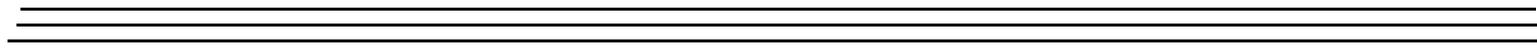
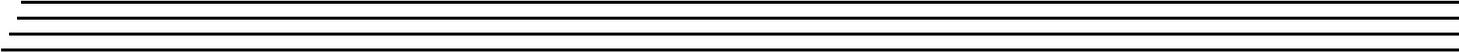
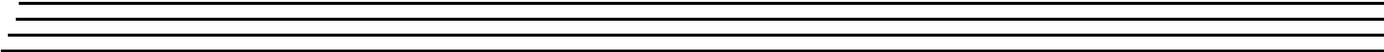




UM-23654-Z

***User's Manual for  
Standard TEMPpoint, VOLTpoint,  
and MEASURpoint USB  
Instruments***

***DT9871, DT9871U, DT9872, DT9873, DT9874***



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# About this Manual

TEMPpoint™ is a family of temperature measurement instruments that includes the DT9871, DT9871U, DT8871, DT8871U, DT9872, and DT8872. This manual describes the DT9871, DT9871U, and DT9872 USB models.

VOLTpoint™ is a family of voltage measurement instruments that includes the DT9873 and DT8873. This manual describes the DT9873 USB model.

MEASURpoint™ a family of mixed temperature and voltage measurement instruments that includes the DT9874 and DT8874. This manual describes the DT9874 USB model.

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**Note:** For information on the DT8871U, DT8871, DT8872, DT8873, and DT8874 LXI models of TEMPpoint, VOLTpoint, and MEASURpoint, refer to the *User's Manual for Standard TEMPpoint, VOLTpoint, and MEASURpoint LXI Instruments*.

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The first part of this manual describes how to install and set up your instrument, and verify that the instrument is working properly.

The second part of this manual describes the features and capabilities of your instrument using the IVI-COM instrument driver software. Troubleshooting information is also provided.

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**Note:** If you are programming the instrument using the IVI-COM driver, refer to the DtxMeasurement IVI-COM driver online help for more information.

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## Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for using and/or programming a TEMPpoint, VOLTpoint, or MEASURpoint instrument in the Microsoft® Windows® XP, Windows Vista®, Windows 7, or Windows 8 operating system. It is assumed that you have some familiarity with thermocouples, RTDs, and/or voltages and that you understand your application.

## How this Manual is Organized

This manual is organized as follows:

- [Chapter 1, “Overview,”](#) summarizes the major features of the TEMPpoint, VOLTpoint, and MEASURpoint instruments, as well as the supported software and accessories.
- [Chapter 2, “Preparing to Use the Instrument,”](#) describes how to unpack the instrument, check the system requirements, install the software, and view the documentation online.
- [Chapter 3, “Setting Up and Installing the Instrument,”](#) describes how to apply power to the instrument and connect the instrument to your computer.
- [Chapter 4, “Wiring Signals,”](#) describes how to wire signals to the instrument.
- [Chapter 5, “Verifying the Operation of Your Instrument,”](#) describes how to verify the operation of the instrument.
- [Chapter 6, “Principles of Operation,”](#) describes the analog input and digital I/O features of the TEMPpoint, VOLTpoint, and MEASURpoint instruments in detail.
- [Chapter 7, “Troubleshooting,”](#) provides information that you can use to resolve problems with your instrument, should they occur.
- [Appendix A, “Specifications,”](#) lists the specifications of the TEMPpoint, VOLTpoint, and MEASURpoint instruments.
- [Appendix B, “Connector Pin Assignments,”](#) describes the pin assignments of the digital I/O connector on the TEMPpoint, VOLTpoint, and MEASURpoint instruments.
- 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**.
-  CAUTION – This icon denotes a caution, which advises you to consult the documentation where this symbol is marked.

CAUTION – Do not operate this product in a manner not specified in this document. Product misuse can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way.

## Related Information

Refer to the following documents for more information on using a TEMPpoint, VOLTpoint, or MEASURpoint USB instrument:

- DtxMeasurement IVI-COM Driver online help. This document describes how to use the IVI-COM driver to access the capabilities of a TEMPpoint, VOLTpoint, or MEASURpoint instrument.

The IVI-COM driver works with any development environment that supports COM programming, including MATLAB® from The MathWorks™, Microsoft® Visual C#.NET or Visual Basic®.NET, Agilent® VEE Pro, National Instruments™ LabVIEW™ or LabWindows™, and so on.

- *QuickDAQ User's Manual* (UM-25242). This manual describes how to create a QuickDAQ application to acquire and analyze data from a TEMPpoint, VOLTpoint, or MEASURpoint instrument.
- IVI foundation ([www.ivifoundation.org](http://www.ivifoundation.org))
- *Omega Complete Temperature Measurement Handbook and Encyclopedia*® or the Omega Engineering web site: <http://www.omega.com>. Both resources provide valuable information on thermocouple types, RTD types, standards, and linearization.

## Where To Get Help

Should you run into problems installing or using a TEMPpoint, VOLTpoint, or MEASURpoint instrument, the Data Translation Technical Support Department is available to provide technical assistance. Refer to [Chapter 7](#) 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.mccdaq.com](http://www.mccdaq.com)).





# ***Overview***

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## Hardware Features

Data Translation provides a number of USB instruments to meet your measurement needs, including the following:

- TEMPpoint – a family of temperature measurement instruments
- VOLTpoint – a family of voltage measurement instruments
- MEASURpoint – a family of mixed temperature and voltage measurement instruments

All of these instruments support Version 2.0 and 1.1 of the USB bus.

The following sections summarize the features of the TEMPpoint, VOLTpoint, and MEASURpoint USB instruments.

### TEMPpoint Features

TEMPpoint instruments include the following models: DT9871U, DT9871, and DT9872.

Figure 1 shows a DT9871U instrument.



Figure 1: TEMPpoint Instrument

The key features of TEMPpoint instruments are as follows:

- *DT9871U and DT9871:*
  - Configurable analog input channels for thermocouple or differential voltage inputs; easy-access jacks for each channel for quick wiring
  - One CJC (cold junction compensation) input for each thermocouple channel

- B, E, J, K, N, R, S, and T thermocouple types supported; the instrument automatically linearizes the measurements and returns the data as a 32-bit, floating-point temperature values
- Input range of  $\pm 0.075$  V for the DT9871U (with  $0.25$   $\mu$ V RMS A/D noise using no software filtering) and  $\pm 1.25$  V for the DT9871 (with  $5$   $\mu$ V RMS A/D noise using no software filtering)
- Break-detection circuitry to detect open thermocouple inputs
- *DT9872:*
  - Configurable analog input channels for RTDs and differential voltage inputs; easy-access jacks for each channel for quick wiring
  - $100\ \Omega$ ,  $500\ \Omega$ , and  $1000\ \Omega$  platinum RTD types supported using alpha curves of  $0.00385$  (European) or  $0.00392$  (American)
  - 4-wire, 3-wire, or 2-wire configurations; the DT9872 automatically linearizes the measurements and returns the data as 32-bit, floating-point temperature, resistance, or voltage values
  - Input range of  $\pm 1.25$  V
- One 24-bit, Delta-Sigma A/D converter per channel for simultaneous, high-resolution measurements
- Throughput rate of up to 10 Samples/s for all channels.
- Software or external, digital trigger on digital input line 0 starts acquisition
- Auto-calibrating front-end resets the zero point on each power-up; in addition, the instrument supports anytime calibration, performing an auto-calibration function on software command
- Measurement Calibration Utility allows you to calibrate the instrument in the field (see [page 20](#) for more information on this utility)
- 8 opto-isolated digital input lines; you can read the digital input port through the analog input data stream for correlating analog and digital measurements
- 8 opto-isolated digital output lines; the outputs are solid-state relays that operate from  $\pm 30$  V at currents up to 400 mA (peak) AC or DC

## VOLTpoint Features

Figure 2 shows a VOLTpoint instrument.



**Figure 2: VOLTpoint Instrument**

The key features of VOLTpoint (DT9873) instruments are as follows:

- Direct connection of analog input channels for differential voltage inputs; removable screw terminal blocks for each channel for quick wiring
- One 24-bit, Delta-Sigma A/D converter per channel for simultaneous, high-resolution measurements
- Software-selectable input range of  $\pm 10$  V or  $\pm 60$  V per channel (note that for the  $\pm 60$  V range, no more than 30 V<sub>rms</sub>, 42.4 V<sub>pk</sub>, 60 VDC is allowed)
- Throughput rate of up to 10 Samples/s for all channels
- Software or external, digital trigger on digital input line 0 starts acquisition
- Auto-calibrating front-end resets the zero point on each power-up; in addition, the instrument supports anytime calibration, performing an auto-calibration function on software command
- Measurement Calibration Utility allows you to calibrate the instrument in the field (see [page 20](#) for more information on this utility)
- 8 opto-isolated digital input lines; you can read the digital input port through the analog input data stream for correlating analog and digital measurements
- 8 opto-isolated digital output lines; the outputs are solid-state relays that operate from  $\pm 30$  V at currents up to 400 mA (peak) AC or DC

## MEASURpoint Features

The standard MEASURpoint (DT9874) instrument provides 16 thermocouple channels, 16 RTD channels, and 16 voltage channels. Figure 3 shows a MEASURpoint instrument.



Figure 3: MEASURpoint Instrument

The key features of MEASURpoint instruments are as follows:

- *Analog Input Channels 0 to 15:*
  - Configurable channels for thermocouple or differential voltage inputs; easy-access jacks for each channel for quick wiring
  - One CJC (cold junction compensation) input for each thermocouple channel
  - B, E, J, K, N, R, S, and T thermocouple types supported; the instrument automatically linearizes the measurements and returns the data as a 32-bit, floating-point temperature values
  - Input range of  $\pm 0.075$  V (with  $0.25$   $\mu$ V RMS A/D noise using no software filtering)
  - Break-detection circuitry to detect open thermocouple inputs
- *Analog Input Channels 16 to 31:*
  - Configurable analog input channels for RTDs and differential voltage inputs; easy-access jacks for each channel for quick wiring
  - $100$   $\Omega$ ,  $500$   $\Omega$ , and  $1000$   $\Omega$  platinum RTD types supported using alpha curves of  $0.00385$  (European) or  $0.00392$  (American)

- 4-wire, 3-wire, or 2-wire configurations; the DT9872 automatically linearizes the measurements and returns the data as 32-bit, floating-point temperature, resistance, or voltage values
- Input range of  $\pm 1.25$  V
- *Analog Input Channels 31 to 48:*
  - Direct connection of analog input channels for differential voltage inputs; removable screw terminal blocks for each channel for quick wiring
  - Software-selectable input range of  $\pm 10$  V or  $\pm 60$  V (note that for the  $\pm 60$  V range, no more than 30 V<sub>rms</sub>, 42.4 V<sub>pk</sub>, 60 VDC is allowed)
- One 24-bit, Delta-Sigma A/D converter per channel for simultaneous, high-resolution measurements
- 30 VAC, 60 VDC continuous functional isolation ch-ch and ch-gnd, verified by a 500 V<sub>pk</sub> withstand
- Throughput rate of up to 10 Samples/s for all channels
- Software or external, digital trigger on digital input line 0 starts acquisition
- Auto-calibrating front-end resets the zero point on each power-up; in addition, the instrument supports anytime calibration, performing an auto-calibration function on software command
- Measurement Calibration Utility allows you to calibrate the instrument in the field (see [page 20](#) for more information on this utility)
- 8 opto-isolated digital input lines; you can read the digital input port through the analog input data stream for correlating analog and digital measurements
- 8 opto-isolated digital output lines; the outputs are solid-state relays that operate from  $\pm 30$  V at currents up to 400 mA (peak) AC or DC

## Supported Software

The following software is available for use with the TEMPpoint, VOLTpoint, and MEASURpoint USB instruments:

- **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 these features:
  - 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 these features:
  - 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.
- **DtxMeasurement IVI-COM driver** – This driver provides access to the instrument's functions through a COM server. The IVI-COM driver works in any 32-bit or 64-bit development environment that supports COM programming, including MATLAB, Visual Basic.NET, Visual C#.NET, Agilent VEE Pro, LabVIEW, LabWindows, and others.
- **Measurement Calibration Utility** – Users can calibrate a TEMPpoint, VOLTpoint, or MEASURpoint instrument in the field using precise calibration equipment and the Measurement Calibration Utility. Since each instrument consists of up to 48 individual channels, great care must be taken to ensure that proper warm-up times are followed and precise calibration equipment is used.

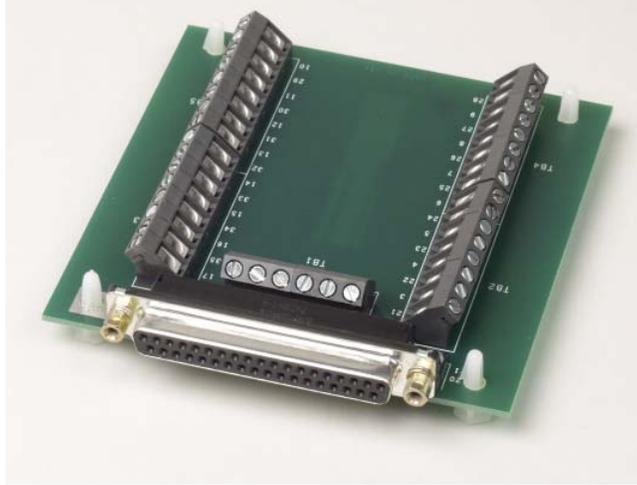
The calibration utility ships with a comprehensive help file that describes the required equipment and calibration procedure, including warm-up times, for each instrument.

The calibration utility allows you to revert to the factory calibration for any or all channels, or revert back to the last user calibration values, if desired. In addition, this utility generates a report that lists the starting and ending calibration values for each channel, allowing traceability.

## Accessories

The following optional accessories are available for TEMPpoint, VOLTpoint, or MEASURpoint instruments:

- **STP37 screw terminal panel** – The STP37, shown in [Figure 4](#), permits easy screw terminal connections for accessing the digital I/O signals of a TEMPpoint, VOLTpoint, or MEASURpoint instrument.



**Figure 4: STP37 Screw Terminal Panel**

- **EP333 cable** – The EP333, shown in [Figure 5](#), is a 2-meter shielded cable with two 37-pin connectors that connects the STP37 screw terminal panel to the digital I/O connector of the instrument.

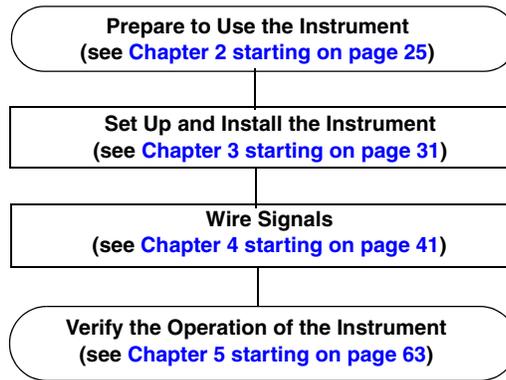


**Figure 5: EP333 Cable**

- **EP373 Single Rack-mount Kit** – Mounts one TEMPpoint, VOLTpoint, or MEASURpoint instrument in a rack.
- **EP374 Dual Rack-mount Kit** – Mounts two TEMPpoint, VOLTpoint, or MEASURpoint instruments side-by-side in a rack.

## Getting Started Procedure

The flow diagram shown in [Figure 6](#) illustrates the steps needed to get started using a TEMPpoint, VOLTpoint, or MEASURpoint instrument. This diagram is repeated in each Getting Started chapter; the shaded area in the diagram shows you where you are in the getting started procedure.



**Figure 6: Getting Started Flow Diagram**

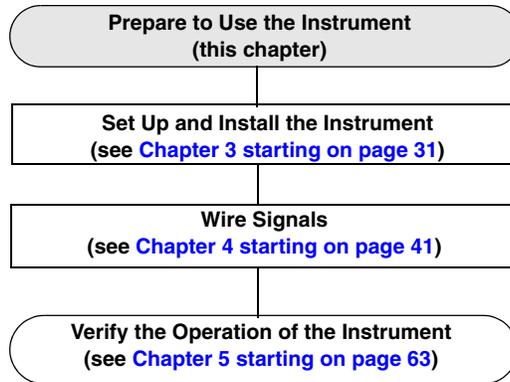
# ***Part 1: Getting Started***





## ***Preparing to Use the Instrument***

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## **Unpacking**

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

- TEMPpoint, VOLTpoint, or MEASURpoint instrument
- USB cable
- EP361 +5V power supply and cable
- For DT9872, DT9874, and DT9874 instruments, a bag of pluggable screw terminable blocks

If an item is missing or damaged, contact Data Translation. If you are in the United States, call the Customer Service Department at (508) 946-5100. 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.mccdaq.com](http://www.mccdaq.com)).

Once you have unpacked your instrument, check the system requirements, as described in the next section.

## ***Checking the 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)  
Windows XP SP3 (32-bit)
- Disk Space: 4 GB
- Acrobat Reader 5.0 or later for viewing documentation

## ***Installing the Software***

Install the software for your instrument from the web at  
**<https://www.mccdaq.com/downloads/DTSsoftware/MEASURpoint>**.

The installation program guides you through the installation process.

## Viewing the Documentation

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**Note:** To view the documentation, you must have Adobe Reader 5.0 or greater installed on your system.

---

You can access the documentation for your instrument from the Windows Start menu as follows:

- For documentation about the TEMPpoint, VOLTpoint, or MEASURpoint instrument, click **Programs -> Data Translation, Inc -> Hardware Documentation -> User's Manual for Standard TEMPoint, VOLTpoint, and MEASURpoint USB Instruments.**
- For documentation on QuickDAQ, click **Programs -> Data Translation, Inc -> QuickDAQ -> QuickDAQ User's Manual**
- For documentation on the DtxMeasurement IVI-COM driver, click **Programs -> Data Translation, Inc -> DtxMeasurement -> DtxMeasurement IVI Driver 1.1.8 Documentation.**

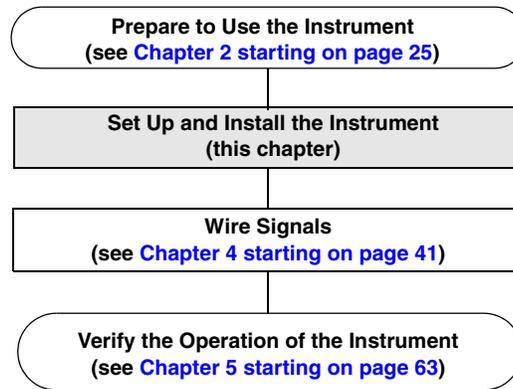
The following may be helpful when using Adobe Reader:

- To navigate to a specific section of the document, click a heading from the table of contents on the left side of the document.
- Within the document, click the text shown in blue to jump to the appropriate reference (the pointer changes from a hand to an index finger).
- To go back to the page from which the jump was made, click the right mouse button and **Go Back**, or from the main menu, click **Document**, and then **Go Back**.
- To increase or decrease the size of the displayed document, from the main menu, click **View**, and then **Zoom**.
- By default, Adobe Reader smooths text and monochrome images, sometimes resulting in blurry images. If you wish, you can turn smoothing off by clicking **File**, and then **Preferences/General**, and unchecking **Smooth Text and Images**.

# 3

## ***Setting Up and Installing the Instrument***

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Attaching the Instrument to the Computer .....	35
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---

**Note:** Your TEMPpoint, VOLTpoint, and MEASURpoint instruments are factory-calibrated. Thereafter, yearly recalibration is recommended. Refer to [page 94](#) for more information on calibration.

---

## Applying Power

TEMPpoint, VOLTpoint, and MEASURpoint instruments are shipped with an EP361 +5V power supply and cable. To apply power to the instrument, do the following:

1. Connect the +5 V power supply to the power connector on the rear panel of the instrument. Refer to [Figure 7](#).



**Figure 7: Attaching a +5 V Power Supply to the Instrument**

2. Plug the power supply into a wall outlet.

---

**IMPORTANT:** For proper grounding of your measurement instrument, ensure that you use the power supply and cable (EP361) that is provided with the instrument and that you use all three prongs of the cable when connecting it to your wall outlet.

---

3. Press the Power Switch to turn on the instrument.  
*The Power LED on the front panel lights to indicate that power is on.*

Figure 8 shows the location of the Power LED on the front panel of the instrument; a MEASURpoint instrument is shown in this example.



Figure 8: Power LED on the Front Panel of the Instrument

---

## Attaching the Instrument to the Computer

This section describes how to attach a TEMPpoint, VOLTpoint, or MEASURpoint instrument to the host computer.

---

**Notes:** Most computers have several USB ports that allow direct connection to USB devices. If your application requires more TEMPpoint, VOLTpoint, or MEASURpoint instruments than you have USB ports for, you can expand the number of USB devices attached to a single USB port by using expansion hubs. For more information, refer to [page 38](#).

You can unplug a USB instrument, 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 an instrument once it is plugged back in.

---

You must install the device driver before connecting your instrument to the host computer. See [page 29](#) for more information.

### Connecting Directly to the USB Ports

To connect a TEMPpoint, VOLTpoint, or MEASURpoint instrument directly to a USB port on your computer, do the following:

1. Make sure that you have attached a power supply to the instrument.
2. Attach one end of the USB cable to the USB port on the rear panel of the instrument, as shown in [Figure 9](#).



**Figure 9: Attaching the Instrument to the Host Computer**

3. Attach the other end of the USB cable to one of the USB ports on the host computer.  
*The operating system automatically detects the instrument 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**.

For Windows XP:

  - a. Click **Next** and/or **Finish** as required in the wizard.  
*Once the firmware is loaded, the wizard restarts to initiate the firmware to accept commands.*
  - b. Click **Next** and/or **Finish** again.

---

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

---

If the power supply and the instrument are attached correctly, the USB LED on the rear panel, shown in [Figure 10](#), turns green.



**Figure 10: LEDs on the Rear Panel of the Instrument**

5. Repeat the steps to attach another TEMPpoint, VOLTpoint, or MEASURpoint instrument to the host computer, if desired.

## Connecting to an Expansion Hub

Expansion hubs are powered by their own external power supply. Theoretically, you can connect up to five expansion hubs to a USB port on the host computer. However, the practical number of instruments that you can connect to a single USB port depends on the throughput you want to achieve. Each of the hubs supports up to four instruments.

To connect multiple TEMPpoint, VOLTpoint, or MEASURpoint instruments to an expansion hub, do the following:

1. Make sure that you have attached a power supply to the instrument.
2. Attach one end of the USB cable to the instrument and the other end of the USB cable to an expansion hub.
3. Connect the power supply for the expansion hub to an external power supply.
4. Connect the expansion hub to the USB port on the host computer using another USB cable.

*The operating system automatically detects the instrument and starts the Found New Hardware wizard.*

5. 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**.

For Windows XP:

- a. Click **Next** and/or **Finish** as required in the wizard.  
*Once the firmware is loaded, the wizard restarts to initiate the firmware to accept commands.*
- b. Click **Next** and/or **Finish** again.

---

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

---

*If the power supply and the instrument are attached correctly, the USB LED on the rear panel, shown in [Figure 10](#), turns green.*

6. Repeat these steps until you have attached the number of expansion hubs (up to five) and instruments (up to four per hub) that you require. Refer to [Figure 11](#).  
*The operating system automatically detects the instruments as they are installed.*

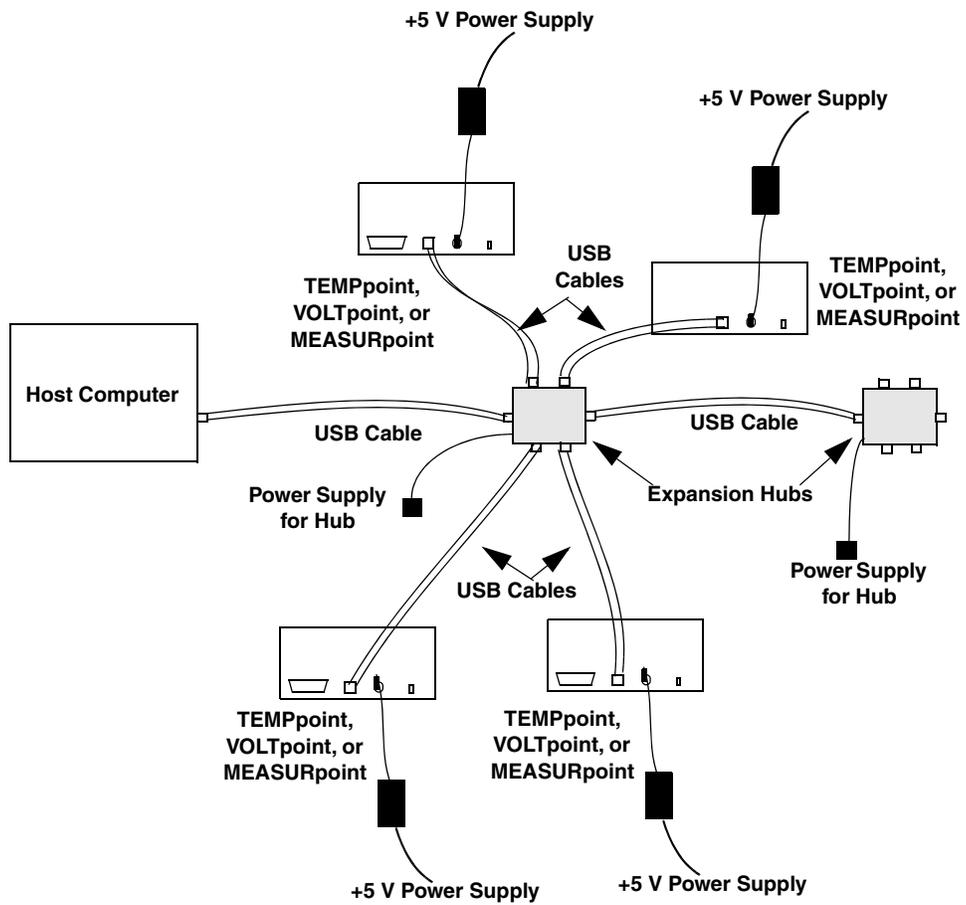


Figure 11: Attaching Multiple Instruments Using Expansion Hubs

---

## 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 device driver for a TEMPpoint, VOLTpoint, or MEASURpoint instrument, do the following:

1. If you have not already done so, power up the host computer and all peripherals.
2. From the Windows Start menu, select **Settings -> Control Panel**.
3. From the Control Panel, double-click **Open Layers Control Panel**.  
*The Data Acquisition Control Panel dialog box appears.*
4. Click the name of the instrument that you want to configure, and then click **Advanced**.  
*The Configurable Board Options dialog box appears.*
5. For each channel, set the **Channel Configuration** as voltage (the default) or one of the supported sensor types for that channel.

---

**Note:** If you wish, you can overwrite these channel input types programmatically using your software development environment or application.

---

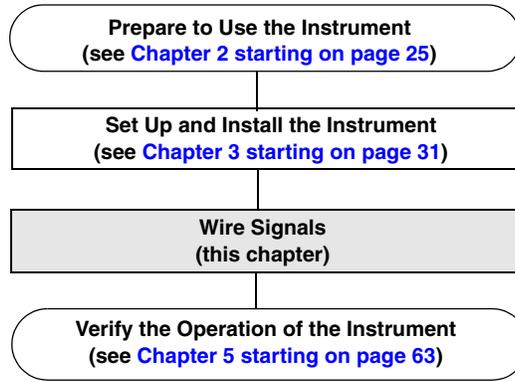
6. Click **OK**.
7. If you want to rename the instrument, click **Edit Name**, enter a new name for the instrument, and then click **OK**. The name is used to identify the instrument in all subsequent applications.
8. Repeat steps 4 to 7 for the other instrument that you want to configure.
9. When you are finished configuring the instrument, click **Close**.

Continue with the instructions on wiring in [Chapter 4](#) starting on [page 41](#).



## ***Wiring Signals***

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---

## **General Wiring Recommendations**

Keep the following recommendations in mind when wiring signals to a TEMPpoint, VOLTpoint, or MEASURpoint instrument:

- 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 the instrument's front panel 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, select an appropriate wire length and gauge for each thermocouple; in general, use the shortest wire length and largest gauge for the application to yield best results.
- Use shielded wire for maximum rejection of electrical interference.

## ***Warm-Up Time***

For accurate thermocouple measurements, MEASURpoint instruments require a warm-up time of 1 hour for the analog circuitry to stabilize.

For accurate RTD measurements, ensure that your RTD sensors and external calibration resistors warm up for 1 minute after the MEASURpoint instrument has been warmed up for 1 hour.

## Connecting Thermocouple Inputs

The DT9871U, DT9871, and DT9874 instruments contain thermocouple jacks for connecting thermocouple inputs.

---

**Note:** On the standard DT9874 instrument, channels 0 to 15 correspond to the thermocouple input channels.

---

Internally, these signals are connected in differential mode. You can mix and match the following thermocouple types across channels: B, E, J, K, N, R, S, and/or T.

Each thermocouple input jack is polarized and accepts a mating plug in the appropriate orientation. Table 1 lists the color designations for the + and – polarities of the supported thermocouple types for both the ANSI (American) and IEC (International) standards.

**Table 1: Thermocouple Color Designation Standards**

Thermocouple Standard	Thermocouple Type	Wire Color Coding + Polarity	Wire Color Coding – Polarity
ANSI	Type J	White	Red
	Type K	Yellow	Red
	Type T	Blue	Red
	Type E	Violet	Red
	Type S	Black	Red
	Type R	Black	Red
	Type B	Gray	Red
	Type N	Orange	Red
IEC	Type J	Black	White
	Type K	Green	White
	Type T	Brown	White
	Type E	Violet	White
	Type S	Orange	White
	Type R	Orange	White
	Type B	Gray	White
	Type N	Pink	White

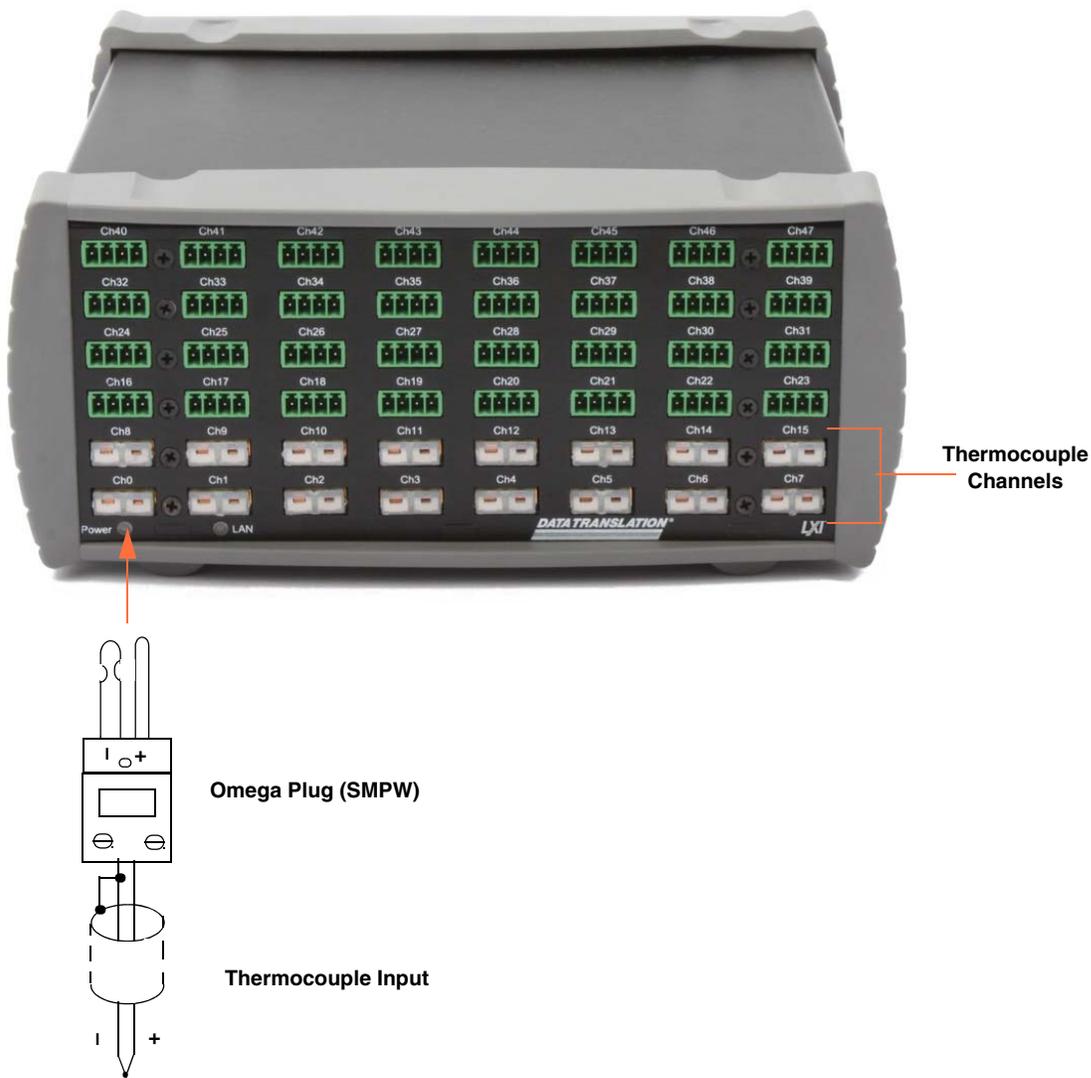
For more information on thermocouple standards, refer to the following web site:  
<http://www.omega.com/thermocouples.html>.

**CAUTION:**

When connecting inputs to the thermocouple connectors on a MEASURpoint or TEMPpoint instrument, it is highly recommended that you use only original Omega thermocouple plugs (SMPW), as connectors from other suppliers may not be equivalent mechanically. Refer to [page 126](#) for more information on the connectors.

If you use connectors from suppliers other than Omega, there is a risk that you may mechanically damage the thermocouple connectors on the MEASURpoint or TEMPpoint instrument.

Figure 12 shows how to connect a thermocouple input to a thermocouple channel.



**Figure 12: Connecting Thermocouple Inputs**

## Connecting RTD Inputs

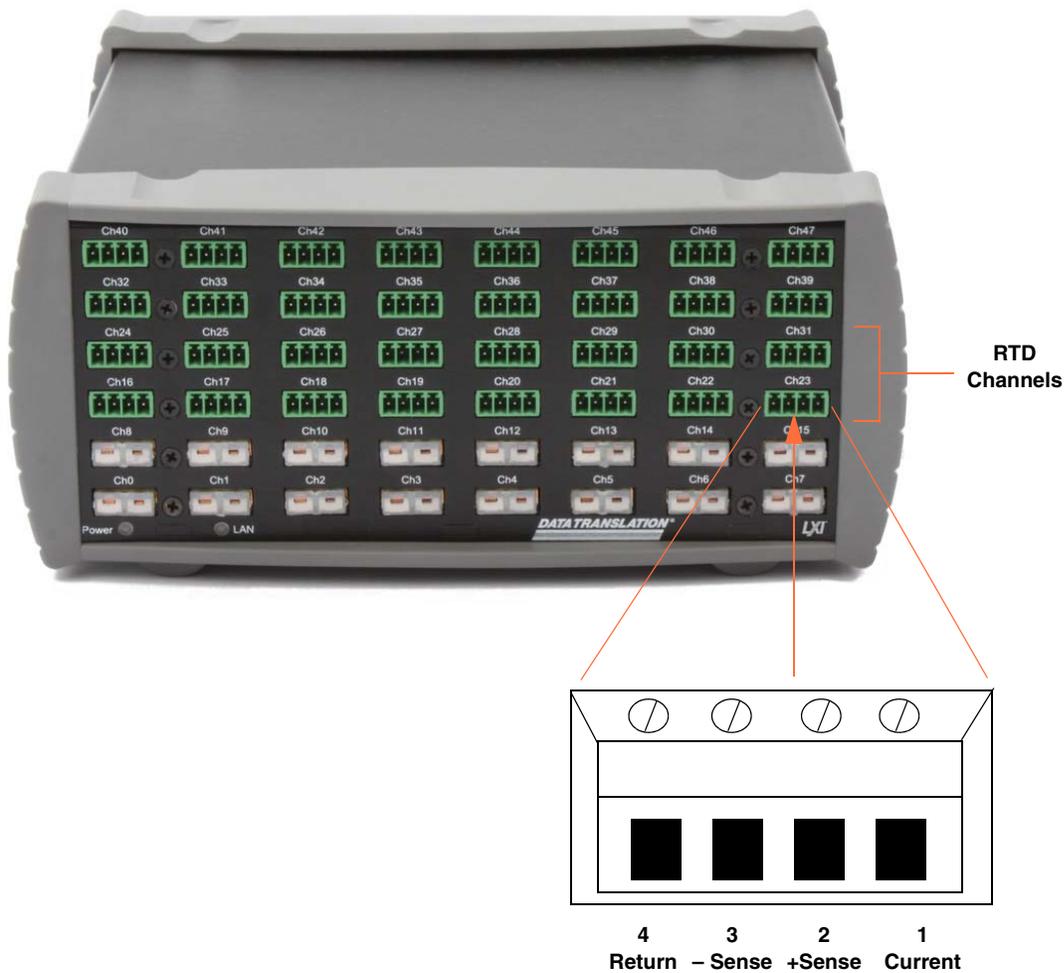
Each DT9872 and DT9874 contains pluggable screw terminals for connecting RTD inputs. Internally, these signals are connected in differential mode.

---

**Note:** On the standard DT9874 instrument, channels 16 to 31 correspond to the RTD input channels.

---

Figure 13 shows the numbering of the screw terminal blocks for RTD connections.



**Figure 13: Screw Terminal Block Numbering for RTD Connections**

The DT9872 supplies each RTD channel with 425  $\mu$ A of excitation current to prevent self-heating. The resistance of the RTD circuit increases gradually, repeatably, and linearly with temperature. As the resistance increases, the voltage drop across the RTD also increases.

The DT9872 reads this voltage drop and automatically converts the voltage to the appropriate temperature based on the RTD type.

The DT9872 and DT9874 support Pt100 (100  $\Omega$  Platinum), Pt500 (500  $\Omega$  Platinum), and Pt1000 (1000  $\Omega$  Platinum) RTD types using Alpha coefficients of 0.00385 and 0.00392; you can mix and match RTD types across RTD channels. Refer to the following web site for more information on RTD types: <http://www.omega.com>.

To connect an RTD input, you can use a 4-wire, 3-wire, or 2-wire connection scheme, described in the following subsections. For the best accuracy, use 4-wire RTD connections; this connection scheme enables Kelvin sensing to minimize errors due to lead wire resistance.

## 4-Wire RTD Connections

The 4-wire configuration offers the best accuracy with long connection wires, compared to the 3- and 2-wire configurations. The 4-wire connection scheme eliminates errors due to lead wire resistance ( $R_L$ ) and thermal heating. Wire impedance of up to 100  $\Omega$  anywhere in the hookup is automatically cancelled as long as the sense wires are connected.

Figure 14 shows a 4-wire RTD connection.

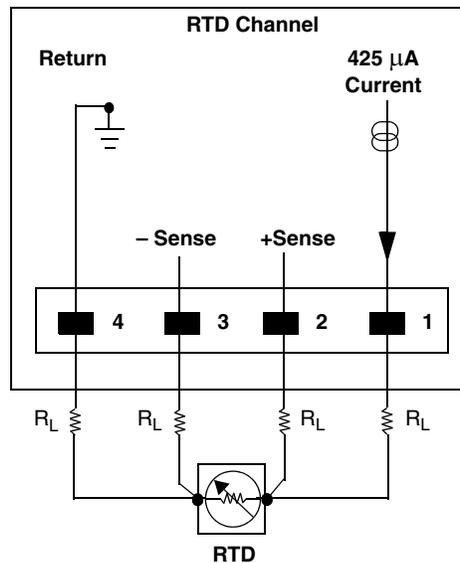


Figure 14: 4-Wire RTD Connection

## 3-Wire RTD Connections

The 3-wire configuration eliminates one wire from the 4-wire RTD connection. Lead wire resistance ( $R_L$ ) errors in the return wire from  $-Sense$  may be introduced unless the voltage drop is essentially equal and opposite to the voltage drop across  $+Sense$ .

Figure 15 shows a 3-wire RTD connection.

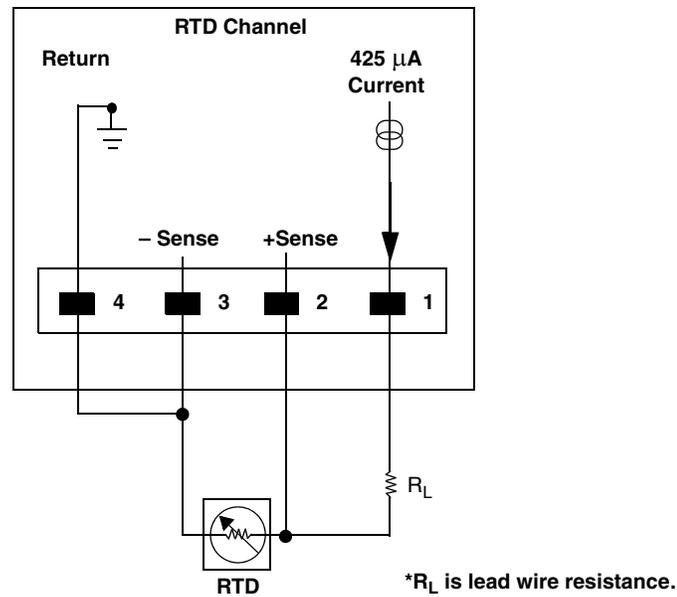


Figure 15: 3-Wire RTD Connection

## 2-Wire RTD Connections

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  $0.5 \Omega$  in each wire, the lead resistance adds a  $1 \Omega$  of error to the resistance measurement. Using a  $100 \Omega$  RTD (Pt100) with a  $0.00385/^\circ\text{C}$  European curve coefficient, the resistance represents an initial error of  $1 \Omega / (0.385 \Omega / ^\circ\text{C})$  or  $2.6^\circ\text{C}$ . Since the lead wire resistance changes with ambient temperature, additional errors are also introduced in the measurement.

[Figure 16](#) shows a 2-wire RTD connection.

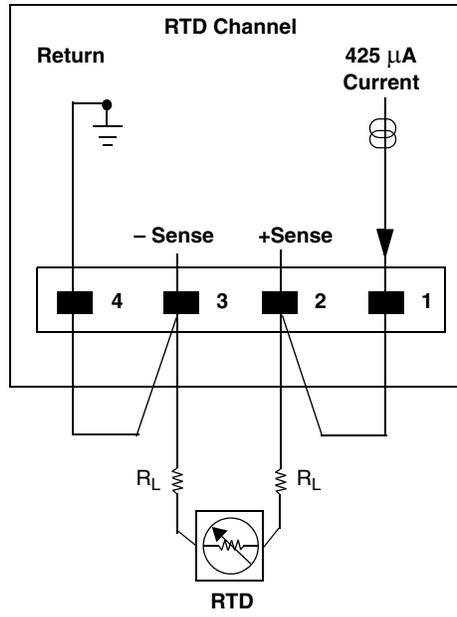


Figure 16: 2-Wire RTD Connection

---

## Connecting Voltage Inputs

The way you connect voltage inputs depends on the channel type you are using. This section describes how to connect voltage inputs to thermocouple input channels, RTD input channels, and voltage input channels.

### Connecting Voltage Inputs to Thermocouple Channels

[Figure 17](#) shows how to connect a differential voltage input to a thermocouple input channel on the DT9871U, DT9871, or DT9874 instrument.

---

**Note:** On the standard DT9874 instrument, channels 0 to 15 correspond to the thermocouple input channels.

---

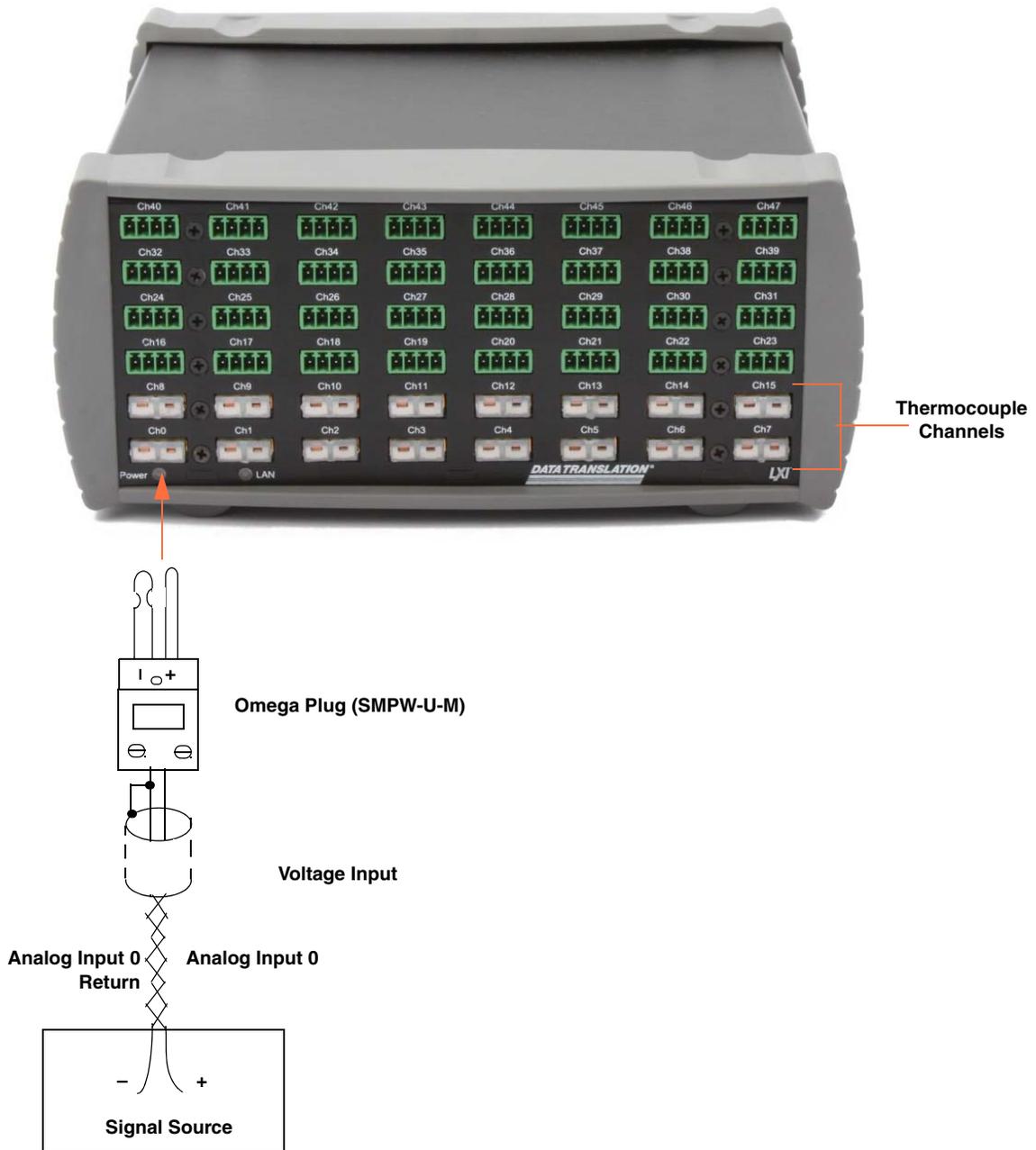


Figure 17: Connecting Voltage Inputs to a Thermocouple Channel

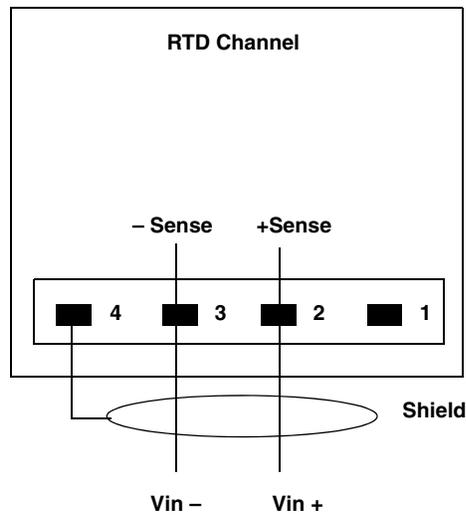
## Connecting Voltage Inputs to RTD Channels

Figure 18 shows how to connect a voltage input to an RTD channel on a DT9872 or DT9874 instrument.

---

**Note:** On the standard DT9874 instrument, channels 16 to 31 correspond to the RTD input channels.

---



**Figure 18: Connecting Voltage Inputs to an RTD Channel**

The input impedance is well over 100 M $\Omega$  using the voltage  $-Sense$  and  $+Sense$  inputs.

For best accuracy when connecting voltage inputs, use twisted-pair wires with a dead-ended shield connected to pin 4 of the screw terminal block.

## Connecting Voltage Inputs to Voltage Channels

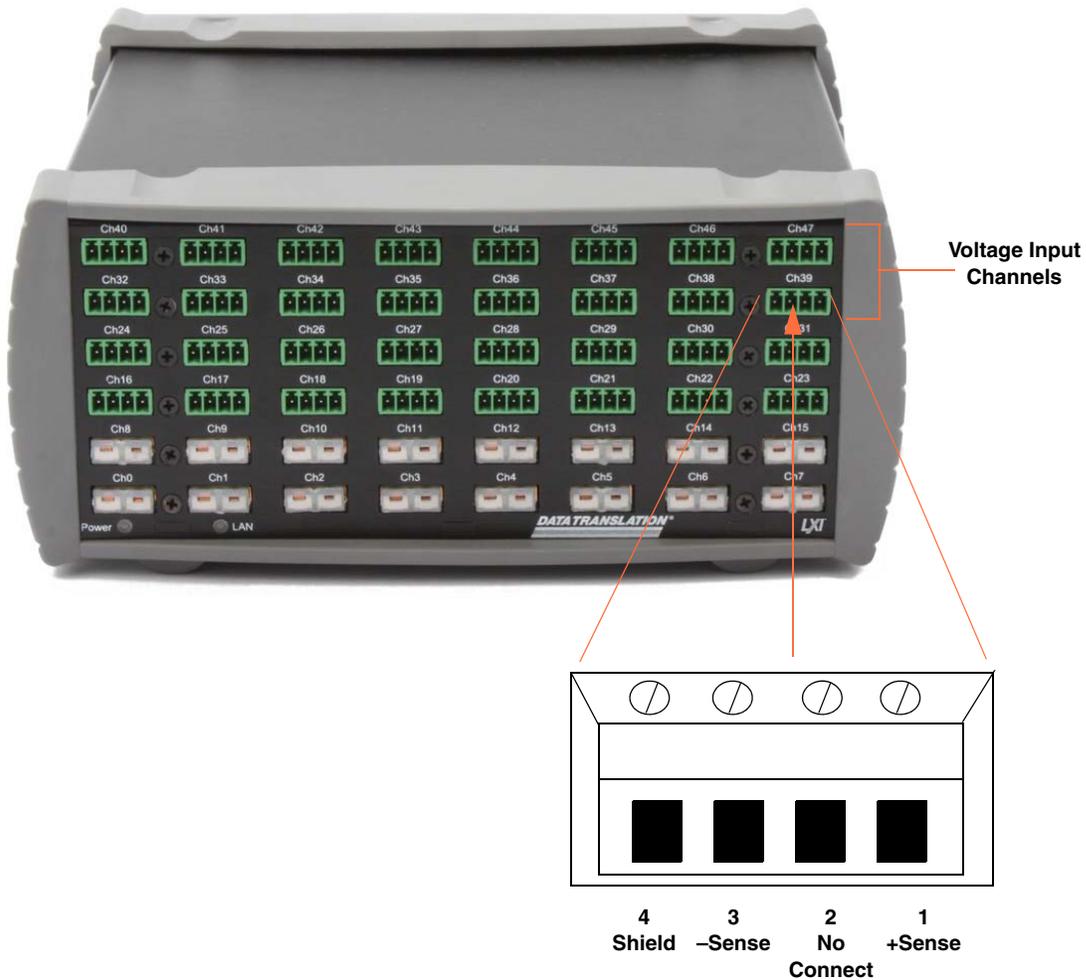
Each DT9873 and DT9874 contains pluggable screw terminals for connecting voltage inputs.

---

**Note:** On the standard DT9874 instrument, channels 32 to 47 correspond to the voltage input channels.

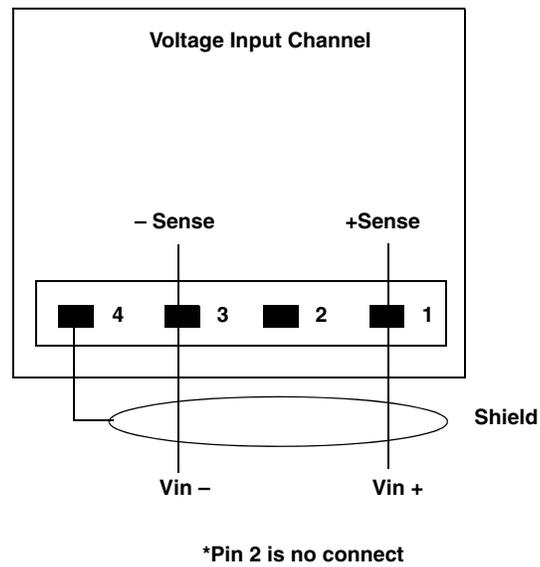
---

Figure 19 shows the numbering of the screw terminal blocks for voltage input connections.



**Figure 19: Screw Terminal Block Numbering for Voltage Connections**

Figure 20 shows how to connect voltage inputs to the DT9873 and DT9874.



**Figure 20: Connecting Voltage Inputs**

The input impedance is well over 100 M $\Omega$  using the voltage -Sense and +Sense inputs.

---

**Note:** For best accuracy when connecting voltage inputs, use twisted-pair wires with a dead-ended shield connected to pin 4 of the screw terminal block.

---

## Connecting Current Loop Inputs

In some applications, such as solar cell, fuel cell, and car battery testing applications, you may want to accurately sense and measure current in a high voltage loop.

TEMPpoint, VOLTpoint, and MEASURpoint instruments provide channel-to-channel functional isolation of 60 VDC maximum continuous working voltage, meaning that each input can be referenced to 60 VDC maximum, with a 500 Vpk withstand rating, verified by a 5 s dielectric withstand test.

The way you connect current loop inputs depends on the channel type you are using. This section describes how to connect current loop inputs to thermocouple input channels, RTD input channels, and voltage input channels.

### Connecting Current Loop Inputs to Thermocouple Channels

Thermocouple input channels on the DT9871U and DT9874 have an input range of  $\pm 0.075$  V. Therefore, you can use a 1  $\Omega$  series resistor to measure  $\pm 0.075$  A. Similarly, you can use a 0.1  $\Omega$  series resistor to measure  $\pm 0.75$  A.

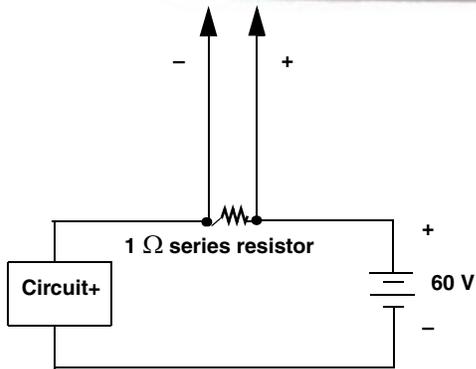
Thermocouple input channels on the DT9871 have an input range of  $\pm 1.25$  V. Therefore, you can use a 1  $\Omega$  series resistor to measure  $\pm 1.25$  A. Similarly, you can use a 0.1  $\Omega$  series resistor to measure  $\pm 12.5$  A or a 10  $\Omega$  series resistor to measure  $\pm 0.125$  A.

[Figure 21](#) shows how to wire your signals to measure a current loop. In this example, the input is referenced to  $\pm 60$  V.

---

**Note:** On the standard DT9874 instrument, channels 0 to 15 correspond to the thermocouple input channels.

---



Use a 1  $\Omega$  series resistor to convert current to voltage.

For thermocouple channels on the DT9871U and DT9874, 1  $\Omega = 0.075 \text{ A} = 0.075 \text{ V}$ .  
 For thermocouple channels on the DT9871, 1  $\Omega = 1.25 \text{ A} = 1.25 \text{ V}$ .

Figure 21: Connecting Current Loop Inputs to Thermocouple Channels

## Connecting Current Loop Inputs to RTD Channels

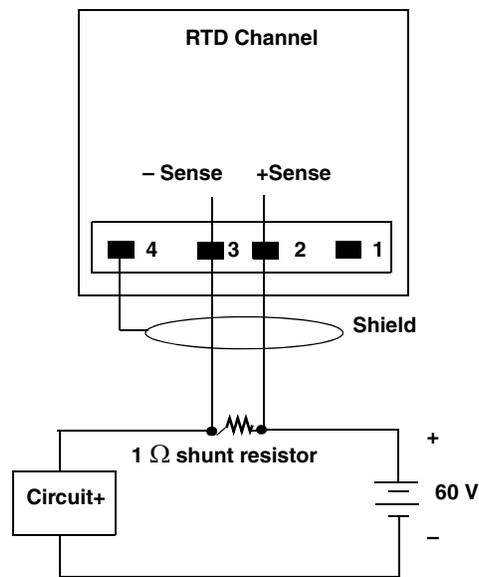
RTD channels on the DT9872 and DT9874 instruments have an input range of  $\pm 1.25$  V. Therefore, you can use a  $1\ \Omega$  shunt resistor to measure  $\pm 1.25$  A. Similarly, you can use a  $0.1\ \Omega$  shunt resistor to measure  $\pm 12.5$  A or a  $10\ \Omega$  shunt resistor to measure  $\pm 0.125$  A.

Figure 22 shows how to wire your signals to measure a current loop. In this example, the input is referenced to  $\pm 60$  V.

---

**Note:** On the standard DT9874 instrument, channels 16 to 31 correspond to the RTD input channels.

---



Use a  $1\ \Omega$  shunt resistor to convert current to voltage:  $1\ \Omega = 1.25\ \text{A} = 1.25\ \text{V}$ .

Figure 22: Connecting Current Loop Inputs to RTD Channels

## Connecting Current Loop Inputs to Voltage Channels

Voltage channels on the DT9873 and DT9874 instruments have an input range of  $\pm 10$  V or  $\pm 60$  V. You select the input range for each channel using software.

With the 24-bit A/D converter, high current, high side current shunts can be used for resolutions of less than 0.01 A on a 100 A range.

Typical Shunts:

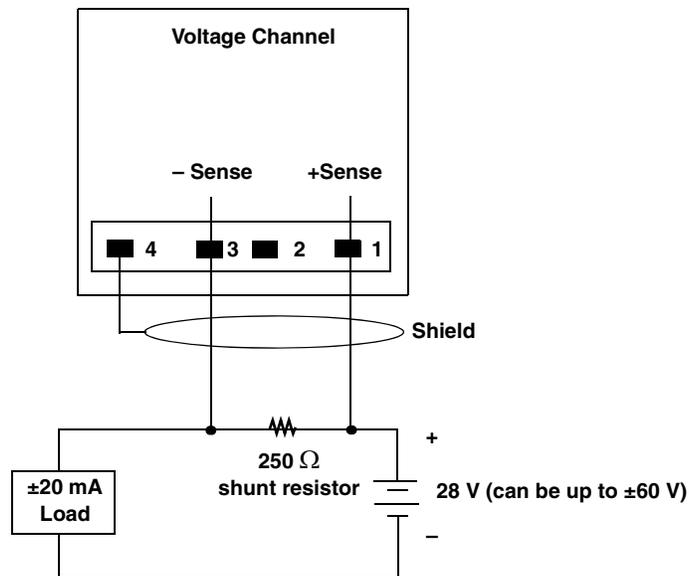
- Vishay WSMS5515  
.2 m $\Omega$  - 2W - 100A - 20mV
- Vishay CSM2512S  
10 m $\Omega$  - 1W - 10A - 100mV
- Deltec MUB-500-50  
.1 m $\Omega$  - 25W - 500A - 50mV

---

**Notes:** On the DT9874 instrument, channels 32 to 47 correspond to the voltage input channels.

---

Figure 23 shows an example of wiring signals to measure  $\pm 20$  mA using the  $\pm 10$  V input range.

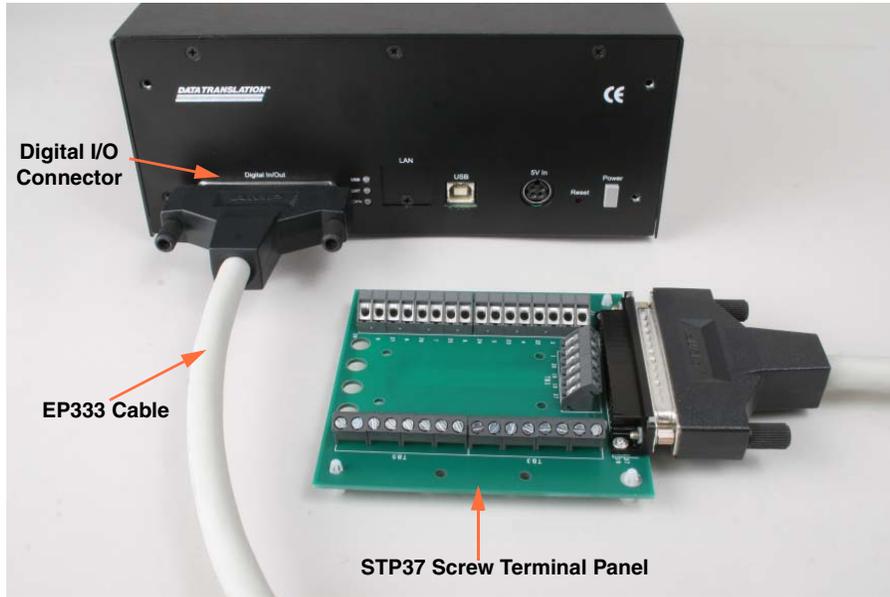


In this example, the input range is  $\pm 10$  V.

**Figure 23: Connecting a Current Loop Input to a Voltage Channel to Measure  $\pm 20$  mA**

## Connecting Digital I/O Signals

To make digital I/O connections easier, you can use the optional STP37 screw terminal panel and EP333 cable with your TEMPpoint, VOLTpoint, or MEASURpoint instrument. Connect the STP37 to the digital I/O connector of the instrument as shown in [Figure 24](#):



**Figure 24: Connecting the Instrument to the STP37**

[Figure 25](#) shows the layout of the STP37 screw terminal panel and lists the assignments of each screw terminal.

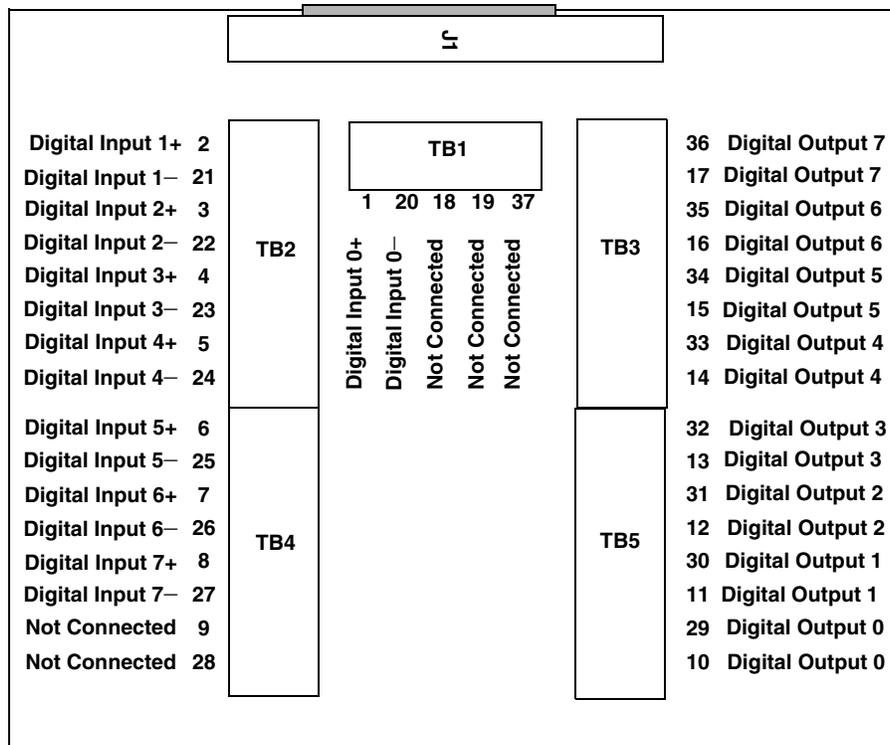
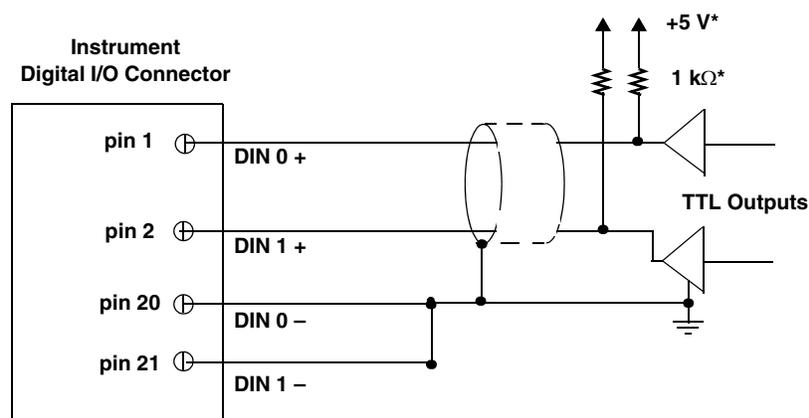


Figure 25: STP37 Screw Terminal Panel

## Connecting Digital Input Signals

Figure 26 shows how to connect digital input signals (lines 0 and 1, in this case) to the digital I/O connector on the TEMPpoint, VOLTpoint, or MEASURpoint instrument.



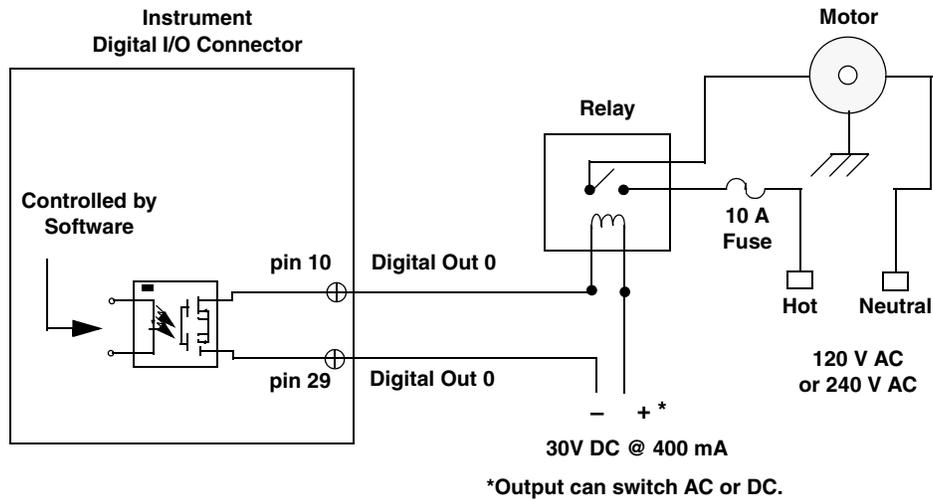
\*1 kΩ pull-up to +5 V required for TTL outputs.

Figure 26: Connecting Digital Inputs

## Connecting Digital Output Signals

The digital output lines of a TEMPpoint, VOLTpoint, or MEASURpoint instrument act as solid-state relays. The customer-supplied signal can be  $\pm 30$  V at up to 400 mA (peak) AC or DC.

You can use the digital output lines of the instrument to control solid-state or mechanical relays or high-current electric motors. Figure 27 shows how to connect digital output signals to line 0 of the instrument to control a motor relay.



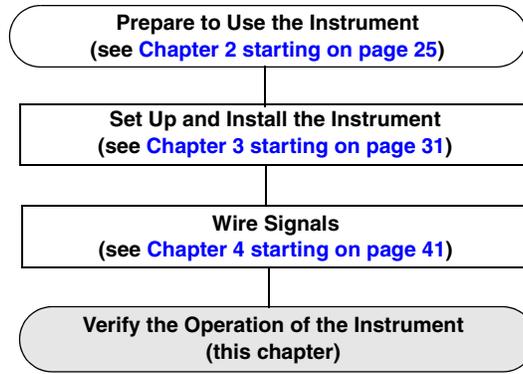
**Note:** Relay, motor, and circuits must be properly rated. Reinforced isolation must be maintained between the digital output circuits and the relay/motor switching circuits.

**Figure 27: Switching up to 30 V at 400 mA**

# 5

## ***Verifying the Operation of Your Instrument***

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## Overview

You can verify the operation of your TEMPpoint, VOLTpoint, or MEASURpoint instrument using the base version of the QuickDAQ application that is provided with the instrument. (Refer to [page 29](#) for information on installing the QuickDAQ application.)

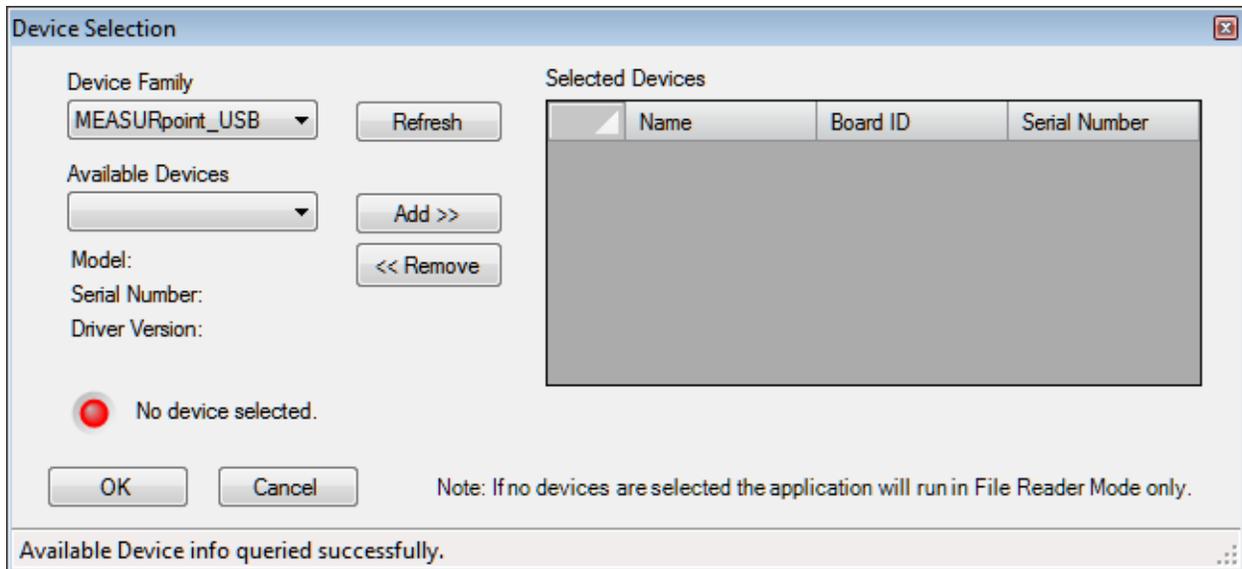
This chapter describes how to use QuickDAQ to measure and display temperature and voltage data from a data acquisition device. For this example, the following sensors are connected to a DT9874 MEASURpoint instrument:

- T thermocouple is connected to analog input channel 0
- 4-wire, Euro PT1000 RTD is connected to analog input channel 8
- $\pm 10$  V input signal is connected to analog input channel 16

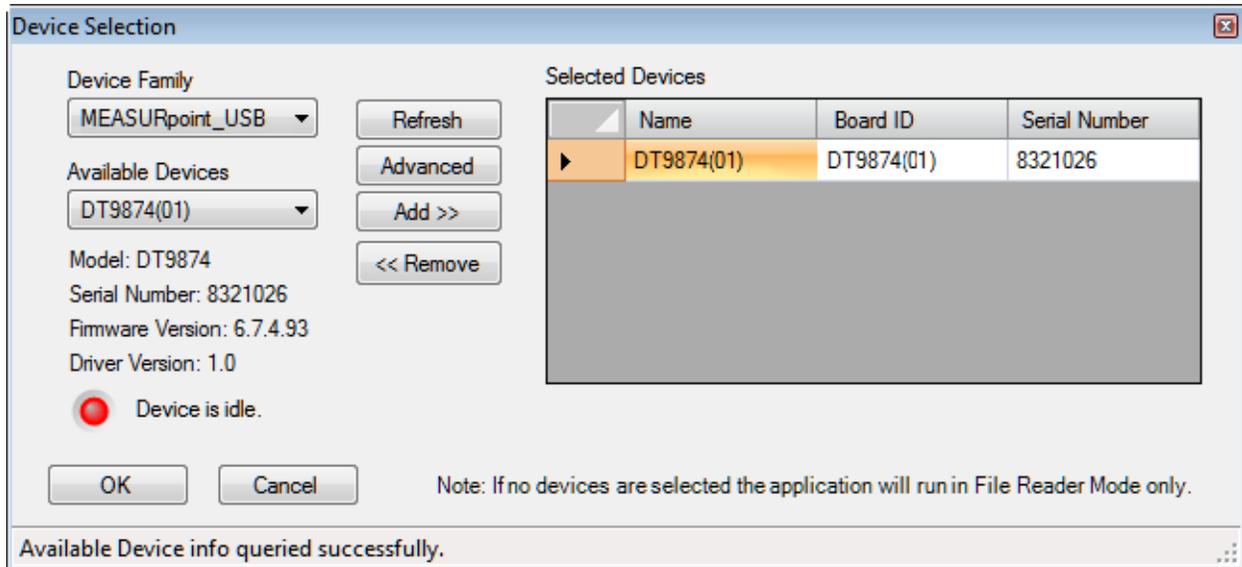
## Select the Instrument

To get started with QuickDAQ, follow these steps:

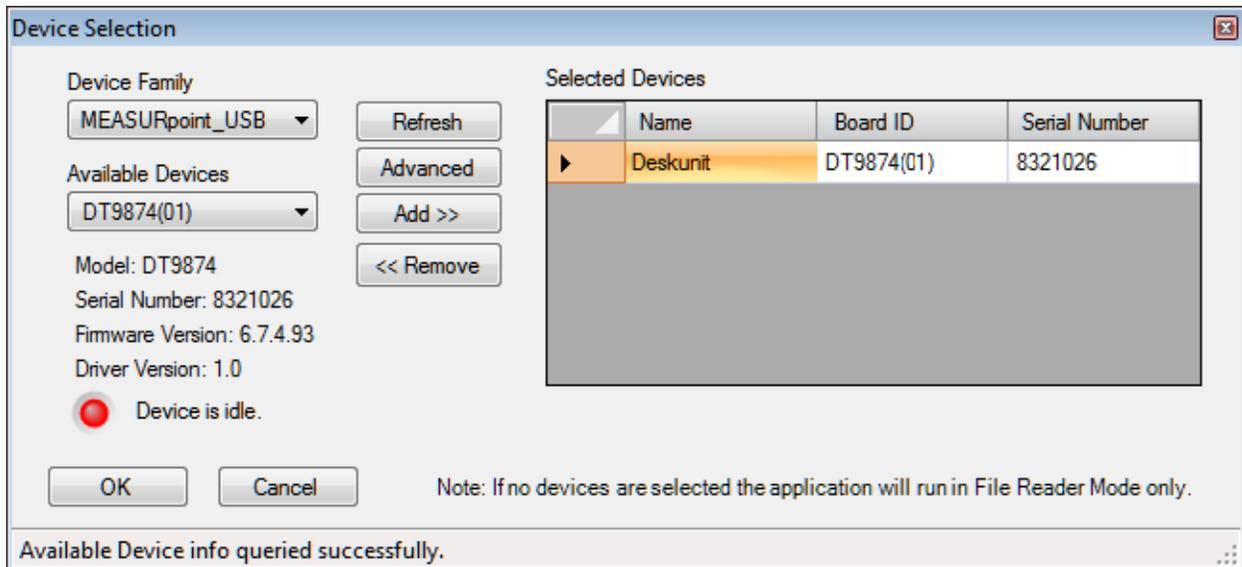
1. Connect your instrument to the USB port of your computer, and connect your sensors to the instrument.
2. Start QuickDAQ.  
*The Device Selection window appears.*
3. Select **MEASURpoint\_USB** for the Device Family name.



4. By default, the application "discovers" all devices that are available for the specified device family and displays the module name of 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 that corresponds to your instrument, and click **Add**.  
*Information about the device, including the model number, serial number, firmware version, driver version, and scanning status is displayed.*



6. If you want to rename your device, do the following:
  - a. Click the Row Selector button for the device.
  - b. Click the module name in the **Name** column to highlight it and enter a meaningful name to represent each available device.  
*In this example, Deskunit is used as the device name.*

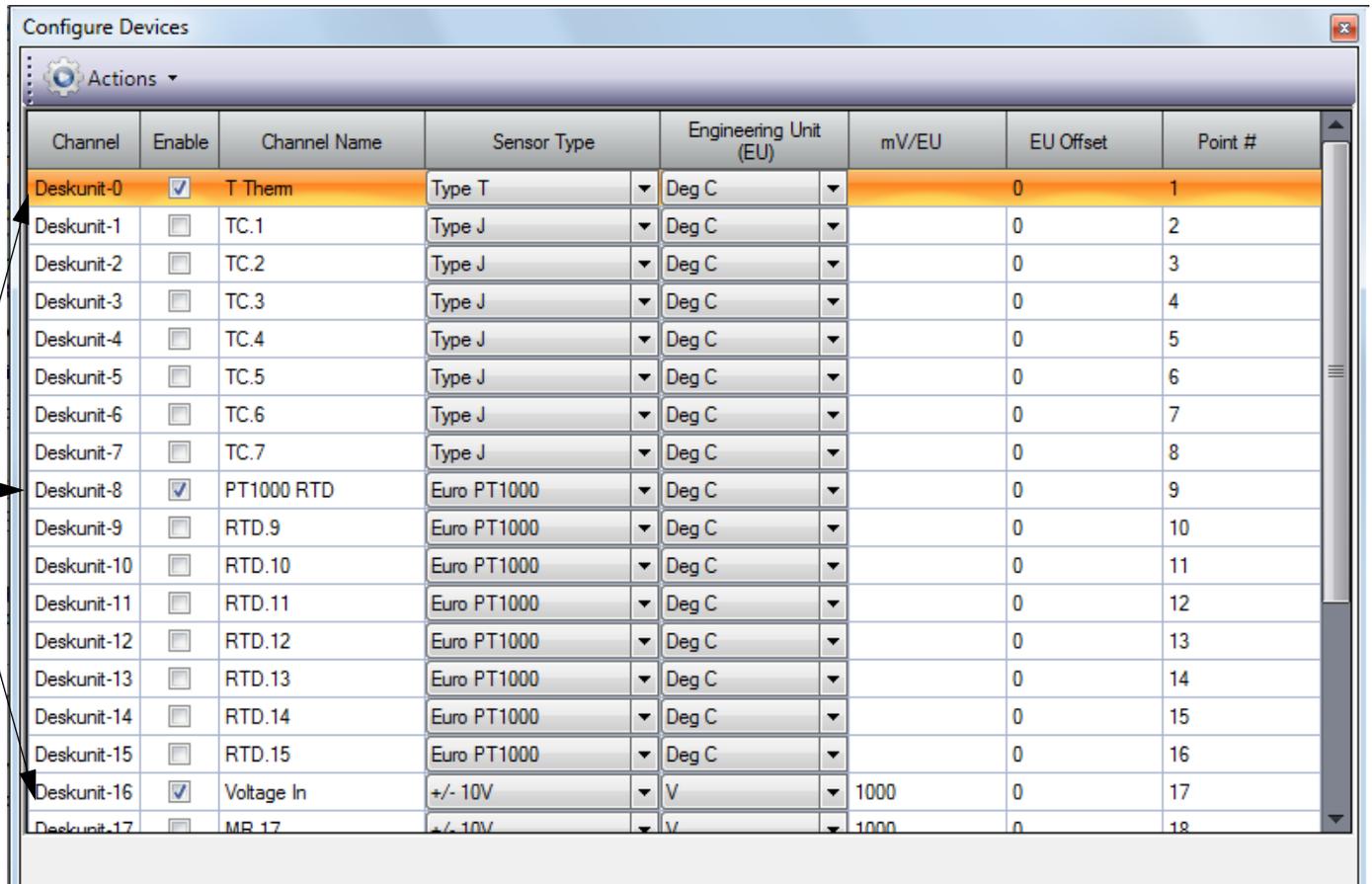


7. Click **OK**.  
*The QuickDAQ interface is displayed.*

## 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, 8, and 16 by clicking the checkbox under the **Enable** column.



Channel	Enable	Channel Name	Sensor Type	Engineering Unit (EU)	mV/EU	EU Offset	Point #
Deskunit-0	<input checked="" type="checkbox"/>	T Therm	Type T	Deg C		0	1
Deskunit-1	<input type="checkbox"/>	TC.1	Type J	Deg C		0	2
Deskunit-2	<input type="checkbox"/>	TC.2	Type J	Deg C		0	3
Deskunit-3	<input type="checkbox"/>	TC.3	Type J	Deg C		0	4
Deskunit-4	<input type="checkbox"/>	TC.4	Type J	Deg C		0	5
Deskunit-5	<input type="checkbox"/>	TC.5	Type J	Deg C		0	6
Deskunit-6	<input type="checkbox"/>	TC.6	Type J	Deg C		0	7
Deskunit-7	<input type="checkbox"/>	TC.7	Type J	Deg C		0	8
Deskunit-8	<input checked="" type="checkbox"/>	PT1000 RTD	Euro PT1000	Deg C		0	9
Deskunit-9	<input type="checkbox"/>	RTD.9	Euro PT1000	Deg C		0	10
Deskunit-10	<input type="checkbox"/>	RTD.10	Euro PT1000	Deg C		0	11
Deskunit-11	<input type="checkbox"/>	RTD.11	Euro PT1000	Deg C		0	12
Deskunit-12	<input type="checkbox"/>	RTD.12	Euro PT1000	Deg C		0	13
Deskunit-13	<input type="checkbox"/>	RTD.13	Euro PT1000	Deg C		0	14
Deskunit-14	<input type="checkbox"/>	RTD.14	Euro PT1000	Deg C		0	15
Deskunit-15	<input type="checkbox"/>	RTD.15	Euro PT1000	Deg C		0	16
Deskunit-16	<input checked="" type="checkbox"/>	Voltage In	+/- 10V	V	1000	0	17
Deskunit-17	<input type="checkbox"/>	MB.17	+/- 10V	V	1000	0	18

3. Under the **Channel Name** column, enter a meaningful name for each channel. For this example, enter the following names:
  - For analog input channel 0, enter **T Therm** as the channel name.
  - For analog input channel 8, enter **PT1000 RTD** as the channel name.
  - For analog input channel 16, enter **Voltage In** as the channel name.
4. Under the **Sensor** column, select the following sensor types for the analog input channels:
  - For analog input channel 0, select **Type T** as the thermocouple type.
  - For analog input channel 8, select **Euro PT1000** as the RTD type.
  - For analog input channel 16, select **+/-10V** as the input voltage range.

5. Under the **Engineering Units** column, **Deg C** is selected by default. If you want to change this setting, change the temperature units under the **Acquisition Config - Acquisition** tab.

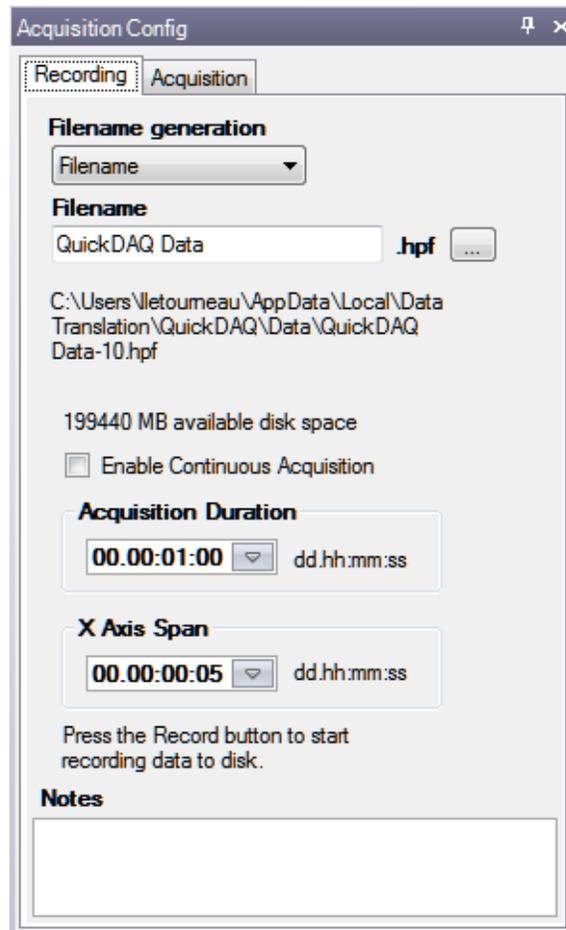
*In this example, Deg C is used.*

6. If you know the offset for your calibrated thermocouple and RTD, enter it under the **EU Offset** column. For this example, leave **0** as the EU offset for the thermocouple and RTD channels and **1000** as the EU offset for the voltage input channel.
7. Leave the test point values for each channel unchanged.
8. Click **Close** to close the Channel Configuration dialog box.

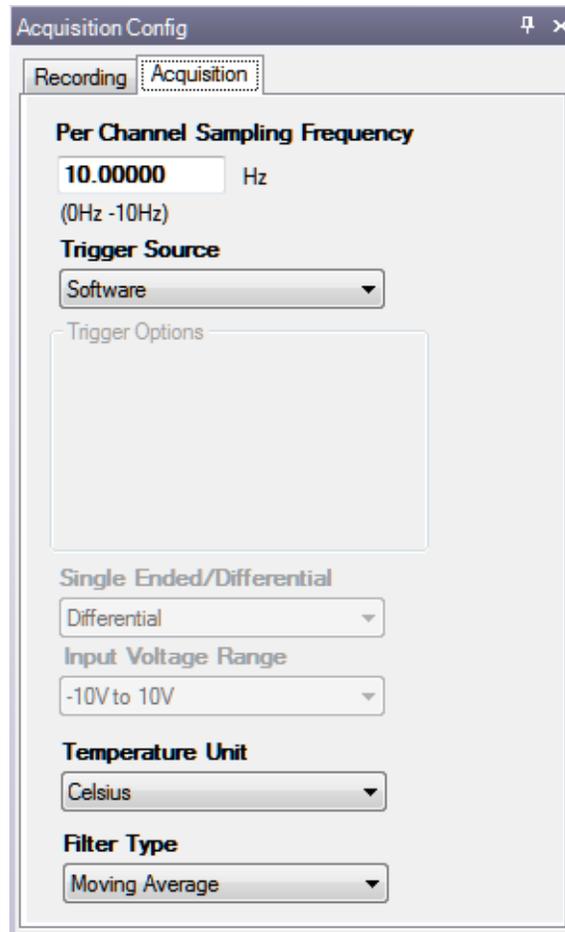
## Configure the Parameters of the Acquisition Config Window

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

1. Click the **Recording** tab.



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**, select **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**, enter **5 seconds** as the span for the x-axis.
7. Click the **Acquisition** tab.



8. For this example, ensure that the following default settings are used:
  - **Sampling Frequency:** 10 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 Display Window

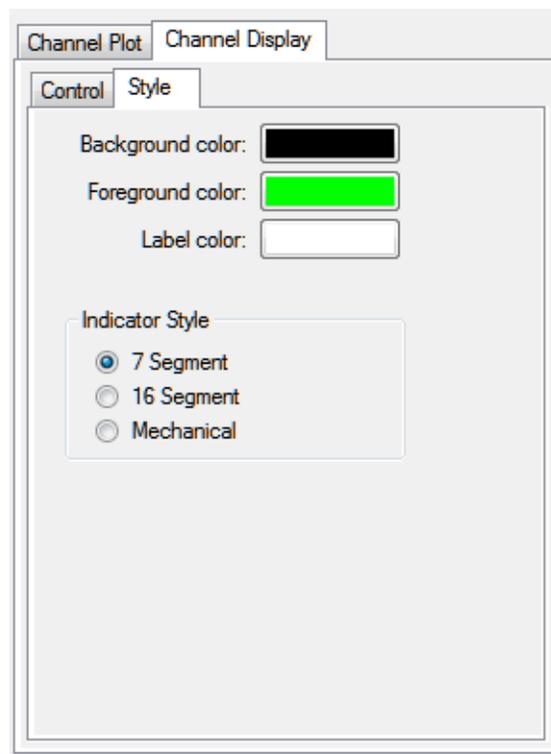
Configure the appearance of the Channel Display window as follows:

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

Channel Name	Visible Plot	Visible Display	Visible Statistics	Show Cursor	Plot Column	Signal Group	Color
Deskunit.T Therm	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1	A	Red
Deskunit.PT1000 RTD	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1	A	Blue
Deskunit.Voltage In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1	B	Brown

2. Click the **Channel Display - Style** tab, and select the color scheme that you want for the Channel Display window.

*In this example, black is used for the background color, green is used for the foreground color, and white is used for the label color.*

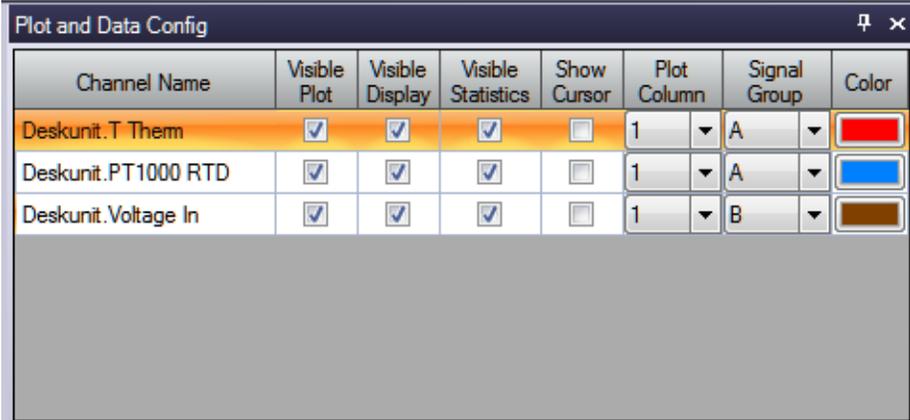


3. Leave the indicator style as **7 segment**.

## Configure the Appearance of the Channel Plot Window

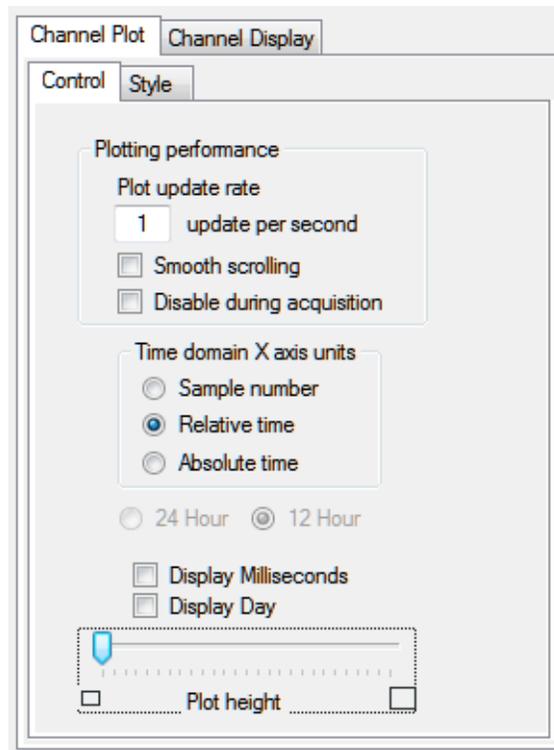
Configure the appearance of the Channel Plot window as follows:

1. In the **Plot and Data Config** window, set up the following parameters:
  - a. Ensure that the **Visible Plot** column is checked for all three enabled channels.
  - b. Leave the **Show Cursor** column unchecked for all three enabled channels.
  - c. Under **Plot Column**, use the default plot column setting of 1 for all three enabled channels.
  - d. Under the **Signal Group** column, select **A** for the thermocouple and RTD channels, and select **B** for the voltage input channel.
  - e. Under the **Color** column, assign a unique color to each trace.



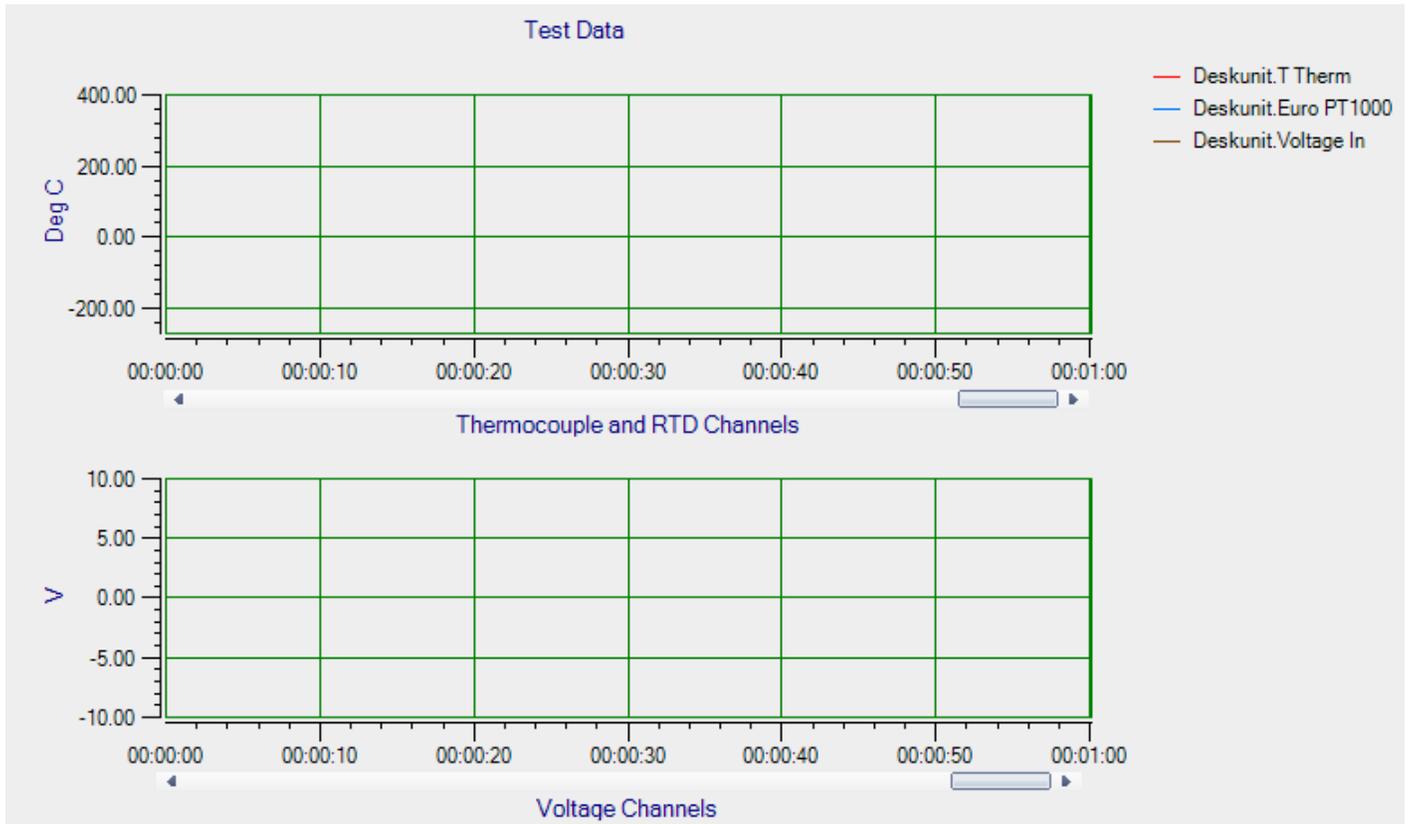
Channel Name	Visible Plot	Visible Display	Visible Statistics	Show Cursor	Plot Column	Signal Group	Color
Deskunit.T Therm	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1	A	Red
Deskunit.PT1000 RTD	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1	A	Blue
Deskunit.Voltage In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1	B	Brown

2. Click the **Channel Plot - Control** tab, and slide the **Plot height** bar to the left until you can see both plots on the screen at once.



3. Leave the following settings unchanged:
  - **Plot update rate:** 1
  - **Smooth scrolling:** unchecked
  - **Disable during acquisition:** unchecked
  - **Time domain X axis units:** Relative time
  - **Display Milliseconds:** unchecked
  - **Display Days:** unchecked
4. In the display area, click the tab for the **Channel Plot** window.
5. Click the **Show Legend** control (  ) on the toolbar.
6. For the top plot in this window, change the text for the label on the x-axis, by doing the following:
  - a. Right-click on the label.
  - b. Select **Edit Label**.
  - c. Enter the following text: **Thermocouple and RTD Channels**
7. For the bottom plot in this window, change the text for the label on the x-axis, by doing the following:
  - a. Right-click on the label.
  - b. Select **Edit Label**.

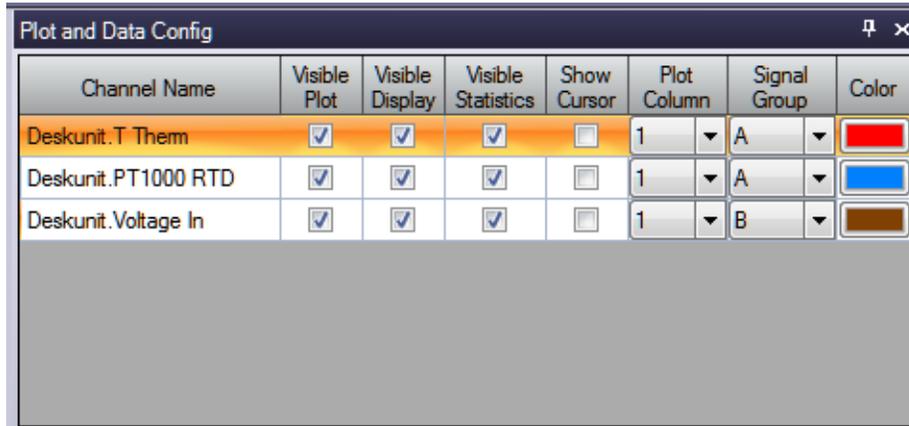
- c. Enter the following text: **Voltage Channels**  
*The Channel Plot window should appear as follows:*



## 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 all three enabled channels:



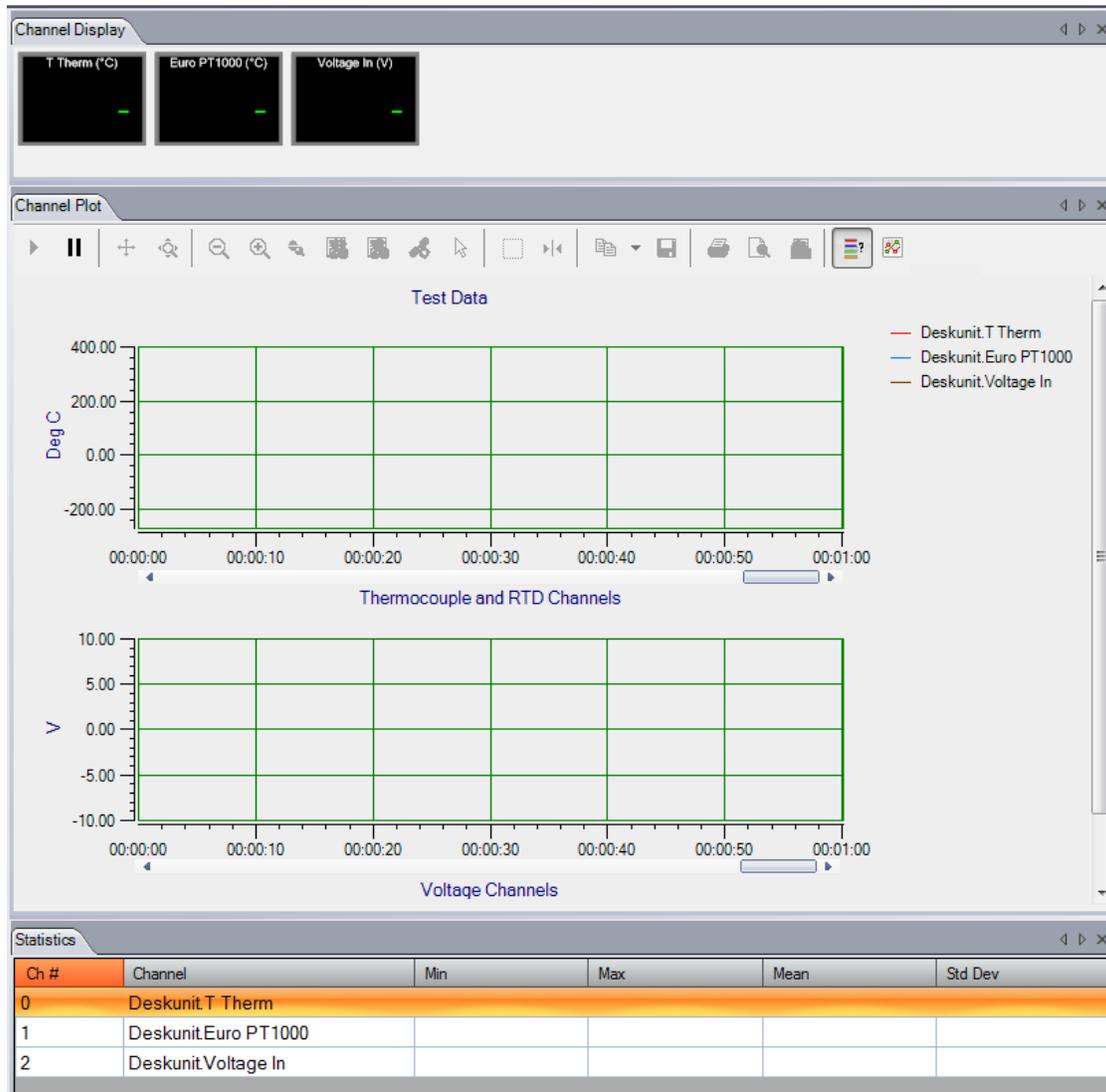
Channel Name	Visible Plot	Visible Display	Visible Statistics	Show Cursor	Plot Column	Signal Group	Color
Deskunit.T Them	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1	A	Red
Deskunit.PT1000 RTD	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1	A	Blue
Deskunit.Voltage In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1	B	Brown

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 the following 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:



Perform the following steps to position the Channel Display window at the top of the display area, the Channel Plot window in the middle of the display area, and the Statistics window at the bottom of the display area:

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.

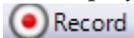
*The Statistics window is now placed at the bottom of the display area.*

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.

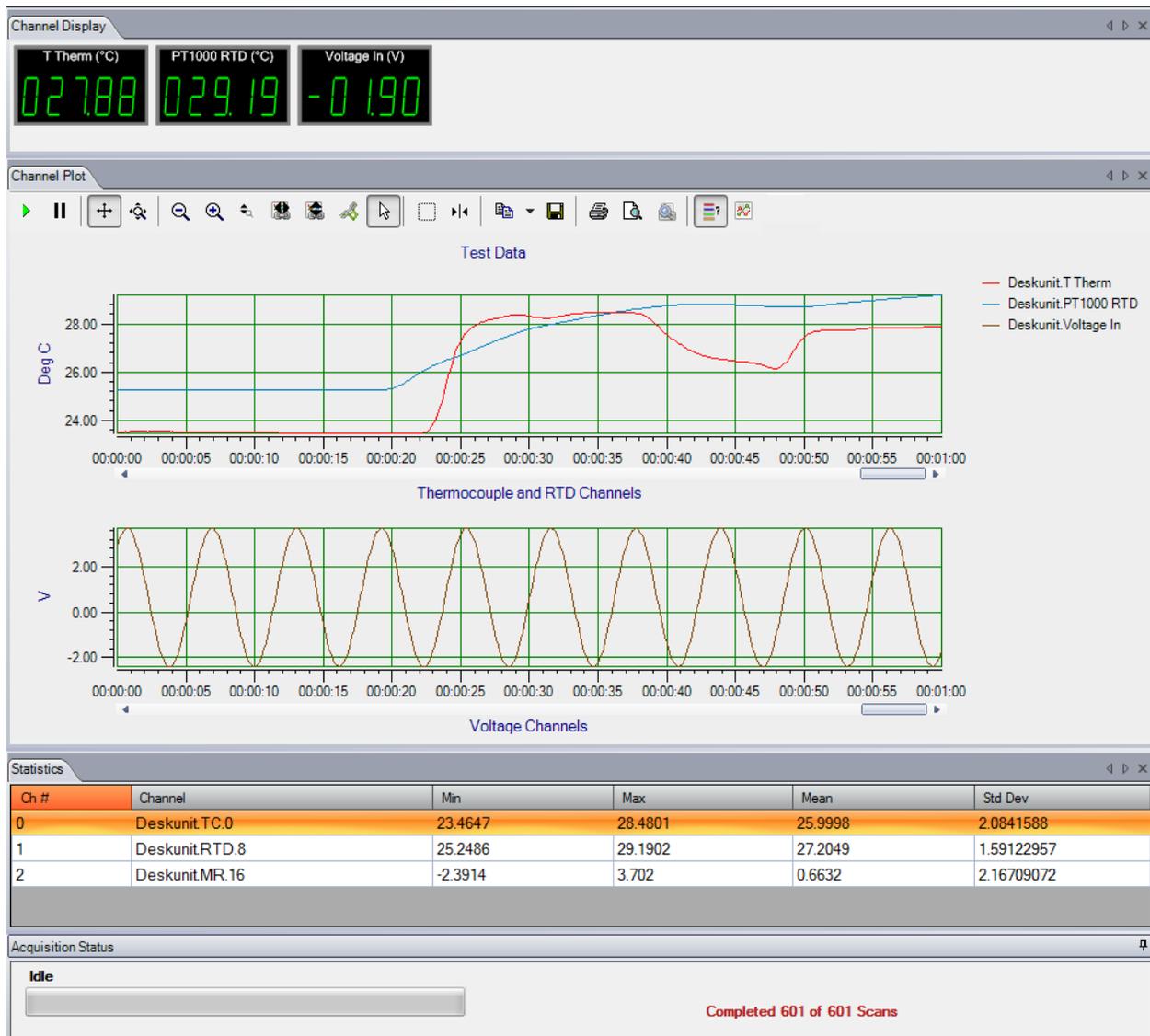
*The Channel Plot window is now placed in the middle of the display area, revealing the Channel Display window at the top of the display area.*

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 (  ).

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 Instrument***





## ***Principles of Operation***

Block Diagrams .....	84
Analog Input Features .....	89
Digital I/O Features .....	100

## Block Diagrams

This section includes the block diagrams for the DT9871U, DT9871, and DT9872 TEMPpoint instruments, DT9873 VOLTpoint instrument, and DT9874 MEASURpoint instruments.

### DT9871U Block Diagram

Figure 28 shows the block diagram of the DT9871U TEMPpoint instrument.

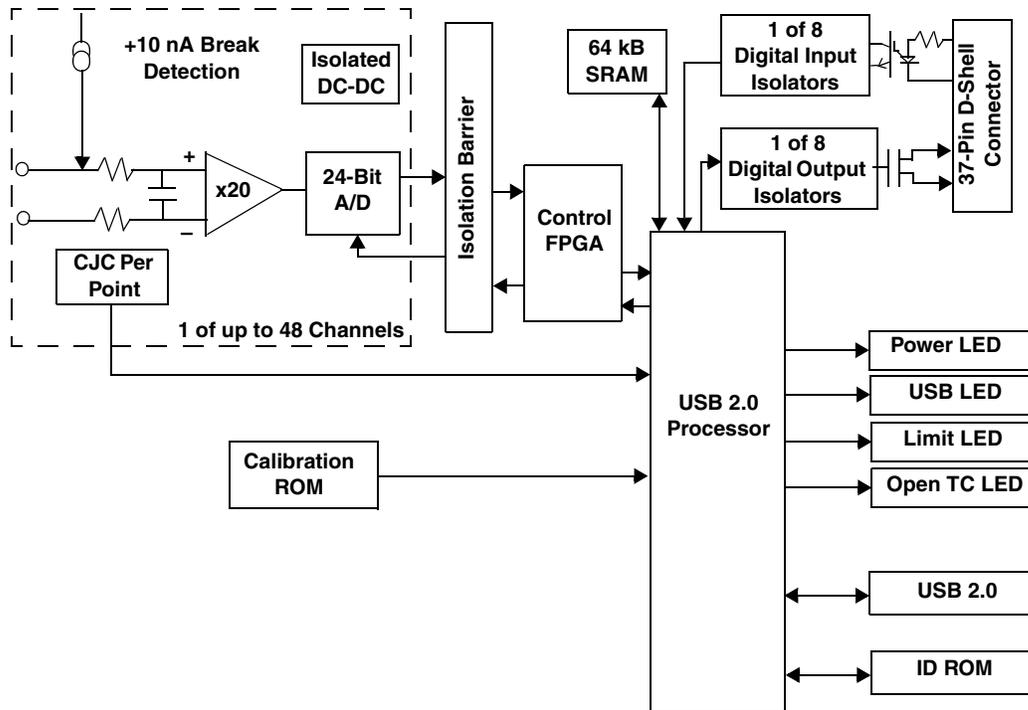


Figure 28: Block Diagram of the DT9871U TEMPpoint Instrument

## DT9871 Block Diagram

Figure 29 shows the block diagram of the DT9871 instrument.

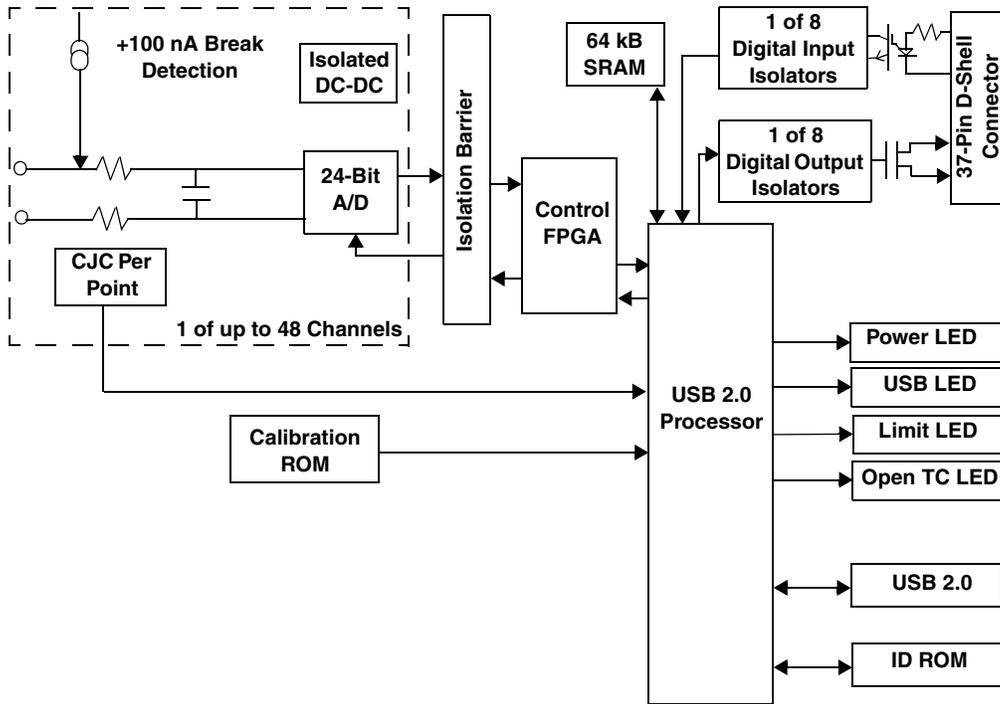


Figure 29: Block Diagram of the DT9871 TEMPpoint Instrument

## DT9872 Block Diagram

Figure 30 shows the block diagram of the DT9872 TEMPpoint instrument.

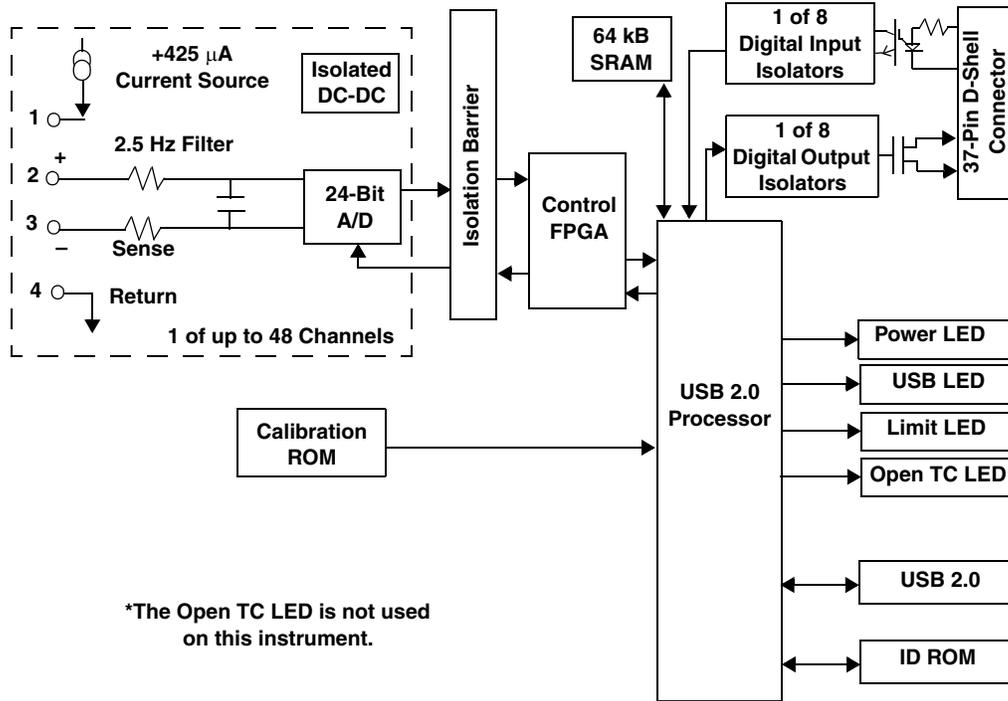


Figure 30: Block Diagram of the DT9872 TEMPpoint Instrument

## DT9873 Block Diagram

Figure 31 shows the block diagram of the DT9873 VOLTpoint instrument.

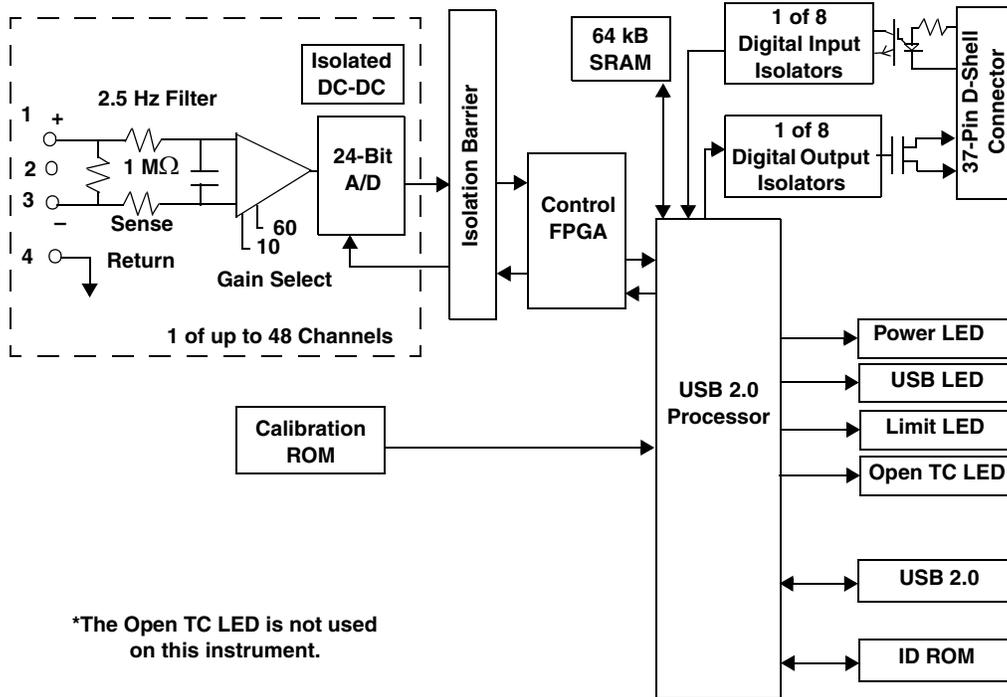


Figure 31: Block Diagram of the DT9873 VOLTpoint Instrument

## DT9874 Block Diagram

Figure 32 shows the block diagram of the DT9874 MEASURpoint instrument.

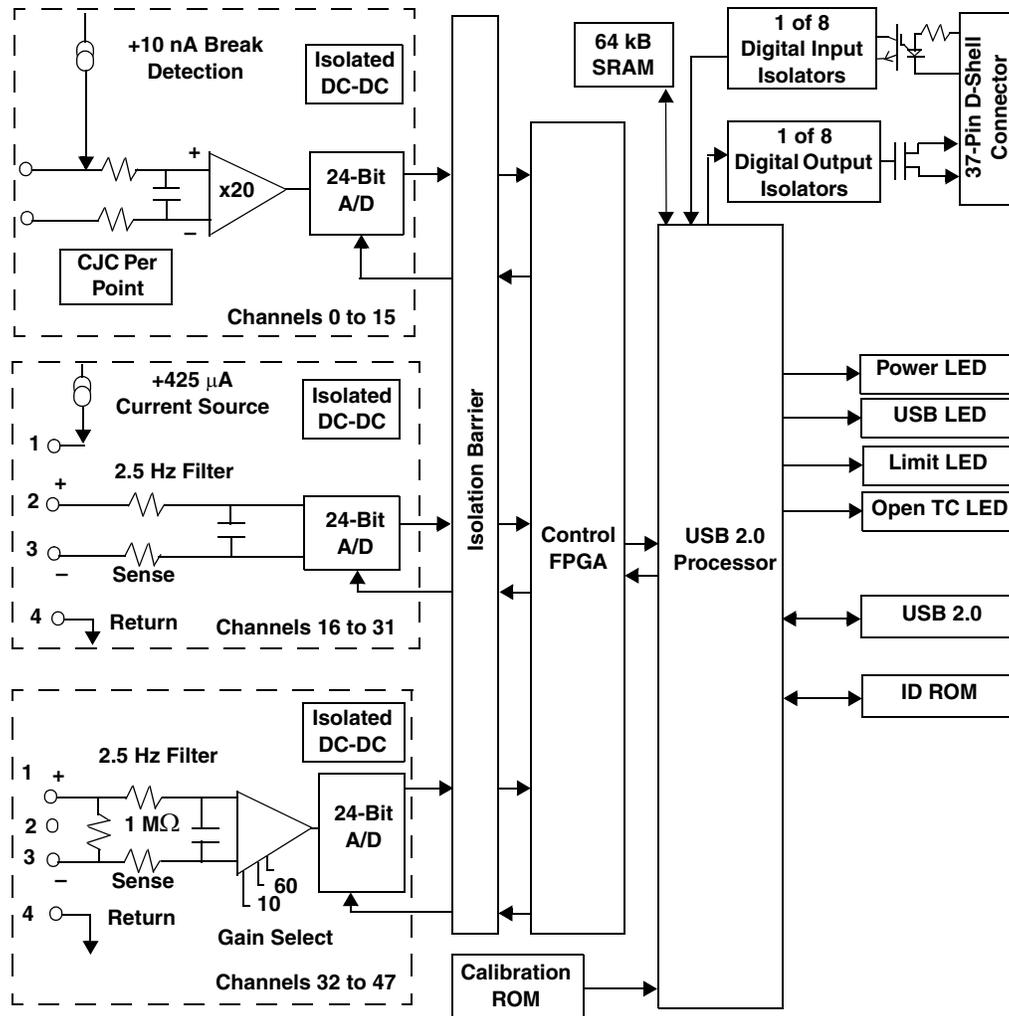


Figure 32: Block Diagram of the DT9874 MEASURpoint Instrument

## Analog Input Features

This section describes the following features of the analog input (A/D) subsystem on TEMPpoint, VOLTpoint, and MEASURpoint instruments:

- Analog input channels, described on this page
- Input ranges, described on [page 92](#)
- Resolution, described on [page 94](#)
- Calibration, described on [page 94](#)
- Sample clock, described on [page 95](#)
- Trigger source, described on [page 95](#)
- Conversion modes, described on [page 96](#)
- Filtering, described on [page 97](#)
- Data format, described on [page 97](#)
- Error conditions, described on [page 98](#)

### Analog Input Channels

TEMPpoint, VOLTpoint, and MEASURpoint instruments provide up to 48 analog input channels. The number of channels and the channel types supported (thermocouple, RTD, or voltage input) depend on the specific instrument model you purchased, as shown in [Table 2](#).

**Table 2: Number and Type of Analog Input Channels**

Instrument Type	Models	# of Analog Input Channels	Channel Types
TEMPpoint	DT9871U-8 and DT9871-8	8	8 thermocouple inputs (numbered 0 to 7)
	DT9871U-16 and DT9871-16	16	16 thermocouple inputs (numbered 0 to 15)
	DT9871U-24 and DT9871-24	24	24 thermocouple inputs (numbered 0 to 23)
	DT9871U-32 and DT9871-32	32	32 thermocouple inputs (numbered 0 to 31)
	DT9871U-40 and DT9871-40	40	40 thermocouple inputs (numbered 0 to 39)
	DT9871U-48 and DT9871-48	48	48 thermocouple inputs (numbered 0 to 47)
	DT9872-8	8	8 RTD inputs (numbered 0 to 7)
	DT9872-16	16	16 RTD inputs (numbered 0 to 15)
	DT9872-24	24	24 RTD inputs (numbered 0 to 23)
	DT9872-32	32	32 RTD inputs (numbered 0 to 31)
	DT9872-40	40	40 RTD inputs (numbered 0 to 39)
	DT9872-48	48	48 RTD inputs (numbered 0 to 47)

**Table 2: Number and Type of Analog Input Channels (cont.)**

Instrument Type	Models	# of Analog Input Channels	Channel Types
VOLTpoint	DT9873-8	8	8 voltage inputs (numbered 0 to 7)
	DT9873-16	16	16 voltage inputs (numbered 0 to 15)
	DT9873-24	24	24 voltage inputs (numbered 0 to 23)
	DT9873-32	32	32 voltage inputs (numbered 0 to 31)
	DT9873-40	40	40 voltage inputs (numbered 0 to 39)
	DT9873-48	48	48 voltage inputs (numbered 0 to 47)
MEASURpoint	DT9874-16T-16R-16V	48	16 thermocouple inputs (numbered 0 to 15)
			16 RTD inputs (numbered 16 to 31)
			16 voltage inputs (numbered 32 to 47)

### ***Thermocouple Input Channels***

For channels that support thermocouples, you can attach a voltage input or any of the following thermocouple types in a mix and match fashion: B, E, J, K, N, R, S, and/or T.

By default, these channels are configured for voltage inputs. You can specify the thermocouple types for channels using the DT-Open Layers Control Panel applet, described on [page 40](#), the QuickDAQ application, or by using an API call in your application program.

---

**Note:** In a mix-and-match system, it is easy to accidentally mismatch the software and hardware configuration for a channel. Therefore, it is recommended that you pay particular attention when configuring channels, since the resultant errors may be not large enough to notice initially, but may be significantly larger than the accuracy specification for the instrument.

---

Since each channel has its own 24-bit A/D, analog inputs are measured simultaneously. Refer to [page 96](#) for more information on specifying the channels for a scan.

[Table 3](#) lists the supported measurement range for each thermocouple type. (Refer to [page 92](#) for information on the supported input range for voltage measurements.)

**Table 3: Supported Measurement Range for Each Thermocouple Type**

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

Refer to [Appendix A](#) for the thermocouple accuracy of thermocouple channels over the dynamic range of the instrument.

### Cold Junction Compensation

Each thermocouple channel has its own cold-junction compensation (CJC) at the input. The software reads the value of the CJC input along with the value of the analog input channel and automatically corrects for errors based on the specified thermocouple type and the thermocouple linearization data stored in onboard ROM.

A separate multiplexed A/D is used to acquire all the CJC input values. The software takes care of correlating the CJC measurements with the analog input measurements.

---

**Note:** 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 97](#) for more information on this feature.

---

### Open Thermocouple Detection

Break detection circuitry (+10 nA on the DT9871U and DT9874; +100 nA on the DT9871) is provided for thermocouple channels to ensure that open thermocouples are detected. The Open (OPN) LED on the rear panel lights when this condition occurs; see [Figure 10 on page 37](#) for the location of this LED.

In addition, 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. This value is returned anytime a voltage greater than 100 mV is measure on the input, since this value is greater than any legitimate thermocouple voltage.

If the channel is configured for a voltage input (not a thermocouple type), the Open (OPN) LED never lights and the `SENSOR_IS_OPEN` value is not returned. Instead, the voltage value is returned. If no input is connected to the channel, the software returns a value of approximately 0.7 V due to the open thermocouple detection pull-up circuit.

## **RTD Channels**

For channels that support RTDs, you can attach a voltage input or any of the following RTD types in a mix and match fashion: Platinum 100  $\Omega$  (Pt100), Platinum 500  $\Omega$  (Pt500), or Platinum 1000  $\Omega$  (Pt1000) RTD using an European alpha curve of 0.00385 or an American alpha curve of 0.00392. The supported temperature measurement range for these RTD types is  $-200^{\circ}\text{C}$  ( $-328^{\circ}\text{F}$ ) to  $850^{\circ}\text{C}$  ( $1562^{\circ}\text{F}$ ). You can also measure a resistance value between 0 and 4k Ohms, if desired. (Refer to [page 92](#) for information on the supported input range for voltage measurements.)

By default, all channels are configured for voltage inputs. You can specify the RTD types for channels using the DT-Open Layers Control Panel applet, described on [page 40](#), the QuickDAQ application, or by using an API call in your application program

---

**Notes:** In a mix-and-match system, it is easy to accidentally mismatch the software and hardware configuration for a channel. Therefore, it is recommended that you pay particular attention when configuring channels, since the resultant errors may be not large enough to notice initially, but may be significantly larger than the accuracy specification for the instrument.

---

Since each channel has its own 24-bit A/D, analog inputs are measured simultaneously. Refer to [page 96](#) for more information on specifying the channels for a scan.

## **Input Ranges**

The input voltage range that is supported by your TEMPpoint, VOLTpoint, or MEASURpoint instrument depends on the specific instrument model that you purchased, as shown in [Table 4](#).

**Table 4: Supported Input Ranges**

Instrument Type	Models	Input Range
TEMPpoint	DT9871U	$\pm 0.75$ V for all channels
	DT9871	$\pm 1.25$ V for all channels
	DT9872	$\pm 1.25$ V for all channels
VOLTpoint	DT9873	$\pm 10$ V or $\pm 60$ V (software-selectable for each channel) <sup>a</sup>
MEASURpoint	DT9874-16T-16R-16V	$\pm 0.75$ V for channels 0 to 15; $\pm 1.25$ V for channels 15 to 31; $\pm 10$ V or $\pm 60$ V for channels 32 to 47 (software-selectable for each channel) <sup>a</sup>

a. Note that the maximum input voltage for the  $\pm 60$  V range cannot be more than 30 Vrms, 42.4 Vpk, 60 VDC.

### ***Out of Range Data for Thermocouple Channels***

Each thermocouple type corresponds to an allowable voltage range. If a voltage is measured on the input that is outside of the legal range for the selected thermocouple type, the channel may be configured for the wrong type of thermocouple or something other than a thermocouple may be connected to the channel.

For channels configured with a thermocouple type of None (voltage), the Limit (LMT) LED on the rear panel of the instrument lights to alert you when the voltage is out of range; see [Figure 10 on page 37](#) for the location of this LED.

For channels configured with a thermocouple type other than None (voltage), the LMT LED lights when the temperature limit is out of range for the specified thermocouple type.

In addition, if the input voltage is less than the legal voltage range for the selected thermocouple 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 thermocouple type, the software returns the value TEMP\_OUT\_OF\_RANGE\_HIGH (88888 decimal).

---

**Note:** 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 approximately 0.7 V over a few seconds.

In this case, the temperature value rises very quickly, and you will receive the TEMP\_OUT\_OF\_RANGE\_HIGH (88888 decimal) value followed by the OPEN\_SENSOR (99999 decimal) value. In this case, the OPN LED lights when the open thermocouple is detected and the LMT LED lights when the temperature limit is out of range for the thermocouple type.

---

## **Out of Range Data for RTD Channels**

Each RTD type corresponds to an allowable voltage range. If a voltage is measured on the input that is outside of the legal range for the selected RTD type, the channel may be configured for the wrong type of RTD or something other than an RTD may be connected to the channel.

For channels configured with a RTD type of voltage, the Limit (LMT) LED on the rear panel of the instrument lights to alert you when the voltage is out of range (greater than +1.25 V or less than -1.25 V); see [page 37](#) for the location of this LED. For channels configured with an RTD type other than voltage, the LMT LED lights when the temperature limit is out of range for the specified RTD type.

In addition, if the input voltage is less than the legal voltage range for the selected RTD type, the software returns the value TEMP\_OUT\_OF\_RANGE\_LOW (-88888.0 decimal). If the input voltage is greater than the legal voltage range for the selected RTD type, the software returns the value TEMP\_OUT\_OF\_RANGE\_HIGH (88888.0 decimal).

## **Out of Range Data for Voltage Channels**

Each voltage input channel has an allowable voltage range ( $\pm 10$  V or  $\pm 60$  V on MEASURpoint instruments). You configure the input range for each channel using software. If a voltage is measured on the input that is outside of the legal range for that channel, the Limit (LMT) LED on the rear panel of the instrument lights to alert you; see [page 37](#) for the location of this LED.

## **Resolution**

TEMPpoint, VOLTpoint, and MEASURpoint instruments support a resolution of 24 bits for the analog input subsystem; you cannot specify the resolution in software.

## **Calibration**

Each TEMPpoint, VOLTpoint, and MEASURpoint instrument is factory-calibrated to meet or exceed its published specifications using standards traceable to NIST.

The calibration process includes multiple steps. First, the A/D on each channel is calibrated for offset and gain; these values (including the zero point) are stored in ROM. Then, each CJC circuit is calibrated for thermocouple input channels, and the reference current is characterized for RTD channels.

While each instrument was designed to preserve high accuracy measurements over time, it is recommended that your instrument be recalibrated every year to ensure that it meets or exceeds specifications.

You can calibrate your instrument in the field using precise calibration equipment and the Measurement Calibration Utility, described on [page 15](#).

Optionally, you can return your instrument to Data Translation for recalibration. For information on factory recalibration, contact Data Translation at 508-946-5100 (if you are in the USA) or call your local distributor (if you are located outside the USA); see our web site ([www.mccdaq.com](http://www.mccdaq.com)) for the name and telephone number of your nearest distributor.

In addition, each instrument auto-calibrates on each power-up cycle to guarantee high-accuracy measurements. This process, also known as auto-zeroing, resets the zero point of each A/D. You can also auto-calibrate the instrument at any time (as long as acquisition is not in progress) using a software command. Refer to your software documentation for more information on the auto-calibration feature.

## Sample Clock Source

TEMPpoint, VOLTpoint, and MEASURpoint instruments support an internal clock with a maximum sampling rate of 10 Samples/s.

Use software to specify an internal clock source and a clock frequency between 0.000152590219 Hz and 10.0 Hz.

---

**Note:** The clock frequency that you specify is rounded to the closest "correct" value that the instrument can accept without error. Internally, the 10 Hz clock is divided by an integer in the range of 1 to 65535 (the internal clock divider) to determine the closest value. Using software, you can query this setting to determine the actual clock frequency that is used.

---

When the continuous operation is started, all the channels specified in the channel list are read simultaneously at the specified clock frequency.

## Trigger Source

A trigger is an event that occurs based on a specified set of conditions. Acquisition starts when the instrument detects the initial trigger event and stops when you stop the operation.

TEMPpoint, VOLTpoint, and MEASURpoint instruments support the following trigger sources for starting analog input operations:

- **Software trigger** – A software trigger event occurs when you start the analog input operation (the computer issues a write to the instrument to begin conversions).
- **External digital trigger** – An external digital trigger event occurs when the instrument detects a voltage from +3 V to +28 V DC on digital input line 0. Initially, the external signal must be low and then go high for at least 100 ms to be detected as a trigger. Once triggered, the state of digital input 0 is ignored.

## Conversion Modes

TEMPpoint, VOLTpoint, and MEASURpoint instruments support continuous scan conversion modes for reading input measurements.

Continuous scan mode takes full advantage of the capabilities of the TEMPpoint, VOLTpoint, and MEASURpoint instruments. Use continuous scan mode if you want to accurately control the period between successive simultaneous conversions of specific channels.

In addition to the analog input channels, this conversion mode allows you to read the digital input port (all 8 digital input lines) as part of the analog input data stream. This feature is particularly useful when you want to correlate the timing of analog and digital events.

### ***Specifying Analog Input Channels***

Using software, enable the analog input channels that you want to sample by specifying the channel numbers in the channel list. You can also read the value of the digital input port through the analog input data stream by specifying the digital input channel in the channel list; the number of the digital input channel depends on how many channels the TEMPpoint, VOLTpoint, or MEASURpoint instrument provides, as shown in [Table 5](#).

**Table 5: Supported Channels for Continuous Operations**

Total Number of Analog Input Channels	Channel for Reading the Digital Input Port
0 to 7	8
0 to 15	16
0 to 23	24
0 to 31	32
0 to 39	40
0 to 47	48

The channels are read in order from the lowest channel number to the highest channel number in the list of enabled channels; this process is known as a scan.

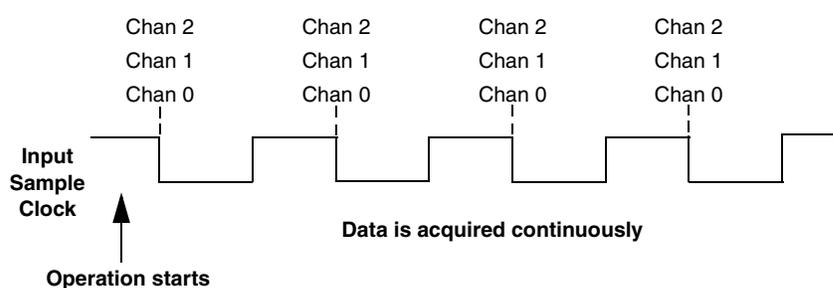
### ***How Continuous Scan Works***

When you issue a command to start the scan, the instrument simultaneously samples all the analog input channels, CJC inputs (if applicable), and the digital input port, and converts the analog inputs to temperature, resistance, or voltage based on the sensor type. If the channel is enabled, the sampled data is placed in the FIFO on the instrument.

The FIFO on the instrument is used as a circular buffer. Acquisition continues indefinitely until you stop the operation. When the FIFO is full, the operation wraps to the beginning of the FIFO; values are overwritten starting at the first location in the FIFO. It is up to your application to retrieve the data from the FIFO; refer to your software documentation for more information.

The conversion rate is determined by the frequency of the input sample clock; refer to [page 95](#) for more information about the input sample clock. The sample rate, which is the rate at which a single entry in the channel list is sampled, is the same as the conversion rate due to the simultaneous nature of the MEASURpoint instrument.

[Figure 33](#) illustrates scanning a list of three enabled channels: channel 0, channel 1, and channel 2. In this example, analog input data is acquired simultaneously on each clock pulse of the input sample clock. Data is acquired continuously.



**Figure 33: Continuous Scan Mode**

## Filtering

TEMPpoint, VOLTpoint, and MEASURpoint instruments use a Delta-Sigma analog-to-digital converter (ADC) for each analog input channel to provide simultaneous sampling of all inputs. The Delta-Sigma converter operates at 10 Hz effectively providing a filter that rejects 50 Hz and 60 Hz power line frequency components and that removes *aliasing*, a condition where high frequency input components erroneously appear as lower frequencies after sampling.

In addition to the filter provided in hardware, you can further reduce noise by selecting one of the following filter options in software: Moving Average or Raw. Refer to your software documentation for more information on selecting a filter type.

## Data Format

TEMPpoint, VOLTpoint, and MEASURpoint instruments return data as 32-bit floating-point values. How the data is returned depends on the channel type, as described in the following subsections.

### **Data Format for Thermocouple Channels**

If you specify a thermocouple type of None for a thermocouple input channel, a voltage measurement is selected and the instrument returns a voltage value. For the DT9871U and DT9874 instruments, the value is in the range of  $\pm 0.075$  V; for the DT9872 instrument, the value is in the range of  $\pm 1.25$  V. For all other thermocouple types, a temperature value, in degrees C, or one of the error constants, described on [page 99](#), is returned.

In normal operation, one floating-point value is returned for each enabled channel (including the digital input port). If you enable the capability of returning CJC data in the data stream, described on [page 91](#), 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 RTD Channels**

If you specify an RTD type of None for an RTD input channel, a voltage measurement is selected and the instrument returns a voltage value in the range of  $\pm 1.25$  V. If you specify an RTD type of Ohms, a resistance value is returned. For all other RTD types, a temperature value, in degrees C, or one of the error constants, described on [page 99](#), is returned.

One floating-point value is returned for each enabled channel (including the digital input port).

### **Data Format for Voltage Channels**

For voltage channels on a MEASURpoint instrument, a voltage value in the range of  $\pm 10$  V or  $\pm 60$  V is returned for each channel, depending on how the channel was configured. Note that the maximum input voltage for the  $\pm 60$  V range cannot be more than 30 Vrms, 42.4 Vpk, 60 VDC.

One floating-point value is returned for each enabled channel (including the digital input port).

## **Error Conditions**

TEMPpoint, VOLTpoint, and MEASURpoint instruments 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 91](#)
- 88888.0 – TEMP\_OUT\_OF\_RANGE\_HIGH, described on [page 93](#) and [page 94](#)
- -88888.0 – TEMP\_OUT\_OF\_RANGE\_LOW, described on [page 93](#) and [page 94](#)

If any of these constants is reported, the A/D subsystem continues to acquire data; the error condition is cleared when the data falls within range.

## Digital I/O Features

TEMPpoint, VOLTpoint, and MEASURpoint instruments provide 8 digital input lines and 8 digital output lines that you can use to control external equipment, including solid-state or mechanical relays.

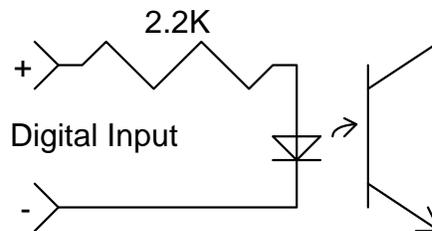
This section describes the following digital I/O features:

- Digital input lines, described below
- Digital output lines, described on [page 101](#)
- Channel-to-channel functional isolation, described on [page 101](#)
- Resolution, described on [page 101](#)
- Operation modes, described on [page 101](#)

### Digital Input Lines

TEMPpoint, VOLTpoint, and MEASURpoint instruments feature eight, isolated, digital input lines.

Digital inputs operate from +3 to +28 V DC, with a switching time of 2 ms maximum. [Figure 34](#) shows the digital input circuitry; a 2.2 k $\Omega$  resistor is used in series with the LED in the opto-isolator input.



**1 of 8 Opto-Isolators**

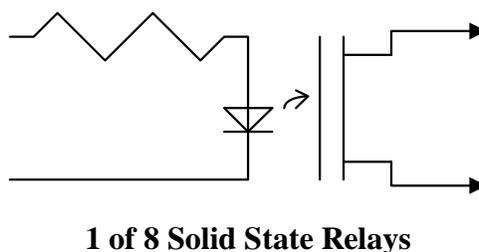
**Figure 34: Digital Input Circuitry**

A digital line is high (switch is closed) if its value is 1; a digital line is low (switch is open) if its value is 0.

## Digital Output Lines

TEMPpoint, VOLTpoint, and MEASURpoint instruments feature eight, latched and isolated digital output lines. The outputs are solid-state relays that operate at  $\pm 30$  V and 400 mA peak (AC or DC). Switching time is 2 ms maximum.

Figure 35 shows the digital output circuitry.



**Figure 35: Digital Output Circuitry**

Digital outputs resemble a switch; the switch is closed if the state of the digital output line is 1, and the switch is open if the state of the digital output line is 0. On power up or reset, the digital outputs are disabled.

## Channel-to-Channel Functional Isolation

Each TEMPpoint, VOLTpoint, and MEASURpoint instrument includes channel-to-channel functional isolation of up to 60 V between digital I/O lines.

## Resolution

Each TEMPpoint, VOLTpoint, and MEASURpoint instrument provides 8 bits of resolution for the digital input port to accommodate the 8 digital input lines and 8 bits of resolution for the digital output port to accommodate the 8 digital output lines. These lines are organized as isolated, dedicated ports. You cannot configure port resolution through software.

## Operation Modes

Using software, you can read from a single digital input line or the entire digital input port, or write to a single digital output line or the entire digital output port. You can also return the value of the entire digital input port in the analog input data stream if you want to correlate analog input data with digital events; refer to [page 96](#) for more information.





## ***Troubleshooting***

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## General Checklist

Should you experience problems using a TEMPpoint, VOLTpoint, or MEASURpoint instrument, do the following:

1. Read all the documentation provided for your product, including any “Read This First” information.
2. Install the latest software from the web at <https://www.mccdaq.com/downloads/DTSsoftware/MEASURpoint>.
3. Check that your system meets the requirements stated in [Chapter 2](#).
4. Check that you have installed your hardware properly using the instructions in [Chapter 3](#).
5. Check that you have wired your signals properly using the instructions in [Chapter 4](#).
6. Search the DT Knowledgebase in the Support section of the Data Translation web site (at [www.mccdaq.com](http://www.mccdaq.com)) for an answer to your problem.

If you still experience problems, try using the information in [Table 6](#) to isolate and solve the problem. If you cannot identify the problem, refer to [page 106](#).

**Table 6: Troubleshooting Problems**

Symptom	Possible Cause	Possible Solution
Instrument is not recognized	You plugged the instrument 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 instruments to the computer.
Instrument does not respond.	The instrument configuration is incorrect.	Check the configuration of your device driver; see the instructions in <a href="#">Chapter 3</a> .
	The instrument is damaged.	Contact Data Translation for technical support; refer to <a href="#">page 106</a> .
Intermittent operation.	Loose connections or vibrations exist.	Check your wiring and tighten any loose connections or cushion vibration sources; see the instructions in <a href="#">Chapter 4</a> .
	The instrument is overheating.	Check environmental and ambient temperature; consult the specifications on <a href="#">page 124</a> 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 <a href="#">Chapter 4</a> .
Device failure error reported.	The instrument 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 <a href="#">Chapter 4</a> .
	The instrument was removed while an operation was being performed.	Ensure that your instrument is properly connected; see the instructions in <a href="#">Chapter 3</a> .

**Table 6: Troubleshooting Problems (cont.)**

Symptom	Possible Cause	Possible Solution
Data appears to be invalid.	An open connection exists.	Check your wiring and fix any open connections; see the instructions in <a href="#">Chapter 4</a> .
	A transducer is not connected to the channel being read.	Check the transducer connections; see the instructions in <a href="#">Chapter 4</a> .
	The thermocouple, RTD, 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 <a href="#">Chapter 4</a> .
	Your instrument may need recalibration.	<p>The instrument is calibrated at the factory. Thereafter, yearly calibration is recommended. Use the Measurement Calibration Utility, described on <a href="#">page 16</a>, or return your instrument to Data Translation for recalibration.</p> <p>For information on factory recalibration, contact Data Translation at 508-946-5100 (if you are in the USA) or call your local distributor (if you are located outside the USA); see our web site (<a href="http://www.mccdaq.com">www.mccdaq.com</a>) for the name and telephone number of your nearest distributor.</p>
USB 2.0 is not recognized.	Your operating system does not have the appropriate Service Pack installed.	Ensure that you load the appropriate Windows Service Pack (version 2 for Windows XP). If you are unsure of whether you are using USB 2.0 or USB 1.1, run the Open Layers Control Panel applet, described in <a href="#">Chapter 3</a> .
	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 operation. Consult Microsoft for more information.

## **Technical Support**

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**Note:** TEMPpoint, VOLTpoint, and MEASURpoint instruments have a 1 year warranty from the factory. If you open the instrument's enclosure, you will void this warranty.

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If you have difficulty using your TEMPpoint, VOLTpoint, or MEASURpoint instrument, Data Translation's Technical Support Department is available to provide technical assistance.

To request technical support, go to our web site at <https://www.mccdaq.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 MEASURpoint Software that you are using
- Your contract number, if applicable

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

## ***If Your Instrument Needs Factory Service***

Most hardware models can be functionally tested, evaluated for repairs (if needed), and calibrated to factory specifications. An RMA # must be obtained from Application Engineering in advance of sending any product back to Measurement Computing. Customers outside of the USA must contact their local distributor for a return procedure. Calibration certificates for most analog models can be obtained for a fee (certificate must be requested at time of RMA # assignment).





# *Specifications*

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**Note:** All analog input specifications are based on the Moving Average filter type.

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## Basic Instrument Specifications

[Table 7](#) lists the basic instrument specifications for the DT9871, DT9871U, DT9872, DT9873, and DT9874 instruments. For basic environmental specifications, please see [page 124](#).

**Table 7: Basic Instrument Specifications**

Feature	Specifications
Number of channels in channel list	Up to 48 analog input channels and one digital input port
A/D converter type	High stability 24-bit Sigma-Delta
Measurement category ratings	Do not connect to signals or use for measurements within measurement categories II, III, or IV

## Thermocouple Specifications

[Table 8](#) lists the thermocouple specifications for thermocouple channels on the DT9871, DT9871U, and DT9874 instruments.

**Table 8: Thermocouple Specifications**

Feature	Specifications
Thermocouple types (software-selectable)	B, E, J, K, N, R, S, T
A/D resolution	24-bits
Sample rate	10 Samples/s <sup>a</sup>
Thermal disturbance channel-to-channel	None
Upscale break detection current DT9871U and DT9874: DT9871:	+10 nA +100 nA
System temperature error DT9871U and DT9874: DT9871:	See <a href="#">Table 9</a> and <a href="#">Table 10</a> on page 112 See <a href="#">Table 11</a> on page 114

a. Older versions of the DT9871 instrument may support a maximum sampling rate of 7.5 Samples/s.

## System Temperature Error for the DT9871U and DT9874

Table 9 lists the typical accuracy of the DT9871U and DT9874 for each thermocouple type at several temperature points over the dynamic range of the instrument.

**Table 9: Typical Thermocouple Accuracy of the DT9871U and DT9874**

Input Temp.	Thermocouple Type <sup>a</sup>							
	J	K	T	E	S	R	B	N
-100° C	±0.17°C	±0.17°C	±0.16°C	±0.16°C	-----	-----	-----	±0.16°C
0° C	±0.15°C	±0.16°C	±0.16°C	±0.15°C	±0.20°C	±0.20°C	-----	±0.16°C
100° C	±0.18°C	±0.15°C	±0.16°C	±0.15°C	±0.18°C	±0.18°C	-----	±0.15°C
300° C	±0.15°C	±0.17°C	±0.16°C	±0.15°C	±0.18°C	±0.18°C	±0.23°C	±0.15°C
500° C	±0.15°C	±0.15°C	-----	±0.15°C	±0.18°C	±0.17°C	±0.21°C	±0.15°C
700° C	±0.15°C	±0.15°C	-----	±0.16°C	±0.18°C	±0.18°C	±0.17°C	±0.16°C
900° C	±0.15°C	±0.17°C	-----	±0.17°C	±0.18°C	±0.18°C	±0.19°C	±0.16°C
1100° C	±0.15°C	±0.16°C	-----	-----	±0.19°C	±0.18°C	±0.18°C	±0.16°C
1400° C	-----	-----	-----	-----	±0.18°C	±0.18°C	±0.17°C	-----

a. **Conditions for accuracy measurements:**

MEASURpoint warm-up time of 1 hour. Inclusive of typical 0.15°C CJC error. Exclusive of thermocouple errors.

Table 10 lists the maximum accuracy of the DT9871U and DT9874 for each thermocouple type at several temperature points over the dynamic range of the instrument.

**Table 10: Maximum Thermocouple Accuracy of the DT9871U and DT9874**

Input Temp.	Thermocouple Type <sup>a</sup>							
	J	K	T	E	S	R	B	N
-100° C	±0.35°C	±0.38°C	±0.39°C	±0.34°C	-----	-----	-----	±0.43°C
0° C	±0.33°C	±0.35°C	±0.35°C	±0.32°C	±0.96°C	±0.98°C	-----	±0.40°C
100° C	±0.34°C	±0.31°C	±0.34°C	±0.31°C	±0.77°C	±0.76°C	-----	±0.37°C
300° C	±0.31°C	±0.36°C	±0.32°C	±0.30°C	±0.67°C	±0.65°C	±1.52°C	±0.35°C
500° C	±0.30°C	±0.33°C	-----	±0.30°C	±0.64°C	±0.61°C	±1.02°C	±0.34°C
700° C	±0.30°C	±0.33°C	-----	±0.31°C	±0.62°C	±0.58°C	±0.80°C	±0.35°C
900° C	±0.30°C	±0.36°C	-----	±0.31°C	±0.60°C	±0.56°C	±0.72°C	±0.35°C
1100° C	±0.31°C	±0.35°C	-----	-----	±0.59°C	±0.54°C	±0.65°C	±0.35°C
1400° C	-----	-----	-----	-----	±0.57°C	±0.53°C	±0.59°C	-----

a. **Conditions for accuracy measurements:**

MEASURpoint warm-up time of 1 hour. Maximum accuracy inclusive of 0.25°C CJC error. Exclusive of thermocouple errors.

The histograms shown in [Figure 36](#) and [Figure 37](#) characterize the Gaussian system noise distribution for each of the available filter types on the DT9871U and DT9874. Note that converting  $\mu\text{V}$  error to temperature error depends on thermocouple type. For example, a K thermocouple changes approximately  $39 \mu\text{V}$  per degrees C; therefore, a noise level of  $0.1 \mu\text{V}$  adds less than  $0.003^\circ \text{C}$  error ( $0.1 \mu\text{V} / 39 \mu\text{V}$ ) for a type K thermocouple.

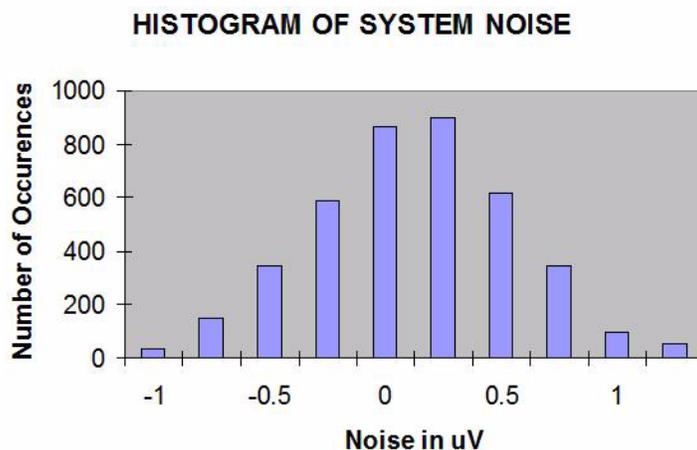


Figure 36: System Noise on the DT9871U and DT9874 Using No Software Filter (Raw Filter)

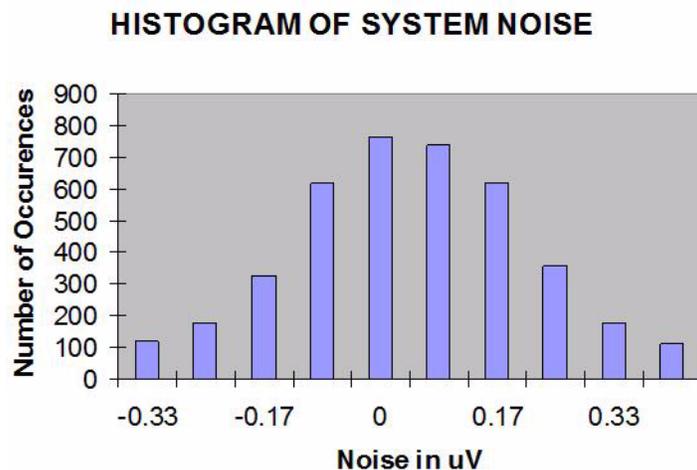


Figure 37: System Noise on the DT9871U and DT9874 Using the Moving Average Filter

## System Temperature Error for the DT9871

Table 11 lists the typical accuracy of the DT9871 for each thermocouple type at several temperature points over the dynamic range of the instrument.

**Table 11: Typical Thermocouple Accuracy of the DT9871**

Input Temperature	Thermocouple Type <sup>a</sup>							
	J	K	T	E	S	R	B	N
-100° C	±0.33°C	±0.37°C	±0.38°C	±0.31°C	-----	-----	-----	±0.44°C
0° C	±0.30°C	±0.33°C	±0.33°C	±0.28°C	±1.12°C	±1.14°C	-----	±0.39°C
100° C	±0.31°C	±0.29°C	±0.31°C	±0.27°C	±0.88°C	±0.86°C	-----	±0.35°C
300° C	±0.29°C	±0.34°C	±0.29°C	±0.26°C	±0.75°C	±0.71°C	±1.84°C	±0.33°C
500° C	±0.28°C	±0.31°C	-----	±0.26°C	±0.71°C	±0.66°C	±1.20°C	±0.33°C
700° C	±0.27°C	±0.30°C	-----	±0.27°C	±0.68°C	±0.63°C	±0.92°C	±0.33°C
900° C	±0.27°C	±0.34°C	-----	±0.28°C	±0.66°C	±0.60°C	±0.80°C	±0.33°C
1100° C	±0.28°C	±0.34°C	-----	-----	±0.64°C	±0.58°C	±0.71°C	±0.34°C
1400° C	-----	-----	-----	-----	±0.62°C	±0.56°C	±0.64°C	-----

a. **Conditions for accuracy measurements:**

MEASURpoint warm-up time of 1 hour. Inclusive of typical 0.2°C CJC error (maximum CJC error is 0.3°C).  
Exclusive of thermocouple errors.

The histograms shown in Figure 38 and Figure 39 characterize the Gaussian system noise distribution for each of the available filter types on the DT9871. Note that converting  $\mu\text{V}$  error to temperature error depends on thermocouple type. For example, a K thermocouple changes approximately 39  $\mu\text{V}$  per degrees C; therefore, a noise level of 10  $\mu\text{V}$  adds 0.3° C error (10  $\mu\text{V}$  / 39  $\mu\text{V}$ ) for a type K thermocouple.

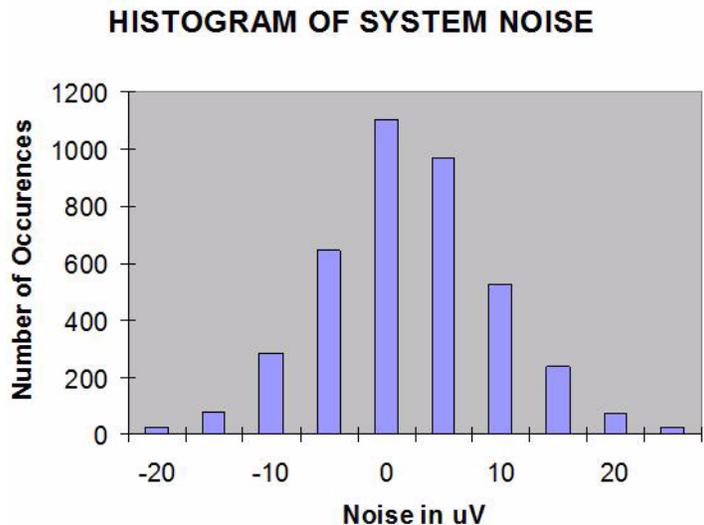


Figure 38: System Noise on the DT9871 Using No Software Filter (Raw Filter)

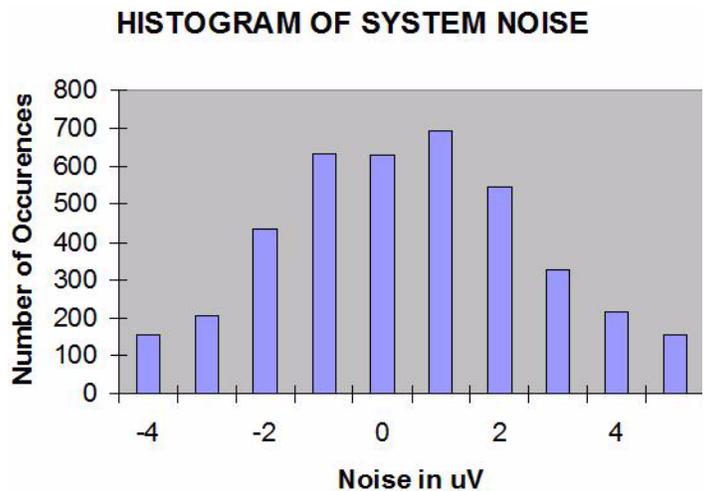


Figure 39: System Noise on the DT9871 Using the Moving Average Filter

## RTD Specifications

Table 12 lists the specifications for RTD channels on the DT9872 and DT9874.

**Table 12: RTD Specifications**

Feature	Specifications
RTD types (software-selectable)	Platinum 100 $\Omega$ , 500 $\Omega$ , and 1000 $\Omega$
A/D converter resolution	24-bits
Sample rate	10 Samples/s <sup>a</sup>
Supported temperature range	-200 to +850° C (European standard)
Current source Absolute current:	425 $\mu$ A, $\pm$ 0.5% at 25° C (calibrated in firmware)
Drift:	10 ppm/° C maximum
Drift per year:	$\pm$ 100 ppm typical
Internal reference	+1.250 $\pm$ 0.002 V
Thermal disturbance channel-to-channel	None
Supported RTD alpha curves	See Table 13

a. Older versions of this instrument may support a maximum sampling rate of 7.5 Samples/s.

Table 13 lists the RTD alpha curves that are supported by RTD channels.

**Table 13: Supported RTD Alpha Curves**

Alpha (Average Temperature Coefficient of Resistance (/°C))	Nominal Resistance at 0° C	Organization	Standard
0.00385	100 $\Omega$	British Standard	BS1904: 1984
		Deutschen Institut für Normung	DIN 43760: 1980
0.00392	98.129 $\Omega$	Scientific Apparatus Manufacturers of America	SAMA RC-4-1966

## Temperature Specifications

Table 14 lists the temperature specifications for thermocouple channels on the DT9871, DT9871U, and DT9874 instruments.

**Table 14: Temperature Specifications for Thermocouple Channels**

Feature	Specifications
Additional error due to ambient temperature change <sup>a</sup> J-type thermocouple: K-type thermocouple: B-type thermocouple: E-type thermocouple: N-type thermocouple: R-type thermocouple: S-type thermocouple: T-type thermocouple:	0.010° C per degree ambient change, typical 0.011° C per degree ambient change, typical 0.014° C per degree ambient change, typical 0.010° C per degree ambient change, typical 0.011° C per degree ambient change, typical 0.012° C per degree ambient change, typical 0.012° C per degree ambient change, typical 0.010° C per degree ambient change, typical
MEASURpoint warm-up time	1 hour
CJC Error (maximum):  Accuracy:  Drift per year:	±0.25° C  Corrected in ROM @ 25° C to zero error  ±50 ppm typical

a. Includes the A/D reference, gain, and CJC errors.

Table 15 lists the temperature specifications for RTD channels on the DT9872 and DT9874.

**Table 15: Temperature Specifications for RTD Channels**

Feature	Specifications
System temperature error <sup>a</sup>	
Pt100:	Offset (typical): $\pm 0.03^{\circ}\text{C}$ Offset (maximum): $\pm 0.30^{\circ}\text{C}$ RMS noise: $0.03^{\circ}\text{C}$ Temperature resolution: $0.002^{\circ}\text{C}$ Maximum system error: $\pm 0.80^{\circ}\text{C}^{\text{b}}$
Pt500:	Offset (typical): $\pm 0.007^{\circ}\text{C}$ Offset (maximum): $\pm 0.07^{\circ}\text{C}$ RMS noise: $0.007^{\circ}\text{C}$ Temperature resolution: $0.0004^{\circ}\text{C}$ Maximum system error: $\pm 0.16^{\circ}\text{C}^{\text{b}}$
Pt1000:	Offset (typical): $\pm 0.003^{\circ}\text{C}$ Offset (maximum): $\pm 0.03^{\circ}\text{C}$ RMS noise: $0.003^{\circ}\text{C}$ Temperature resolution: $0.0002^{\circ}\text{C}$ Maximum system error: $\pm 0.08^{\circ}\text{C}^{\text{b}}$
Warm-up time	
MEASURpoint:	1 hour
RTD sensors and external calibration resistors:	1 minute

a. Includes the A/D reference and gain errors.

b. Includes a maximum linearity error of 10 ppm and a calibration setup error of 10 ppm. Users must be aware that subtle resistor value tolerances and self-heating of the external calibration resistors contribute calibration setup errors.

## Voltage Measurement Specifications

Table 16 lists the voltage measurement specifications for the DT9871, DT9871U, DT9872, DT9873, and DT9874 instruments.

**Table 16: Voltage Measurement Specifications**

Feature	Specifications
Input voltage range (no compensation) DT9871U and DT9874 thermocouple channels: DT9871: DT9872 and DT9874 RTD channels: DT9873 and DT9874 voltage channels:	$\pm 0.0750$ V $\pm 1.2500$ V $\pm 1.2500$ V $\pm 10$ V or $\pm 60$ V (software selectable) <sup>a</sup>
A/D converter resolution	24-bits
Voltage resolution DT9871U and DT9874 thermocouple channels: DT9871: DT9872 and DT9874 RTD channels: DT9873 and DT9874 voltage channels:	0.015 $\mu$ V 0.3 $\mu$ V 0.3 $\mu$ V 1.2 $\mu$ V for the $\pm 10$ V input range; 12 $\mu$ V for the $\pm 60$ V input range <sup>a</sup>
Sample rate	10 Samples/s
Input impedance DT9871U and DT9874 thermocouple channels: DT9871: DT9872 and DT9874 RTD channels: DT9873 and DT9874 voltage channels:	5 M $\Omega$ typical 5 M $\Omega$ typical >100 M $\Omega$ >1 M $\Omega$ (Power ON or OFF)
Input common mode voltage	60 VDC, 30 VAC
Common mode rejection @ 60 Hz and 50 Hz	> 150 dB
Coupling	DC
System linearity DT9871U and DT9874 thermocouple channels: DT9871: DT9872 and DT9874 RTD channels: DT9873 and DT9874 voltage channels:	$\pm 0.005\%$ $\pm 0.005\%$ $\pm 0.001\%$ $\pm 0.001\%$
System gain error (includes all noise sources; gain = 1) DT9871U and DT9874 thermocouple channels: DT9871: DT9872 and DT9874 RTD channels: DT9873 and DT9874 voltage channels:	$\pm 0.00075\%$ of full-scale range $\pm 0.00075\%$ of full-scale range $\pm 0.00075\%$ of full-scale range $\pm 0.01\%$ of reading
System zero error (includes all noise sources; no filter) DT9871U and DT9874 thermocouple channels: DT9871: DT9872 and DT9874 RTD channels: DT9873 and DT9874 voltage channels:	0.25 $\mu$ V RMS 5 $\mu$ V RMS $\pm 12$ $\mu$ V $\pm 300$ $\mu$ V for the $\pm 10$ V input range; $\pm 2$ mV for the $\pm 60$ V input range <sup>a</sup>

**Table 16: Voltage Measurement Specifications (cont.)**

Feature	Specifications
System drift error, zero DT9871U and DT9874 thermocouple channels: DT9871: DT9872 and DT9874 RTD channels: DT9873 and DT9874 voltage channels:	$\pm 0.02 \mu\text{V}/^\circ\text{C}$ typical $\pm 0.02 \mu\text{V}/^\circ\text{C}$ typical $\pm 0.10 \mu\text{V}/^\circ\text{C}$ $\pm 0.5 \mu\text{V}/^\circ\text{C}$ for the $\pm 10\text{ V}$ input range; $\pm 5 \mu\text{V}/^\circ\text{C}$ for the $\pm 60\text{ V}$ input range <sup>a</sup>
System drift error, gain DT9871U and DT9874 thermocouple channels: DT9871: DT9872 and DT9874 RTD channels: DT9873 and DT9874 voltage channels:	$\pm 4 \text{ ppm}/^\circ\text{C}$ $\pm 4 \text{ ppm}/^\circ\text{C}$ $\pm 10 \text{ ppm}/^\circ\text{C}$ $\pm 15 \text{ ppm}/^\circ\text{C}$
A/D reference Drift: Drift per year:	$\pm 8 \text{ ppm}/^\circ\text{C}$ maximum $\pm 100 \text{ ppm}$ typical
Full-scale long-term stability DT9871U and DT9874 thermocouple channels:  DT9871:  DT9872 and DT9874 RTD channels:  DT9873 and DT9874 voltage channels:	$\pm 100 \text{ ppm/year}$ typical  $\pm 100 \text{ ppm/year}$ typical  $\pm 0.05^\circ\text{C}$ per year @ $0^\circ\text{C}$ ( $\pm 0.27^\circ\text{C}$ per year @ full-scale temperature)  $\pm 100 \text{ ppm/year}$ typical
Warm-up time for the DT9873 and DT9874 voltage channels:	1 hour

a. For the  $\pm 60\text{ V}$  range, no more than  $30\text{ V}_{\text{rms}}$ ,  $42.4\text{ V}_{\text{pk}}$ ,  $60\text{ VDC}$  is allowed.

## Isolation and Protection Specifications

Table 17 lists the isolation and protection specifications for the analog input subsystem on the DT9871, DT9871U, DT9872, DT9873, and DT9874 instruments.

**Table 17: Isolation and Protection Specifications**

Feature	Specifications
DT9871U, DT9871, and DT9874 Thermocouple Channels Overvoltage Protection (Power On/Off) Pin 2 referenced to pin 3: Pin 2 and 3 referenced to earth ground:	$\pm 40$ V 30 VAC, 42.4 Vpk, 60 VDC max. <sup>a</sup>
DT9872 and DT9874 RTD Channels Overvoltage Protection (Power On/Off) Pin 1 referenced to pin 4: Pin 2 referenced to pin 4: Pin 3 referenced to pin 4: Pin 1, 2, or 3 referenced to earth ground:	$\pm 4$ V <sup>b</sup> $\pm 40$ V $\pm 20$ V 30 VAC, 42.4 Vpk, 60 VDC max. <sup>a</sup>
DT9873 and DT9874 Voltage Input Channels Overvoltage Protection (Power On/Off) Pin 1 referenced to pin 3: Pins 1 and 3 referenced to earth ground:	$\pm 30$ VAC, 42.4 Vpk, 60 VDC max. <sup>a</sup> 30 VAC, 42.4 Vpk, 60 VDC max. <sup>a</sup>
ESD protection per standard EN61000-4-2:2009 (see page 125 for more) Arc: Contact:	8 kV 4 kV
Isolation voltage to the host computer	30 VAC, 42.4 Vpk, 60 VDC max. <sup>a</sup>
Channel-to-channel isolation	30 VAC, 42.4 Vpk, 60 VDC max. <sup>a</sup>

a. These pins are functionally isolated for a maximum of 30 VAC, 60 VDC Ch-Earth, verified by a 500 Vpk withstand.

b. Determined by internal protection diodes to the power supply. No damage occurs if current is limited to  $\pm 10$  mA.

## Memory Specifications

Table 18 lists the memory specifications for the analog input subsystem on the DT9871, DT9871U, DT9872, DT9873, and DT9874 instruments.

**Table 18: Memory Specifications**

Feature	Specifications
Data memory onboard	4 MByte
For Data logger built in, maximum time before old data is overwritten <sup>a</sup>	
48 channels @ 10 Hz:	30 minutes
48 channels @ 1 Hz:	5 hours
48 channels @ 0.1 Hz:	50 hours

- a. Assumes limit detection is off for all channels, and for thermocouple channels, assumes CJC data is not collected. If power fails, all temperature data in the system is lost. The channel input type and filter settings are still available after power on, but the channel and digital I/O labels and channel limits are lost.

## Digital I/O Specifications

Table 19 lists the specifications for the digital input (DIN) and digital output (DOUT) subsystems on the DT9871, DT9871U, DT9872, DT9873, and DT9874 instruments.

**Table 19: Digital I/O Specifications**

Feature	Specifications
Number of digital I/O lines	16 (8 In, 8 Out)
Number of ports	2, 8-bit (1 In, 1 Out)
Inputs Input type: High input voltage: Low input voltage: High input current: Low input current: Termination	DC +3 to +28 V < +1.5 V 2.2 k $\Omega$ resistor to 1.2 V 2.2 k $\Omega$ resistor to 1.2 V Series 2.2 k $\Omega$
Outputs Output type: Output driver: High output: Low output: Breakdown voltage: Contact impedance:	Solid-state relay CMOS $\pm 30$ V 0.4 V @ 400 mA $\pm 60$ V 1 $\Omega$
Isolation voltage To computer ground: Channel to channel:	30 VAC, 42.4 Vpk, 60 VDC max. <sup>a</sup> 30 VAC, 42.4 Vpk, 60 VDC max. <sup>a</sup>

a. These pins are functionally isolated for a maximum of 30 VAC, 60 VDC Ch-Earth, verified by a 500 Vpk withstand.

## Power, Physical, and Environmental Specifications

Table 20 lists the power, physical, and environmental specifications for the DT9871, DT9871U, DT9872, DT9873, and DT9874 instruments.

**Table 20: Power, Physical, and Environmental Specifications**

Feature	Specifications
USB power +5 V Standby: +5 V Power On: +5 V Enumeration:	500 $\mu$ A maximum (360 $\mu$ A typical) 2 mA maximum (1 mA typical) 2 mA maximum (1 mA typical)
External power requirements	+5 V $\pm$ 0.25V @ 2 A (0.9 mA typical)
Physical Dimensions of enclosure:  Weight:	88.14 (H) x 212.85 mm (W) x 211.43 mm (D)  1704 g
Environmental Operating temperature range: Storage temperature range: Relative humidity: Altitude: Pollution degree:	Indoor use only 0° C to 55° C -25° C to 85° C 10 to 90%, noncondensing up to 2000 m 2

## Regulatory Specifications

The DT9871, DT9871U, DT9872, DT9873, and DT9874 instruments are CE-compliant. [Table 21](#) lists the regulatory specifications for the DT9871, DT9871U, DT9872, DT9873, and DT9874 instruments.

**Table 21: Regulatory Specifications**

Feature	Specifications
Emissions (EMI)	FCC Part 15, Class A EN 55011:2009/A1:2010 (CISPR 11:2009/A1:2010), Group 1, Class A
Immunity	EN 61326-1:2013 (IEC 61326-1:2012), Class A Electrical Equipment for Measurement, Control, and Laboratory Use  <u>EMC Requirements</u> 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 2011/65/EU)	Compliant (as of July 1st, 2006)

## Connector Specifications

This section lists the specifications for the following connector types:

- Thermocouple connectors
- RTD connectors
- Voltage connectors

### Thermocouple Connectors

Table 22 lists the specifications for the thermocouple connectors used on the DT9871, DT9871U, and DT9874 instruments.

**Table 22: Thermocouple Connector Specifications**

Feature	Specifications
Thermocouple jacks	Omega plugs  SMPW-U-M – For voltage measurements SMPW-J-M – For J thermocouple type SMPW-K-M – For K thermocouple type SMPW-T-M – For T thermocouple type SMPW-E-M – For E thermocouple type SMPW-S-M – For S thermocouple type SMPW-R-M – For R thermocouple type SMPW-B-M – For B thermocouple type SMPW-N-M – For N thermocouple type
Thermocouple connector	Omega part# PCC-SMP-U-100-R-CE-ROHS

#### CAUTION:

**When connecting inputs to the thermocouple connectors on a MEASURpoint or TEMPpoint instrument, it is highly recommended that you use only original Omega thermocouple plugs (SMPW), as connectors from other suppliers may not be equivalent mechanically.**

**If you use connectors from suppliers other than Omega, there is a risk that you may mechanically damage the thermocouple connectors on the MEASURpoint or TEMPpoint instrument.**

## RTD Connectors

Table 23 lists the specifications for the RTD connectors used on the DT9872 and DT9874 instruments.

**Table 23: RTD Connector Specifications**

Feature	Specifications
4-Position screw terminal block header	Phoenix Contact 1803293
4-Position screw terminal block plug	Phoenix Contact 1803594

## Voltage Connectors

Table 24 lists the specifications for the voltage connectors used on the DT9871, DT9871U, DT9872, DT9873, and DT9874 instruments.

**Table 24: Voltage Connector Specifications**

Feature	Specifications
4-Position screw terminal block header	Phoenix Contact 1803293
4-Position screw terminal block plug	Phoenix Contact 1803594

## External Power Supply Specifications

Table 25 lists the specifications for the EP361 +5 V external power supply that is used with the DT9871, DT9871U, DT9872, DT9873, and DT9874 instruments.

**Table 25: External Power Supply (EP361) Specifications**

Feature	Specifications
Type	Total Power medical power supply (TPES22-050400 or TPEMG24-S050400-7)
Input voltage	Typical 90 - 264 V AC
Input current TPES22-050400	Typical 0.38 A at 115 V AC, 0.15 A at 230 V AC
TPEMG24-S050400-7	Typical 0.347 A at 115 V AC, 0.215 A at 230 V AC
Frequency	47 to 63 Hz
Inrush current TPES22-050400	35 A at 230 V AC typical or less than 30 A by adding thermistor
TPEMG24-S050400-7	6.274 A RMS at 230 V AC
Output voltage	5 V DC
Output current	4.0 A
Output wattage TPES22-050400	Typical 22 - 24 W
TPEMG24-S050400-7	Typical 20 - 24 W
Noise and ripple	1% peak to peak
Regulatory specifications TPES22-050400	UL, N, CE, FCC Class B
TPEMG24-S050400-7	UL, ITE, CE, FCC Class B, Energy Star compliant



## ***Connector Pin Assignments***

Table 26 lists the pin assignments for the 37-pin digital I/O connector on TEMPpoint, VOLTpoint, and MEASURpoint instruments.

**Table 26: Digital I/O Connector Pin Assignments**

Pin	Description	Pin	Description
1	Digital Input 0+	–	
2	Digital Input 1+	20	Digital Input 0–
3	Digital Input 2+	21	Digital Input 1–
4	Digital Input 3+	22	Digital Input 2–
5	Digital Input 4+	23	Digital Input 3–
6	Digital Input 5+	24	Digital Input 4–
7	Digital Input 6+	25	Digital Input 5–
8	Digital Input 7+	26	Digital Input 6–
9	Not Connected	27	Digital Input 7–
10	Digital Output 0	28	Not Connected
11	Digital Output 1	29	Digital Output 0
12	Digital Output 2	30	Digital Output 1
13	Digital Output 3	31	Digital Output 2
14	Digital Output 4	32	Digital Output 3
15	Digital Output 5	33	Digital Output 4
16	Digital Output 6	34	Digital Output 5
17	Digital Output 7	35	Digital Output 6
18	Not Connected	36	Digital Output 7
19	Not Connected	37	Not Connected

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