

**New!**  
8, 16, or 24  
analog inputs!

**ECONseries**

**BUS: USB**

**Type: Economy, Mini-Instruments**

# ECONseries

## Economy USB

### Mini-Instruments

#### Flexible Yet Economical

- A variety of low-cost ECONseries modules are available to provide flexible yet economical solutions.
- Choose the number of analog I/O and digital I/O channels, the resolution you need, and the signal range of your application.

#### Easy Plug-and-Play Measurements

- Connect the module to the USB 2.0 or 1.1 port of your PC.
- Attach signals directly to screw terminals on the module.
- Run multiple subsystem operations simultaneously.
- No power supply needed.

#### Oscilloscope Function

- Stream, plot, and analyze data from up to eight analog input channels.
- Zoom in or out of live signals.
- Print your data or save it to an Excel file.

#### Chart Recorder Function

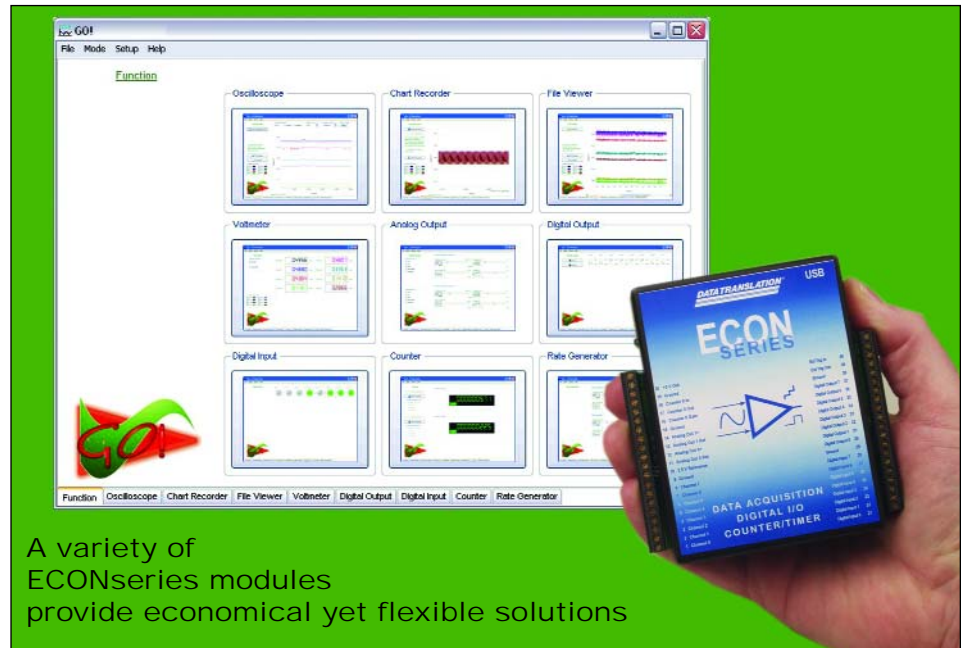
- Record up to 32,000 data points from up to eight analog input channels and log data to Excel.

#### Digital Voltmeter Function

- Measure data from up to eight analog input channels and view it in a 5-digit digital display.
- Display the maximum or true root mean square (RMS) value.



The GO! Application allows instant out-of-the-box measurements with standard instrument-like displays



A variety of ECONseries modules provide economical yet flexible solutions

**Figure 1.** The ECONseries features the powerful GO! application to provide economical, multifunction data acquisition instruments for the USB bus. Simply install the software, connect your module to any USB port, and GO!

#### File Viewer Function

- Load a previously saved Excel file.
- Scroll, zoom, or print your data.

#### Waveform Generation

- Generate DC, sine, rectangle, or triangle waveforms from up to two analog output channels.
- Select the frequency, amplitude, offset, and duty cycle of your signal.

#### Digital I/O Control

- Monitor and control up to 28 digital I/O lines.

#### External Event Counting

- Count pulses from the counter/timer for 1, 2, or 5 seconds or for an unlimited time.

#### Rate Generation

- Control the frequency of a continuous pulse output signal from the counter/timer.

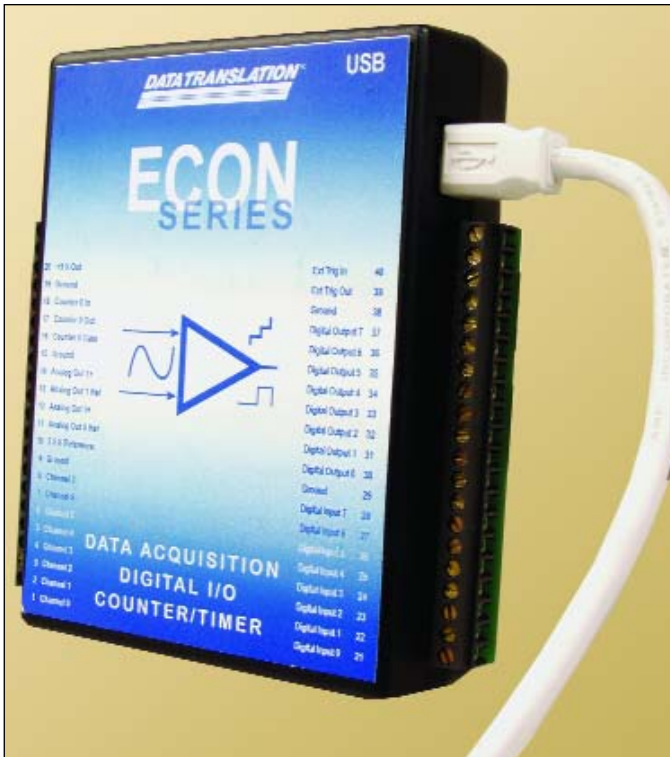
### ECONseries Modules

	Series Description	Subsystem (AI = Analog Input, SAI = Simultaneous AI, AO = Analog Output)	Resolution (bits) @ Throughput (kS/S)	Independent Subsystem Operation at Full Throughput	Analog Input FSR	Waveform Analog Output FSR	Clocks & Triggers External/Internal	Power Fully Loaded
Simultaneous	DT9816	6 SAI, 0 AO, 16 DIO, 1 C/T	16-bits @ 50 kS/s Per Channel*	Yes to 50 kS/s	±10 V, ±5 V	—	Yes/Yes	USB <200 mA
	DT9816-A	6 SAI, 0 AO, 16 DIO, 1 C/T	16-bits @ 150 kS/s Per Channel*	Yes to 150 kS/s	±10 V, ±5 V	—	Yes/Yes	USB <200 mA
General Purpose	DT9812-10V	8 AI, 2 AO, 16 DIO, 1 C/T	12-bits @ 50 kS/s Aggregate	Yes to 50 kS/s	±10 V, ±5 V, ±2.5 V, ±1.25 V	±10 V	Yes/Yes	USB <175 mA
	DT9813-10V	16 AI, 2 AO, 8 DIO, 1 C/T						
	DT9814-10V	24 AI, 2 AO, 1 C/T						
	DT9812-2.5V	8 AI, 2 AO, 16 DIO, 1 C/T	12-bits @ 50 kS/s Aggregate	Yes to 50 kS/s	0 to 2.44 V, 1.22 V, 0.61 V, 0.305 V, 0.1525 V	0 to 2.44 V	Yes/Yes	USB <100 mA
	DT9810	8 AI, 0 AO, 20 DIO, 1 C/T	10-bits @ 25 kS/s Aggregate	Yes to 25 kS/s	0 to 2.44 V	—	No/Yes	USB <100 mA
Digital I/O	DT9817	28 DIO, 1 C/T Sink = 10 mA, Source = 4.5 mA	—	Yes	—	—	—	USB <150 mA
	DT9817-H	28 DIO, 1 C/T Sink = 64 mA, Source = 15 mA	—	Yes	—	—	—	USB <500 mA

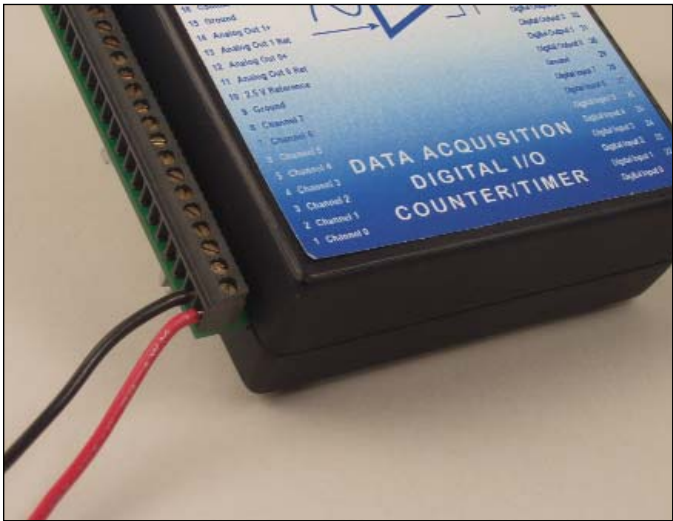
\*Note: Aggregate throughput = 300 kS/s for DT9816, 900 kS/s for DT9816-A.

All ECONseries modules are:

- ESD protected up to 4 kV contact and 8 kV arc
- Non-isolated, utilizing the same ground as the USB port
- Single-ended analog input
- Powered from USB source, no power supply needed



**Figure 2.** Connect to a host computer using the standard USB 1.1 or 2.0 plug-in connector on the ECONseries module. The USB connector provides power to the module, eliminating the need for an external power supply, while providing complete enumeration for all data flow.



**Figure 3.** Connect sensors directly to the screw terminal of the module. Screw terminals can accept AWG 26 to AWG 16 size wire.

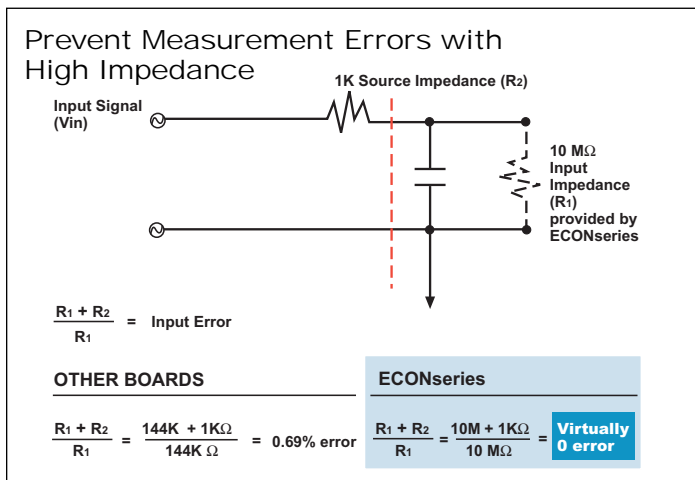
**Easy hook-up, all connections identified**

- Shielded, rugged enclosure provides noise immunity
- Standard USB Connector
- LED Indicator provides USB status
- Built-in signal I/O screw terminal connectors

**Figure 4.** ECONseries modules provide easy signal and USB connections in a shielded, rugged enclosure.

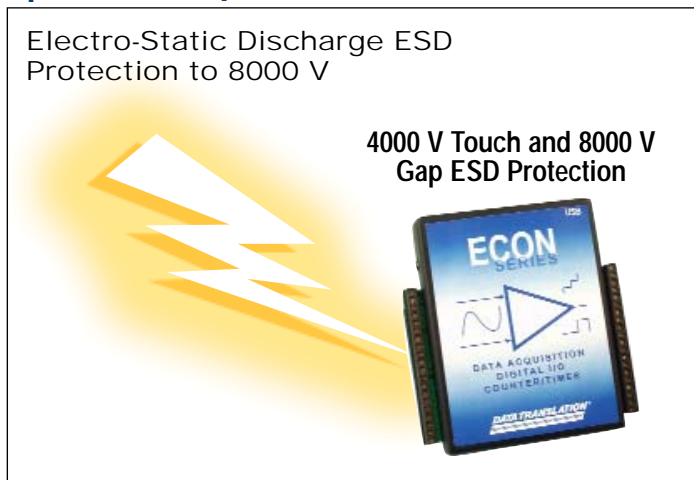
# The ECONseries design provides the following major advantages:

## Prevents Measurement Errors



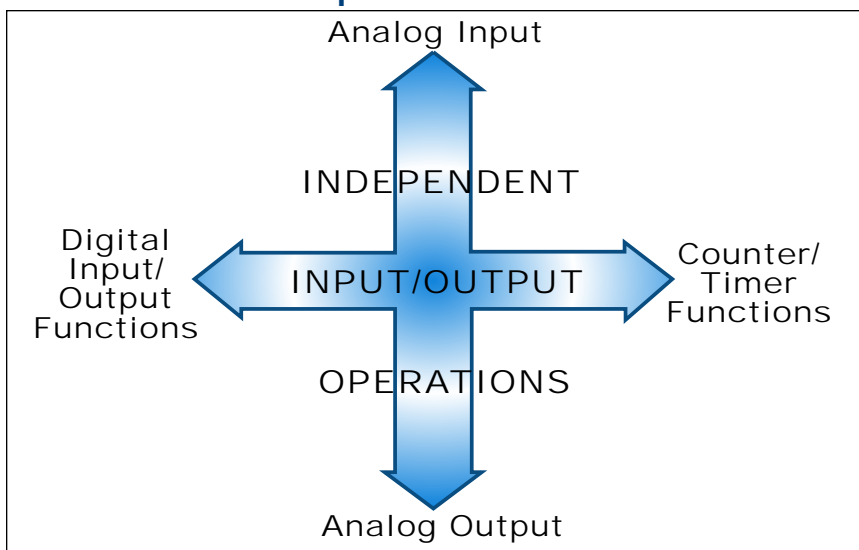
**Figure 5.** The ECONseries provides 10 MOhms of input impedance for virtually error-free analog input measurements.

## Operates Reliably



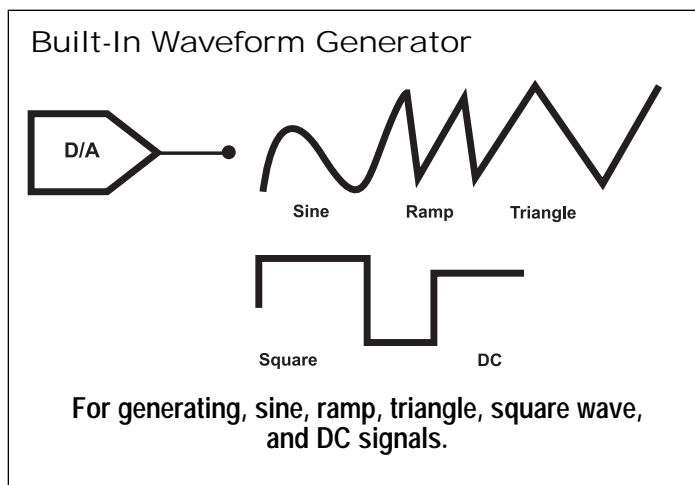
**Figure 6.** The ECONseries provides 4000 V touch and 8000 V gap ESD protection circuitry for superior noise immunity.

## Performs Simultaneous Operations



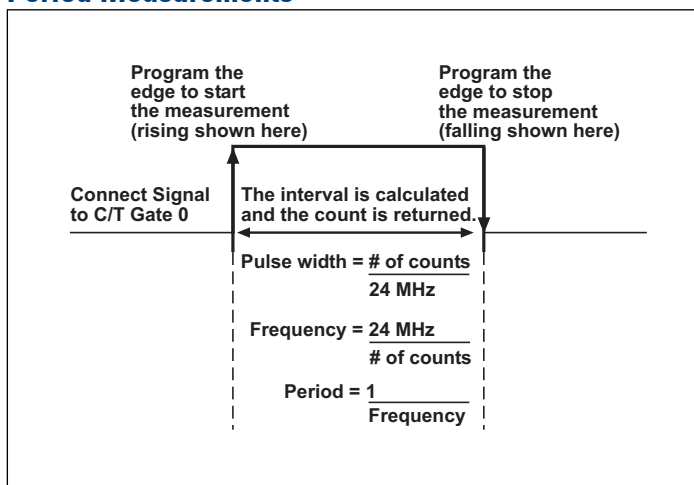
**Figure 7.** The ECONseries supports independent subsystem operations - great for measurement and control applications.

## Generates Waveforms at up to 50 kHz



**Figure 8.** The DT9812-2.5 V, DT9812-10V, DT9813-10V, and the DT9814-10V modules provide 2 waveform DACs for generating sine, ramp, triangle, square wave, and DC signals.

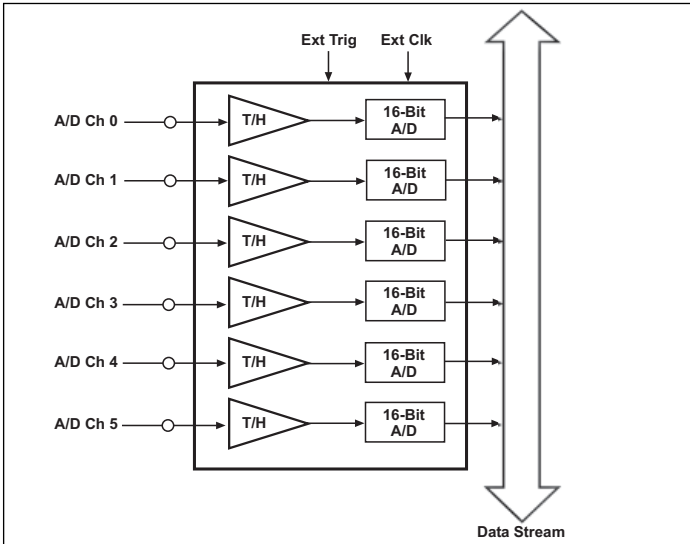
## Detects Edges for Pulse Width, Frequency, & Period Measurements



**Figure 9.** Programmable edges allow you to use the counter/timer of an ECONseries module to measure the pulse width, frequency, and period of a signal.

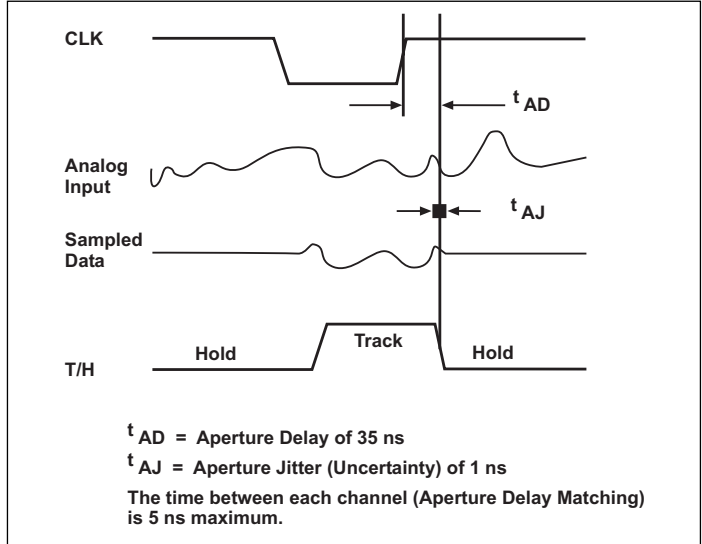
# The DT9816 design provides the following additional advantages:

## Six Simultaneously Sampled Analog Inputs



**Figure 10.** The DT9816 and DT9816-A feature six, independent, successive-approximation A/D converters with track-and-hold circuitry. Each converter uses a common clock and trigger for simultaneous sampling of all six analog input signals at up to 50 kHz per channel for the DT9816 at 150 kHz per channel for the DT9816-A.

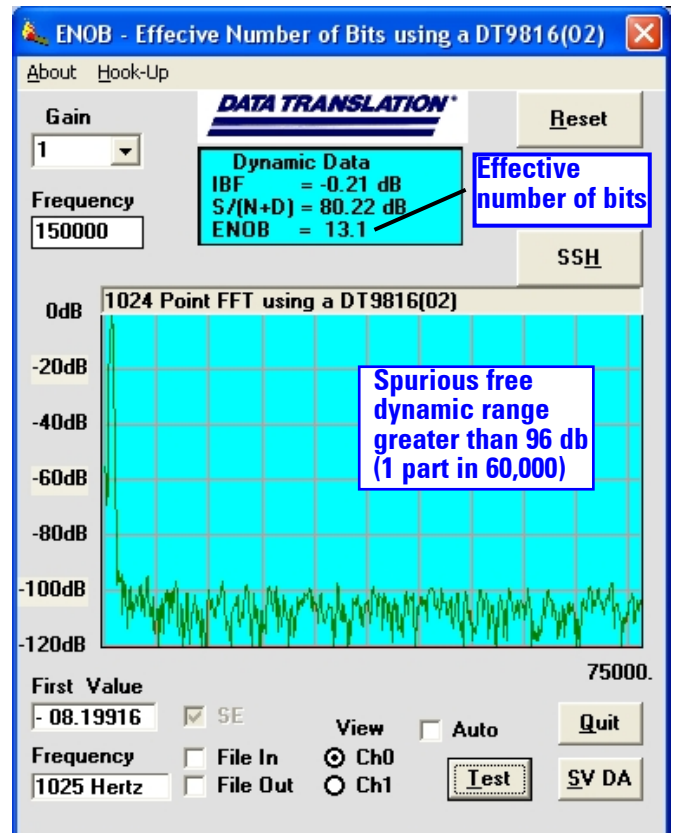
## Accurate Measurements Designed In



**Figure 11.** The A/D design of the DT9816 and DT9816-A features built-in accuracy. A maximum aperture delay of 35 ns (the time that it takes the A/D to switch from track to hold mode) is well matched at 5 ns across all six track-and-hold circuits, virtually eliminating the channel-to-channel skew that is associated with multiplexed inputs. A maximum aperture uncertainty of 1 ns (the jitter or variance in aperture delay), virtually eliminates phase noise in your data.

## DT9816 and DT9816-A Key Features:

- High-Speed Simultaneous Acquisition**  
 Acquire all six analog input channels simultaneously at up to 50 kHz per channel (DT9816) or 150 kHz per channel (DT9816-A).
- High-Resolution Data**  
 The DT9816 and DT9816-A feature 16-bit resolution for precision measurements.
- Two Bipolar Input Ranges**  
 The DT9816 and DT9816-A feature +/- 10 V and +/- 5 V signal input ranges for maximum flexibility.
- Digital I/O Functions**  
 The DT9816 and DT9816-A have 8 fixed digital inputs and 8 fixed digital outputs for controlling external equipment.
- Multifunction Counter/Timer**  
 The DT9816 and DT9816-A have one 16-bit counter/timer for event counting, frequency measurement, and continuous pulse output operations.



**Figure 12.** This graph shows the outstanding quality of the DT9816-A for all error sources ... effective number of bits greater than 13.1 from all sources. Note the absence of harmonic content and digital switching noise across the full spectrum.

## Overview

The ECONseries features the powerful GO! application to provide economical, multifunction instruments for the USB bus. Simply install the software, connect your module to any USB port, and GO!

ECONseries modules are available in a number of configurations to offer the maximum flexibility - select the number of analog and digital I/O channels, the resolution you need, and the signal range required by your application.



## GO! Application

For measurements right out of the box, use the GO! application. The GO! application automatically detects and configures the module you are using, and provides the following standard instrument-like displays for data acquisition, control, and display:

- Oscilloscope - Stream, plot, and analyze data from up to eight analog input channels. The software automatically adjusts for resolution and input signal range. You can scroll, pan, zoom, or freeze live signals; select the trigger type, level, and channel; and print or save your data to an Excel file.

- Chart Recorder - View and record up to 32,000 data points from eight analog input channels. Data is logged to an Excel file.
- Voltmeter - Measure and view data from up to eight analog input channels with a 5-digit digital display. You can choose to display the maximum or true root mean square (RMS) value.
- File Viewer - Load a previously saved Excel file. You can scroll, zoom, pan, or print your data.
- Waveform Generation - Generate DC, sine, rectangle, triangle waveforms from up to two analog output channels. You can select the duty cycle, frequency, amplitude, and offset of the signal.
- Digital Input - Monitor the status of up to 28 digital inputs using LEDs.
- Digital Output - Control the state of up to 28 digital output lines using switches.
- Counter - Count pulses from the counter/timer for 1, 2, or 5 seconds or for an unlimited time and view the count in a 9-digit digital display.
- Rate Generator - Control the frequency and duty cycle of a continuous pulse output signal from the counter/timer.

## Throughput

Before selecting a module, consider whether you need analog inputs, and if so, what kind of throughput you need.

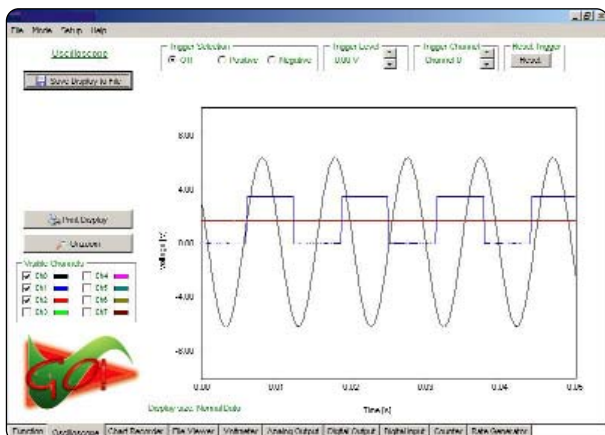
Modules with multiplexed inputs, such as the DT9810, DT9812-2.5V, DT9812-10V, DT9813-10V, and DT9814-10V provide only one A/D converter that is shared by the inputs (see Figure 23). A multiplexer selects or switches the channel to acquire, which introduces a settling time and phase shift between channels. In a multiplexed architecture, the total or aggregate throughput is the maximum rate of the sampling clock. The DT9810 provides an aggregate throughput of up to 25 kHz, while the DT9812-2.5V, DT9812-10V, DT9813-10V, and DT9814-10V provide an aggregate throughput of up to 50 kHz. The per channel rate is determined by dividing the maximum sampling rate by the number of inputs sampled. For example, if you are acquiring 8 inputs on a DT9812-10V, the per channel rate is 6.25 kS/s.

In contrast, modules that provide separate A/D converters per channel (see Figure 24), such as the DT9816 and DT9816-A, eliminate the phase shift between signals, allowing you to correlate simultaneous measurements of multiple inputs. The per channel sampling rate, in this case, is the maximum rate of the sampling clock (50 kS/s for the DT9816 and 150 kS/s for the DT9816-A).

## Analog Inputs

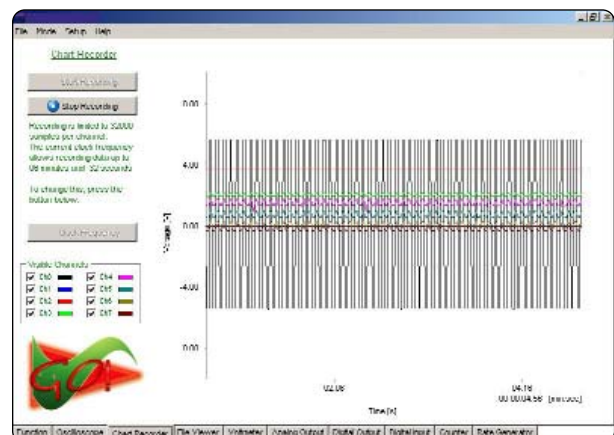
The DT9810, DT9812 2.5V, and DT9812-10V modules provide 8

## Oscilloscope



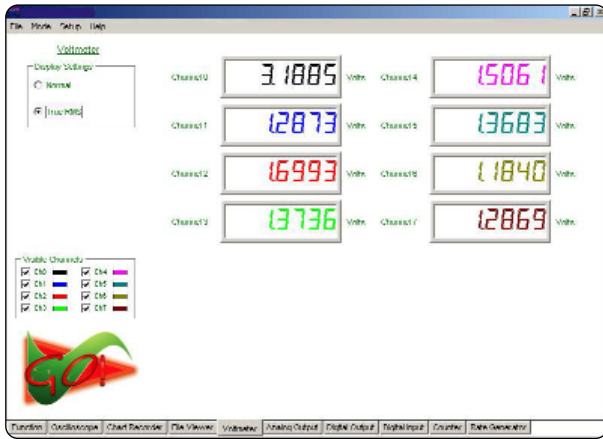
**Figure 13** Use the Oscilloscope tab of the GO! application to stream, plot, and analyze data from up to eight single-ended analog input channels. The software automatically adjusts for resolution and input signal range. You can scroll, pan, zoom, or freeze live signals; select the trigger type, level, and channel; and print or save your data to an Excel file.

## Chart Recorder



**Figure 14.** Use the Chart Recorder tab of the GO! application to view and record up to 32,000 data points from up to eight single-ended analog input channels. Data is logged to an Excel file.

## Voltmeter



**Figure 15.** Use the Voltmeter tab of the GO! application to measure and view data from up to eight analog input channels in a 5-digit digital display. You can choose to display the maximum or RMS value.

multiplexed single-ended analog input channels, the DT9813-10V provides 16 channels, and the DT9814-10V provides 24 channels. The DT9816 and DT9816-A modules provide 6 separate 16-bit analog converters for simultaneous acquisition of up to 6 single-ended analog inputs.

The DT9810 provides 10-bit resolution, while the DT9812-2.5V, DT9812-10V, DT9813-10V, and the DT9814-10V provide 12-bit resolution. For maximum resolution, the DT9816 and DT9816-A provide 16-bit resolution.

DT9810 and DT9812-2.5V modules feature a full-scale input signal range of 0 to 2.44 V. If you need a full-scale input signal range of  $\pm 10$  V, the DT9812-10V, DT9813-10V, DT9814-10V, DT9816 and DT9816-A are available. The DT9816 and DT9816-A

modules also feature a full-scale input signal range of  $\pm 5$  V.

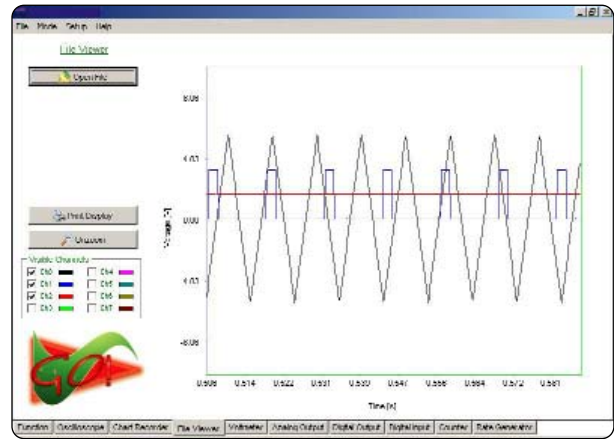
The DT9812-2.5V provides gains of 1, 2, 4, 8, and 16; the DT9812-10V, DT9813-10V, and DT9814-10V provides programmable gains of 1, 2, 4, and 8; and the DT9816 and DT9816-A provide gains of 1 and 2.

The GO! application provides the Oscilloscope (Figure 13), Chart Recorder (Figure 14), Voltmeter (Figure 15), and File Viewer (Figure 16) instrument-like displays to acquire, view, print, and save data from all eight of the analog input channels on the ECONseries modules.

## Waveform Generation

The DT9812-2.5V module provides 2, 12-bit waveform analog output channels with an output

## File Viewer



**Figure 16.** Use the File Viewer tab of the GO! application to load a previously saved Excel file. You can scroll, zoom, pan, or print your data.

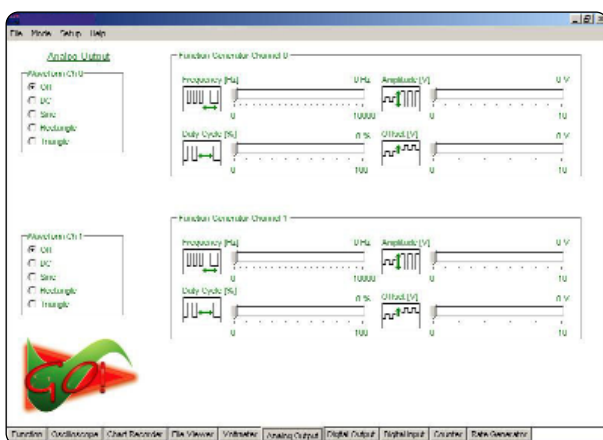
### Effective Input Ranges

Gain	DT9812-2.5V	DT9812-10V, DT9813-10V, DT9814-10V	DT9816
1	0 to 2.44 V	$\pm 10$ V	$\pm 10$ V
2	0 to 1.22 V	$\pm 5$ V	$\pm 5$ V
4	0 to 0.61 V	$\pm 2.5$ V	—
8	0 to 0.305 V	$\pm 1.25$ V	—
16	0 to 0.1525 V	—	—

Note: The GO! Application uses a gain of 1. Gains of 2, 4, 8, and 16 (DT9812-2.5V only) are supported at the driver level.

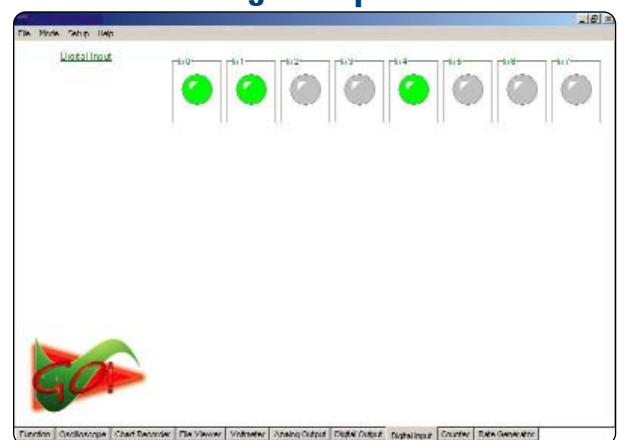
signal range of 0 to 2.5 V. The DT9812-10V, DT9813-10V, and DT9814-10V modules provide 2, 12-bit analog output channels with an output signal range of  $\pm 10$  V. These modules support an update rate of up to 50 kS/s.

## Waveform Generator



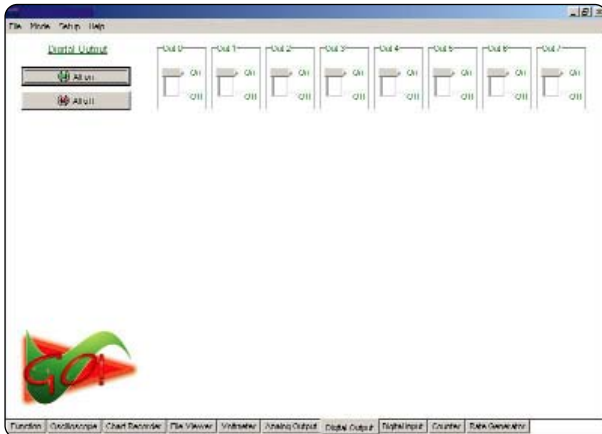
**Figure 17.** Use the Waveform Generator tab of the GO! application to generate DC, sine, rectangle, triangle waveforms from one or both analog output channels. You can select the duty cycle, frequency, amplitude, and offset of the signal.

## Digital Input



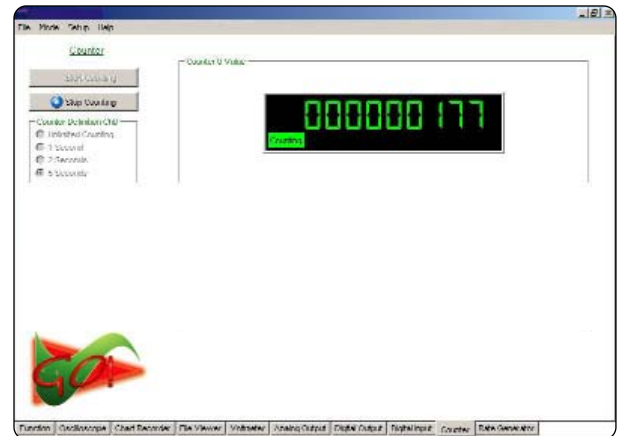
**Figure 18.** Use the Digital Input tab of the GO! application to monitor the status of the digital inputs using LEDs. The GO! application supports up to 16 digital inputs.

## Digital Output



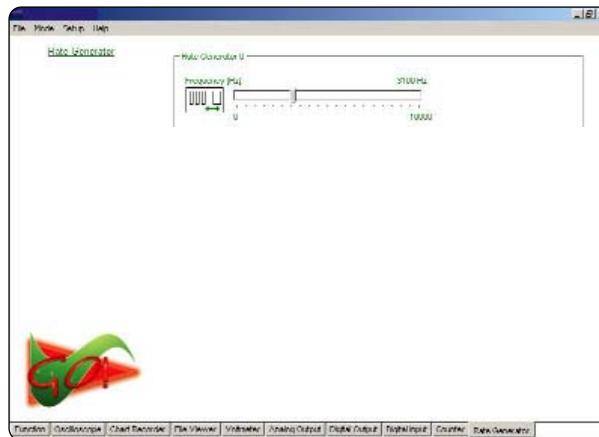
**Figure 19.** Use the Digital Output tab of the GO! application to control the state of the digital output lines using switches. The GO! application supports up to 12 digital outputs.

## Counter



**Figure 20.** Use the Counter tab of the GO! application to count pulses from the counter/timer for 1, 2, or 5 seconds or for an unlimited time and view the count in a 9-digit display.

## Rate Generator



**Figure 21.** Use the Rate Generator tab of the GO! application to control the frequency of a continuous pulse output signal from the counter/timer.

Use the Waveform Generator display of the GO! application (Figure 17) to generate sine, rectangle, triangle, or DC waveforms from one or both analog output channels. You can select the frequency, amplitude, duty, and offset cycle of the signal.

Simultaneous analog input and analog output operations are supported at the driver level.

## Digital I/O Lines

The DT9812-2.5V, DT9812-10V, DT9816, and DT9816-A modules feature 8 digital input lines and 8 digital output lines. The DT9813-10V provides 4 digital input lines, and 4 digital output lines. The DT9810 module provides 20 programmable digital I/O lines. If you need more digital I/O lines and do not need

analog I/O functionality, select the DT9817 or DT9817-H module, which provide 28 programmable digital I/O lines. The DT9817-H provides high drive capability with 15 mA source and 64 mA sink.

Use the Digital Input or Digital Output display of the GO! application (Figure 18 & 19) to monitor and control the digital I/O lines.

## Multifunction Counter/Timers

The DT9816 and DT9816-A support one 16-bit counter/timer channel. All other modules feature one 32-bit user counter/timer channel. You can perform event counting, frequency measurement, and continuous pulse output operations using this counter/timer.

Use the Counter display of the GO! application (Figure 20) to count pulses from the counter/timer or the Rate Generator display (Figure 21) to generate a pulse output signal.

Programmable gates, clocks, and output signals are also supported at the driver level for maximum flexibility. In addition, programmable edges allow you to measure the time between two edges of a signal to determine the pulse width, frequency, or period of a signal.

## Flexible Clocks and Triggers

The DT9810, DT9812-2.5V, DT9812-10V, DT9813-10V, DT9814-10V, DT9816, and

DT9816-A modules support an internal trigger and internal clock. In addition, the DT9812-2.5V, DT9812-10V, DT9813-10V, DT9814-10V, DT9816, and DT9816-A modules support an external trigger and clock.

Use the internal trigger to start an analog input operation based on a software command, or use the external trigger to start an analog input operation based on an external event.

Use the external clock signal to pace an analog input operation at a rate not available with the internal clock or when you want to pace at uneven intervals.

## Synchronizing Multiple Modules

You can synchronize the analog input operations of multiple DT9812-2.5V, DT9812-10V, DT9813-10V, DT9814-10V, DT9816, or DT9816-A modules by connecting the output of the counter/timer from one module to the clock input of the next module as shown in Figure 22.

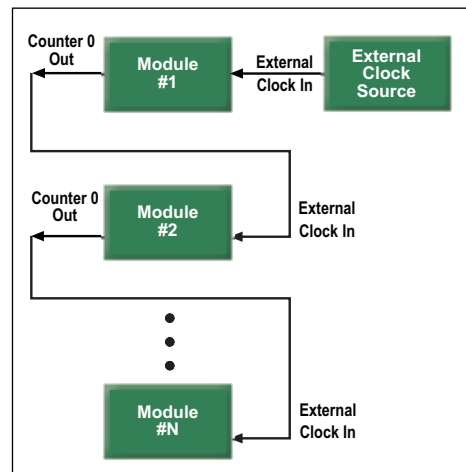


Figure 22. You can synchronize the analog I/O operations of multiple modules by connecting them together.

## Easy Signal Connections

Screw terminals on the module allow easy and direct signal connections. No extra accessories are required! Simply wire your signals to the module and you're all set.

And, because of the module's high impedance, measurement errors are prevented.

## DT9810 Pin Assignments

### DT9810 Screw Terminal Assignments

Screw	Signal Terminal	Screw	Signal Terminal
20	USB +5 V Out	40	Reserved
19	Ground	39	Reserved
18	Counter 0 In	38	Ground
17	Counter 0 Out	37	Digital I/O 15
16	Counter 0 Gate	36	Digital I/O 14
15	Ground	35	Digital I/O 13
14	Digital I/O 19	34	Digital I/O 12
13	Digital I/O 18	33	Digital I/O 11
12	Digital I/O 17	32	Digital I/O 10
11	Digital I/O 16	31	Digital I/O 9
10	2.44 V Reference	30	Digital I/O 8
9	Analog Ground	29	Ground
8	Analog In Ch 7	28	Digital I/O 7
7	Analog In Ch 6	27	Digital I/O 6
6	Analog In Ch 5	26	Digital I/O 5
5	Analog In Ch 4	25	Digital I/O 4
4	Analog In Ch 3	24	Digital I/O 3
3	Analog In Ch 2	23	Digital I/O 2
2	Analog In Ch 1	22	Digital I/O 1
1	Analog In Ch 0	21	Digital I/O 0

## DT9810 Block Diagram

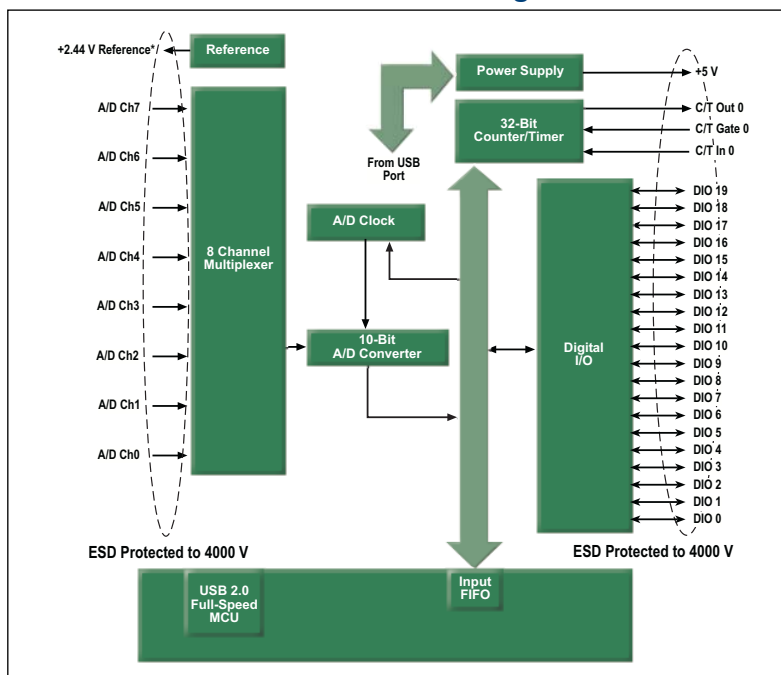


Figure 23. This block diagram shows all the functional signals of the DT9810 USB module for performing analog input, digital I/O, and counter/timer operations.

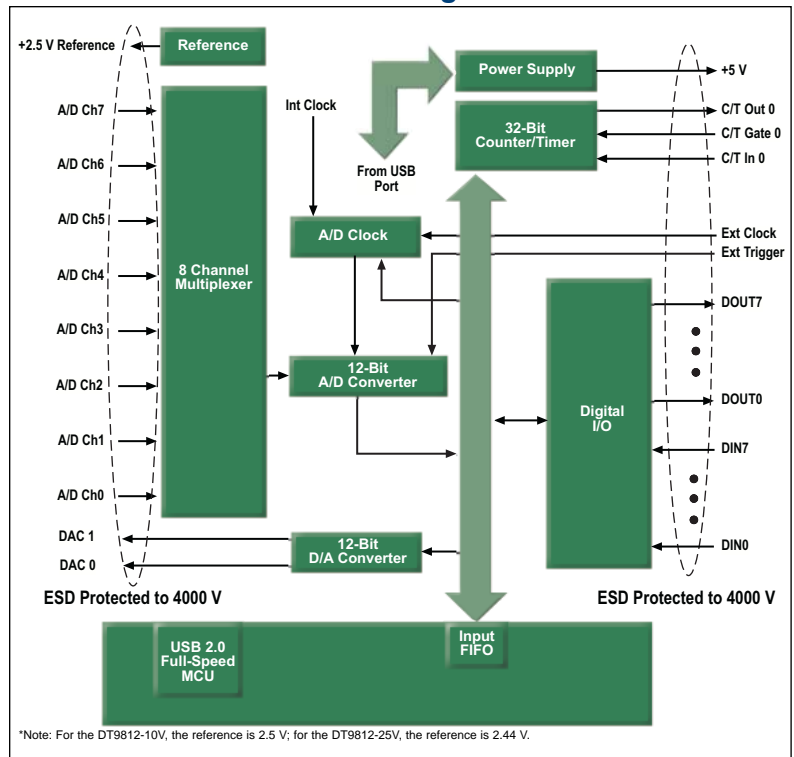
**DT9812-2.5V & DT9812-10V  
Pin Assignments**

**DT9812-2.5V & DT9812-10V  
Screw Terminal Assignments**

Screw	Signal Terminal	Screw	Signal Terminal
20	USB +5 V Out	40	Ext Trig In
19	Ground	39	Ext Clock In
18	Counter 0 In	38	Ground
17	Counter 0 Out	37	Digital Output 7
16	Counter 0 Gate	36	Digital Output 6
15	Ground	35	Digital Output 5
14	DAC 1	34	Digital Output 4
13	DAC 1 Return	33	Digital Output 3
12	DAC 0	32	Digital Output 2
11	DAC 0 Return	31	Digital Output 1
10	2.5 V Reference*	30	Digital Output 0
9	Analog Ground	29	Ground
8	Analog In Ch 7 High	28	Digital Input 7
7	Analog In Ch 6 High	27	Digital Input 6
6	Analog In Ch 5 High	26	Digital Input 5
5	Analog In Ch 4 High	25	Digital Input 4
4	Analog In Ch 3 High	24	Digital Input 3
3	Analog In Ch 2 High	23	Digital Input 2
2	Analog In Ch 1 High	22	Digital Input 1
1	Analog In Ch 0 High	21	Digital Input 0

\*Note: For the DT9812-10V, the reference is 2.5 V; for the DT9812-25V, the reference is 2.44 V.

**DT9812-2.5V & DT9812-10V  
Block Diagram**



\*Note: For the DT9812-10V, the reference is 2.5 V; for the DT9812-25V, the reference is 2.44 V.

**Figure 24.** This block diagram shows all the functional signals of the DT9812-2.5V and DT9812-10V USB modules for performing analog I/O, digital I/O, and counter/timer operations.

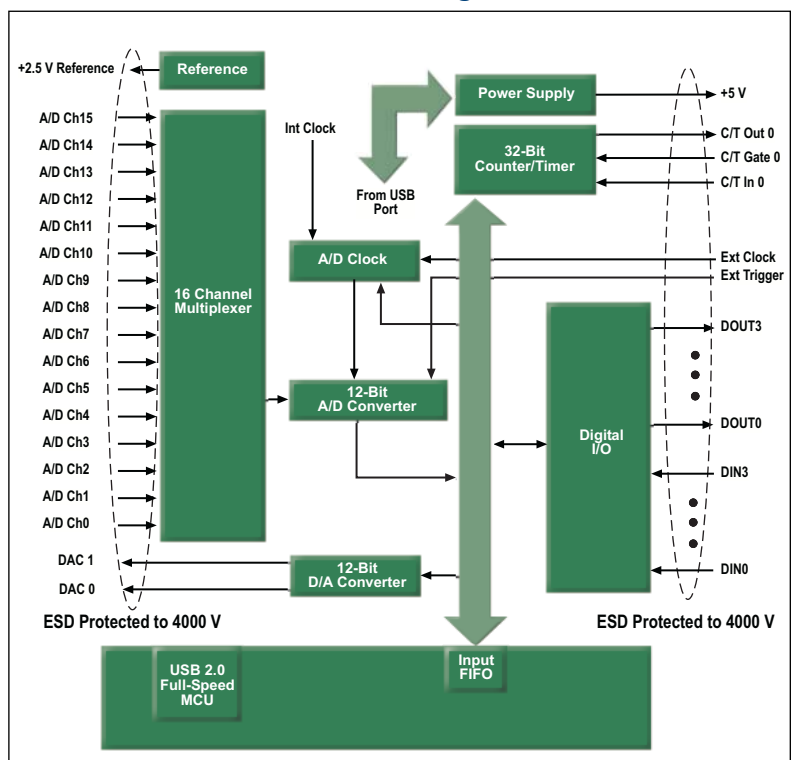
**DT9813-10V  
Pin Assignments**

**DT9813-10V  
Screw Terminal Assignments**

Screw Terminal	Signal	Screw Terminal	Signal
20	+5 V Power	40	Ext Trig In
19	Ground	39	Ext Clock In
18	Counter 0 In	38	Ground
17	Counter 0 Out	37	Digital Input 3
16	Counter 0 Gate	36	Digital Input 2
15	Ground	35	Digital Input 1
14	DAC 1	34	Digital Input 0
13	DAC 1 Return	33	Digital Output 3
12	DAC 0	32	Digital Output 2
11	DAC 0 Return	31	Digital Output 1
10	2.5 V Reference*	30	Digital Output 0
9	Analog Ground	29	Ground
8	Analog In Ch 7 High	28	Analog In Ch 15 High
7	Analog In Ch 6 High	27	Analog In Ch 14 High
6	Analog In Ch 5 High	26	Analog In Ch 13 High
5	Analog In Ch 4 High	25	Analog In Ch 12 High
4	Analog In Ch 3 High	24	Analog In Ch 11 High
3	Analog In Ch 2 High	23	Analog In Ch 10 High
2	Analog In Ch 1 High	22	Analog In Ch 9 High
1	Analog In Ch 0 High	21	Analog In Ch 8 High

\*Note: For the DT9812-10V, the reference is 2.5 V; for the DT9812-25V, the reference is 2.44 V.

**DT9813-10V  
Block Diagram**



**Figure 25.** This block diagram shows all the functional signals of the DT9813-10V module for performing analog I/O, digital I/O, and counter/timer operations.

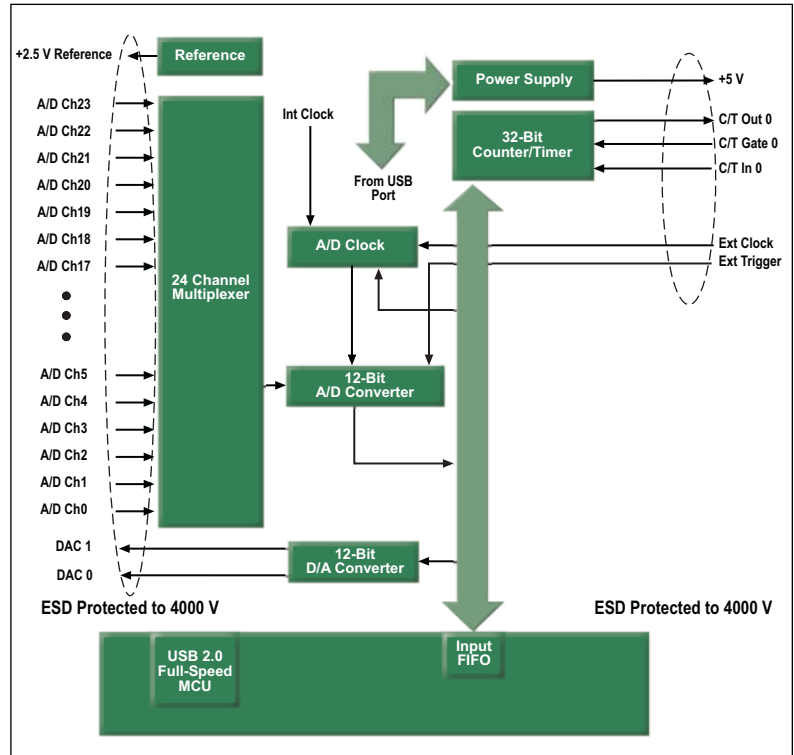
## DT9814-10V Pin Assignments

### DT9814-10V Screw Terminal Assignments

Screw Terminal	Signal	Screw Terminal	Signal
20	+5 V Power	40	Ext Trig In
19	Ground	39	Ext Clock In
18	Counter 0 In	38	Ground
17	Counter 0 Out	37	Analog In Ch 23 High
16	Counter 0 Gate	36	Analog In Ch 22 High
15	Ground	35	Analog In Ch 21 High
14	DAC 1	34	Analog In Ch 20 High
13	DAC 1 Return	33	Analog In Ch 19 High
12	DAC 0	32	Analog In Ch 18 High
11	DAC 0 Return	31	Analog In Ch 17 High
10	2.5 V Reference*	30	Analog In Ch 16 High
9	Analog Ground	29	Ground
8	Analog In Ch 7 High	28	Analog In Ch 15 High
7	Analog In Ch 6 High	27	Analog In Ch 14 High
6	Analog In Ch 5 High	26	Analog In Ch 13 High
5	Analog In Ch 4 High	25	Analog In Ch 12 High
4	Analog In Ch 3 High	24	Analog In Ch 11 High
3	Analog In Ch 2 High	23	Analog In Ch 10 High
2	Analog In Ch 1 High	22	Analog In Ch 9 High
1	Analog In Ch 0 High	21	Analog In Ch 8 High

\*Note: For the DT9812-10V, the reference is 2.5 V; for the DT9812-25V, the reference is 2.44 V.

## DT9814-10V Block Diagram



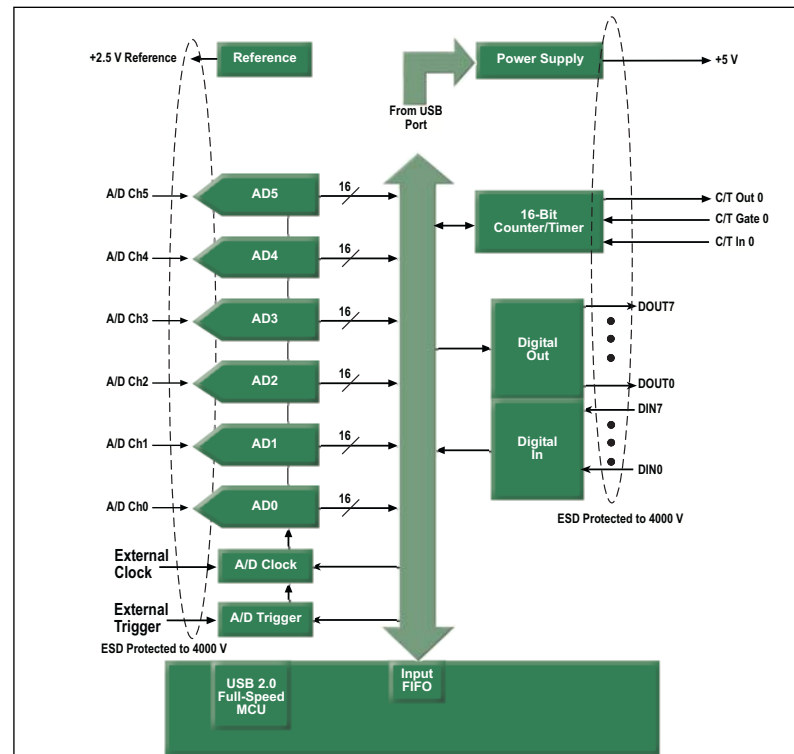
**Figure 26.** This block diagram shows all the functional signals of the DT9814-10V module for performing analog I/O, digital I/O, and counter/timer operations.

## DT9816 and DT9816-A Pin Assignments

### DT9816 and DT9816-A Screw Terminal Assignments

Screw Terminal	Signal	Screw Terminal	Signal
20	USB +5 V Out	40	Ext Trigger
19	Ground	39	Ext Clock
18	Counter 0 In	38	Ground
17	Counter 0 Out	37	Digital Output 7
16	Counter 0 Gate	36	Digital Output 6
15	Ground	35	Digital Output 5
14	Reserved	34	Digital Output 4
13	Reserved	33	Digital Output 3
12	Reserved	32	Digital Output 2
11	Reserved	31	Digital Output 1
10	2.5 V Reference	30	Digital Output 0
9	Ground	29	Ground
8	Reserved	28	Digital Input 7
7	Reserved	27	Digital Input 6
6	Analog In 5	26	Digital Input 5
5	Analog In 4	25	Digital Input 4
4	Analog In 3	24	Digital Input 3
3	Analog In 2	23	Digital Input 2
2	Analog In 1	22	Digital Input 1
1	Analog In 0	21	Digital Input 0

## DT9816 and DT9816-A Block Diagram



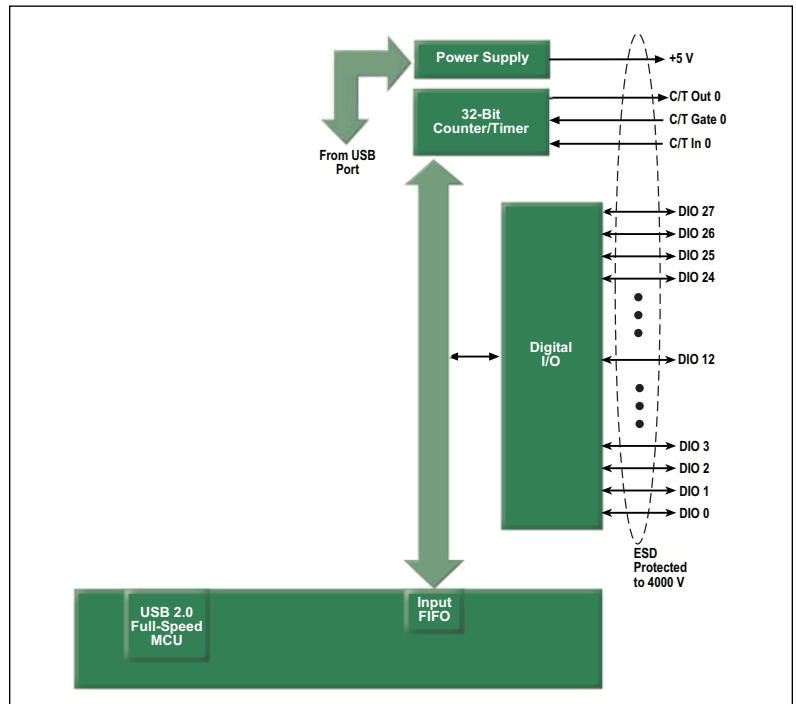
**Figure 27.** This block diagram shows 6 separate A/D's and all the functional signals of the DT9816 and DT9816-A USB modules for performing analog I/O, digital I/O, and counter/timer operations.

**DT9817 and DT9817-H  
Pin Assignments**

**DT9817 and DT9817-H  
Screw Terminal Assignments**

Screw	Signal Terminal	Screw	Signal Terminal
20	USB +5 V Out	40	Reserved
19	Ground	39	Reserved
18	Counter 0 In	38	Ground
17	Counter 0 Out	37	Digital I/O 15
16	Counter 0 Gate	36	Digital I/O 14
15	Ground	35	Digital I/O 13
14	Digital I/O 27	34	Digital I/O 12
13	Digital I/O 26	33	Digital I/O 11
12	Digital I/O 25	32	Digital I/O 10
11	Digital I/O 24	31	Digital I/O 9
10	Reserved	30	Digital I/O 8
9	Ground	29	Ground
8	Digital I/O 23	28	Digital I/O 7
7	Digital I/O 22	27	Digital I/O 6
6	Digital I/O 21	26	Digital I/O 5
5	Digital I/O 20	25	Digital I/O 4
4	Digital I/O 19	24	Digital I/O 3
3	Digital I/O 18	23	Digital I/O 2
2	Digital I/O 17	22	Digital I/O 1
1	Digital I/O 16	21	Digital I/O 0

**DT9817 and DT9817-H  
Block Diagram**



**Figure 28.** This block diagram shows all the functional signals of the DT9817 and DT9817-H USB modules for performing digital I/O and counter/timer operations.

## A/D Subsystem Specifications

Feature	DT9810 Specifications	DT9812-2.5V Specifications	DT9812-10V, DT9813-10V, DT9814-10V Specifications	DT9816 & DT9816-A Specifications
Number of analog input channels	8 single-ended	8 single-ended	8 single-ended (DT9812-10V) 16 single-ended (DT9813-10V) 24 single-ended (DT9814-10V)	6 single-ended
Number of gains	—	5 (1, 2, 4, 8, 16)	4 (1, 2, 4, 8)	—
Resolution	10-bit	12-bit	12-bit	16-bit
Data encoding	binary	binary	twos complement	twos complement
System accuracy, to % of FSR				
Gain = 1:	0.1%	0.04%	0.04%	±0.02%
Gain = 2:	—	0.06%	0.06%	±0.02%
Gain = 4:	—	0.08%	0.08%	—
Gain = 8:	—	0.10%	0.15%	—
Gain = 16:	—	0.15%	—	—
Range	0 to 2.44 V	0 to 2.44, 1.22 V, 0.61 V, 0.305 V, 0.1525 V	±10 V, ±5 V, ±2.5 V, ±1.25 V	±5 V, ±10 V
Nonlinearity	0.1%	0.05%	0.05%	0.007%
Differential nonlinearity	±1/2 LSB	±1/2 LSB	±1/2 LSB	0.006%
Inherent quantizing error	1 LSB	1 LSB	1 LSB	±2 LSB
Drift				
Zero:	±20 µV/°C	±50 µV/°C	±100 µV/°C	±25 µV/°C
Gain:	±50 ppm/°C	±100 ppm/°C	±100 ppm/°C	±50 ppm/°C
Differential linearity:	monotonic	monotonic	monotonic	monotonic to 14 bits
Input impedance <sup>1</sup>				
Off channel:	10 MΩ, 10 pf	10 MΩ, 10 pf	10 MΩ, 10 pf	—
On channel:	10 MΩ, 100 pf	10 MΩ, 100 pf	10 MΩ, 100 pf	10 MΩ, 10 pf
Input bias current	±10 nA	±10 nA	±10 nA	±10 nA
Maximum input voltage (without damage)				
Power on:	±35 V	±35 V	±35 V	±35 V
Power off:	±20 V	±20 V	±20 V	±20 V
A/D conversion time	40 µs	8 µs	8 µs	4 µs (DT9816-A) 8 µs (DT9816)
Channel acquisition time (±½ LSB)	40 µs	20 µs	20 µs	1 µs
Sample-and-hold				
Aperture uncertainty:	2 ns	2 ns	2 ns	1 ns
Aperture delay:	200 ns	200 ns	200 ns	35 ns
Aperture match:				5 ns
Gain match:				0.05%
Zero match:				±3.0 mV
Throughput	25 kHz aggregate	50 kHz aggregate	50 kHz aggregate	50 kHz per channel (DT9816) 150 kHz per channel (DT9816-A)
ESD protection (per spec)				
Arc:	8 kV	8 kV	8 kV	8 kV
Contact:	4 kV	4 kV	4 kV	4 kV
Reference	2.44 V	2.44 V	2.5 V	2.5 V
Monotonicity	Yes	Yes	Yes	to 14 bits
Sample Clock				
Internal:	Yes	Yes	Yes	Yes
External:	No	Yes	Yes	Yes
Trigger Source				
Internal:	Yes	Yes	Yes	Yes
External:	No	Yes	Yes	Yes

<sup>1</sup> Very high input impedance minimizes any source error.

## D/A Subsystem Specifications

Feature	DT9812-2.5V Specifications	DT9812-10V, DT9813-10V, DT9814-10V Specifications
Number of waveform analog output channels	2	2
Resolution	12-bit	12-bit
Data encoding	Binary	Twos complement
Nonlinearity	0.05%	0.05%
Differential nonlinearity	± 1 LSB	±1 LSB
Inherent quantizing error	1 LSB	1 LSB
Output range	0 to 2.44 V	±10 V
Error		
Zero:	±1 mV	±4 mV
Gain:	±0.1%	±0.2%
Drift		
Zero (bipolar):	±20 $\mu$ V / <sup>o</sup> C	±100 $\mu$ V / <sup>o</sup> C
Gain:	±100 ppm	±100 ppm
Throughput		
Waveform generation mode:	50 kHz	50 kHz
Continuously paced analog output mode:	50 kHz	50 kHz
FIFO <sup>1</sup>	2048	2048
Current output	±2 mA	±2 mA
Output impedance	<200 $\Omega$	<0.2 $\Omega$
Capacitive driver capability	1000 pF minimum	1000 pF minimum
Protection	Short to ground	Short to ground
Power-on voltage	0 V ±5 mV	0 V ±10 mV
Settling time to 0.01% of FSR	20 $\mu$ s	20 $\mu$ s
Slew rate	2 V / $\mu$ s	2 V / $\mu$ s
Glitch energy	1 $\mu$ V -sec	1 $\mu$ V -sec
ESD protection (per spec)		
Arc:	8 kV	8 kV
Contact:	4 kV	4 kV
Monotonicity	Yes	Yes
Output Clock		
Internal:	Yes	Yes
External:	No	No
Trigger Source		
Internal:	Yes	Yes
External:	No	No

<sup>1</sup> FIFO is used for both A/D and D/A on the module.

## DIN/DOUT Subsystem Specifications

Feature	DT9810 Specifications	DT9812-2.5V, DT9812-10V, DT9813-10V Specifications	DT9816 and DT9816-A Specifications	DT9817 and DT9817-H Specifications
Number of digital I/O lines	20 programmable	16 (8 in/8 out) DT9812-10V 8 (4 in/4 out) DT9813-10V	16 (8 in/8 out)	28 programmable
Number of ports	2, 8-bit and 1, 4-bit	2, 8-bit/2, 4-bit	2, 8-bit	3, 8-bit and 1, 4-bit
Input termination	No	No	No	No
Logic family	TTL	TTL	TTL	TTL
Logic sense	Positive true	Positive true	Positive true	Positive true
Inputs				
Input type:	Level sensitive	Level sensitive	Level sensitive	Level sensitive
Input logic load:	1 TTL Load	1 TTL Load	1 TTL Load	1 TTL Load
High input voltage:	2.4 V min	2.4 V min	2.4 V min	2.4 V min
Low input voltage:	0.8 V max	0.8 V max	0.8 V max	0.8 V max
Low input current:	-0.4 mA max	-0.4 mA max	-0.4 mA max	-0.4 mA max
Outputs				
Fan out:	12 mA	12 mA	12 mA	12 mA
High output:	2.8 V min	2.8 V min	2.8 V min	2.8 V min
Low output:	0.6 V max	0.6 V max	0.6 V max	0.6 V max
High output current (source):	2 mA	2 mA	2 mA	4.5 mA (DT9817) 15 mA (DT9817-H)
Low output current (sink):	10 mA	10 mA	10 mA	10 mA (DT9817) 64 mA (DT9817-H)
Software I/O selectable	Yes	No	Yes	Yes
ESD protection (per spec)				
Arc:	8 kV	8 kV	8 kV	8 kV
Contact:	4 kV	4 kV	4 kV	4 kV

**C/T Subsystem Specifications**

<b>Feature</b>	<b>DT9810, DT9812-2.5V, DT9812-10V, DT9813-10V, DT9814-10V, DT9817 and DT9817-H Specifications</b>	<b>DT9816 and DT9816-A Specifications</b>
Number of counter/timers	1	1
Resolution	32-bit	16-bit
Counter/timer modes	Event counting, frequency measurement, edge-to-edge measurement, rate generation	Event counting, frequency measurement, rate generation (square wave out)
Minimum pulse width (minimum amount of time it takes a C/T to recognize an input pulse)	200 ns	200 ns
Logic family	TTL	TTL
Inputs	Level sensitive	Level sensitive
Input logic load:	1 TTL Load	1 TTL Load
High input voltage:	2.4 V min	2.4 V min
Low input voltage:	0.8 V max	0.8 V max
Low input current:	-0.4 mA max	-0.4 mA max
Outputs		
Fan out:	12 mA	12 mA
High output:	2.8 V min	2.8 V min
Low output:	0.6 V max	0.6 V max
High output current (source):	2 mA	2 mA
Low output current (sink):	12 mA	12 mA
ESD protection (per spec)		
Arc:	8 kV	8 kV
Contact:	4 kV	4 kV
Internal clock frequency	4 Hz to 12 MHz (15 Hz to 12 MHz for DT9812-2.5 V and DT9812-10 V)	4 Hz or 12 MHz
External clock divider	2 to 130050 (2 to 65536 for DT9812-2.5V and DT9812-10V)	—

**External Trigger Specifications\***

<b>Feature</b>	<b>Specifications</b>
Trigger sources	
Internal:	Software initiated
External:	Software selectable
Input type	Low-level or falling-edge sensitive
Logic family	TTL
Inputs	Level sensitive
Input logic load:	1 TTL Load
High input voltage:	2.4 V min
Low input voltage:	0.8 V max
Low input current:	-0.4 V mA max
Minimum pulse width	
High:	200 ns
Low:	200 ns
Triggering modes	
Single scan:	Yes
Continuous scan:	Yes

\* External trigger available on the DT9812-2.5V, DT9812-10V, DT9816 and DT9816-A modules for analog input operations only.

**External Clock Specifications\***

Feature	Specifications
Input type:	Edge sensitive
Logic family:	TTL
Inputs:	
Input logic load:	Level sensitive
Input termination:	1 TTL Load
High input voltage:	2.4 V min
Low input voltage:	0.8 V max
Low input current:	-0.4 mA max
Oscillator frequency:	40 kHz max
Minimum pulse width	
High:	200 ns
Low:	200 ns

\* External clock available on the DT9812-2.5V, DT9812-10V, and DT9816 modules for analog input operations only.

**Power, Physical, and Environmental Specifications**

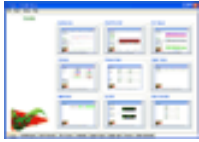
Feature	DT9810, DT9817 and DT9817-H Specifications	DT9812-2.5V Specifications	DT9812-10V, DT9813-10V, DT9814-10V Specifications	DT9816 and DT9816-A Specifications
Power +5 V Enumeration Operation Operation	<100 mA <100 mA (DT9810) <150 mA (DT9817) <500 mA (DT9817-H)	<100 mA <100 mA	<100 mA <175 mA	<100 mA <250 mA
Physical Weight (board): Weight (box with screw terminals and feet):	60.3 g 133.4 g	65.3 g 138.4 g	65.3 g 138.4 g	65.8 g 138.8 g
Physical Dimensions (board): Dimensions (box with screw terminals and feet):	100 mm (L) x 100 mm (W) x 15.5 mm (H) 107.7 mm (L) x 100 mm (W) x 33.5 mm (H)			
Environmental* Operating temperature range: Storage temperature range: Relative humidity:	0 to 55° C -40° to 85° C to 95% non-condensing			

Specifications at 25° C.

## Creating Custom Applications

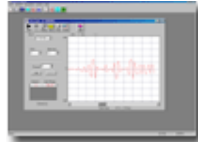
The **GO! application** provides an easy-to-use solution for measuring signals right out of the box! If, you'd rather create your own application, the ECONseries is fully DT-Open Layers-compliant, allowing users of all levels - from programmers to application users - the ability to create a program for the ECONseries. The following software choices are available:

## Options for Solution Development



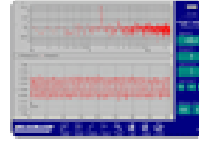
### GO!

8 mini-instruments,  
no programming



### Quick DataAcq

Ready-to-measure,  
source code  
included



### Scope

Chart recording  
& multi-channel  
oscilloscope  
functions



### DTx-EZ

Free Visual  
Studio  
Development  
Tools



### DT Measure Foundry

Graphical  
programming,  
drag & drop  
no code, no wires

- **Quick Data Acq** allows you to collect your displays and save your data to disk. Source code included.
- Run the **Scope** application with any DT-Open Layers data acquisition board for chart recording, data logging, and multi-channel oscilloscope functions.
- For Microsoft® Visual Basic and Visual C++ programmers, **DTx-EZ** provides ActiveX controls that allow quick and easy development of test and measurement applications.
- For nonprogrammers, an evaluation version of **DT Measure Foundry** is available. DT Measure Foundry is a powerful visual software environment for creating test and measurement, control, and analysis applications. By dragging and dropping instrument-like components, called panels, on to your worksheet and configuring their property pages, you can develop powerful applications quickly. No programming or wiring is required!
- The Data Acquisition Software Development Kit (**SDK**) is also available if you'd prefer to call API-level functions in Microsoft C to access DT-Open Layers features.

If you are looking for additional software solutions, the following

application is available as a free download on our website.

- For LabVIEW programmers, **DT-LV Link** provides a collection of Virtual Instruments (VIs) that give you the ability to access the functions of the ECONseries modules through LabVIEW.

### Cross-Series Compatibility Saves Programming Time, Protects Your Investment

Virtually all Data Translation data acquisition boards, including the ECONseries, are compatible with the DT-Open Layers 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 programming is needed. For example, if you are currently using a DT300 board on a PCI bus, upgrading to a ECONseries module on the USB bus is simple - just load and configure the new driver and you're done.

### ECONseries User Manuals

Each ECONseries module includes a getting started and user's manual. Manuals are provided in electronic (PDF) format on the ECON CD that is shipped with the module. You can also purchase hard copies, if desired.

### Technical Support

Extensive information, including drivers, example code, pinouts, a searchable Knowledgebase, and much more, is available 24 hours a day on our web site at [www.datatranslation.com](http://www.datatranslation.com).

You can also contact Technical Support through email at [tsupport@datx.com](mailto:tsupport@datx.com) with any questions.

### Ordering Summary

#### ECONseries Modules

- DT9810
- DT9812-2.5V
- DT9812-10V
- DT9813-10V
- DT9814-10V
- DT9816
- DT9816-A
- DT9817
- DT9817-H

#### System Requirements

- Windows 2000/XP Professional Edition operating system.
- USB Ports - one or more (version 2.0 or 1.1).
- CD-ROM drives - one or more.

#### Software

All software, including the GO! Application, is provided on the ECON CD that ships with the module.

#### Accessories

- DIN Mount Kit

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