DT9805 Series

USB Thermocouple Measurement Modules

Key Features

- *Easy plug-and-play thermocouple measurements outside of the PC using USB 2.0 or 1.1.*
- *Up to 7 differential thermocouple channels and one CJC channel per module*.*
- *Scalable design for adding more channels (up to 889 thermocouples). Simply add more modules to your system using a single USB port and one or more USB hubs.*
- *Software support for multiple thermocouple types (B, E, J, K, N, R, S, T). Mix and match thermocouple types by configuring each channel separately.*
- *Free DT Thermocouple Measurement application (SP1305) for immediate temperature measurements with no programming. Just connect to the PC, connect your thermocouple inputs, and run! Linearized temperature measurements, based on the thermocouple types you specify, are returned in degrees C, F, or K.*
- *Thermocouple break detection.*
- *Programmable gains of 1, 10, 100, and 500 per channel for input ranges of +/- 10 V, +/- 1 V, +/- 0.10 V, and +/- 0.020 V. Autoranging is also available (for single-value operations) to automatically select the gain based on your input range.*
- *2, 16-bit analog output channels (DT9806 only).*
- *8 Digital input lines. The digital lines can also be clocked synchronously at the analog input rate for time-stamping analog data and digital events.*
- *9 Digital output lines, including one dynamic digital output line that can be updated synchronously at the analog input rate for synchronizing external devices.*
- *2, 16-bit counter/timer channels for event counting, frequency measurement, continuous pulse output, one-shot, and repetitive one-shot operations.*

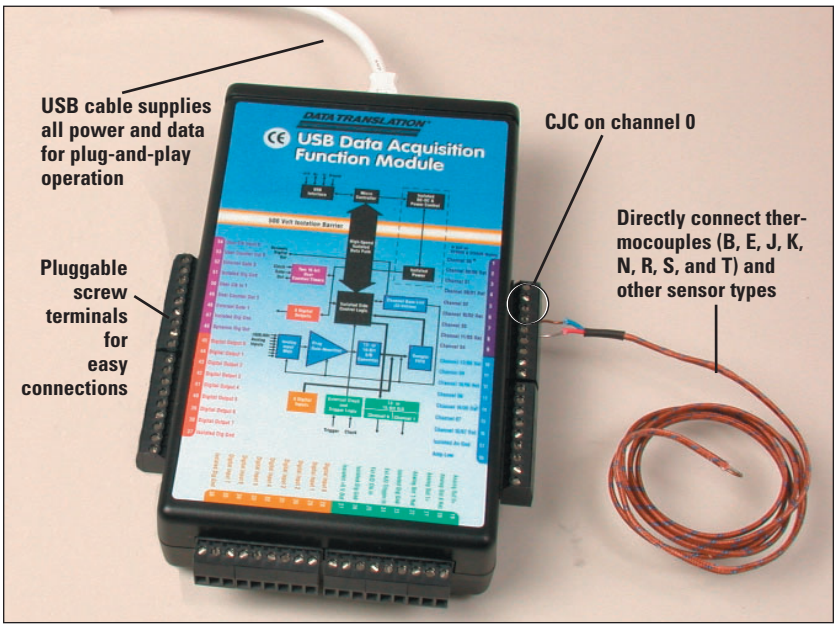

Figure 1. The DT9805 Series modules are ideally suited for plug-and-play thermocouple measurements. Pluggable screw terminal blocks allow you to connect thermocouples and other sensor types directly to the module.

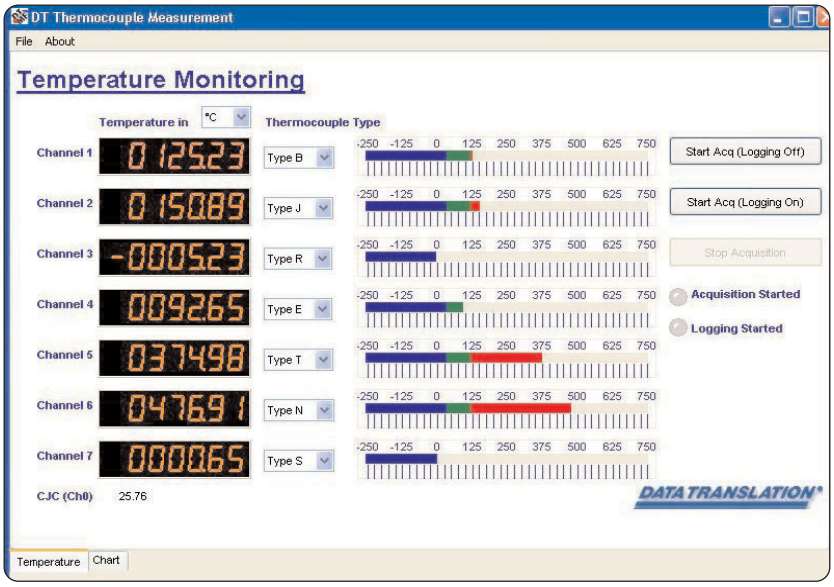

Figure 2. Use a DT9805 Series module with the free DT Thermocouple Measurement application (SP1305) for immediate linearized temperature measurements without programming. Simply connect the module to the PC using the supplied USB cable, connect your thermocouple inputs, and run the application. This view shows the temperature measurements of all 7 thermocouple inputs and the CJC channel in a digital display.

Key Features - *Continued*

- *500 Volt galvanic isolation maximizes analog signal integrity and protects your computer.*
- *Flexible acquisition modes (single-value, continuous, and triggered scan).*
- *High resolution 16-bit A/D converter with throughputs as high as 50 kSamples/second (gains of 1 or 10).*
- *Selectable trigger and clock sources (software and digital) for acquiring analog data.*
- *Combines with DT Measure Foundry, Data Translation's powerful software for creating test and measurement, control, and analysis applications.*
- *Ships with the Data Acquisition OMNI CD, which includes Ready-to-Measure™ applications, DT-Open Layers for .NET Class Library, an evaluation version of DT Measure Foundry, and more.*

*You can directly connect other sensor types, such as pressure, accelerometer, and other measurement inputs, as well.

Overview

The DT9805 Series brings true plug-and-play temperature measurements to PCs with USB 2.0 or 1.1 ports. Simply attach the DT9805 Series module to the PC using the supplied USB cable, directly connect up to 7 thermocouples to the screw terminals on the module, and run the free DT Thermocouple Measurement application (SP1305). Linearized temperature data is returned in degrees C, F, or K. You don't have to open your computer or do any programming. It's that simple. All power is provided from the USB cable to the PC.

If you'd rather create a custom application, the DT9805 Series offers a variety of software solutions to help you.

The DT9805 Series consists of the DT9805 and DT9806 modules. Both modules feature a Cold Junction Compensation (CJC) channel, 7 differential analog input channels, 8 digital input lines, 9 digital output lines, and 2 counter/timer channels. In addition, the DT9806 provides 2 analog output channels for high-resolution, single-value output operations. To add more channels (up to 889 thermocouples), simply add more modules to your system using one or more USB hubs.

Specialized Analog Input Design

The DT9805 Series provides a CJC channel on analog input channel 0 that provides 10 mV/° C with an accuracy of 1° (from 5° to 45° C). Seven differential analog input channels are available for connecting B, E, J, K, N, R, S, or T thermocouple inputs. (If you want to measure other low-level analog input signals, such as pressure and flow sensors, you can use these channels to connect up to 16 single-ended/pseudo-differential or 8 differential analog inputs.) Thermocouple break detection is also provided to set the value to full-scale if an open circuit is detected at the input.

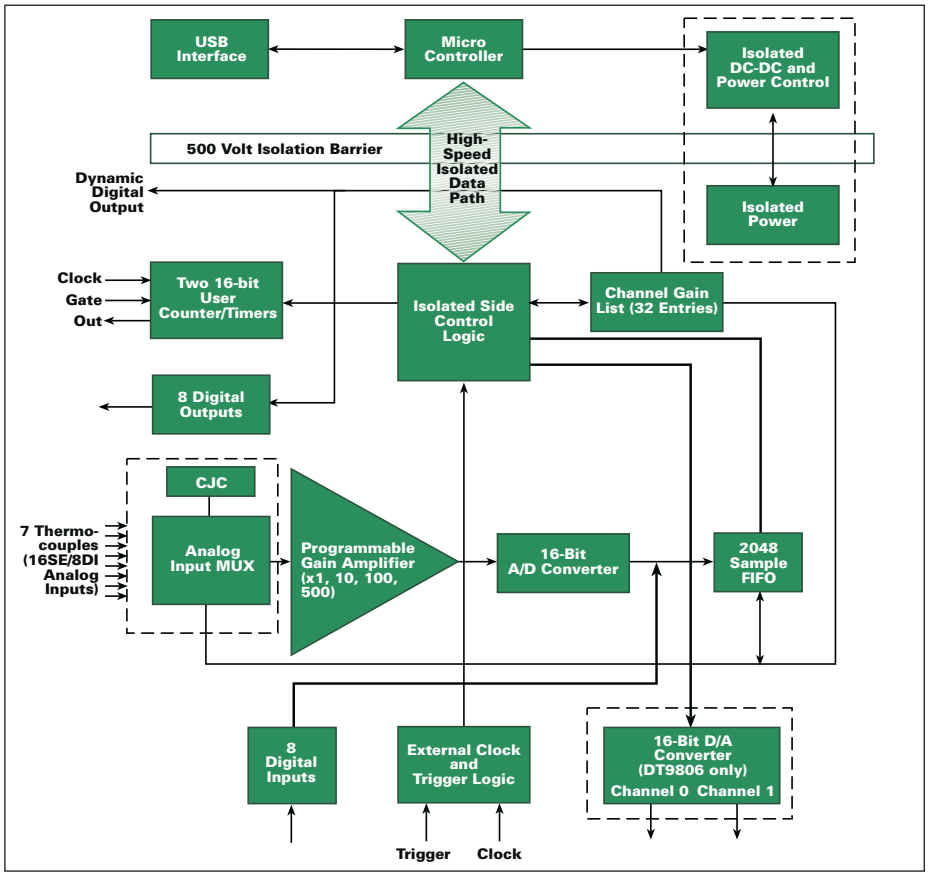

Figure 3. This block diagram shows all the subsystems and user-accessible signals of the DT9805 Series modules.

All analog inputs are multiplexed to a single 16-bit analog-to-digital (A/D) converter.

Four programmable gains (1, 10, 100, and 500) are provided to support input signal ranges of +/- 10 V, +/-1 V, +/-0.10 V, and +/-0.020 V. For thermocouple inputs, which are typically in the range of 20 mV, DT9805 Series modules provide a dynamic range of 100,000:1 (100 db) to ensure that the input signals are amplified to the full +/-10 V range of the A/D converter and digitized to 16 bits for maximum accuracy. Each channel is configurable, allowing you to mix and match input signals according to your needs. In addition, DT9805 Series modules support autoranging, where the software can determine the appropriate gain based on the input range you specify (in single-value mode).

The maximum sampling rate depends on the gain that is used: 50 kSamples/s when the gain is 1 or 10, 10 kSamples/s when the gain is 100, and 2 kSamples/s when the gain is 500. The minimum sampling rate is 0.75 Hz.

Flexible Acquisition Modes

Using the DT9805 Series, you can acquire a single sample from a single analog input channel or multiple samples from multiple analog input channels. A 32-location channel-gain list gives you the flexibility to sample non-sequential analog input channels, analog input channels with different gains, and digital inputs with the analog input channels you want at the A/D sample rate.

The DT9805 Series provides two ways to cycle throught the channel-gain list:

- Continuous scan mode – Choose this mode if you want to accurately control the period between conversions of individual channels in a channel-gain list.
- Triggered scan mode – Choose this mode if you want to accurately control both the period between conversions of individual channels in a channel-gain list and the period between each scan, or cycle, through the channel-gain list. This mode is useful when synchronizing or controlling external equipment or when acquiring a buffer of data on each trigger or retrigger.

High-Resolution Analog Outputs

The DT9806 module provide two DC-level analog output channels for single-value operations. A 16-bit digital-to-analog converter provides high-resolution output values with an output range of +/- 10 V.

Flexible Digital I/O Lines

DT9805 Series modules feature 8 digital input lines for single-value operations. You can also read all the digital input lines simultaneously with the analog input channels at the A/D clocked rate. The digital input lines can be clock separately as the only channel in the channel-gain list at up to 50 kSamples/second.

Nine digital outputs are provided. The digital outputs have sufficient current capability to drive external solid-state relay modules (sink 12 mA and source 12 mA). Eight of these digital outputs are provided for single-value operations. A dynamic digital output line is also provided for synchronizing external devices. You can program the value of this line to change state as an analog input channel is read.

Programmable Clocks and Triggers

For starting analog input measurements, you can select either an internal or external trigger source. Select the internal trigger to start the operation based on a software command. Select an external trigger to start the acquisition based on an external event. To use the external trigger, connect a TTL-level signal to the screw terminal of the module labeled External A/D Trigger. The trigger occurs on the rising edge of this signal.

For pacing analog input measurements, you can select either the internal clock source provided by the module or an external clock source. An external clock is useful when you want to pace acquisitions at rates not available with the internal clock or when you want to pace at uneven intervals. To use an external clock, connect a TTL-level signal to the screw terminal of the module labeled External A/D Sample Clock In. Conversions start on the rising edge of this signal.

User Connections

Pin Number	Signal Description	Pin Number	Signal Description
1	Analog Input 00/CJC Circuit	28	Digital Input 0
2	Analog Input 08/00 Return	29	Digital Input 1
3	Analog Input 01	30	Digital Input 2
4	Analog Input 09/01 Return	31	Digital Input 3
5	Analog Input 02	32	Digital Input 4
6	Analog Input 10/02 Return	33	Digital Input 5
7	Analog Input 03	34	Digital Input 6
8	Analog Input 11/03 Return	35	Digital Input 7
9	Analog Input 04	36	Isolated Digital Ground
10	Analog Input 12/04 Return	37	Isolated Digital Ground
11	Analog Input 05	38	Digital Output 7
12	Analog Input 13/05 Return	39	Digital Output 6
13	Analog Input 06	40	Digital Output 5
14	Analog Input 14/06 Return	41	Digital Output 4
15	Analog Input 07	42	Digital Output 3
16	Analog Input 15/07 Return	43	Digital Output 2
17	Isolated Analog Ground	44	Digital Output 1
18	Amp Low	45	Digital Output 0
19	Analog Output 0+	46	Dynamic Digital Output
20	Analog Output 0 Return	47	Isolated Digital Ground
21	Analog Output 1+	48	External Gate 1
22	Analog Output 1 Return	49	User Counter Output 1
23	Isolated Digital Ground	50	User Clock Input 1
24	External A/D Trigger	51	Isolated Digital Ground
25	External A/D Sample Clock In	52	External Gate 0
26	Isolated Digital Ground	53	User Counter Output 0
27	Isolated +5 V Out	54	User Clock Input 0

Multifunction Counter/Timers

DT9805 Series modules feature two 32-bit user counter/timers that you can use for event counting, frequency generation (continuous pulse output), one-shot, and repetitive one-shot operations. You can connect or cascade counters together either in software or by external connections to the screw terminals of the module. Programmable gates, clocks, and output signals are also supported.

500 V Galvanic Isolation Protects Your Data

Computers are susceptible to ground-spikes through any external port. These spikes can cause system crashes and may even cause permanent damage to your computer. DT9805 Series modules feature 500 Volts of galvanic isolation to protect your computer from ground-spikes and to ensure a reliable stream of data.

User Connections

DT9805 Series modules provide pluggable screw terminal blocks for connecting all signals. You can remove these screw terminal blocks for easy wiring. Pin assignments are clearly marked on the module for quick setup.

USB 2.0 Compatibility

DT9805 Series modules are fully compatible with USB 2.0 and USB 1.1. USB 2.0 is both forward and backward compatible with USB 1.1, resulting in a seamless transition process for users. A USB cable is shipped with the DT9805 Series for connecting the module to the USB 2.0 or USB 1.1 port of your computer.

Power

All power is provided through the USB cable to the module. No external power supply or battery is required.

Free DT Thermocouple Measurement Application

For real-time measurement and display of linearized thermocouple data without programming, use the free DT Thermocouple Measurement application (SP1305), available from the Download Software link at www.datatranslation.com. The DT Thermocouple Measurement application provides the following features:

- Plug and play operation with the DT9805 Series.
- Automatically detects the module and configures the device driver.
- Supports 2-wire thermocouple inputs.
- Allows you to specify the thermocouple type (B, E, J, K, N, R, S, and T) for each channel.
- Provides a digital view of live signals showing the temperature of each thermocouple input as well as the CJC channel, shown in Figure 2.
- Provides a graphical view of live signals in a chart recorder display, shown in Figure 4, for analysis.

  You can set up the chart to display each thermocouple signal in its own band or all thermocouple signals in one band. In addition, you can set up the chart display to automatically scale the y-axis based on your input signal (autoscale) or scale the y-axis to the first input signal in your buffer (capture-scale). Other options are provided for showing or hiding the reference cursors, holding the display from updating, printing the display, and saving the results to disk. Scrolling, panning, and zooming functions allow you to see the entire signal in one display.
- Logs data directly to disk for post-analysis in Excel or other programs.
- Loads saved signal files into the chart recorder display for analysis.

Any combination of thermocouple types can be connected to one module – for example, use three J-types, two T-types, and two K-types – all at the same time.

Customize Applications Using DT Measure Foundry

If you need more flexibility than the DT Thermocouple Measurement application provides, use DT Measure Foundry to modify the application or to create your own application. DT Measure Foundry is a powerful software package that allows non-programmers to create test and measurement, control, and analysis applica-

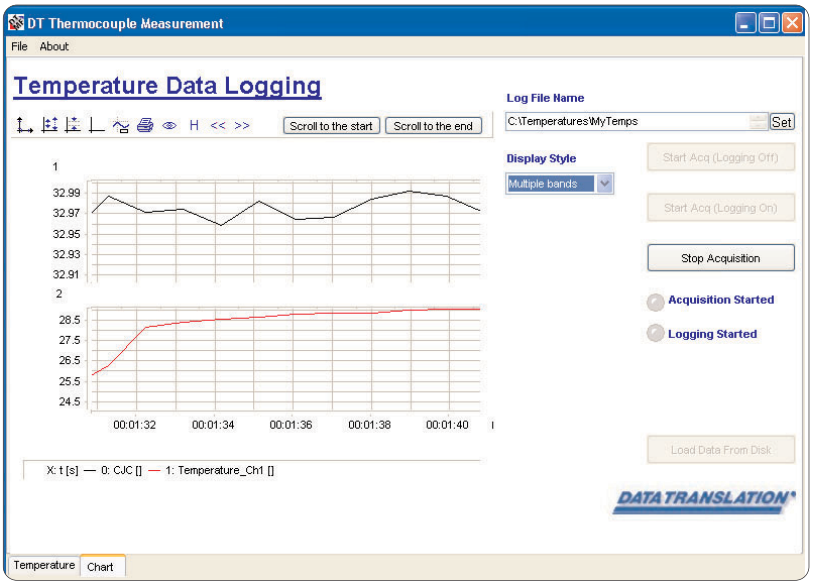

Figure 4. The Chart view of the DT Thermocouple Measurement application allows you to log thermocouple data to a chart recorder display and to a file for further analysis in Excel or other programs. In this example, the temperature of a T-type thermocouple and the CJC channel are displayed.

tions. It includes a Thermocouple Linearization panel specifically for dealing with thermocouples. This panel automatically adjusts for the CJC channel, linearizes raw analog input data based on the thermocouple types you specify, and returns the data in degrees C, F, or K.

Save Programming Time and Protect Your Investment with DT-Open Layers

Virtually all Data Translation data acquisition boards, including the DT9805 Series, are compatible with the DT-Open Layers for .NET Class Library software standard. This means that if your application was developed with one of Data Translation's software products, you can easily upgrade to a new Data Translation board. Little or no reprogramming is needed. For example, if you are currently using a DT301 on the PCI bus, upgrading to a DT9805 Series module on the USB bus is simple – just load and configure the new driver and you're done.

Analog Inputs

Thermocouple Measurement	
Number of analog input channels	
Differential:	8 (7 thermocouple inputs, 1 CJC)
Single-ended/pseudo-differential:	16
CJC Voltage @ 25°C	+0.250 V
CJC Accuracy	+1° from 5° to 45° C
CJC Warm-up time	10 to 20 minutes*
Thermocouple break detection current	+50 nA (high-side differential) outputs full-scale for gains greater than 1, or 2.5 V for gains of 1
Resolution	16 bits
Channel-gain list	32 locations
Input FIFO size	2048 samples
Input gains	1, 10, 100, 500
Input range	±10, 1, 0.1, 0.02 V
Drift	
Zero:	±25 + (5 µV*Gain)/°C
Gain:	±20 ppm/°C
System Accuracy (Full Scale)	0.01% @ Gain=1 0.02% @ Gain=10 0.03% @ Gain=100 0.04% @ Gain=500
Input impedance	100 MΩ, 10 pF, Off 100 MΩ, 100 pF, On
Input bias current	±10 nA
Common mode voltage	±11 V maximum (operational)
Maximum input voltage	±40 V maximum (protection)
Channel acquisition time	6 µs (gain = 1), 250 µs (gain = 500)
A/D conversion time	8 µs
Common mode rejection	>74 db
DC Accuracy	
Nonlinearity (integral)	±4 LSB
Differential nonlinearity	±1.2 LSB (no missing codes)
A/D converter noise	0.4 LSB rms
Channel-to-channel offset	±40.0 µV
AC Accuracy	
Effective number of bits (ENOB)	14.1 bits
Total harmonic distortion (THD)	–90 dB typical
Channel crosstalk	–80 dB @ 1 kHz
Clocking and trigger input	
Maximum A/D pacer clock	
Single analog input throughput	50 kS/s @ 0.01% accuracy at a gain of 1-10
Multiple analog input throughput	50 kS/s @ 0.01% accuracy at a gain of 1-10 10 kS/s @ 0.03% accuracy at a gain of 100 2 kS/s @ 0.04% accuracy at a gain of 500
Single digital input channel	Maximum A/D rate
Minimum A/D pacer clock throughput	0.75 S/s
External A/D sample clock	
Minimum pulse width:	600 ns (high); 600 ns (low)
Maximum frequency (analog inputs):	750 kHz
Maximum frequency (digital inputs only):	Maximum A/D rate
External digital (TTL) trigger	
High-level input voltage:	2.4 V minimum
Low-level input voltage:	0.8 V maximum
Minimum pulse width:	600 ns (high); 600 ns (low)
Maximum frequency:	750 kHz

*Using the DT9800 Series control panel applet, you can choose to keep power on to the module allowing the analog circuitry to stabilize.

Analog Outputs

	DT9806
Number of analog output channels	2 (voltage output)
Resolution	16 bits
Output range	±10 V
Output throughput	Single value (system dependent)
Error	
Gain: Zero:	±6 LSBs Software adjustable to 0
Current output	±5 mA minimum
Output impedance	0.3 Ω typical
Capacitive drive capability	0.001 µF (no oscillators)
Nonlinearity (integral)	±4 LSBs
Differential linearity	±1.0 LSB (monotonic)
Protection	Short circuit to Analog Common
Power-on voltage	0 V ±10 mV
Settling time to 0.01% of FSR	50 µs, 20 V step; 10.0 µs, 100 mV step
Slew rate	2 V/ µs

Digital I/O

	Port A	Port B	Dynamic Digital Output
Number of lines	8 input	8 output	1 output
Inputs			
High-level input voltage:	2.0 V minimum		
Low-level input voltage:	0.8 V maximum		
High-level input current:	3 µA		
Low-level input current:	–3 µA		
Maximum internal pacer clock rate (single digital channel):	Maximum A/D rate		Maximum A/D rate
Outputs			
Output driver high voltage:		2.4 V minimum (IOH = –1 mA);	2.4 V minimum (IOH = 1 mA);
Output driver low voltage:		0.5 V maximum (IOL = 12 mA)	0.5 V maximum (IOL = 2 mA)

Counter/Timer

Number of counter/timer channels	2
Clock Inputs	
High-level input voltage:	2.4 V minimum
Low-level input voltage:	0.8 V maximum
Minimum pulse width:	600 ns (high); 600 ns (low)
Maximum frequency:	750.0 kHz
Gate Inputs	
High-level input voltage:	2.4 V minimum
Low-level input voltage:	0.8 V maximum
Minimum pulse width:	600 ns (high); 600 ns (low)
Counter Outputs	
Output driver high voltage:	3.0 V minimum (1 mA source)
Output driver low voltage:	0.4 V maximum (2 mA sink)

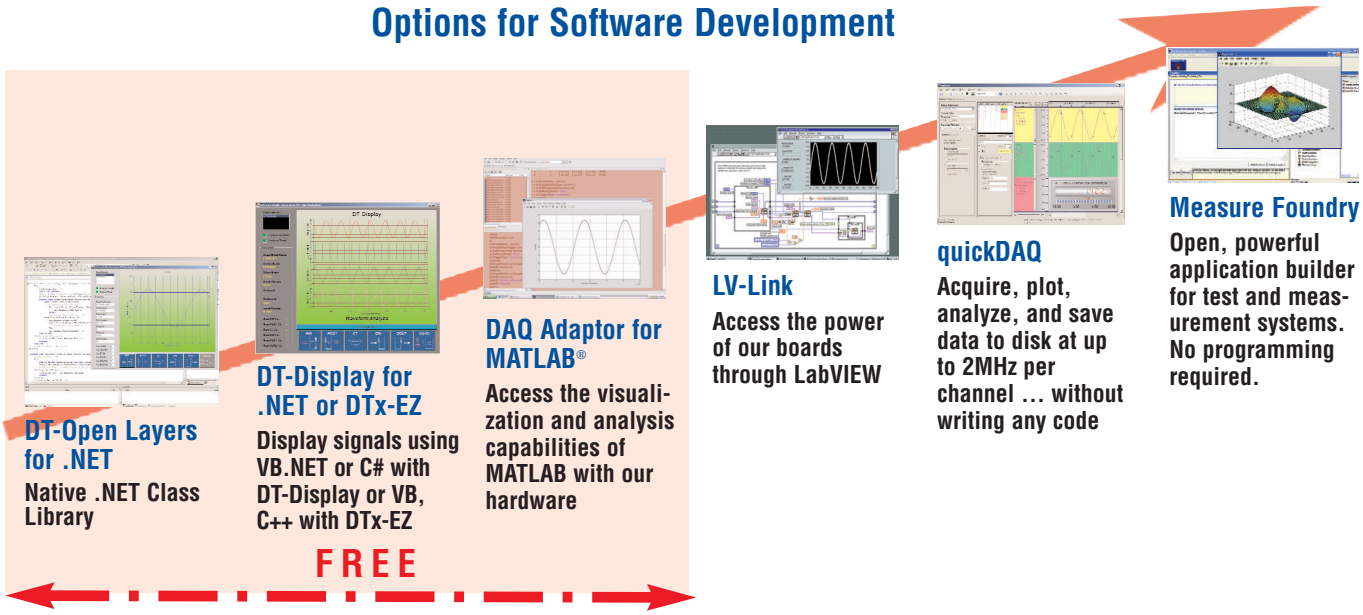

Figure 18. There are many software choices available for application development. Each option offers development capability at different levels. Choose from ready-to-measure applications to full graphical programming with Measure Foundry.

Software

All boards ship with the Omni CD that includes the following software:

- **DT-Open Layers for .NET with DT-Display:**
  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.
  - **DT-Display for .NET** is a control for plotting data to a Windows form. It provides a powerful and user-friendly interface for rendering data.
- **DT-Open Layers for Win32:**
  DT-Open Layers for Win32 consists of the DataAcq SDK and DTx-EZ.
  - The **DataAcq 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.
  - **DTx-EZ** provides visual programming tools for Microsoft Visual Basic and Visual C++ that enable quick and easy development of test and measurement applications.

Note: If you have an existing application that was written using the DataAcq SDK, we recommend that you migrate your application to use the DT-Open Layers for .NET Class Library. This will guarantee compatibility with future Data Translation hardware and software.

- **Drivers:**
  The 32-bit WDM device drivers make your application cross-platform compatible. These drivers support Data Translation USB and PCI boards using Windows 2000/XP.

You can choose to install demo versions of the following software from the CD:

- **Measure Foundry** is an open, powerful application builder for test and measurement systems. No programming is required!
- **quickDAQ** is a high performance, ready-to-run application that lets you acquire, plot, analyze, and save data to disc at 2MHz per channel without writing any code. quickDAQ supports applications from temperatue measurement to high-speed testing and analysis.
- **LV-Link** contains all necessary VIs, examples, and documentation to use Data Translation hardware in LabVIEW 8.0 and greater.

The following software is available as a free download from our web site.

- **DAQ Adaptor for MATLAB** to access the visualization and analysis capabilties of MATLAB from The MathWorks™.

Power, Physical, and Environmental Specifications

Power (provided by the USB cable)	
+5 V standby	0.5 µA maximum
+5 V enumeration	100 mA maximum
+5 V power on	500 mA maximum
+5 V isolated power out (TB 27)	10 mA maximum
Physical	
Dimensions:	6.5 inches (length) by 4.5 inches (width) by 1.4 inches (depth)
Weight:	9 oz. (255 grams)
I/O connector:	USB
Certification and compliance	FCC Part 15 Class B verified; will not compromise FCC compliance of host computer CE
Environmental	
Operating temperature range:	0°C to 55°C
Storage temperature range:	–25°C to 85°C
Relative humidity:	To 95%, noncondensing

DT9805 Series User's Manuals

A getting started and user's manual are provided in electronic (PDF) format on the CD-ROM provided with the module. You can also purchase a hard copy of these manuals, if you wish.

Technical Support

As you develop your application, technical support is available when you need it. Extensive information is available 24 hours a day on our web site at www.datatranslation.com, including drivers, example code, pinouts, a searchable KnowledgeBase, and much more.

Support is also available from your point of purchase. You can also request complimentary support via e-mail or fax at any time.

Ordering Summary

All Data Translation hardware products are covered by a 1-year warranty. For pricing information, see a current price list, visit our web site, or contact your local reseller.

DT9805 Series

Each DT9805 Series module is shipped with the Data Acquisition Omni CD, which includes DT-Open Layers-compliant drivers for Microsoft Windows 2000/XP, Ready-to-Measure software, and comprehensive user's manuals in PDF format. Manuals are available in hard-copy form for an additional charge.

- DT9805 USB function module with 16-bit, 50 kS/s analog inputs, and no analog outputs
- DT9806 USB function module with 16-bit, 50 kS/s analog inputs, and 2, 16-bit analog outputs)

Software

The following software can be purchased separately:

- Measure Foundry is an open, powerful application builder for test and measurement systems.
  SP1300-CD
- quickDAQ is a high-performance, ready-to-run application that lets you acquire, plot analyze, an save data to disk at up to 2 MHz per channel.
  SP8501-CD
- LV Link to access the power of our boards through LabVIEW.
  SP0811

Data Translation now offers free downloads on the Web for:

- DAQ Adaptor for MATLAB to access the analysis and visualization tools in MATLAB.

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