

DT9818

Isolated, Embedded USB Data Acquisition Module

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The DT9818 combines the functionality of multiple boards in a single USB 2.0 module to provide simultaneous analog input, analog output, digital I/O, and counter/timer operations. The DT9818 module features up to 32 single-ended or 16 differential analog input channels; depending on the model selected. All analog input signals are multiplexed to a single analog-to-digital converter. The DT9818 supports sampling rates of up to 150 kSamples/s with 16-bit resolution. Four programmable gains (1, 2, 4, and 8) are provided to support input signal ranges of ± 10 V, ± 5 V, ± 2.5 V, and ± 1.25 V for each individual channel.

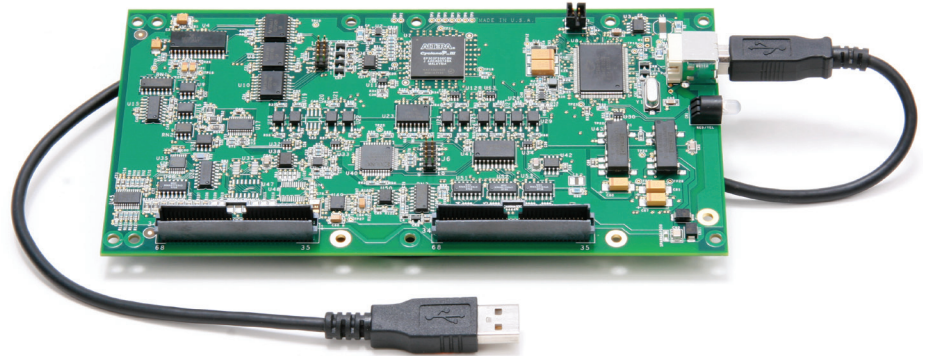


Figure 1. The DT9818 is a high performance, isolated data acquisition module that can be readily embedded in industrial or laboratory applications. It allows synchronous or asynchronous operation for all the analog, digital, and counter/timer functions, while running off USB power.

Key Features:

- **Board-level OEM version...** embed in custom applications
- **500 V galvanic isolation...** prevents ground loops, maximizes analog signal integrity, and protects the computer
- **Runs on USB power...** ideal for portable applications... no external power supply needed
- **Simultaneous operation** of analog input, analog output, digital I/O, and counter/timer subsystems... no restrictions
- **16-bit resolution**, 150 kHz throughput on both the A/D and D/A
- **Up to 32 SE or 16 DI** analog input channels
- **Two deglitched analog outputs** for smooth waveform generation... less than 1.0 nV-sec glitch energy
- **8 digital input/output lines** clocked synchronously at the analog input/output rate
- **Two 32-bit counter/timer channels** acquired/read synchronously at the analog input rate
- **Independent clock** sources (internal and external) for pacing analog inputs and analog outputs
- **Independent trigger** sources (internal and external) for starting analog input and analog output operations
- **Flexible acquisition modes** (single value, continuous, and triggered scan) for input operations, and flexible output modes (single value, continuous, and waveform generation) for output operations
- **High-speed USB** data at rates up to 480 Mbps
- **Many software choices available** for application development... from ready-to-measure programs like Measurement Applets and quickDAQ to full graphical programming with Measure Foundry®

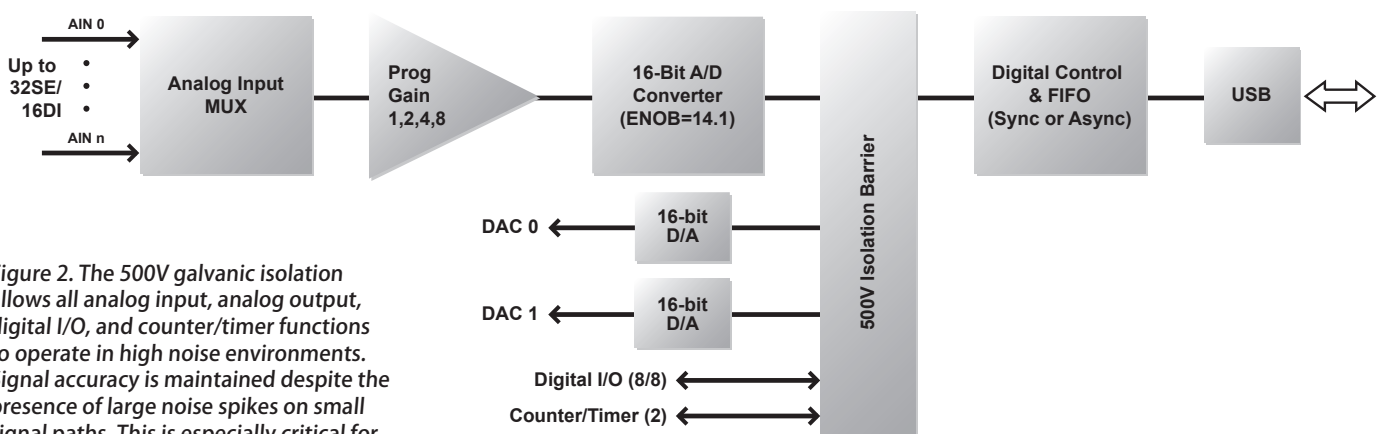


Figure 2. The 500V galvanic isolation allows all analog input, analog output, digital I/O, and counter/timer functions to operate in high noise environments. Signal accuracy is maintained despite the presence of large noise spikes on small signal paths. This is especially critical for embedded applications.

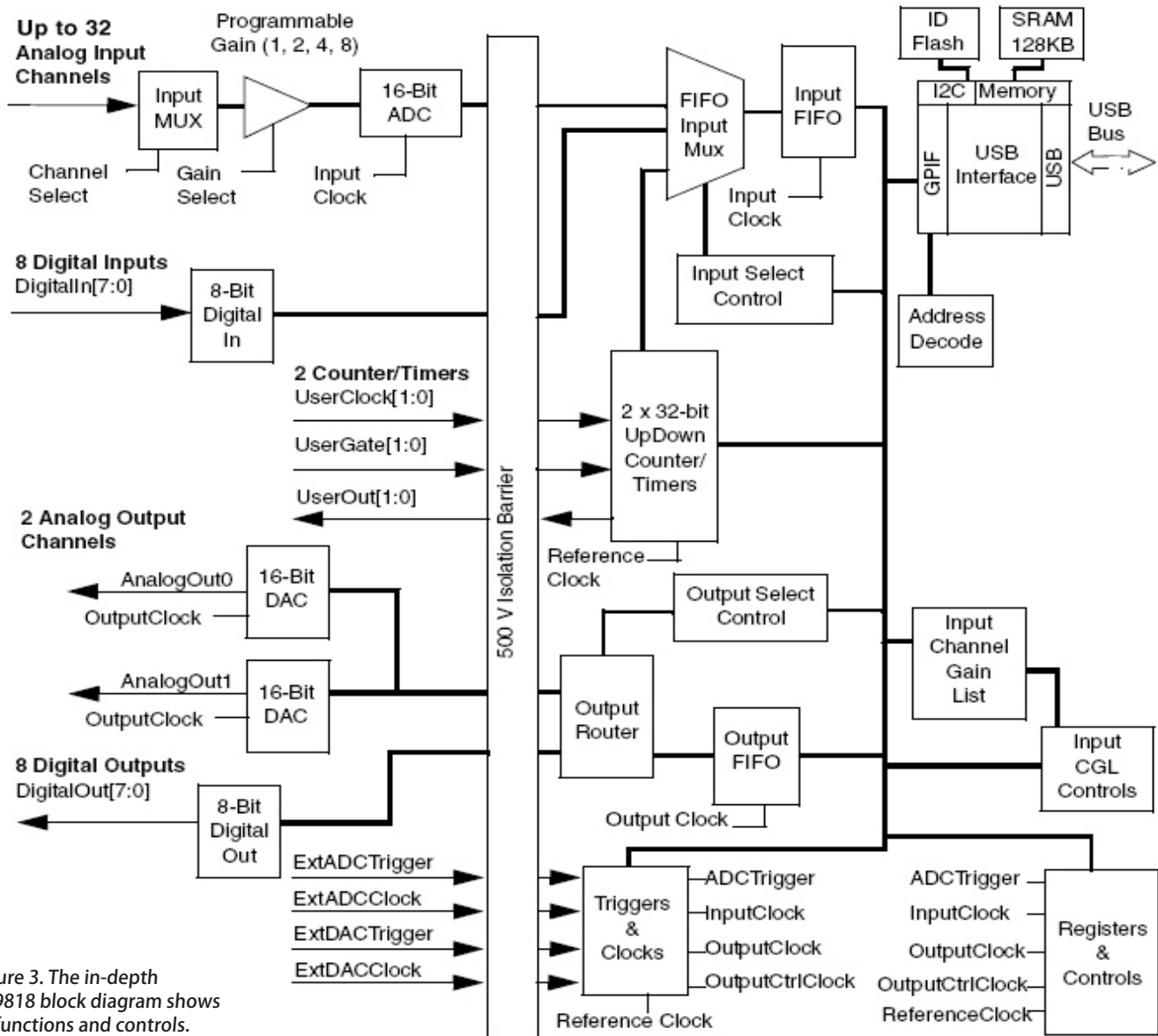


Figure 3. The in-depth DT9818 block diagram shows all functions and controls.

For embedded applications, helpful connection panels are available. Figure 4 shows DIN type mass terminations, while Figure 5 shows screw terminal terminations.

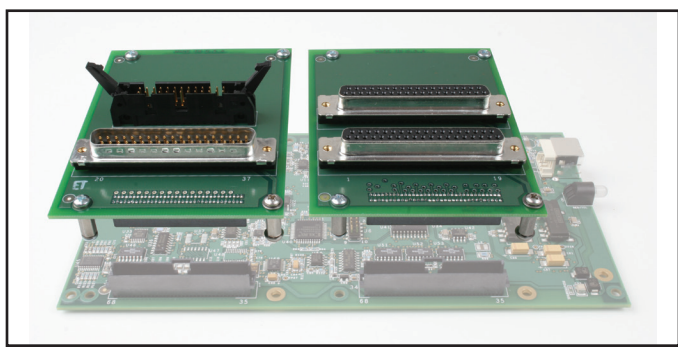


Figure 4. This example shows an EP353 accessory panel, which plugs into connector J2, and an EP356 accessory panel, which plugs into J3.

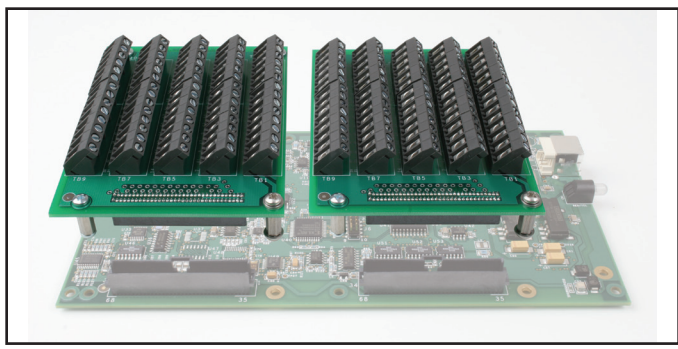


Figure 5. The EP355 screw terminal panel plugs into the J2 or J3 connector of a DT9818 module.

Uncompromised, High-Integrity Performance

Clean Signal Connection...
Up to 32 high-speed analog input channels

Ultra Digital I/O...
Full digital I/O flexibility for pattern generation and synchronizing with external events

Full-Featured Counter/ Timers... Two 32-bit counter/timers ideal for automotive testing applications

Pure Signal Generation...
Two waveform deglitched DACs

External Control...
Flexible clocks and triggers

High Throughput...
Fast settling instrumentation amplifier maintains high-speed while switching channels

Precision Measurements...
True 16-bit resolution at 150kHz throughput for measuring dynamic signals

Fully Protected...
500V galvanic isolation protects your computer and maintains signal integrity

No Limits...
Full simultaneous operation of all subsystems

Designed for Low Noise...
Multi-layer PCB provides optimal grounding and shielding to maintain signal integrity

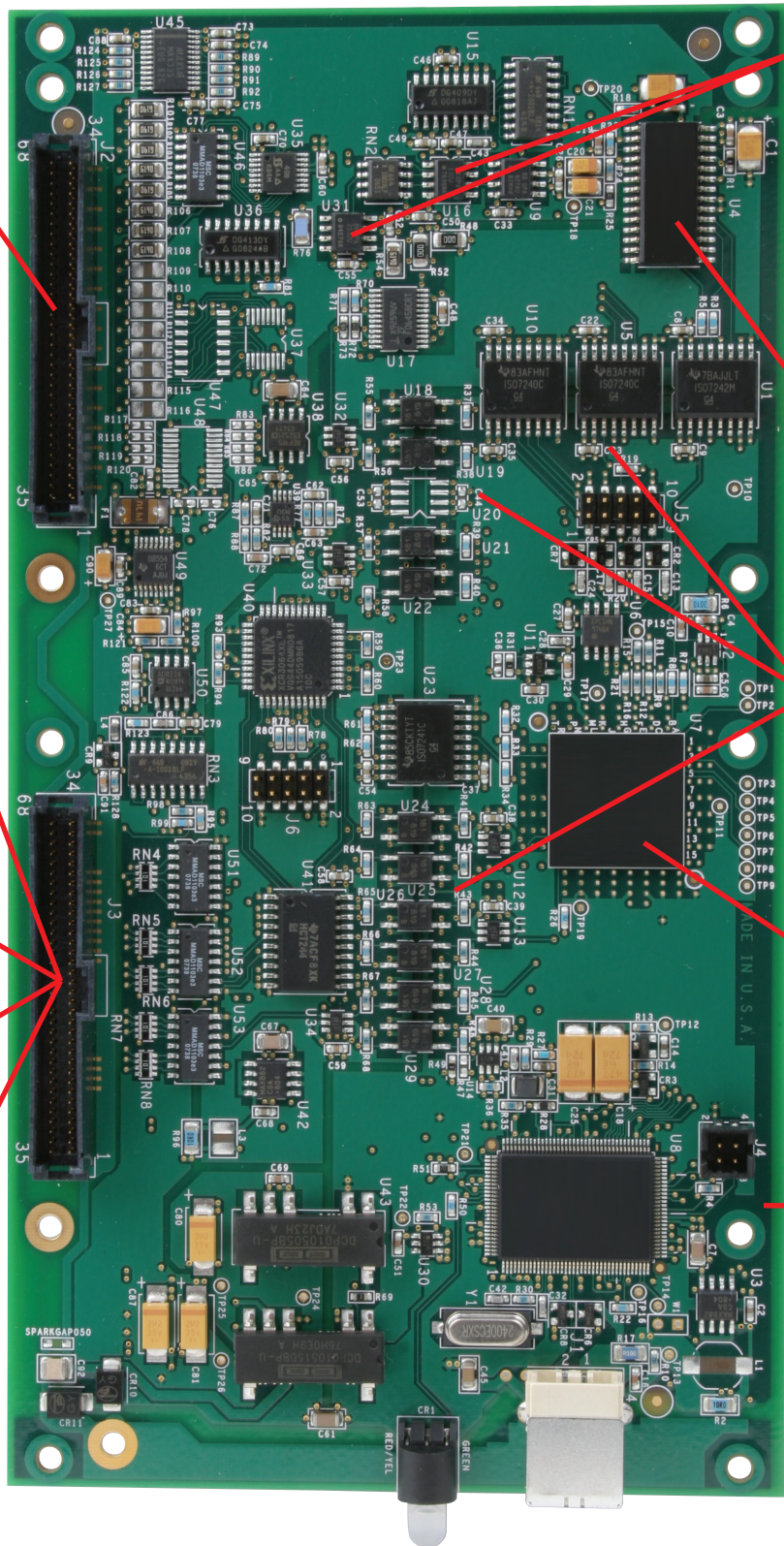


Figure 6. DT9818 board-level OEM version can be embedded into custom applications.

Flexible Acquisition Modes... Using The Input Channel-Gain List

The DT9818 module can acquire data from one or more analog input channels using an input channel-gain list. A 1024-location channel-gain list allows great flexibility in configuring channels, sample rates, and gains. For example, it permits sampling non-sequential analog input channels, analog input channels with different gains, and digital inputs and counter/timer channels with the analog input channels at the A/D sample rate.

All input channels can be entered in the input channel-gain list (CGL), as shown in Table 1.

For each entry in the input channel-gain list, specify the channel to sample and the gain to apply to that channel. Channels in an input channel-gain list are sampled in order from the first entry to the last entry in the list. Channel numbering is zero-based; that is, the first entry in the input channel-gain list is entry 0, the second entry is entry 1, and so on.

The DT9818 module provides two ways to cycle through the channel-gain list:

- Continuous scan mode** – Choose this mode to accurately control the period between conversions of individual channels in the channel-gain list.
- Triggered scan mode** – Choose this mode to accurately control both the period between conversions of individual channels in the channel-gain list and the period between each scan. This mode emulates a sample-and-hold function and is useful when synchronizing or controlling external equipment, or when acquiring a buffer of data on each trigger. Using this mode allows acquisitions of up to 262,144 samples per trigger (256 times per trigger x 1024-location channel-gain list).

Channel List Entry	Channel	Gain	Operation	Description
0	4	1	AIN4	Read analog input channel 4 using a gain of 1 (input range $\pm 10V$).
1	5	2	AIN5	Read analog input channel 5 using a gain of 2 (input range $\pm 5V$).
2	4	1	AIN4	Read analog input channel 4 using a gain of 1 (input range $\pm 10V$).
3	6	4	AIN6	Read analog input channel 6 using a gain of 4 (input range $\pm 2.5V$).
4	16	1	DIN ^a	Read the digital input port.
5	17	1	C/T0 ^b	Read the lower 16-bit word of counter/timer 0.
6	18	1	C/T0 ^b	Read the upper 16-bit word of counter/timer 0.
7	19	1	C/T1 ^c	Read the lower 16-bit word of counter/timer 1.
8	20	1	C/T1 ^c	Read the upper 16-bit word of counter/timer 1.
⋮	⋮	⋮	⋮	⋮
1023	0	8	AIN0	Read analog input channel 0 using a gain of 8 (input range $\pm 1.25V$).

- To read the digital input port, specify channel 16
- To read C/T0, specify channel 17 to read the lower 16-bit word and channel 18 to read the upper 16-bit word of the 32-bit counter.
- To read C/T1, specify channel 19 to read the lower 16-bit word and channel 20 to read the upper 16-bit word of the 32-bit counter.

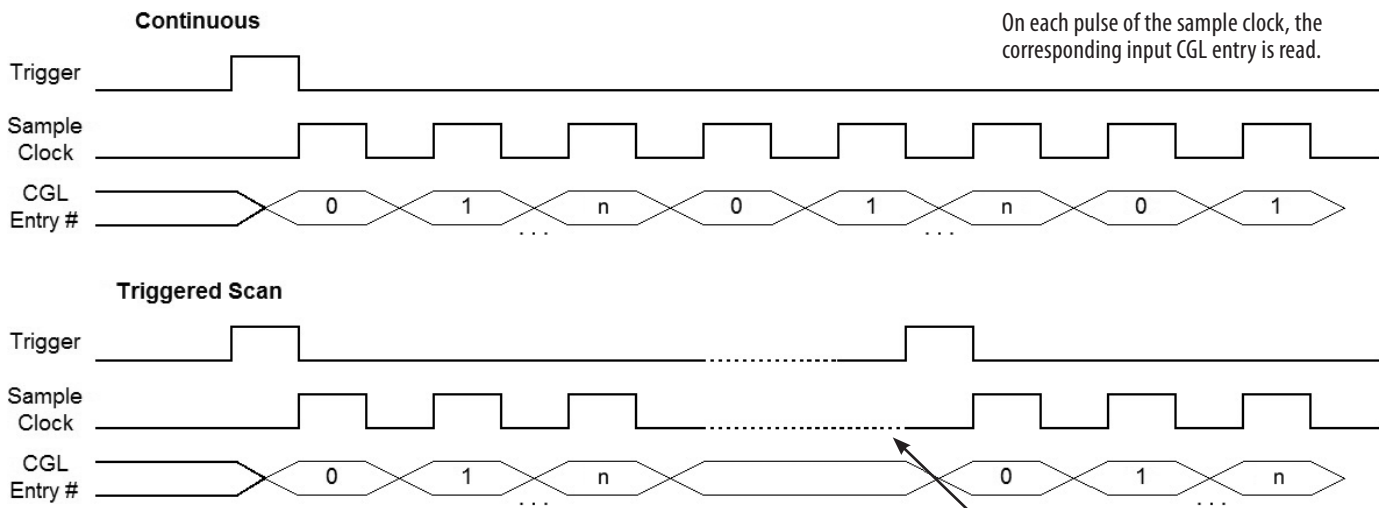


Figure 7. Timing Diagram for Continuous Input and Triggered Scan Operations.

Flexible Output Modes... Using The Output Channel-Gain List

The DT9818 module provides a great deal of flexibility in the output of analog and digital signals. For example, output a single value from a single analog output channel or multiple values from multiple analog output channels. An output-channel list gives the flexibility of updating only the analog output channels desired or updating the digital output lines with specified analog output channels at the D/A clock rate. Analog output channels can be updated at up to 150 kSamples/s.

All output channels can be entered in the output channel-gain list (CGL), as shown in Table 2. The output channel-gain list is fixed at 3 entries.

Channel List Entry	Channel	Gain	Operation	Description
0	0	1	DAC 0	Update DAC 0.
1	1	1	DAC 1	Update DAC 1.
2	2	1	Digital Output Port ^a	Updated the digital output port.

a. To update the digital output port, specify channel 2.

The DT9818 module features the following output modes:

- **Continuous output mode** – Choose this mode to accurately control the period between conversions of individual output channels in the output-channel list.
- **Waveform mode** – Choose this mode to output waveforms repetitively from an output FIFO on the module. Using waveform mode, multiple channels can be updated at up to 150 kSamples/s.

Using software, specify the values to output to each channel using a buffer of up to 16K bytes. Figure 8 shows the timing diagrams for continuous output and waveform operations.

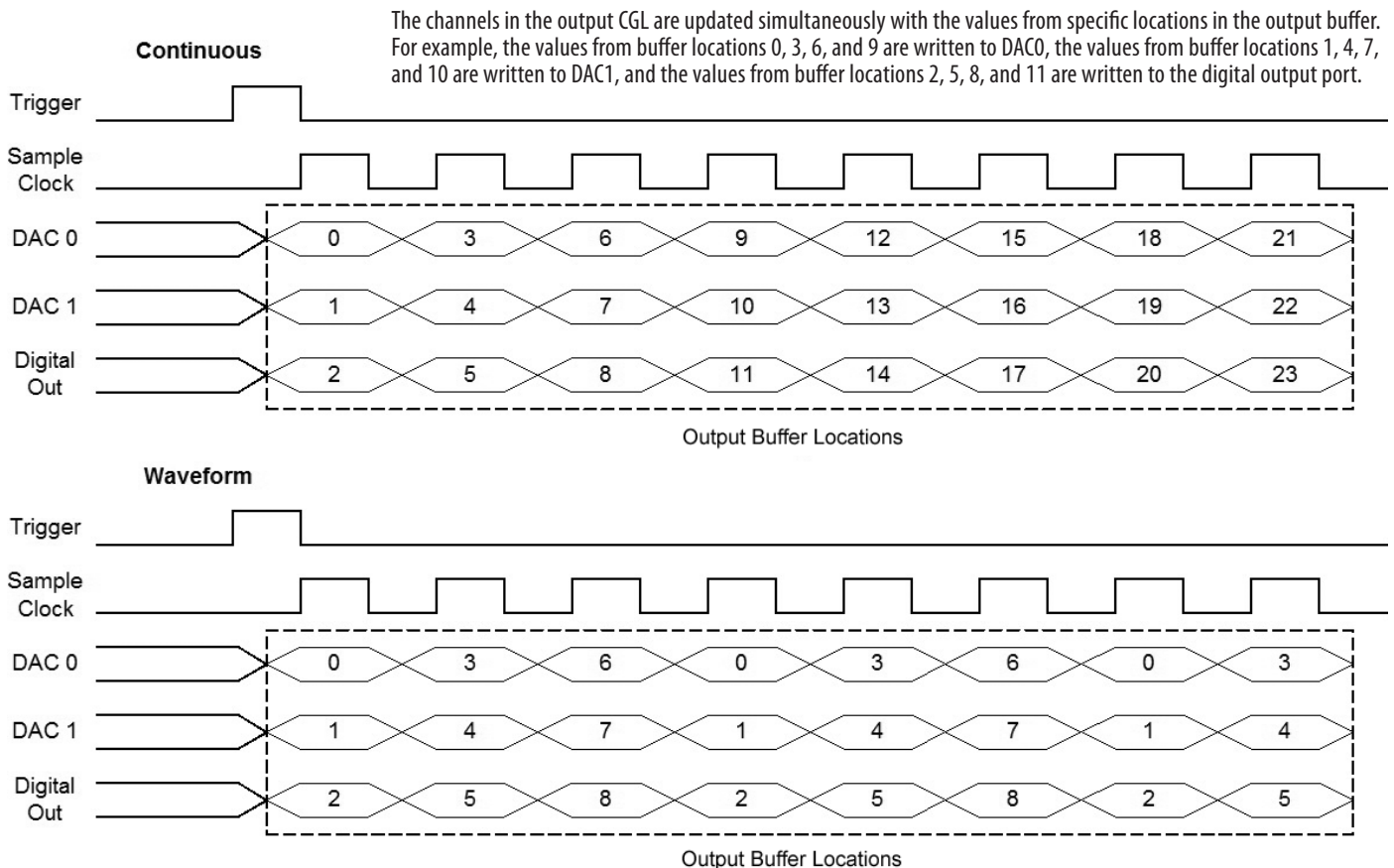


Figure 8. Timing Diagram for Continuous Output and Waveform Generation Operations.



Figure 9. The DT9818 is also available in a BNC boxed version that houses the DT9818-OEM board. This model is useful for OEM prototypes and end-user applications. Models are: DT9818-16SE-BNC for a single-ended analog input configuration, and the DT9818-8DI-BNC for differential inputs.

High-Speed Digital I/O Lines

DT9818 module features one digital input port, consisting of 8 digital input lines and one digital output port, consisting of 8 digital output lines. The resolution is fixed at 8-bits.

The following digital I/O operation modes are available:

- **Single-value operations** are the simplest to use but offer the least flexibility and efficiency. Use software to specify the digital I/O port and a gain of 1 (the gain is ignored). Data is then read from or written to all the digital I/O lines. For a single-value operation, a clock or trigger source cannot be specified. Single-value operations stop automatically when finished.
- **Continuous digital I/O** takes full advantage of the capabilities of the DT9818 module. Simply specify a clock source, scan mode, trigger source, buffer, and buffer wrap mode for the operation.
 - **Digital input** – For digital input operations, enter the digital input port (all 8 digital input lines) as channel 16 in the input channel-gain list. The input sample clock (internal or external) paces the reading of the digital input port (as well as the acquisition of the analog input and counter/timer channels).
 - **Digital output** – For digital output operations, enter the digital output port (all 8 digital output lines) as channel 2 in the output channel-gain list. The output clock (internal or external) paces the update of the digital output port (as well as the update of the analog output channels).

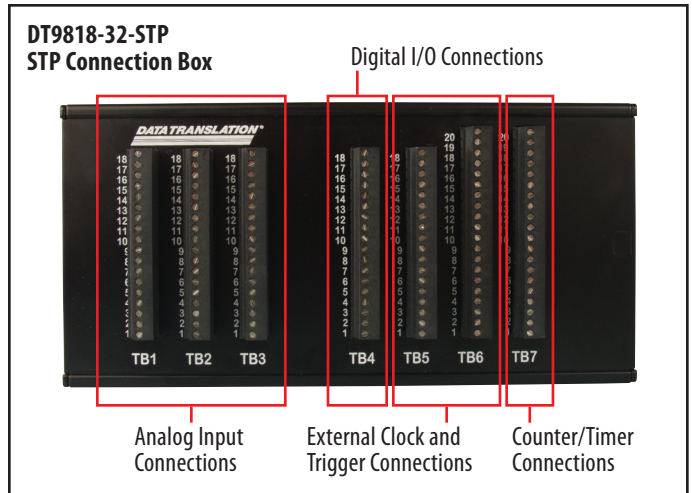


Figure 10. The DT9818-32-STP is an STP boxed version allowing access to all I/O connections through screw terminals.

High-Speed, High-Resolution Analog Outputs

The DT9818 module provides two streaming analog output channels. Each analog output channel has its own digital-to-analog converter and provides an output signal range of ± 10 V. A maximum update rate of 150 kSamples/second with 16-bit resolution is standard. Ultra-smooth waveforms can be produced with less than 1.0 nV-sec glitch energy from the D/As. For gap-free simultaneous stimulus and response, the analog output channels can be updated as the analog input data is acquired. In addition, you can update the digital output lines with the analog output channels at the analog output rate.

Multifunction Counter/Timers

The DT9818 module features two 32-bit user counter/timers. If desired, read the value of the counter/timer channels with the analog input channels and digital input lines at the A/D clock rate. The following counter/timer functions are supported: event counting, up/down counting, frequency measurement, edge-to-edge measurement, continuous edge-to-edge measurement (for determining the frequency and period width of a signal), rate generation, one-shot, and repetitive one-shot operations. To read the period of a signal as part of the analog input data stream, use continuous edge-to-edge measurement mode. Programmable gates, clocks, and output signals are also supported.

ENOB... The Accuracy Figure of Merit...

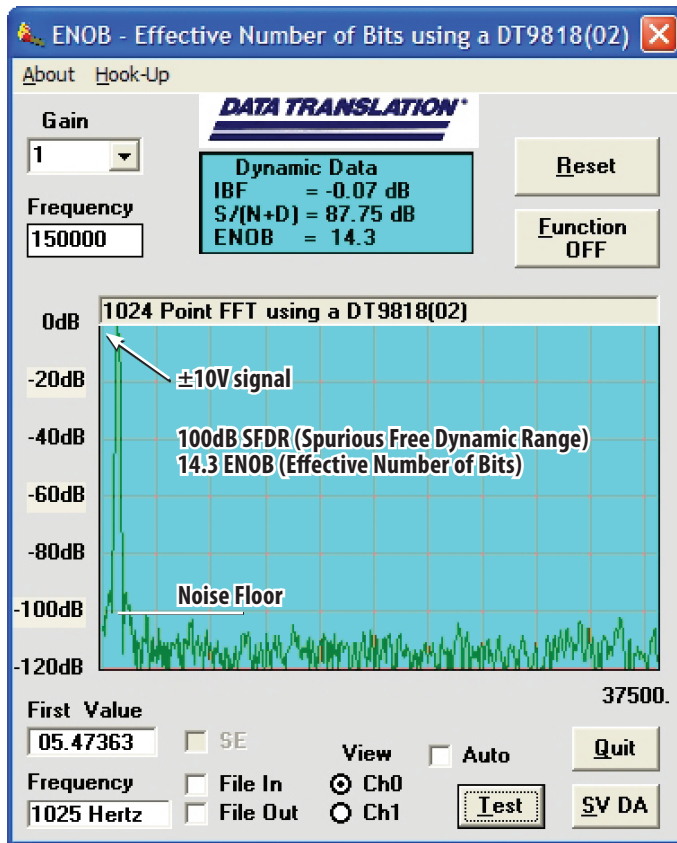


Figure 11. The ENOB program has a 1kHz sine wave on channel 0 with a signal level 0.06db below full scale and channel 1 is tied to ground or zero volts. (Full scale is $\pm 10V$). The program is scanning both channels at a 150kHz rate. The actual sampling rate of channel 0 would then be 75kHz for a Nyquist Frequency of 37.5kHz as shown in the graph for channel 0. An FFT is computed on channel zero and displayed. The signal to noise plus distortion is 87.75dB for an Effective Number of Bits of 14.3. The primary component on the left side of the chart is the DC component of the signal.

Flexible Clocks and Triggers

For maximum flexibility, the DT9818 module provides independent clocks and triggers for the A/D and D/A subsystems. This allows the analog output subsystem to be triggered and clocked synchronously with, or independent of, the analog input subsystem. Each subsystem supports an internal clock and external clock input, as well as the following trigger types: software command and external digital input trigger.

USB 2.0 Compatibility

The DT9818 module is fully compatible with USB 2.0 and USB 1.1. USB 2.0 extends the speed of connection to up to 480 Mbps. For optimal performance, it is recommended that you use the DT9818 module with a USB 2.0 port. The DT9818 Series can be used with a USB 1.1 port, but at USB 1.1 performance. The DT9818 is a complete high speed, 16-bit data acquisition system that runs on USB power only. No special power requirements.

500 V Galvanic Isolation Protects Your Data

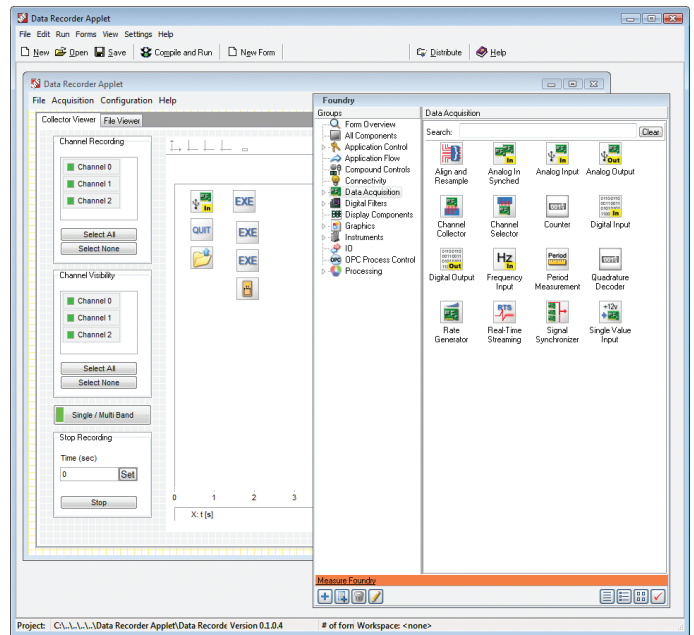
Computers are susceptible to ground-spikes through any external port. These spikes can cause system crashes and may even cause permanent damage to the computer. The DT9818 module features 500 Volts of galvanic isolation to protect the computer from ground-spikes and to ensure a reliable stream of data.

Software Options

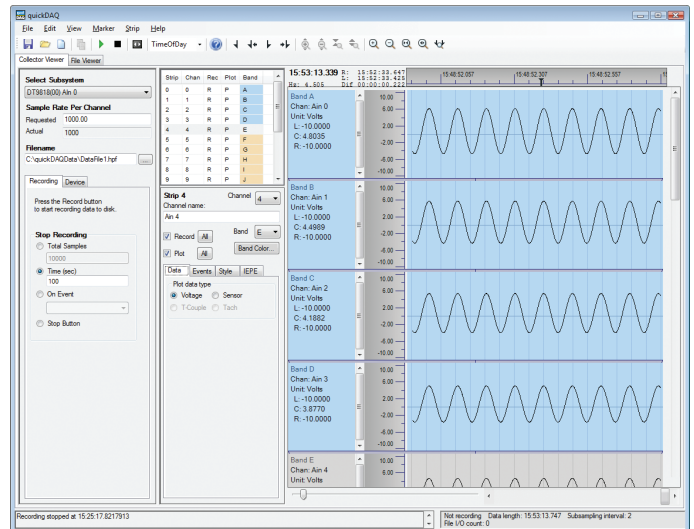
Many software choices are available for application development, from ready-to-measure applications to programming environments.

The following software is available for use with USB modules and is provided on the Data Acquisition Omni CD:

- DT9818 Device Driver** – The device driver allows the use of a DT9818 module with any of the supported software packages or utilities.
- Measure Foundry®** – An evaluation version of this software is included on the Data Acquisition Omni CD. Measure Foundry® is a drag-and-drop test and measurement application builder designed to give top performance with ease-of-use development.
- Measurement Applets** – Included in the Measure Foundry evaluation version. These small applications, developed with Measure Foundry, can be modified or combined to provide a specific solution. Order the full development version of Measure Foundry to develop applications using real hardware.
- quickDAQ application** – An evaluation version of this .NET application is included on the Data Acquisition Omni CD. quickDAQ acquires analog data from all devices supported by DT-Open Layers for .NET software at high speed, plots it during acquisition, analyzes it, and/or saves it to disk for later analysis. *Note: quickDAQ supports analog input functions only. DT9817 and DT9835 modules are DIO only and are not supported.*
- Quick DataAcq application** – The Quick DataAcq application provides a quick way to get up and running using your USB module. Using this application, verify key features of the module, display data on the screen, and save data to disk.
- DT-Open Layers® for .NET Class Library** – Use this class library if you want to use Visual C#® or Visual Basic® for .NET to develop application software for your USB module using Visual Studio® 2003/2005/2008; the class library complies with the DT-Open Layers standard.
- DataAcq SDK** – Use the Data Acq SDK to use Visual Studio 6.0 and Microsoft® C or C++ to develop application software for your USB module using Windows®; the DataAcq SDK complies with the DT-Open Layers standard.
- DTx-EZ** – DTx-EZ provides ActiveX® controls, which allows access to the capabilities of your USB module using Microsoft Visual Basic or Visual C++®; DTx-EZ complies with the DT-Open Layers standard.
- DAQ Adaptor for MATLAB** – Data Translation's DAQ Adaptor provides an interface between the MATLAB® Data Acquisition (DAQ) toolbox from The MathWorks™ and Data Translation's DT-Open Layers architecture.
- LV-Link** – An evaluation version of this software is included on the Data Acquisition Omni CD. Use LV-Link to use the LabVIEW™ graphical programming language to access the capabilities of your USB module.



The data recorder applet is developed with Measure Foundry and allows you to acquire data, plot it, and save it to disk.



quickDAQ acquires analog data from all devices supported by DT-Open Layers for .NET software at high speed, plots it during acquisition, analyzes it, and/or saves it to disk for later analysis.

Cross-Series Compatibility

Virtually all Data Translation data acquisition modules are compatible with the DT-Open Layers for .NET Class Library. 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.

User Manual

The DT9818 module includes a user's manual that provides getting started and reference information about using the DT9818. The manual is provided in electronic (PDF) format on the Data Acquisition Omni CD provided with the module.

Technical Support

Application engineers are available by phone and email during normal business hours to discuss your application requirements. Extensive product information, including drivers, example code, pinouts, a searchable Knowledge Base, and much more, is available 24 hours a day on our web site at www.datatranslation.com.

Accessories for OEM Configurations

For applications where the DT9818 module is embedded in other equipment, the following optional accessories are available:

- EP353 – This accessory panel plugs into connector J2 of a DT9818 module and provides one 37-pin, D-sub connector and one 26-pin connector for attaching analog input signals (see Figure 4).
- EP355 – This screw terminal panel plugs into connector J2 or J3 of a DT9818 module and provides 14-position screw terminal blocks for attaching analog I/O and digital I/O signals. (See Figure 5).
- EP356 – This accessory panel plugs into connector J3 of a DT9818 module and provides two 37-pin, D-sub connectors. You can use one of these connectors to attach analog output, counter/timer, trigger, and clock signals, and the other connector to attach digital I/O signals. (See Figure 4).
- STP37 – This screw terminal panel allows you to connect analog input, digital I/O, analog output, counter/timer, and clock/trigger signals from the EP353 or EP356 screw terminal panel.
- EP333 – 2-meter shielded cable with two 37-pin connectors that connect an EP356 accessory panel to an STP37 screw terminal panel.
- EP360 – 2-meter shielded cable with two 37-pin connectors that connect an EP353 accessory panel to an STP37 screw terminal panel.

For more information about the DT9832 Series, including specifications, please visit: <http://www.datatranslation.com/info/DT9818/>

Ordering Summary

All Data Translation hardware products are covered by a 1-year warranty. For pricing information, please visit our website or contact your local reseller.

USB DAQ Modules

- DT9818-OEM
- DT9818-8DI-BNC
- DT9818-16SE-BNC
- DT9818-32-OEM
- DT9818-32-STP

Accessories

- **BNC DIN Rail Kit** – Kit for mounting USB modules in BNC enclosure to a DIN rail. Includes mounting clips, screws, and instructions. DIN Rail not included.
- **EP333** – 2-meter shielded cable for the EP356 and STP37
- **EP353** – Accessory panel with one 37-pin connector and one 27-pin connector
- **EP355** – Screw terminal panel
- **EP356** – Accessory panel with two 37-pin, D-sub connectors
- **EP360** – 2-meter shielded cable for the EP353 and STP37
- **STP37** – Screw terminal panel

Software

The following software is available for purchase separately:

- **Measure Foundry** (SP1300-CD) – Test and measurement application builder for Windows® XP, Vista, Windows 7.
- **quickDAQ** (SP8501-CD) – High-performance, ready-to-run application that lets you acquire, plot, analyze, and save data to disk at up to 2 MHz per channel.
- **LV-Link** – Access the power of Data Translation boards through LabVIEW™.

Free Software Downloads

The following software is available for free download from our website:

- **DAQ Adaptor for MATLAB** – Access the analyzation and visualization tools of MATLAB®.
- **Measurement Applets**