DATAQ INSTRUMENTS

The way PC-based instrumentation should be

DI-245

Millivolt, Voltage, and Thermocouple Data Acquisition System

User's Manual

Manual Revision D

DATAQ INSTRUMENTS

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Designed and manufactured in the
United States of America

Warranty and Service Policy

Product Warranty

DATAQ Instruments, Inc. warrants that this hardware will be free from defects in materials and workmanship under normal use and service for a period of 1 year from the date of shipment. DATAQ Instruments' obligations under this warranty shall not arise until the defective material is shipped freight prepaid to DATAQ Instruments. The only responsibility of DATAQ Instruments under this warranty is to repair or replace, at its discretion and on a free of charge basis, the defective material.

This warranty does not extend to products that have been repaired or altered by persons other than DATAQ Instruments employees, or products that have been subjected to misuse, neglect, improper installation, or accident.

DATAQ Instruments shall have no liability for incidental or consequential damages of any kind arising out of the sale, installation, or use of its products.

Service Policy

1. All products returned to DATAQ Instruments for service, regardless of warranty status, must be on a freight-prepaid basis.

2. DATAQ Instruments will repair or replace any defective product within 5 days of its receipt.

3. For in-warranty repairs, DATAQ Instruments will return repaired items to the buyer freight prepaid. Out of warranty repairs will be returned with freight prepaid and added to the service invoice.

Table of Contents

1. Introduction

This manual contains information designed to familiarize you with the features and functions of the DI-245 USB millivolt, volt, and Thermocouple data acquisition system.

Features

The **DI-245** data acquisition instrument is a portable data recording module that communicates through your computer's USB port. Power is derived from the interface port so no external power is required. Features include:

- 4 fixed differential analog inputs protected to ±150V (transient) programmable as voltage or thermocouple inputs.
- ±50V full scale measurement range.
- 12 programmable gain ranges per channel (±10, 25, 50, 100, 250, 500 mV; ±1, 2.5, 5, 10, 25, 50 V).
- Thermocouple types J, K, T, B, R, S, E, and N are supported
- Two dedicated digital inputs for WINDAQ remote control operations; Remote start/stop and remote events.
- Sample throughput rates up to 2 kHz maximum (for a single channel - 200 Hz with multiple channels) and as low as 0.709 samples per hour.
- A push-button to tag remote events in WINDAQ software.
- Three status LEDs for easy notification of system status.

Analog Inputs

The DI-245 features four differential channel inputs located on the sixteen-position screw terminal blocks for easy connection and operation (other terminals used for digital inputs). Each channel can be programmed to acquire data as Voltage (ranges: ±10, 25, 50, 100, 250, 500 mV; ±1, 2.5, 5, 10, 25, 50 V) or Thermocouple temperature (types J, K, T, B, R, S, E, and N are supported).

Utilize the functionality of WINDAQ software to experience all the features encased in these small, inexpensive instruments.

Digital Inputs

The DI-245 contains two digital lines (bits) for WINDAQ remote control operations (Evnt/DI0 and Rcrd/DI1). Connect switch closures or discrete levels with a maximum input of 30V and a threshold of 1.8V. The inputs float at 1 level, about 3.3V relative to the "-" terminal, and require sinking about 50uA to bring them down to 0.8V and guarantee a 0.

Software

All software required to record and playback waveforms is included with the purchase of any DI-245 data acquisition system via download.

WINDAQ® Recording and Playback Software

WINDAQ Acquisition and WINDAQ Waveform Browser allow you to record and playback data acquired through your instrument. WINDAQ software is an invaluable resource to record and analyze your data and is available for free from our web site (www.dataq.com).

WINDAQ Data Acquisition software (free) can be used to record waveforms directly and continuously to disk while monitoring a real time display of the waveforms on-screen.

WINDAQ Waveform Browser playback software (also known as "WWB") offers an easy way to review and analyze acquired waveforms. A built-in data file translator allows the user to display multiple waveforms acquired by WINDAQ Acquisition software or any of a wide range of data acquisition packages. The software's disk-streaming design allows data files of any length to be graphically displayed rapidly, in normal or reverse time directions. Seven standard cursor-based measurements, frequency domain, and statistical analysis functions help simplify waveform analysis and interpretation. WINDAQ Waveform Browser is free and installed when installing WINDAQ Software.

The DATAQ Instruments Hardware Manager

This software can be found in the Start menu under the WINDAQ program group called **DATAQ Instruments Hardware Manager**. Access WINDAQ Acquisition software and manage multiple DATAQ Instruments devices in this easy-to-use point and click environment. View the Help files by clicking on View Help in the Help menu or by pressing F1.

Help

All WINDAQ software utilizes context-sensitive help. Help may be accessed through the Help menu or by pressing the F1 key with any pull-down menu item selected. This will take you directly to the Help topic most relevant to that particular function or feature. Help topics discuss in detail each function available in the software.

2. Specifications

Analog Inputs

Number of Channels: 4

Channel 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	
T	-190 to 400	±(0.1% of span + 1)
B	600 to 1000	±(0.2% of span + 4)
	1001 to 1810	±(0.1% of span + 3)
R	-40 to 300	±(0.2% of span + 6)
	301 to 1760	±(0.1% of span + 3)
S	-40 to 400	±(0.2% of span + 6)
	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)
	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 span + 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 Vrms
Minimum common mode rejection (330Ω unbalance):	>110 db (DC to 60 Hz)
Channel-to-channel crosstalk rejection: ($R_{source} \leq 330\ \Omega$; $Freq_{source} \leq 60$ Hz)	> 100 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

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- 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
Push button:	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

Power

Source:	From PC USB port
Power consumption:	0.75 Watts

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

WinDaq software:	Click for supported operating systems
Programming:	DATAQ Instruments Dot Net SDK, Instrument protocol, DLL, and ActiveX Control

3. Installation

The following items are included with each DI-245 Data Acquisition System. Verify that you have the following:

- A DI-245 USB data acquisition instrument.
- USB cable.
- A DATAQ Instruments screwdriver for signal lead connections.

If an item is missing or damaged, call DATAQ Instruments at 330-668-1444. We will guide you through the appropriate steps for replacing missing or damaged items. Save the original packing material in the unlikely event that your unit must, for any reason, be sent back to DATAQ Instruments.

Installing WINDAQ Software and the DATAQ Instruments Hardware Manager

All software for the DI-245 can be installed via a downloadable executable directly from the DATAQ Instruments web site. No CD is shipped with the device. You may burn the executable onto a CD to transport the software to a computer with no internet connection.

1. Disconnect all DATAQ Instruments USB devices from your Computer.

2. Go to run.dataq.com in your web browser.
3. Select the DI-245 model and click on the WinDaq software link.
4. Subscribe to our mailing list (you can opt out after) to receive a link for download.
5. Click on the link and save the file to your local hard drive.
6. Double-click on the downloaded file to extract the program and begin software installation.

7. Follow the on-screen prompts and enter any required information.

8. Software installation is complete - you will now see a "Successful Installation" box - click **OK** to exit WINDAQ Installation.

You can now plug the device(s) into your PC. Click on the appropriate program group (specified above — default is Start > Programs > WINDAQ) and click on "DATAQ Instruments Hardware Manager" to access WINDAQ software.

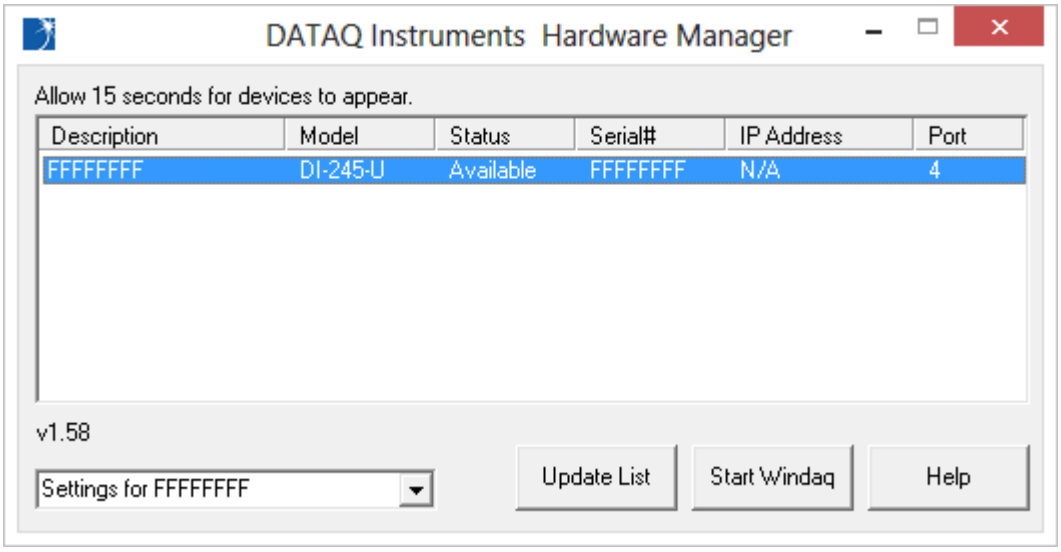
Connecting the Instrument to Your Computer

DI-245 instruments can be connected to your computer's USB port using the provided USB cable. No external power is required. Connect one end of the communications cable to the instrument port and the other to your PC's port.

Note: *Use a powered USB hub or a USB port on your PC. Non-powered USB hubs may not have sufficient power to run the instrument.*

DATAQ Instruments Hardware Manager

The DATAQ Instruments Hardware Manager is installed when installing any DI-245 instrument. This software allows you to effectively manage multiple devices installed on the same PC. The DATAQ Instruments Hardware Manager may be accessed through the Windows Program Manager Group as specified during installation (default is *Start > Programs > WINDAQ > DATAQ Instruments Hardware Manager*). All available devices will automatically appear in the list box when you run the software.

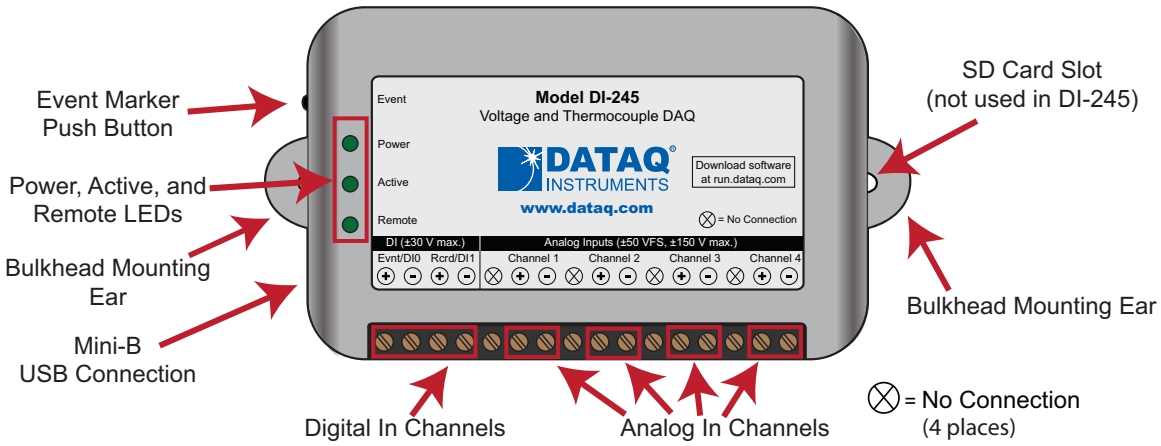


The Hardware Manager allows you to start WINDAQ Acquisition software (select the device and click on the **Start Windaq** button) and must be used when multiple DATAQ Instruments devices are installed. It also provides crucial information about your device needed for custom programming (Serial # and COM Port).

Please note: *The description of DI-245 models cannot be modified.*

Click on the Help button for help with the DATAQ Instruments Hardware Manager.

4. Controls, Indicators, and Connections



Please note: *The SD card slot is not used in the DI-245. Allowing foreign materials to enter the device through the SD card slot may result in damage to the instrument.*

Mini-B USB Connection

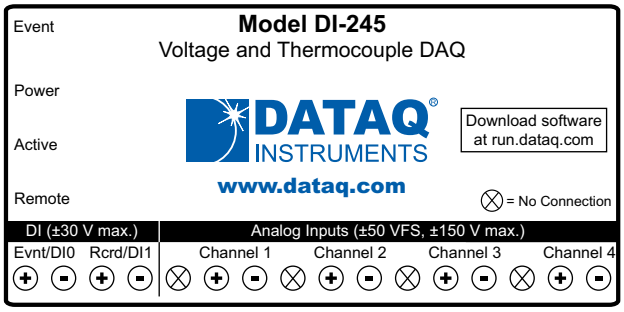
Use the supplied USB cable to connect and power the instrument through your computer's USB port.

Connecting Input Signals

All input signal connections are made to the 16-port screw terminal. Each terminal is labeled directly on the instrument case.

DI-245 Signal Connections

Refer to the following for screw terminal port identification.



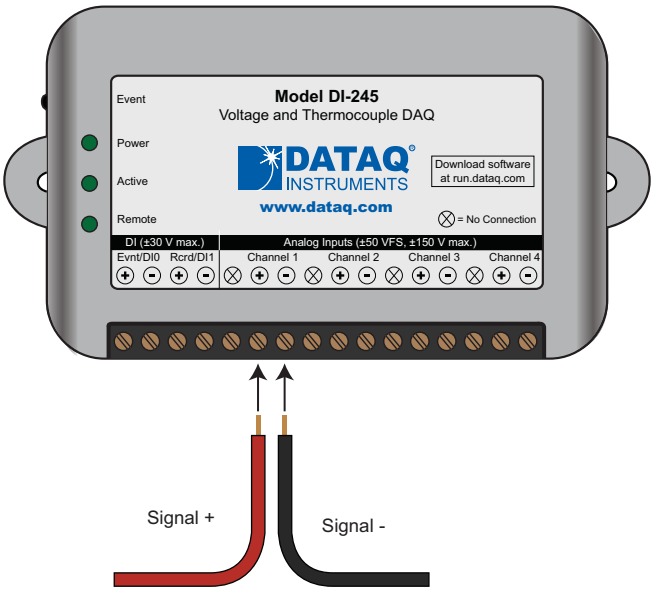
Analog Inputs Ch#: Analog channels 1-4 (±50VFS, ±150V transient max.)

DI: General purpose digital inputs (bits 0-1). Can also be used for specific WINDAQ functions (± 30 Vmax).
Digital Input bit 0 (**Evnt/DI0**)—WINDAQ Remote Event Marker
Digital Input bit 1(**Rcrd/DI1**)—WINDAQ Remote Start/Stop

No Connection: ⊗ = No connection, Reserved.

Connect Analog Input Channel 1

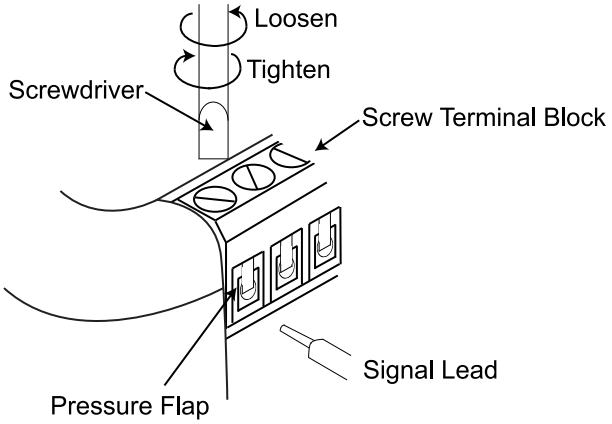
Use the following diagram to connect Analog Input Channel 1.



Connecting Signal Leads

To connect signal leads to the DI-245:

1. Insert the stripped end of a signal lead into the desired terminal directly under the screw.
2. Tighten the pressure flap by rotating the screw clockwise with a small screwdriver. Make sure that the pressure flap tightens only against the signal wire and not the wire insulation. Do not over-tighten.
3. Tug gently on the signal lead to ensure that it is firmly secured.



When an input signal is connected and WINDAQ Acquisition software is run, WINDAQ's real time display immediately reveals the input waveform on your computer's monitor.

Gain Settings for Voltage Measurements

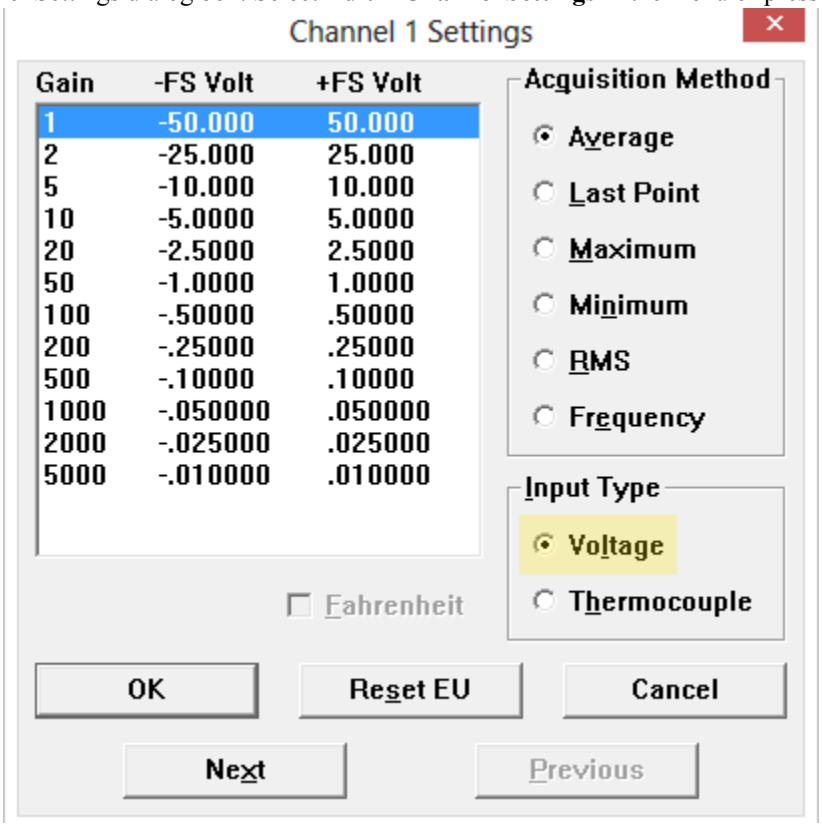
Each analog input channel on the DI-245 may be programmed for one of 12 gain ranges.

Measurement Range	Gain Setting
±50V Full Scale	1
±25V Full Scale	2
±10V Full Scale	5
±5V Full Scale	10
±2.5V Full Scale	20
±1V Full Scale	50
±500mV Full Scale	100
±250mV Full Scale	200
±100mV Full Scale	500
±50mV Full Scale	1000
±25mV Full Scale	2000
±10mV Full Scale	5000

Change the gain setting for each channel individually:

1. Select the channel (click on the channel box in the left hand side of the waveform screen).

2. Open the Channel Settings dialog box. Select **Edit** > **Channel Settings** in the menu or press F10.



3. Select VOLTAGE in the INPUT TYPE selection box, and then select the desired gain setting for that channel.

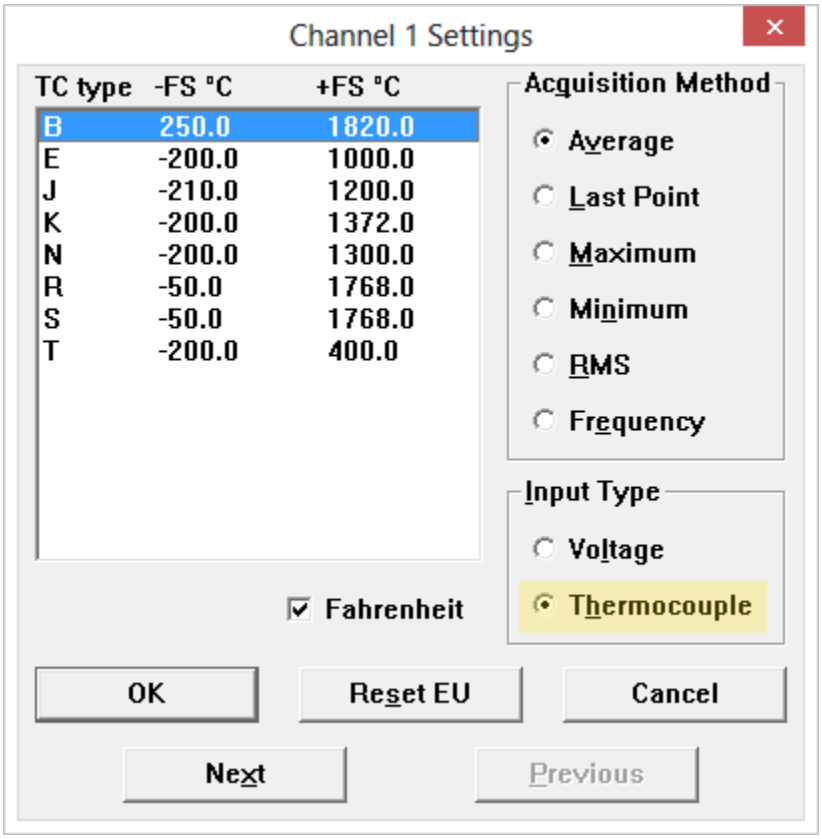
4. Click the **Next** button to access channel settings for the next channel or click the **OK** button to close the dialog box.

Thermocouple Measurements

Each analog input channel on the DI-245 may be programmed for one of 8 possible thermocouple types (B, E, J, K, N, R, S, or T). Change the TC type for each channel individually:

1. Select the channel (click on the channel box in the left hand side of the waveform screen).

2. Open the Channel Settings dialog box. Select **Edit** > **Channel Settings** in the menu or press F10.



3. Change the Input Type to “Thermocouple.”

4. Select the desired thermocouple type for that channel.

5. Click the **Next** button to access channel settings for the next channel or click the **OK** button to close the dialog box.

Temperature scale may be changed to Celcius by clicking on the “Fahrenheit” checkbox. This changes the scale for **all** thermocouple temperature measurements.

Calibrate CJC

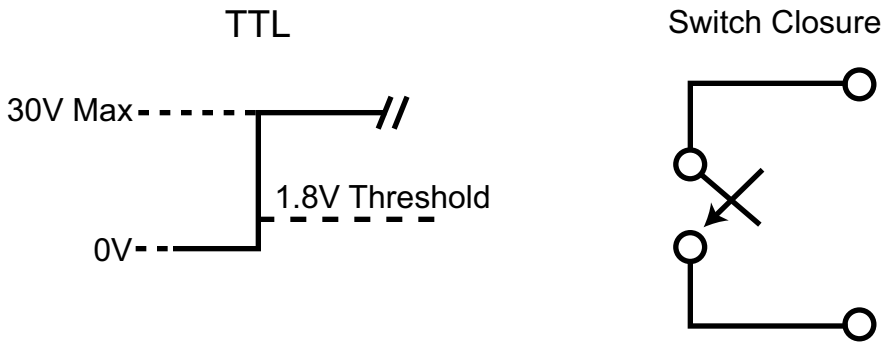
Calibrate the CJC of each Thermocouple channel using the menu item **Edit** > **Calibrate CJC**.

Digital Inputs

The DI-245 contains 2 general purpose digital inputs that can also be used for specific WINDAQ functions:

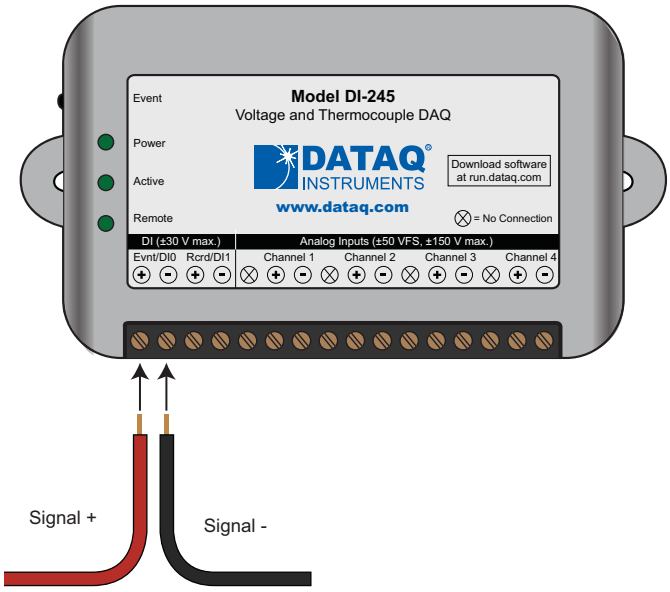
Evnt/DI0 is for WINDAQ Remote Events. This bit inserts an event marker in your data (channel 9 must be enabled).
Rcrd/DI1 is for WINDAQ Remote Storage. This bit can be programmed to begin recording data. (channel 9 must be enabled).

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.



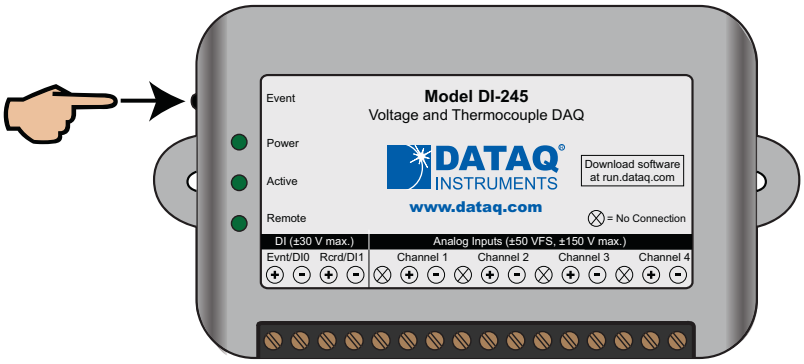
WINDAQ Remote Events (Evnt/DI0)

To use a switch closure or TTL signal to record WINDAQ Event Markers, connect signal leads to the appropriate Remote Control Event terminals on the DI-245 as shown below.

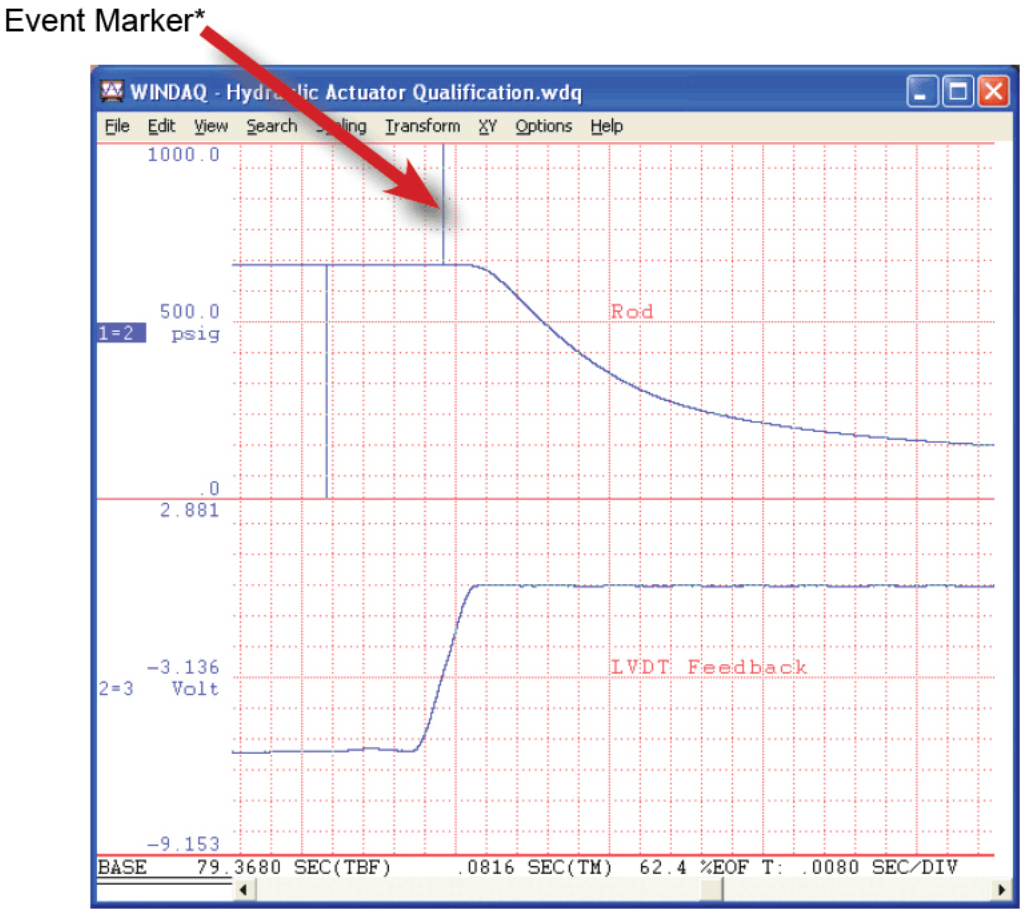


Once the switch closure or TTL signal is connected, activate Remote Events through WINDAQ Acquisition Software. Events may be automatically placed on the rising or falling edge of the trigger signal. Enable the digital input channel (channel 9) then use the menu command **Options** > **Remote Events +** to set WINDAQ to place event markers on low-to-high transitions of the Event input. Use the menu command **Options** > **Remote Events -** to set WINDAQ to place event markers on high-to-low transitions of the Event input.

Event markers may also be placed in your data file manually by pressing the push button on the DI-245 Instrument. You must enable Remote Events in WINDAQ to use the button (use the menu command **Options** > **Remote Events +***or* **Options** > **Remote Events -**).



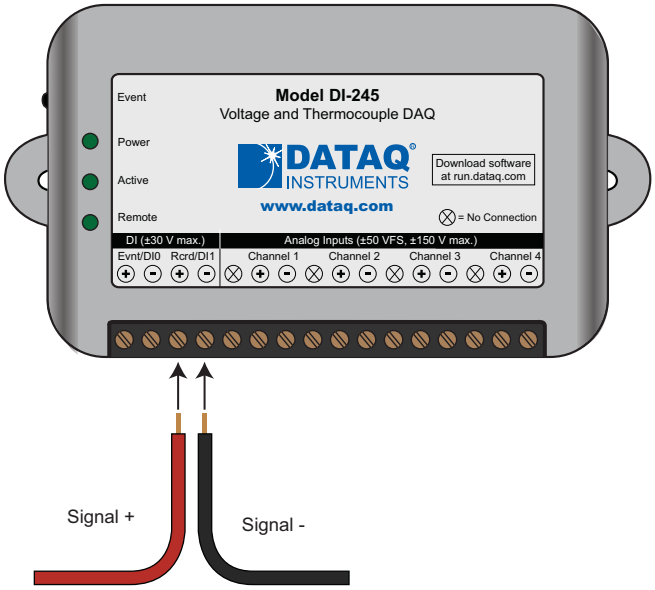
An example event marker in a WINDAQ data file is shown below.



***Please Note:** Event Markers do not display in the real-time WINDAQ acquisition software - they only display in the WINDAQ playback software (WWB).*

WINDAQ Remote Storage (Rcrd/DI1)

To use a switch closure or TTL signal to begin recording data remotely, connect signal leads to the appropriate Remote Control Record terminals on the DI-245 as shown below.



Once the switch closure or TTL signal is connected, activate Remote Storage (Record) through WINDAQ Acquisition Software. Storage to Disk may be automatically placed on the rising or falling edge of the trigger signal. Use the menu command **Options** > **Remote Storage 1** to set WINDAQ to begin recording on low-to-high transitions of the Record input. Use the menu command **Options** > **Remote Storage 0** to set WINDAQ to begin recording on high-to-low transitions of the Record input.

LED Indicators

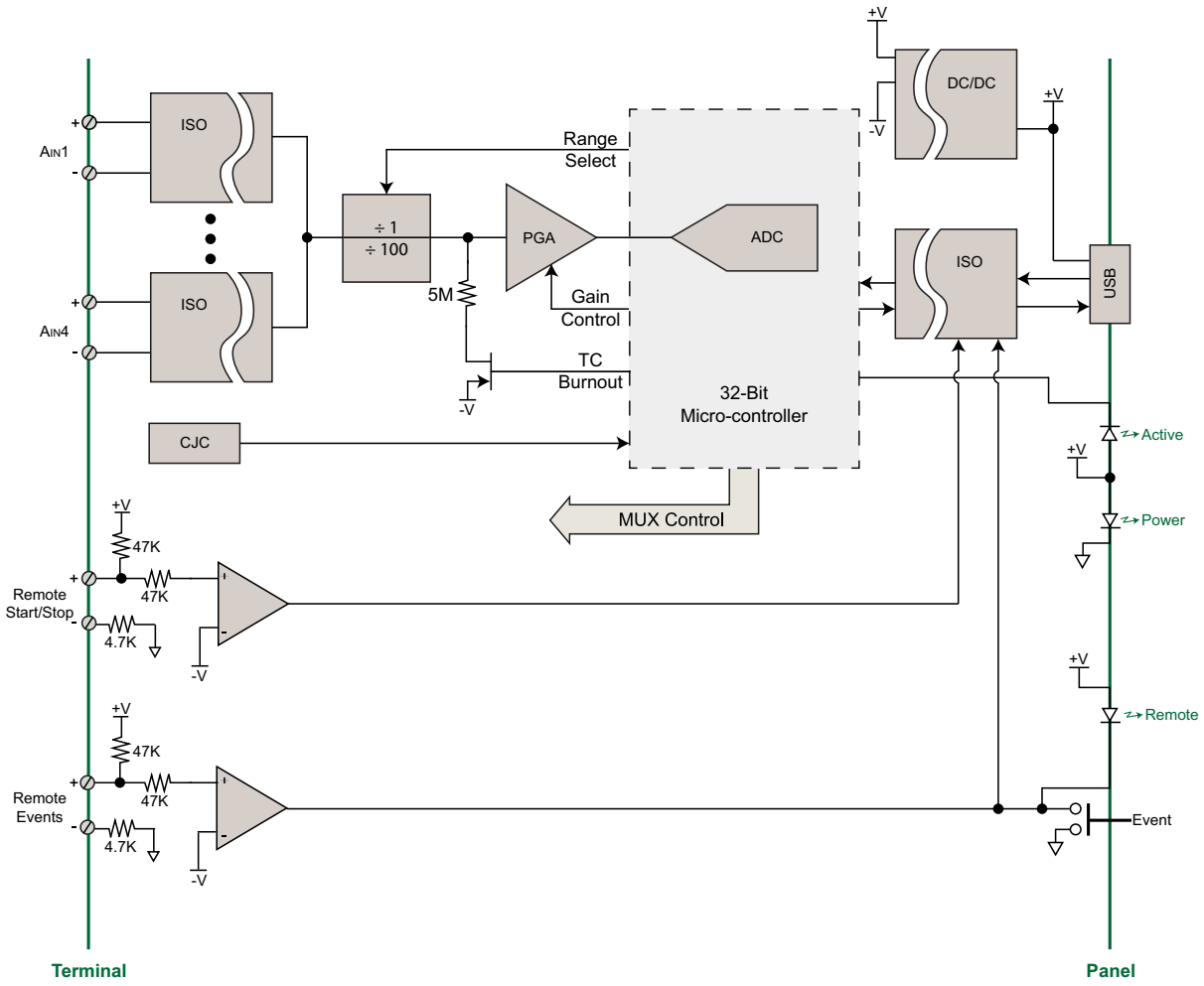
The DI-245 provides three green LEDs for instrument status and notification.

Power: Indicates power is applied via the USB cable.

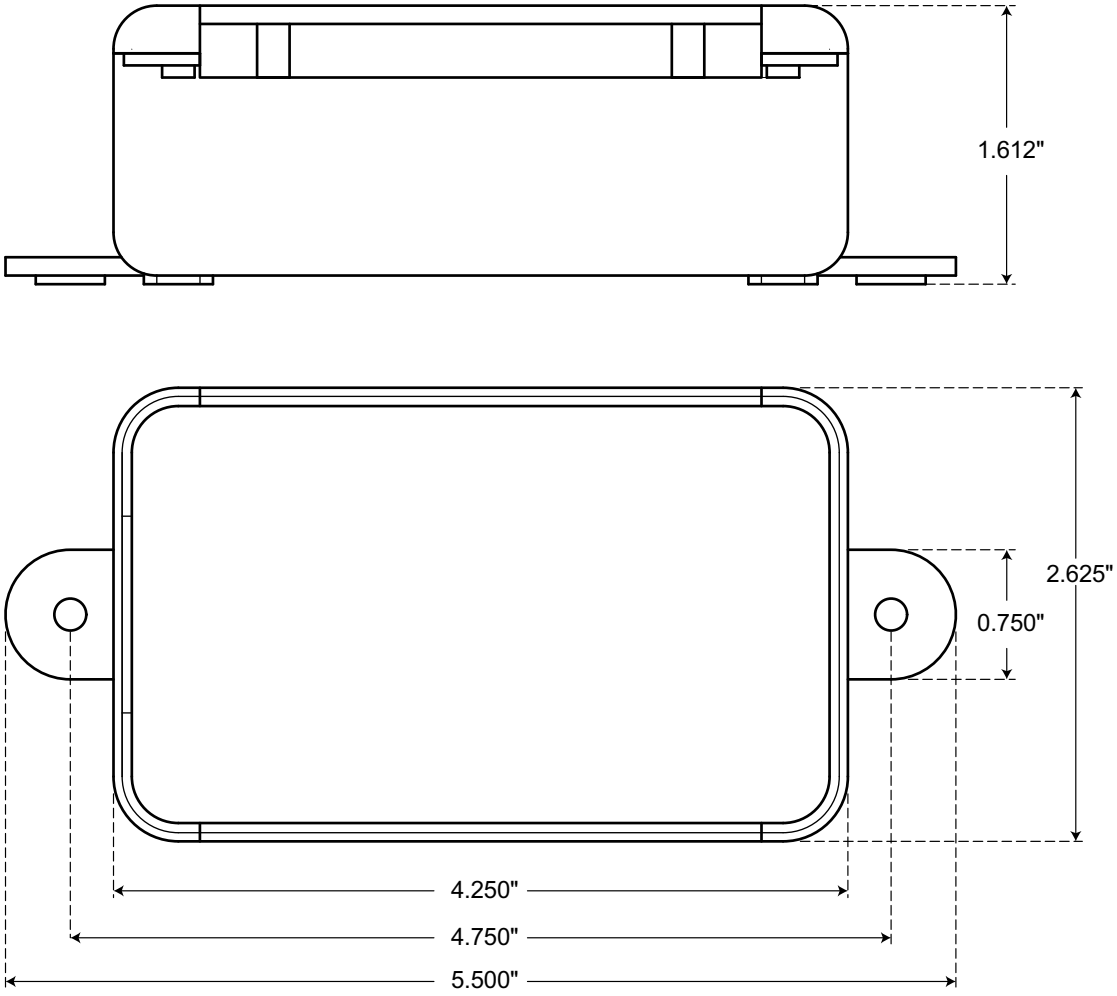
Active: Indicates the device is in use either by WINDAQ Acquisition Software or a custom user-developed program.

Remote: Indicates when the Event Button is pushed or the Event terminals are connected via a relay contact or digital input.

5. DI-245 Block Diagram



6. Dimensional Drawing



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