TEMPpoint™

Precision Temperature Measurement Instruments

TEMPpoint™ is a family of precision instruments designed for high accuracy measurement of thermocouple, RTD and voltage signals. Available in both USB and Ethernet (LXI) versions, TEMPpoint can be configured with up to 48 input channels. Each TEMPpoint instrument ships with a ready-to-measure application, allowing you to view, graph, and export your data.

TEMPpoint uses ISO-Channel™ technology to eliminate connection problems by using galvanic isolation methods to guarantee 1000V isolation between sensor grounds. The result is that accuracy is preserved for all sensor inputs. Formerly, connections to sensors for industrial measurement have frequently resulted in noisy results or ground loops. The implied assumption is that each sensor's ground is at the same reference potential. But if the grounds are different from one another, severe common mode noise problems occur.

Figure 1. TEMPpoint allows direct connection of thermouple, RTD, and voltage sensors with 1000V isolation between any of the 48 channels. Ground loops are eliminated through the isolation of each channel using the ISO-Channel technology.

Key TEMPpoint Features

- ISO-Channel™ for each input signal... preserves accuracy
- Dedicated 24-bit, Delta Sigma A/D converter for each thermocouple, voltage, or RTD input channel for simultaneous, high-resolution measurements
- 1000V galvanic isolation channel-to-channel and to the host computer to protect signal integrity
- 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 Instrument Calibration Utility allows you to calibrate the instrument in the field
- Digital I/O galvanically isolated to 250V
  - □ 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 ±30 V at currents up to 400 mA (peak) AC or DC
- Easy access jacks for quick wiring
- Ethernet or USB operation

Key Thermocouple Input channel features

- Dedicated CJC (cold junction compensation) input for each thermocouple channel
- Voltage input ranges: ±75mV
- 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
- Break-detection circuitry to detect open thermocouple inputs

Key RTD Input channel features

- Voltage input ranges: ±1.25V
- 100 Ω, 500 Ω, and 1000 Ω platinum RTD types supported using alpha curves of 0.00385 (European) or 0.00392 (American)
- 4-wire, 3-wire, or 2-wire configurations; the DT8872 automatically linearizes the measurements and returns the data as 32-bit, floating-point temperature, resistance, or voltage values

Front Panel (DT9871U/DT8871U)

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

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

Each channel is independent... no effect of one on another

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

48-CHANNEL VERSION SHOWN

Figure 2. Every channel provides direct thermocouple or precision voltage connections as shown above.

Front Panel (DT9872/DT8872)

Instant stabilization... virtually no warm-up time

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

Each channel is independent... no effect of one on another

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

48-CHANNEL VERSION SHOWN

Figure 3. Every channel provides direct RTD or precision voltage connections as shown above.

Rear Panel

USB or Ethernet (LXI) connection

Fully DIN/CE compliant

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

00409D2C664A

Auto-MDIX not supported

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

DT8871/DT8872 SHOWN

LXI-C compliant for seamless integration into an ATE system.

Figure 4. Digital I/O, power, and USB or Ethernet connections are provided on the back panel.

Thermocouple, Voltage, and RTD Inputs

TEMPpoint instruments support up to 48 inputs with 24-bit resolution per channel. Because TEMPpoint architecture uses an A/D per channel, sampling rates of up to 10Hz per channel over all 48 channels can be reached.

On the DT9871U and DT8871U, a voltage or thermocouple input (type B, E, J, K, N, R, S, and/or T) can be attached to any channel in a mix or match fashion. This gives the user ultimate flexibility when setting up an application. The DT9871U and DT8871U provide an input range of $\pm$75mV. 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.

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 Ω (Pt100), Platinum 500 Ω (Pt500), or Platinum 1000 Ω (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.

Calibration

Each TEMPpoint 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. Optionally, you can return your instrument to Data Translation for recalibration.

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.

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 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.

Filtering

TEMPpoint 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, noise can further be reduced noise by selecting one of the following filter options in software: Moving Average or Raw.

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$30V and 400mA peak (AC or DC) with a switching time of 2ms maximum.

Figure 5. 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.

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).

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.

Board 1 and Board 4

Board 2 and Board 5

Board 3 and Board 6
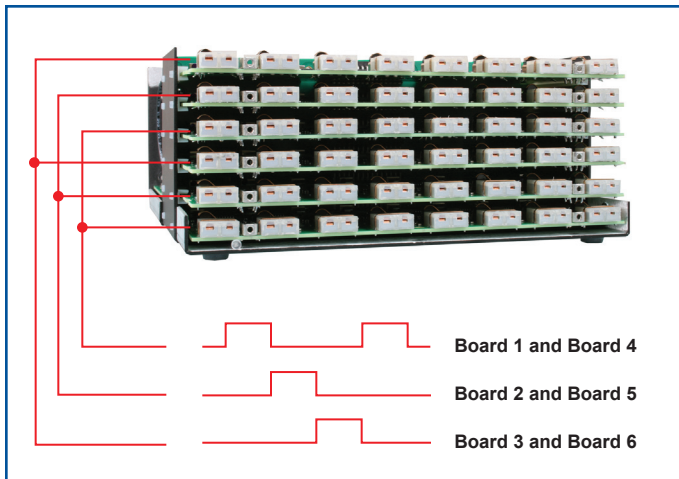
Figure 6. Custom designed DC-DC converters supply power to two non-adjacent boards at a time to reduce power surges and noise and improve system performance.

Remote Measurements

TEMPpoint is available as a USB or Ethernet instrument. The Ethernet instruments are class C devices that comply with LXI version 1.1. The network-ready versions of TEMPpoint 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.

ISO-Channel

ISO-Channel uses galvanic isolation methods to guarantee 1000V isolation between any input channel to any other input channel and earth ground. Common mode noise and ground loop problems are eliminated with ISO-Channel since sensors that are at different ground reference levels are easily accommodated, even if they are at widely differing voltages of hundreds of volts or transients to thousands of volts. ISO-Channel vastly increases reliability by implementing a 24-bit A/D converter per channel on each of many channels, all operating in parallel. Older system designs with relay front ends are prone to system failure through "sticking channels" or magnetic field influence. The all solidstate ISO-Channel provides digital transfer of valuable sensor data with optical or transformer isolation.

The result is that accuracy is preserved for all sensor inputs. This is especially useful when conditions change in the electrical environmental due to motor current surges, electromagnetic radiation, or noisy industrial equipment turning on/off.

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, ground loops, and acts as an "insurance policy" against the damaging effects of high voltages. Plus running at 10Hz provides extremely high normal mode rejection for power line related noise. The combination of isolation, Sigma-Delta inherent filtering, and the added analog filtering to remove high-frequency noise, gives the ultimate in measurement performance.
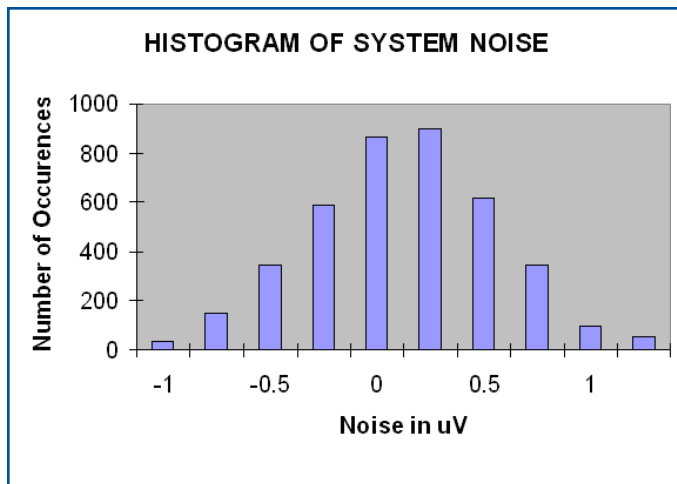
Measurement Accuracy

DT9871U/DT8871U Accuracy

The following table shows the typical thermocouple accuracy of the DT9871U and DT8871U instruments.

	-100°C	0°C	100°C	300°C	500°C	700°C	900°C	1100°C	1400°C
Type J	±0.17°C	±0.15°C	±0.18°C	±0.15°C	±0.15°C	±0.15°C	±0.15°C	±0.15°C	—
Type K	±0.17°C	±0.16°C	±0.15°C	±0.17°C	±0.15°C	±0.15°C	±0.17°C	±0.16°C	—
Type T	±0.16°C	±0.16°C	±0.16°C	±0.16°C	—	—	—	—	—
Type E	±0.16°C	±0.15°C	±0.15°C	±0.15°C	±0.15°C	±0.16°C	±0.17°C	—	—
Type S	—	±0.2°C	±0.18°C	±0.18°C	±0.18°C	±0.18°C	±0.18°C	±0.19°C	±0.18°C
Type R	—	±0.2°C	±0.18°C	±0.18°C	±0.17°C	±0.18°C	±0.18°C	±0.18°C	±0.18°C
Type B	—	—	—	±0.23°C	±0.21°C	±0.17°C	±0.19°C	±0.18°C	±0.17°C
Type N	±0.16°C	±0.16°C	±0.15°C	±0.15°C	±0.15°C	±0.16°C	±0.16°C	±0.16°C	—

Conditions for Accuracy:
- Warm-up time of 30 minutes.
- Exclusive of noise (see following histograms).
- Exclusive of thermocouple errors.
- Inclusive of typical 0.15°C CJC errors (maximum CJC error is 0.25°C).
- Inclusive of typical 0.25µV offset error (maximum offset error is 2.5µV).

The following histograms show the Gaussian noise distribution for available TEMPpoint software filters. Converting µV error to temperature error depends on thermocouple type. For example, a K thermocouple changes approximately 39 µV per degrees C; therefore, a noise level of .1 µV adds less than .003 degrees C error (ie. 0.1 µV / 39 µV).

Raw Filter
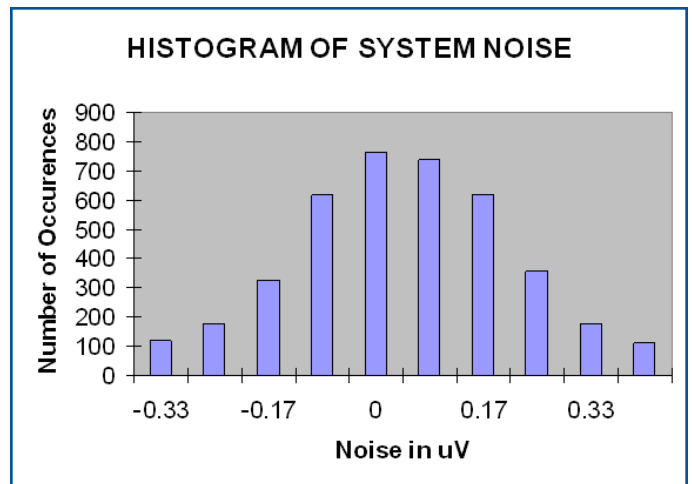
Moving Average Filter

DT9872/DT8872 Accuracy

The table at right shows the accuracy of the DT9872 and DT8872 instruments for several common RTD types.

Supported Measurement Range	
RTD Type	**System Temperature Error[1]**
Pt100	±0.07°C, ±0.005% of reading
Pt500	±0.01°C, ±0.005% of reading
Pt1000	±0.01°C, ±0.005% of reading

1. The system temperature error is based on the auto zero and system noise error (±0.07° C for a Pt100 RTD, ±0.01° C for a Pt500 RTD, or ±0.007° C for a Pt1000 RTD) plus the gain error of the A/D and output impedance of the current source over the voltage range (±0.005% of the reading). For example, the maximum error of a Pt100 RTD at 100° C is ±0.075° C (±0.07° C plus a gain error of ±0.005° C).

Software

MEASURpoint Framework application

The MEASURpoint Framework application is included with all TEMPpoint instruments. This ready-to-measure application allows you to acquire thermocouple, RTD, and/or voltage data from multiple instruments, record data to disk, display the results in both a plot and a digital display, and read a recorded data file.

Key Software Features

- Discover and select instruments
- Configure all input channel settings for the attached sensors
- Load/save multiple hardware configurations
- On each device, acquire temperature and voltage data from all enabled channels simultaneously at up to 10Hz per channel
- Log acquired data to disk
- Display acquired data during acquisition in a digital display using the Channel Display window and/or as a waveform in the Channel Plot window
- View statistics about the acquired data, including the minimum, maximum, and mean values and the standard deviation in the Statistics window

- Open recorded data in Microsoft Excel® for further analysis
- Customize many aspects of the acquisition, display, and recording functions, including the acquisition duration, sampling frequency, trigger settings, filter type, and temperature units to use
- Fully configurable graphical user interface
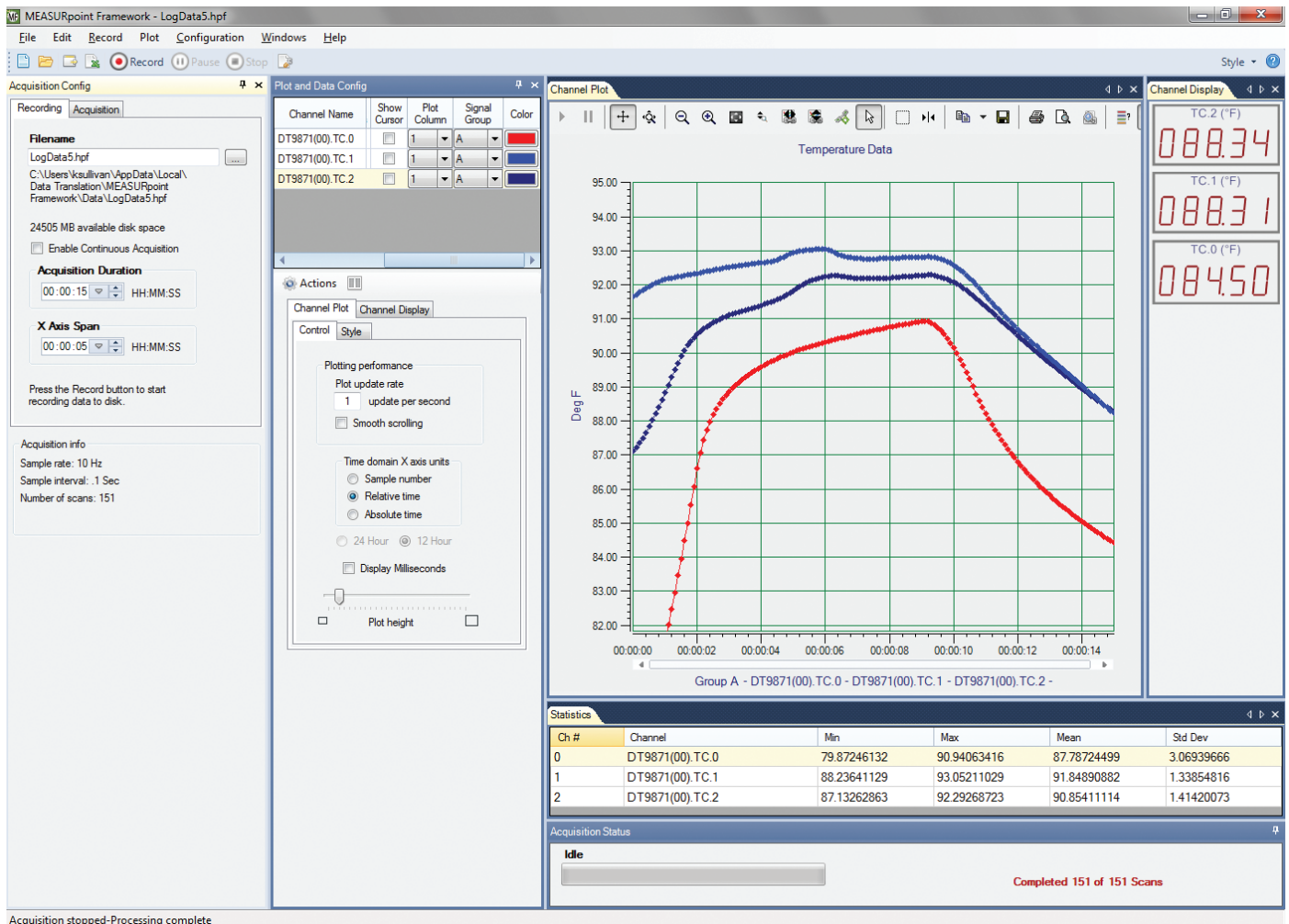
Additional Software Support

The following software support is available for all TEMPpoint instruments:

- **Eureka Discovery Utility** – This utility helps you locate or "discover" all LXI (Ethernet) instruments that are connected to your system and provides the following information about your instrument: the IP address, manufacturer, model number, serial number, and version of the firmware that is running on your instrument. In addition, you can use this utility to configure Windows firewall settings and update the firmware for your Data Translation LXI instrument.
- **Instrument Web Interface** – This built-in interface allows you to verify the operation of your instrument and perform basic functions with Internet Explorer and no additional software. Using it, you can configure your instrument, control output signals, measure input signals, and save results to disk.
- **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#®, Visual Basic® for .NET, or C++ under Visual Studio® 2003/2005/2008. You can also use the IVI-COM driver with LabVIEW® from National Instruments' or MATLAB® and the Instrument Control Toolbox from the MathWorks™ to program TEMPpoint instruments.
- **SCPI Commands** – Use VISA or network sockets to program and control TEMPpoint LXI instruments by sending SCPI commands. Comprehensive user manual and example programs provided.

Web-Based Application & Setup

Web Access

Using the built-in web-based application, you can configure, measure, and control the TEMPpoint instruments either locally or remotely.

Measurement & Control Pages

You can use the measurement and control web pages to start or stop a scan, update the value of the digital output port, or read the value of the digital input port.

Configuration Pages

Web pages are provided for configuring the following aspects of your VOLTpoint 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.

Ordering Summary

TEMPpoint Instruments

DTx87x–xx

- **1U** = Thermocouple
- **2** = RTD

- **8** = Ethernet
- **9** = USB

Number of Channels
- **08** = 8 Channels
- **16** = 16 Channels
- **24** = 24 Channels
- **32** = 32 Channels
- **40** = 40 Channels
- **48** = 48 Channels
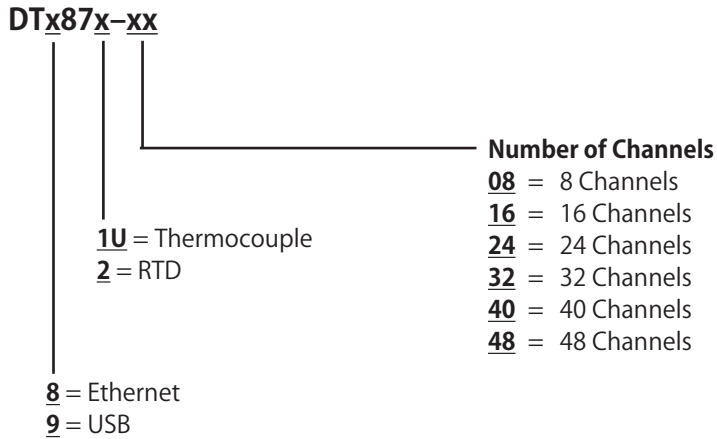
Ordering Examples
DT9871U-16 TEMPpoint USB instrument with 16 thermocouple channels.
DT8872-32 TEMPpoint Ethernet instrument with 32 RTD channels.

Options

- **STP37** – Digital I/O screw terminal panel
- **EP333** – Cable for attaching the STP37 to the TEMPpoint instrument
- **EP373** – Single Rack-Mount Kit
- **EP374** – Dual Rack-Mount Kit

Enclosure Options

TEMPpoint Instruments with Rack Mount Kit

Rugged NEMA enclosures.

For more information about TEMPpoint, please visit:
http://www.datatranslation.com/info/TEMPpoint/