

Temperature Measurement Instruments *Ultra-Accurate . . . by Design*

TEMPpoint is a family of temperature measurement instruments designed for high accuracy and industrial robustness. These instruments allow direct thermocouple, RTD, and precision voltage measurements with a PC. Both USB and Ethernet (LXI) versions are available. Your TEMPpoint instrument comes with a ready-to-measure application, allowing you to be productive immediately — temperature and voltage values can be viewed, graphed, or exported to Excel, and allow limit checking for control or monitoring of a manufacturing process.

Key Design Features:

- **Dedicated 24-bit, Delta-Sigma A/D converter for each thermocouple, voltage, or RTD channel** for simultaneous, high-resolution measurements
- **Dedicated CJC (cold junction compensation) input for each thermocouple channel** for $\pm 0.01\%$ accuracy per reading
- **1000V galvanic isolation channel-to-channel** and to the host computer to protect signal integrity
- **+100 nA break-detection circuitry** to detect open thermocouple inputs
- **Input range of $\pm 1.25V$**
- **Throughput rate of up to 10Hz** for all 48 channels
- **Self-calibrating front-end** stores thermocouple linearization coefficients in onboard ROM for highly accurate measurements
- **Auto-zeroing A/D's** which automatically calibrate each time the instrument is turned on; or when powering off/on is not an option, perform “anytime” calibration to achieve the same results
- **Easy-access jacks for quick wiring** thermocouple inputs and screw terminals for RTDs
- **B, E, J, K, N, R, S, and T thermocouple types supported;** the DT9871 automatically linearizes the measurements and returns the data as a 32-bit, floating-point temperature values
- **Digital I/O galvanically isolated to 250V**
 - **8 opto-isolated digital input lines**
 - **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
- **Read the digital input port through the analog input data stream** for correlating analog and digital measurements



Figure 1. TEMPpoint provides highly accurate, 24-bit resolution temperature or voltage measurements on 48 channels. It also provides the ultimate in galvanic isolation (1000V channel-to-channel) to protect signal integrity in harsh environments.



Figure 2. TEMPpoint instruments feature quick wiring with easy access jacks for thermocouple inputs on the DT9871 and DT8871 and screw terminals for RTDs on the DT9872 (shown above) and DT8872.

TEMPpoint Front Panel: DT9871/DT8871

Fast warm-up and stabilization... get results quickly

Complete galvanic isolation...
1000V channel-to-channel protection

Direct thermocouple connection...
dedicated A/D and CJC per channel



48 channels are each independent... no effect of one on another

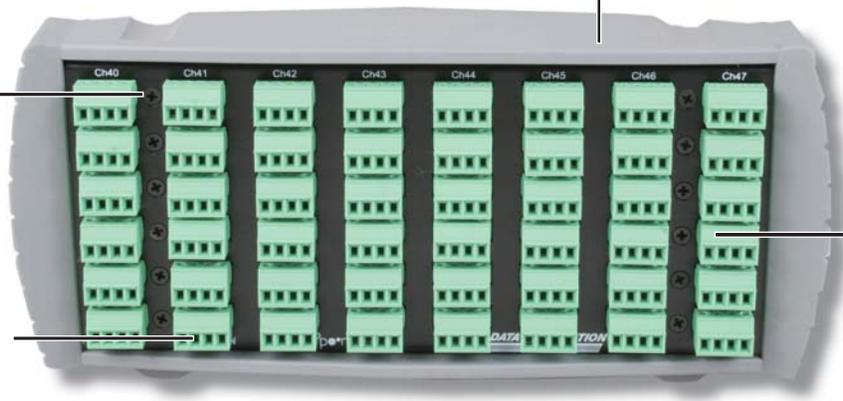
Figure 4. All 48 channels provide direct thermocouple or precision voltage connections as shown above.

TEMPpoint Front Panel: DT9872/DT8872

Instant stabilization... virtually no warm-up time

1000V channel-to-channel galvanic isolation protects signal integrity

Direct RTD connection...
4-wire to eliminate errors



Channels are all independent...
It's like 48 separate instruments

Figure 5. All 48 channels provide direct, 4-wire RTD or precision voltage connections as shown above.

TEMPpoint Back Panel

USB or Ethernet (LXI) connection

Fully DIN/CE compliant

Rugged digital I/O for driving relays for valves or switches... 250V isolation

2U high (½ width rack)... fits on bench or in rack

Designed for low power... less than 4W



STP37 and EP333 for easy connection of DIO

Figure 6. Digital I/O, power, and USB or Ethernet connections are provided on the back panel.

Thermocouple, Voltage, and RTD Inputs

TEMPpoint instruments support 48 inputs with 24-bit resolution per channel. On the DT9871 and DT8871, a voltage or thermocouple input can be attached to any channel in a mix or match fashion. This gives the user ultimate flexibility when setting up an application.

The DT9872 and DT8872 provide a 4-wire RTD input with Kelvin sensing for maximum accuracy by eliminating errors due to wire resistance. You can attach a voltage input or any of the following RTD types to these channels in a mix and match fashion: Platinum 100 W (Pt100), Platinum 500 W (Pt500), or Platinum 1000 W (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°C (-328°F) to 850°C (1562°F). You can also measure a resistance value, in Ohms, if desired.

The DT9871 and DT8871 provide an input range of $\pm 1.25\text{V}$ and a gain of 1. Because TEMPpoint architecture uses an A/D per channel, sampling rates of up to 10Hz per channel over all 48 channels can be reached.

Having an A/D per channel allows the conversion to be done right at the CJC point to get more accurate thermocouple readings.

Digital Input/Output Lines

TEMPpoint instruments feature eight, isolated, digital input lines. The digital input lines operate from +3 to +28V DC, with a switching time of 2ms maximum.

TEMPpoint instruments are perfect for driving relays directly, featuring eight, isolated, digital output lines. The outputs are solid-state relays that operate at $\pm 30\text{V}$ and 400mA peak (AC or DC) with a switching time of 2ms maximum.

TEMPpoint instruments include channel-to-channel isolation of up to 250V between digital I/O lines. If the application requires greater channel-to-channel isolation, every other digital line may be used. This reduces the number of digital I/O lines, but provides channel-to-channel isolation of 500V (one channel can be +250V while the adjacent channel can be -250V).

Triggers

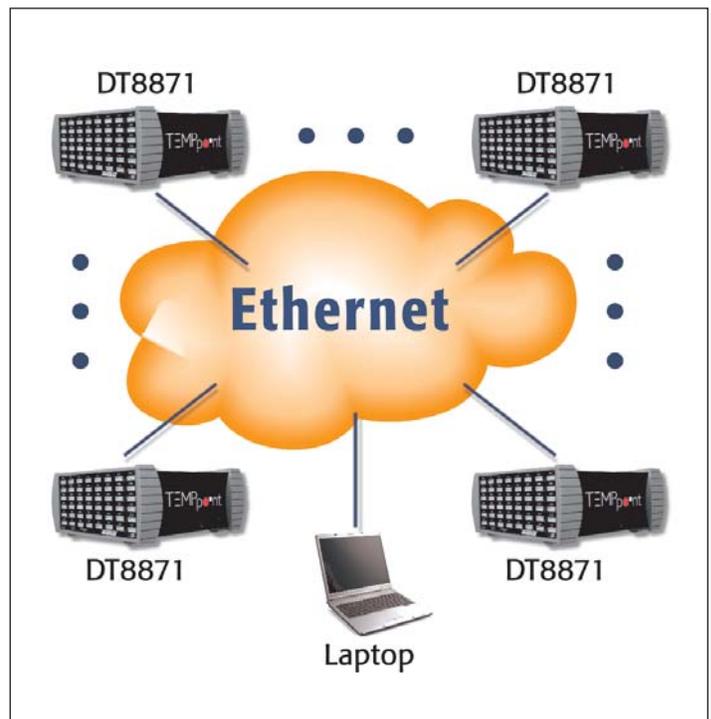
A trigger is an event that occurs based on a specified set of conditions. Acquisition starts when the instrument detects the initial trigger event and stops when either all the buffers that have been queued to the subsystem have been filled or you stop the operation. TEMPpoint instruments support a software trigger only.



Figure 8. Digital inputs and outputs are easily connected via the 37-pin D-sub connector on the back of the instrument using the STP-37 screw terminal panel and 37-pin EP333 cable.

Remote Measurements

The network-ready versions of TEMPpoint (DT8871/DT8872) provide a standard Ethernet connection to support remote monitoring and control from the field or on the factory floor. Temperature channels can be expanded by simply adding more instruments to the network.



Delta-Sigma Converters Reduce Noise

TEMPpoint instruments use Delta-Sigma analog-to-digital converters which provide an anti-aliasing filter. This type of converter is perfect for accurate temperature measurement as the filter rejects 50Hz and 60Hz power line frequency components; this eliminates the need to oversample and average your measurements. You can further reduce noise by using one of the four software-selectable filters provided:

- Raw
- Moving average
- Quiet
- Nominal

Eliminate Amplifiers

Many devices employ amplifiers in their analog circuitry to "boost" the small voltage levels associated with thermocouples. Typically, amplification is required when lower resolution, 16-bit A/D converters are used. Without this boost, accurate temperature measurement would not be possible.

For example, consider a +/- 10 volt 16-bit A/D with a gain of 1. The value of an lsb is:

$$\frac{20V}{2^{16}} = 300mV$$

Since thermocouples typically change 50 mV per degree Celsius, this system would only be "accurate" to approximately 6 degrees!

By using A/D converters with greater resolution, amplifiers become unnecessary as the A/D's themselves can discern much smaller changes in input voltage. For example, by using a +/- 2.5 volt, 24-bit A/D the resolution would become,

$$\frac{5V}{2^{24}} = .300mV$$

This is 1000 times smaller than the 16-bit converter. So even without amplification, much smaller voltages can be digitized without being subjected to drift errors. This design yields more stability and greater accuracy.

"Anytime" Calibration

Auto-zeroing is a feature of some A/D converters which virtually eliminates offset errors and increases long-term stability. TEMPpoint is equipped with state-of-the-art, auto-zeroing A/D's which automatically calibrate each time the instrument is turned on. When powering off/on is not an option, simply perform an "anytime" calibration while the instrument is running to achieve the same results. Total freedom for the customer.

A CJC Circuit on Every Channel

Thermocouples are "relative" not "absolute" temperature measuring devices that generate voltage as a function of the temperature difference between both ends. To measure absolute temperature, you need to know the temperature of one end of the thermocouple to find the temperature of the other end. This is where the CJC circuit comes in. The CJC measures the temperature of the end of thermocouple

that plugs into the instrument. TEMPpoint incorporates an independent CJC circuit for every channel. This a more costly approach, but makes TEMPpoint more accurate and more immune to temperature variations both inside and outside the instrument.

1000V Galvanic Isolation

A vast majority of thermocouple applications reside in industrial environments. By their nature, such environments create a wide variety of problems for data acquisition systems, including temperature instrumentation. Noise and high voltage inherent in industrial machinery can adversely affect a temperature measuring instrument from a relatively benign discrepancy in an acquired value to the destruction of the entire instrument. High quality galvanic isolation helps both situations.

Galvanic isolation improves system accuracy by eliminating the unwanted effects of voltage transients and acts as an "insurance policy" against the damaging effects of high voltages.

High-Stability, Low Drift Voltage References

Temperature measurement systems compare the voltages produced by a thermocouple with a known voltage before the data can be properly digitized and stored. This is where voltage references come in.

TEMPpoint uses high-precision, high-stability, low-drift voltage references rated at 4 PPM per degree and 100 PPM drift per year. This means TEMPpoint is accurate now and will remain that way over time.

Custom Designed DC-DC Converters

Our custom DC-DC converters circuits have a unique power distribution system that supplies power to only 2 of the 6 boards at any one time. Cycling non-adjacent boards in this manner creates less power surges, reduces noise, and improves the overall system performance.

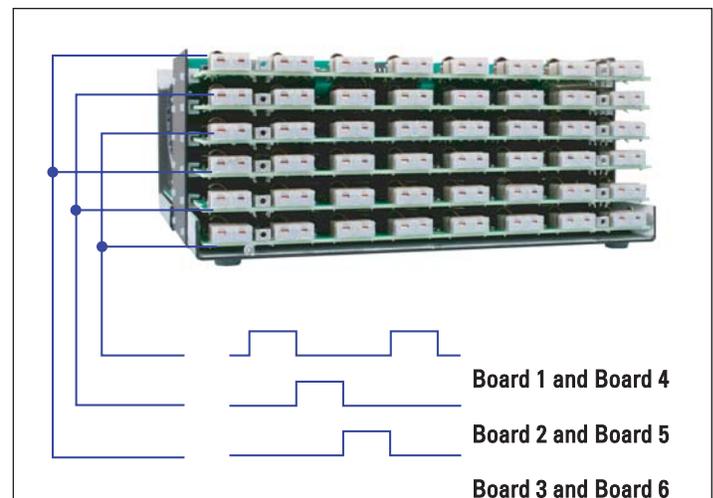


Figure 9. Custom designed DC-DC converters supply power to two non-adjacent boards at a time to reduce power surges and noise and improve system performance.

Thermocouple Types

The DT9871 and DT8871 instruments support up to 48 thermocouple channels. You can attach a voltage input or any of the following thermocouple types to these channels in a mix and match fashion: B, E, J, K, N, R, S, and/or T. The voltage measurement circuit is a very precise device of 0 to +/- 1.25V full scale with an accuracy of +/- 0.4 mV. The following table lists the supported measurement range for each thermocouple type.

Supported Measurement Range		
Thermocouple Type	Minimum	Maximum
B	0° C (32° 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)	1370° C (2498° F)
N	-200° C (-328° F)	1300° C (2372° F)
R	-50° C (-58° F)	1750° C (3182° F)
S	-50° C (-58° F)	1750° C (3182° F)
T	-200° C (-328° F)	400° C (725° F)

DT9871/DT8871 Calculated Accuracy

The following table shows the accuracy of the DT9871 and DT8871 instruments for each thermocouple type at several points over the dynamic range of the instrument.

	-100° C	0° C	100° C	300° C	500° C	700° C	900° C	1100° C	1400° C
Type J	± 0.45° C	± 0.40° C	± 0.40° C	± 0.38° C	± 0.37° C	± 0.36° C	± 0.35° C	± 0.37° C	—
Type K	± 0.54° C	± 0.45° C	± 0.41° C	± 0.46° C	± 0.42° C	± 0.42° C	± 0.47° C	± 0.47° C	—
Type T	± 0.56° C	± 0.46° C	± 0.42° C	± 0.38° C	—	—	—	—	—
Type E	± 0.42° C	± 0.37° C	± 0.35° C	± 0.33° C	± 0.32° C	± 0.34° C	± 0.35° C	—	—
Type S	—	± 2.04° C	± 1.56° C	± 1.29° C	± 1.21° C	± 1.15° C	± 1.10° C	± 1.06° C	± 1.03° C
Type R	—	± 2.08° C	± 1.53° C	± 1.23° C	± 1.12° C	± 1.05° C	± 0.99° C	± 0.94° C	± 0.92° C
Type B	—	—	—	± 3.47° C	± 2.19° C	± 1.65° C	± 1.40° C	± 1.23° C	± 1.09° C
Type N	± 0.68° C	± 0.58° C	± 0.52° C	± 0.48° C	± 0.46° C	± 0.46° C	± 0.46° C	± 0.47° C	—

Conditions for Accuracy Measurements:

Maximum limits

Inclusive of CJC errors

Inclusive of noise

Warmup time of 9 minutes

Exclusive of thermocouple errors

Capability That Fits Each Application Need

The TEMPpoint application is an executable program built with Measure Foundry. The benefit for the user is that the application can be modified or expanded to meet a particular need. For example, the user might want to apply a unique algorithm or formula to data that is derived from a thermocouple. Use of Measure Foundry's "Melting Pot" component allows the modification straightforwardly. Other extensions to the TEMPpoint application can also be achieved with Measure Foundry. These can then be distributed to run locally or remotely.

TEMPpoint Application

Your TEMPpoint instrument comes with a ready-to-measure application for measuring temperature data. Developed using Measure Foundry, the TEMPpoint application allows you to acquire temperature measurements from up to 48 thermocouple or RTD channels, display the data on the screen, and log data to disk for analysis.

You can be productive right out of the box using this software... without writing code! You can even export the data to other applications, like Measure Foundry, Microsoft Excel, and MATLAB for more advance analysis. And, since source code is also provided, you can customize the application to suit your needs using Measure Foundry.

Key Software Features

- **Acquire temperature data** from all TEMPpoint instruments on up to 48 channels simultaneously at up to 7.5Hz per channel
- **Configure the channel type and scan rate** to suit your application
- **Add alarms** and min/max points for process control
- **Display live signals** for real-time visual analysis
- **Log data to disk** for analysis
- **No coding necessary**, just load and start measuring right out-of-the-box
- **Export data** into other applications for advanced post-processing and analysis
- **Customize the application**, if desired, using the provided source code and Measure Foundry

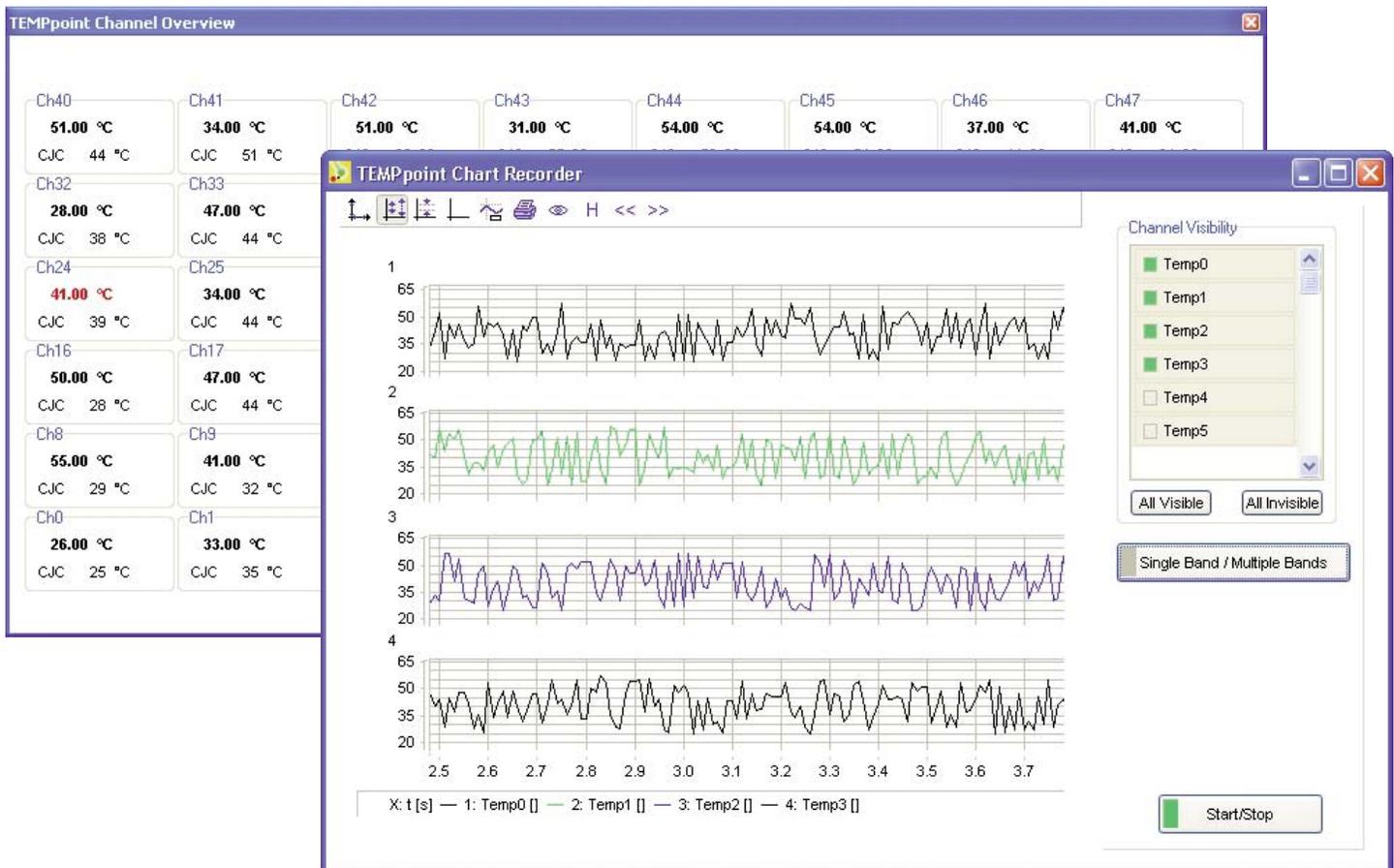


Figure 7. The TEMPpoint application is a ready-to-run executable that can be easily modified and extended using Measure Foundry. You can select the channels to display, configure the thermocouple or RTD type, visually analyze the data in real-time, save the data to a file, and analyze the data in Microsoft Excel.

Web Access

Using our web-based application, you can configure, measure, and control the DT8871 and DT8872 instruments either locally or remotely. In addition, this application provides a special email notification feature that allows you to leave your application unattended without worry – you will be notified via email once your measurements exceed specified alarm limits.

Item	Value
Manufacturer	Data Translation Inc.
Instrument model	DT8871
Firmware revision	1.3.0.1
Serial number	08029023
Description	LXI certified at LXI PlugFest Feb 2008
LXI Class	C
LXI version	1.1
Hostname	kajam.datx.com
MAC address	00:40:9D:2C:66:4A
IP address	192.43.218.135 (DHCP)
Time source	192.43.244.18
Current Time	Thu Apr 17 1:55 PM 2008
VISA resource string	TCPIP0::kajam.datx.com::INSTR

The main web page shows information about your TEMPpoint instrument on the network.

Web pages are provided for configuring the following aspects of your TEMPpoint instrument: Local Area Network (LAN), input channels that you want to measure, scan parameters (such as the scan rate), alarm limits, and digital I/O lines.

Channel	Enable Channel	Type	Label
0	<input type="checkbox"/> Enable	PT100	
1	<input checked="" type="checkbox"/> Enable	V	
2	<input checked="" type="checkbox"/> Enable	V	
3	<input checked="" type="checkbox"/> Enable	V	
4	<input type="checkbox"/> Enable	A_PT1000	
5	<input type="checkbox"/> Enable	A_PT1000	

Configuration Web Pages

Web pages are provided for configuring the following aspects of your TEMPpoint instrument: Local Area Network (LAN), input channels that you want to measure, scan parameters (such as the scan rate), alarm limits, and digital I/O lines.

Port	Label	Current state	Change state
0	LED 1	OFF	OFF
1	Valve 1	ON	ON
2	LED 2	ON	ON
3	Valve 2	OFF	OFF
4	LED 3	ON	ON
5	Valve 3	ON	ON
6	Valve 4	ON	ON

Control Web Pages

You can use the Control web pages to start or stop a scan or to update the value of the digital output port

Channel	Value	Channel	Value	Channel	Value	Channel	Value	Channel	Value
Ch 40 - Omega	30.1a Ω	Ch 41 - PT1000	144.7 °C	Ch 42 - PT1000	+112.2 °C	Ch 43 - PT1000	+198.3 °C	Ch 44 - PT1000	131a °C
Ch 45 - PT1000	-88888.0 °C	Ch 46 - PT1000	-88888.0 °C	Ch 47 - Volt	0.02 V	Channel 22	0.26 V	Channel 23	0.24 V
Channel 24	0.39 V	Channel 25	0.23 V	Channel 26	0.3a V	Channel 27	0.21 V	Channel 28	0.33 V
Channel 29	0.52 V	Channel 30	0.32 V	Channel 31	0.08 V	Channel 32	0.24 V	Channel 33	0.28 V
Channel 34	0.5 V	Channel 35	0.32 V	Channel 36	0.08 V	Channel 37	0.24 V	Channel 38	0.21 V
Channel 39	0.45 V	Channel 40	0.40 V	Channel 41	0.34 V	Channel 42	0.38 V	Channel 43	0.31 V
Channel 44	0.57 V	Channel 45	0.35 V	Channel 46	0.54 V	Ch 47 - Volt	1171a Ω	Ch 48 - PT1000	88888.0 °C
Ch 49 - Omega	1171a Ω	Ch 50 - PT1000	88888.0 °C	Ch 51 - PT1000	33a.3 °C	Ch 52 - PT1000	25.0 °C	Ch 53 - PT1000	88888.0 °C
Ch 54 - PT1000	28a.1 °C	Ch 55 - PT1000	5.2 °C	Ch 56 - Volt	0.42 V	Ch 57 - Volt	0.42 V	Ch 58 - Volt	0.42 V

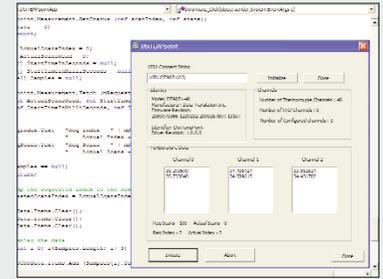
Measurement Web Pages

You can use the Measurements web pages to view your temperature results in a Meter display, as well as the value of the digital input port.

For USB and LXI Versions:

IVI-COM Driver

This driver is provided to write application programs for TEMPpoint using an IVI-COM instrument interface. It can be used with programs written in Visual C# or Visual Basic for .NET under Visual Studio 2003 or Visual Studio 2005. You can also use the IVI-COM driver with LabVIEW from National Instruments or MATLAB® from the MathWorks® to program TEMPpoint instruments.



For USB Versions Only:

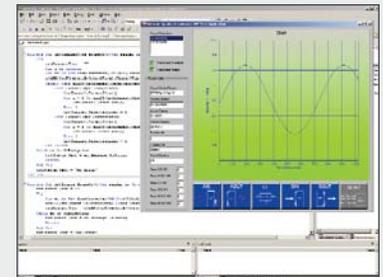
Getting Started with TEMPpoint Example Program

The Getting Started example application for TEMPpoint is a temperature measurement application written using Visual Basic.NET and the DT-Open Layers for .NET Class Library. Using this application, you can quickly verify the operation of your instrument. Since the source code is provided as an example for the DT-Open Layers for .NET Class Library, you can customize this application as you wish.



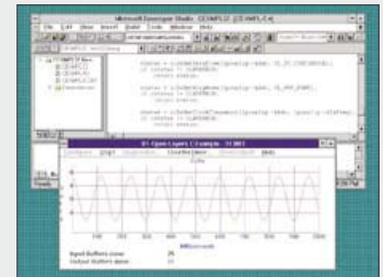
DT-Open Layers for .NET Class Library

The DT-Open Layers for .NET Class Library is a collection of classes, methods, properties, and events that provides a programming interface for DT-Open Layers-compatible hardware devices. It can be used from any language that conforms to the Common Language Specification (CLS), including Visual Basic.NET, Visual C#, Visual C++.NET with managed extensions, and Visual J#.NET.



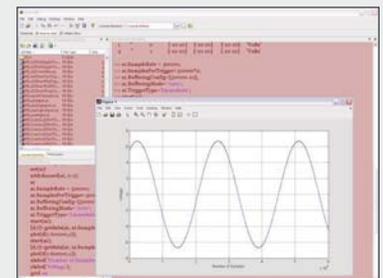
Win32 SDK

This SDK consists of the necessary header files, libraries, example programs, and documentation to develop your own DT-Open Layers data acquisition and control applications. It is intended for use with non .NET languages, such as ANSI C, Visual C++ 6.0, and Visual Basic 6.0



DAQ Adaptor for MATLAB

Data Translation's DAQ Adaptor provides an interface between the MATLAB Data Acquisition (DAQ) subsystem from The MathWorks and Data Translation's DT-Open Layers architecture.



Instrument	Summary	Includes
DT9871	Thermocouple or voltage measurement instrument for USB	EP365 USB Cable EP361 +5V power supply and cable TEMPpoint CD
DT8871	Thermocouple or voltage measurement instrument for Ethernet (LXI)	EP372 Ethernet Cable EP361 +5V power supply and cable TEMPpoint CD
DT9872	RTD, PRT, voltage, or resistance measurement instrument for USB	EP365 USB Cable EP361 +5V power supply and cable TEMPpoint CD
DT8872	RTD, PRT, voltage, or resistance measurement instrument for Ethernet (LXI)	EP372 Ethernet Cable EP361 +5V power supply and cable TEMPpoint CD

Options

STP37	Digital I/O screw terminal panel
EP333	Cable with two 37-pin male DSUB connectors for attaching the STP37 to the TEMPpoint instrument
SP1309-CD	Instrument Pak for Measure Foundry Professional
Rack Mount Adapter Kits	EP373 Single Rack-Mount Kit EP374 Dual Rack-Mount Kit

TEMPpoint CD Includes:

Application Software

- TEMPpoint application program
- Web-based application program

Development Software

- Evaluation version of Measure Foundry test & measurement application builder
- IVI-COM instrument driver for .NET and LabVIEW development
- TEMPpoint device drivers
- Data Acq SDK for Win32 development
- DAQ Adaptor for MATLAB for MATLAB development