

# DT9862

## 10 MS/s High-Speed, Isolated Simultaneous USB Data Acquisition Module

### Overview

The DT9862 is a high-speed, high-performance USB data acquisition module that provide throughput rates up to 10 MS/s on one channel, 10 MS/s burst sampling on 2 channels, or 5 MS/s on 2 channels continuously. The DT9862 provides a bandwidth of 10 MHz. Each analog input has its own A/D converter to eliminate phase shift between channels and to allow you to correlate measurements at the exact same instant in time. Each DT9862 Series module also includes three quadrature encoders for measuring absolute and relative position and for detecting rotational speed.

### Key Features

- 2 simultaneous, 16-bit A/D channels
- Sample rates up to 10 MS/s/ch
- $\pm 500$  V galvanic isolation prevents ground loops
- 10 MHz bandwidth
- Two optional 16-bit deglitched D/A channels with sample rates up to 2 MS/s/ch
- Two 32-bit counter/timer, 32 DIO lines
- Three 32-bit quadrature encoders
- Simultaneous subsystem operation: analog input, analog output, digital I/O, counter/timer, and quad encoders
- Compatible with LabVIEW™ and MATLAB®
- Includes free QuickDAQ software to get up and running quickly
- SMA connectors

### Supported Operating Systems

- Windows® 10/8/7/Vista® 32/64-bit

### High-Speed Analog Input Channels

DT9862 modules support two single-ended analog inputs. Each channel features its own 16-bit A/D converter, with sample rates up to 10 MS/s per channel. Using a DT9862 module, data can be acquired from a single analog input channel or from both analog input channels using the analog input channel list.

### Input Sample Clock Sources

The DT9862 module allows the following clock sources to pace analog input operations:

- Internal A/D clock
- External A/D clock



The DT9862 high-speed USB data acquisition module features SMA connectors to ensure signal integrity at maximum sample rate of up to 10 MS/s per channel.

### Maximum Sample Rates and Data Rates to the Host for Various Channel List Configurations

Input Channel List Configuration	Maximum Sample Rate	Maximum Data Rate to Host
Burst Sampling: 2 analog input channels	10 MS/s/ch <sup>1</sup>	28.57 MB/s <sup>1</sup>
1 analog input channel (either channel 0 or channel 1)	10 MS/s/ch	20 MB/s
2 analog input channels	5 MS/s/ch	28.57 MB/s
2 analog in channels + digital in + 2 counter/timers + 3 quad encoders	0.96 MS/s/ch <sup>3</sup>	25 MB/s

<sup>1</sup> Both channels captured in FIFO at 10 MS/s. Max acquire time for 2 analog channels is 3.2768 ms. Sample rate formula: sample rate x number of channels)/1 x 65536. This is a subset of continuous acquire (the number of samples is less than or equal to the size of the input FIFO).

<sup>2</sup> Rates as high as 7.143 MHz have been attained with an optimized system

<sup>3</sup> Sample rate below 1 MS/s can reduce accuracy.

For the complete table of Maximum Sampling Frequencies and Streaming Data Rates to the Host for Various Channel List Configurations, see Appendix E in the DT9862 User's Manual.

### Bandwidth of the DT9862

The DT9862 is a digitizer and provides a bandwidth of 10 MHz. It does not allow for under-sampling. For the DT9862, specify a sampling frequency that is at least twice as fast as the input's highest frequency component (Nyquist sampling theory). For example, to accurately sample a 1 MHz signal, specify a sampling frequency of at least 2 MHz. Doing so avoids an error condition called aliasing, in which high frequency input components erroneously appear as lower frequencies after sampling.

# DT9862-2-2 Board Callouts

## All Power Functions Synchronized

Eliminates "beat" frequencies, minimizes subtle errors in sampling

## ±500 V Galvanic Isolation Barrier Maximizes Signal Integrity

Prevents ground loops, protects computer

## Full Simultaneous Operation and Triggering of all Functions

Analog inputs, analog outputs, DIO, counter/timer, quad encoders

## Synchronous Triggering & Operation for Data Streaming to Host Memory

Via external trigger or internal clock - allows exact data correlation & response of DUT to stimuli

32 Digital I/O, 2 Counter/Timers (32-bit), 3 Quad Encoders (32-bit)

Input/Output Timing and Trigger Control

Input FIFO Holds 64K samples

Output FIFO Holds 128 Ksamples

## 10 Layer PC Board

Includes 4 Layers of Ground Plane for Power and Ground to give noise-free operation

Board Dimensions:  
7.85" (199.34 mm) W  
9.18" (233.17 mm) L  
0.85" (21.59 mm) H

DT9862-2-2 Board

## 2 High-Speed Parallel 16-bit A/D Channels

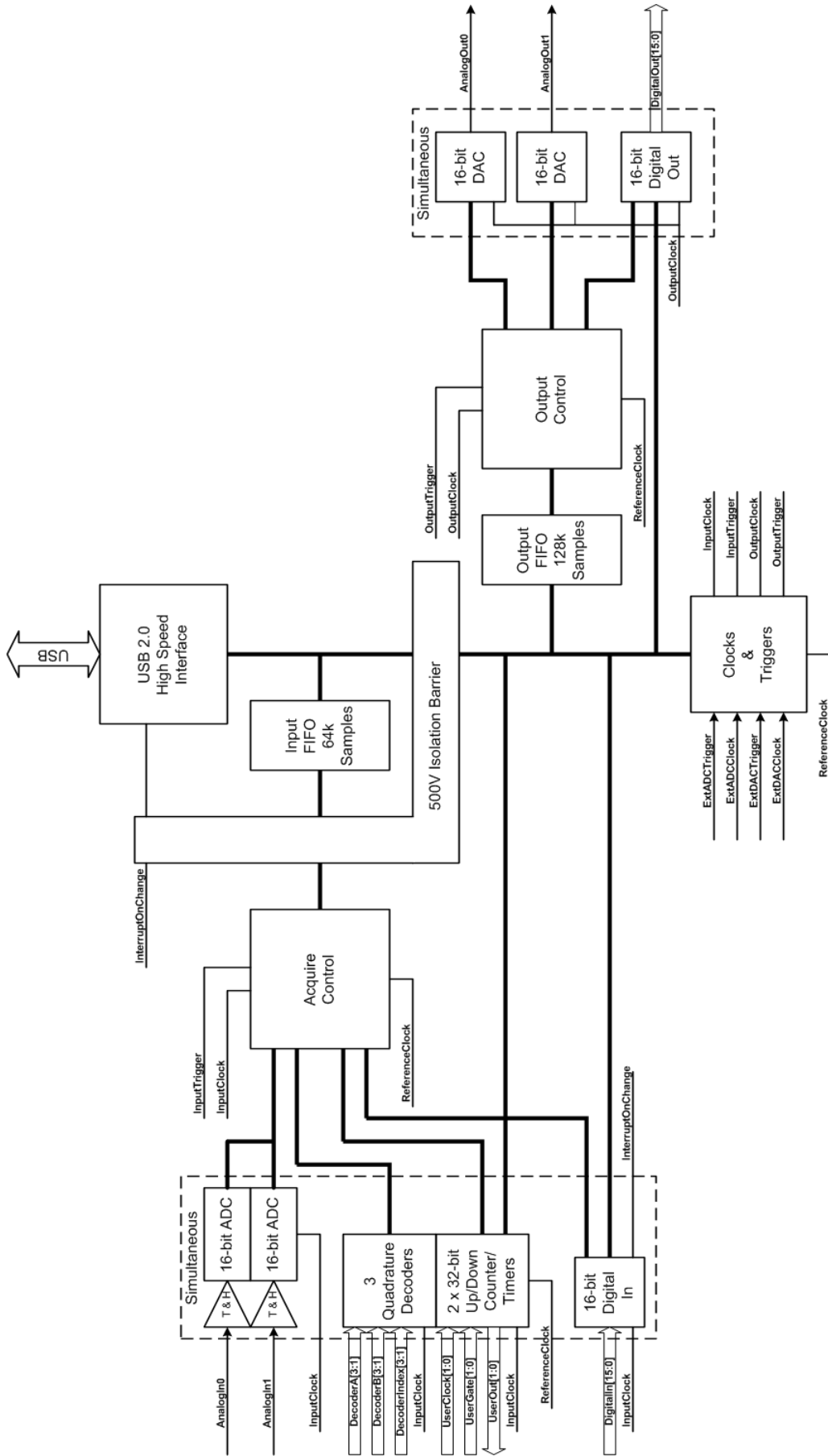
10 MS/s/ch sample rate on a single channel  
5 MS/s/ch sample rate on both channels operating simultaneously, ±2.5 V

## "Screw-on" SMA Connectors for All Analog Inputs and Outputs, Clocks, Triggers

Provides best high frequency characteristics and impedance matching

## 2 Fast Settling, Deglitched 16-bit D/A Channels

2 MHz (500 nS) settling with small step of <100 mV  
500 kS/s (2 uS) sample rate for full scale ±2.5 V



Block Diagram of the DT9862 Module

## Analog Input Conversion Modes

The DT9862 supports the following conversion modes:

- Single-Value Mode
- Continuous Scan Mode

### Single-Value Mode

Single value operations are the simplest to use. Using software, specify the analog input channel to sample. The module acquires the data from the specified channel and returns the data immediately. For a single-value operation, a clock source, trigger source, scan mode, or buffer cannot be specified. Single-value operations stop automatically when finished.

### Continuous Scan Mode

Continuous scan mode takes full advantage of the capabilities of the DT9862 module. Use continuous scan mode to accurately control the period between successive simultaneous conversions of all channels in a channel list. Specify the channel list, clock source, trigger source, scan mode, and buffer using software.

## Input Triggers

A trigger is an event that occurs based on a specified set of conditions. Acquisition starts when the module detects the initial trigger event and stops when all the allocated buffers have been filled or when the operation is stopped.

The DT9862 module supports the following trigger sources:

- Software trigger
- External digital (TTL) trigger
- Analog threshold trigger

## Data Transfer

Before acquisition begins, buffers must be allocated to hold the data. An event is raised whenever a buffer is filled allowing data to be moved and/or processed as needed. Data is written to multiple allocated input buffers continuously; when no more empty buffers are available, the operation stops. The data is gap-free.

## High-Speed, High-Resolution Analog Outputs

The DT9862 module supports up to two 16-bit DC-level analog output channels (depending on the DT9862 model selected). The DACs are deglitched to prevent noise from interfering with the output signal. They power up to a value of  $0\text{ V} \pm 10\text{ mV}$ . The DT9862 module can output data to a single DAC or sequentially to both DACs and/or the digital output port.

## Output Clock Sources

The DT9862 module allows the following clock sources to pace analog output operations:

- Internal DAC clock
- External DAC clock

## Output Triggers

A trigger is an event that occurs based on a specified set of conditions. The DT9862 series modules support the following output trigger sources:

- Software trigger
- External digital (TTL) trigger

## Analog Output Conversion Modes

The DT9862 supports the following conversion modes:

- Single-Value Operations
- Continuous analog output operations

## Streaming Analog Output

Use streaming analog output mode to accurately control the period between conversions of individual channels in the output channel list. Use software to fill the output buffer with the values that you want to write to the DACs and to the digital output port, if applicable.

## Waveform Generation

Use waveform generation mode if you want to output a waveform repetitively. Use software to allocate the memory and specify the waveform pattern.

## High-Speed Digital I/O Lines

The DT9862 module supports one digital input port, consisting of 16 digital input lines and one digital output port, consisting of 16 digital output lines. The resolution is fixed at 16 bits. You can read all 16 digital input lines or write all 16 digital output lines with a single-value digital I/O operation. In addition, you can specify the digital input port in an analog input channel list to perform a continuous digital input operation, or you can specify the digital output port in an output channel list to perform a continuous digital output operation.

The DT9862 module allows you to program the first eight digital input lines to perform interrupt-on-change operations.

## Counter/Timer Channels

The DT9862 module provides two 32-bit counter/timers. Each counter accepts a clock input signal and gate input signal and outputs a pulse (pulse output signal). Using software, one or more of the counter/timers can be specified in the analog input channel list.

The following clock sources are available for the counter/timers:

- Internal counter/timer clock
- External counter/timer clock

## Gate Types

The edge or level of the Counter n Gate signal determines when a counter/timer operation is enabled. The DT9862 supports the following gate types:

- None
- Logic-low level external gate input
- Logic-high level external gate input
- Falling-edge external gate input
- Rising-edge external gate input

## Pulse Output Types and Duty Cycles

The DT9862 series modules can output the following types of pulses from each counter/timer:

- High-to-low transitions – The low portion of the total pulse output period is the active portion of the counter/timer clock output signal.
- Low-to-high transitions – The high portion of the total pulse output period is the active portion of the counter/timer pulse output signal.

## Counter/Timer Operation Modes

DT9862 supports the following counter/timer operation modes:

- Event counting
- Up/down counting
- Frequency measurement
- Edge-to-edge measurement
- Continuous edge-to-edge measurement
- Rate generation
- One-shot
- Repetitive one-shot

## Quadrature Encoder

The Quadrature Encoder module contains three quadrature encoders which allow simultaneous decoding of three quadrature encoded inputs. The quadrature encoders may be used to provide relative or absolute position or, by calculating the difference between samples, the rotational speed.

## ±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. These modules feature 500 Volts of galvanic isolation to protect your computer from ground-spikes and to ensure a reliable stream of data.

## EMI and ESD Design Criteria

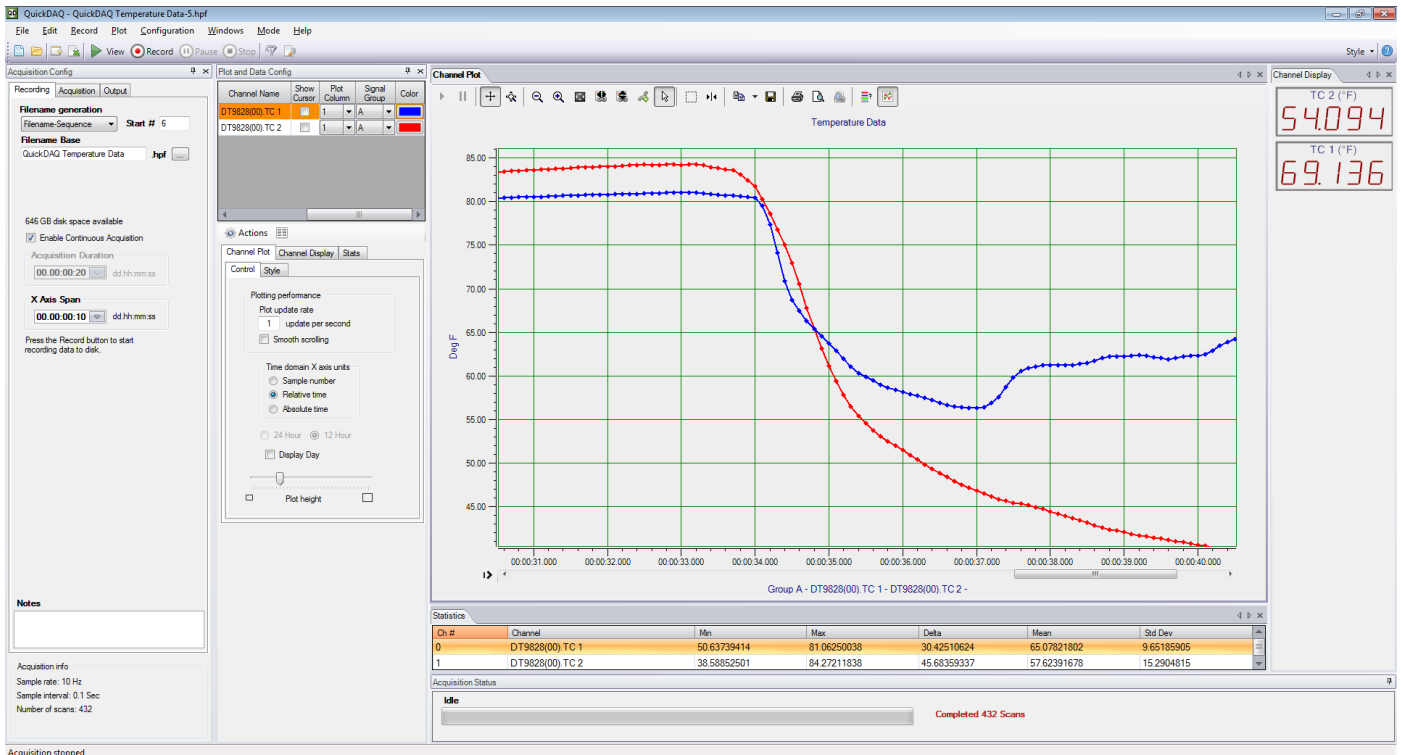
The DT9862 has been designed to perform with the lowest noise characteristics. Damping resistors in series with every I/O line minimize ringing and EMI and provide current limits that protect against transient signals.

## Flexible Packaging Configurations

The DT9862 provides SMA connectors. Physical dimensions in enclosure (L x W x H): 9.319 x 8.380 x 1.720 in. (236.7 x 212.85 x 43.69 mm). The standard DT9862 module is shipped with an EP361 +5 V power supply and cable.

## 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.



*QuickDAQ ships free-of-charge and allows you to get up and running quickly.*

## QuickDAQ

QuickDAQ allows you to acquire and display from all Data Translation USB and Ethernet data acquisition devices that support analog input streaming. Combine QuickDAQ with Data Translation hardware to acquire data, record data to disk, display the results in both a plot and digital display, and read a recorded data file. Be productive right out of the box with this powerful data logging software. Data can be exported to other applications like Microsoft Excel® and The MathWorks MATLAB® for more advanced analysis. Two additional options can be purchased to add FFT analysis capabilities to the base package.

### Key Features

- **QuickDAQ Base Package (Free)**
  - o Ready-to-measure application software
  - o Configure, acquire, log, display, and analyze data
  - o Customize many aspects of the acquisition, display, and recording functions to suit your needs
- **FFT Analysis Option (License Required)**
  - o Includes all the features of the QuickDAQ Base Package
  - o Perform single-channel FFT operations including:
    - ◇ Auto Spectrum
    - ◇ Spectrum
    - ◇ Power Spectral Density
  - o Configure and view dynamic performance statistics

- o Supports Hanning, Hamming, Bartlett, Blackman, Blackman Harris, and Flat Top response windows
- **Advanced FFT Analysis Option (License Required)**
  - o Includes all the features of the QuickDAQ Base Package and FFT Analysis Package
  - o Perform 2-channel FFT operations including:
    - ◇ FRF
    - ◇ Cross-Spectrum
    - ◇ Cross Power Spectral Density
    - ◇ Coherence
    - ◇ Coherent Output Power
  - o Supports real, imaginary, and Nyquist display functions
  - o Additional FFT analysis functions supported: Exponential, Force, Cosiner Taper
  - o Save data to .uff file format

## Other Software Options

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

The following software is available for use with the DT9862 or DT9862S module and is provided on the Data Acquisition Omni CD:

- **DT9862 Device Driver** – The device driver allows you to use a DT9862 or DT9862S module with any of the supported software packages or utilities.
- **DT9862 Calibration Utility** – This utility allows you to calibrate features of a DT9862 or DT9862S module.
- **Quick DataAcq** application – The Quick DataAcq application provides a quick way to get up and running. 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 using Visual Studio® 2003-2012; the class library complies with the DT-Open Layers standard.
- **DataAcq SDK** – Use the DataAcq SDK to use Visual Studio 6.0 and Microsoft® C or C++ to develop application software using Windows 10/8/7/Vista/XP 32/64-bit; the DataAcq SDK 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** – Data Translation's LV-Link is a library of VIs that enable LabVIEW™ programmers to access the data acquisition features of DT-Open Layers compliant USB and PCI devices.

## Ordering Summary

### HARDWARE

- DT9862-2-2
- DT9862-2-0

### ACCESSORIES

- **EP379** – Dual-Rack mount kit
- **EP380** – Single-Rack mount kit
- **EP390** – 1.52-meter cable with two 78-pin connectors that connect the STP78 screw terminal panel to the DT9862
- **STP78** – Screw terminal panel for connecting digital signals to the DT9862

### FREE SOFTWARE

- **QuickDAQ**
- **DAQ Adaptor for MATLAB** – Access the analysis and visualization tools of MATLAB®.
- **LV-Link** – Access the power of Data Translation boards through LabVIEW™.

### OPTIONAL SOFTWARE

- **QuickDAQ FFT Analysis Option** (License Required)
- **QuickDAQ Advanced FFT Analysis Option** (License Required)