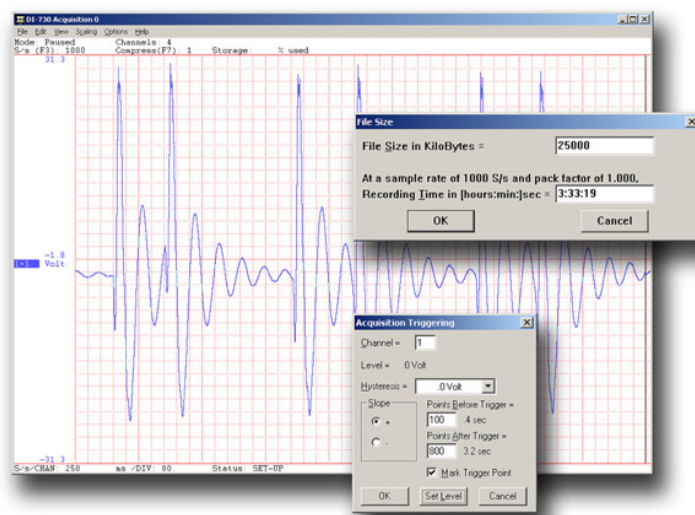
Annotate

Of course, you can label any channel with text that describes it — "Motor 1," "Engine speed," "Vertical position," etc. But WᴉɴDᴀQ also allows you to supply commented event markers while you record — "Beginning test phase 1," "Small vibrations noticed," "Starting cool-down cycle," etc. Your comments and our acquired data combine to form a complete diary of your data acquisition session.
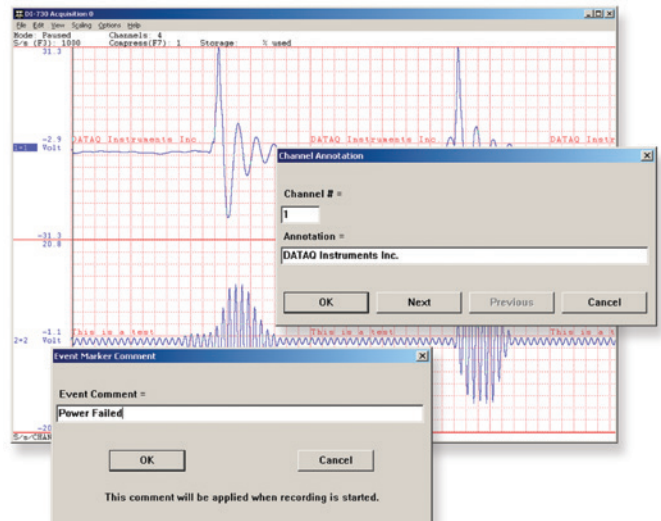
Playback

Recording is only half the solution. WinDaq's Waveform Browser playback software allows you to graphically manipulate waveforms in ways you've never seen on a PC. Compress an entire recording to one screen-width for a bird's eye view, then expand around an area of interest for a closer look. Use the cursor to measure amplitudes and timing with precision. Move to any event marker with the click of a mouse button.
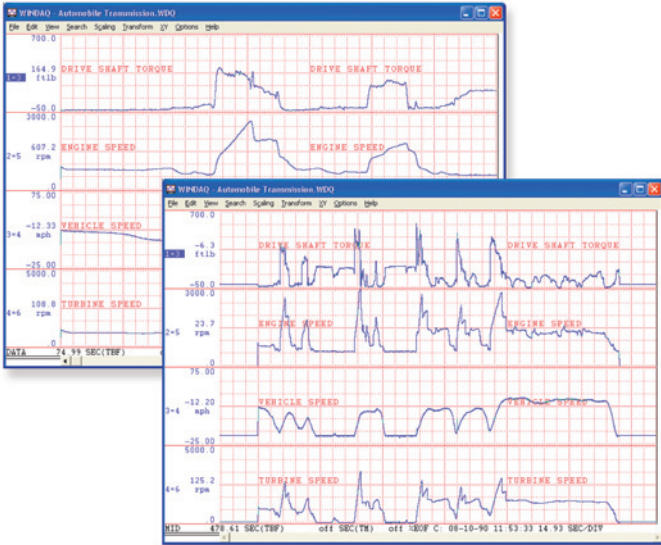
Multitask

Double your productivity and let WinDaq record while you review last week's results from your spreadsheet, or compose a memo with your word processor. You can even play back data already stored to disk while you're still recording.
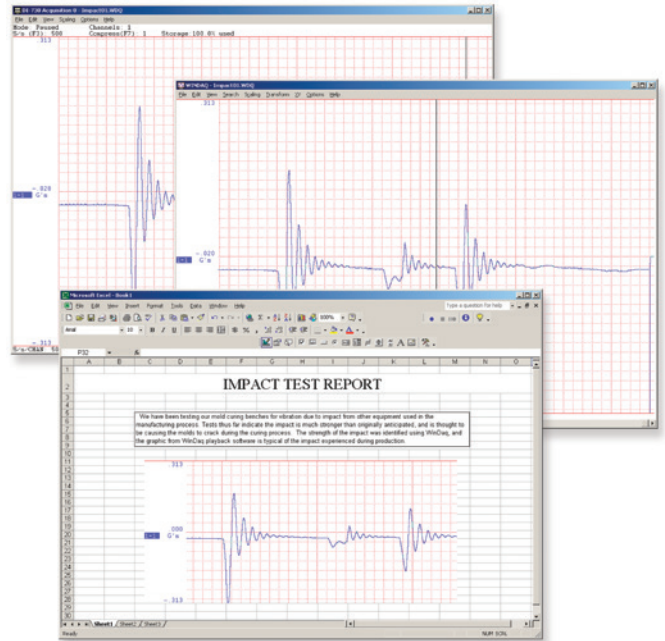
Analyze

Waveform interpretation is easy with our built-in analysis functions. Apply frequency and filtering analysis with the WinDaq Waveform Browser FFT and DFT functions. Analyze any range of waveform data with the statistics function. Use X-Y plotting to examine the relationship of one channel to another. Optional Advanced CODAS analysis functions allow waveform peak detection, integration, differentiation, arithmetic operations, and more.
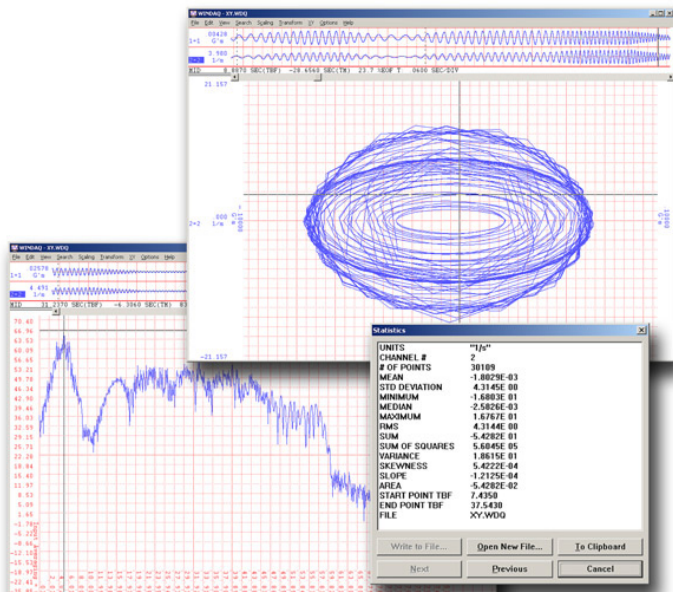
Export

The WinDaq Waveform Browser can export any range of data to your spreadsheet, or any other analysis or presentation package you use. You can even copy a graphical image displayed by the WinDaq Waveform Browser and paste it directly into a word processing document. Finally, export any range of waveform graphics to your printer for a hard copy record.
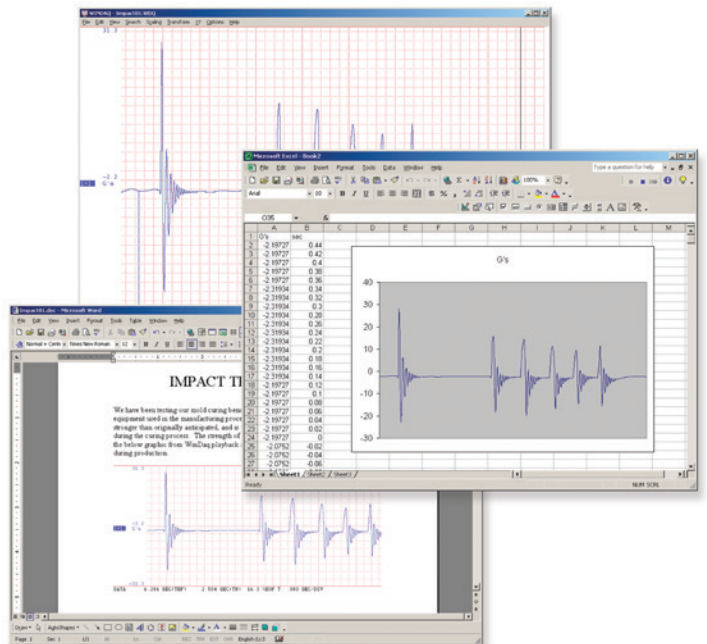
For programmers, the DI-245 is supported outside of the supplied ready-to-run WinDaq application by a published protocol, ActiveX Control, and a .NET class. The protocol defines the nuts-and-bolts communication syntax to and from the instrument that is necessary to configure the DI-245, allow it to take measurements, and to retrieve those measurements by a connected PC. You'd use the DI-245 at its protocol level if you wanted to program the instrument outside the Windows environment, and/or use a programming language that is not supported by .NET or ActiveX. For example, operating systems such as OSX and Linux, and programing languages such as Java and Python are candidate situations for use with the DI-245 Protocol. Otherwise, programming the DI-245 using a .NET language such as Visual BASIC and C# under Windows is a candidate for the .NET class that is provided with the instrument. ActiveX can be used with VB 6 and other support programming environments.
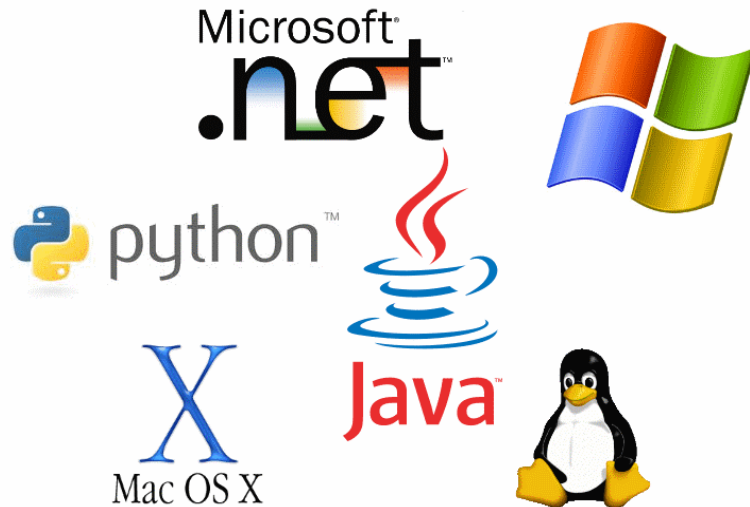
Typical Configurations and Applications

The DI-245 is deployed as a monitoring device and placed between a system to be qualified and a PC. Connection between the instrument and the PC is made with the provided USB cable. Field wiring connects the DI-245 to various analog signals that describe the system under test. The DI-245 conditions applied signals before digitizing the results and delivering them to a connected PC. Mixed milli-volts, volts, and thermocouple measurements are supported on a channel-by-channel basis, with measurement function selected entirely in software. This range of isolated measurements available on a per channel basis allows the DI-245 to address a wide range of applications.
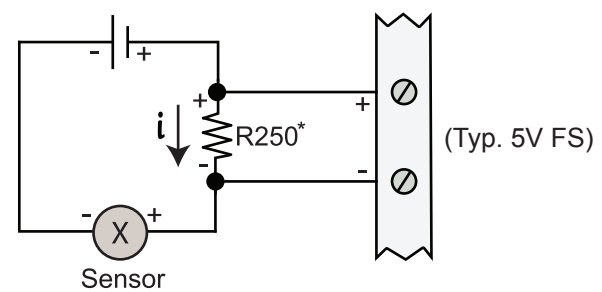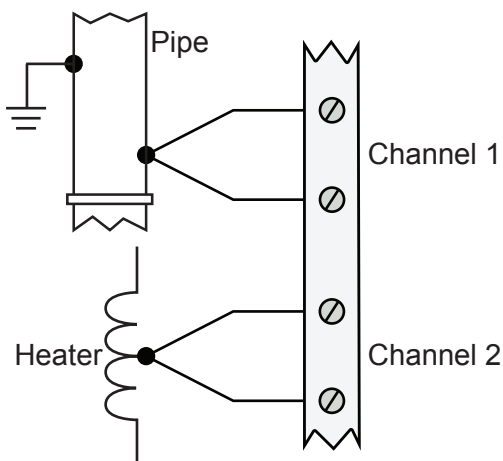
General configuration
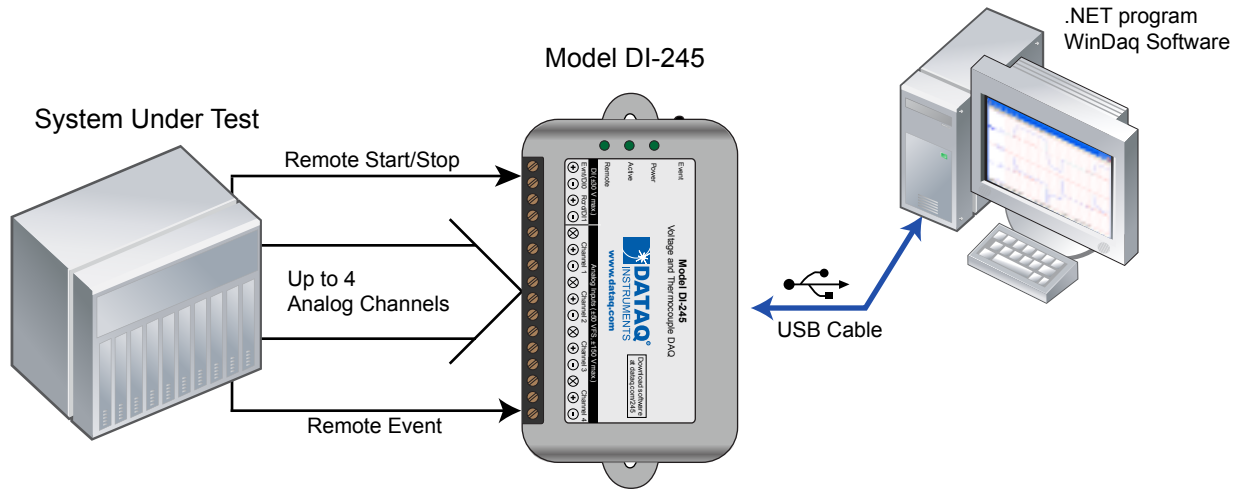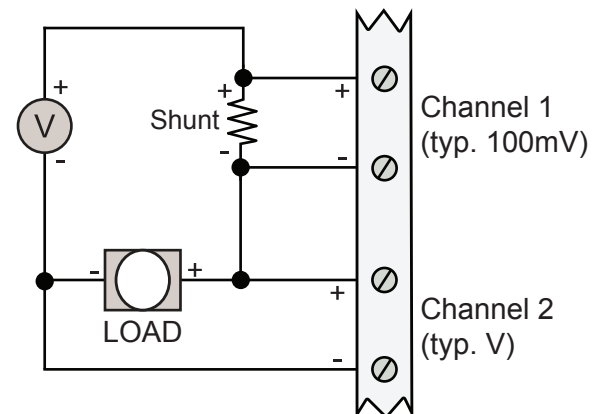

4-20 mA current (low-side shunt)
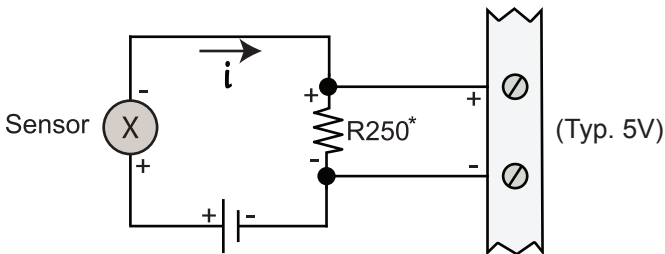
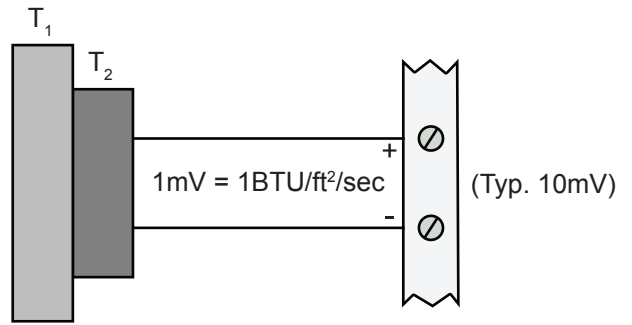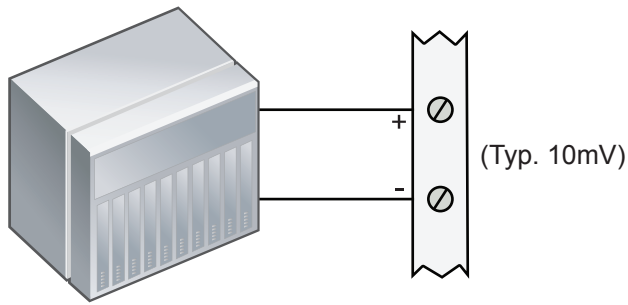## 4-20 mA current (high-side shunt)

Grounded and Powered Thermocouple

Simultaneous voltage and current

*Model R250, 250 shunt resistor, see Ordering Guide

Unamplified Chromatagraph Outputs (HPLC, GC)

(Typ. 10mV)

Heat Flux Sensor

T_1

T_2

$1mV = 1BTU/ft^2/sec$

(Typ. 10mV)

Photovoltaic Measurements

Sunlight

Charge Controller

Shunt $Load_I$

Channel 1 (typ. 100mV)

LOAD $Load_V$

Channel 2 (typ. 24V)
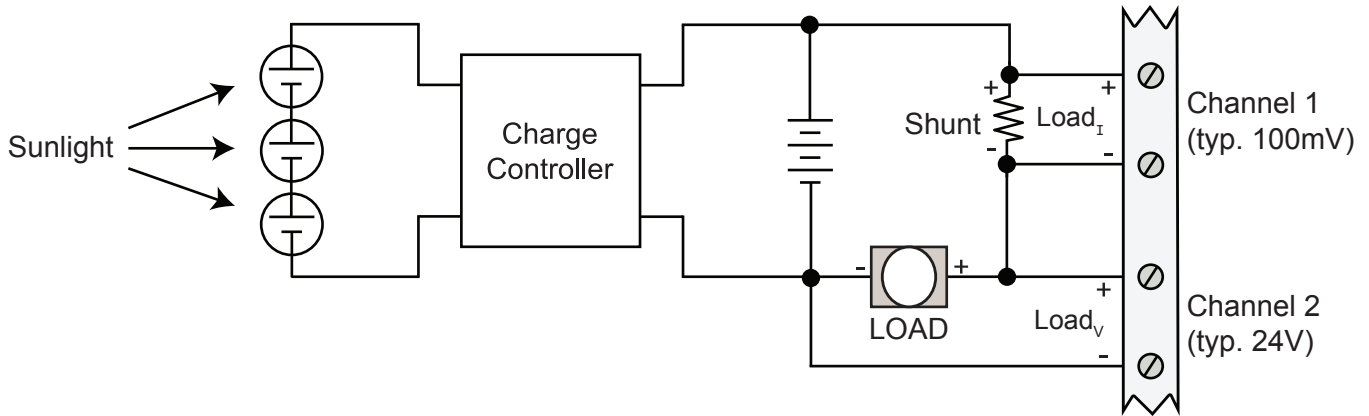
Remote Control Close Up

The DI-245 supports several methods to increase measurement flexibility and data record interpretation. The remote record feature allows you to synchronize WinDaq recordings to external processes by remotely enabling and disabling WinDaq's stream-to-disk feature. Remote events allow you to insert an event marker in the data stream (see inset) to identify when an event occurred relative to recorded waveform activity. Events can be activated by the pushbutton on the DI-245 enclosure, through a keyboard keystroke (which also allows you to record a description), or remotely via the remote event input. The stream-to-disk function can also be controlled through the keyboard, or through the remote record input. Valid remote record and event signals are switch closures, or discrete levels with a maximum input of 30 V and a threshold of 1.8 V. Used without WinDaq software, these remote discrete inputs are available for general-purpose use.

Event Marker

Manually push button to insert an Event Marker in the Data Stream

Event

TTL

30V Max

1.8V Threshold

0V

Switch Closure

TTL or Switch Closure
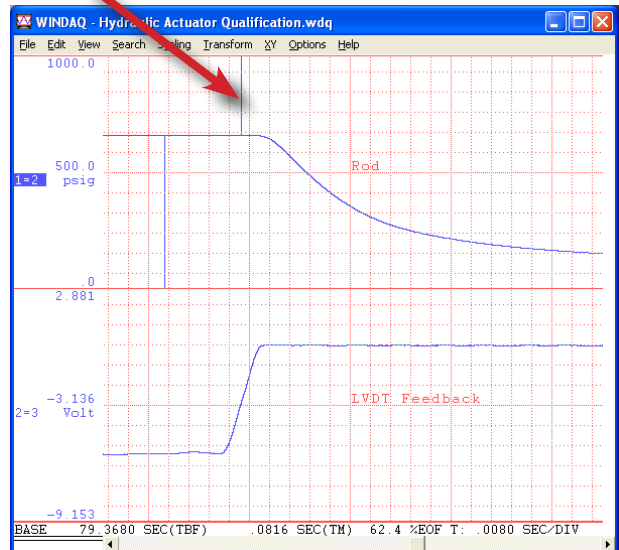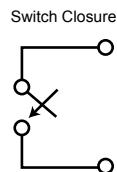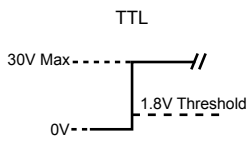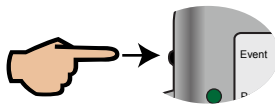
The DI-245's analog channel isolation allows it to be used where you could not use non-isolated instruments. Discrepancies in ground reference between the instrument and one or more signal sources are everywhere, and are called common mode voltages (shown as V_{CM} in the supporting diagrams below.) When you connect grounds that are at different potentials together, current conducts through them to produce annoyingly noisy results and even damage to the instrument if ground currents are large enough. The DI-245's isolation feature avoids ground currents by deploying an isolation barrier on each analog input to ensure that signal source and instrument grounds never come in contact. Moreover, some measurements are not even possible without isolation regardless of how carefully you plan your grounds. Examples are current measurements using shunts, stacked battery cell measurements, and powered or grounded thermocouple applications.

Grounded Thermocouple

Powered Thermocouple

$$V_{CM} = V_{CM} + V$$

Stacked Cell

$$V_{CM} = 3V_C$$
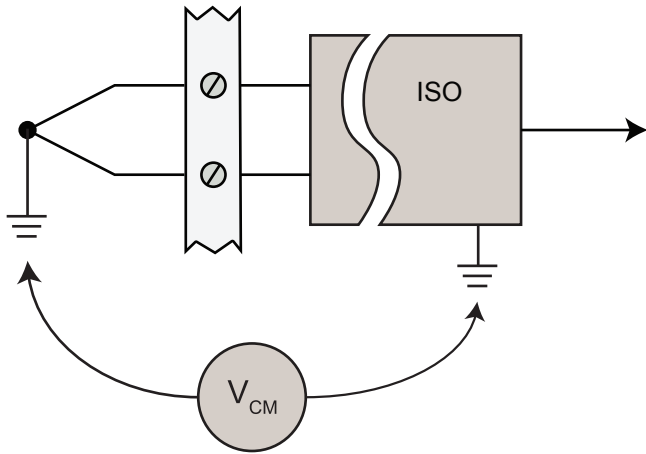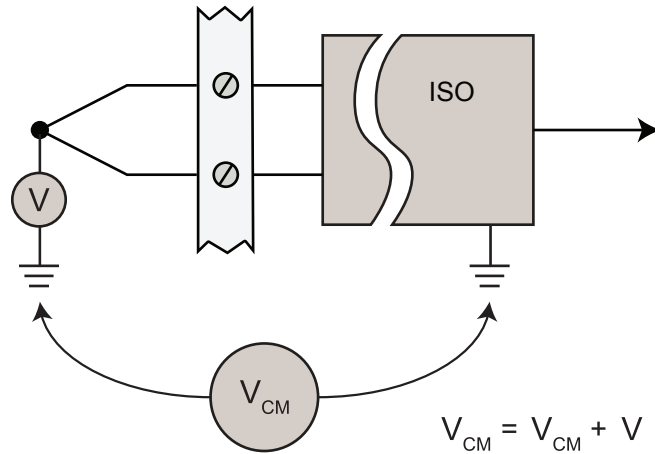
Current Shunt

DI-245 Specifications

Signal Inputs
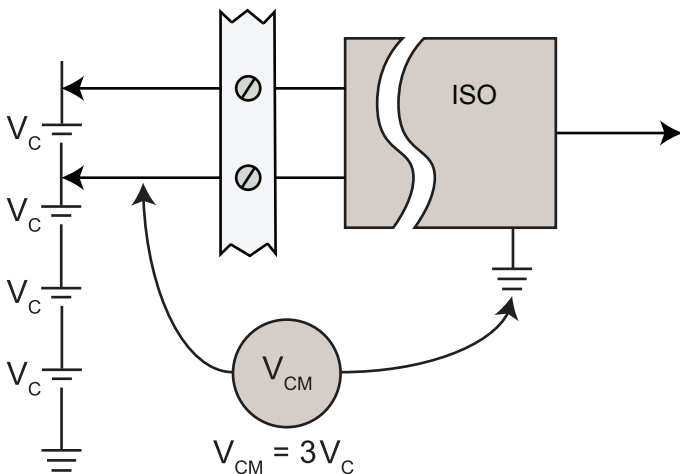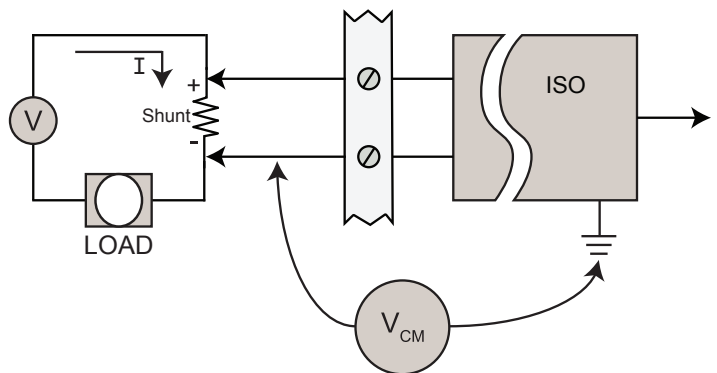
Analog Inputs

Number of Channels:	4
Configuration:	Differential, Isolated
Programmable measurements per channel:	Voltage, thermocouple

Programmable thermocouple types and measurement range per channel:

Over 25 ±3 °C ambient temperature range.
Stable ambient temperature.
Following 30 minutes warm-up.
Excluding common mode error.
Excluding thermocouple error.

TC type	Temperature Measurement range (°C)	Accuracy (°C)
J	-190 to 1200	±(0.1% of span + 2)
K	-180 to 1360	±(0.1% of span + 2)
T	-190 to 400	±(0.1% of span + 1)
B	600 to 1000	±(0.2% of span + 4)
B	1001 to 1810	±(0.1% of span + 3)
R	-40 to 300	±(0.2% of span + 6)
R	301 to 1760	±(0.1% of span + 3)
S	-40 to 400	±(0.2% of span + 6)
S	401 to 1750	±(0.1% of span +3)
E	-160 to 990	±(0.1% of span + 1)
N	-170 to 50	±(0.1% of span + 3)
N	51 to 1290	±(0.1% of span + 1)

Programmable voltage measurements ranges per channel:

At 25 °C ambient temperature.
Following 30 minutes warm-up.
Excluding common mode error.

Range (±)	Accuracy
10 mV	±(0.05% of range + 10 µV)
25 mV	
50 mV	
100 mV	
250 mV	
500 mV	
1 V	
2.5 V	
5 V	
10 V	
25 V	
50 V	

Input impedance:	1 MΩ, all ranges
Isolation:	Input-to-output, Channel-to-channel
Absolute max input without damage:	120 Vrms
Maximum common mode voltage:	120 V (±dc or rms)
Minimum common mode rejection (330Ω unbalance):	>100 db (DC to 60 Hz)
Channel-to-channel crosstalk rejection: ($R_{source} \leq 330\ \Omega$; $Freq_{source} \leq 60$ Hz)	> 110 db

Digital Inputs

Number of channels:	2
Pull-up value:	47 KΩ
Isolation:	None
Input high voltage threshold:	1.80 V minimum
Input low voltage threshold:	1.40 V maximum
Absolute maximum input without damage:	±30 V peak

Power

Source:	From PC USB port
Power consumption:	0.75 Watts

ADC Characteristics

Voltage measurement resolution:

Range (±)	Resolution	Units
10 mV	1.22	µV
25 mV	3.05	
50 mV	6.10	
100 mV	12.20	
250 mV	30.52	
500 mV	61.04	
1 V	122.07	
2.5 V	305.18	
5 V	610.35	
10 V	1.22	mV
25 V	3.05	
50 V	6.10	

Minimum temperature measurement resolution:

TC type	Resolution	Units
J	0.086	°C
K	0.096	
T	0.037	
B	0.096	
R/S	0.111	
E	0.073	
N	0.092	

4-20 mA current loop resolution: (5 VFS range with 250-Ω shunt resistor)	6553 ADC counts over the 4-20 mA range
Maximum sample throughput rate:	Single enabled channel: 2 kHz Two or more enabled channels: 200 Hz
Min sample throughput rates:	Hardware only: 3.58423 Hz with a single enabled channel, or 0.358423 Hz with two or more enabled channels. With WinDaq software: 0.709 samples per hour
Sample rate timing accuracy:	50 ppm

Indicators, Connections, Controls

Interface:	USB 2.0 (mini-B style connector)
Indicators (LED):	Power, Active, Event
Input connections:	One 16-position terminal strip
Pushbutton:	Manual event when used with WinDaq software

Environmental

Operating temperature range:	0 to 40 °C
Storage temperature:	-20 to 40 °C
Storage humidity:	0 to 90 %RH, non-condensing

Physical Characteristics

Enclosure:	Hardened Plastic
Mounting:	Desktop; bulkhead
Dimensions:	2.625D × 5.5W × 1.53H in. (6.67D × 13.97W × 3.89H cm.)
Weight:	4 ounces, 114 grams

Software Support

WinDaq Software:	OS support: Visit http://www.dataq.com/products/windaq/window-compatability.
Programming:	DATAQ Instruments Dot Net SDK, Instrument protocol, DLL, and ActiveX Control

Ordering Guide

Description	Order No.
DI-245 Millivolt, Volt and Thermocouple Data Acquisition System Includes DI-245 data acquisition hardware, USB cable (6-ft.), screwdriver for screw terminal, NIST traceable calibration certificate, WinDaq data acquisition and Playback software, .NET Class, ActiveX Control, and protocol document.	DI-245
R250 250Ω shunt resistor for 4-20 mA process current loop measurements.	R250

DATAQ®
INSTRUMENTS

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Data Acquisition Product Links
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