DT9829

USB Multi-Sensor Measurement Module
Software-Selectable Precision Measurement for Any Sensor


Overview

The DT9829 is a portable data acquisition multi-sensor measurement module for USB. Use the DT9829 software to select from many sensor types and their parameters: voltage inputs, current, thermocouples, RTDs, thermistors, resistance, bridge-based sensors, and strain gages.

Any Sensor

Key Features

- Direct connection of many types of sensors – software-selectable per channel
  - o Thermocouples: B, E, J, K, N, R, S, and T types
  - o RTD: Pt100, Pt500, Pt1000 – 2-, 3-, and 4-wire
  - o Thermistors: 2-, 3-, and 4-wire
  - o Bridge-based sensors: internal 3.0 VDC excitation, ±200 mV input range
  - o Voltage: ±10 V, ±2 V, ±200 mV input range
  - o Current: ±25 mA
  - o Resistance: 0 kΩ to 200 kΩ, 2-, 3, and 4-wire
  - o 3-wire configurations provide lead wire compensation
- Software-selectable sensor type and parameters to configure, record and analyze each channel in 3 easy steps (see page 2)
- Each input channel independent – no interactions between sensors on any channel
- Sample rates to 960 S/s
- 24-bit sigma-delta ADC eliminates aliasing for extremely accurate measurements
- Thermocouple CJC and open circuit detection
- 4 isolated digital inputs and digital outputs
- ±500 V galvanic isolation to PC and ground
- USB 2.0 powered – no extra power supply needed
- Terminal block connections

Supported Operating Systems
- Windows® 10/8/7/Vista® 32/64-bit
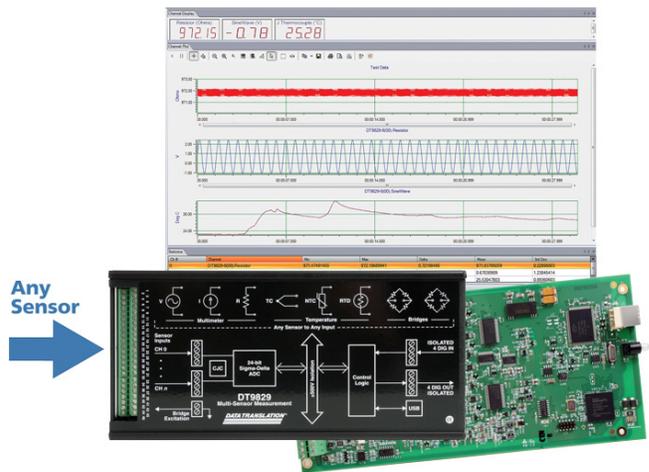
The low-cost DT9828 thermocouple measurement module, combined with the included QuickDAQ ready-to-measure application software, is a powerful temperature data logger. Accuracy to 0.09° C, low noise, and sampling to 600 S/s allow high-quality measurement far beyond other products.

Precision Measurement for Any Sensor

Any sensor type can be connected to any of 8 screw terminal inputs and the QuickDAQ application software allows selection of the sensor. The software and hardware act seamlessly to make all measurements of the sensor without ANY other user interaction.

The result is the ability to measure any sensor on any of 8 channels via software selection. All the messy details are taken care of by the software and the hardware inside the module. There is no interaction between channels, regardless of the sensor type for any channel.

Accuracies have been meticulously designed to preserve the integrity of the sensor measurement. For example, thermocouples have built-in cold junction compensation circuitry that is positioned right at the connector to prevent air flow or error sources in the connection. An additional example is the ability to perform 2, 3, or 4 wire resistor, thermistor or RTD measurements on any channel. Further, the design includes automatic compensation for the errors normally incurred from lead wire resistance in the commonly used 3-wire configuration.

Parameter	Sensor	Feature	Accuracy
Temperature	Thermocouple	CJC included	±0.10 ºC (J)
	RTD (Pt100, 500, 1000)*	• 425 µA excitation • 2-, 3-, and 4-wire connections • Callendar Van-Dusen transfer function	• Pt100: ±0.11º C (typ • Pt500: ±0.08º C (typ) • Pt1000: ±0.06º C (typ)
	Thermistor (NTC)		±0.005º C
Strain, Weight, Torque, Pressure	Load cell, strain gage, general-purpose bridge	• Quarter-bridge, Half-bridge, Full-bridge • 120 Ω minimum bridge resistance	±0.05% of reading
Electrical	Voltage	±10 V, ±2 V, ±200 mV	±0.05% of reading
	Current	±25 mA	±0.1% of reading
	Resistance	• 0 to 4 kΩ or 4 kΩ to 200 kΩ • 2-, 3-, and 4-wire connections	±0.01% of reading

Any sensor above can be connected to any input of the DT9829 for precise measurement of its value. All necessary elements for the sensor are enabled through software selection.

Configure, Record, and Analyze in 3 Easy Steps

Step 1: Select Device & Configuration

Step 2: Select Sensor Parameter per Channel

Temperature	Strain	Voltage

Step 3: Record and Analyze

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Block diagram of the DT9829 shows that up to 8 sensors of any type can be connected for precision measurement. Applications in industry, lab, or field can take advantage of the portable operation running off USB power.

Faceplate
Includes connection diagram
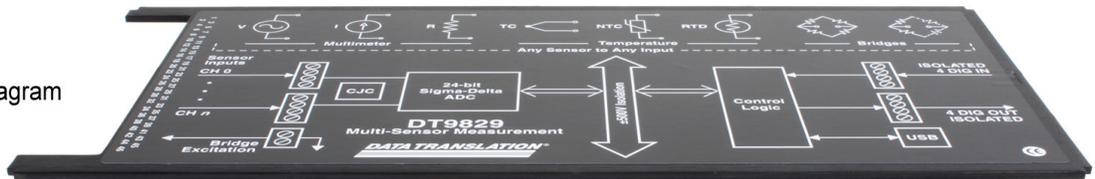
DT9829 board
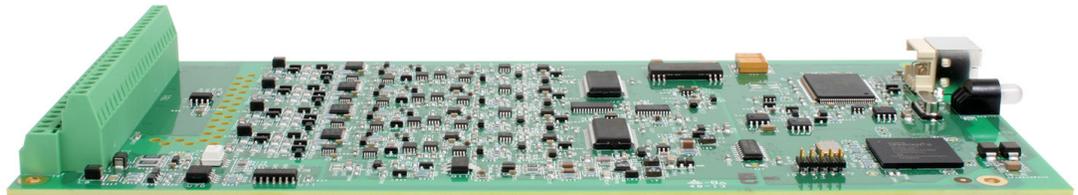
CE-Compliant Enclosure
Maintains signal integrity

Exploded view – the DT9829 case packages the DT9829 in a CE-compliant enclosure

DT9829

User I/O Connections... ESD protection built-in

CJC Sensor...16-bit digital cold junction sensor for thermocouples

Isolated Digital I/O... isolates from sensors and computer ground

Thermal mechanical isolation...insulates heating from board to terminal block

Input Protection... prevents overvoltage

Channel 0 block, ch 2, ch 4, ch 6...even channels on top of board, odd channels 1,3,5,7 directly underneath on bottom of board... inner layer ground planes and channel-to-channel ground partitions prevent noise.

3.0V Bridge Power Supply...provides complete internal bridge solution

Precision Instrumentation Amplifier...for low noise

Analog Differential Multiplexer...configures channel for user selection/syncs with ADC sampling to minimize noise

24-Bit delta-sigma ADC...low noise, high accuracy

Precision Current Source...10uA, 425uA for resistor, RTD, Thermistor

Digital Isolator... Isolates digital ground from analog ground

Isolated Power... isolates measurement circuits from computer ground

FPGA Control Logic

USB Controller... high speed

USB connector, LED indicator...power and data acquisition status

Every design factor is presented to show the uncompromised, high-integrity performance built into the DT9829.

Analog Input Channels

The DT9829 supports 8 differential analog input channels that are multiplexed to a single 24-bit Delta-Sigma A/D converter on the module, providing outstanding accuracy. Each analog input channel can accept any one of the following sensor types: voltage, current, thermocouple, RTD, resistance, thermistor, bridge-based sensors, or strain gage. Channel configuration is done completely through software, making set-up simple.

Voltage Input Support

The DT9829 is versatile enough to support three effective input ranges for measuring voltage signals: ±10 V, ±2 V, and ±200 mV. Using software, the user specifies a gain of 1, 5, or 50 to achieve a range of ±10 V, ±2 V, or ±200 mV, respectively.

Floating and grounded signal sources can be wired to screw terminals to preserve signal integrity.

Current Measurement

Measurement of current output devices up to a range of ±25 mA are supported by the DT9829. The hardware switches in a precision resistor across the terminals of the channel to measure the current source.

Thermocouple Measurement

The DT9829 supports J, K, T, B, E, N, R, and S thermocouple types. All eight input channels are tied to a single CJC to provide highly-accurate and consistent temperature measurements.

RTD Measurement

The DT9829 module supports Platinum 100 Ω, 500 Ω, and 1000 Ω RTDs. The resistance of the RTD circuit increases gradually and repeatedly with temperature in a nonlinear fashion. Measured resistance is then converted to temperature using the Callendar Van Dusen transfer function. Using software, the user specifies the coefficients that are used by this transfer function.

The module provides 425 µA of excitation for RTD inputs. Two-wire, three-wire (with lead-wire compensation), and four-wire connection schemes are supported using screw terminals on the module.

Resistance Measurement

For resistance measurements, the DT9829 module supports measurement ranges of 0 to 4 kΩ or 4 kΩ to 200 kΩ. The module provides a 425 µA current source for the 0 kΩ to 4 kΩ range and a 10 µA current source for the 4 kΩ to 200 kΩ range.

The module measures the voltage produced across a connected resistor when the appropriate current source is applied to determine resistance. Two-wire, three-wire (with lead wire compensation), and four-wire connection schemes are supported using the screw terminals on the module

Thermistor Measurement

The DT9829 supports Negative Temperature Coefficient (NTC) thermistors with a resistor value of 2252 Ω to 100 kΩ at 25 °C. The resistance of NTC thermistors increases with decreasing temperature. The typical usable measurement range is -100 °C to 325 °C. The DT9829 module can read a maximum resistance of 200 kΩ.

Two-wire, three-wire (with lead wire compensation), and four-wire connection schemes are supported using the screw terminals on the module.

Bridge and Strain Gage Measurement

The DT9829 supports a full range of bridge-based sensors and strain gages, and provides 3.0 V of bridge excitation for powering the bridge or strain gage.

For bridge-based sensors, the DT9829 supports transducers, such as load cells, as well as general-purpose quarter-bridge, half-bridge, and full-bridge configurations.

The DT9829 also supports the following strain gage configurations:

- Quarter-Bridge, Quarter-Bridge Temp Comp
- Half-Bridge Poisson, Half-Bridge Bending
- Full-Bridge Bending, Full-Bridge Bending Poisson, Full-Bridge Axial Poisson

Powerful software included with the module allows the user to specify the bridge configuration, including the gage factor, lead wire resistance, Poisson ratio, and nominal gage resistance.

Clocks and Triggers

The DT9829 uses an internal A/D sample clock to pace analog input operations and a software trigger to start acquisition. This allows for ultimate flexibility in designing your system. The module provides a maximum throughput rate of 960 samples/second.

Isolated Digital I/O

The DT9829 features four, isolated, TTL, 12 V and 24 V compatible digital input lines and four, isolated, open-collector digital output lines. The DT9829 can read the value of the digital input port in the analog input data stream, perfect for synchronizing analog input measurements with digital events.

## Lead Wire Compensation for 3-Wire Configurations

The DT9829 module supports 2-, 3-, and 4-wire configurations for RTDs, resistance, and thermistor measurements. The 4-wire configuration is the most accurate because it eliminates potential errors due to lead wire resistance. The 2-wire configuration is typically the least accurate because the lead wire resistance may contribute significant measurement errors, particularly if the lead connections are long.

The 3-wire configuration also has the potential for measurement errors due to lead wire resistance. However, the DT9829 module is designed to compensate for these errors, making this configuration as accurate as a 4-wire configuration if the connection leads are of the same length and gauge.

The following diagram shows a 3-wire connection for an RTD. The sensed voltage includes the voltage across the sensor as well as the voltage across the top lead wire. Internally, the DT9829 module senses the voltage across the return lead, multiplies the voltage by 2, and subtracts the result from the voltage sensed at CH+ to produce a corrected measurement for the sensor.

R_L is lead wire resistance.
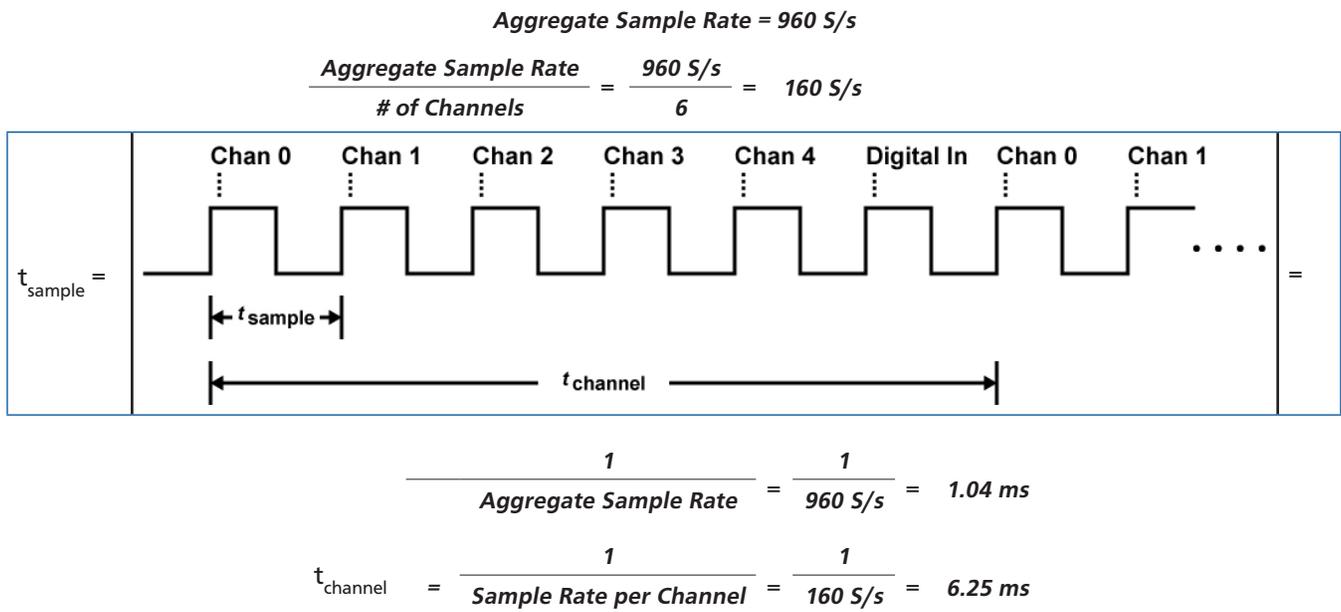V_e is voltage across the lead wires.
V_r is voltage across the RTD.
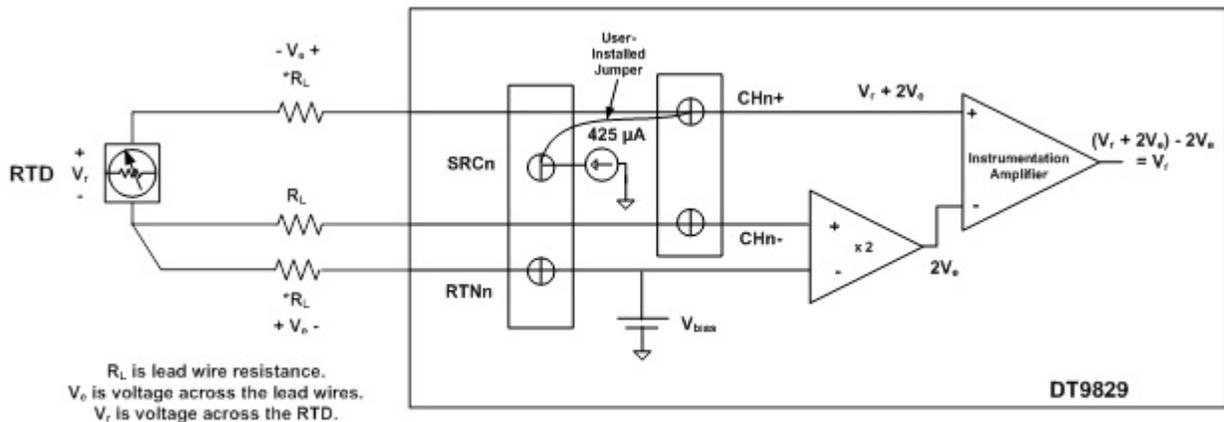
*Use the same gauge and length wire for the current source and the return leads.
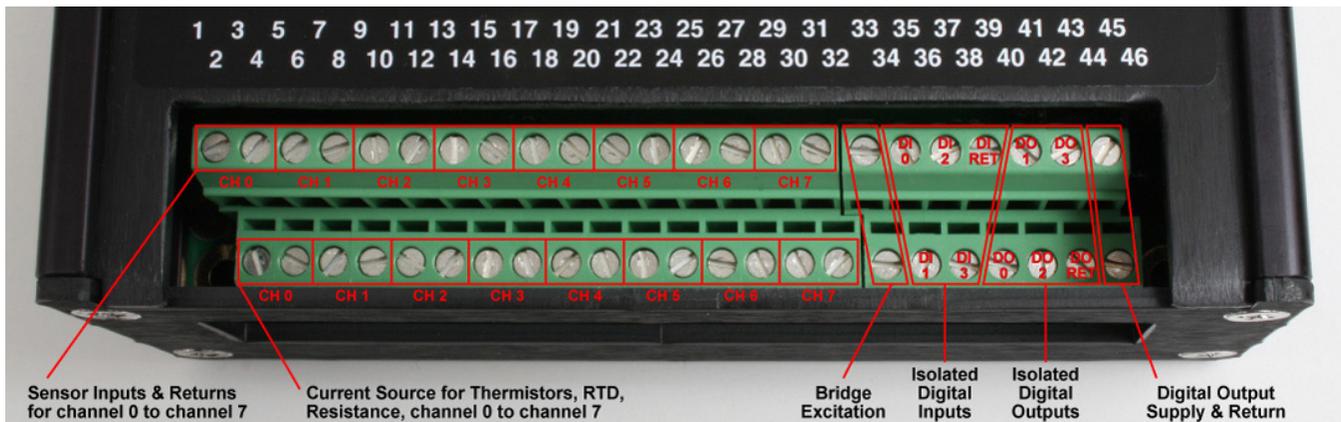
Input connections are easily made via screw terminals for all sensor inputs.

Combining Analog and Digital Input Data In One Stream

The following diagram shows the timing for a channel gain list consisting of 5 analog input channels and the digital input port. Note that the digital input port may be read as a single-value operation or as part of the analog input stream, as it is in this example. With the module set to the maximum aggregate sample rate of 960 samples/second, the resulting per channel sample rate is 160 samples/second.

$$\text{Aggregate Sample Rate} = 960 \text{ S/s}$$

$$\frac{\text{Aggregate Sample Rate}}{\text{\# of Channels}} = \frac{960 \text{ S/s}}{6} = 160 \text{ S/s}$$

$$\frac{1}{\text{Aggregate Sample Rate}} = \frac{1}{960 \text{ S/s}} = 1.04 \text{ ms}$$

$$t_{channel} = \frac{1}{\text{Sample Rate per Channel}} = \frac{1}{160 \text{ S/s}} = 6.25 \text{ ms}$$

QuickDAQ

QuickDAQ allows you to acquire and display from all Data Translation USB and Ethernet data acquisition devices that support analog input streaming. Combine QuickDAQ with Data Translation hardware to acquire data, record data to disk, display the results in both a plot and digital display, and read a recorded data file. Be productive right out of the box with this powerful data logging software. Data can be exported to other applications like Microsoft Excel® and The Mathworks MATLAB® for more advanced analysis. Two additional options can be purchased to add FFT analysis capabilities to the base package.

Key Features

- **QuickDAQ Base Package (Free)**
  - o Ready-to-measure application software
  - o Configure, acquire, log, display, and analyze your data
  - o Customize many aspects of the acquisition, display, and recording functions to suit your needs

- **FFT Analysis Option (License Required)**
  - o Includes all the features of the QuickDAQ Base Package
  - o Perform single-channel FFT operations including:
    - ◊ Auto Spectrum
    - ◊ Spectrum
    - ◊ Power Spectral Density
  - o Configure and view dynamic performance statistics
  - o Supports Hanning, Hamming, Bartlett, Blackman, Blackman Harris, and Flat Top response windows
- **Advanced FFT Analysis Option (License Required)**
  - o Includes all the features of the QuickDAQ Base Package and FFT Analysis Package
  - o Perform 2-channel FFT operations including:
    - ◊ FRF
    - ◊ Cross-Spectrum
    - ◊ Cross Power Spectral Density
    - ◊ Coherence
    - ◊ Coherent Output Power
  - o Supports real, imaginary, and Nyquist display functions
  - o Additional FFT analysis functions supported: Exponential, Force, Cosiner Taper
  - o Save data to .uff file format
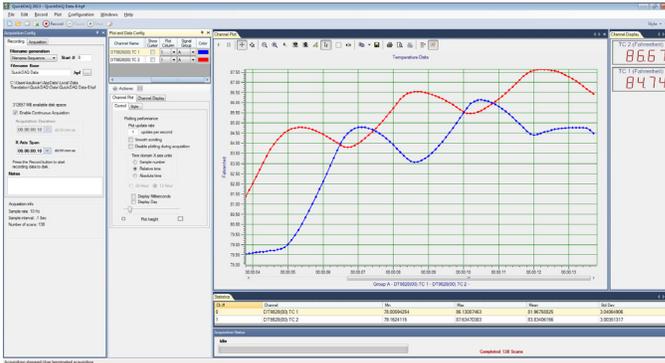
QuickDAQ ships free-of-charge and allows you to get up and running quickly.

Other Software Options

There are many software choices available for application development, from ready-to-measure applications to programming environments.

The following software is available for use with the DT9824 module and is provided on the Data Acquisition Omni CD:

- **DT9829 Device Driver** –The device driver allows you to use a DT9824 module with any of the supported software packages or utilities.
- **DT9829 Calibration Utility** – This utility allows you to calibrate features of a DT9829 module.
- **Quick DataAcq** application – The Quick DataAcq application provides a quick way to get up and running. Using this application, verify key features of the module, display data on the screen, and save data to disk.
- **DT-Open Layers® for .NET Class Library** – Use this class library if you want to use Visual C#® or Visual Basic® for .NET to develop application software using Visual Studio® 2003-2012; the class library complies with the DT-Open Layers standard.
- **DataAcq SDK** – Use the DataAcq SDK to use Visual Studio 6.0 and Microsoft® C or C++ to develop application software using Windows 10/8/7/Vista/XP 32/64-bit; the DataAcq SDK complies with the DT-Open Layers standard.
- **DAQ Adaptor for MATLAB** – Data Translation's DAQ Adaptor provides an interface between the MATLAB® Data Acquisition (DAQ) toolbox from The MathWorks™ and Data Translation's DT-Open Layers architecture.
- **LV-Link** – Data Translation's LV-Link is a library of VIs that enable LabVIEW™ programmers to access the data acquisition features of DT-Open Layers compliant USB and PCI devices.

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DT9829-Datasheet

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