DATA TRANSLATION

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DT9829 Series User's Manual

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This equipment has been tested and found to comply with CISPR EN55022 Class A and EN61000-6-1 requirements and also with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Changes or modifications to this equipment not expressly approved by Data Translation could void your authority to operate the equipment under Part 15 of the FCC Rules.

Note: This product was verified to meet FCC requirements under test conditions that included use of shielded cables and connectors between system components. It is important that you use shielded cables and connectors to reduce the possibility of causing interference to radio, television, and other electronic devices.

Canadian Department of Communications Statement

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la class A prescrites dans le Règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.

Table of Contents

About this Manual 11
Intended Audience 11
How this Manual is Organized 11
Conventions Used in this Manual 12
Related Information 12
Where To Get Help 13

Chapter 1: Overview 15
Features 16
Supported Software 18
Accessories 21
Getting Started Procedure 22

Chapter 2: Installing a Module 25
Unpacking 27
System Requirements 28
Attaching Modules to the Computer 29
Connecting Directly to the USB Ports 30
Connecting to an Expansion Hub 31
Configuring the Device Driver 33

Chapter 3: Wiring Signals 35
General Wiring Recommendations 37
Connecting Voltage Input Signals 39
Connecting Current Output Devices 41
Connecting Thermocouple Inputs 43
Connecting RTD Inputs 44
4-Wire RTD Connection 44
3-Wire RTD Connection with Lead Wire Compensation 45
2-Wire RTD Connection 46
Connecting Resistance Measurements 47
4-Wire Resistance Measurement 47
3-Wire Resistance Measurement with Lead Wire Compensation 48
2-Wire Resistance Measurement 49
Connecting Thermistors 50
2-Wire Thermistor Connection 50
3-Wire Thermistor Connection with Lead Wire Compensation 51
4-Wire Thermistor Connection 52
Connecting Bridge-Based and General-Purpose Bridge Sensors 53

Connecting Strain Gages 55
Connecting a Quarter-Bridge (Axial and Bending) Circuit 55
Connecting a Quarter-Bridge Temp Comp Circuit 58
Connecting a Half-Bridge Poisson Circuit. 60
Connecting a Half-Bridge Bending Circuit 62
Connecting a Full-Bridge Bending Circuit 64
Connecting a Full-Bridge Bending Poisson Configuration. 66
Connecting a Full-Bridge Axial Poisson Circuit. 68
Connecting Digital Input Signals. 70
Connecting Digital Output Signals 71

Chapter 4: Verifying the Operation of a Module 73
Selecting the Device 75
Performing the Measurement. 77
Configure the Channels 77
Configure the Parameters of the Acquisition Config Window 78
Configure the Appearance of the Channel Plot Window 82
Configure the Appearance of the Channel Display Window. 83
Configure the Appearance of the Statistics Window. 85
Position the Windows. 85
Start the Measurement 86

Chapter 5: Principles of Operation 89
Block Diagram and Board Layout 90
Analog Input Features. 92
Analog Input Channels 92
Specifying a Single Channel 92
Specifying One or More Channels 93
Voltage Input Support 93
Current Support 94
Thermocouple Support 94
Cold Junction Compensation 95
Open Thermocouple Detection 95
RTD Support 96
Resistance Measurement Support 97
Thermistor Support. 97
Bridge and Strain Gage Support. 98
Bridge-Based Sensors 100
General-Purpose Bridge Sensors 101
Strain Gages 101
Quarter-Bridge Configuration 104
Quarter-Bridge Temp Comp Configuration 105

Half-Bridge Poisson Configuration . . . 106
Half-Bridge Bending Configuration . . . 107
Full-Bridge Bending Circuit . . . 108
Full-Bridge Bending Poisson Configuration. . . . 109
Full-Bridge Axial Poisson Configuration . . . 110
Input Ranges and Gains . . . 111
Input Resolution . . . 111
A/D Sample Rate . . . 112
Input Trigger . . . 113
Analog Input Conversion Modes . . . 114
Single-Value Operations . . . 114
Continuous Scan Mode . . . 114
Filtering. . . . 115
Data Format . . . 116
Data Format for Voltage Inputs . . . 116
Data Format for Current Output Devices . . . 116
Data Format for Thermocouples . . . 116
Data Format for RTDs . . . 116
Data Format for Resistance Measurements . . . 116
Data Format for Thermistors . . . 116
Data Format for Bridge-Based Sensors . . . 117
Data Format for Strain Gage . . . 117
Error Conditions . . . 117
Digital I/O Features. . . . 118
Digital Input Lines . . . 118
Digital Output Lines . . . 118
Resolution. . . . 119
Operation Modes. . . . 119

Chapter 6: Supported Device Driver Capabilities. . . . 121
Data Flow and Operation Options. . . . 123
Buffering . . . 124
Triggered Scan Mode . . . 124
Data Encoding. . . . 124
Channels . . . 125
Gain . . . 126
Ranges . . . 126
Resolution . . . 127
Current and Resistance Support . . . 127
Thermocouple, RTD, and Thermistor Support . . . 128
IEPE Support. . . . 129
Bridge and Strain Gage Support . . . 129

Start Triggers . . . 130
Reference Triggers . . . 130
Clocks . . . 131
Counter/Timers . . . 132
Tachometer . . . 133

Chapter 7: Calibration . . . 135
About Calibration . . . 136
Running the Calibration Utility . . . 137
Required Calibration for Each Sensor Type . . . 138
Voltage Input Calibration Steps . . . 138
RTD Calibration Steps . . . 138
Thermistor Calibration Steps . . . 138
Resistance Measurement Calibration Steps . . . 138
Current Measurement Calibration Steps . . . 139
Thermocouple Calibration Steps . . . 139
Bridge and Strain Gage Calibration Steps . . . 139

Chapter 8: Troubleshooting . . . 141
General Checklist . . . 142
Technical Support . . . 144
If Your Module Needs Factory Service . . . 145

Appendix A: Specifications . . . 147
Basic Module Specifications . . . 148
Analog Input Specifications . . . 149
Voltage Input Specifications . . . 150
Current Specifications . . . 152
Resistance Specifications . . . 153
RTD Specifications . . . 154
Thermistor Specifications . . . 156
Thermocouple Specifications . . . 157
System Temperature Error for the DT9829 Series . . . 158
Thermocouple Measurement Noise . . . 160
Thermocouple Noise Calculation Example . . . 160
Bridge and Strain Gage Specifications . . . 162
Bridge Supply Capability . . . 163
Digital I/O Specifications . . . 164
Isolation and Protection Specifications . . . 165
Power, Physical, and Environmental Specifications . . . 166
Terminal Block Specifications . . . 167
Regulatory Specifications . . . 168

Appendix B: Pin Assignments and LED Status Indicators 169
Screw Terminals 170
USB Connector 171
LED Status Indicators 172

Index 173

About this Manual

The first part of this manual describes how to install and set up your DT9829 Series module and device driver, and verify that your module is working properly.

The second part of this manual describes the features of the DT9829 Series module, the capabilities of the DT9829 Series Device Driver, and how to program the DT9829 Series module using the DT-Open Layers for .NET Class Library™ software. Troubleshooting and calibration information is also provided.

Note: For more information on the class library, refer to the *DT-Open Layers for .NET Class Library User's Manual*. If you are using the DataAcq SDK or a software application to program your device, refer to the documentation for that software for more information.

Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for using and/or programming the DT9829 Series module for data acquisition operations in the Microsoft® Windows Vista®, Windows 7, or Windows 8 operating system. It is assumed that you have some familiarity with data acquisition principles and that you understand your application.

How this Manual is Organized

The manual is organized as follows:

- Chapter 1, "Overview," describes the major features of the DT9829 Series module, as well as the supported software and accessories.
- Chapter 2, "Installing a Module," describes how to install the DT9829 Series module.
- Chapter 3, "Wiring Signals," describes how to wire signals to the DT9829 Series module.
- Chapter 4, "Verifying the Operation of a Module," describes how to verify the operation of the DT9829 Series module with the QuickDAQ application.
- Chapter 5, "Principles of Operation," describes all of the features of the DT9829 Series module.
- Chapter 6, "Supported Device Driver Capabilities," lists the data acquisition subsystems and the associated features accessible using the DT9829 Series Device Driver.
- Chapter 7, "Calibration," describes how to calibrate the analog input circuitry of the DT9829 Series module.
- Chapter 8, "Troubleshooting," provides information that you can use to resolve problems with the DT9829 Series module and the device driver, should they occur.
- Appendix A, "Specifications," lists the specifications of the DT9829 Series module.

- Appendix B, "Pin Assignments and LED Status Indicators," shows the pin assignments for the connectors and screw terminals on the modules, and describes the LEDs on the modules.
- An index completes this manual.

Conventions Used in this Manual

The following conventions are used in this manual:

- Notes provide useful information or information that requires special emphasis, cautions provide information to help you avoid losing data or damaging your equipment, and warnings provide information to help you avoid catastrophic damage to yourself or your equipment.
- Items that you select or type are shown in **bold**.

Related Information

Refer to the following documents for more information on using the DT9829 Series module:

- *Benefits of the Universal Serial Bus for Data Acquisition.* This white paper describes why USB is an attractive alternative for data acquisition. It is available on the Data Translation web site (www.datatranslation.com).
- *QuickDAQ User's Manual* (UM-24774). This manual describes how to create a QuickDAQ application to acquire and analyze data from DT-Open Layers data acquisition devices.
- *DT-Open Layers for .NET User's Manual* (UM-22161). For programmers who are developing their own application programs using Visual C# or Visual Basic .NET, this manual describes how to use the DT-Open Layers for .NET Class Library to access the capabilities of Data Translation data acquisition devices.
- *DataAcq SDK User's Manual* (UM-18326). For programmers who are developing their own application programs using the Microsoft C compiler, this manual describes how to use the DT-Open Layers DataAcq SDK™ to access the capabilities of Data Translation data acquisition devices.
- *DAQ Adaptor for MATLAB* (UM-22024). This document describes how to use Data Translation's DAQ Adaptor to provide an interface between the MATLAB Data Acquisition subsystem from The MathWorks and Data Translation's DT-Open Layers architecture.
- *LV-Link Online Help*. This help file describes how to use LV-Link™ with the LabVIEW™ graphical programming language to access the capabilities of Data Translation data acquisition devices.
- Microsoft Windows Vista, Windows 7, or Windows 8 documentation.
- USB web site (http://www.usb.org).
- *Omega Complete Temperature Measurement Handbook and Encyclopedia®.* This document, published by Omega Engineering, provides information on how to linearize voltage values into temperature readings for various thermocouple types.

Where To Get Help

Should you run into problems installing or using a DT9829 Series module, the Data Translation Technical Support Department is available to provide technical assistance. Refer to Chapter 8 for more information. If you are outside the United States or Canada, call your local distributor, whose number is listed on our web site (www.datatranslation.com).

Overview

Features 16
Supported Software 18
Accessories 21
Getting Started Procedure 22

Features

DT9829 Series modules, shown in Figure 1, are portable, data acquisition, multi-sensor devices for USB. The DT9829 Series supports a universal array of sensor types, including voltage inputs, current, thermocouples, RTDs, resistance, thermistors, bridge-based sensors, general-purposes bridges, and strain gages.

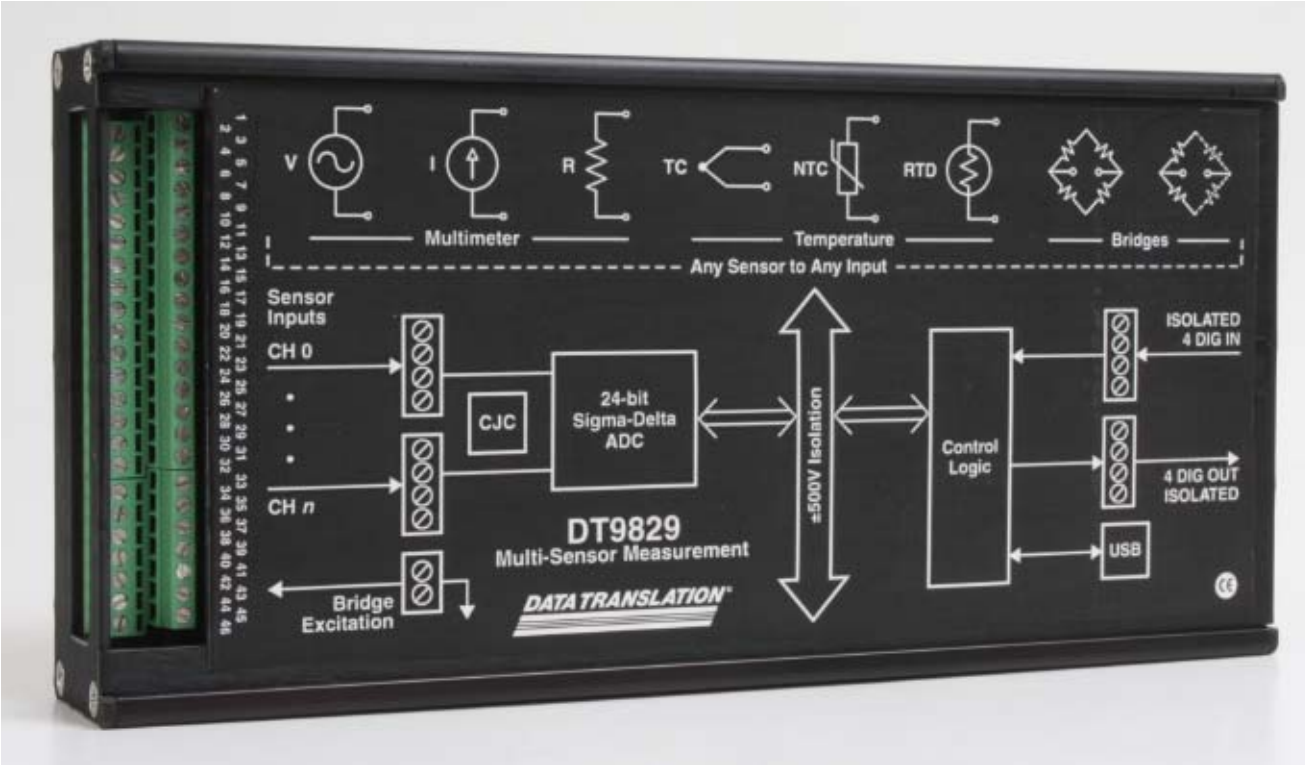


Figure 1: DT9829 Series Module

The key features of DT9829 Series module are as follows:

- The DT9829-2 provides two differential analog input channels, the DT9829-4 provides four differential analog input channels, and the DT9829-8 provides eight differential analog input channels.
- Each channel is software-configurable for one of the following sensor inputs: voltage, current, thermocouple, RTD, resistance, thermistor, bridge-based sensor, or strain gage.
- All analog input channels are multiplexed to a single Delta-Sigma A/D converter.
- For voltage inputs, supports an input range of ±10 V, ±2 V, or ±200 mV.
- For current measurements, supports a current source of ±25 mA.
- For thermocouples, supports B, E, J, K, N, R, S, and T thermocouple types, provides one CJC for all eight channels, and supports open thermocouple detection.

- For RTDs, supports Platinum 100 Ω, 500 Ω, or 1000 Ω RTD types using 2-, 3-, or 4-wire connections and the following Temperature Coefficient of Resistance (TCR) values: 0.003750, 0.003850, 0.003911, 0.003916, 0.003920, 0.003928, and custom values.
- For resistance measurements, supports measurement ranges of 0 to 4 kΩ and 4 kΩ to 200 kΩ using 2-, 3-, or 4-wire connections; the DT9829 Series provides a 425 µA current source for the 0 to 4 kΩ range and a 10 µA current source for the 4 kΩ to 200 kΩ range.
- For thermistors, supports NTC (Negative Temperature Coefficient) thermistors with a resistor value of 2252 Ω to 100 kΩ using 2-, 3-, or 4-wire connections.
- For bridge-based sensors and strain gages, such as load cells and general-purpose full-, half-, and quarter-bridge sensors, provides 3.0 V bridge excitation, supports 120 Ω minimum bridge resistance, and provides internal bridge-completion resistors for quarter- and half-bridge configurations.
- Input resolution of 24 bits.
- Analog throughput of up to 960 Samples/s (120 Samples/s for 8 analog input channels).
- Four, isolated, TTL, 12 V and 24 V digital inputs; you can read the status of the digital input port in the analog input stream.
- Four, isolated, open-collector digital outputs.
- ±500 V galvanic isolation to the computer.
- USB 3.0, USB 2.0 full speed, or USB 1.1 support.
- Powered by USB bus; no external power supply required.
- A software calibration utility is provided for calibrating the module.

Supported Software

The following software is available for use with DT9829 Series module and is shipped on the Data Acquisition OMNI CD:

- **DT9829 Series Device Driver** – The device driver allows you to use the DT9829 Series module with any of the supported software packages or utilities. Refer to Chapter 2 starting on page 25 for more information on loading and configuring the device driver.
- **DT9829 Calibration Utility** – The DT9829 Calibration Utility allows you to calibrate the analog input circuitry of a DT9829 Series module. Refer to Chapter 8 starting on page 141 for more information on this utility.
- **QuickDAQ Base Version** – The base version of QuickDAQ is free-of-charge and allows you to acquire and analyze data from all Data Translation USB and Ethernet devices, except the DT9841 Series, DT9817, DT9835, and DT9853/54. Using the base version of QuickDAQ, you can perform the following functions:
  - Discover and select your devices.
  - Configure all input channel settings for the attached sensors.
  - Load/save multiple hardware configurations.
  - Generate output stimuli (fixed waveforms, swept sine waves, or noise signals).
  - On each supported data acquisition device, acquire data from all channels supported in the input channel list.
  - Choose to acquire data continuously or for a specified duration.
  - Choose software or triggered acquisition.
  - Log acquired data to disk in an .hpf file.
  - Display acquired data during acquisition in either a digital display using the Channel Display window or as a waveform in the Channel Plot window.
  - Choose linear or logarithmic scaling for the horizontal and vertical axes.
  - View statistics about the acquired data, including the minimum, maximum, delta, and mean values and the standard deviation in the Statistics window.
  - Export time data to a .csv or .txt file; you can open the recorded data in Microsoft Excel® for further analysis.
  - Read a previously recorded .hpf data file.
  - Customize many aspects of the acquisition, display, and recording functions to suit your needs, including the acquisition duration, sampling frequency, trigger settings, filter type, and temperature units to use.

- **QuickDAQ FFT Analysis Option** – When enabled with a purchased license key, the QuickDAQ FFT Analysis option includes all the features of the QuickDAQ Base version plus basic FFT analysis features, including the following:
  - The ability to switch between the Data Logger time-based interface and the FFT Analyzer block/average-based interface.
  - Supports software, freerun, or triggered acquisition with accept and reject controls for impact testing applications.
  - Allows you to perform single-channel FFT (Fast Fourier Transform) operations, including AutoSpectrum, Spectrum, and Power Spectral Density, on the acquired analog input data. You can configure a number of parameters for the FFT, including the FFT size, windowing type, averaging type, integration type, and so on.
  - Allows you to display frequency-domain data as amplitude or phase.
  - Supports dB or linear scaling with RMS (root mean squared), peak, and peak-to-peak scaling options
  - Supports linear or exponential averaging with RMS, vector, and peak hold averaging options.
  - Supports windowed time channels.
  - Supports the following response window types: Hanning, Hamming, Bartlett, Blackman, Blackman Harris, and Flat top.
  - Supports the ability to lock the waveform output to the analysis frame time.
  - Allows you to configure and view dynamic performance statistics, including the input below full-scale (IBF), total harmonic distortion (THD), spurious free dynamic range (SFDR), signal-to-noise and distortion ratio (SINAD), signal-to-noise ratio (SNR), and the effective number of bits (ENOB), for selected time-domain channels in the Statistics window.
  - Supports digital IIR (infinite impulse response) filters
- **QuickDAQ Advanced FFT Analysis Option** – When enabled with a purchased software license, the QuickDAQ Advanced FFT Analysis option includes all the features of the QuickDAQ Base version with the FFT Analysis option plus advanced FFT analysis features, including the following:
  - Allows you to designate a channel as a Reference or Response channel.
  - Allows you to perform two-channel FFT analysis functions, including Frequency Response Functions (Inertance, Mobility, Compliance, Apparent Mass, Impedance, Dynamic Stiffness, or custom FRF) with H1, H2, or H3 estimator types, Cross-Spectrum, Cross Power Spectral Density, Coherence, and Coherent Output Power.
  - Supports the Exponential response window type.
  - Supports the following reference window types: Hanning, Hamming, Bartlett, Blackman, Blackman Harris, FlatTop, Exponential, Force, and Cosine Taper windows.
  - Supports real, imaginary, and Nyquist display functions.
  - Allows you to save data in the .uff file format.

- **Quick DataAcq application** – The Quick DataAcq application provides a quick way to get up and running using a DT9829 Series module. Using this application, you can verify key features of the modules, 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 your own application software for a DT9829 Series module using Visual Studio 2003-2012; the class library complies with the DT-Open Layers standard.
- **DataAcq SDK** – Use the Data Acq SDK if you want to use Visual Studio 6.0 and Microsoft C or C++ to develop your own application software for a DT9829 Series module using Windows Vista, Windows 7, or Windows 8; 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) subsystem from The MathWorks and Data Translation's DT-Open Layers architecture.
- **LV-Link** – LV-Link allows you to access the capabilities of a DT9829 Series module from the LabVIEW graphical programming language.

Refer to the Data Translation web site (www.datatranslation.com) for information about selecting the right software package for your needs.

Accessories

The BNC DIN Rail Kit, shown in Figure 2, allows you to mount the DT9829 module in a DIN rail. The kit includes mounting clips, screws, and instructions. The rail is not included.

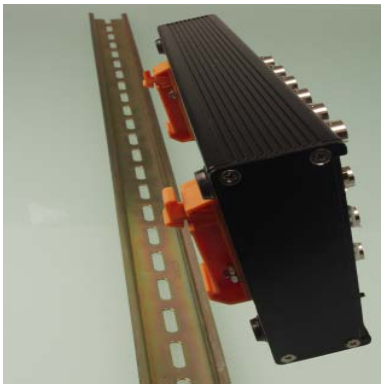


Figure 2: BNC DIN Rail Kit

Getting Started Procedure

The flow diagram shown in Figure 3 illustrates the steps needed to get started using a DT9829 Series module. This diagram is repeated in each Getting Started chapter; the shaded area in the diagram shows you where you are in the procedure.

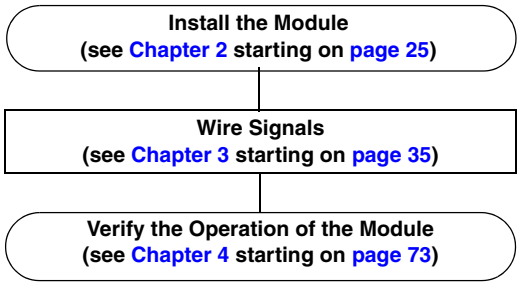
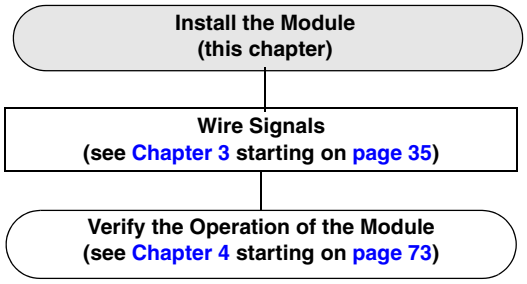


Figure 3: Getting Started Flow Diagram

Part 1: Getting Started

Installing a Module

Unpacking 27
System Requirements 28
Attaching Modules to the Computer. 29
Configuring the Device Driver. 33


Install the Module
(this chapter)
Wire Signals
(see Chapter 3 starting on page 35)
Verify the Operation of the Module
(see Chapter 4 starting on page 73)

Unpacking

Open the shipping box and verify that the following items are present:

- DT9829 Series module
- EP365 USB cable
- Data Acquisition OMNI CD

If an item is missing or damaged, contact Data Translation. If you are in the United States, call the Customer Service Department at (508) 481-3700, ext 1323. An application engineer will guide you through the appropriate steps for replacing missing or damaged items. If you are located outside the United States, call your local distributor, listed on Data Translation's web site (www.datatranslation.com).

System Requirements

For reliable operation, ensure that your computer meets the following system requirements:

- Processor: Pentium 4/M or equivalent
- RAM: 1 GB
- Screen Resolution: 1024 x 768 pixels
- Operating System: Windows 8, Windows 7, Windows Vista (32- and 64-bit)
- Disk Space: 4 GB

Attaching Modules to the Computer

You can attach a DT9829 Series module to the host computer in one of two ways:

- Connect directly to a USB port of the host computer, described on this page. Use this method if one or two modules are sufficient for your application.
- Connect to one or more self-powered USB hubs, described on page 31. Use this method if your application requires more modules than the USB ports on the host computer.

You **must** install the device driver before connecting a DT9829 Series module to the host computer.

Note: The DT9829 Series module is a low-power device (using less than 500 mA); therefore, it does not require an external power supply.

Note that the number and types of bridges that can be powered from a DT9829 Series module is limited by the 500 mA maximum current that may be drawn from the host USB port. Table 1 shows the number of bridge channels that are supported given different bridge configurations.

Table 1: Number of Bridge Channels that Can Be Powered By the USB Host Port

Bridge Configuration	Total Number of Bridge Channels	Number of Channels Based on Bridge Resistance		
		120 Ω Bridge Resistance	350 Ω Bridge Resistance	1 kΩ Bridge Resistance
Full Bridge	8	0	0	8
	8	0	8	0
	3	3	0	0
	6	2	2	2
Half Bridge or Quarter Bridge	8	0	0	8
	8	0	8	0
	6	6	0	0
	8	4	Any	Any

Connecting Directly to the USB Ports

To connect a DT9829 Series module directly to a USB port on your computer, do the following:

1. Attach one end of the EP365 (USB) cable, which is shipped with the module, to the USB port on the module.
2. Attach the other end of the EP365 cable to one of the USB ports on the host computer. Figure 4 shows the USB port on a DT9829 Series module.
   The operating system automatically detects the USB device and starts the Found New Hardware wizard.

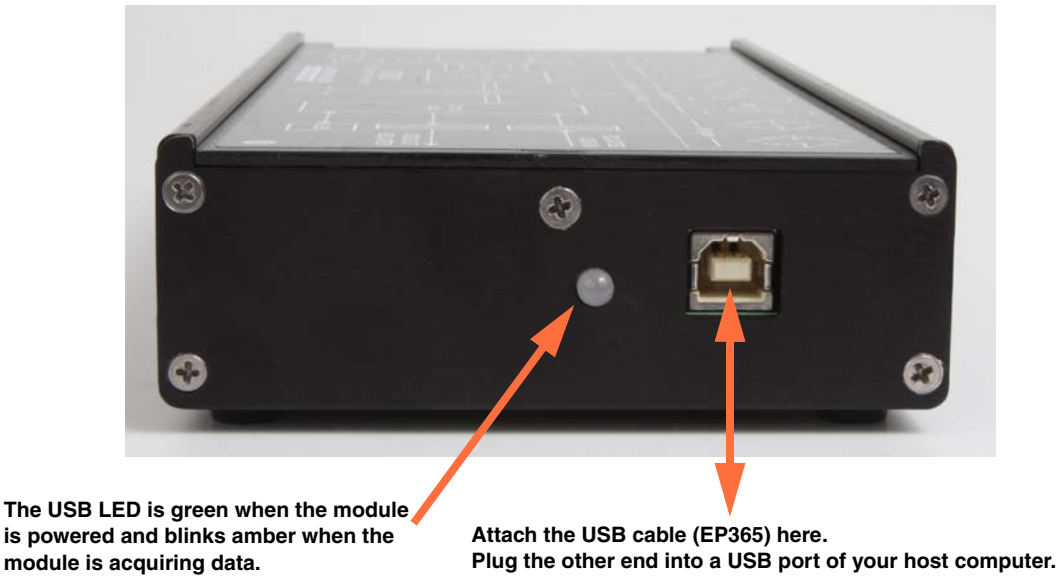


Figure 4: Attaching the Module to the Host Computer

3. *For Windows Vista:*
   a. Click **Locate and install driver software (recommended)**.
      The popup message "Windows needs your permission to continue" appears.
   b. Click **Continue**.
      The Windows Security dialog box appears.
   c. Click **Install this driver software anyway**.

Note: Windows 7 and Windows 8 find the device automatically.

4. Repeat these steps to attach another DT9829 Series module to the host computer, if desired.

Note: You can unplug a module, and then plug it in again, if you wish, without causing damage. This process is called hot-swapping.

Your application may take a few seconds to recognize a module once it is plugged back in.

Once you have connected your module to the host computer, power is turned on to the module when your application program opens the module. The LED on the module, shown in Figure 4 on page 30, turns green to indicate that power is turned on. Power is turned off to the module when your application program terminates its connection to the module.

Connecting to an Expansion Hub

Expansion hubs are powered by their own external power supply. The practical number of DT9829 Series modules that you can connect to a single USB port depends on the throughput you want to achieve.

To connect multiple DT9829 Series modules to an expansion hub, do the following:

1. Attach one end of the USB cable to the module and the other end of the USB cable to an expansion hub.
2. Connect the power supply for the expansion hub to an external power supply.
3. Connect the hub to the USB port on the host computer using another USB cable.
   The operating system automatically detects the USB device and starts the Found New Hardware wizard.
4. *For Windows Vista*:
   a. Click **Locate and install driver software (recommended)**.
      The popup message "Windows needs your permission to continue" appears.
   b. Click **Continue**.
      The Windows Security dialog box appears.
   c. Click **Install this driver software anyway**.

Note: Windows 7 and Windows 8 find the device automatically.

5. Repeat these steps until you have attached the number of hubs and modules that you desire. Refer to Figure 5.
   The operating system automatically detects the USB devices as they are installed.

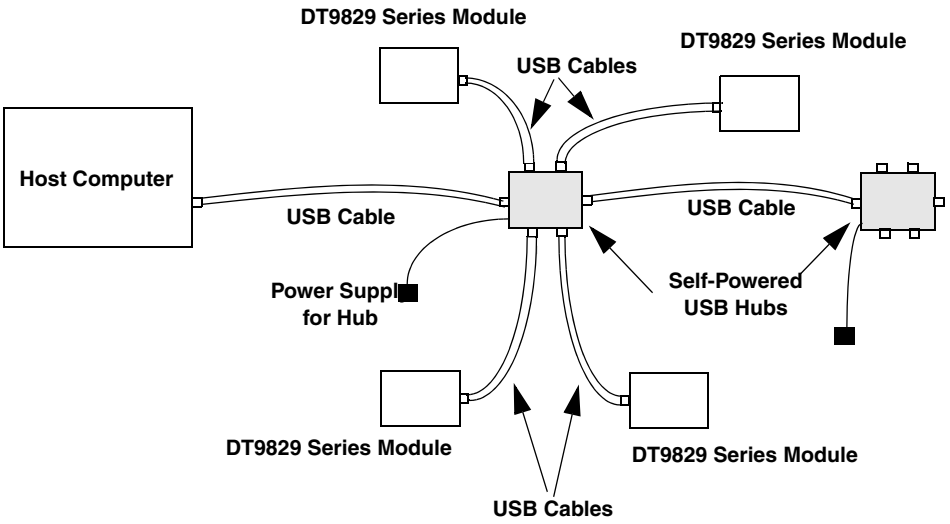


Figure 5: Attaching Multiple Modules Using Expansion Hubs

Note: You can unplug a module, and then plug it in again, if you wish, without causing damage. This process is called hot-swapping.

Your application may take a few seconds to recognize a module once it is plugged back in.

Once you have connected your module to the host computer, power is turned on to the module when your application program opens the module. The LED on the module, shown in Figure 4 on page 30, turns green to indicate that power is turned on. Power is turned off to the module when your application program terminates its connection to the module.

Configuring the Device Driver

Note: In Windows 7, Windows 8, and Vista, you must have administrator privileges to run the Open Layers Control Panel. When you double-click the Open Layers Control Panel icon, you may see the Program Compatibility Assistant. If you do, select **Open the control panel using recommended settings**. You may also see a Windows message asking you if you want to run the Open Layers Control Panel as a "legacy CPL elevated." If you get this message, click **Yes**.

If you do not get this message and have trouble making changes in the Open Layers Control Panel, right click the DTOLCPL.CPL file and select **Run as administrator**. By default, this file is installed in the following location:

Windows 7, Windows 8, and Vista (32-bit)
C:\Windows\System32\Dtolcpl.cpl

Windows 7, Windows 8, and Vista (64-bit)
C:\Windows\SysWOW64\Dtolcpl.cpl

To configure the DT9829 Series Device Driver, do the following:

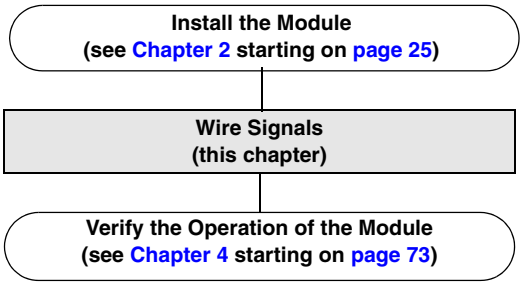
1. If you have not already done so, power up the host computer and all peripherals.
2. From the Windows Control Panel, double-click the **Open Layers Control Panel** icon.
   The Data Acquisition Control Panel dialog box appears.
3. Click the DT9829 Series module that you want to configure.
4. If you want to rename the module, click **Edit Name**.
5. Enter a new name for the module, and then click **OK**.

Note: This name is used to identify the module in all subsequent applications.

6. When you are finished configuring the module, click **Close**.
7. Repeat steps 3 to 6 for the other modules that you want to configure.
8. Close the Control Panel.

Wiring Signals

General Wiring Recommendations 37
Connecting Voltage Input Signals 39
Connecting Current Output Devices 41
Connecting Thermocouple Inputs 43
Connecting RTD Inputs 44
Connecting Resistance Measurements 47
Connecting Thermistors 50
Connecting Bridge-Based and General-Purpose Bridge Sensors 53
Connecting Strain Gages 55
Connecting Digital Input Signals 70
Connecting Digital Output Signals 71



Note: It is recommended that you run the DT9829 Calibration Utility prior to using a DT9829 Series module. Refer to Chapter 8 starting on page 141 for instructions.

General Wiring Recommendations

Keep the following recommendations in mind when wiring signals to a DT9829 Series module:

- Separate power and signal lines by using physically different wiring paths or conduits.
- To avoid noise, do not locate the instrument and cabling next to sources that produce high electromagnetic fields, such as large electric motors, power lines, solenoids, and electric arcs, unless the signals are enclosed in a mumetal shield.
- Locate module as far away as possible from sources of high or low temperatures or strong air currents, such as fans.
- Prevent electrostatic discharge to the I/O while the instrument is operational.
- When wiring thermocouples, use a wire insulation strip length of 0.197 inches (5 mm).
- Use 16 AWG to 26 AWG shielded wire for maximum rejection of electrical interference.
- Terminate all unused channels to analog ground.

Note: The DT9829 Series module requires a warm-up time of 10 minutes for the analog circuitry to stabilize.

Figure 6 shows the screw terminals on the DT9829 Series modules.

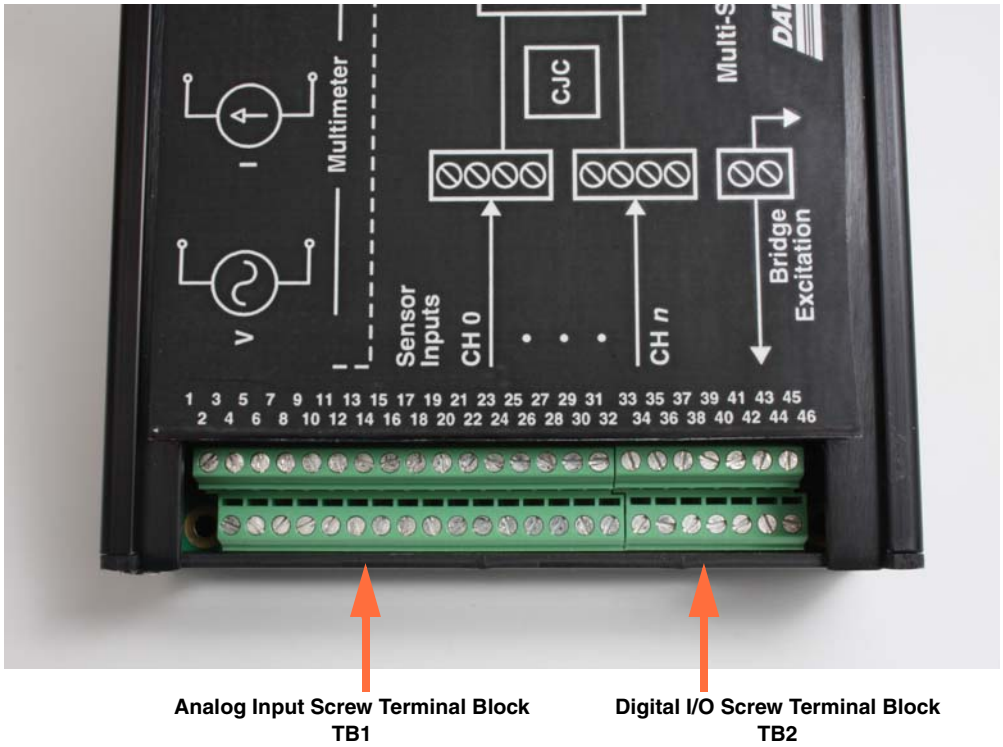


Figure 6: Screw Terminals on the DT9829 Series Modules

Table 2 describes the screw terminals on a DT9829 Series module.

Table 2: DT9829 Series Screw Terminal Designations

Screw Terminal Block	Screw Terminal Top Row	Signal Description	Screw Terminal Block	Screw Terminal Bottom Row	Signal Description
TB1	1	CH0+	TB1	2	SRC 0
	3	CH0–		4	RTN 0
	5	CH1+		6	SRC 1
	7	CH1–		8	RTN 1
	9	CH2+		10	SRC 2
	11	CH2–		12	RTN 2
	13	CH3+		14	SRC 3
	15	CH3–		16	RTN 3
	17	CH4+		18	SRC 4
	19	CH4–		20	RTN 4
	21	CH5+		22	SRC 5
	23	CH5–		24	RTN 5
	25	CH6+		26	SRC 6
	27	CH6–		28	RTN 6
	29	CH7+		30	SRC 7
	31	CH7–		32	RTN 7
TB2	33	EXC+ (3.0 V Bridge Out)	TB2	34	EXC– (Bridge Return)
	35	Digital Input 0		36	Digital Input 1
	37	Digital Input 2		38	Digital Input 3
	39	Digital Input Return		40	Digital Output 0
	41	Digital Output 1		42	Digital Output 2
	43	Digital Output 3		44	Digital Output Return
	45	Digital Output Supply[a]		46	Digital Output Supply Return

a. Supplies ranging from 3 VDC to 30 VDC are supported.

Connecting Voltage Input Signals

DT9829 Series modules support differential inputs with an effective input range of ±10 V, ±2 V, or ±200 mV per channel.

Figure 7 illustrates how to connect a floating signal source to a DT9829 Series module. (A floating signal source is a voltage source that has no connection with earth ground, such as a thermocouple or battery-operated device.)

Note: If you connect a floating voltage source to a DT9829 Series module, enable the bias return termination resistor in software.

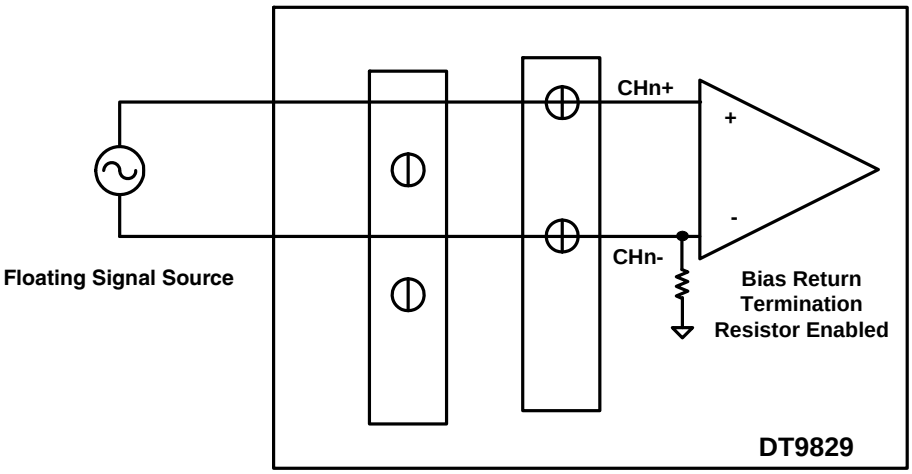


Figure 7: Connecting a Floating Voltage Source

Figure 8 illustrates how to connect a differential voltage source with a grounded reference to a DT9829 Series module. Examples include differential outputs from a data acquisition device.

Note: If you connect a differential voltage source with a grounded reference to a DT9829 Series module, disable the bias return termination resistor in software (the default setting).

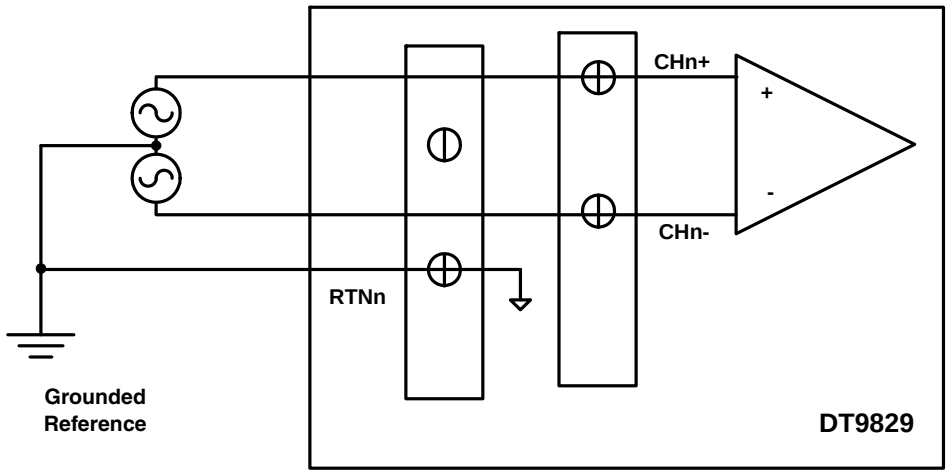


Figure 8: Connecting a Differential Voltage Source with a Grounded Reference

Figure 9 illustrates how to connect a grounded voltage source to a DT9829 Series module. Examples include outputs from plug-in instruments.

Note: If you connect a grounded voltage source to a DT9829 Series module, enable the bias return termination resistor in software.

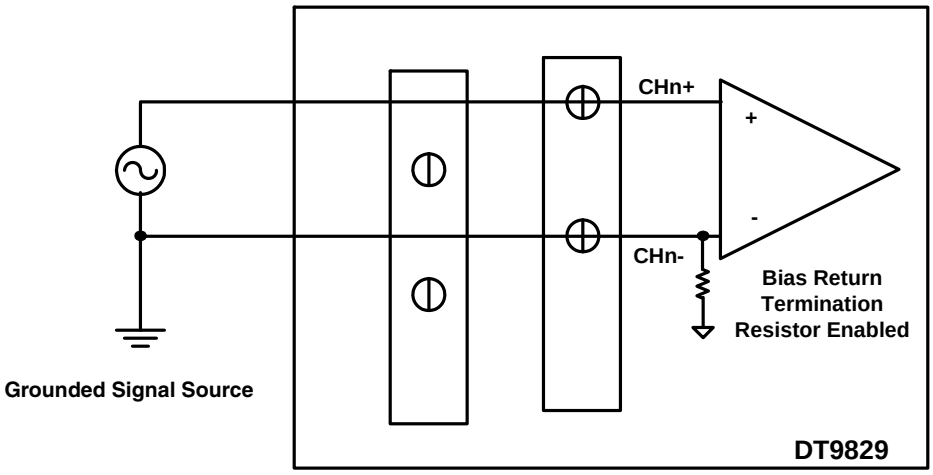


Figure 9: Connecting a Grounded Voltage Source

Connecting Current Output Devices

DT9829 Series modules support measuring current up to a range of 0 to 25 mA or 0 to –25 mA. The DT9829 Series module switches in a precision resistor across the channel terminals to measure the current.

Figure 10 shows an example of wiring a floating current signal source to a DT9829 Series module.

Note: If you connect a floating current source to a DT9829 Series module, enable the bias return termination resistor in software.

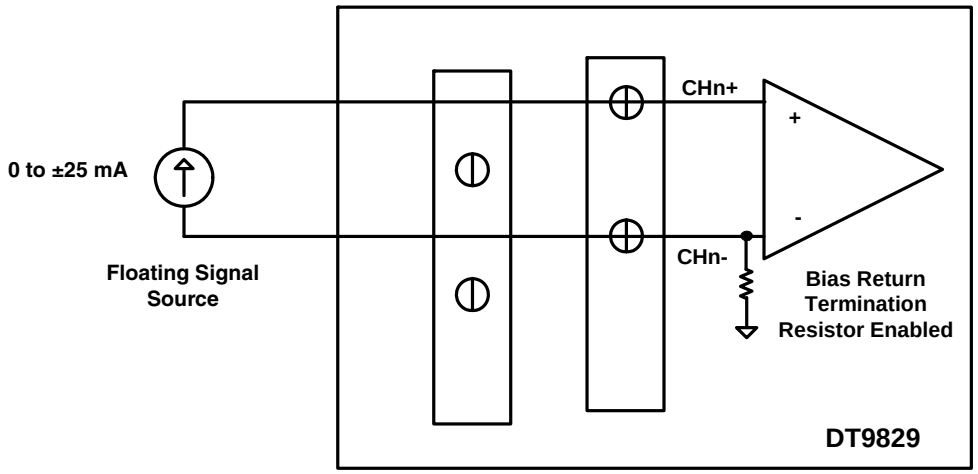


Figure 10: Connecting a Floating Current Source

Figure 11 illustrates how to connect a grounded current source to a DT9829 Series module.

Note: If you connect a grounded current source to a DT9829 Series module, enable the bias return termination resistor in software.

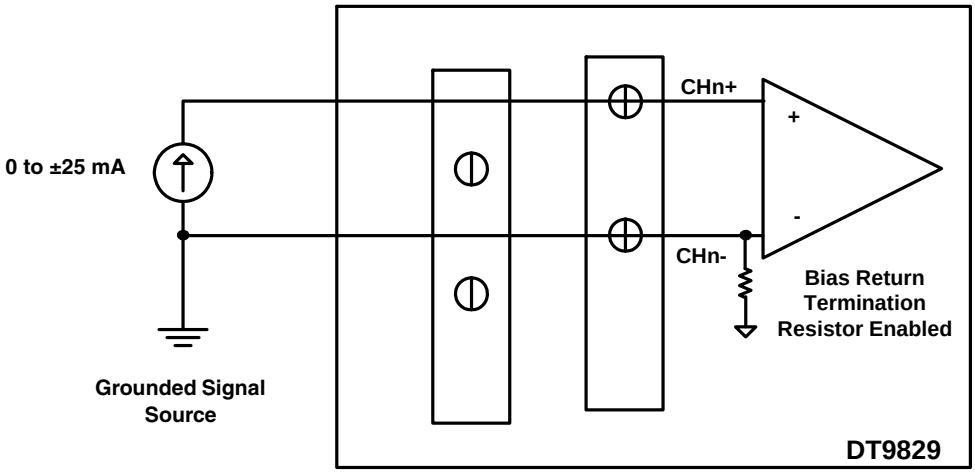


Figure 11: Connecting a Grounded Current Source to a DT9829 Series Module

Connecting Thermocouple Inputs

Thermocouple channels on a DT9829 Series module are connected in differential mode internally. You can mix and match the following thermocouple types across channels: B, E, J, K, N, R, S, and/or T.

Figure 12 shows how to connect a thermocouple input to a DT9829 Series module.

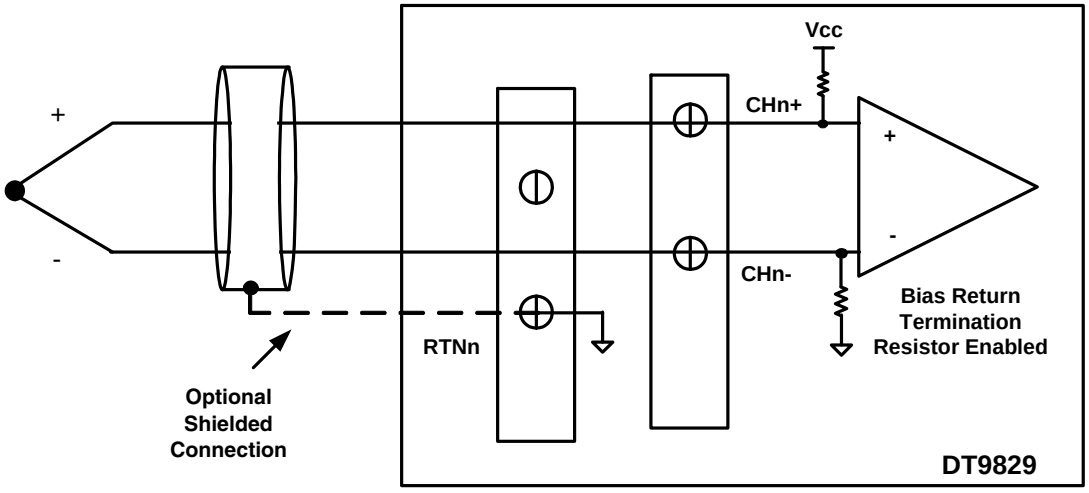


Figure 12: Connecting Thermocouple Inputs

Notes: The software automatically enables the bias return termination resistor for thermocouple measurements.

One cold-junction compensation (CJC) circuit is provided for channels 0 to 7 on the module. The software reads the value of the CJC input and applies it to the value of the thermocouple input to correct for errors based on the specified thermocouple type.

The output of the channel goes to positive, full-scale if an open circuit is detected at the input.

Connecting RTD Inputs

RTD channels on a DT9829 Series module are connected in differential mode internally.

The DT9829 Series module supplies each RTD channel with 425 µA of excitation current to prevent self-heating.

To connect an RTD input, you can use a 4-wire, 3-wire, or 2-wire connection scheme, described in the following subsections.

Note: The software automatically disables the bias return termination resistor for RTD measurements.

Refer to the page 96 and to the following web site for more information on RTD types: http://www.omega.com.

4-Wire RTD Connection

The 4-wire configuration offers the best accuracy with long connection wires, compared to the 3- and 2-wire configurations. The separate sense connection leads across the RTD eliminate any potential errors due to the resistance of the lead wires that carry the RTD excitation current. The total lead wire resistance is limited by the RTD value and the measurement range in use. For 100 Ω RTD configurations, the sum of the RTD resistance and lead wire resistance is limited to 470 Ω. For 500 and 1000 Ω RTD configurations, the total resistance is limited to 4700 Ω.

Figure 13 shows a 4-wire RTD connection.

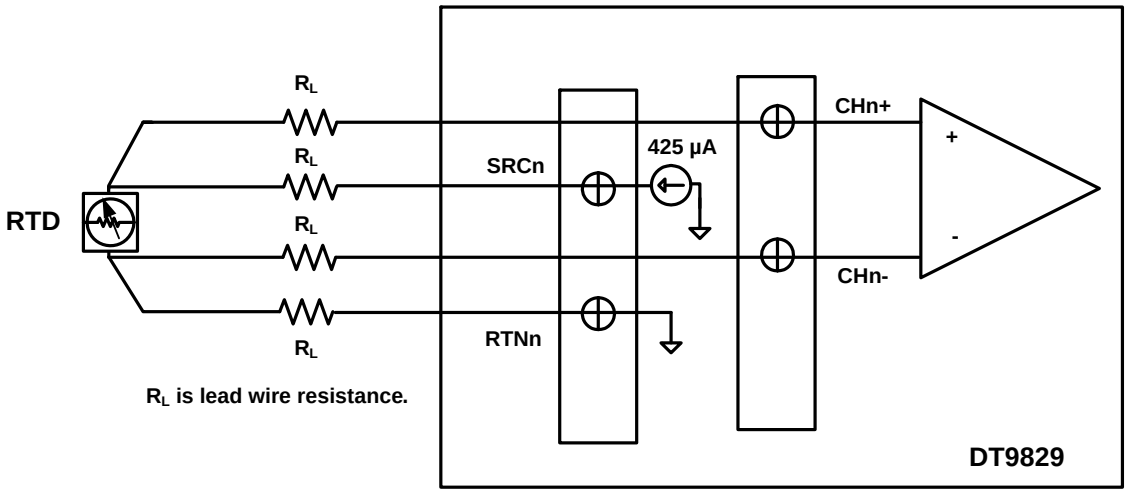


Figure 13: 4-Wire RTD Connection

3-Wire RTD Connection with Lead Wire Compensation

The 3-wire configuration eliminates one wire from the 4-wire RTD connection. In this configuration, the sensed voltage includes the voltage across the RTD as well as the voltage across the top lead wire. However, the DT9829 Series corrects for the error that is introduced from the voltage drop across the top lead wire by sensing the voltage across the current source return lead and effectively nulling the error voltages. For optimum performance, the two lead wires that carry the excitation current should be of the same gauge and length.

Figure 14 shows a 3-wire RTD connection. Internally, the DT9829 Series 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 RTD.

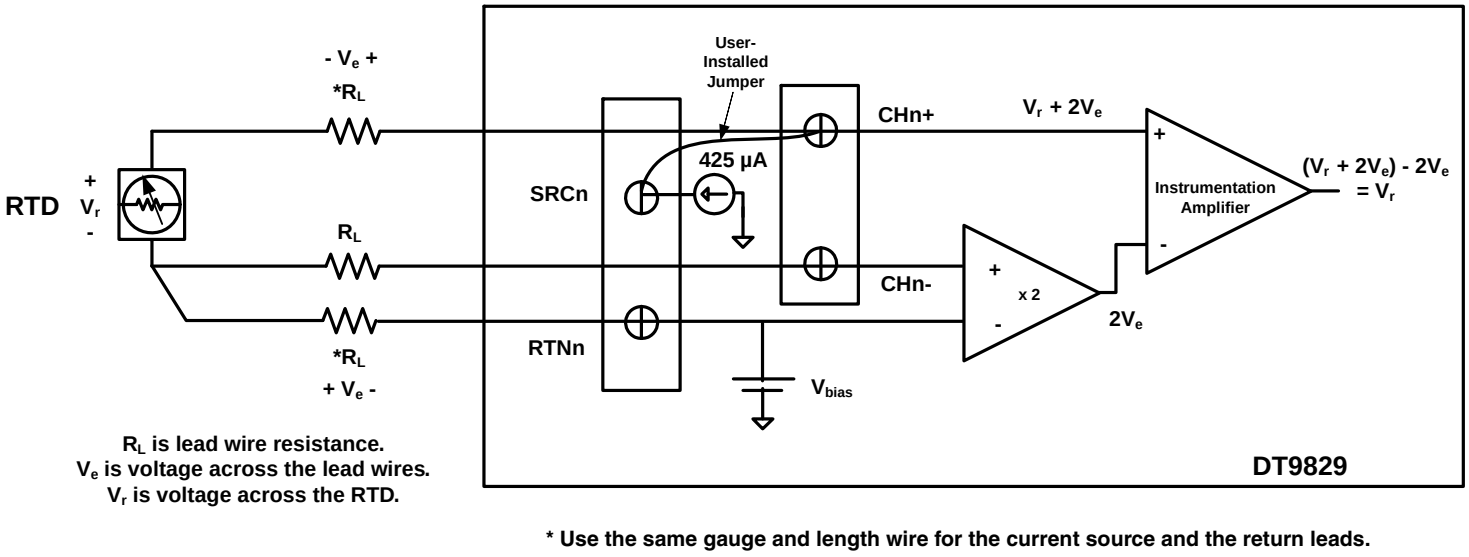


Figure 14: 3-Wire RTD Connection

2-Wire RTD Connection

The 2-wire configuration is the least accurate of the RTD wiring configurations because the lead wire resistance (R_L) and its variation with temperature contribute significant measurement errors, particularly if the lead wire is long. If you decide to use the 2-wire connection scheme, ensure that you use short lead wire connections.

For example, if the lead resistance is 0.5 Ω in each wire, the lead resistance adds a 1 Ω of error to the resistance measurement. Using a Temperature Coefficient of Resistance of 0.00385 Ω / Ω /° C with a 100 Ω RTD, the resistance represents an initial error of 1 Ω /(0.385Ω /°C) or 2.6°C. Since the lead wire resistance changes with ambient temperature, additional errors are also introduced in the measurement.

Figure 15 shows a 2-wire RTD connection.

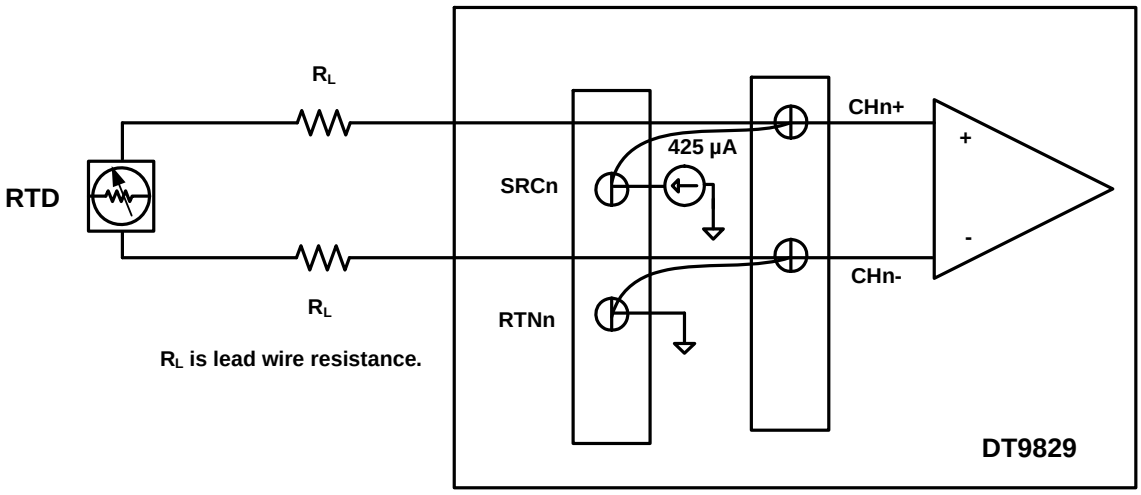


Figure 15: 2-Wire RTD Connection

Connecting Resistance Measurements

Resistance measurement channels on a DT9829 Series module are connected in differential mode internally.

DT9829 Series module supply each 4 kΩ input channel with 425 µA of excitation and each 200 kΩ input channel with 10 µA of excitation.

The module measures the voltage produced across the connected resistor when the appropriate current source is applied to it to determine resistance.

To connect a resistor input, you can use a 4-wire, 3-wire, or 2-wire connection scheme, described in the following subsections.

Note: The software automatically disables the bias return termination resistor for resistance measurements.

4-Wire Resistance Measurement

The 4-wire configuration offers the best accuracy with long connection wires, compared to the 3- and 2-wire configurations. The separate sense connection leads across the resistor being measured eliminate any potential errors due to the resistance of the lead wires that carry the excitation current. The total lead wire resistance is limited by the value of the resistor being measured and the measurement range in use. For the 0 to 4 kΩ measurement range, the sum of the resistance being measured and the lead wire resistance is limited to 4700 Ω. For the 4 kΩ to 200 kΩ measurement range, the total resistance is limited to 200 kΩ.

Figure 16 shows a 4-wire resistance measurement.

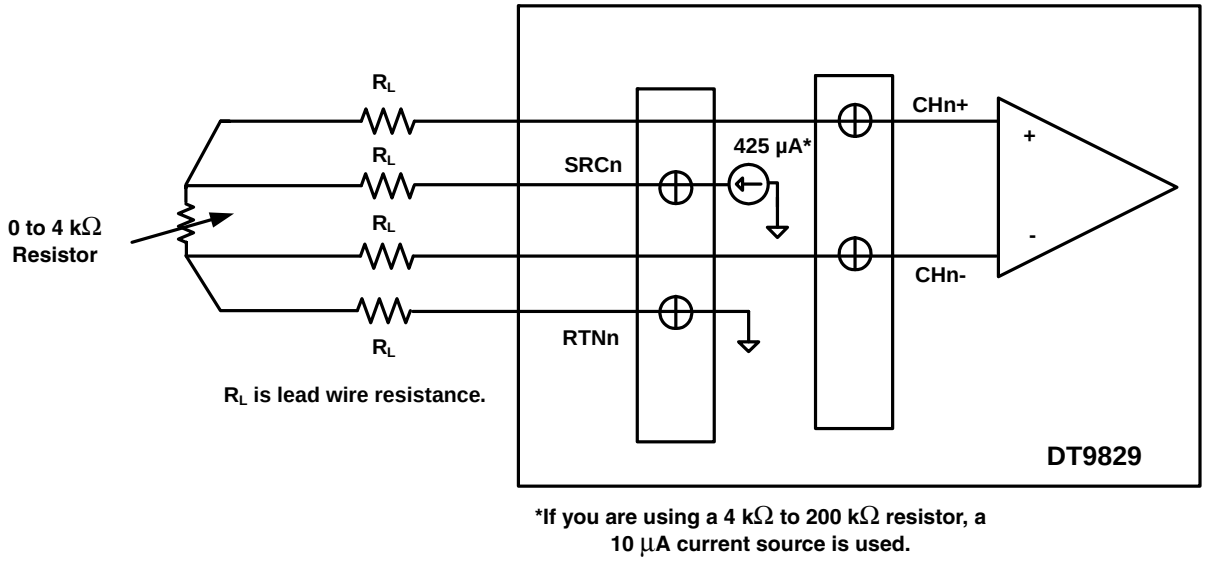


Figure 16: 4-Wire Resistance Measurement

3-Wire Resistance Measurement with Lead Wire Compensation

The 3-wire configuration eliminates one wire from the 4-wire connection. In this configuration, the sensed voltage includes the voltage across the resistor as well as the voltage across the top lead wire. However, the DT9829 Series corrects for the error that is introduced from the voltage drop across the top lead wire by sensing the voltage across the current source return lead and effectively nulling the error voltages. For optimum performance, the two lead wires that carry the excitation current should be of the same gauge and length.

Figure 17 shows a 3-wire resistance measurement. Internally, the DT9829 Series module senses the voltage across the return lead, multiplies by 2, and subtract the result from the voltage sensed at CH+ to produce a corrected measurement for the resistor.

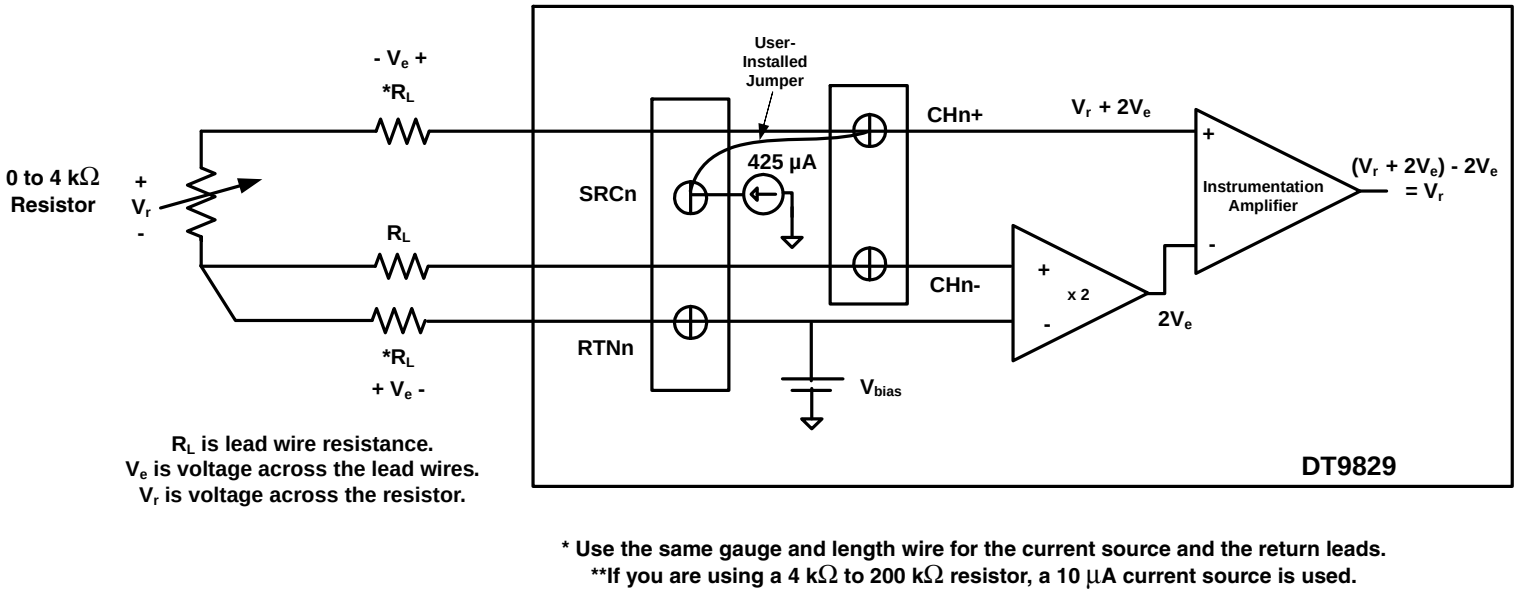


Figure 17: 3-Wire Resistance Measurement

2-Wire Resistance Measurement

The 2-wire configuration is the least accurate of the wiring configurations because the lead wire resistance (R_L) contributes significant measurement errors, particularly if the lead wire is long. If you decide to use the 2-wire connection scheme, ensure that you use short lead wire connections.

Figure 18 shows a 2-wire resistance measurement connection.

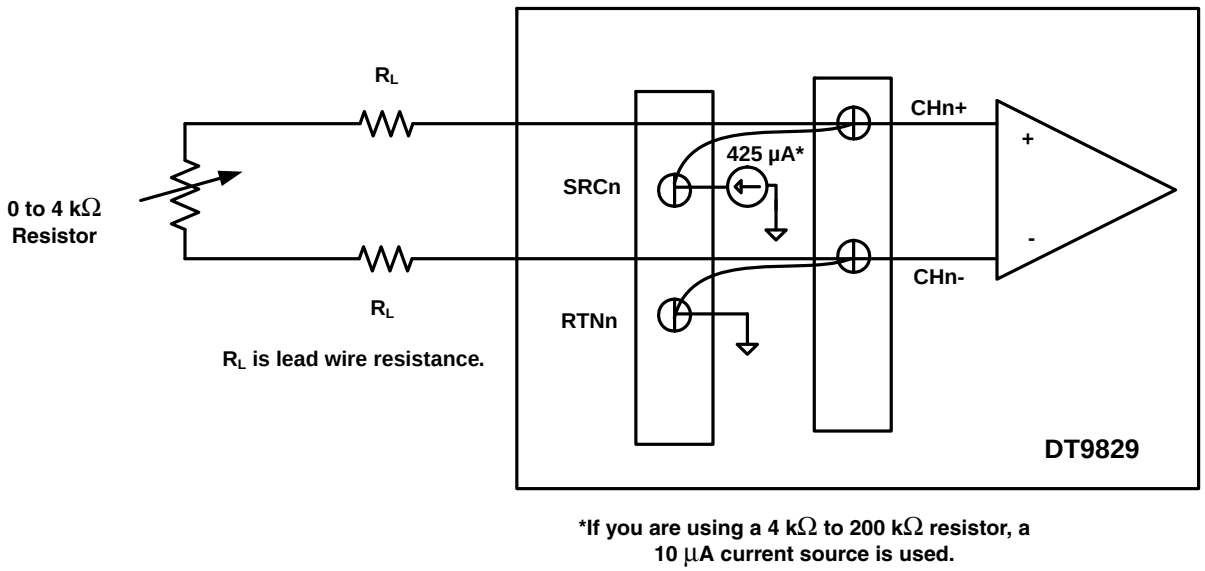


Figure 18: 2-Wire Resistance Measurement

Connecting Thermistors

Thermistors on a DT9829 Series module are connected in differential mode internally.

The DT9829 Series module supports NTC (Negative Temperature Coefficient) thermistors with a resistor value of 2252 Ω to 100 kΩ at 25° C. The module supplies 10 µA of excitation current for each thermistor channel.

To connect a thermistor, you can use a 2-wire, 3-wire, or 4-wire connection scheme, described in the following subsections. The total resistance of the thermistor being measured and the lead wire resistance should not exceed 200 kΩ.

Note: The software automatically disables the bias return termination resistor for thermistor measurements.

2-Wire Thermistor Connection

Because of the high sensitivity and relatively high resistance value of thermistors, the 2-wire configuration, shown in Figure 19, is the measurement configuration that is used most often. In the case of long lead wire connections, more accurate measurements my be obtained with the 3- or 4-wire configuration.

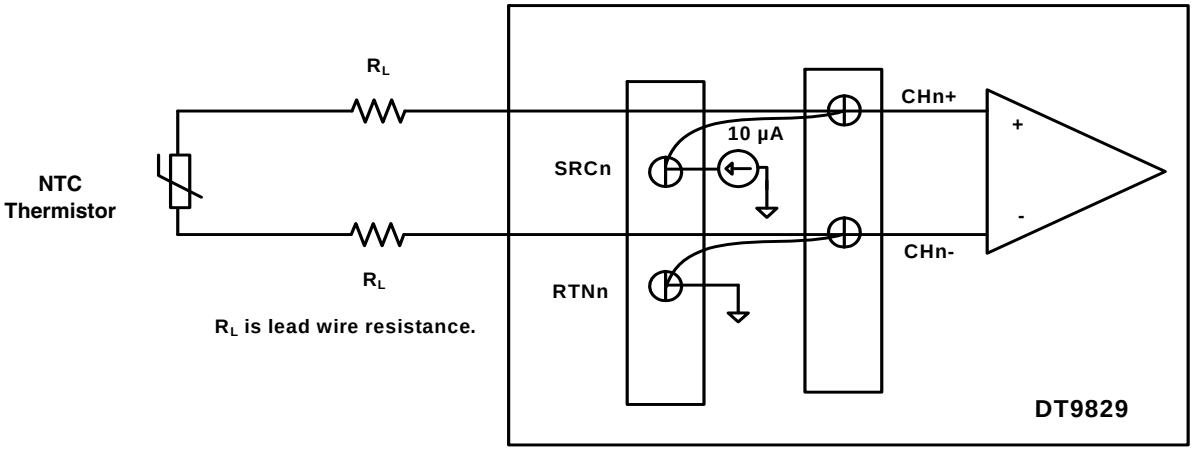


Figure 19: 2-Wire Thermistor Connection

3-Wire Thermistor Connection with Lead Wire Compensation

In the 3-wire configuration, the sensed voltage includes the voltage across the thermistor as well as the voltage across the top lead wire. However, the DT9829 Series corrects for the error that is introduced from the voltage drop across the top lead wire by sensing the voltage across the current source return lead and effectively nulling the error voltages. For optimum performance, the two lead wires that carry the excitation current should be of the same gauge and length.

Figure 20 shows a 3-wire thermistor connection. Internally, the DT9829 Series module senses the voltage across the return lead, multiplies by 2, and subtract the result from the voltage sensed at CH+ to produce a corrected measurement for the thermistor.

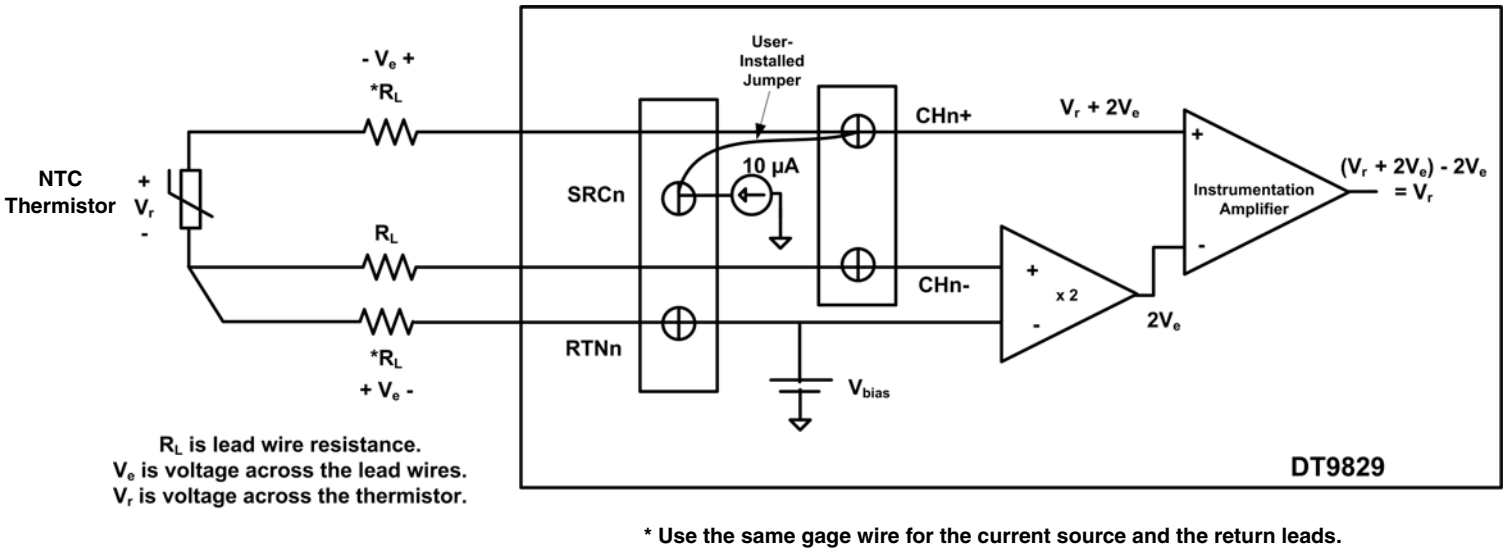


Figure 20: 3-Wire Thermistor Connection

4-Wire Thermistor Connection

Figure 21 shows a 4-wire thermistor connection.

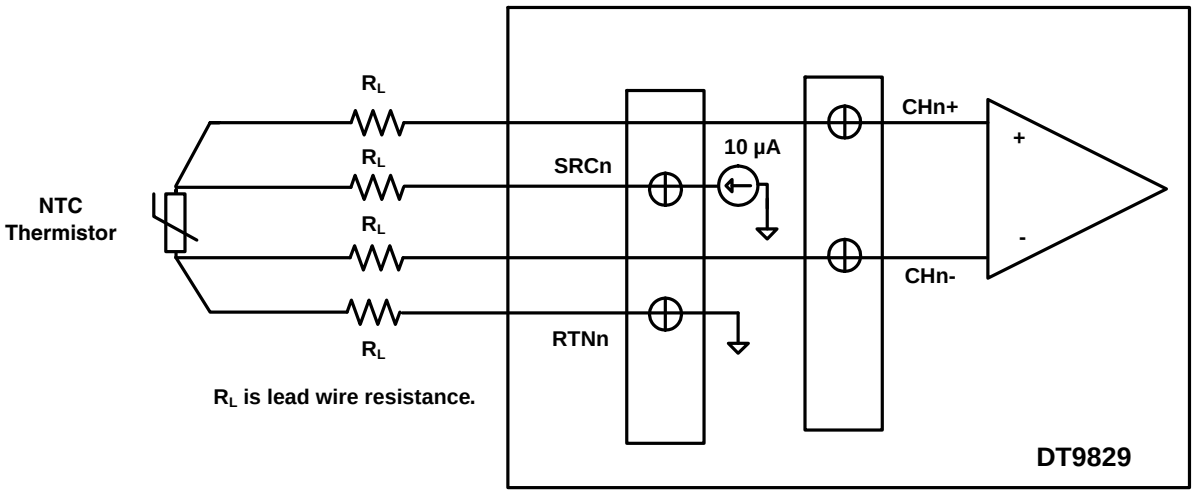


Figure 21: 4-Wire Thermistor Connection

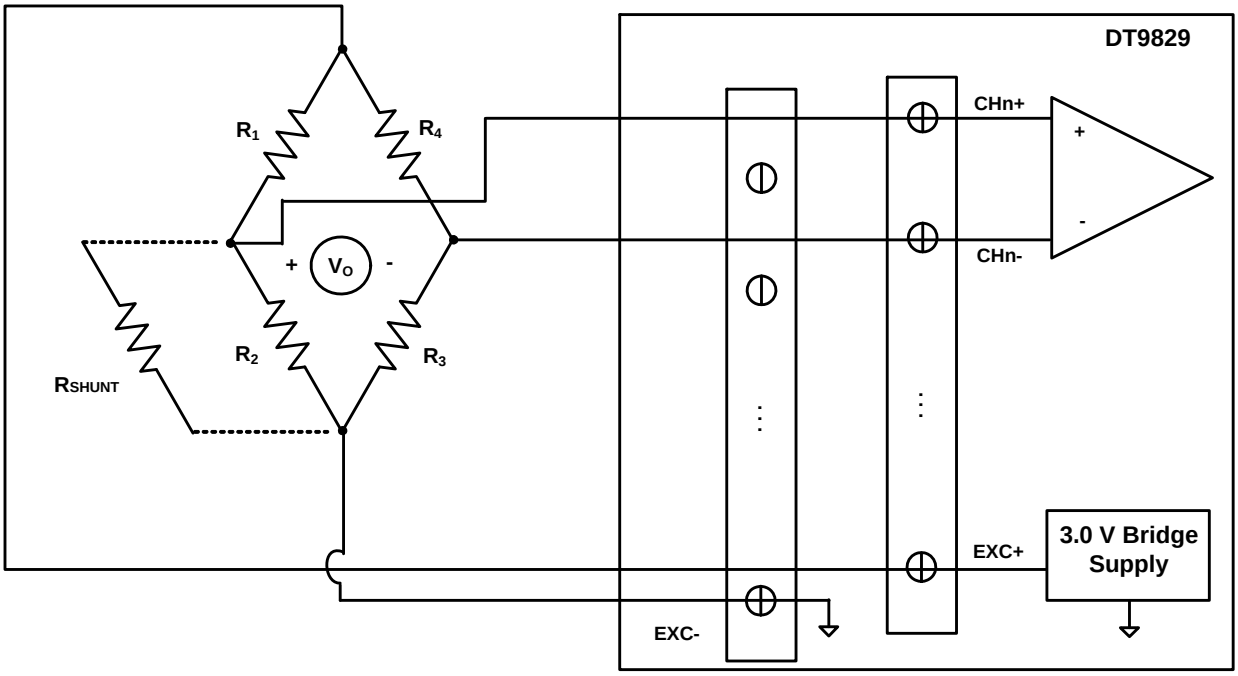
Connecting Bridge-Based and General-Purpose Bridge Sensors

DT9829 Series modules support bridge-based sensors, such as load cells (force sensors), pressure transducers, and/or torque sensors, and general full-bridge and half-bridge sensors that are based on the Wheatstone bridge.

The module provides 3.0 V bridge excitation for powering the sensor, and internal resistors for completing the half-bridge circuit.

Note: The software automatically disables the bias return termination resistor for bridge-based measurements.

Figure 22 shows how to connect a bridge-based sensor or general-purpose full-bridge sensor to a DT9829 Series module. Note that for calibration of a full-bridge sensor, a shunt resistor can be applied to any of the resistive elements.

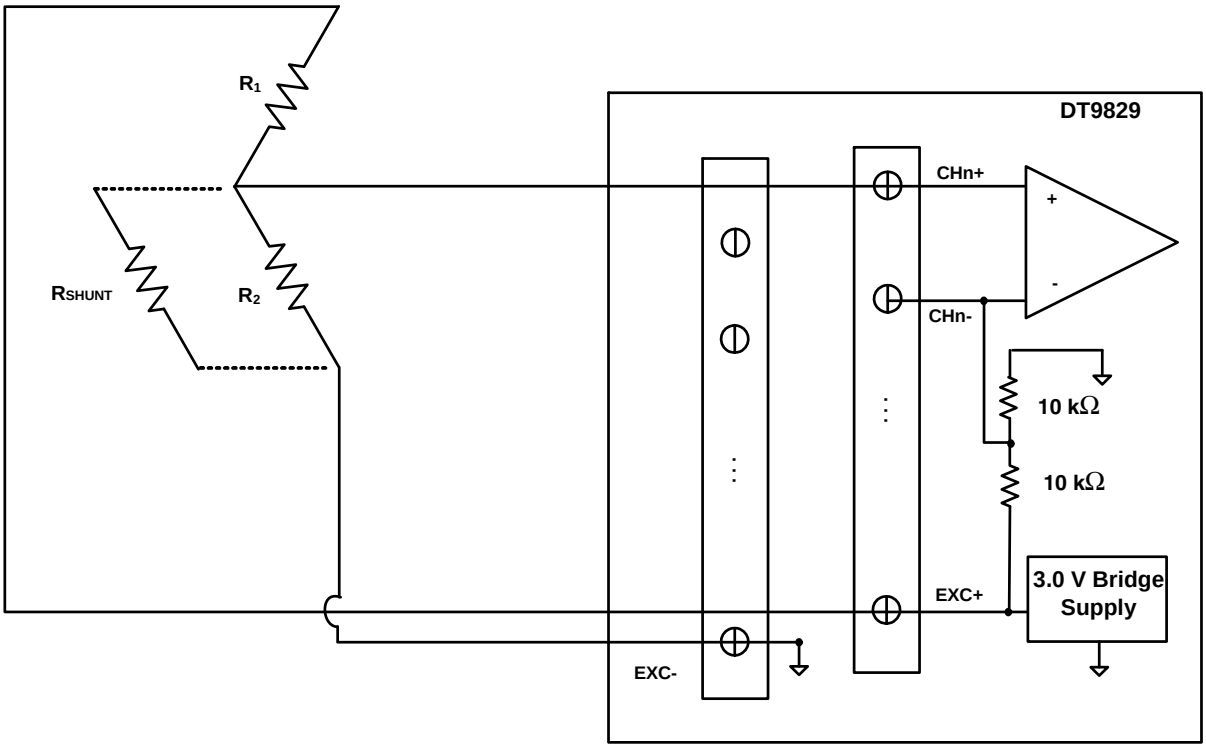


Note that the Bridge Excitation output terminals (EXC+ and EXC-) are used for all channels. For calibration, a shunt resistor can be applied to any of the resistive elements.

Figure 22: Connecting a Bridge-Based Sensor or General-Purpose Full-Bridge Sensor

Notes: Refer to the sensor manufacturer for information on wiring to your sensor type.

Figure 23 shows how to connect a general-purpose half-bridge sensor to a DT9829 Series module. Note that for calibration of a half-bridge sensor, a shunt resistor can be applied to element R1 or R2.



Note that the Bridge Excitation output terminals (EXC+ and EXC-) are used for all channels. For calibration, a shunt resistor can be applied to element R_1 or R_2.

Figure 23: Connecting a General-Purpose Half-Bridge Sensor

Connecting Strain Gages

This section describes how to connect the following strain gage configurations to a DT9829 Series module:

- Quarter-Bridge (Axial and Bending)
- Quarter-Bridge Temp Comp
- Half-Bridge Poisson
- Half-Bridge Bending
- Full-Bridge Bending
- Full-Bridge Bending Poisson
- Full-Bridge Axial Poisson

Note: The software automatically disables the bias return termination resistor for strain gage measurements.

Connecting a Quarter-Bridge (Axial and Bending) Circuit

The Quarter-Bridge configuration, shown in Figure 24, measures axial or bending strain.

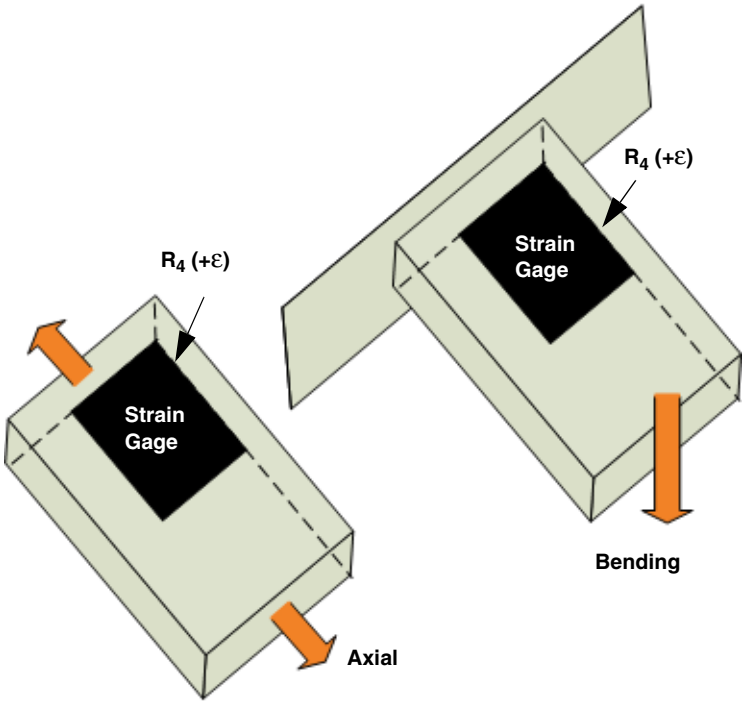


Figure 24: Quarter-Bridge Configuration

The Quarter-Bridge configuration has the following characteristics:

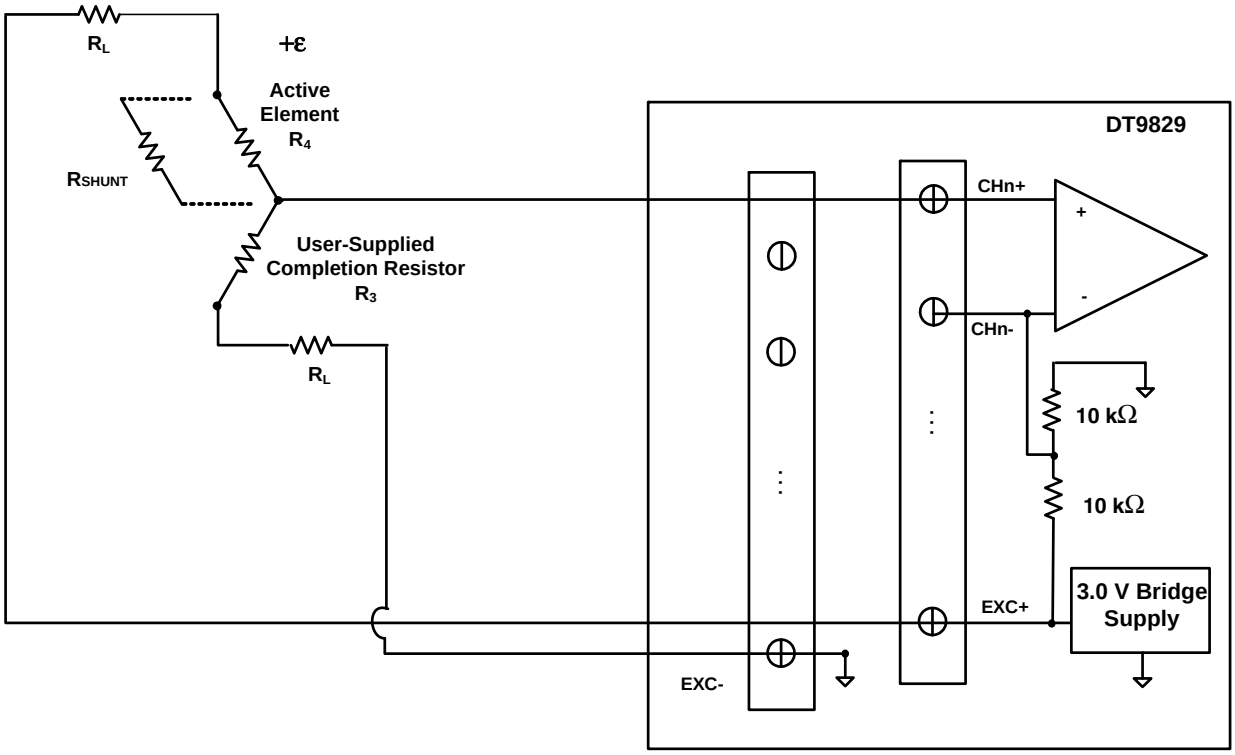
- A single active strain gage element is mounted in the direction of axial or bending strain.
- You must supply a resistor (R_3) that matches the nominal resistance of the bridge to complete the bridge externally.

Note: In some cases, you may wish to use a rosette, which is arrangement of two or three closely positioned strain gage grids that are oriented to measure the normal strains along different directions in the underlying surface of a test material. DT9829 Series modules support rectangular and delta rosettes; tee rosettes are not supported.

A rectangular rosette is an arrangement of three strain gage grids where the second grid is angularly displaced from the first grid by 45 degrees and the third grid is angularly displaced from the first grid by 90 degrees. A delta rosette is an arrangement of three strain gage grids where the second grid is angularly displaced from the first grid by 60 degrees and the third grid is angularly displaced from the first grid by 120 degrees.

To use a rectangular or delta rosette, use the Quarter-Bridge configuration with the proper bridge completion. You can then read the strain value from each analog input channel individually, and if desired, use software to calculate the minimum and maximum principal strain values and their associated angles (in degrees).

Figure 25 shows how to connect a Quarter Bridge circuit to a DT9829 Series module. Use the same gage wire for the EXC+ and EXC– lines to ensure that the resistances are matched. In this example, a user-supplied resistor is mounted at the strain gage. If the lead wire resistance is known, you can enter the lead wire correction coefficient in software (enter the resistance of one line, not the sum of the two lines). Refer to page 102 for more information on lead wire correction.



Note that the Bridge Excitation output terminals (EXC+ and EXC-) are used for all channels. For calibration, a shunt resistor can be applied to element R_4.

Figure 25: Connecting a Quarter-Bridge Circuit to a DT9829 Series Module

When setting up your strain gage, you can use shunt calibration to correct for errors due to lead wire resistance (R_L) in the excitation wiring. To perform shunt calibration in a Quarter-Bridge configuration, connect a shunt resistor across R_4 of the connected bridge. Then, use software to read the value of the bridge, compare it to the expected value, and calibrate the channel. Once you have performed shunt calibration, disconnect the shunt resistor. Refer to page 101 for more information on shunt calibration.

For information on the transfer function that is used for the Quarter-Bridge configuration (with and without lead wire correction and/or shunt calibration), refer to page 104.

Connecting a Quarter-Bridge Temp Comp Circuit

The Quarter-Bridge Temp Comp configuration, shown in Figure 26, measures axial and bending strain and compensates for temperature.

Note: This configuration is often confused with the more commonly used Half-Bridge Poisson configuration, described on page 60. In the Half-Bridge Poisson configuration, the R_3 element is active and is bonded to the strain specimen to measure the effect of the Poisson ratio. In the Quarter-Bridge Temp Comp configuration, R_3 is not active (a dummy strain gage is used) and is not bonded to the specimen.

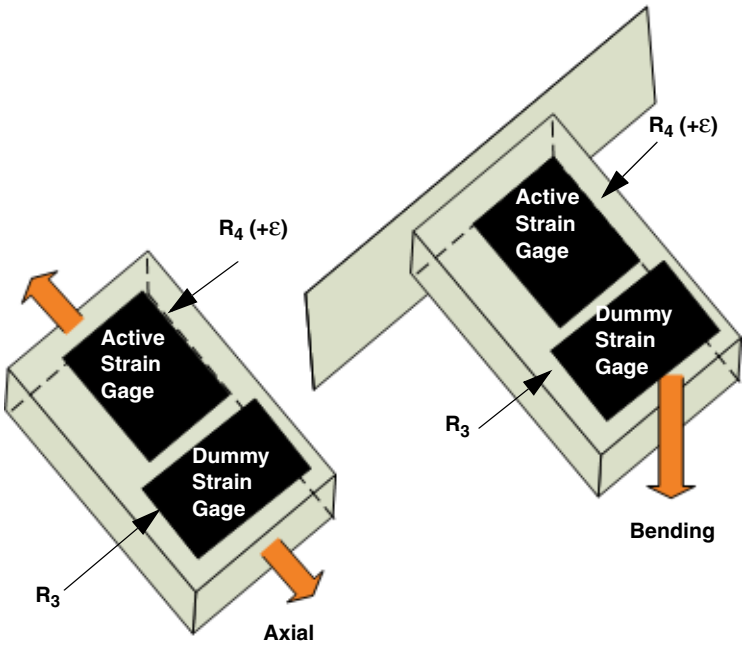


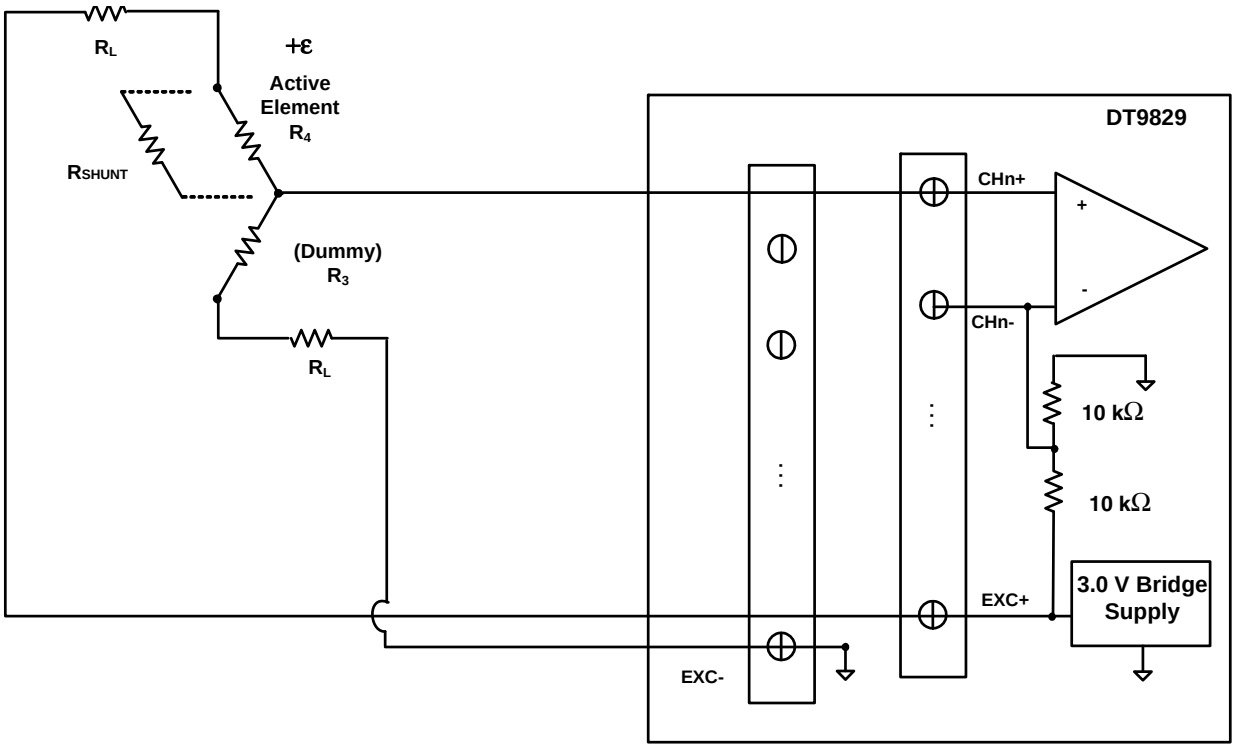
Figure 26: Quarter-Bridge Temp Comp Configuration

The Quarter-Bridge Temp Comp configuration has the following characteristics:

- Uses active strain gage element and one passive (dummy) strain gage element.
- The active strain gage element is mounted in the direction of axial or bending strain.
- The passive (dummy) strain gage element, R_3, is mounted in close thermal contact with the strain specimen to compensate for temperature, but is not bonded to the specimen; it does not respond to the axial or bending strain of the specimen.

  Although it is not necessary, the dummy strain gage element is usually mounted perpendicular to the axis of strain.

Figure 27 shows how to connect a Quarter-Bridge Temp Comp circuit to a DT9829 Series module. Use the same gage wire for the EXC+ and EXC– lines to ensure that the resistances are matched. In this example, a user-supplied resistor is mounted at the strain gage. If the lead wire resistance is known, you can enter the lead wire correction coefficient in software (enter the resistance of one line, not the sum of the two lines). Refer to page 102 for more information on lead wire correction.



Note that the Bridge Excitation output terminals (EXC+ and EXC-) are used for all channels. For calibration, a shunt resistor can be applied to element R_4.

Figure 27: Connecting a Quarter-Bridge Temp Comp Circuit to a DT9829 Series Module

When setting up your strain gage, you can use shunt calibration to correct for errors due to lead wire resistance (R_L) in the excitation wiring. To perform shunt calibration in a Quarter-Bridge Temp Comp configuration, connect a shunt resistor across R_4 of the connected bridge. Then, use software to read the value of the bridge, compare it to the expected value, and calibrate the channel. Once you have performed shunt calibration, disconnect the shunt resistor. Refer to page 101 for more information on shunt calibration.

For information on the transfer function that is used for the Quarter-Bridge Temp Comp configuration (with and without lead wire correction and/or shunt calibration), refer to page 105.

Connecting a Half-Bridge Poisson Circuit

The Half-Bridge Poisson configuration, shown in Figure 28, measures either axial or bending strain, compensates for temperature, and compensates for the aggregate effect on the principle strain measurement due to the Poisson ratio of the specimen material.

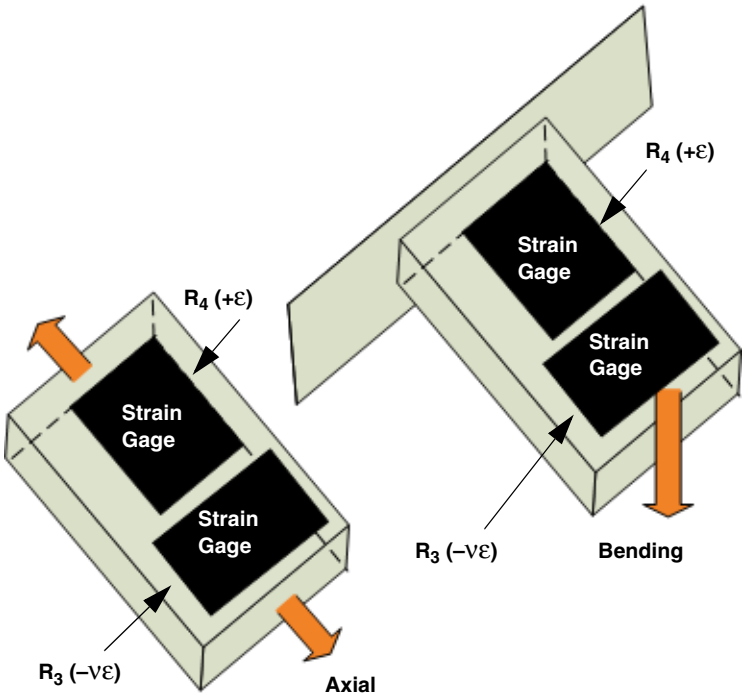


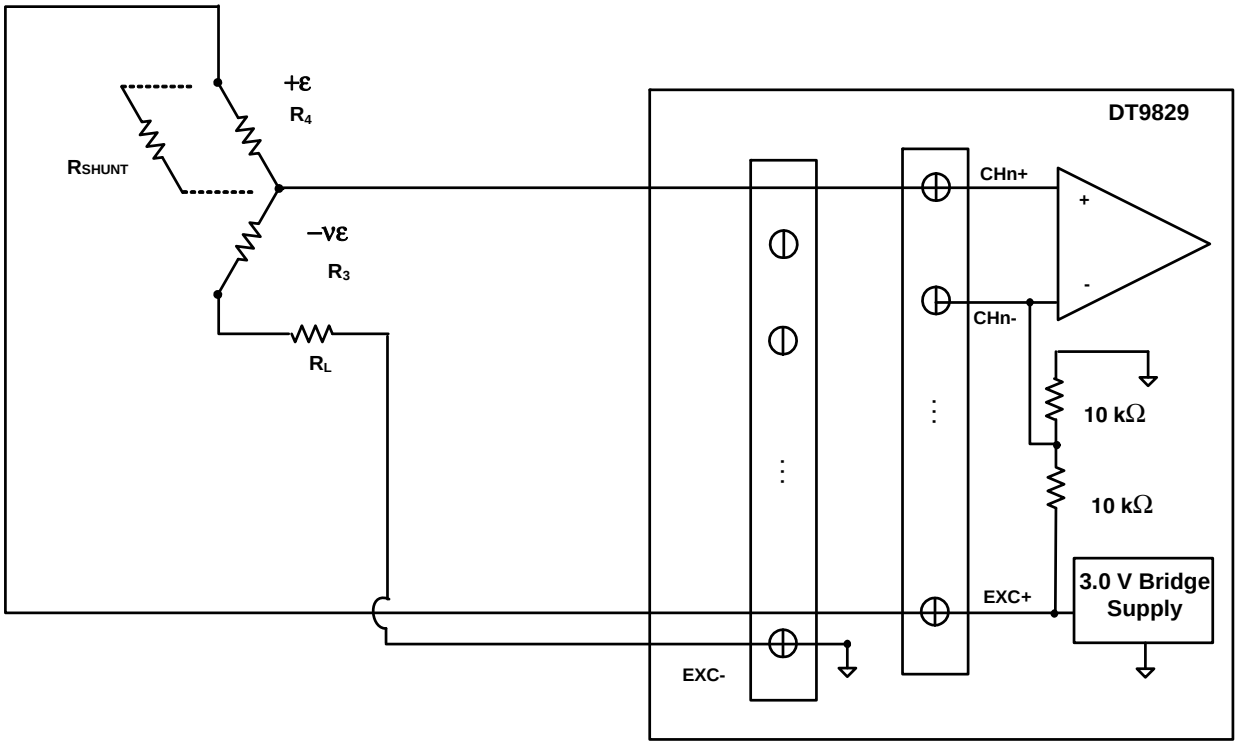
Figure 28: Half-Bridge Poisson Configuration

The Half-Bridge Poisson configuration has the following characteristics:

- Uses two active strain gage elements.
- One strain gage element, R_4 (+ε), is mounted in the direction of axial strain.

  The other strain gage element, R_3 (–νε), is mounted transversely (perpendicular) to the axis of strain to measure the Poisson effect.
- DT9829 Series modules provide two internal 10 kΩ resistors (R_1 and R_2) to complete the sensor side of the bridge circuit.

Figure 29 shows how to connect a Half-Bridge Poisson circuit to a DT9829 Series module. Use the same gage wire for the EXC+ and EXC– lines to ensure that the resistances are matched. In this example, a user-supplied resistor is mounted at the strain gage. If the lead wire resistance is known, you can enter the lead wire correction coefficient in software (enter the resistance of one line, not the sum of the two lines). Refer to page 102 for more information on lead wire correction.



Note that the Bridge Excitation output terminals (EXC+ and EXC-) are used for all channels. For calibration, a shunt resistor can be applied to element R_3 or R_4.

Figure 29: Connecting a Half-Bridge Poisson Circuit to a DT9829 Series Module

When setting up your strain gage, you can use shunt calibration to correct for errors due to lead wire resistance (R_L) in the excitation wiring. To perform shunt calibration in a Half-Bridge Poisson configuration, connect a shunt resistor across R_3 or R_4 of the connected bridge. Then, use software to read the value of the bridge, compare it to the expected value, and calibrate the channel. Once you have performed shunt calibration, disconnect the shunt resistor. Refer to page 101 for more information on shunt calibration.

For information on the transfer function that is used for the Half-Bridge Poisson configuration (with and without lead wire correction and/or shunt calibration), refer to page 106.

Connecting a Half-Bridge Bending Circuit

The Half-Bridge Bending configuration, shown in Figure 30, measures bending strain, rejects axial strain, and compensates for temperature.

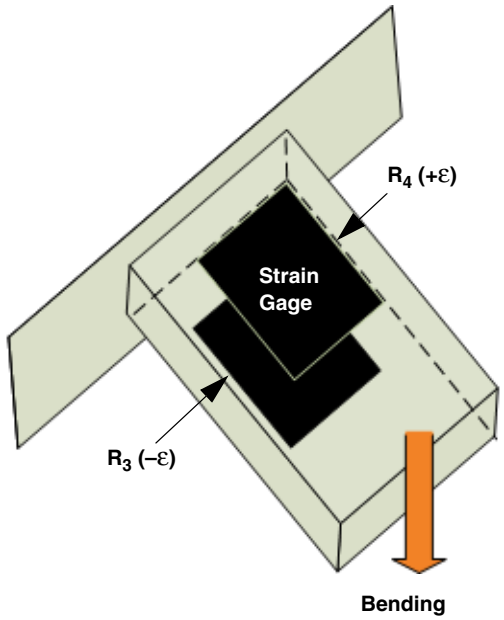


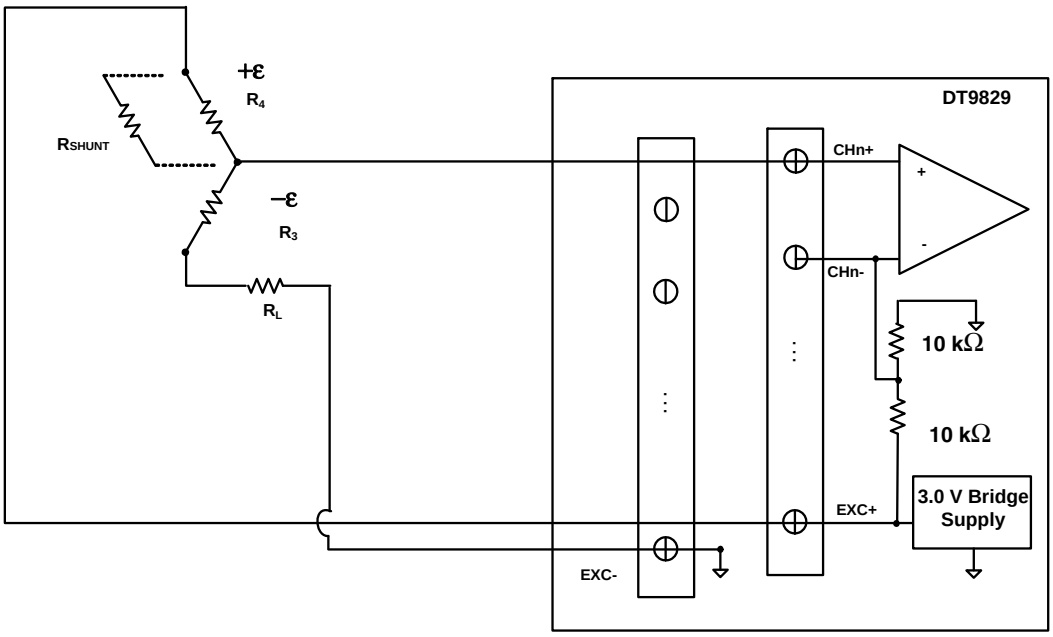
Figure 30: Half-Bridge Bending Configuration

The Half-Bridge Bending configuration has the following characteristics:

- Uses two active strain gage elements.
- One strain gage element, R_4 (+ε), is mounted in the direction of bending strain on the top of the specimen.

  The other strain gage element, R_3 (–ε), is mounted in the direction of bending strain on the bottom of the specimen.
- DT9829 Series modules provides two internal 10 kΩ resistors (R_1 and R_2) to complete the sensor side of the bridge circuit.

Figure 31 shows how to connect a Half-Bridge Bending circuit to a DT9829 Series module. Use the same gage wire for the EXC+ and EXC– lines to ensure that the resistances are matched. In this example, a user-supplied resistor is mounted at the strain gage. If the lead wire resistance is known, you can enter the lead wire correction coefficient in software (enter the resistance of one line, not the sum of the two lines). Refer to page 102 for more information on lead wire correction.



Note that the Bridge Excitation output terminals (EXC+ and EXC-) are used for all channels. For calibration, a shunt resistor can be applied to element R_3 or R_4.

Figure 31: Connecting a Half-Bridge Bending Circuit to a DT9829 Series Module

When setting up your strain gage, you can use shunt calibration to correct for errors due to lead wire resistance (R_L) in the excitation wiring. To perform shunt calibration in a Half-Bridge Bending configuration, connect a shunt resistor across R_3 or R_4 of the connected bridge. Then, use software to read the value of the bridge, compare it to the expected value, and calibrate the channel. Once you have performed shunt calibration, disconnect the shunt resistor. Refer to page 101 for more information on shunt calibration.

For information on the transfer function that is used for the Half-Bridge Bending configuration (with and without lead wire correction and/or shunt calibration), refer to page 107.

Connecting a Full-Bridge Bending Circuit

The Full-Bridge Bending configuration, shown in Figure 32, measures bending strain. It also rejects axial strain and compensates for temperature.

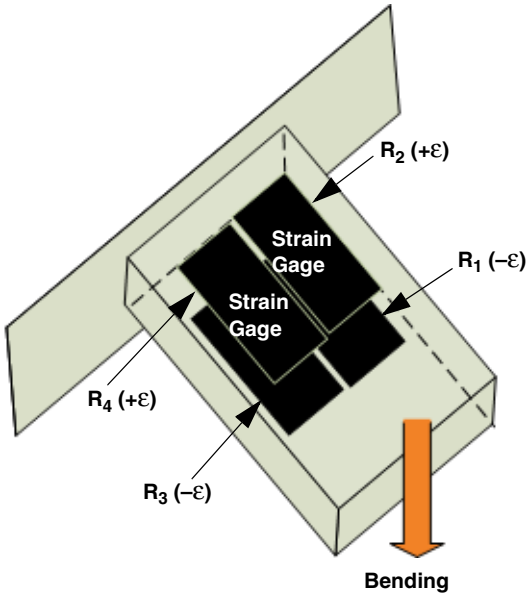


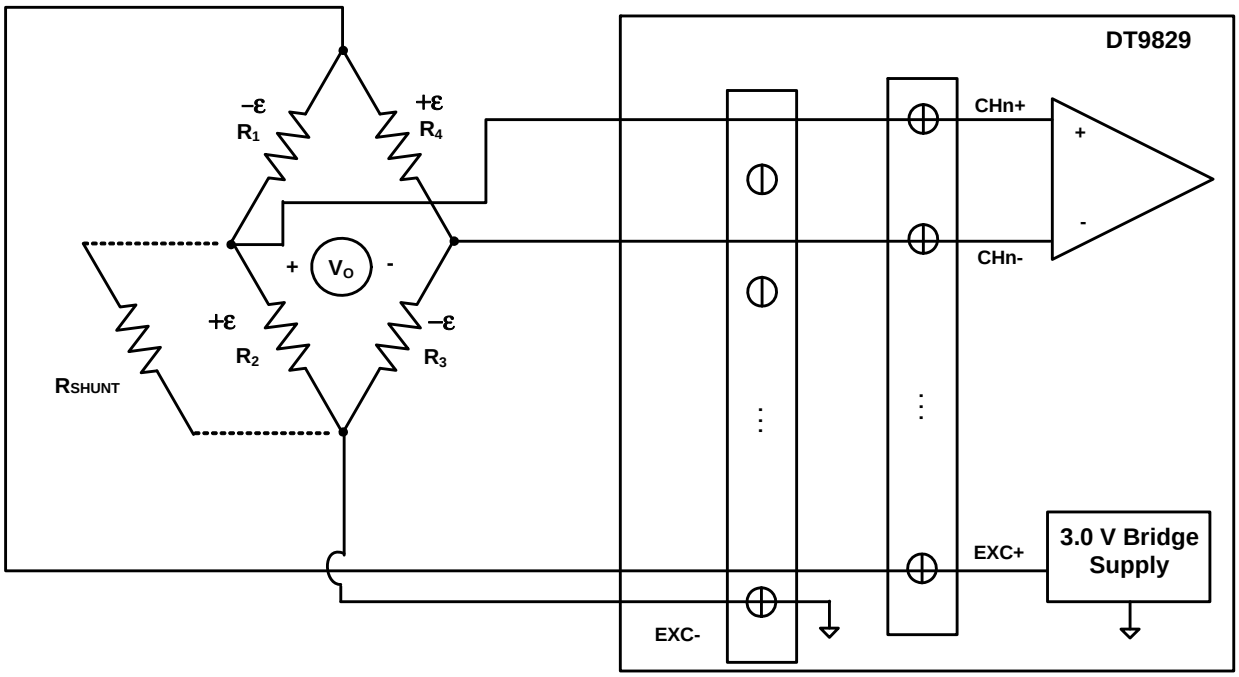
Figure 32: Full-Bridge Bending Configuration

The Full-Bridge Bending configuration has the following characteristics:

- Uses four active strain gages.
- Two strain gages, R_4 (+ε) and R_2 (+ε), are mounted in the direction of bending strain on the top of the specimen.

  The other two strain gages, R_3 (–ε) and R_1 (–ε), are mounted in the direction of bending strain on the bottom of the specimen.

Figure 33 shows how to connect a Full-Bridge Bending circuit to a DT9829 Series module. Use the same gage wire for the EXC+ and EXC– lines to ensure that the resistances are matched. In this example, a user-supplied resistor is mounted at the strain gage. If the lead wire resistance is known, you can enter the lead wire correction coefficient in software (enter the resistance of one line, not the sum of the two lines). Refer to page 102 for more information on lead wire correction.



Note that the Bridge Excitation output terminals (EXC+ and EXC-) are used for all channels. For calibration, a shunt resistor can be applied to any of the resistive elements.

Figure 33: Connecting a Full-Bridge Bending Circuit to a DT9829 Series Module

When setting up your strain gage, you can use shunt calibration to correct for errors due to lead wire resistance (R_L) in the excitation wiring. To perform shunt calibration in a Full-Bridge Bending configuration, connect a shunt resistor across any of the active elements of the bridge. Then, use software to read the value of the bridge, compare it to the expected value, and calibrate the channel. Once you have performed shunt calibration, disconnect the shunt resistor. Refer to page 101 for more information on shunt calibration.

For information on the transfer function that is used for the Full-Bridge Bending configuration (with and without lead wire correction and/or shunt calibration), refer to page 108.

Connecting a Full-Bridge Bending Poisson Configuration

The Full-Bridge Bending Poisson configuration, shown in Figure 34, measures bending strain. It also rejects axial strain, compensates for temperature, and compensates for the aggregate effect on the principle strain measurement due to the Poisson's ratio of the specimen material.

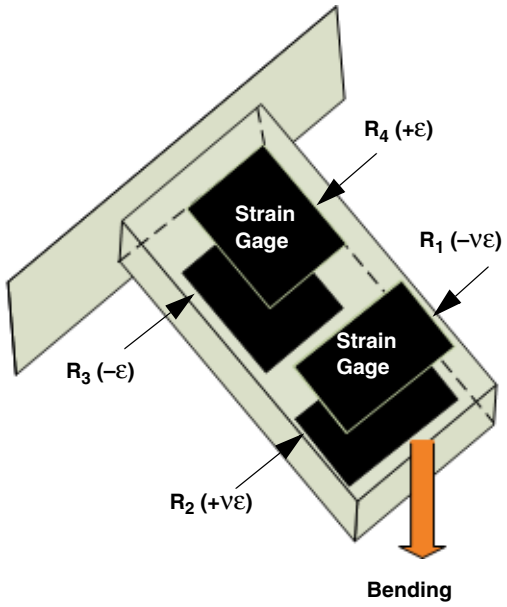


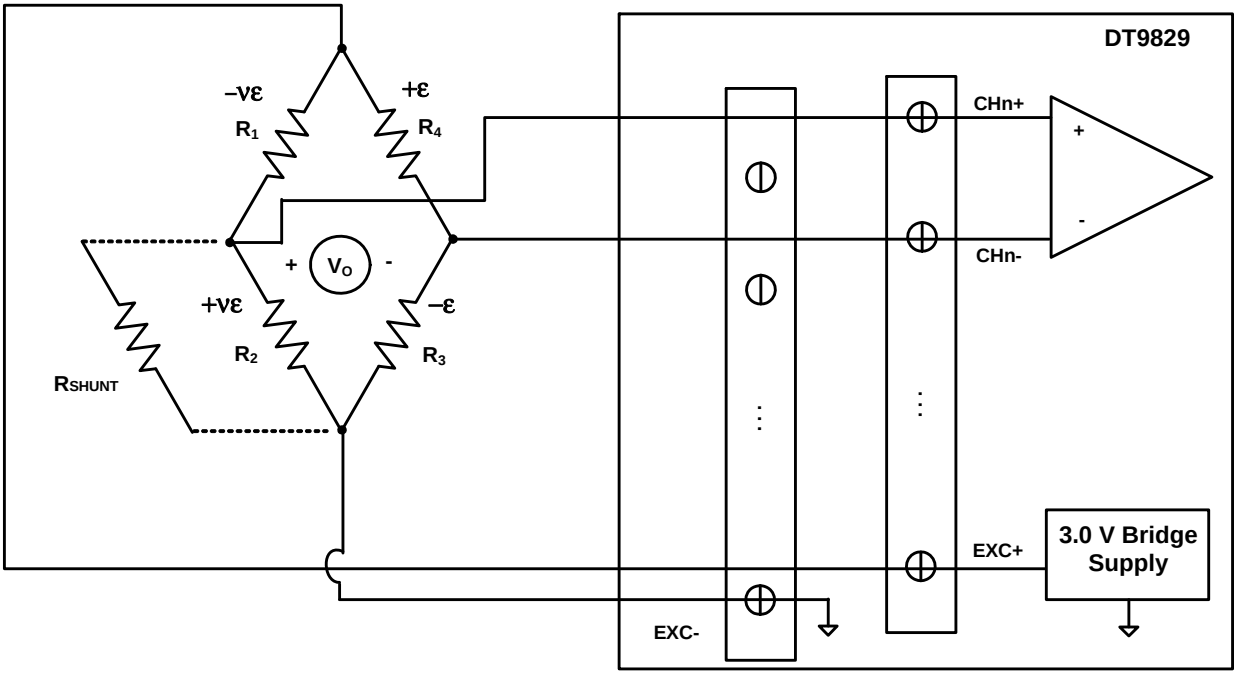
Figure 34: Full-Bridge Bending Poisson Configuration

The Full-Bridge Bending Poisson configuration has the following characteristics:

- Uses four active strain gages.
- Two strain gages, R_4 (+ε) and R_3 (–ε), are mounted in the direction of bending strain, with one mounted on the top and the other on the bottom of the specimen.

  The other two strain gages, R_2 (+νε) and R_1 (–νε), measure the Poisson effect and are mounted transversely (perpendicular) to the axis of bending strain, with one mounted on the top and the other on the bottom of the specimen.

Figure 35 shows how to connect a Full-Bridge Bending Poisson circuit to a DT9829 Series module. Use the same gage wire for the EXC+ and EXC– lines to ensure that the resistances are matched. In this example, a user-supplied resistor is mounted at the strain gage. If the lead wire resistance is known, you can enter the lead wire correction coefficient in software (enter the resistance of one line, not the sum of the two lines). Refer to page 102 for more information on lead wire correction.



Note that the Bridge Excitation output terminals (EXC+ and EXC-) are used for all channels. For calibration, a shunt resistor can be applied to any of the resistive elements.

Figure 35: Connecting a Full-Bridge Bending Poisson Circuit to a DT9829 Series Module

When setting up your strain gage, you can use shunt calibration to correct for errors due to lead wire resistance (R_L) in the excitation wiring. To perform shunt calibration in a Full-Bridge Bending Poisson configuration, connect a shunt resistor across any of the active elements of the bridge. Then, use software to read the value of the bridge, compare it to the expected value, and calibrate the channel. Once you have performed shunt calibration, disconnect the shunt resistor. Refer to page 101 for more information on shunt calibration.

For information on the transfer function that is used for the Full-Bridge Bending Poisson configuration (with and without lead wire correction and/or shunt calibration), refer to page 109.

Connecting a Full-Bridge Axial Poisson Circuit

The Full-Bridge Axial Poisson configuration, shown in Figure 36, measures axial strain. It also compensates for temperature, rejects bending strain, and compensates for the aggregate effect on the principle strain measurement due to the Poisson ratio of the specimen material.

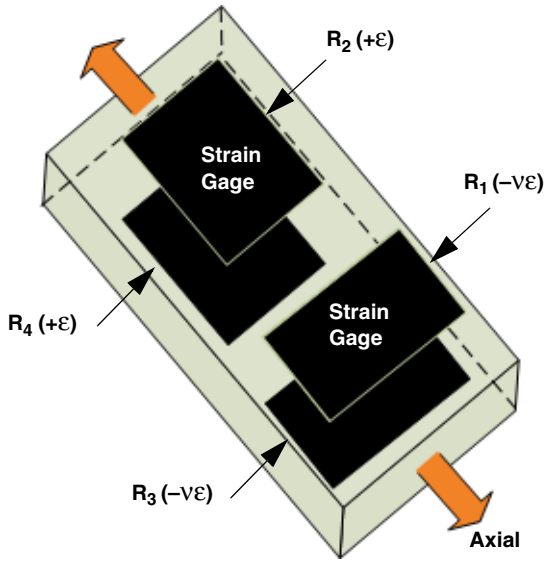


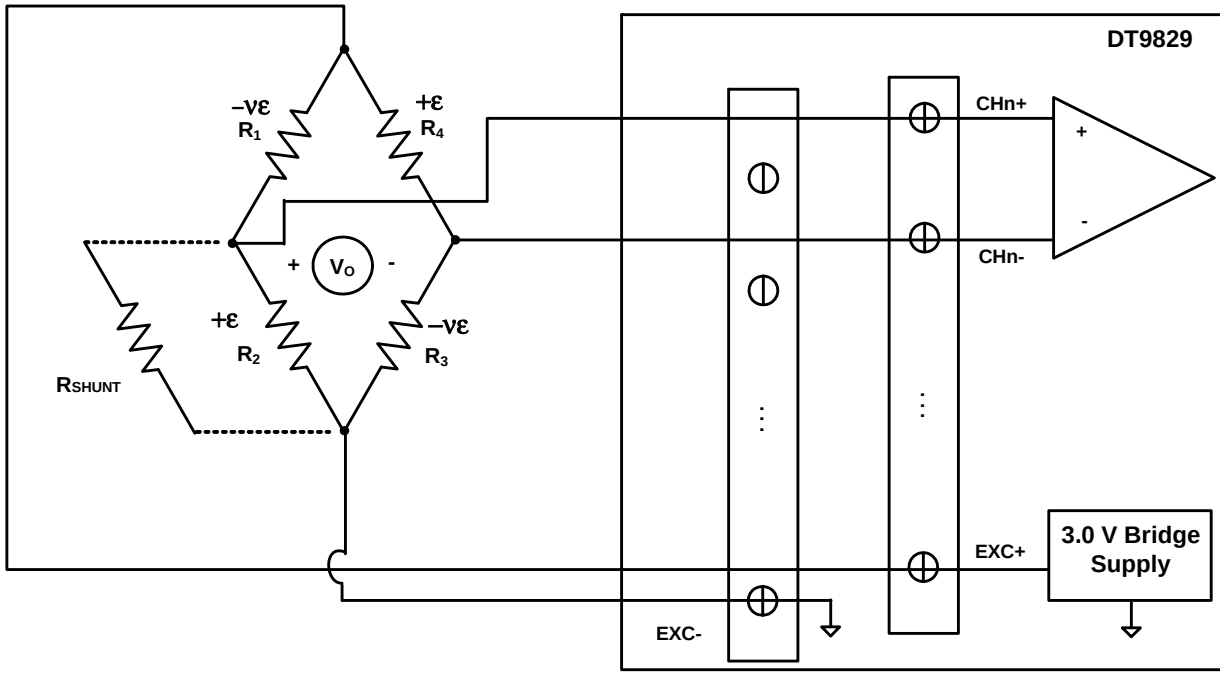
Figure 36: Full-Bridge Axial Poisson Configuration

The Full-Bridge Axial Poisson configuration has the following characteristics:

- Uses four active strain gages.
- Two strain gages, R_4 (+ε) and R_2 (+ε), are mounted in the direction of axial strain, with one mounted on the top and the other on the bottom of the specimen.

  The other two strain gages, R_3 (–νε) and R_1 (–νε), measure the Poisson effect and are mounted transversely (perpendicular) to the axis of axial strain, with one mounted on the top and the other on the bottom of the specimen.

Figure 37 shows how to connect a Full-Bridge Axial Poisson circuit to a DT9829 Series module. Use the same gage wire for the EXC+ and EXC– lines to ensure that the resistances are matched. In this example, a user-supplied resistor is mounted at the strain gage. If the lead wire resistance is known, you can enter the lead wire correction coefficient in software (enter the resistance of one line, not the sum of the two lines). Refer to page 102 for more information on lead wire correction.



Note that the Bridge Excitation output terminals (EXC+ and EXC-) are used for all channels. For calibration, a shunt resistor can be applied to any of the resistive elements.

Figure 37: Connecting a Full-Bridge Axial Poisson Circuit to a DT9829 Series Module

When setting up your strain gage, you can use shunt calibration to correct for errors due to lead wire resistance (R_L) in the excitation wiring. To perform shunt calibration in a Full-Bridge Axial Poisson configuration, connect a shunt resistor across any of the elements of the bridge. Then, use software to read the value of the bridge, compare it to the expected value, and calibrate the channel. Once you have performed shunt calibration, disconnect the shunt resistor. Refer to page 101 for more information on shunt calibration.

For information on the transfer function that is used for the Full-Bridge Axial Poisson configuration (with and without lead wire correction and/or shunt calibration), refer to page 110.

Connecting Digital Input Signals

DT9829 Series modules support up to four, isolated, TTL, 12 V and 24 V digital input lines. You connect digital input signals to the screw terminals 35 to 38 on the module. Screw terminal 39 is the common Digital Input Return signal.

Figure 38 shows how to connect digital input signals (lines 0 and 1, in this case) to a DT9829 Series module.

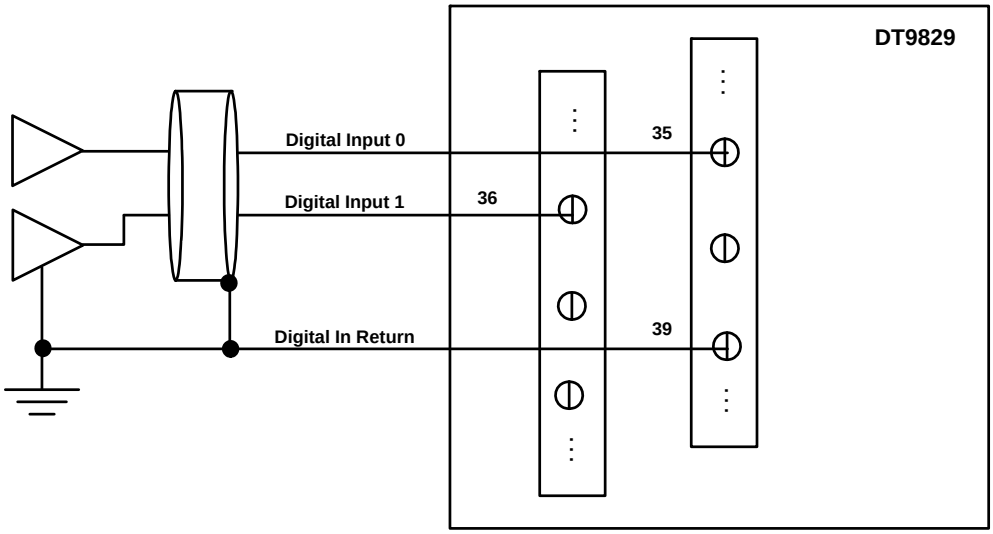


Figure 38: Connecting Digital Inputs (Shown for Digital Input Lines 0 and 1)

Connecting Digital Output Signals

DT9829 Series modules provide four open-collector digital outputs and a common return that are isolated from the analog input circuitry, USB ground, and digital input ground. The open collector outputs have a drive capability of 2 mA maximum and can control circuitry that is powered from an external supply.

You connect digital output signals to the screw terminals 40 to 43 on a DT9829 Series module. Screw terminal 44 is the common Digital Output Return signal.

Screw terminals 45 and 46 on a DT9829 Series module are available for connecting an external supply (in the 3.3 VDC to 30 VDC range) and an external supply return. Each open collector output has a weak pull-up resistor of 100 kΩ to the external supply terminal (screw terminal 45). Connecting a 3.3 V to 5 V supply provides outputs that are capable of driving TTL-level logic.

Figure 39 shows an example of connecting an open-collector digital output on a DT9829 Series module to an external supply and logic gate.

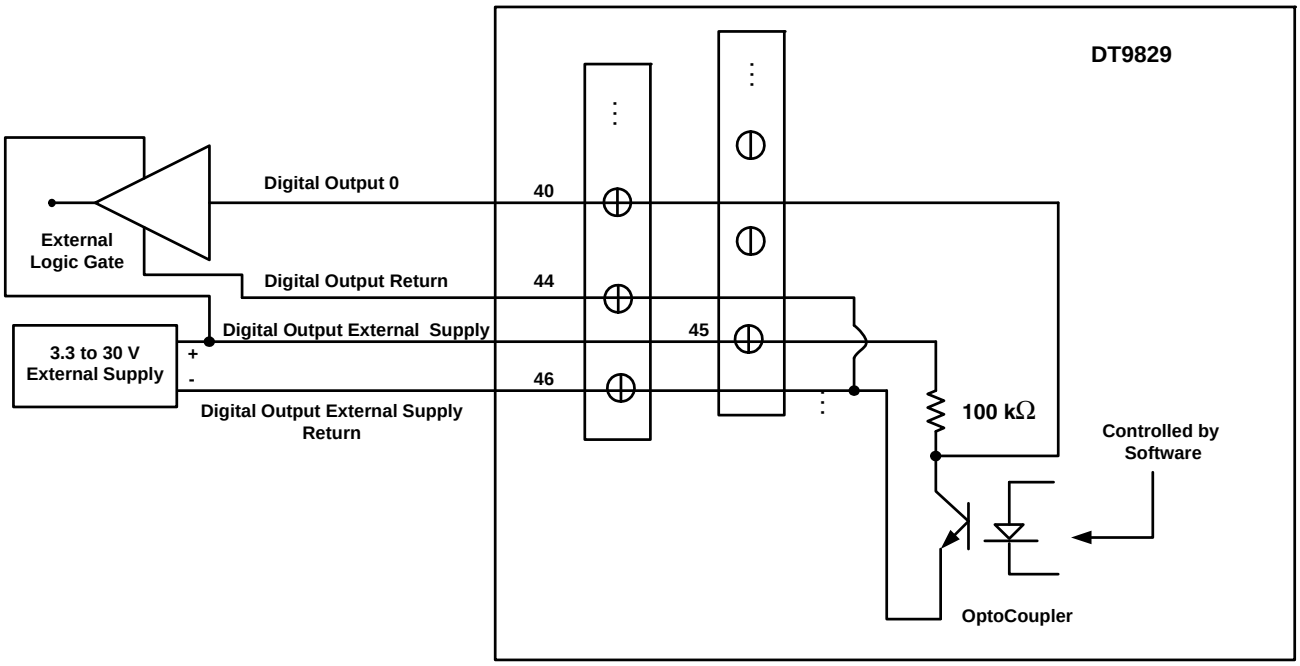
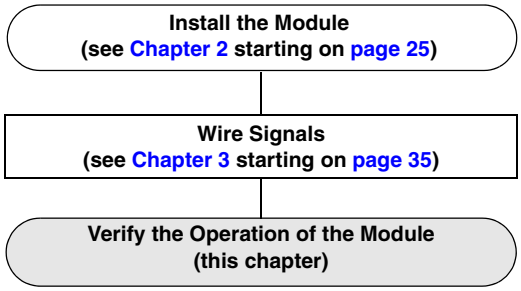


Figure 39: An Example of Connecting an Open-Collector Digital Output of a DT9829 Series Module to an External Supply and Logic Gate (Shown for Digital Output Line 0)

Verifying the Operation of a Module

Selecting the Device 75
Performing the Measurement 77

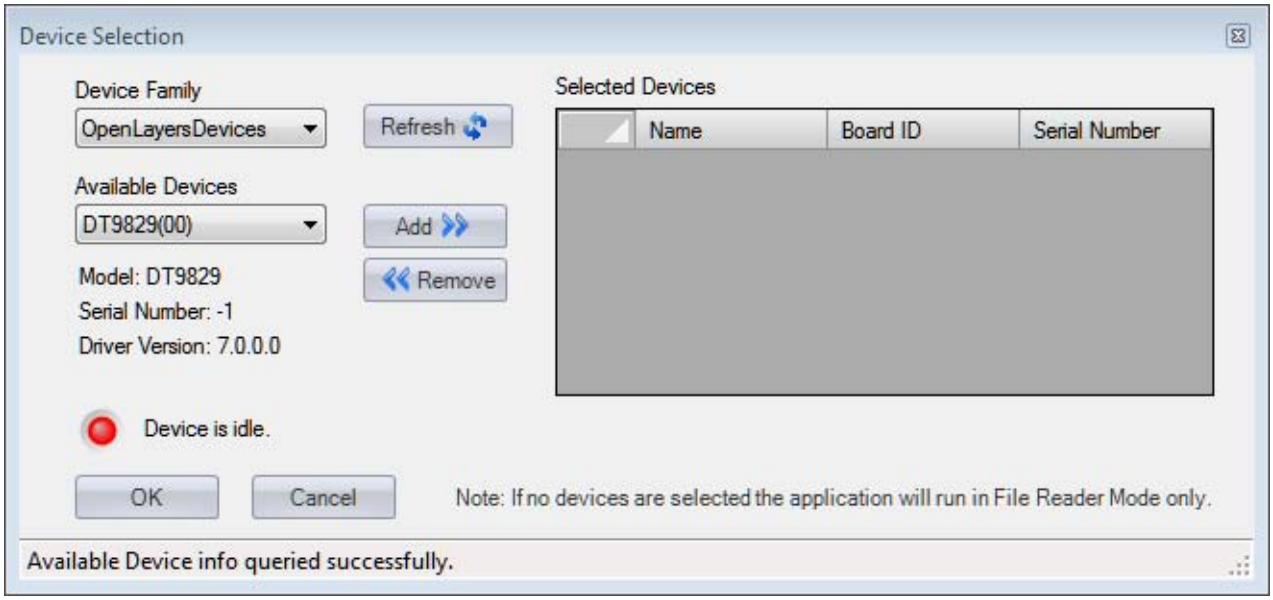


QuickDAQ allows you to acquire and analyze data from all Data Translation USB and Ethernet devices, except the DT9841 Series, DT9817, DT9835, and DT9853/54. This chapter describes how to verify the operation of a DT9829 Series module using the QuickDAQ base version.

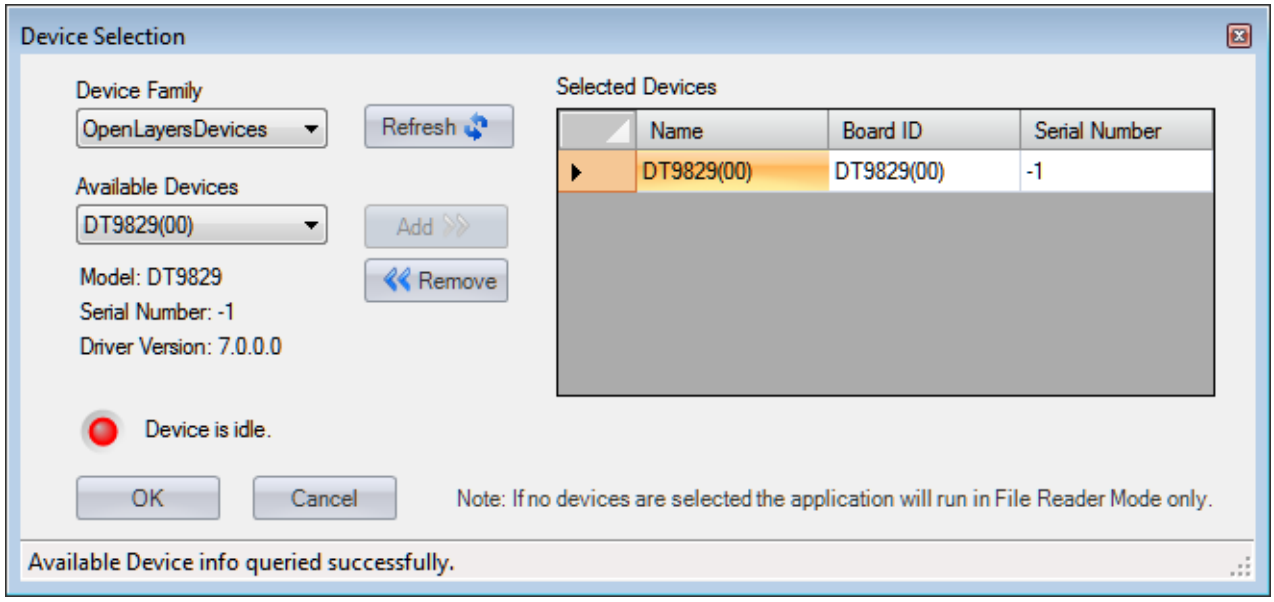
Selecting the Device

To get started with your DT9829 Series module and the QuickDAQ application, follow these steps:

1. Connect your sensors to the module.
2. Connect the DT9829 Series module to the USB port of your computer,.
3. Start the QuickDAQ application.
   The Device Selection window appears.

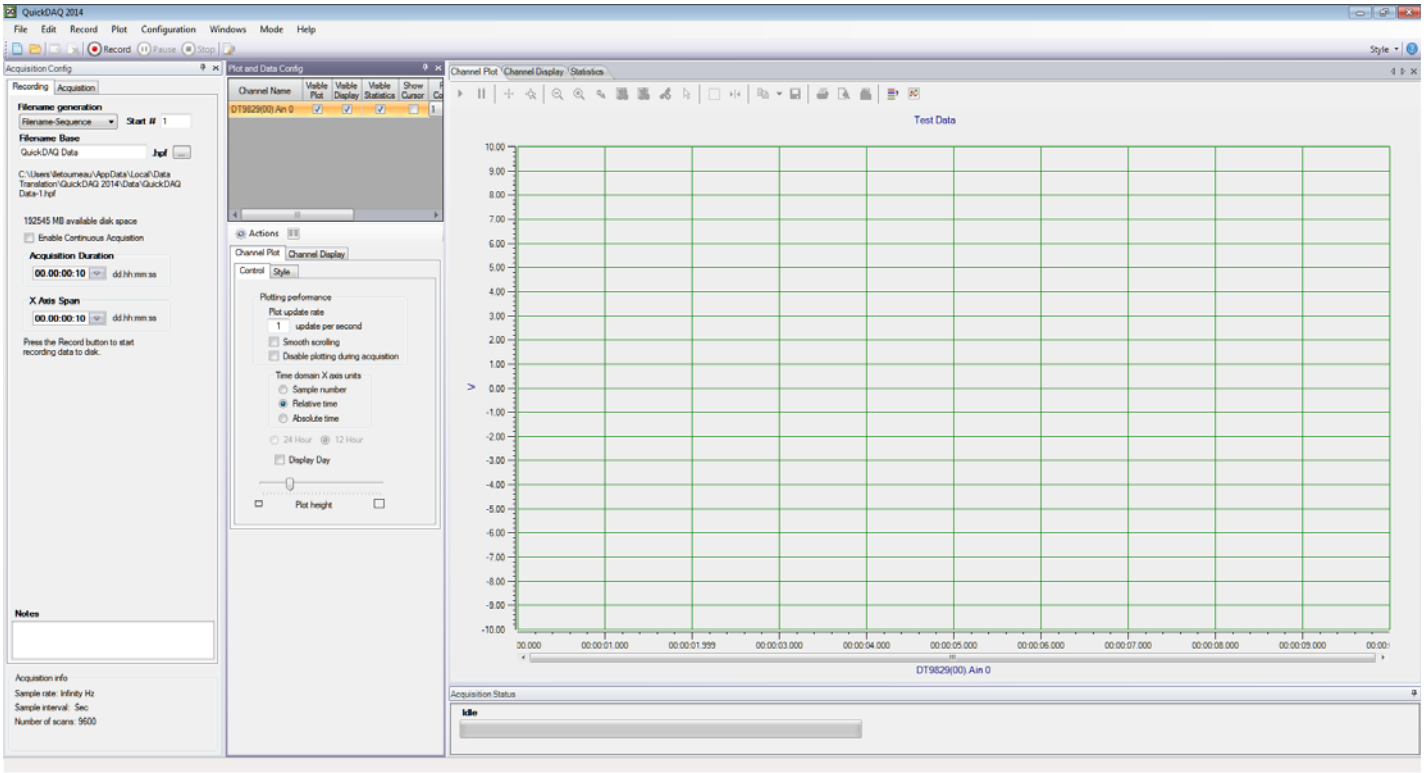


4. For the Device Family selection, select **OpenLayersDevices**.
   By default, the application "discovers" all devices that are available for the specified device family and displays the module name for the USB devices in the drop-down list. If you want to refresh this list to determine if other devices are available, click **Refresh**.
5. Select the module name for the DT9829 Series module that you want to use from the list of Available Devices, and click **Add**.
   Information about the device, including the model number, serial number, firmware version, driver version, and scanning status is displayed.



6. (Optional) If you want to remove a device from list of selected devices, click the Row Selector button for the device, and then click **Remove**.

7. Once you have added all the devices that you want to use with the application, click **OK**. *The latest state is saved and used when the application is next run, and the interface of the QuickDAQ application is displayed.*



Performing the Measurement

The following steps describe how to use the QuickDAQ application to measure data from a DT9829-8 module. In this example, resistance, voltage, and temperature data is measured.

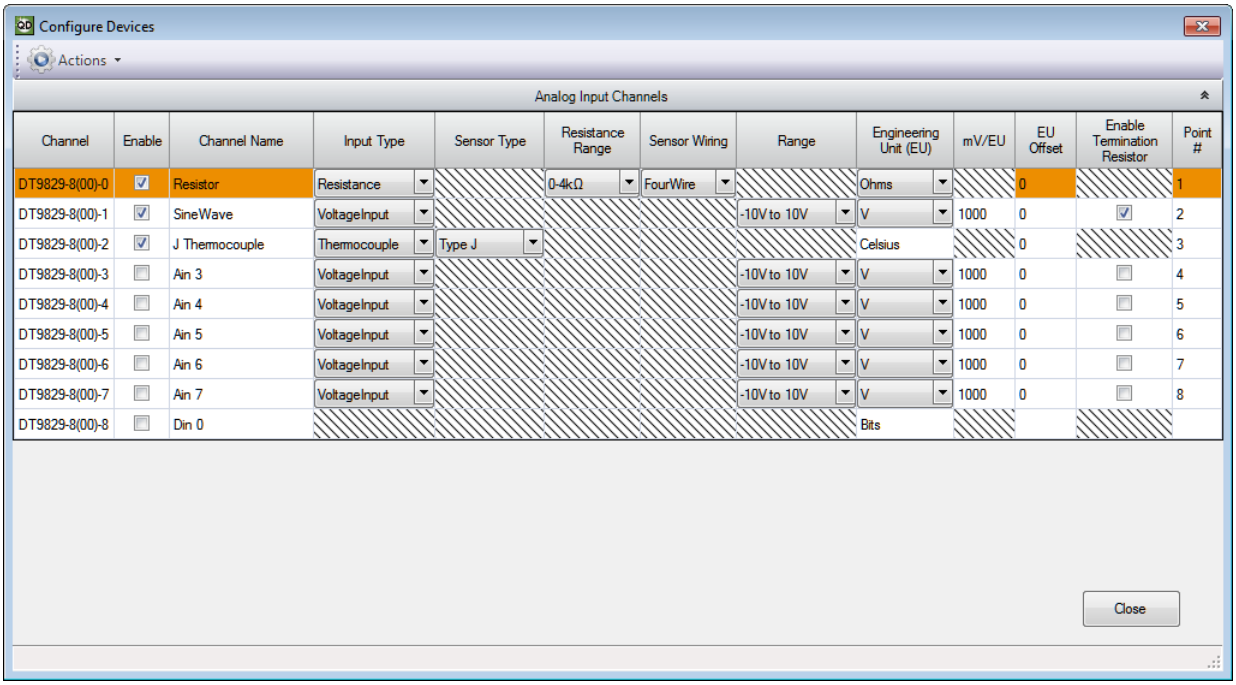
Sensors are connected to the DT9829-8 module as follows:

- A resistor in the 0 to 4 kΩ range is connected to analog input channel 0 using a four-wire configuration.
- A sine wave in the range of ±10 V is connected to analog input channel 1. In this case, the signal source is grounded.
- A type J thermocouple is connected to analog input channel 2.

Configure the Channels

Configure the channels as follows:

1. Configure each analog input channel by clicking the **Configuration** menu, and clicking **Input Channel Configuration**, or by clicking the **Input Channel Configuration** toolbar button ( ).
2. Enable analog input channels 0, 1, and 2 by clicking the checkbox under the **Enable** column.



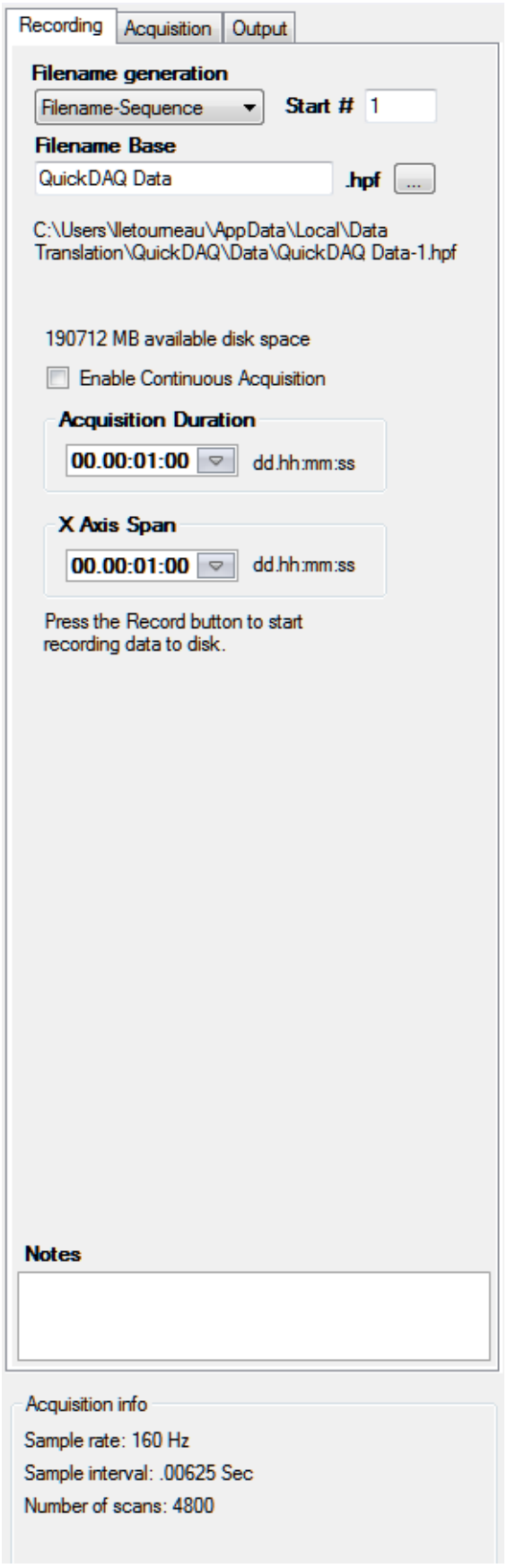
3. Under the **Channel Name** column, enter a meaningful name for the channel.
   *For this example, enter **Resistor** for analog input channel 0, **SineWave** for analog input channel 1, and **J Thermocouple** for analog input channel 2.*

4. Configure the settings for analog input channel 0 as follows:
   a. Under the **Input Type** column, select **Resistance**.
   b. Under the **Resistance Range** column, select 0 to 4 kΩ.
   c. Under the **Sensor Wiring** column, select **FourWire**.
   d. Under the **Engineering Units** column, select **Ohms**.
5. Configure the settings for analog input channel 1 as follows:
   a. Under the **Input Type** column, select **VoltageIn**.
   b. Under the **Range** column, select **-10 to +10V**.
   c. Under the **Engineering Units** column, select **V**.
   d. Under the **Enable Termination Resistor** column, ensure that box is checked, as this example uses a grounded voltage source.
6. Configure the settings for analog input channel 2 as follows:
   a. Under the **Input Type** column, select **Thermocouple**.
   a. Under the **Sensor Type** column, select **Type J**.
   b. Under the **Engineering Units** column, the value that is configured in the **Acquisition** tab, described on page 82, is shown here.
   c. If you know the offset for your calibrated thermocouple, enter it under the **EU Offset** column.
   *For this example, leave **0** as the EU offset for the thermocouple.*
7. Leave the test point values for each channel unchanged.
8. Click **Close** to close the Channel Configuration dialog box.

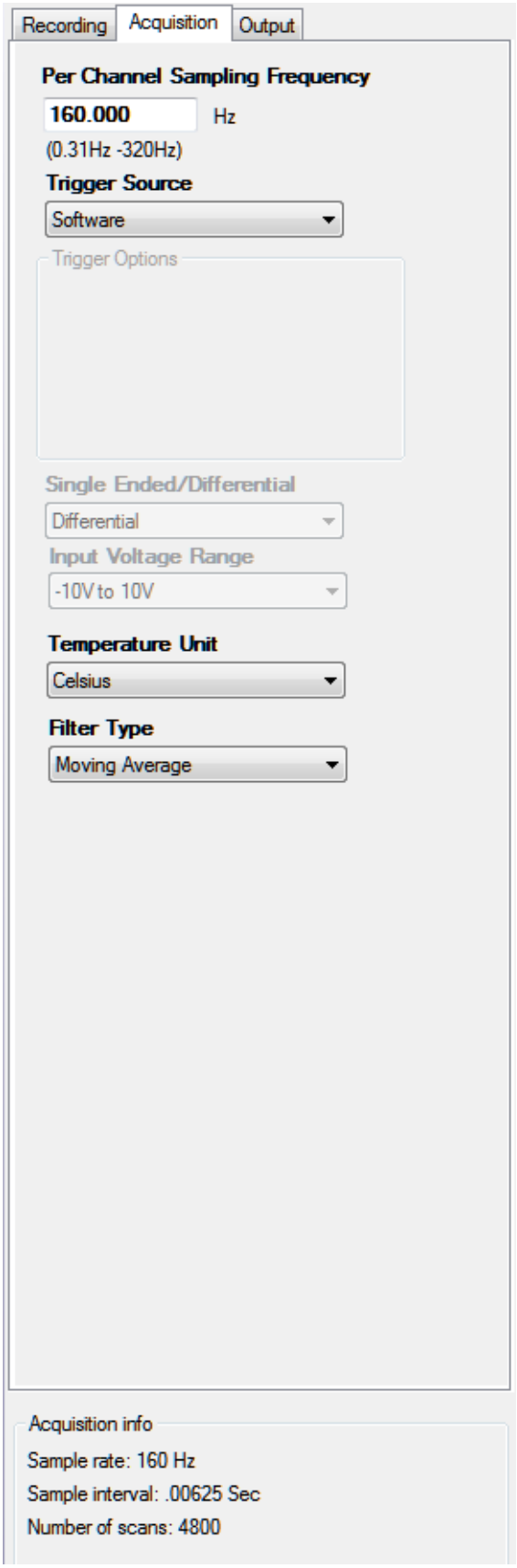
Configure the Parameters of the Acquisition Config Window

For this example, set the Acquisition Config parameters as follows:

1. Click the **Recording** tab.


Recording
Acquisition
Output
Filename generation
Filename-Sequence
Start #
1
Filename Base
QuickDAQ Data
.hpf
...
C:\Users\lletourneau\AppData\Local\Data Translation\QuickDAQ\Data\QuickDAQ Data-1.hpf
190712 MB available disk space
Enable Continuous Acquisition
Acquisition Duration
00.00:01:00
dd.hh:mm:ss
X Axis Span
00.00:01:00
dd.hh:mm:ss
Press the Record button to start recording data to disk.
Notes
Acquisition info
Sample rate: 160 Hz
Sample interval: .00625 Sec
Number of scans: 4800

2. For **Filename generation**, select **Filename**.
3. Enter a meaningful name for the data file.
   *In this example, **QuickDAQ Data.hpf** is used.*
4. Leave the **Enable Continuous Acquisition** checkbox unchecked.
5. For **Acquisition Duration**, enter **1 minute** as the time to acquire the measurement data.
   The amount of available disk space is shown; in addition, the number of scans in the Acquisition Info area is updated based on the acquisition duration that is selected.
6. For **X Axis Span**, select **1 minute** as the span for the x-axis.
7. Click the **Acquisition** tab.

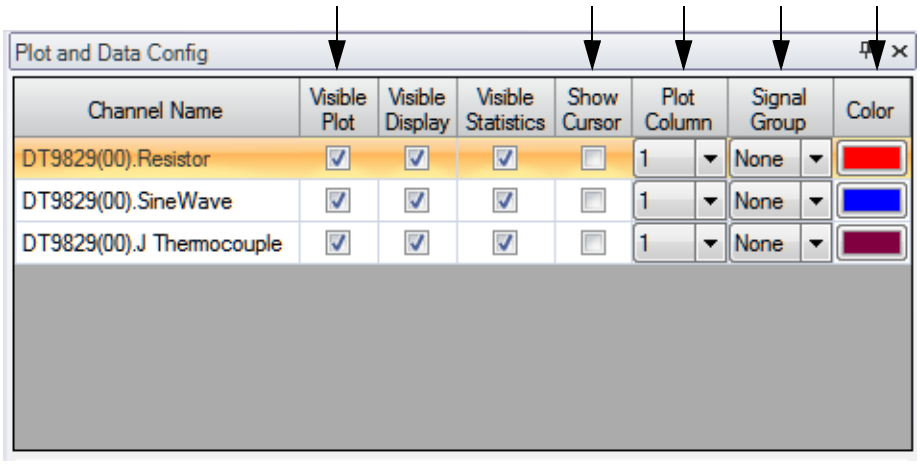

Recording
Acquisition
Output
Per Channel Sampling Frequency
160.000
Hz
(0.31Hz -320Hz)
Trigger Source
Software
Trigger Options
Single Ended/Differential
Differential
Input Voltage Range
-10V to 10V
Temperature Unit
Celsius
Filter Type
Moving Average
Acquisition info
Sample rate: 160 Hz
Sample interval: .00625 Sec
Number of scans: 4800

8. For this example, ensure that the following settings are used:
   - **Per Channel Sampling Frequency:** 160 Hz
   - **Trigger Source:** Software
   - **Temperature Unit:** Celsius
   - **Filter type:** Moving Average
9. If desired, hide the **Acquisition Config** window by clicking the **Auto-Hide** pin ( ) in the top, right corner of the window.

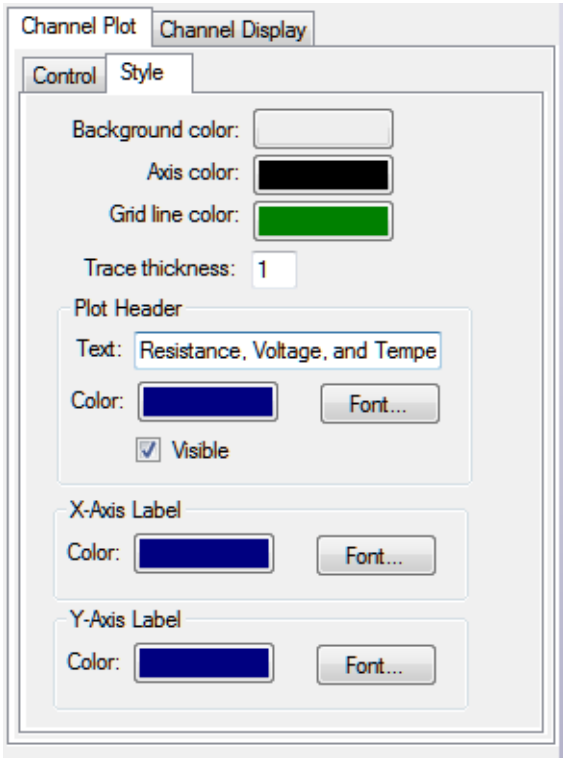
Configure the Appearance of the Channel Plot Window

Configure the appearance of the Channel Plot window as follows:

1. In the **Plot and Data Config** window, set up the following parameters:
   a. Ensure that the **Visible Plot** column is checked for the enabled channels.
   b. Leave the **Show Cursor** column unchecked for the enabled channels.
   c. Under **Plot Column**, use the default plot column setting of 1 for the enabled channels.
   d. Under the **Signal Group** column, select **None** for the enabled channels.
   e. Under the **Color** column, assign a unique color to each trace.



2. Click the **Channel Display - Style** tab.
3. In the **Text** field, enter **Resistance, Voltage, and Temperature Data**.

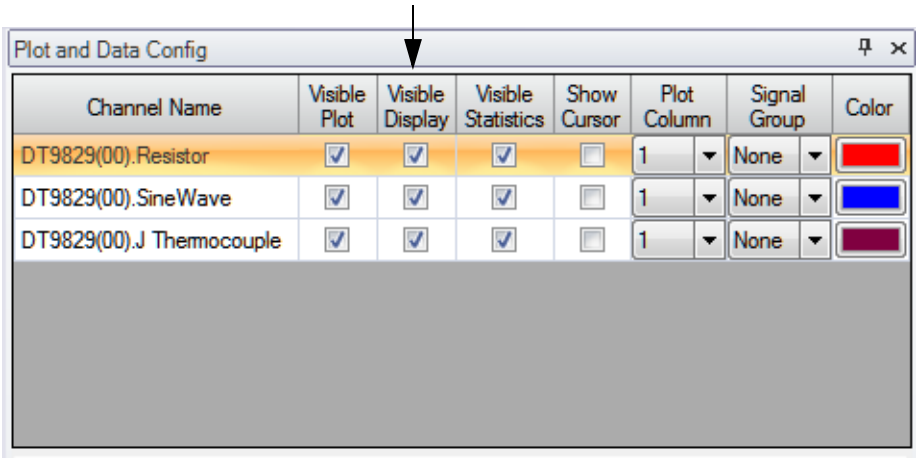


4. You can modify the remaining parameters if desired.
   This example leaves the remaining parameters unchanged.

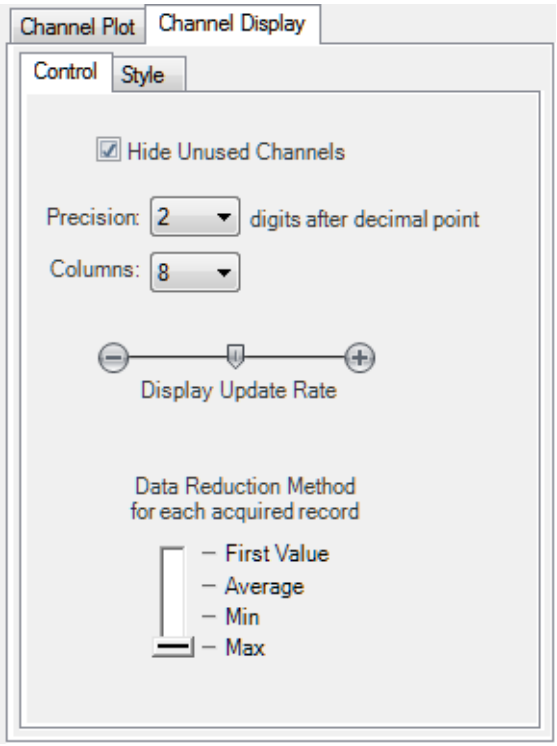
Configure the Appearance of the Channel Display Window

Configure the appearance of the Channel Display window as follows:

1. Ensure that the **Visible Display** column in the **Plot and Data Config** window is checked for both enabled channels.



2. Click the **Channel Display - Control** tab, and select the **Hide Unused Channels** checkbox so that only analog input channels 0 and 1 are displayed.

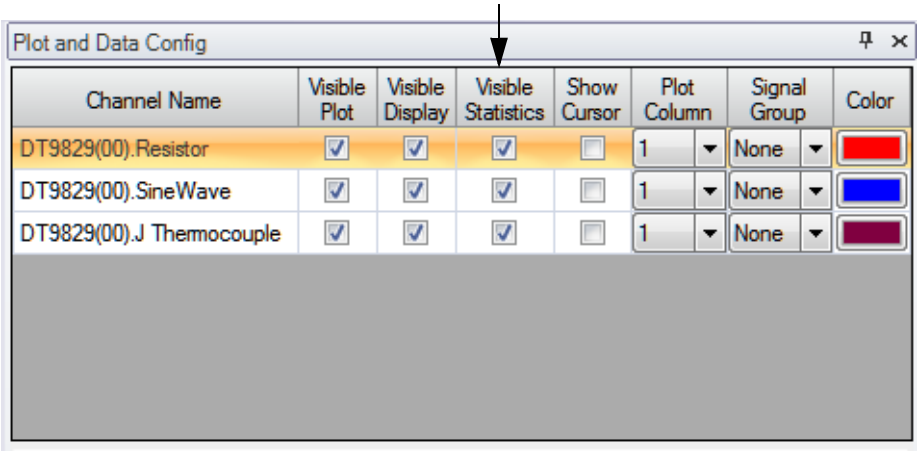


3. For the Data Reduction Method, select **Max** so that the maximum value of the most recent buffer is displayed for each channel.
4. Leave the default values for the remaining parameters.

Configure the Appearance of the Statistics Window

Configure the appearance of the Statistics window as follows:

1. Ensure that the **Visible Statistics** column in the **Plot and Data Config** window is checked for both channels:



2. If desired, hide the **Plot and Data Config** window by clicking the **Auto-Hide** pin ( ) in the top, right corner of the window.

Position the Windows

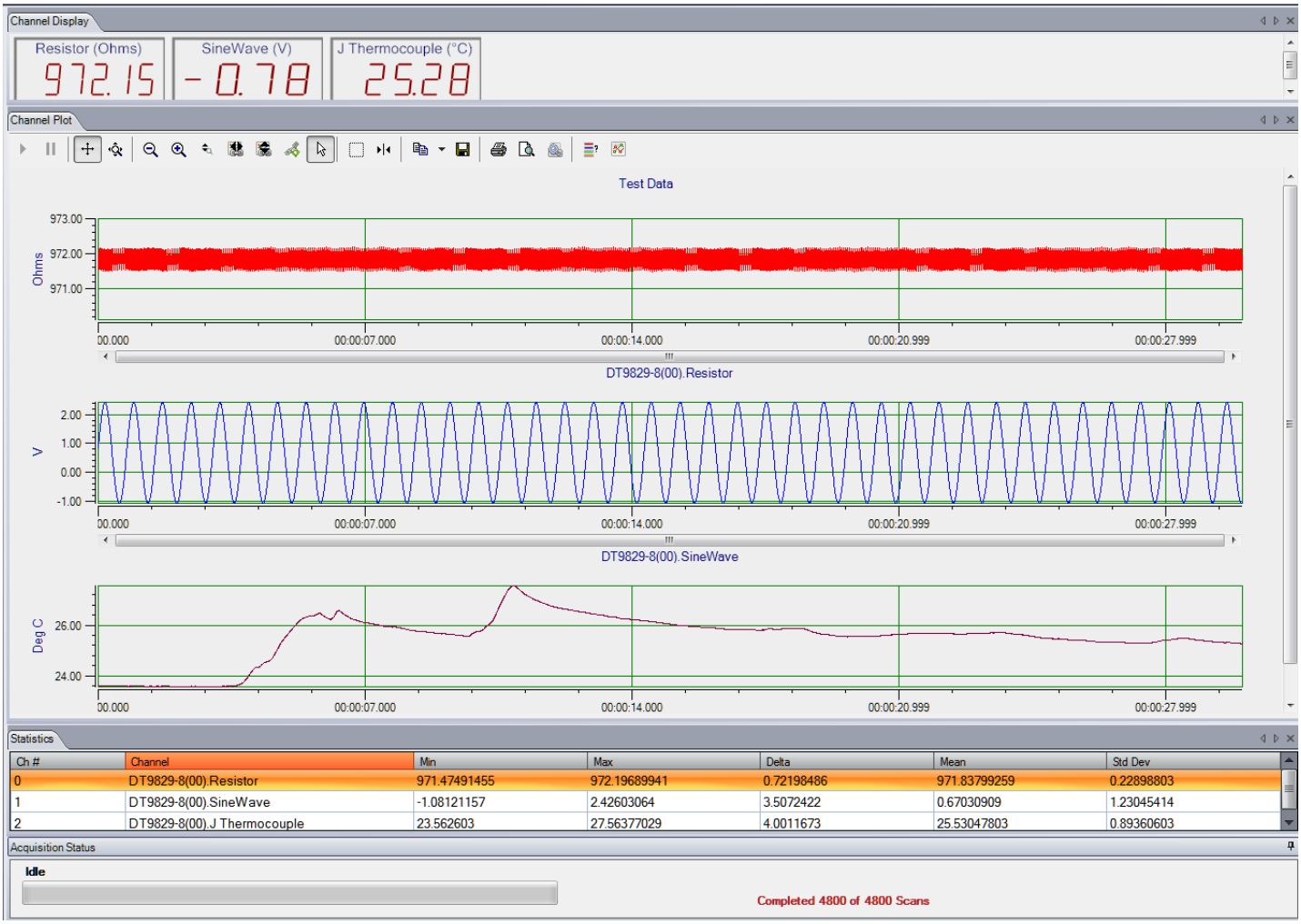
If you want see the data that is displayed in the Channel Display, Channel Plot, and Statistics windows at once, you need to move the windows to different locations in the display area.

In this example, the Channel Display window is located at the top of the display area, the Channel Plot window is located in the middle of the display area, and the Statistics window is located at the bottom of the display area. To position the windows for this example, do the following:

1. Click the tab for the **Statistics** window, drag the window toward the middle of the display area, move the mouse over the guide on the bottom of the guide diamond, and then release the mouse button.
   The Statistics window is now placed at the bottom of the display area.
2. Click the tab for the **Channel Plot** window, drag the window toward the middle of the display area, move the mouse over the guide on the bottom of the guide diamond, and then release the mouse button.
   The Channel Plot window is now placed in the middle of the display area, revealing the Channel Display window at the top of the display area.
3. Resize each window, as desired.

Start the Measurement

Once you have configured the channels and the display area, start acquisition and log data to disk by clicking the **Record** toolbar button (Record).
Results similar to the following are displayed in the display area.



If desired, you can view the data in Excel by clicking the **Open Current Data in Excel** toolbar button ( ).

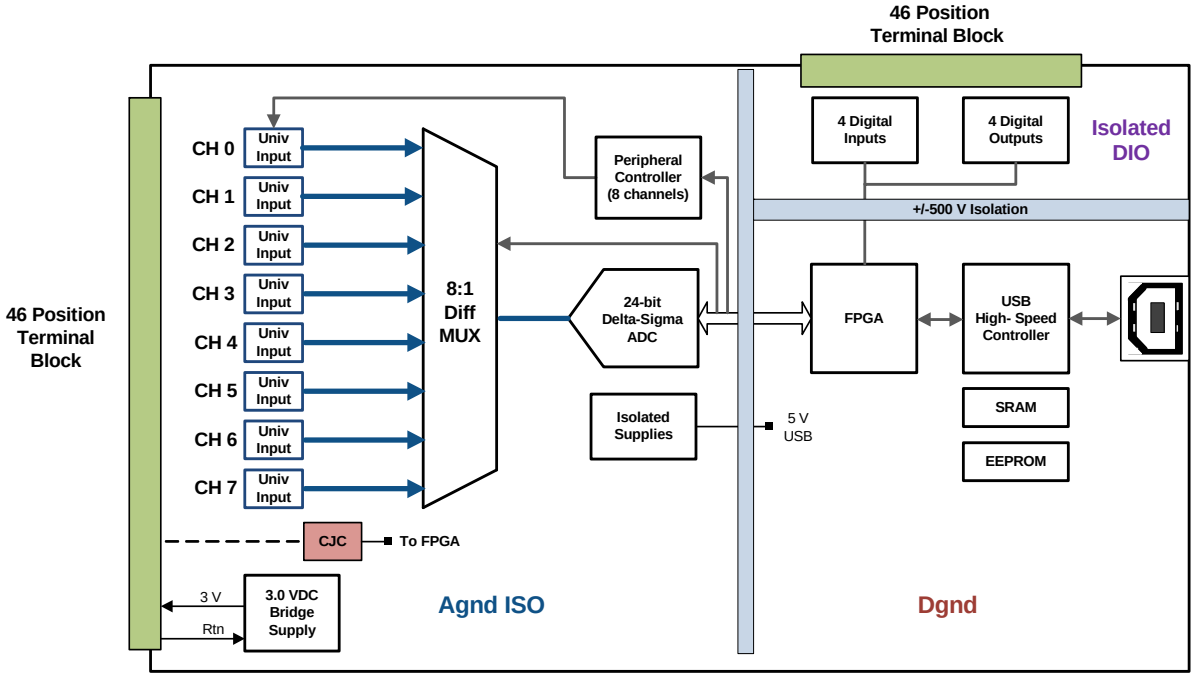
Part 2: Using Your Module

Principles of Operation

Block Diagram and Board Layout 90
Analog Input Features 92
Digital I/O Features 118

Block Diagram and Board Layout

Figure 40 shows a block diagram of a DT9829 Series module.



Notes:
The DT9829-2 has two analog input channels (0 and 1);
the DT9829-4 has four analog input channels (0 to 3);
the DT9829-8 has eight analog input channels (0 to 7).

Figure 40: Block Diagram of a DT9829 Series Module

Figure 41 shows the board layout and describes the design features of the DT9829 Series modules.

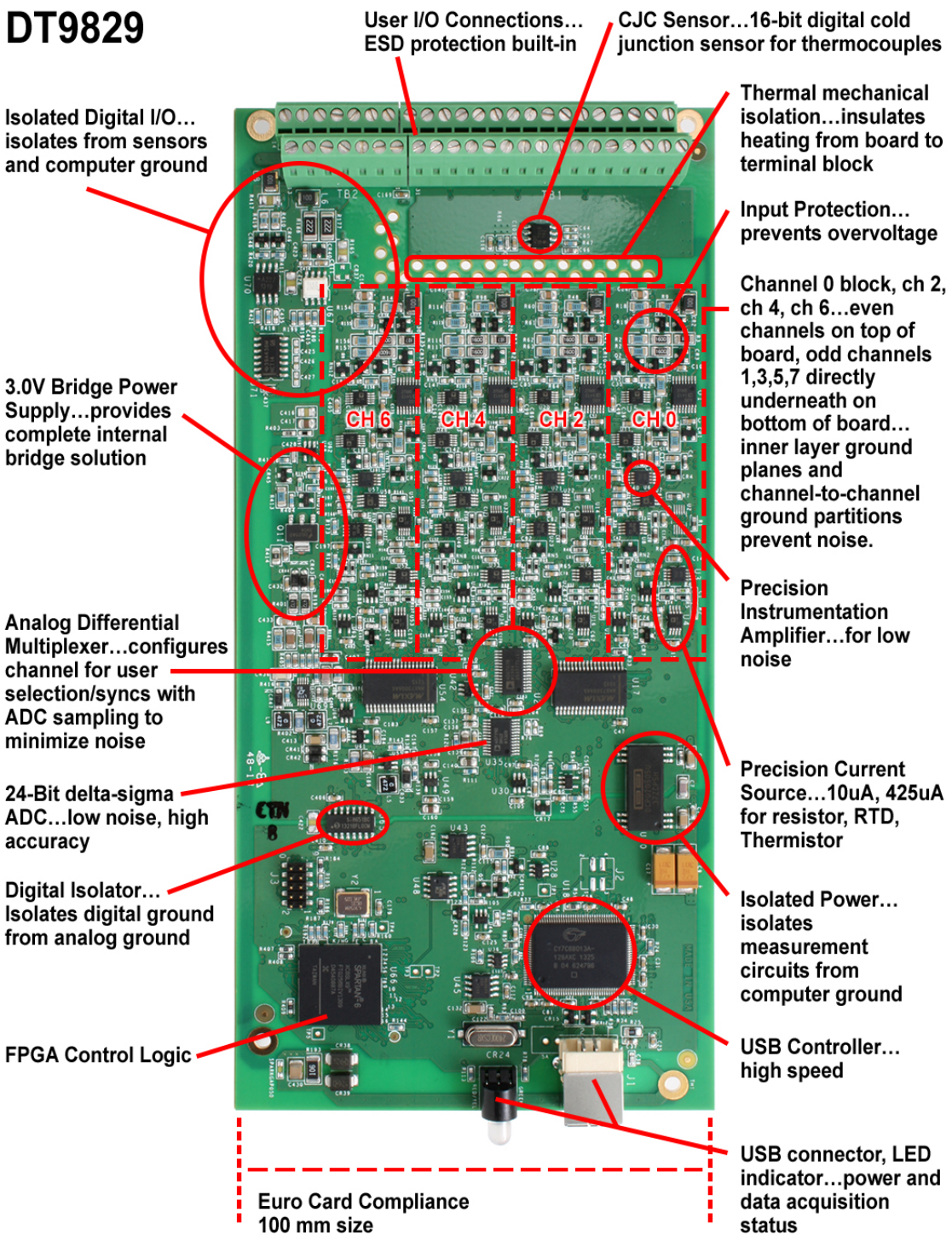


Figure 41: DT9829 Series Board Layout and Design Features

Analog Input Features

This section describes the features of the analog input (A/D) subsystem, including the following:

- Analog input channels, described next
- Voltage input support, described on page 93
- Current support, described on page 94
- Thermocouple support, described on page 94
- RTD support, described on page 96
- Resistance measurement support, described on page 97
- Thermistor support, described on page 97
- Bridge and strain gage support, described on page 98
- Input ranges and gains, described on page 111
- Input resolution, described on page 111
- A/D sample rate, described on page 112
- Triggers, described on page 113
- Analog input conversion modes, described on page 114
- Filtering, described on page 115
- Data format, described on page 116
- Error conditions, described on page 117

Analog Input Channels

The DT9829-2 module supports two differential analog input channels (numbered 0 to 1), the DT9829-4 module supports four differential analog input channels (numbered 0 to 3), and the DT9829-8 module supports eight differential analog input channels (numbered 0 to 7). The analog input channels are multiplexed to a single 24-bit Delta-Sigma A/D converter on the module.

Each analog input channel can accept one of the following sensor types: voltage input, current, thermocouple, RTD, resistance, thermistor, bridge-based sensors, and strain gages. You specify the sensor type for each channel using software.

The following subsections describe how to read the values from the analog input channels in software.

Specifying a Single Channel

The simplest way to acquire data from a single analog input channel is to specify the channel for a single-value analog input operation using software. Refer to page 114 for more information on single-value operations.

Specifying One or More Channels

You can read data from one or more analog input channels as well as the digital input port using an analog input channel list. Reading the digital input port (digital lines 0 to 3) using the analog input channel list is particularly useful when you want to correlate the timing of analog and digital events. Using software, you specify the input channels in the order that you want to sample them.

You can enter up to 1024 entries in the channel list. If you are using the DT9829-2, channels 0 and 1 correspond to the analog input channels, and channel 2 corresponds to the digital input port. If you are using the DT9829-4, channels 0 to 3 correspond to the analog input channels, and channel 4 corresponds to the digital input port. If you are using the DT9829-8, channels 0 to 7 correspond to the analog input channels, and channel 8 corresponds to the digital input port.

You can specify the channels in the list sequentially (starting either with 0 or with any other analog input channel) or randomly. You can also specify a single channel or the same channel more than once in the list.

The channels are read in order from the first entry to the last entry in the channel list. Refer to page 114 for more information on the supported conversion modes.

Voltage Input Support

DT9829 Series modules support differential voltage inputs. You can connect a floating voltage source, grounded voltage source, or a differential voltage source with a grounded reference to the module.

Note: If you have connected a floating voltage source or a grounded voltage source, you must enable the bias return termination resistor in software. If you have connected a differential voltage source with a grounded reference, you must disable the bias return input termination resistor in software (the default setting). Refer to page 39 for more information.

If you specify an analog input channel for a voltage input sensor type, the analog input subsystem is configured for an input range of ±10 V. You must specify a gain value of 1, 5, or 50 to determine the effective input range (±10 V, ±2 V, ±200 mV) that is used by each channel. Table 3 lists the supported gains and effective input ranges for DT9829 Series modules.

Table 3: Gains and Effective Input Ranges

Gain	Effective Input Range
1	±10 V
5	±2 V
50	±200 mV

For each channel, choose the gain that has the smallest effective range that includes the signal you want to measure. For example, if the range of your analog input signal is ±1.05 V, specify a gain of 5 for the channel; the effective input range for this channel is then ±2 V, which provides the best sampling accuracy for that channel.

How you specify the gain depends on whether you are performing a single-value or continuous scan operation. Refer to page 114 for more information.

Current Support

DT9829 Series module support the measurement of current output devices up to a range of –25 mA to 25 mA. You can connect a floating current source or a grounded current source to the module.

When you specify the channel for a current sensor type, the hardware switches in a precision resistor across the terminals of the channel to measure the current source. The current source requires a compliance voltage of +5 V for 20 mA of output current.

Notes: If you have connected a floating or grounded current source, enable the bias return termination resistor in software. Refer to page 41 for more information.

For the current sensor type, the software automatically applies a gain of 5 to yield an effective input range of ±2 V for the channel.

Thermocouple Support

You can attach one of the following thermocouple types to each analog input channel: J, K, T, B, E, N, R, and/or S.

Using software, you specify the channel for a thermocouple sensor type, and then specify the specific thermocouple type that is used for each channel. Table 4 lists the supported measurement range for each thermocouple type.

Table 4: Supported Measurement Range for Each Thermocouple Type

Thermocouple Type	Supported Measurement Range	
	Minimum	Maximum
J	–210° C (–346° F)	1200° C (2192° F)
K	–200° C (–328° F)	1372° C (2502° F)
T	–200° C (–328° F)	400° C (752° F)
B	250° C (482° F)	1820° C (3308° F)
E	–200° C (–328° F)	1000° C (1832° F)

Table 4: Supported Measurement Range for Each Thermocouple Type (cont.)

Thermocouple Type	Supported Measurement Range	
	Minimum	Maximum
N	–200° C (–328° F)	1300° C (2372° F)
R	–50° C (–58° F)	1768° C (3214° F)
S	–50° C (–58° F)	1768° C (3214° F)

Refer to page 158 for the thermocouple accuracy. Refer to page 43 for wiring information.

Note: For the thermocouple sensor type, the software automatically applies a gain of 50 to yield an effective input range of ±200 mV for the channel.

Cold Junction Compensation

One cold-junction compensation (CJC) circuit is provided for all thermocouple input channels on a DT9829 Series module.

The software reads the value of the CJC input and applies it to the value of the thermocouple input to correct for errors based on the specified thermocouple type.

The update time for the CJC circuitry is 240 ms, typical. The software takes care of correlating the CJC measurements with the analog input measurements.

Note: When using the DT-Open Layers for .NET Class Library, the software provides the option of returning CJC values in the data stream. This option is seldom used, but is provided if you want to implement your own temperature conversion algorithms in software when using continuous operations. Refer to page 116 for more information on this feature.

Open Thermocouple Detection

A 100 MΩ pull-up resistor is provided on the high side input of each differential thermocouple channel for open thermocouple detection. When an open thermocouple is detected, a positive, full-scale input voltage is returned.

The software returns the value SENSOR_IS_OPEN (99999 decimal) for any channel that was configured for a thermocouple input and has either an open thermocouple or no thermocouple connected to it.

RTD Support

Typical RTDs have a supported temperature measurement range of –200° C (–328° F) to 850° C (1562° F). The resistance of an RTD changes with temperature.

As the temperature and resistance increase, the voltage drop across the RTD also increases. For RTDs, the DT9829 Series module reads this voltage drop and converts the voltage to the appropriate temperature according to the Callendar-Van Dusen transfer function:

$$R_T = R_0[1 + AT + BT^2 + CT^3(T - 100)]$$

where,

- R_T is the resistance at temperature.
- R_0 is the resistance at 0° C.
- A, B, and C are the Callendar-Van Dusen coefficients for a particular RTD type. (The value of C is 0 for temperatures above 0° C.)

The DT9829 Series module supports the standards listed in Table 5 for measuring Platinum 100 Ω, 500 Ω, and/or 1000 Ω RTDs; the coefficients used by the Callendar-Van Dusen transfer function are also listed:

Table 5: Common Standards and Callendar-Van Dusen Coefficients Supported By RTD Channels

Standard	Temperature Coefficent of Resistance (TCR)	R0 Coefficient	A Coefficient	B Coefficient	C Coefficient
Low Cost	0.003750 Ω / Ω /° C	1000 Ω	3.81×10^{-3}	-6.02×10^{-7}	-6.0×10^{-12}
DIN/IEC 60751 ASTM-E1137	0.003850 Ω / Ω /° C	100 Ω, 500 Ω, 1000 Ω	3.9083×10^{-3}	-5.775×10^{-7}	-4.183×10^{-12}
US Industrial Standard	0.003911 Ω / Ω / ° C	100 Ω	3.9692×10^{-3}	-5.8495×10^{-7}	-4.233×10^{-12}
Japanese JISC 1604-1989	0.003916 Ω / Ω /° C	100 Ω	3.9739×10^{-3}	-5.870×10^{-7}	-4.4×10^{-12}
SAMA RC21-4-1966	0.003920 Ω / Ω /° C	98.129 Ω	3.9787×10^{-3}	-5.869×10^{-7}	-4.167×10^{-12}
ITS-90	0.003928 Ω / Ω /° C	100 Ω	3.9888×10^{-3}	-5.915×10^{-7}	-3.85×10^{-12}

Using software, you specify the channel for an RTD sensor type, and then specify the TCR value to apply by setting the specific RTD type. If the TCR value is 0.003850 Ω / Ω / ° C, you must also specify the R0 coefficient, which corresponds to the resistance of the RTD that you are using; values are 100 Ω (the default), 500 Ω, or 1000 Ω. The software automatically applies the remaining coefficients based on the selected RTD type.

If desired, you can also specify a custom RTD type. For custom RTD types, you must specify the values for the R0, A, B, and C coefficients used in the transfer function.

DT9829 Series modules provide 425 µA of excitation for RTD inputs. You can use a 2-, 3-, or 4-wire scheme when connecting RTD inputs to the module. Refer to page 44 for wiring information.

Note: For 100 Ω RTDs, the software automatically applies a gain of 50 to yield an effective input range of ±200 mV.

For 500 Ω and 1000 Ω RTDs, the software automatically applies a gain of 5 to yield an effective input range of ±2 V.

Resistance Measurement Support

For resistance measurements, DT9829 Series modules support measurement ranges of 0 to 4 kΩ and 4 kΩ to 200 kΩ in 2-, 3-, or 4-wire configurations. The module provides a 425 µA current source for the 0 to 4 kΩ range and a 10 µA current source for the 4 kΩ to 200 kΩ range.

Using software, you specify the channel for a resistance sensor type, and then specify either the current source or the resistor range that you are using.

The module measures the voltage produced across a connected resistor when the appropriate current source is applied to it to determine the resistance.

Refer to page 47 for wiring information.

Note: For the resistance sensor type, the software automatically applies a gain of 5 to yield an effective input range of ±2 V for the channel.

Thermistor Support

Thermistors show a large change in resistance that is proportional to a small change in temperature and have high nominal resistance, which diminishes the effect of lead wire resistance.

DT9829 Series modules support NTC (Negative Temperature Coefficient) thermistors with a resistor value of 2252 Ω to 100 kΩ at 25° C using a 2-, 3-, or 4-wire connection scheme. Refer to page 50 for wiring information.

The resistance of NTC thermistors increases with decreasing temperature. Thermistors have a typical usable measurement range of –100° to 325° C. DT9829 Series modules can read a maximum resistance of 200 kΩ, which may limit the low end of the measurable temperature range, depending on the type and value of the thermistor used.

The resistance to temperature relationship is characterized by the Steinhart-Hart equation:

$$\frac{1}{T} = A + BlnR + Cln(R)^3$$

where,

- T is the temperature, in degrees Kelvin.
- R is the resistance at T, in ohms.
- A, B, and C are the Steinhart-Hart coefficients for a particular thermistor type and value, and are supplied by the thermistor manufacturer.

Using software, you specify the channel for a thermistor sensor type, and specify the A, B, and C coefficients for the thermistor. The module uses a value of 10 µA for the current source.

Note: For the thermistor sensor type, the software automatically applies a gain of 5 to yield an effective input range of ±2 V for the channel.

Bridge and Strain Gage Support

DT9829 Series modules support bridge-based sensors and strain gages. All of these sensor types are based on the concept of a Wheatstone bridge.

A Wheatstone bridge is a network of four resistors configured as two parallel voltage dividers. One or more of the resistors can be an active sensing element. Physical phenomena, such as a change in strain applied to a specimen or a temperature shift, changes the resistance of the active sensing elements in the Wheatstone bridge. The Wheatstone bridge configuration is used to help measure the small variations in resistance that the sensing elements produce corresponding to a physical change in the specimen.

Figure 42 shows a basic circuit diagram of a Wheatstone bridge.

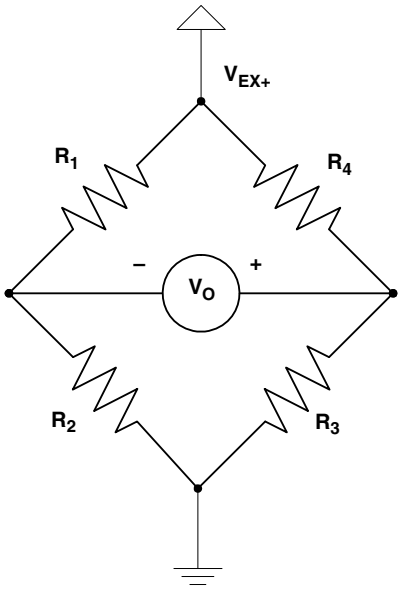


Figure 42: Wheatstone Bridge Circuit Diagram

Electrically, a Wheatstone bridge is equivalent of two parallel voltage divider circuits, where R_1 and R_2 comprise one voltage divider circuit, and R_4 and R_3 comprise the second voltage divider circuit. The output of the bridge is measured between the middle nodes of the voltage dividers (V_O).

DT9829 Series modules provide 3.0 V bridge excitation (V_{EX+}) for powering the bridge.

Notes: The number and types of bridges that can be powered from a DT9829 Series module is limited by the 500 mA maximum current that may be drawn from the host USB port. Table 1 on page 29 shows the number of bridge channels that are supported given different bridge configurations.

For bridge-based sensors or strain gages, the software automatically applies a gain of 50 to yield an effective input range of ±200 mV for the channel.

Bridge-Based Sensors

DT9829 Series modules support bridge-based sensors, such as load cells, pressure transducers, and torque sensors that are based on the Wheatstone bridge.

A load cell, which consists of a number of strain gages, measures load and force by determining the deformation of a structural member as a load or force is applied. Pressure transducers, which consist of strain gages mounted on a diaphragm, measure the deformation of the diaphragm that is proportional to the pressure that is applied. Torque sensors, which consist of strain gages mounted on a torsion bar, measure the shear stress as the torsion bar turns that is proportional to the torque.

These transducers typically use 350 Ω nominal bridge resistance. Refer to page 53 for wiring information.

Use software to configure the channel for a bridge sensor type, and select the full-bridge configuration. Then, enter the sensitivity of the sensor, as provided by the manufacturer. For example, a 1.5 mV reading from a load cell rated for 100 pounds with a rated output of 2 mV/V output corresponds to a reading of 25 pounds.

The following transfer function is used for bridge-based sensors:

$$Vr = \frac{Vs - Vu}{VEX}$$

where,

- V_r is the voltage ratio between the reference and measure conditions, divided by the excitation voltage.
- V_{EX} is the excitation voltage that is specified in software. For DT9829 Series modules, this value is 3.0 V.
- V_s is the measured voltage output when strained.
- V_u is the initial, unstrained voltage output. For a zero-calibrated sensor, this value is 0.

The output equation is as follows:

$$Y = \frac{Vr - C}{Ro}$$

where,

- Y is the measured output in engineering units.
- V_r is the voltage ratio between the reference and measure conditions, divided by the excitation voltage.
- C is the capacity, or full-scale range of the transducer, in engineering units.
- $R_o$is the rated output of the transducer at full capacity. It is expressed as a sensitivity in units of mV per Volt of excitation.

Note: DT9829 Series modules do not support TEDs, remote sensing, or internal shunt calibration.

General-Purpose Bridge Sensors

DT9829 Series modules support general-purpose bridge sensors. Use software to configure the channel for a bridge-based sensor, and select the full-bridge, half-bridge, or quarter-bridge configuration.

The external bridge circuit can consist of up to two resistive elements (for quarter-bridge or half-bridge configurations) or four resistive elements (for a full-bridge configuration). DT9829 Series module provide two bridge completion resistors for half-bridge and quarter-bridge configurations. For quarter-bridge configurations, the user must supply an external completion resistor. The resistive elements vary with strain or temperature. You can also add fixed resistors, if desired. Refer to page 54 for wiring information.

You can measure the normalized output of the bridge in mV/V. The module derives this value by dividing the bridge output, in millivolts, by the calibrated 3.0 V bridge supply value, in volts.

To yield an output in the desired engineering units, you can apply your own bridge transfer function to the normalized output value.

For example, you could connect a thermistor in a half-bridge configuration with a fixed resistor to the DT9829 Series module. By reading the normalized output value of this bridge, you can determine the general relationship between output voltage (in mV) per volt of excitation. You can then apply your own bridge transfer function to the normalized bridge output value to determine the temperature of the thermistor from the thermistor temperature-resistor relationship.

Strain Gages

A strain gage is a collection of all the active elements of a Wheatstone bridge. You use different bridge configurations for different tasks. To configure a channel for a strain gage measurement on a DT9829 Series module, use software to select the strain gage sensor type, and select one of 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

The configuration that you select determines the way you wire the sensor elements to the channel. Refer to Chapter 3, starting on page 55, for wiring information.

The module determines measured strain by referencing the acquired data when the bridge is in the strained condition to the acquired data when the bridge in an unstrained condition. The difference in measurements is then applied to the appropriate transfer function for the particular bridge configuration, which yields a value of strain in units of strain or microstrain.

You can modify this transfer function by correcting for lead wire resistance. You enter the value of the lead wire resistance from the DT9829 Series module to the strain gage. The software applies the correction coefficient to the bridge transfer function for the particular channel.

Shunt calibration is another method of compensating for the lead wire resistance in the bridge. It is used to calibrate a configured channel to an artificial amount of strain that is simulated by altering the resistance of one element of the connected bridge. You must wire your own external shunt resistor to the DT9829 Series module, as shown in the wiring diagrams in Chapter 3. With the bridge in the unstrained condition, you shunt one of the elements of the bridge with a known precision resistor value. Using software, you can then read the value of the bridge, compare it to the expected value, and calibrate the channel accordingly.

You can also perform offset nulling for a strain gage. Under ideal conditions, a balanced bridge with zero strain applied produces zero volts. In practice, the output of a bridge in an unstrained condition is offset from zero slightly due to imperfect matching of bridge resistances. It is not necessary to balance a bridge prior to the measurement. Instead, you can use software to make a reference measurement with the bridge in an unstrained condition. All subsequent data is then offset in software by the reference value.

Note: DT9829 Series modules do not support remote sensing.

The following sections provide the circuit diagram for each of the supported bridge configurations as well as the bridge transfer function that the DT9829 Series module uses to convert voltage to strain for each configuration. The following terms are used in this section:

- ε is the measured strain (+e is the tensile strain and $-\varepsilon$ is the compressive strain).
- GF is the gage factor, which is specified by the gage manufacturer. You specify this value in software for each bridge (analog input channel).
- R_g is the nominal gage resistance, which is specified by the gage manufacturer. You specify this value in software for each bridge (analog input channel).
- R_L is the lead wire resistance. You specify this value in software for each bridge (analog input channel).
- ν is the Poisson ratio, defined as the negative ratio of transverse strain to axial (longitudinal) strain. You specify this value in software for each bridge (analog input channel).
- V_{EX} is the excitation voltage that is specified in software. For the DT9829 Series module, this value is 3.0 V.

- V_u is the initial, unstrained voltage output.
- V_s is the measured voltage output when strained.
- V_r is the voltage ratio that is used in the voltage-to-strain conversion equations and is defined by the following equation:

$$V_r = \frac{Vs - Vu}{V_{EX}}$$

For shunt calibration, these definitions are used:

- $\varepsilon_s$is a calculated value. It is the expected value of strain with the shunt calibration resistor engaged.
- R_{SH} is the shunt calibration resistance.
- $\varepsilon_{SH}$is the measured value of strain with a shunt calibration resistor engaged.
- U is a calculated value. It is the expected value of V_r with a shunt calibration resistor applied to the bridge.

  Note that the sign of U depends on which of the four bridge elements are shunted.

  If R_1 or R_3 is shunted, U is negative and is determined as follows:

$$U = \frac{-R_g}{4R_{sh} + 2R_g}$$

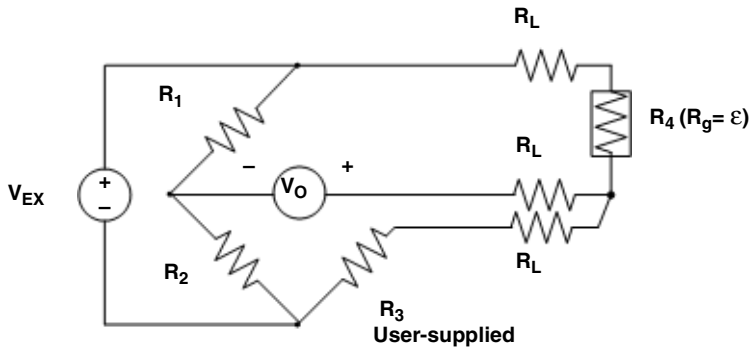
  If R_2 or R_4 is shunted, U is positive and is determined as follows:

$$U = \frac{R_g}{4R_{sh} + 2R_g}$$

Quarter-Bridge Configuration

Figure 43 shows the circuit diagram that the DT9829 Series module uses for a 3-wire Quarter-Bridge configuration.

Note: This configuration is used with rectangular and delta rosettes. Tee rosettes are not supported. Refer to page 55 for more information on rosettes.



In this diagram:

R_1 and R_2 are half-bridge completion resistors that are provided by the DT9829 Series.

R_3 is the quarter-bridge completion resistor that you must supply.

R_4 is the active strain-gage element that measures the tensile strain (R_g = +ε).

Figure 43: Quarter-Bridge Circuit Diagram

For a 3-wire Quarter-Bridge configuration, the following bridge transfer function is used to convert voltage to strain when lead wire correction and shunt calibration are not used:

$$Strain(\varepsilon) = \frac{-4V_r}{GF(1+2V_r)}$$

When lead wire correction is used, the following transfer function is used for the Quarter Bridge configuration:

$$Strain(\varepsilon) = \frac{-4V_r}{GF(1+2V_r)}\left(1+\frac{R_L}{R_g}\right)$$

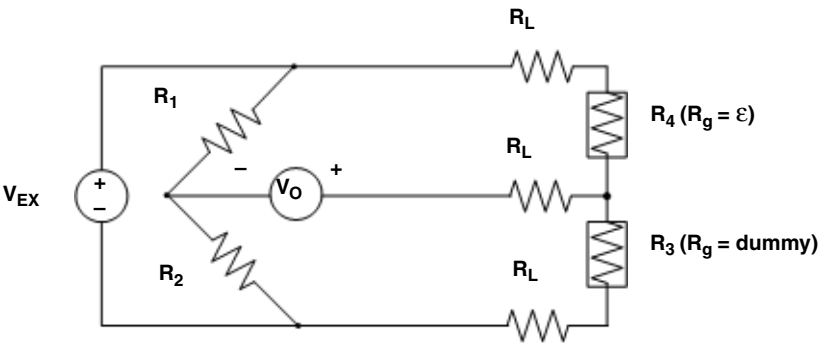
When lead wire correction and shunt calibration are used across R_3 or R_4, the following transfer function is used for the Quarter-Bridge configuration:

$$Strain(\varepsilon) = \frac{-4V_r}{GF(1+2V_r)}\left(1+\frac{R_L}{R_g}\right)\left(\frac{\varepsilon_s}{\varepsilon_{SH}}\right)$$

Refer to page 55 for information on wiring a Quarter-Bridge configuration to the DT9829 Series module.

Quarter-Bridge Temp Comp Configuration

Figure 44 shows the circuit diagram that the DT9829 Series module uses for the Quarter-Bridge Temp Comp configuration. This circuit diagram (and bridge transfer function) is also used for a Quarter-Bridge configuration where the user places a resistor at the strain gage.



In this diagram:

R_1 and R_2 are half-bridge completion resistors that are provided by the DT9829 Series.

R_4 is an active strain-gage element that measures axial or bending strain in the principal direction of strain ($R_g = +\varepsilon$).

R_3 is a dummy strain gage element (R_g = dummy gage) that has the same nominal resistance and temperature coefficient as R_4.

Figure 44: Quarter-Bridge Temp Comp Circuit Diagram

For the Quarter-Bridge Temp Comp configuration, the following bridge transfer function is used to convert voltage to strain when lead wire correction and shunt calibration are not used:

$$Strain(\varepsilon) = \frac{-4V_r}{GF(1+2V_r)}$$

When lead wire correction is used, the following transfer function is used for the Quarter-Bridge Temp Comp configuration:

$$Strain(\varepsilon) = \frac{-4V_r}{GF(1+2V_r)}\left(1+\frac{R_L}{R_g}\right)$$

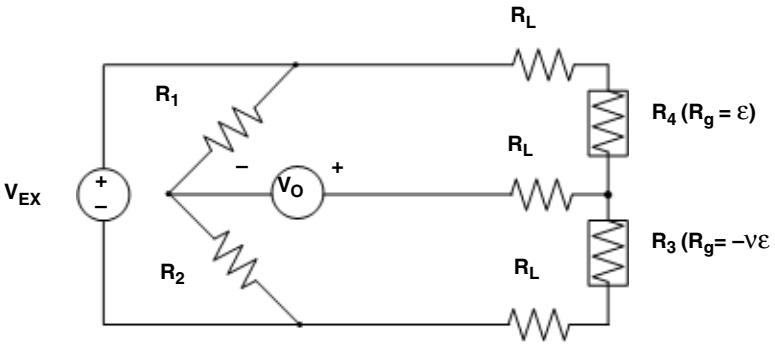
When lead wire correction and shunt calibration are used across R_3 or R_4, the following transfer function is used for the Quarter-Bridge Temp Comp configuration:

$$Strain(\varepsilon) = \frac{-4V_r}{GF(1+2V_r)}\left(1+\frac{R_L}{R_g}\right)\left(\frac{\varepsilon_s}{\varepsilon_{SH}}\right)$$

Refer to page 58 for information on wiring a Quarter-Bridge Temp Comp configuration to the DT9829 Series module.

Half-Bridge Poisson Configuration

Figure 45 shows the circuit diagram that the DT9829 Series module uses for the Half-Bridge Poisson configuration.



In this diagram:

R_1 and R_2 are half-bridge completion resistors that are provided by the DT9829 Series.

R_4 is the active strain-gage element that measures strain in the direction of axial or bending strain ($R_g = +\varepsilon$).

R_3 is the active strain gage that measures strain in the direction perpendicular to the principal axis of strain ($R_g = -\nu\varepsilon$).

Figure 45: Half-Bridge Poisson Circuit Diagram

For the Half-Bridge Poisson configuration, the following bridge transfer function is used to convert voltage to strain when lead wire correction and shunt calibration are not used:

$$Strain(\varepsilon) = \frac{-4V_r}{GF[(1+\nu)-2V_r(\nu-1)]}$$

When lead wire correction is used, the following transfer function is used for the Half-Bridge Poisson configuration:

$$Strain(\varepsilon) = \frac{-4V_r}{GF[(1+\nu)-2V_r(\nu-1)]}\left(1+\frac{R_L}{R_g}\right)$$

When lead wire correction and shunt calibration are used across R_3 or R_4, the following transfer function is used for the Half-Bridge Poisson configuration:

$$Strain(\varepsilon) = \frac{-4V_r}{GF[(1+\nu)-2V_r(\nu-1)]}\left(1+\frac{R_L}{R_g}\right)\left(\frac{\varepsilon_s}{\varepsilon_{SH}}\right)$$

Refer to page 60 for information on wiring a Half-Bridge Poisson configuration to the DT9829 Series module.

Half-Bridge Bending Configuration

Figure 46 shows the circuit diagram that the DT9829 Series module uses for the Half-Bridge Bending configuration.

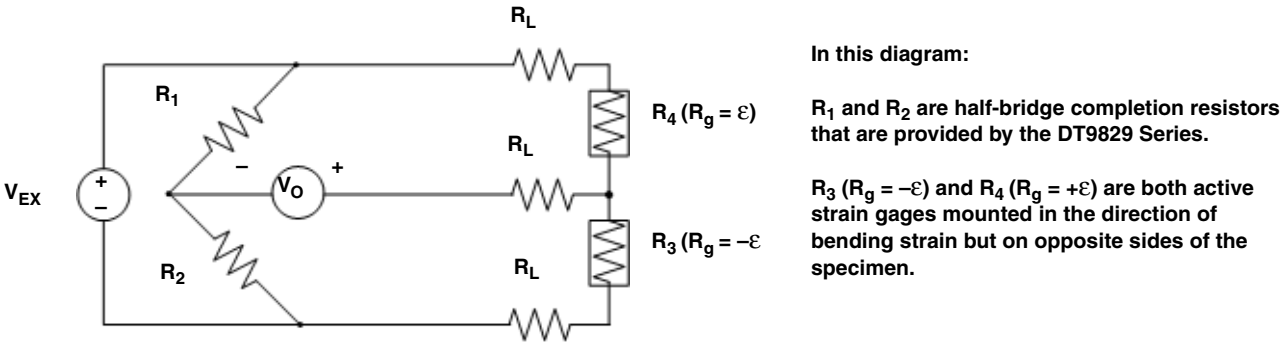


Figure 46: Half-Bridge Bending Circuit Diagram

For the Half-Bridge Bending configuration, the following bridge transfer function is used to convert voltage to strain when lead wire correction and shunt calibration are not used:

$$Strain(\varepsilon) = \frac{-2V_r}{GF}$$

When lead wire correction is used, the following transfer function is used for the Half-Bridge Bending configuration:

$$Strain(\varepsilon) = \frac{-2V_r}{GF}\left(1 + \frac{R_L}{R_g}\right)$$

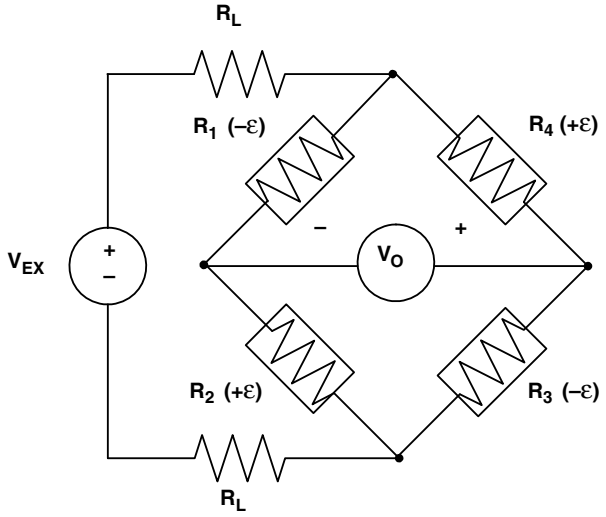
When lead wire correction and shunt calibration are used across R_3 or R_4, the following transfer function is used for the Half-Bridge Bending configuration:

$$Strain(\varepsilon) = \frac{-2V_r}{GF}\left(1 + \frac{R_L}{R_g}\right)\left(\frac{\varepsilon_s}{\varepsilon_{SH}}\right)$$

Refer to page 62 for information on wiring a Half-Bridge Bending configuration to the DT9829 Series module.

Full-Bridge Bending Circuit

Figure 47 shows the circuit diagram that the DT9829 Series module uses for the Full-Bridge Bending configuration.



In this diagram:

Four active strain gage elements are used.

R_1 (–ε) and R_3 (–ε) are mounted in the direction of bending strain on the bottom of the specimen.

R_2 (+ε) and R_4 (+ε) are mounted in the direction of bending strain on the top of the specimen.

Figure 47: Full-Bridge Bending Circuit Diagram

For the Full-Bridge Bending configuration, the following bridge transfer function is used to convert voltage to strain when lead wire correction and shunt calibration are not used:

$$Strain(\varepsilon) = \frac{-V_r}{GF}$$

When lead wire correction is used, the following transfer function is used for the Full-Bridge Bending configuration:

$$Strain(\varepsilon) = \frac{-V_r}{GF}\left(1 + \frac{2R_L}{R_g}\right)$$

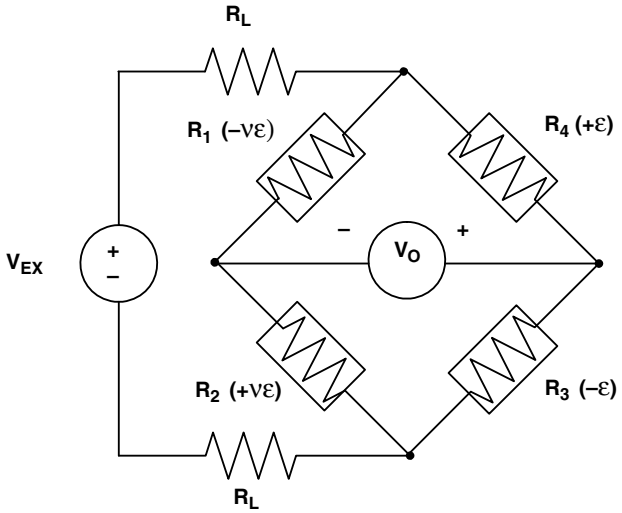
When lead wire correction and shunt calibration are used across R_1, R_2, R_3, or R_4, the following transfer function is used for the Full-Bridge Bending configuration:

$$Strain(\varepsilon) = \frac{-V_r}{GF}\left(1 + \frac{2R_L}{R_g}\right)\left(\frac{\varepsilon_s}{\varepsilon_{SH}}\right)$$

Refer to page 64 for information on wiring a Full-Bridge Bending configuration to the DT9829 Series module.

Full-Bridge Bending Poisson Configuration

Figure 48 shows the circuit diagram that the DT9829 Series module uses for the Full-Bridge Bending Poisson configuration.



In this diagram:

Four active strain gage elements are used.

R_3 (–ε) and R_4 (+ε) are mounted in the direction of bending strain with R_4 mounted on the top of the specimen and R_3 mounted on the bottom of the specimen.

R_1 (–νε) and R_2 (+νε) act together as a Poisson gage and are mounted perpendicular to the principal axis of strain with R_1 mounted on the top of the specimen and R_2 mounted on the bottom of the specimen.

Figure 48: Full-Bridge Bending Poisson Circuit Diagram

For the Full-Bridge Bending Poisson configuration, the following bridge transfer function is used to convert voltage to strain when lead wire correction and shunt calibration are not used:

$$Strain(\varepsilon) = \frac{-2V_r}{GF(1+\nu)}$$

When lead wire correction is used, the following transfer function is used for the Full-Bridge Bending Poisson configuration:

$$Strain(\varepsilon) = \frac{-2V_r}{GF(1+\nu)}\left(1+\frac{2R_L}{R_g}\right)$$

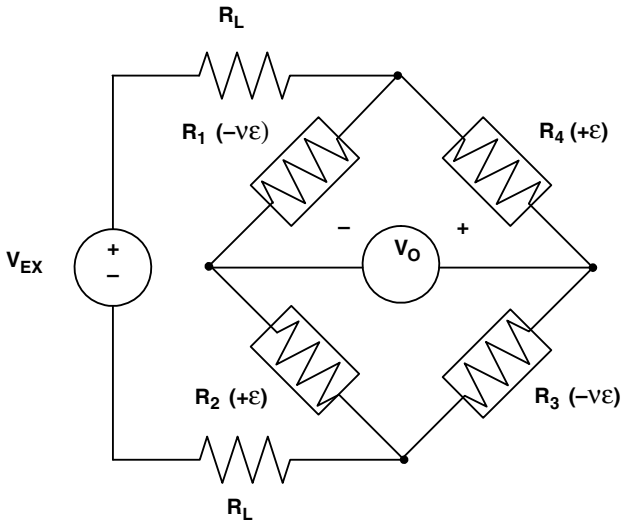
When lead wire correction and shunt calibration are used across R_1, R_2, R_3, or R_4, the following transfer function is used for the Full-Bridge Bending Poisson configuration:

$$Strain(\varepsilon) = \frac{-2V_r}{GF(1+\nu)}\left(1+\frac{2R_L}{R_g}\right)\left(\frac{\varepsilon_s}{\varepsilon_{SH}}\right)$$

Refer to page 66 for information on wiring a Full-Bridge Bending Poisson configuration to the DT9829 Series module.

Full-Bridge Axial Poisson Configuration

Figure 49 shows the circuit diagram that the DT9829 Series module uses for the Full-Bridge Axial Poisson configuration.



In this diagram:

Four active strain gage elements are used.

R_2 (+ε) and R_4 (+ε) are mounted in the direction of axial strain with R_2 mounted on the top of the specimen and R_4 mounted on the bottom of the specimen.

R_1 (–νε) and R_3 (–νε) act together as a Poisson gage and are mounted perpendicular to the principal axis of strain with R_1 mounted on the top of the specimen and R_3 mounted on the bottom of the specimen.

Figure 49: Full-Bridge Axial Poisson Circuit Diagram

For the Full-Bridge Axial Poisson configuration, the following bridge transfer function is used to convert voltage to strain when lead wire correction and shunt calibration are not used:

$$Strain(\varepsilon) = \frac{-2V_r}{GF[(\nu + 1) - V_r(\nu - 1)]}$$

When lead wire correction is used, the following transfer function is used for the Full-Bridge Axial Poisson configuration:

$$Strain(\varepsilon) = \frac{-2V_r}{GF[(\nu + 1) - V_r(\nu - 1)]}\left(1 + \frac{2R_L}{R_g}\right)$$

When lead wire correction and shunt calibration are used across R_1, R_2, R_3, or R_4, the following transfer function is used for the Full-Bridge Axial Poisson configuration:

$$Strain(\varepsilon) = \frac{-2V_r}{GF[(\nu + 1) - V_r(\nu - 1)]}\left(1 + \frac{2R_L}{R_g}\right)\left(\frac{\varepsilon_s}{\varepsilon_{SH}}\right)$$

Refer to page 68 for information on wiring a Full-Bridge Axial Poisson configuration to the DT9829 Series module.

Input Ranges and Gains

The DT9829 Series module supports an input range of ±10 V. The gain that is applied and the effective input range that is used depends on the sensor type for the channel, as shown in Table 6.

Table 6: Input Ranges and Gains Supported

Sensor Type	Supported Gain	Effective Input Range
Voltage	1	±10 V
	5	±2 V
	50	±200 mV
Current	5	±2 V
Thermocouples	50	±200 mV
100 Ω RTD	50	±200 mV
500 and 1000 Ω RTDs	5	±2 V
Thermistor	5	±2 V
Resistance	5	±2 V
Bridges and Strain Gages	50	±200 mV

Note: If a voltage is measured on the input that is outside of the range for the selected input type, the channel may be configured for the wrong input type.

When measuring temperature, if the input voltage is less than the legal voltage range for the selected input type, the software returns the value TEMP_OUT_OF_RANGE_LOW (–88888 decimal). If the input voltage is greater than the legal voltage range for the selected input type, the software returns the value TEMP_OUT_OF_RANGE_HIGH (88888 decimal).

If you are continuously measuring from a properly configured thermocouple input channel and the thermocouple opens or becomes disconnected, the open thermocouple pull-up circuit causes the input voltage to rise to an out-of-range condition. The response times for detecting an open circuit is 20 ms. As the input voltage rises, you will receive the TEMP_OUT_OF_RANGE_HIGH (88888 decimal) value followed by the SENSOR_IS_OPEN (99999 decimal) value.

Input Resolution

DT9829 Series modules support a resolution of 24 bits for the analog input subsystem.

A/D Sample Rate

DT9829 Series modules use a single programmable data rate A/D converter with a synchronously operated multiplexer.

The maximum total throughput is 960 Samples/s, and the minimum total throughput rate is 0.9375 Samples/s.

Using software, specify the channels that you want to sample in the channel list, and then set the desired sampling frequency. The software sets the sampling frequency to the closest possible value. You can use software to return the actual frequency that is used.

Note: In QuickDAQ, you specify the per channel sampling frequency. In the DT-Open Layers Class Library and the Data Acq SDK, you specify the aggregate (total) sampling frequency.

According to sampling theory (Nyquist Theorem), specify a frequency that is at least twice as fast as the input's highest frequency component. For example, to accurately sample a 20 Hz signal, specify a sampling frequency of at least 40 Hz. Doing so avoids an error condition called *aliasing*, in which high frequency input components erroneously appear as lower frequencies after sampling.

The per channel sample rate depends on the total throughput rate and the number of channels in the channel list. The hardware automatically accounts for the setting time of the sinc filter on the A/D converter and the settling time between channels.

Table 7 shows examples of per channel data rates on a DT9829 Series module for selected throughput rates and number of input channels. Note that the digital input port is considered an additional channel when it is read in the analog input data stream.

Table 7: Example of Per Channel Data Rates for Selected Throughput Rates

Number of Input Channels[a]	Throughput Rate (Samples/s)[b]											
	960	480	320	240	192	160	137.14	120	106.67	96	87.27	80
1	960.00	480.00	320.00	240.00	192.00	160.00	137.14	120.00	106.67	96.00	87.27	80.00
2	480.00	240.00	160.00	120.00	96.00	80.00	68.57	60.00	53.335	48.00	43.64	40.00
3	320.00	160.00	106.67	80.00	64.00	53.33	45.71	40.00	35.56	32.00	29.09	26.67
4	240.00	120.00	80.00	60.00	48.00	40.00	34.29	30.00	26.67	24.00	21.82	20.00
5	192.00	96.00	64.00	48.00	38.40	32.00	27.43	24.00	21.33	19.20	17.45	16.00
6	160.00	80.00	53.33	40.00	32.00	26.67	22.86	20.00	17.78	16.00	14.55	13.33
7	137.14	68.57	45.71	34.29	27.43	22.86	19.59	17.14	15.24	13.71	12.47	11.43
8	120.00	60.00	40.00	30.00	24.00	20.00	17.14	15.00	13.33	12.00	10.91	10.00
9	106.67	53.33	35.56	26.67	21.33	17.78	15.24	13.33	11.85	10.67	9.70	8.89

a. The DT9829-2 module has two analog input channels, the DT9829-4 module has four analog input channels, and the DT9829-8 module has eight analog input channels. The digital input port is an additional channel in the list.
b. The per channel data rates have been rounded to two digits. You can determine the actual rate through software.

The driver determines the full set of throughput rates by applying the following formula:

$$ThroughputRate = \frac{960}{FS} \text{ Samples/s}$$

where,

FS is an integer, frequency-scaling factor that the driver uses. In this case, values for *FS* range from 1 to 1023. The software chooses the scaling factor that will yield the closest possible value to the sampling frequency that you specified.

You can determine the data rate per channel as follows:

$$DataRatePerChannel = \frac{ThroughputRate}{NumberOfChannels}$$

For example, to sample all eight analog input channels on a DT9829-8 module at the maximum rate, the data rate per channel is 960/8, or 120 Samples/s.

Input Trigger

The DT9829 Series modules support a software trigger event to start the analog input operation. A software trigger occurs when you start the analog input operation (the computer issues a write to the module to begin conversions). Using software, specify the trigger source as a software trigger.

Analog Input Conversion Modes

The DT9829 Series modules support single-value and continuous scan conversion modes. This section describes each of these conversion modes.

Single-Value Operations

Single-value operations are simpler to use than continuous operations. Using software, you specify the analog input channel (0 to 7) that you want to use. The module acquires the data from the specified channel and returns the data immediately.

For single-value operations, you cannot specify a clock frequency, trigger source, scan mode, or buffer. Single-value operations stop automatically when finished; you cannot stop a single-value operation.

Continuous Scan Mode

Continuous scan mode takes full advantage of the capabilities of a DT9829 Series module. You can specify a channel list, sampling frequency, start trigger, and buffer using software.

You can enter up to 1024 entries in the channel list, where channels 0 to 7 correspond to the analog input channels, and channel 8 corresponds to the digital input port. You can specify the channels in the list sequentially (starting either with 0 or with any other analog input channel) or randomly. You can also specify a single channel or the same channel more than once in the list.

When a software trigger (software command) is detected, the module cycles through the channel list, acquiring and converting the value for each entry in the list (this process is defined as the scan). The sampled data is placed in the allocated buffer(s). When the module gets to the end of the channel list, it wraps to the start of the channel list and repeats the process continuously until you stop the operation.

Using software, you can stop a scan by performing either an orderly stop or an abrupt stop. In an orderly stop, the module finishes acquiring the current buffer, stops all subsequent acquisition, and transfers the acquired data to host memory; any subsequent triggers are ignored. In an abrupt stop, the module stops acquiring samples immediately; the current buffer is not completely filled, it is returned to the application only partially filled, and any subsequent triggers are ignored.

The conversion rate is determined by the sampling frequency of the input sample clock; refer to page 112 for more information about the input sample clock.

To select continuous scan mode, use software to specify the following parameters:

- Specify the data flow as Continuous
- Specify the clock source as internal and specify the sampling frequency (refer to page 112)
- Specify the trigger as a software trigger (refer to page 113)

Figure 50 illustrates continuous scan mode with a channel list of three entries: channel 0 through channel 2. In this example, analog input data is acquired when a software trigger is detected.

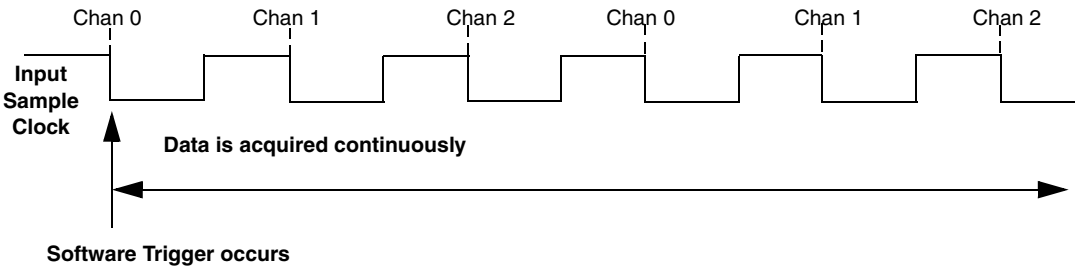


Figure 50: Continuous Scan Mode on a DT9829 Series Module

Note: The USB LED, shown in Figure 4 on page 30, blinks amber while the module is acquiring data.

Filtering

All enabled channels on a DT9829 Series module are multiplexed to a single 24-bit Delta-Sigma analog-to-digital converter (ADC) on the module.

The throughput rate determines the ADC data rate, internal filter response, and noise. On the DT9829 Series modules, the overall throughput rate is programmable to up to 960 Samples/s. The Delta-Sigma ADC noise is inherently low at all sample rates, but sampling at lower rates yields lower noise. Additional noise filtering is implemented in software by a moving average filter, which may be enabled or disabled in software.

The software filtering options are described as follows:

- **Moving average** – (The default filter setting.) This filter type removes unwanted noise from your measurements and provides a compromise of filter functionality and response time. This filter can be used in any application.

  This low-pass filter takes the previous 16 samples, adds them together, and divides by 16.

- **None** – No filter (raw data). Use this option when you want to acquire fast thermocouple response times. The response time is determined by the ADC data rate. Higher throughput rates (data rates) yield faster response times, but the increased bandwidth also results in higher noise.

Data Format

DT9829 Series modules return data as 32-bit floating-point values. One floating-point value is returned for each enabled channel. If the digital input port is in the channel list, that 4-bit value (value 0 to 15) is returned as float.

The following subsection describe the data format for the different sensor types.

Data Format for Voltage Inputs

For channels that are configured with a sensor type of voltage input, a voltage value in the range of ±10 V, ±2 V, or ±200 mV is returned for each channel, depending on the gain for the channel.

Data Format for Current Output Devices

For channels that are configured with a sensor type of current, the module returns a current value within the range of 0 to ±25 mA.

Data Format for Thermocouples

For channels that are configured with a sensor type of thermocouple (providing that the thermocouple type is not None), the module returns a temperature value, in degrees C, or one of the error constants, described on page 117.

If the thermocouple type is None, the module returns a voltage value in the ±200 mV range.

In normal operation, one floating-point value is returned for each enabled channel. If you enable the capability of returning CJC data in the data stream, described on page 95, two floating-point values are returned in the data stream for each enabled analog input channel. The first value in the pair represents the temperature (or voltage) of the channel; the second value in the pair represents the CJC temperature (in degrees C) for that channel.

Data Format for RTDs

For channels that are configured with a sensor type of RTD, the module returns a temperature value, in degrees C.

Data Format for Resistance Measurements

For channels that are configured with a sensor type of Resistance, the module returns a resistance value in ohms.

Data Format for Thermistors

For channels that are configured with a sensor type of thermistor, the module returns a temperature value, in degrees C.

Data Format for Bridge-Based Sensors

For channels that are configured with a sensor type of Bridge, data is either returned in the specified units of the sensor or as the normalized output of the bridge in the ±200 mV range, depending on how you specified this in software.

Data Format for Strain Gage

For channels that are configured with an sensor type of Strain Gage, data is returned in microstrain values.

Error Conditions

DT9829 Series modules report overrun errors by sending an overrun event to the application program. If this error condition occurs, the instrument stops acquiring and transferring data to the host computer. To avoid this error, try one or more of the following:

- Reduce the sample rate
- Close any other applications that are running
- Run the program on a faster computer

Additionally, the following constants may be reported to the host:

- 99999.0 – SENSOR_IS_OPEN, described on page 95
- 88888.0 – TEMP_OUT_OF_RANGE_HIGH, described on page 111
- –88888.0 – TEMP_OUT_OF_RANGE_LOW, described on page 111

An additional error will be reported if an ESD (electrostatic discharge) spike causes an analog input channel to stop working. If the instrument is scanning when this occurs, scanning will stop and an error will be reported. To resume scanning, you must restart the scan. If the channel is functional, scanning will resume. If the channel is not functional, scanning will not resume and the error will be reported once again; contact Customer Service, as described on page 145, to return the module to the factory.

Digital I/O Features

DT9829 Series modules provide four digital inputs and 4 digital outputs that you can use to control external equipment.

This section describes the following digital I/O features of DT9829 Series modules:

- Digital input lines, described on this page
- Digital output lines, described on this page
- Resolution, described on page 119
- Operation modes, described on page 119

Digital Input Lines

DT9829 Series modules features four, isolated, TTL-level, 12 V and 24 V digital input lines. On this module, the digital inputs have a common ground (Digital Input Return) that is isolated from USB, analog, and digital output grounds.

The response time of the digital inputs is less than 1 ms.

Using software, specify the digital input line that you want to read in single-value digital I/O operation. Refer to page 119 for more information about single-value operations.

A digital line is high if its value is 1; a digital line is low if its value is 0.

Digital Output Lines

DT9829 Series modules feature four, isolated, open-collector digital output lines. The digital outputs have a common return that is isolated from the USB ground, analog input ground, and digital input ground.

Each digital output has a 100 kΩ pull-up resistor to the external supply screw terminal. You can connect an external supply in the 3.3 VDC to 30 VDC range to this terminal, and then connect the external supply return to the external supply return screw terminal.

Using software, you can specify the digital I/O line that you want to set in a single-value digital I/O operation. Refer to page 119 for more information about single-value operations.

Setting a digital output line to 0 turns on the corresponding open collector output and pulls the output low. Setting a digital output line to 1 turns off the corresponding open collector; the output is pulled up to the external supply level.

On power up or reset of a DT9829 Series module, the digital output lines are set to 1 (open collectors are off; the outputs are pulled up to the external supply level).

Resolution

The digital input and digital output subsystems on a DT9829 Series module have a resolution of 4 bits.

Operation Modes

DT9829 Series modules support the following digital I/O operation modes:

- **Single-value operations** are the simplest to use but offer the least flexibility and efficiency. You use software to specify the digital I/O port and a gain of 1 (the gain is ignored). Data is then read from or written to all the digital I/O lines. For a single-value operation, you cannot specify a clock frequency or trigger source.

  Single-value operations stop automatically when finished; you cannot stop a single-value operation.

- **Continuous digital input** takes full advantage of the capabilities of the DT9829 Series modules. You can specify a sampling frequency, conversion mode, trigger source, and buffer for the operation.

  If you are using the DT9829-2, channel 2 corresponds to the digital input port. If you are using the DT9829-4, channel 4 corresponds to the digital input port. If you are using the DT9829-8, channel 8 corresponds to the digital input port. Refer to page 93 for more information on specifying channels.

  The A/D converter paces the reading of the digital input port (as well as the acquisition of the analog input channels); refer to page 112 for more information on the sample rates.

Note: If the digital input port is in the channel list, that 4-bit value (value 0 to 15) is returned as float.

Supported Device Driver Capabilities

Data Flow and Operation Options 123
Buffering 124
Triggered Scan Mode 124
Data Encoding 124
Channels 125
Gain 126
Ranges 126
Resolution 127
Current and Resistance Support 127
Thermocouple, RTD, and Thermistor Support 128
IEPE Support 129
Bridge and Strain Gage Support 129
Start Triggers 130
Reference Triggers 130
Clocks 131
Counter/Timers 132
Tachometer 133

The DT9829 Series Device Driver provides support for the analog input (A/D), digital input (DIN), and digital output (DOUT) subsystems. For information on how to configure the device driver, refer to Chapter 2.

Table 8: DT9829 Series Subsystems

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Total Subsystems on Module	1	0	1	1	0	0	0

The tables in this chapter summarize the features available for use with the DT-Open Layers for .NET Class Library and the DT9829 Series module. The DT-Open Layers for .NET Class Library provides properties that return support information for specified subsystem capabilities.

The first row in each table lists the subsystem types. The first column in each table lists all possible subsystem capabilities. A description of each capability is followed by the property used to describe that capability in the DT-Open Layers for .NET Class Library.

Note: The following tables include the capabilities that can be queried. However, some capabilities may not be supported by your device. Blank fields represent unsupported options.

For more information, refer to the description of these properties in the DT-Open Layers for .NET Class Library online help or *DT-Open Layers for .NET Class Library User's Manual*.

Data Flow and Operation Options

Table 9: Data Flow and Operation Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Single-Value Operation Support **SupportsSingleValue**	Yes		Yes	Yes			
Simultaneous Single-Value Output Operations **SupportsSetSingleValues**							
Continuous Operation Support **SupportsContinuous**	Yes		Yes[a]				
Continuous Operation until Trigger **SupportsContinuousPreTrigger**							
Continuous Operation before & after Trigger **SupportsContinuousPrePostTrigger**							
Waveform Operations Using FIFO Only **SupportsWaveformModeOnly**							
Simultaneous Start List Support **SupportsSimultaneousStart**							
Supports Programmable Synchronization Modes **SupportsSynchronization**							
Synchronization Modes **SynchronizationMode**							
Interrupt Support **SupportsInterruptOnChange**							
FIFO Size, in Samples **FifoSize**	1024						
Muting and Unmuting the Output Voltage **SupportsMute**							
Auto-Calibrate Support **SupportsAutoCalibrate**							

a. The DIN subsystem supports continuous mode by allowing you to read the digital input port (all 4 digital input lines) in the analog input channel list. If you are using the DT9829-2, channels 0 and 1 correspond to the analog input channels, and channel 2 corresponds to the digital input port. If you are using the DT9829-4, channels 0 to 3 correspond to the analog input channels, and channel 4 corresponds to the digital input port. If you are using the DT9829-8, channels 0 to 7 correspond to the analog input channels, and channel 8 corresponds to the digital input port.

Buffering

Table 10: Buffering Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Buffer Support **SupportsBuffering**	Yes						
Single Buffer Wrap Mode Support **SupportsWrapSingle**							
Inprocess Buffer Flush Support **SupportsInProcessFlush**	Yes						

Triggered Scan Mode

Table 11: Triggered Scan Mode Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Triggered Scan Support **SupportsTriggeredScan**							
Maximum Number of CGL Scans per Trigger **MaxMultiScanCount**	1	0	0	0			
Maximum Retrigger Frequency **MaxRetriggerFreq**	0	0	0	0			
Minimum Retrigger Frequency **MinRetriggerFreq**	0	0	0	0			

Data Encoding

Table 12: Data Encoding Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Binary Encoding Support **SupportsBinaryEncoding**			Yes	Yes			
Twos Complement Support **SupportsTwosCompEncoding**							
Returns Floating-Point Values **ReturnsFloats**	Yes						

Channels

Table 13: Channel Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Number of Channels **NumberOfChannels**	2, 4, or 8[a]	0	1	1			
SE Support **SupportsSingleEnded**							
SE Channels **MaxSingleEndedChannels**	0	0	0	0			
DI Support **SupportsDifferential**	Yes		Yes	Yes			
DI Channels **MaxDifferentialChannels**	2, 4, or 8[a]	0	1	1			
Maximum Channel-Gain List Depth **CGLDepth**	1024[b]	0	0	0			
Simultaneous Sample-and-Hold Support **SupportsSimultaneousSampleHold**							
Channel-List Inhibit **SupportsChannelListInhibit**							
Support MultiSensor Inputs **SupportsMultiSensor**	Yes						
Bias Return Termination Resistor Support **SupportsInputTermination**	Yes						

a. The DT9829-2 has two analog input channels (0 and 1) and the digital input port (2). The DT9829-4 has four analog input channels (0 to 3) and the digital input port (4). The DT9829-8 has eight analog input channels (0 to 7) and the digital port (8).

b. The channel list can include a maximum of 1024 entries and the entries do not have to be sequential.

Gain

Table 14: Gain Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Programmable Gain Support **SupportsProgrammableGain**	Yes						
Number of Gains **NumberOfSupportedGains**	3	0	0	0			
Gains Available **SupportedGains**	1, 5, 50[a]						

a. For voltage measurements, a gain of 1 yields an effective input voltage range of ±10 V, a gain of 5 yields and effective input range of ±2 V, and a gain of 50 yields an effective input range of ±200 mV.
For current measurements, a gain of 5 is used for an effective input range of ±2 V.
For thermocouple measurements, a gain of 50 is used for an effective input range of ±200 mV.
For 100 Ω RTD measurements, a gain of 50 is used for an effective input range of ±200 mV.
For 500 Ω and 1000 Ω RTD measurements, a gain of 5 is used for an effective input range of ±2 V.
For resistance measurements, a gain of 5 is used for an effective input range of ±2 V.
For thermistors, a gain of 5 is used for an effective input range of ± 2 V.
For bridge-based sensor measurements, a gain of 50 is used for an effective input range of ±200 mV.

Ranges

Table 15: Range Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Number of Voltage Ranges **NumberOfRanges**	1	0	0	0	0		0
Available Ranges **SupportedVoltageRanges**	±10 V[a]	0					

a. For voltage measurements, the effective input voltage range is ±10 V (using a gain of 1), ±2 V (using a gain of 5), or ±200 mV (using a gain of 50).
For current measurements, the effective input range is ±2 V (using a gain of 5).
For thermocouple measurements, the effective input range is ±200 mV (using a gain of 50).
For 100 Ω RTD measurements, the effective input range is ±200 mV (using a gain of 50).
For 500 Ω and 1000 Ω RTD measurements, the effective input range is ±2 V (using a gain of 5).
For resistance measurements, the effective input range is ±2 V (using a gain of 5).
For thermistors, the effective input range is ± 2 V (using a gain of 5).
For bridge-based sensor measurements, the effective input range is ±200 mV (using a gain of 50).

Resolution

Table 16: Resolution Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Software Programmable Resolution **SupportsSoftwareResolution**							
Number of Resolutions **NumberOfResolutions**	1		1	1			
Available Resolutions **SupportedResolutions**	24		4	4			

Current and Resistance Support

Table 17: Current and Resistance Support Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Current Support **SupportsCurrent**	Yes						
Current Output Support **SupportsCurrentOutput**							
Resistance Support **SupportsResistance**	Yes						
Software Programmable External Excitation Current Source for Resistance **SupportsExternalExcitationCurrentSrc**							
Software Programmable Internal Excitation Current Source **SupportsInternalExcitationCurrentSrc**	Yes						
Available Excitation Current Source Values **SupportedExcitationCurrentValues**	425 µA or 10 µA[a]						

a. For resistance channels, resistors in the 0 to 4 kΩ range use a 425 µA current source, and resistors in the 4 kΩ to 200 kΩ range use a10 µA current source.

Thermocouple, RTD, and Thermistor Support

Table 18: Thermocouple, RTD, and Thermistor Support Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Thermocouple Support **SupportsThermocouple**	Yes						
RTD Support **SupportsRTD**	Yes						
Thermistor Support **SupportsThermistor**	Yes						
Voltage Converted to Temperature **SupportsTemperatureDataInStream**	Yes						
Supported Thermocouple Types **ThermocoupleType**	J, K, B, E, N, R, S, T						
Supports CJC Source Internally in Hardware **SupportsCjcSourceInternal**	Yes						
Supports CJC Channel **SupportsCjcSourceChannel**							
Available CJC Channels **CjcChannel**							
Supports Interleaved CJC Values in Data Stream **SupportsInterleavedCjcTemperaturesInStream**	Yes						
Supported RTD Types **RTDType**	Pt3750 Pt3850 Pt3911 Pt3916 Pt3920 Pt3928 Custom						
RTD R0 Coefficient **RtdR0**	100, 500, or 1000 Ω[a]						
Supports Data Filters **SupportsTemperatureFilters**	Yes						
Temperature Filter Types **TemperatureFilterType**	Yes[b]						

a. For the 0.003750 TCR value, the R0 coefficient is 1000 Ω.
For the 0.003850 TCR value, the R0 coefficient can be 100, 500, or 1000 Ω.
For the 0.003920 TCR value, the R0 coefficient is 98.129 Ω.
For the 0.003928 TCR value, the R0 coefficient is 100 Ω.
For the 0.003911 TCR value, the R0 coefficient is 100 Ω.
For the 0.003916 TCR value, the R0 coefficient is 100 Ω.

b. Supports both Moving Average and Raw (none) filter types.

IEPE Support

Table 19: IEPE Support Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
IEPE Support **SupportsIEPE**							
Software Programmable AC Coupling **SupportsACCoupling**							
Software Programmable DC Coupling **SupportsDCCoupling**							
Software Programmable External Excitation Current Source **SupportsExternalExcitationCurrentSrc**							
Software Programmable Internal Excitation Current Source **SupportsInternalExcitationCurrentSrc**							
Available Excitation Current Source Values **SupportedExcitationCurrentValues**							

Bridge and Strain Gage Support

Table 20: Strain Gage Support Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Bridge Support **SupportsBridge**	Yes						
Supported Bridge Configurations **BridgeConfiguration**	Full Bridge Half Bridge Quarter Bridge						
Strain Gage Support **SupportsStrainGage**	Yes						
Supported Strain Gage Bridge Configurations **StrainGageBridgeConfiguration**	Full -Bridge Bending Full-Bridge Bending Poisson Full-Bridge Axial Poisson Half-Bridge Poisson Half-Bridge Bending Quarter-Bridge Quarter-Bridge Temp Comp						
External Excitation Voltage **SupportsExternalExcitationVoltage**							
Internal Excitation Voltage **SupportsInternalExcitationVoltage**	Yes						
Shunt Calibration **SupportsShuntCalibration**	Yes						
Voltage Excitation Per Channel **SupportedPerChannelVoltageExcitation**							
Minimum Excitation Voltage **MinExcitationVoltage**	3.0 V						
Maximum Excitation Voltage **MaxExcitationVoltage**	3.0 V						

Start Triggers

Table 21: Start Trigger Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Software Trigger Support **SupportsSoftwareTrigger**	Yes						
External Positive TTL Trigger Support **SupportsPosExternalTTLTrigger**							
External Negative TTL Trigger Support **SupportsNegExternalTTLTrigger**							
External Positive TTL Trigger Support for Single-Value Operations **SupportsSvPosExternalTTLTrigger**							
External Negative TTL Trigger Support for Single-Value Operations **SupportsSvNegExternalTTLTrigger**							
Positive Threshold Trigger Support **SupportsPosThresholdTrigger**							
Negative Threshold Trigger Support **SupportsNegThresholdTrigger**							
Digital Event Trigger Support **SupportsDigitalEventTrigger**							

Reference Triggers

Table 22: Reference Trigger Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
External Positive TTL Trigger Support **SupportsPosExternalTTLTrigger**							
External Negative TTL Trigger Support **SupportsNegExternalTTLTrigger**							
Positive Threshold Trigger Support **SupportsPosThresholdTrigger**							
Negative Threshold Trigger Support **SupportsNegThresholdTrigger**							
Digital Event Trigger Support **SupportsDigitalEventTrigger**							
Sync Bus Support **SupportsSyncBusTrigger**							
Analog Input Channels Supported for the Threshold Trigger **SupportedThresholdTriggerChannels**							
Post-Trigger Scan Count Support **SupportsPostTriggerScanCount**							

Clocks

Table 23: Clock Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Internal Clock Support **SupportsInternalClock**	Yes						
External Clock Support **SupportsExternalClock**							
Simultaneous Input/Output on a Single Clock Signal **SupportsSimultaneousClocking**							
Base Clock Frequency **BaseClockFrequency**	4.9152 MHz						0
Maximum Clock Divider **MaxExtClockDivider**	1.0						
Minimum Clock Divider **MinExtClockDivider**	1.0						
Maximum Frequency **MaxFrequency**	960 Hz						
Minimum Frequency **MinFrequency**	0.9375 Hz						

Counter/Timers

Table 24: Counter/Timer Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Cascading Support **SupportsCascading**							
Event Count Mode Support **SupportsCount**							
Generate Rate Mode Support **SupportsRateGenerate**							
One-Shot Mode Support **SupportsOneShot**							
Repetitive One-Shot Mode Support **SupportsOneShotRepeat**							
Up/Down Counting Mode Support **SupportsUpDown**							
Edge-to-Edge Measurement Mode Support **SupportsMeasure**							
Continuous Edge-to-Edge Measurement Mode Support **SupportsContinuousMeasure**							
High to Low Output Pulse Support **SupportsHighToLowPulse**							
Low to High Output Pulse Support **SupportsLowToHighPulse**							
Variable Pulse Width Support **SupportsVariablePulseWidth**							
None (internal) Gate Type Support **SupportsGateNone**							
High Level Gate Type Support **SupportsGateHighLevel**							
Low Level Gate Type Support **SupportsGateLowLevel**							
High Edge Gate Type Support **SupportsGateHighEdge**							
Low Edge Gate Type Support **SupportsGateLowEdge**							
Level Change Gate Type Support **SupportsGateLevel**							
Clock-Falling Edge Type **SupportsClockFalling**							
Clock-Rising Edge Type **SupportsClockRising**							
Gate-Falling Edge Type **SupportsGateFalling**							
Gate-Rising Edge Type **SupportsGateRising**							
Interrupt-Driven Operations **SupportsInterrupt**							

Tachometer

Table 25: Tachometer Options

DT9829 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Tachometer Falling Edges **SupportsFallingEdge**							
Tachometer Rising Edges **SupportsRisingEdge**							
Tachometer Stale Data Flag **SupportsStaleDataFlag**							

Calibration

About Calibration 136
Running the Calibration Utility 137
Required Calibration for Each Sensor Type 138

About Calibration

Each channel of a DT9829 Series module is fully calibrated at the factory for each sensor type prior to shipment.

If you are using thermocouple inputs, it is recommended that you recalibrate your DT9829 Series module with your specific thermocouple sensors to ensure the best possible accuracy.

For all sensor types, it is recommended that you recalibrate your device every six months using the DT9829 Calibration Utility.

Note: Ensure that you have connected your module and installed the DT9829 Series Device Driver prior to using the DT9829 Calibration Utility. Refer to Chapter 2 for more information.

Running the Calibration Utility

Note: Ensure that you perform the calibration procedure after the module has been warmed up for 10 minutes.

To run the DT9829 Calibration Utility, do the following:

1. Click **Start** from the Task Bar.
2. Browse to **Programs | Data Translation, Inc | Calibration | DT9829 Calibration Utility**. *The DT9829 Calibration Wizard appears.*
3. Select the module that you want to calibrate, and then click **Next**.

Required Calibration for Each Sensor Type

Different sensor types require different calibration steps. The following sections describe the calibration steps that are required for each sensor type.

Refer to the online help for the DT9829 Calibration Utility for detailed information about each calibration step.

Voltage Input Calibration Steps

For each channel that is configured for a voltage input measurement, you must perform the following calibration steps:

1. Calibrate the voltage offset for gains of 1, 5, and/or 50, depending on the range that you want to use (±10 V, ±2 V, or ±200 mV).
2. Calibrate the voltage gain for gains of 1, 5, and/or 50, depending on the range that you want to use (±10 V, ±2 V, or ±200 mV).

RTD Calibration Steps

For each channel that is configured for an RTD measurement, you must perform the following calibration steps:

1. Calibrate the voltage offset for a gain of 5 if you are using a 500 Ω or 1000 Ω RTD, or a gain of 50 if you are using a 100 Ω RTD.
2. Calibrate the voltage gain for a gain of 5 if you are using a 500 Ω or 1000 Ω RTD, or a gain of 50 if you are using a 100 Ω RTD.
3. Calibrate the 425 µA current source.

Thermistor Calibration Steps

For each channel that is configured for a thermistor measurement, you must perform the following calibration steps:

1. Calibrate the voltage offset for a gain of 5.
2. Calibrate the voltage gain for a gain of 5.
3. Calibrate the 10 µA current source.

Resistance Measurement Calibration Steps

For each channel that is configured for a resistance measurement, you must perform the following calibration steps:

1. Calibrate the voltage offset for a gain of 5.
2. Calibrate the voltage gain for a gain of 5.
3. Calibrate the 425 µA current source if you are using a resistor in the range of 0 to 4 kΩ, or calibrate the 10 µA current source if you are using a resistor in the range of 4 to 200 kΩ.

Current Measurement Calibration Steps

For each channel that is configured for a current measurement, you must perform the following calibration steps:

1. Calibrate the voltage offset for a gain of 5.
2. Calibrate the voltage gain for a gain of 5.
3. Calibrate the current sense.

Thermocouple Calibration Steps

For each channel that is configured for a thermocouple measurement, you must perform the following calibration steps:

1. Calibrate the voltage offset for a gain of 50.
2. Calibrate the voltage gain for a gain of 50.

Once the individual channels have been calibrated, calibrate the CJC sensors for the module. One CJC sensor is used for all the analog input channels.

Bridge and Strain Gage Calibration Steps

For each channel that is configured for a bridge-based or strain gage measurement, you must perform the following calibration steps:

1. Calibrate the voltage offset for a gain of 50.
2. Calibrate the voltage gain for a gain of 50.

Once the individual channels have been calibrated, calibrate the bridge excitation supply for the module. One bridge excitation supply is provided for all the analog input channels.

Troubleshooting

General Checklist 142
Technical Support 144
If Your Module Needs Factory Service 145

General Checklist

Should you experience problems using a DT9829 Series module, do the following:

1. Read all the documentation provided for your product, including any "Read This First" information.
2. Check the OMNI CD for any README files and ensure that you have used the latest installation and configuration information available.
3. Check that your system meets the requirements stated on page 28.
4. Check that you have installed your hardware properly using the instructions in Chapter 2.
5. Check that you have installed and configured the device driver properly using the instructions in Chapter 2.
6. Check that you have wired your signals properly using the instructions in Chapter 3.
7. Search the DT Knowledgebase in the Support section of the Data Translation web site (at www.datatranslation.com) for an answer to your problem.
8. Visit the product's page on the Data Translation web site for the latest tips, white papers, product documentation, and software fixes.

If you still experience problems, try using the information in Table 26 to isolate and solve the problem. If you cannot identify the problem, refer to page 144.

Table 26: Troubleshooting Problems

Symptom	Possible Cause	Possible Solution
Module is not recognized	You plugged the module into your computer before installing the device driver.	From the Control Panel > System > Hardware > Device Manager, uninstall any unknown devices (showing a yellow question mark). Then, install the USB device drivers, and reconnect your USB module to the computer.
Module does not respond.	The module configuration is incorrect.	Check the configuration of your device driver; see the instructions in Chapter 2.
	The module is damaged.	Contact Data Translation for technical support; refer to page 144.
Intermittent operation.	Loose connections or vibrations exist.	Check your wiring and tighten any loose connections or cushion vibration sources; see the instructions in Chapter 3.
	The module is overheating.	Check environmental and ambient temperature; consult the specifications on page 166 of this manual and the documentation provided by your computer manufacturer for more information.
	Electrical noise exists.	Check your wiring and either provide better shielding or reroute unshielded wiring; see the instructions in Chapter 3.

Table 26: Troubleshooting Problems (cont.)

Symptom	Possible Cause	Possible Solution
Device failure error reported.	The module cannot communicate with the Microsoft bus driver or a problem with the bus driver exists.	Check your cabling and wiring and tighten any loose connections; see the instructions in Chapter 3.
	The module was removed while an operation was being performed.	Ensure that your module is properly connected; see the instructions in Chapter 3.
Data appears to be invalid.	An open connection exists.	Check your wiring and fix any open connections; see the instructions in Chapter 3.
	A transducer is not connected to the channel being read.	Check the transducer connections; see the instructions in Chapter 3.
	The thermocouple, RTD, thermistor, full-bridge sensor, or voltage input that you connected to the channel does not match the software configuration for that channel.	Check your wiring and ensure that what you specify in software matches your hardware configuration; see the instructions in Chapter 3.
	Your module may need recalibration.	The module is calibrated at the factory. Thereafter, yearly calibration is recommended. Use the DT9829 Calibration Utility, described on Chapter 7, or return your module to Data Translation for recalibration. For information on factory recalibration, contact Data Translation at 508-481-3700, ext. 1323 (if you are in the USA) of call your local distributor (if you are located outside the USA); see our web site (www.datatranslation.com) for the name and telephone number of your nearest distributor.
USB 2.0 or 3.0 is not recognized.	Your operating system does not have the appropriate Service Pack installed.	Ensure that you load the appropriate Windows Service Pack. If you are unsure of whether you are using USB 3.0, 2.0, or USB 1.1, run the Open Layers Control Panel applet, described on page 33.
	Standby mode is enabled on your PC.	For some PCs, you may need to disable standby mode on your system for proper USB 2.0 or 3.0 operation. Consult Microsoft for more information.

Technical Support

If you have difficulty using a DT9829 Series module, Data Translation's Technical Support Department is available to provide technical assistance.

To request technical support, to go our web site at http://www.datatranslation.com and click on the Support link.

When requesting technical support, be prepared to provide the following information:

- Your product serial number
- The hardware/software product you need help on
- The version of the OMNI CD you are using
- Your contract number, if applicable

If you are located outside the USA, contact your local distributor; see our web site (www.datatranslation.com) for the name and telephone number of your nearest distributor.

If Your Module Needs Factory Service

If your module must be returned to Data Translation, do the following:

1. Record the module's serial number, and then contact the Customer Service Department at (508) 481-3700, ext. 1323 (if you are in the USA) and obtain a Return Material Authorization (RMA).

   If you are located outside the USA, call your local distributor for authorization and shipping instructions; see our web site (www.datatranslation.com) for the name and telephone number of you nearest distributor. All return shipments to Data Translation must be marked with the correct RMA number to ensure proper processing.

2. Using the original packing materials, if available, package the module as follows:

   – Wrap the module in an electrically conductive plastic material. Handle with ground protection. A static discharge can destroy components on the board.

   – Place in a secure shipping container.

3. Return the board to the following address, making sure the RMA number is visible on the outside of the box.

   Customer Service Dept.
   Data Translation, Inc.
   100 Locke Drive
   Marlboro, MA 01752-1192

Specifications

Basic Module Specifications 148
Analog Input Specifications 149
Voltage Input Specifications 150
Current Specifications 152
Resistance Specifications 153
RTD Specifications 154
Thermistor Specifications 156
Thermocouple Specifications 157
Bridge and Strain Gage Specifications 162
Digital I/O Specifications 164
Isolation and Protection Specifications 165
Power, Physical, and Environmental Specifications 166
Terminal Block Specifications 167
Regulatory Specifications 168

Basic Module Specifications

Table 27 lists the basic specifications for the DT9829 Series modules.

Table 27: Basic Module Specifications

Feature	Specifications
Number of analog input channels DT9829-2: DT9829-4: DT9829-8:	 2 Differential (0 and 1) 4 Differential (0 to 3) 8 Differential (0 to 7)
Number of digital input lines	4 Isolated, TTL, 12 V and 24 V compliant
Number of digital output lines	4 Isolated, open-collector outputs
Data coding Analog input: Digital I/O:	 32-Bit floating point Binary
PC interface	USB 2.0 high speed
Power	Supplied by USB interface
Isolation	±500 V galvanic isolation to PC

Analog Input Specifications

Table 28 lists the analog input specifications for the DT9829 Series modules.

Table 28: Analog Input Specifications

Feature	Specifications
Number of analog input channels DT9829-2: DT9829-4: DT9829-8:	 Up to 2, individually configurable Up to 4, individually configurable Up to 8, individually configurable
Input modes	Voltage Current Resistance (2-, 3-, and 4-wire) RTD (2-, 3-, and 4-wire) Thermistor (2-, 3-, and 4-wire) Thermocouple Bridge (Full, Half, and Quarter) Strain gage
A/D converter type	24-bit Sigma-Delta
Sampling mode	Multiplexed
Aggregate sample rate (throughput)	960 Samples per second, maximum[a]

a. Divide the aggregate sample rate by the number of channels used to determine the per channel throughput rate. For example, if you are using eight channels, the maximum throughput is 120 Samples per second.

Voltage Input Specifications

Table 29 lists the voltage measurement specifications for the analog input subsystem on the DT9829 Series modules.

Table 29: Voltage Measurement Specifications

Feature	Specifications
Input ranges (software-selectable)	±10 V (gain of 1), ±2 V (gain of 5), or ±200 mV (gain of 50)
Input impedance	100 MΩ
Input bias current	150 nA
Input common mode voltage range (all ranges)	±12 V
Common mode rejection @50 Hz and 60 Hz	100 dB
Analog filter bandwidth, –3 dB [a]	425 Hz
Overvoltage protection	±24 V
Offset error Gain of 1 (±10 V range): Gain of 5 (±2 V range): Gain of 50 (±200 mV range):	 ±100 µV typical; ±200 µV maximum ±15 µV typical; ±30 µV maximum ±5 µV typical; ±8 µV maximum
Gain error (all ranges)	±0.02% of reading typical; ±0.1% of reading maximum
Offset error Tempco Gain of 1 (±10 V range): Gain of 5 (±2 V range): Gain of 50 (±200 mV range):	 ±10 µV/° C ±2 µV/° C ±1 µV/° C
Gain error Tempco Gain of 1 (±10 V range): Gain of 5 (±2 V range): Gain of 50 (±200 mV range):	 ±60 ppm of reading/° C ±10 ppm of reading/° C ±70 ppm of reading/° C

a. The input signal bandwidth is due to the combined responses of the 425 Hz analog filter and the ADC filter bandwidth. The ADC filter bandwidth is equal to 1.15 x the sampling frequency, in Hz. For example, with eight channels enabled and running at the maximum throughput of 960 Samples/s (120 Samples/second per channel), the ADC filter bandwidth is 1.15 x 960 Hz or 1.1 kHz. In this case, the input signal bandwidth is approximately equal to 425 Hz.

Table 30: Typical Voltage Noise

Throughput (Samples/s)	Noise (μVrms)		
	Gain = 50	Gain = 5	Gain = 1
960	1.2	10.0	40.0
120	0.4	2.5	12.0
60	0.3	2.0	10.0
10	0.2	1.0	5.0

Current Specifications

Table 33 lists the specifications for current measurement channels on the DT9829 Series modules.

Table 31: Current Specifications

Feature	Specifications
Input range	±25 mA
Sensor compliance voltage	5 V maximum @ 20 mA
Input terminal voltage (with respect to Agnd)	±12 V maximum
Common-mode rejection @ 50 Hz and 60 Hz	100 dB
Analog filter bandwidth, –3 dB [a]	425 Hz
Differential overvoltage protection	±15 V
Offset error	±0.5 µA typical; ±1 µA maximum
Gain error	±0.1% of reading typical; ±0.2% of reading maximum
Offset error Tempco	±0.025 µA/° C
Gain error Tempco	±10 ppm of reading/° C

a. The input signal bandwidth is due to the combined responses of the 425 Hz analog filter and the ADC filter bandwidth. The ADC filter bandwidth is equal to 1.15 x the throughput. For example, with eight channels enabled and running at the maximum throughput of 960 Samples/s (120 Samples/second per channel), the ADC filter bandwidth is 1.15 x 960 Samples/s or 1.1 kSamples/s. In this case, the input signal bandwidth is approximately equal to 425 Hz.

Resistance Specifications

Table 33 lists the specifications for resistance measurement channels on the DT9829 Series modules.

Table 32: Resistance Measurement Specifications

Feature	Specifications
Nominal input ranges	200 kΩ, 4 kΩ
Maximum readable values	200 kΩ, 4.7 kΩ
Measurement configuration	2-, 3-, or 4-wire
Offset error 0 to 4 kΩ range: 4 kΩ to 200 kΩ range:	 25 ppm of range, ±0.1 Ω, typical; 50 ppm of range, ±0.2 Ω maximum; 25 ppm of range, ±5 Ω, typical; 50 ppm of range, ±10 Ω, maximum
Gain error 0 to 4 kΩ range: 4 kΩ to 200 kΩ range:	 ±0.02% of reading typical; ±0.10% of reading maximum ±0.02% of reading typical; ±0.10% of reading maximum
Offset error Tempco 0 to 4 kΩ range: 4 kΩ to 200 kΩ range:	 ±0.005 Ω/° C ±0.20 Ω/° C
Gain error Tempco 0 to 4 kΩ range: 4 kΩ to 200 kΩ range:	 ±25 ppm of reading/° C ±25 ppm of reading/° C

RTD Specifications

Table 33 lists the specifications for RTD channels on the DT9829 Series modules.

Table 33: RTD Specifications

Feature	Specifications
RTD types (software-selectable)[a]	100 Ω, 500 Ω, and 1000 Ω, Pt 0.00385 Ω/Ω/° C, IEC 60751, ASTM-E1137 100 Ω,Pt 0.003911 Ω/Ω/° C, US Industrial Standard 100 Ω, Pt 0.003916 Ω/Ω/° C, JISC 1604-1989 100 Ω, Pt 0.003928 Ω/Ω/° C, ITS-90 1000 Ω, Pt 0.00375 Ω/Ω/° C, Low Cost 98.129 Ω, Pt 0.00392 Ω/Ω/° C, SAMA RC21-4-1966
Input ranges 100 Ω RTDs: 500 Ω and 1000 Ω RTDs:	 470 Ω 4700 Ω
Measurement configuration	2-, 3-, or 4-wire
Current source	425 µA ±0.5%
Warm-up time	10 minutes

a. Non-standard RTD types are supported with user-supplied Callendar-Van Dusen coefficients.

Table 34 lists the accuracy specifications for measured resistance for all RTD types.

Table 34: Accuracy Specifications for Measured Resistance for All RTD Types

Range	Gain Error (% of reading)		Offset Error (ppm of Range)		Gain Error Tempco (% of Reading/° C)	Offset Error Tempco (ppm of Range/° C)
	Typical	Maximum	Typical	Maximum		
470 Ω	±0.03	±0.10	±25	±40	±0.0075	±5
4700 Ω	±0.02	±0.10	±7.5	±15	±0.0027	±1

Table 35 lists the accuracy specifications for the Pt100, IEC60751.

Table 35: Accuracy Specifications for the Pt100, IEC60751[a]

Sensor Temperature (° C)	Accuracy Error (° C, Typical)	Accuracy Error (° C, Maximum)	Tempco (° C/C)
–200	±0.04	±0.08	±0.008
–100	±0.07	±0.19	±0.008
0	±0.11	±0.30	±0.008
100	±0.14	±0.41	±0.008
200	±0.17	±0.53	±0.008
400	±0.25	±0.76	±0.008
600	±0.33	±1.04	±0.008
800	±0.41	±1.32	±0.008

a. **Conditions for accuracy specifications:**
Module has been calibrated and warmed up for a minimum of 10 minutes.
Specifications are exclusive of sensor error and measurement noise.
Conversion from resistance to temperature is performed using the Callendar-Van Dusen equation and coefficients for the specified sensor.
Specifications do not include lead wire resistance errors for 2-wire RTD measurements.

Table 36 lists the accuracy specifications for the Pt1000, IEC60751.

Table 36: Accuracy Specifications for the Pt1000, IEC60751[a]

Sensor Temperature (° C)	Accuracy Error (° C, Typical)	Accuracy Error (° C, Maximum)	Tempco (° C/C)
–200	±0.02	±0.06	±0.004
–100	±0.04	±0.16	±0.004
0	±0.06	±0.27	±0.004
100	±0.08	±0.38	±0.004
200	±0.10	±0.49	±0.004
400	±0.15	±0.73	±0.004
600	±0.21	±1.00	±0.004
800	±0.26	±1.28	±0.004

a. **Conditions for accuracy specifications:**
Module has been calibrated and warmed up for a minimum of 10 minutes.
Specifications are exclusive of sensor error and measurement noise.
Conversion from resistance to temperature is performed using the Callendar-Van Dusen equation and coefficients for the specified sensor.
Specifications do not include lead wire resistance errors for 2-wire RTD measurements.

Thermistor Specifications

Table 33 lists the specifications for thermistor channels on the DT9829 Series modules.

Table 37: Thermistor Specifications

Feature	Specifications
Input range	200 kΩ
Maximum readable value	200 kΩ
Measurement configuration	2-, 3-, or 4-wire
Current source	10 µA, ±0.5%
Warm-up time	10 minutes

Table 38 lists the accuracy specifications for measured resistance for all thermistors.

Table 38: Accuracy Specifications for Measured Resistance for All Thermistors

Gain Error (% of reading)		Offset Error (ppm of Range)		Gain Error Tempco (% of Reading/° C)	Offset Error Tempco (ppm of Range/° C)
Typical	Maximum	Typical	Maximum		
±0.02	±0.10	±25.0	±50.0	±0.0027	±1

Table 39 lists the accuracy specifications for typical thermistor elements.

Table 39: Accuracy Specifications for Typical Thermistor Elements (Omega 44000 Series Thermistor Beads)[a]

Sensor Temperature (° C)	R25° C 3000 Ω		R25° C 10000 Ω		R25° C 30000 Ω	
	Typical (° C)	Maximum (° C)	Typical (° C)	Maximum (° C)	Typical (° C)	Maximum (° C)
–40	±0.004	±0.016	_[b]	_[b]	_[b]	_[b]
0	±0.014	±0.039	±0.008	±0.029	±0.005	±0.203
25	±0.042	±0.098	±0.017	±0.050	±0.009	±0.239
50	±0.126	±0.268	±0.042	±0.101	±0.017	±0.288
120	±1.580	±3.106	±0.418	±0.853	±0.165	±0.679

a. **Conditions for accuracy specifications:**
Module has been calibrated and warmed up for a minimum of 10 minutes.
Specifications are exclusive of sensor error and measurement noise.
Conversion from resistance to temperature is performed using the Steinhart-Hart equation and coefficients for the specified sensor.
Specifications do not include lead wire resistance errors for 2-wire thermistor measurements.

b. Resistance at these temperatures exceed the 200 kΩ measurement range.

Thermocouple Specifications

Table 40 lists the specifications for thermocouple channels on the DT9829 Series modules.

Table 40: Thermocouple Specifications

Feature	Specifications
Thermocouple types (software-selectable)	J, K, T, B, E, N, R, S
Full-scale input range	±200 mV
DC differential input impedance	100 MΩ
Open thermocouple detect current	150 nA
Input common-mode voltage (referenced to Agnd)	±10 V
Channel-to-channel common-mode voltage	±15 V
Warm-up time	10 minutes

System Temperature Error for the DT9829 Series

Table 41 lists the typical accuracy errors and Table 42 lists the maximum accuracy errors of the DT9829 Series module for each thermocouple type at several thermocouple measurement values.

The values in Table 41 are the typical errors expected when the module is operating at 23° C ±5° C ambient. The values in Table 42 are the maximum errors expected when operating the module is operating at 23° C ±5° C ambient.

Table 41: Typical Thermocouple Measurement Accuracy of the DT9829 Series at 23° C ±5° C

Thermocouple Temperature	Thermocouple Type[a]							
	J	K	T	E	S	R	B	N
–100° C	±0.12° C	±0.16° C	±0.16° C	±0.10° C	–	–	–	±0.25° C
0° C	±0.10° C	±0.14° C	±0.16° C	±0.10° C	±1.06° C	±1.10° C	–	±0.22° C
100° C	±0.15° C	±0.16° C	±0.15° C	±0.12° C	±0.77° C	±0.75° C	–	±0.21° C
300° C	±0.18° C	±0.25° C	±0.19° C	±0.16° C	±0.65° C	±0.62° C	±1.82° C	±0.24° C
500° C	±0.25° C	±0.28° C	–	±0.22° C	±0.66° C	±0.61° C	±1.14° C	±0.28° C
700° C	±0.31° C	±0.33° C	–	±0.29° C	±0.68° C	±0.62° C	±0.89° C	±0.34° C
900° C	±0.33° C	±0.45° C	–	±0.36° C	±0.70° C	±0.64° C	±0.78° C	±0.40° C
1100° C	±0.42° C	±0.50° C	–	–	±0.73° C	±0.66° C	±0.72° C	±0.47° C
1400° C	–	–	–	–	±0.79° C	±0.72° C	±0.71° C	–

a. **Conditions for accuracy measurements:**
Module has been calibrated and warmed up for 10 minutes.
Module is calibrated at 23° C.
CJC offset is nulled using the CJC calibration process.
The module is operated in a stable environment within the specified limits.
Inclusive of CJC error and input offset, gain, linearity, and long-term stability errors.
Exclusive of thermocouple errors.
Exclusive of noise.
Specifications are valid for 1 year from calibration.

Table 42: Maximum Thermocouple Measurement Accuracy of the DT9829 Series at 23° C ±5° C

Thermocouple Temperature	Thermocouple Type[a]							
	J	K	T	E	S	R	B	N
–100° C	±0.17° C	±0.23° C	±0.24° C	±0.14° C	–	–	–	±0.37° C
0° C	±0.17° C	±0.23° C	±0.25° C	±0.16° C	±1.69° C	±1.76° C	–	±0.34° C
100° C	±0.24° C	±0.26° C	±0.25° C	±0.20° C	±1.23° C	±1.21° C	–	±0.35° C
300° C	±0.33° C	±0.41° C	±0.33° C	±0.29° C	±1.06° C	±1.01° C	±2.93° C	±0.41° C
500° C	±0.46° C	±0.50° C	–	±0.40° C	±1.10° C	±1.02° C	±1.85° C	±0.50° C
700° C	±0.55° C	±0.61° C	–	±0.53° C	±1.15° C	±1.05° C	±1.46° C	±0.61° C
900° C	±0.63° C	±0.80° C	–	±0.67° C	±1.20° C	±1.09° C	±1.29° C	±0.72° C
1100° C	±0.81° C	±0.93° C	–	–	±1.26° C	±1.14° C	±1.21° C	±0.87° C
1400° C	–	–	–	–	±1.40 C	±1.28° C	±1.22° C	–

a. **Conditions for accuracy measurements:**
Module has been calibrated and warmed up for 10 minutes.
Module is calibrated at 23° C.
CJC offset is nulled using the CJC calibration process.
The module is operated in a stable environment within the specified limits.
Inclusive of CJC error and input offset, gain, linearity, and long-term stability errors.
Exclusive of thermocouple errors.
Exclusive of noise.
Specifications are valid for 1 year from calibration.

Thermocouple Measurement Noise

The total temperature measurement noise (short term variation) is the sum of the following two components:

- The equivalent temperature noise due to the noise of the analog input circuitry.
- The CJC sensor noise in degrees C.

The noise due to the analog input circuitry (volts) is converted to temperature by dividing the noise voltage by the sensitivity of the thermocouple type being used at the particular measurement temperature. Thermocouple sensitivities can be derived from commonly available NIST (National Institute of Standards and Technology) Thermocouple Reference Tables. The voltage noise from the analog input circuitry is a function of the programmed throughput rates.

Table 43 provides the typical expected voltage noise values for a DT9829 Series module. Also listed are the typical CJC sensor temperature noise values for a selection of throughput rates.

Table 43: Input Voltage Noise and CJC Sensor Noise for the DT9829 Series

Throughput (Samples/s)	Input Voltage Noise (µV pk-pk, typical)	CJC Noise (°C pk-pk, typical)
960	10.0	0.025
120	3.0	0.025
60	2.0	0.025
10	1.0	0.025

Thermocouple Noise Calculation Example

Assume that you are using a type K thermocouple to measure a temperature of approximately 100° C, and the DT9829 Series module is configured to use a throughput rate of 960 Samples/s. The steps to determine the expected measurement noise are as follows:

1. Determine the CJC noise at the stated throughput rate and filter setting. From Table 43, the CJC noise is 0.025°C pk-pk for a throughput rate of 960 Samples/s.
2. Determine the input voltage noise at the stated throughput rate and filter setting. From Table 43, the voltage noise is 10 µV pk-pk for a throughput rate of 960 Samples/s.
3. Determine the sensitivity of the specified thermocouple type at the measurement temperature. From the NIST Thermocouple Reference Tables, the sensitivity of a Type K thermocouple at 100°C is 41.5 µV/°C.

4. Calculate the equivalent temperature noise by dividing the input voltage noise by the sensitivity of the thermocouple:

   10 µV pk-pk / 41.5 µV/°C = 0.24°C pk-pk

5. To determine the total noise, add the CJC sensor noise to the equivalent temperature noise of the input voltage noise. The total temperature noise is as follows:

   0.025°C pk-pk + 0.24°C pk-pk = 0.265°C pk-pk

Bridge and Strain Gage Specifications

Table 44 lists the bridge and strain gage specifications for the DT9829 Series modules.

Table 44: Bridge and Strain Gage Specifications

Feature	DT9829 Series Specifications
Supported bridge configurations	Full Bridge, Half Bridge, Quarter Bridge (external completion resistor required for quarter bridge configurations)
Input range	±200 mV
Internal Half-Bridge completion resistors	Internal, 10 kΩ divider, 0.1% matching, 2 ppm/° C, tracking
Gain error	±0.05% of reading typical; 0.1% of reading maximum
Offset error	±5 µV typical; ±8 µV maximum

Table 45 lists the bridge compliance voltage specifications for the DT9829 Series modules.

Table 45: Bridge Compliance Voltage Specifications

Feature	DT9829 Series Specifications
Type	Internal. Supplied by the module through the USB connection.
Number	One common supply for up to eight analog input channels
Nominal voltage	3.0 VDC ±0.2%
Stability	35 ppm/° C
Power	225 mW, maximum
Short circuit limit	75 mA, maximum

Bridge Supply Capability

The bridge supply can be used to power up to eight connected bridge circuits (one for each channel). The number and type of bridges that the module can support is limited by the 225 mW power capability of the bridge supply. Table 46 shows the possible channel and bridge configurations.

Table 46: Number of Bridge Channels that Can Be Powered By the USB Host Port

Bridge Configuration	Total Number of Bridge Channels	Number of Channels Based on Bridge Resistance		
		120 Ω Bridge Resistance	350 Ω Bridge Resistance	1 kΩ Bridge Resistance
Full Bridge	8	0	0	8
	8	0	8	0
	3	3	0	0
	6	2	2	2
Half Bridge or Quarter Bridge	8	0	0	8
	8	0	8	0
	6	6	0	0
	8	4	Any	Any

Digital I/O Specifications

Table 47 lists the specifications for the digital I/O subsystems on the DT9829 Series modules.

Table 47: Digital I/O Specifications

Feature	Specifications
Number of digital I/O lines	8 (4 in, 4 out)
Number of ports	2 (4 bits each)
Digital Inputs Input characteristics: Input type: Input high voltage: Input low voltage: Input voltage limits:	 Level-sensitive Optocoupler, 2.2 kΩ in series with LED 2.0 V minimum 0.8 V maximum –5 V to +30 V (relative to Digital Input Return)
Digital Outputs Output characteristics: Current sink capability: Output voltage range: V_{ext} range: Off state leakage:	 Open collector, 100 kΩ pull-up to V_{ext} input 2 mA minimum, V_{CE} (sat) = 0.35 V maximum 30 V maximum 30 V maximum 1 µA maximum
Interrupt on change	No
Inputs clocked with sample clock	Yes
Software I/O selectable	No

Isolation and Protection Specifications

Table 48 lists the isolation and protection specifications for the analog input subsystem on the DT9829 Series modules.

Table 48: Isolation and Protection Specifications

Feature	Specifications
ESD protection per standard EN6100-4-2:2009 (see page 168 for more) Arc: Contact:	 8 kV 4 kV
Isolation voltage from analog input and digital I/O to the host computer	±500 V operational

Power, Physical, and Environmental Specifications

Table 49 lists the power, physical, and environmental specifications for the DT9829 Series modules.

Table 49: Power, Physical, and Environmental Specifications

Feature	Specifications
Power[a]	+5 V ±5% from USB host; 500 mA maximum
Physical Dimensions In enclosure: OEM version (no enclosure):	 Length: 8.667 inches (220.14 mm) Width: 4.170 inches (105.92 mm) Height: 1.575 inches (40 mm) Length: 8.577 inches (217.86 mm) Width: 3.937 inches (100 mm) Height: 0.843 inches (21.41 mm)
Weight In enclosure: OEM version (no enclosure):	 20.63 oz (585 g) 4.71 oz (133.4 g)
Environmental Operating temperature range: Storage temperature range: Relative humidity:	 0° C to 55° C –25° C to 85° C To 95%, noncondensing

a. The number and types of bridges that can be powered from the DT9829 Series module is limited by the 500 mA maximum current that may be drawn from the host USB port. Table 46 on page 163 shows the number of bridge channels that are supported given different bridge configurations.

Terminal Block Specifications

Table 50 lists the screw terminal block specifications for the DT9829 Series modules.

Table 50: Terminal Block Specifications

Feature	Specifications
Analog Input Screw Terminal Block (TB1)	32-position, dual row, 3.5 mm Phoenix Contact 1751536
Digital I/O Screw Terminal Block (TB2)	14-position, dual row, 3.5 mm Phoenix Contact 1751442

Note: Phoenix Contact specifies a wire insulation strip length of 0.197 inches (5 mm) and a wire size of 26 AWG minimum and 16 AWG maximum.

Regulatory Specifications

DT9829 Series modules are CE-compliant. Table 51 lists the regulatory specifications for the DT9829 Series module.

Table 51: Regulatory Specifications

Feature	Specifications
Emissions (EMI)	FCC Part 15, Class A EN55011:2007 (Based on CISPR-11, 2003/A2, 2006)
Immunity	EN61326-1:2006 Electrical Equipment for Measurement, Control, and Laboratory Use EMC Requirements EN61000-4-2:2009 Electrostatic Discharge (ESD) 4 kV contact discharge, 8 kV air discharge, 4 kV horizontal and vertical coupling planes EN61000-4-3:2006 Radiated electromagnetic fields, 3 V/m, 80 to 1000 MHz; 3 V/m, 1.4 GHz to 2 GHz; 1 V/m, 2 GHz to 2.7 GHz EN61000-4-4:2004 Electrical Fast Transient/Burst (EFT) 1 kV on data cables EN61000-4-6:2009 Conducted immunity requirements, 3 Vrms on data cables 150 kHz to 80 MHz
RoHS (EU Directive 2002/95/EG)	Compliant (as of July 1st, 2006)

Pin Assignments and LED Status Indicators

Screw Terminals 170
USB Connector 171
LED Status Indicators 172

Screw Terminals

Table 52 lists the screw terminal assignments of the screw terminals on the DT9829 Series modules.

Table 52: DT9829 Series Screw Terminal Designations

Screw Terminal Block	Screw Terminal Top Row	Signal Description	Screw Terminal Block	Screw Terminal Bottom Row	Signal Description
TB1	1	CH0+	TB1	2	SRC 0
	3	CH0–		4	RTN 0
	5	CH1+		6	SRC 1
	7	CH1–		8	RTN 1
	9	CH2+		10	SRC 2
	11	CH2–		12	RTN 2
	13	CH3+		14	SRC 3
	15	CH3–		16	RTN 3
	17	CH4+		18	SRC 4
	19	CH4–		20	RTN 4
	21	CH5+		22	SRC 5
	23	CH5–		24	RTN 5
	25	CH6+		26	SRC 6
	27	CH6–		28	RTN 6
	29	CH7+		30	SRC 7
	31	CH7–		32	RTN 7
TB2	33	EXC+ (3.0 V Bridge Out)	TB2	34	EXC– (Bridge Return)
	35	Digital Input 0		36	Digital Input 1
	37	Digital Input 2		38	Digital Input 3
	39	Digital Input Return		40	Digital Output 0
	41	Digital Output 1		42	Digital Output 2
	43	Digital Output 3		44	Digital Output Return
	45	Digital Output Supply[a]		46	Digital Output Supply Return

a. Supplies ranging from 3 VDC to 30 VDC are supported.

USB Connector

Figure 51 shows the orientation of the pins used by the USB connector on the DT9829 Series modules.

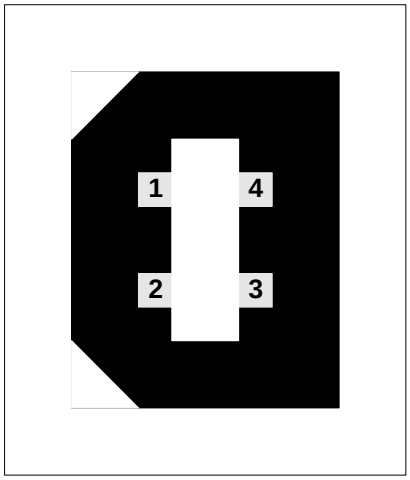


Figure 51: External USB Connector

Table 53 lists the pin assignments of the USB connector.

Table 53: J8 USB Connector Pin Assignments

Pin	Description
1	USB +5 V
2	USB Data –
3	USB Data +
4	USB Ground

LED Status Indicators

The DT9829 Series modules have a single bi-color LED that indicates the status of the module, as described in Table 54.

Table 54: LED Status Indicators on the DT9829 Series Modules

Color of the LED	Status Description
Green	Module is powered
Blinking amber	Module is acquiring data

Index

A

A coefficients
  RTD 96
  thermistor 98
A/D sample clock 112
accessories 21
accuracy specifications, thermocouple 159
administrator privileges 33
aliasing 112
analog input features
  basic module specifications 148, 149
  bridge specifications 162
  bridges 98
  channel list 93
  channels 92
  CJC circuit 95
  clocks 112
  continuous scan operations 114
  conversion modes 114
  current channels 94
  data format 116
  error conditions 117
  filtering 115
  gain 111
  input ranges 111
  open thermocouple detection 95
  resistance measurement channels 97
  resolution 111
  RTD channels 96
  RTD specifications 154
  single-value operations 114
  strain gages 98
  thermistor channels 97
  thermistor specifications 152, 153, 156
  thermocouple channels 94
  thermocouple specifications 157
  thermocouple types 94
  triggers 113
  voltage input channels 93
  voltage input specifications 150
  wiring bridge-based sensors 53
  wiring current signals 41
  wiring general-purpose bridges 53
  wiring resistors 47
  wiring RTD signals 44
  wiring strain gages 55
  wiring thermistor inputs 50
  wiring thermocouple inputs 43
  wiring voltage inputs 39
applet, Open Layers Control Panel 143
application wiring
  bridge-based sensors 53
  current signals 41
  digital inputs 70
  digital outputs 71
  Full-Bridge Axial Poisson strain gages 68
  Full-Bridge Bending Poisson strain gages 66
  Full-Bridge Bending strain gages 64
  general-purpose bridges 53
  Half-Bridge Bending strain gages 62
  Half-Bridge Poisson strain gages 60
  Quarter-Bridge strain gages 55
  Quarter-Bridge Temp Comp strain gages 58
  resistance measurements 47
  RTD inputs 44
  thermistors 50
  thermocouples 43
  voltage input 39
applications
  Quick Data Acq 20
  QuickDAQ 18
attaching the module to the computer 29

B

B coefficients
  RTD 96
  thermistor 98
base clock frequency 131
BaseClockFrequency 131
bias return termination resistor 125
binary encoding 124
block diagram 90
BNC DIN Rail KIt 21
bridge channels 98
  configurations 129
  data format 117
  specifications 162
  support 129
bridge configurations
  full bridge 101
  half bridge 101
  quarter bridge 101

bridge-based sensors 100
BridgeConfiguration 129
buffers 124
  inprocess flush 124

C

C coefficients
  RTD 96
  thermistor 98
C/C++ programs 20
cables, EP365 30
calibration 136
  required steps for each sensor type 138
  running the utility 137
CGL, *see* channel-gain list 125
CGLDepth 125
channel type, differential 125
channel-gain list 93
  depth 125
channels
  analog input 92
  bridges 98
  current 94
  digital inputs 118
  digital outputs 118
  number of 125
  resistance measurement 97
  RTD 96
  strain gages 98
  thermistor 97
  thermocouples 94
  voltage input 93
CJC circuit 43, 95, 128
clocks
  base frequency 131
  internal 131
  maximum external clock divider 131
  maximum throughput 131
  minimum external clock divider 131
  minimum throughput 131
cold junction compensation 95
configuring the device driver 33
connecting signals
  digital inputs 70
  digital outputs 71
connecting to the host computer
  directly 30
  using a self-powered USB hub 31
connector, external USB 171
continuous analog input operations 114
continuous digital input 119
Control Panel applet 143
conversion modes
  continuous scan 114
  digital I/O 119
  single-value analog input 114
conversion rate 114
current channels 94
current support 127
customer service 145

D

DAQ Adaptor for MATLAB 20
data encoding 116
data filters 128
data flow modes
  continuous analog input 123
  single-value 123
data format
  bridge-based sensors 117
  current 116
  resistance measurements 116
  RTDs 116
  strain gages 117
  thermistors 116
  thermocouples 116
  voltage inputs 116
DataAcq SDK 20
device driver 18
Device Selection window 75
differential channels 125
digital I/O features
  input lines 118
  operation modes 119
  output lines 118
  resolution 119
  specifications 164
  wiring inputs 70
  wiring outputs 71
digital input port 119
DIN rail kit 21
DT9829 Calibration Utility 18
DT9829 Device Driver 33
DT-Open Layers for .NET Class Library 20

E

encoding data 116
environmental specifications 166
EP365 30

errors, analog input 117
examples, thermocouple measurement 77
excitation voltage
  internal 129
  maximum 129
  minimum 129
external clock divider
  maximum 131
  minimum 131
external USB connector 171

F

factory service 145
features 16
FIFOSize 123
filters 115, 128
floating-point data 116
floating-point numbers 124
formatting data
  analog input 116
  bridge-based sensors 117
  current 116
  resistance measurements 116
  RTDs 116
  strain gages 117
  thermistors 116
  thermocouples 116
  voltage inputs 116
frequency
  base clock 131
  internal A/D sample clock 112, 131
Full-Bridge Axial Poisson configuration 101
  wiring 68
Full-Bridge Bending configuration 101
  wiring 64
Full-Bridge Bending Poisson configuration 101
  wiring 66

G

gain 111
  actual available 126
  number of 126
gains 93
general-purpose bridges 101

H

Half-Bridge Bending configuration 101
  wiring 62
Half-Bridge Poisson configuration 101
  wiring 60
hot-swapping 31, 32

I

inprocess buffers 124
input ranges 111
interleaved CJC data 128
internal A/D sample clock 112, 131
internal excitation current source 127
  supported values 127
internal excitation voltage 129
isolation specifications 165

L

LabVIEW 20
LED 30
LED status indicator 31, 32, 172
legacy CPL elevated 33
LV-Link 20

M

MATLAB 20
MaxDifferentialChannels 125
MaxExcitationVoltage 129
MaxExtClockDivider 131
MaxFrequency 131
MaxMultiScanCount 124
MinExcitationVoltage 129
MinExtClockDivider 131
MinFrequency 131
moving average filter 115
multisensor inputs 125

N

number of
  differential channels 125
  gains 126
  I/O channels 125
  resolutions 127
  voltage ranges 126
NumberOfChannels 125
NumberOfRanges 126
NumberOfResolutions 127
NumberOfSupportedGains 126
Nyquist Theorem 112

O

Open Layers Control Panel 33, 143
open thermocouple detection 95
operation modes
  continuous digital input 119
  continuous scan 114
  single-value analog input 114
  single-value digital I/O 119

P

physical specifications 166
pin assignments
  external USB connector 171
post-trigger acquisition mode 123
power 31, 32
power specifications 166
programmable gain 126
protection specifications 165

Q

Quarter-Bridge configuration 101
  wiring 55
Quarter-Bridge Temp Comp configuration 101
  wiring 58
Quick Data Acq 20
QuickDAQ
  Advanced FFT Analysis option 19
  Base version 18
  FFT Analysis option 19
QuickDAQ application 74

R

R0 coefficients 96, 128
ranges 111
  number of 126
raw filter 115
recommendations for wiring 37
regulatory specifications 168
resistance measurement channels 97
  2-wire connections 49
  3-wire connections 48
  4-wire connections 47
  data format 116
  support 127
resolution
  analog input 111
  available 127
  digital I/O 119
  number of 127
returning boards to the factory 145
ReturnsFloats 124
RMA 145
rosette 56
RTD channels 96
  2-wire connections 46
  3-wire connections 45
  4-wire connections 44
  A coefficient 96
  B coefficient 96
  C coefficient 96
  data format 116
  R0 coefficient 96, 128
  specifications 154
  support 128
  types 128
RtdR0 128
RTDType 128

S

sample clock 112, 131
screw terminals
  on the DT9829 module 170
SDK 20
SENSOR_IS_OPEN 95
service and support procedure 144
shunt calibration 129
single-value operations 123
  analog input 114
  digital I/O 119
size, module 166
software supported 18
software trigger 113, 130
specifications 147
  basic module 148, 149
  bridge 162
  digital I/O 164
  environmental 166
  isolation and protection 165
  physical 166
  power 166
  regulatory 168
  RTD 154
  system temperature error 158
  terminal block 167
  thermistors 152, 153, 156
  thermocouple 157
  voltage input 150

specifying a single channel
  analog input 92
  digital I/O 119
specifying one or more channels 93
stopping an operation 114
strain gage channels 98, 101
  configurations 129
  data format 117
  Full-Bridge Axial Poisson configuration 68
  Full-Bridge Bending configuration 64
  Full-Bridge Bending Poisson configuration 66
  Half-Bridge Bending configuration 62, 101
  Half-Bridge Poisson configuration 60, 101
  Quarter-Bridge configuration 55, 101
  Quarter-Bridge Temp Comp configuration 58, 101
  support 129
strain gage configurations
  Full-Bridge Axial Poisson 68, 110
  Full-Bridge Bending 64, 108
  Full-Bridge Bending Poisson 66, 109
  Half-Bridge Bending 62, 107
  Half-Bridge Poisson 60, 106
  Quarter-Bridge 55, 104
  Quarter-Bridge Temp Comp 58, 105
StrainGageBridgeConfiguration 129
supported thermocouple types 128
SupportedGains 126
SupportedResolutions 127
SupportedVoltageRanges 126
supports data filters 128
SupportsBinaryEncoding 124
SupportsBridge 129
SupportsBuffering 124
SupportsCjcSourceInternal 128
SupportsContinuous 123
SupportsCurrent 127
SupportsDifferential 125
SupportsInProcessFlush 124
SupportsInputTermination 125
SupportsInterleavedCjcTemperaturesInStream 128
SupportsInternalClock 131
SupportsInternalExcitationCurrentSrc 127
SupportsInternalExcitationVoltage 129
SupportsMultiSensor 125
SupportsProgrammableGain 126
SupportsResistance 127
SupportsRTD 128
SupportsShuntCalibration 129
SupportsSingleValue 123
SupportsSoftwareTrigger 130
SupportsStrainGage 129
SupportsTemperatureDataInStream 128
SupportsTemperatureFilters 128
SupportsThermistor 128
SupportsThermocouple 128
SupportsTriggeredScan 124
system requirements 28
system temperature error 158

T

technical support 144
temperature error 158
temperature filter type 128
TemperatureFilterType 128
terminal block specifications 167
thermistor channels 97
  2-wire connections 50
  3-wire connections 51
  4-wire connections 52
  A coefficients 98
  B coefficients 98
  C coefficients 98
  data format 116
  specifications 152, 153, 156
  support 128
thermocouple channels 94
  accuracy specifications 159
  data format 116
  specifications 157
  support 128
  system temperature error 158
  temperature measurement noise 160
  types 94
thermocouple measurement example 77
ThermocoupleType 128
throughput
  maximum 131
  minimum 131
trigger, software 113, 130
troubleshooting
  procedure 142
  service and support procedure 144
  troubleshooting table 142

U

unpacking 27
USB cable 30
USB LED 30

V

Visual Basic for .NET programs 20
Visual C# programs 20
voltage converted to temperature in hardware 128
voltage input channels 93
  data format 116
  specifications 150
  wiring 39
voltage ranges 93, 126
  number of 126

W

warm-up time 37
Wheatstone bridge 98
wiring signals
  bridge-based sensors 53
  current signals 41
  digital inputs 70
  digital outputs 71
  Full-Bridge Axial Poisson strain gage 68
  Full-Bridge Bending Poisson strain gage 66
  Full-Bridge Bending strain gage 64
  general-purpose bridges 53
  Half-Bridge Bending strain gage 62
  Half-Bridge Poisson strain gage 60
  Quarter-Bridge strain gages 55
  Quarter-Bridge Temp Comp strain gage 58
  recommendations 37
  resistance measurement 47
  RTD signals 44
  thermistor signals 50
  thermocouple input signals 43
  voltage input signals 39
writing programs in
  C/C++ 20
  Visual Basic .NET 20
  Visual C# 20