DT9857E

Dynamic Signal Analyzer for Sound and Vibration Analysis Expandable to 64 Channels

The DT9857E is a high accuracy dynamic signal acquisition module for noise, vibration, and acoustic measurements. Eight or sixteen, 24-bit, IEPE (ICP®) sensor inputs are synchronized with a tachometer input, two measurement counters, and a general purpose counter/timer to provide data streams that are matched in time, for field or laboratory use. Two stimulus D/A outputs, each 32-bit resolution, and an 8-bit digital output port are available for dynamic waveform generation and control. This rugged, compact module, available either as an OEM board or steel-encased module, connects via USB making them ideal for many measurement applications.

Figure 1. The DT9857E offers many capabilities for vibration measurement such as 16 IEPE 24-bit Delta-Sigma sensor inputs, two 32-bit D/A stimulus outputs, a 32-bit tachometer, pre- and post-triggering. The Sync Bus allows expansion to 64 analog input channels and 8 analog output channels, and the ability to time sync all data to the input data stream.

Key Features:

- **Simultaneous IEPE analog inputs**, waveform stimulus analog outputs, tachometer synchronous with input data stream, advanced pre and post triggering, 16 DIO (8 in/8 out), synchronous counter/timers, and Sync Bus for up to 64 A/D channels and 8 D/A channels.
- **All inputs and outputs can be synchronized** for measurement data coherence...
  - Supports the ability to return the value of the digital input port, tachometer, measure counters, and general-purpose counter in the analog input data stream, all synchronous with analog input data stream...providing correlation of tachometer or any digital input with analog signals.
- **Eight (DT9857E-08) or sixteen (DT9857E-16) Simultaneous, IEPE inputs** up to 4mA at 24V compliance, all inputs use 24-bit Delta-Sigma A/D converters for high resolution measurement to 105.6kHz, AC or DC coupling.
- **Two 32-bit D/A converter output channels** for stimulus or waveform generation to 216kHz.
- **Start trigger** (software, threshold, external, or Sync Bus) for acquiring post-trigger samples; reference trigger for acquiring pre/post trigger samples.
- **Analog threshold trigger** on any of the analog input channels to program the threshold value from −10V to +10V.
- **SyncBus connector** for synchronizing acquisition and waveform stimulus on up to four DT9857E modules
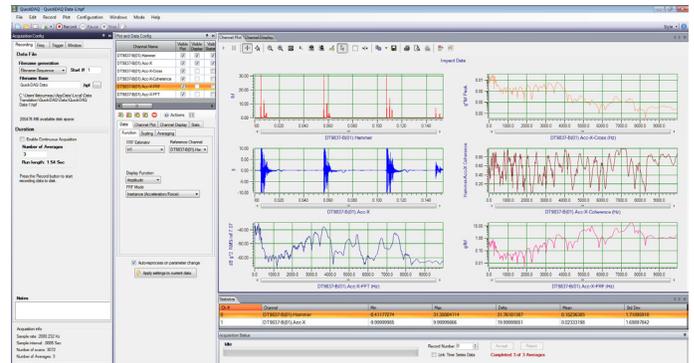- **External 4.75V to 28V Power Supply**

Figure 2. QuickDAQ with Advanced FFT Analysis option adds real-time analysis features to sound & vibration test systems. It supports the DT9857E through a series of easy to use configuration windows.
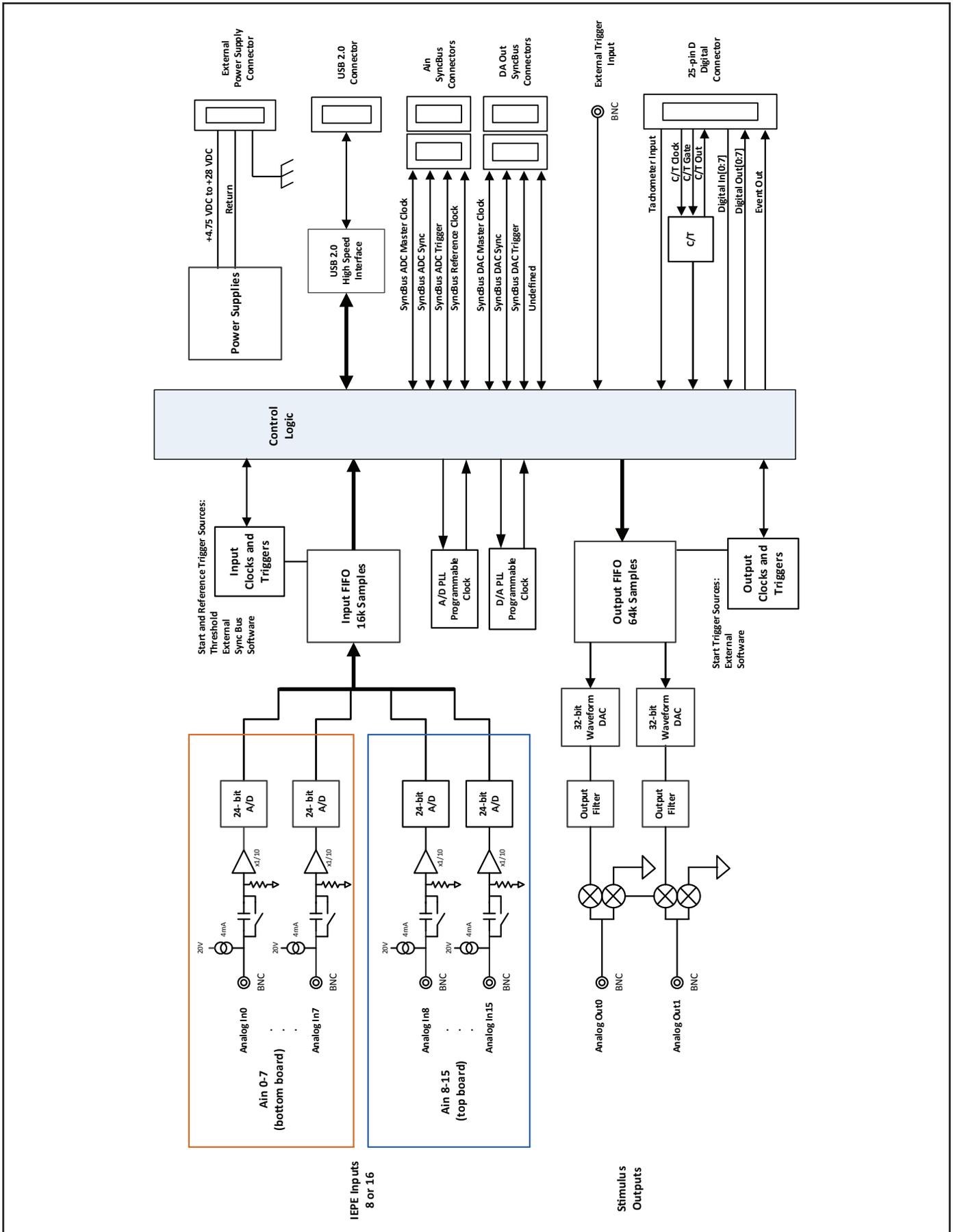
Figure 3. Block diagram shows all functions of the DT9857E with functions in the same general area of the physical board below.
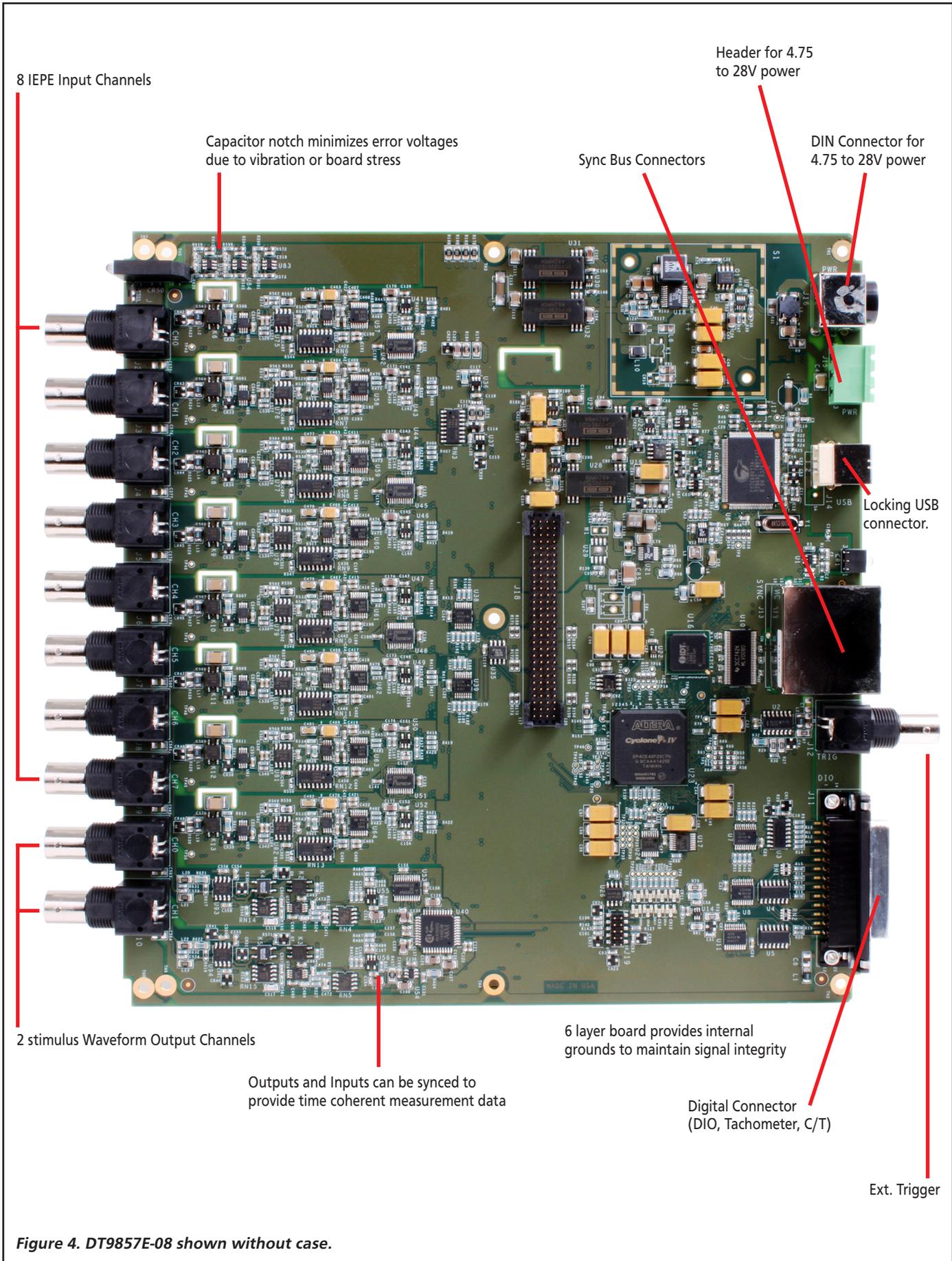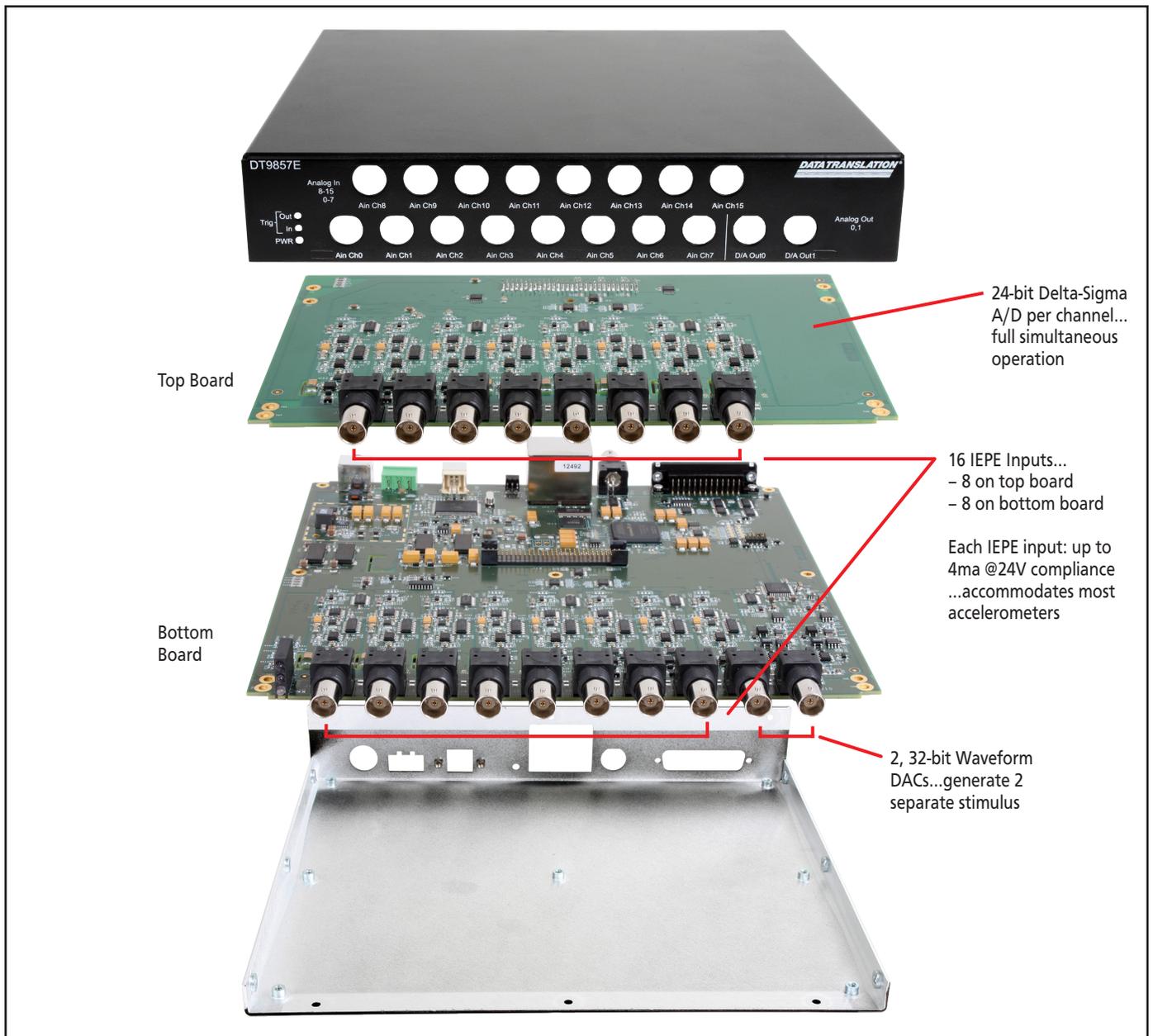
8 IEPE Input Channels

Capacitor notch minimizes error voltages
due to vibration or board stress

Header for 4.75
to 28V power

Sync Bus Connectors

DIN Connector for
4.75 to 28V power

Locking USB
connector.

2 stimulus Waveform Output Channels

Outputs and Inputs can be synced to
provide time coherent measurement data

6 layer board provides internal
grounds to maintain signal integrity

Digital Connector
(DIO, Tachometer, C/T)

Ext. Trigger

Figure 4. DT9857E-08 shown without case.

Figure 5. Exploded view of the DT9857E with a two board construction...with metal case.

Annotations on figure:
- 24-bit Delta-Sigma A/D per channel... full simultaneous operation
- 16 IEPE Inputs... – 8 on top board – 8 on bottom board
- Each IEPE input: up to 4ma @24V compliance ...accommodates most accelerometers
- 2, 32-bit Waveform DACs...generate 2 separate stimulus
- Top Board
- Bottom Board

Analog Input Channels

The DT9857E-08 module provides eight analog input channels and the DT9857E-16 module provides 16 analog input channels. IEPE sensors can be connected to these BNC inputs. Software-selectable gains of 1 and 10 provide effective input ranges of ±10V and ±1V. Each analog input channel uses a 24-bit Delta-Sigma analog-to-digital converter (ADC) that provides anti-aliasing filtering based on the clock rate.

In addition to acquiring data from the analog input channels, the DT9857E supports the ability to simultaneously acquire the value of the tachometer input, general-purpose counter/timer, measure counters, and digital input port in the analog input stream, allowing precise correlation of all input signals.

IEPE Support

Applications that require accelerometer, vibration, noise, or sonar measurements often use IEPE sensors. IEPE conditioning is built-in to the analog input circuitry of the DT9857E module. Each analog input channel provides the following capabilities for IEPE support:

- **Excitation current source** — Internal excitation current source of 4mA.
- **Coupling type** — Software-programmable AC coupling or DC coupling.
- **Compliance voltage** — +24V

Analog Input Clock

The DT9857E module supports an internal A/D clock, which is derived from the 48MHz crystal oscilation. Users can program the sampling frequency at which to pace the input operations. The sampling frequency ranges from 195.3125Hz to 105.469kHz.

Input Triggers

The DT9857E module supports both a start trigger and a reference trigger. Users can specify a start trigger to acquire post-trigger data when the specified start trigger event occurs. To acquire pre- and post-trigger data, users can specify both a start trigger and a reference trigger. In this case, pre-trigger data is acquired when the start trigger occurs and post-trigger data is acquired when the reference trigger occurs. Post-trigger acquisition stops when a user-specified number of samples have been acquired.

The following trigger sources are supported: software trigger source (start trigger only), external digital (TTL) positive or negative trigger, threshold trigger, or Sync Bus trigger (start trigger only).

The software trigger event occurs when the operation is started (the computer issues a write to the module to begin conversions.)

On the DT9857E, the external digital connector is available as a dedicated BNC input.

For the threshold trigger, any analog input channel can be used as the trigger source and the threshold level can range between ±10V (gain of 1) or ±1V (gain of 10). The trigger can be programmed to occur when the signal either rises above or falls below the user-specified threshold value.

The Sync Bus input trigger is available when multiple modules are connected together using the Sync Bus (RJ45) connectors. By specifying the analog input subsystem module as the master and the analog input subsystems of the other connected modules as slaves, the clocks and triggers of the analog input subsystem on the master are propagated to the slave modules through the Sync Bus. Therefore, when the analog input subsystem on the master module is triggered, the analog input subsystems of the slave modules are also triggered.

Analog Output Channels

The DT9857E module supports two 32-bit analog output channels with an output range of ±10V. A two-pole Butterworth filter and quiet start circuitry prevents noise from interfering with the output signal.

The DT9857E module supports single-value, waveform, and continuous analog output operations. In addition, the digital output port can be updated simultaneously with the analog output channels for simultaneous stimulus and control applications.

Analog Output Clock

The DT9857E module supports an internal D/A clock, which is derived from the 48MHz crystal oscillator. The clock frequency of the D/A output clock can be programmed to a value between 30 kHz and 216 kHz for pacing output operations.

Output Triggers

To start an output operation, the following output triggers are supported: software trigger or external digital (TTL) positive or negative trigger. The software trigger event occurs when the operation is started (the computer issues a write to the module to begin the output operation.)

On the DT9857E, the external digital trigger is available as a dedicated BNC input.

The user can use the Sync Bus output trigger when multiple DT9857E modules are connected together using the Sync Bus connectors. By specifying the analog output subsystem of one module as the master and the analog output subsystems of the other connected modules as slaves, the clocks and triggers of the analog output subsystem are propagated to the slave modules through the Sync Bus connectors. Therefore, when the analog output subsystem on the master module is triggered, the analog output subsystems of the slave modules are also triggered.

Tachometer Input

The DT9857E module supports a tachometer input signal with a range of ±30V. The frequency or period between two edges of the tachometer input signal can be measured to calculate the rotational speed of the high-level tachometer input. The value can then be returned the value in the analog input data stream.

The starting edge (either rising or falling) of the tachometer signal is programmable. An internal 12MHz counter is used for the measurement.

On the DT9857E, the tachometer is available as pin 11 of the Digital connector.

General-Purpose Counter/Timer

The DT9857E module supports a 32-bit, general-purpose, counter/timer. The value of the counter/timer can be returned in the analog input data stream, if desired.

The following counter/timer functions are supported: event counting, edge-to-edge measurement, continuous edge-to-edge measurement (for determining the frequency and period width of a signal), continuous pulse output, one-shot, repetitive one-shot, and up/down counting operations.

Programmable gates, clocks, and output signals are also supported.

Measure Counters

Two measure counters are supported by the DT9857E module. The module can measure the frequency or period between two signals or two edges of the same signal and return the value in the analog input data stream. This is useful for correlating analog input and digital positional data.

A variety of programmable signals and edges are supported for the measurement, including the A/D conversion complete, tachometer signal, general-purpose C/T, and digital input signals. An internal 48 MHz counter is used for the measurement.

Digital I/O Lines

The DT9857E module supports one digital input port, consisting of 8 digital input lines and one digital output port, consisting of 8 digital output lines.

Users can read all 8 digital input lines or write to all 8 digital output lines with a single-value digital I/O operation. Users can also return the value of the digital input port in the analog input stream for synchronous input measurements, or update the value of the digital output port in the analog output stream for synchronous waveform stimulus and control.

Synchronizing Multiple Modules

Input operations and output operations can be synchronized on up to four DT9857E modules. In this scheme, one module is the master and the other modules are slaves. When configured as a master, the Sync Bus connector outputs trigger and clock signals. When configured as a slave, the Sync Bus connector accepts trigger and clock signals from the master.

Figure 6 shows how to connect a maximum of four DT9857E modules (64 analog input channels and 8 analog output channels) by using an RJ45.
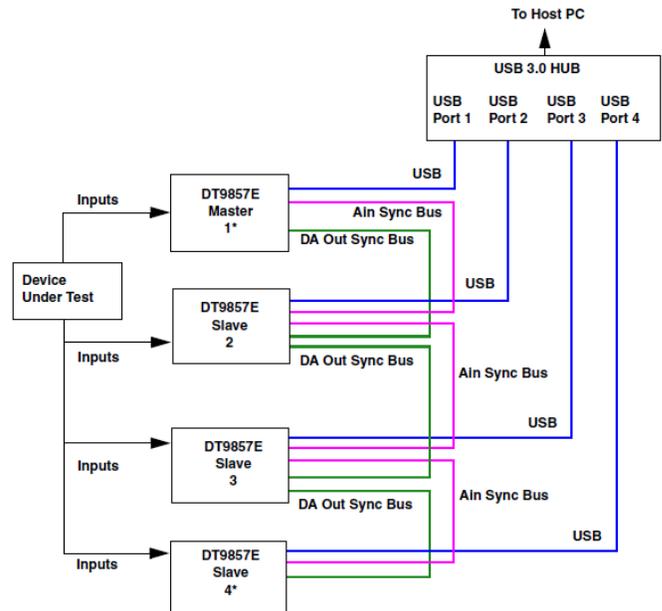
*Note that first and last module in chain must be terminated with 100 Ω using the Control Panel applet.

Figure 6. A Master/Slave connection allows up to four DT9857E modules (up to 64 input channels and up to 8 analog output channels) to be synchronized together.
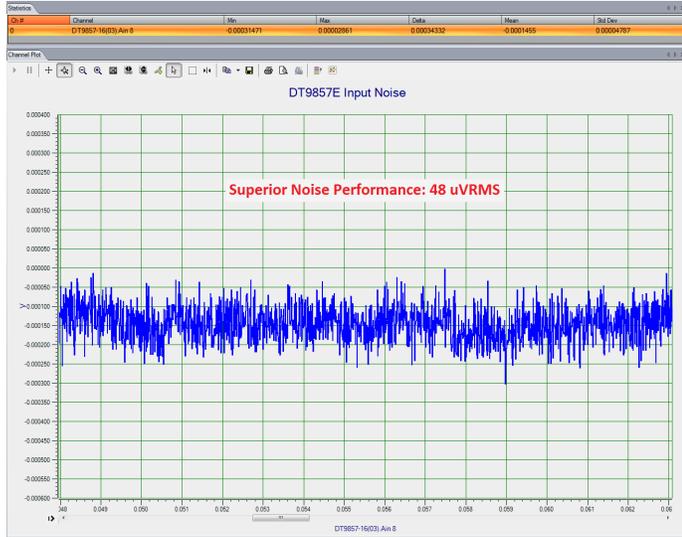
Figure 7a. Up to four DT9857E modules can be synchronized to measure 64 analog inputs and 8 analog outputs.
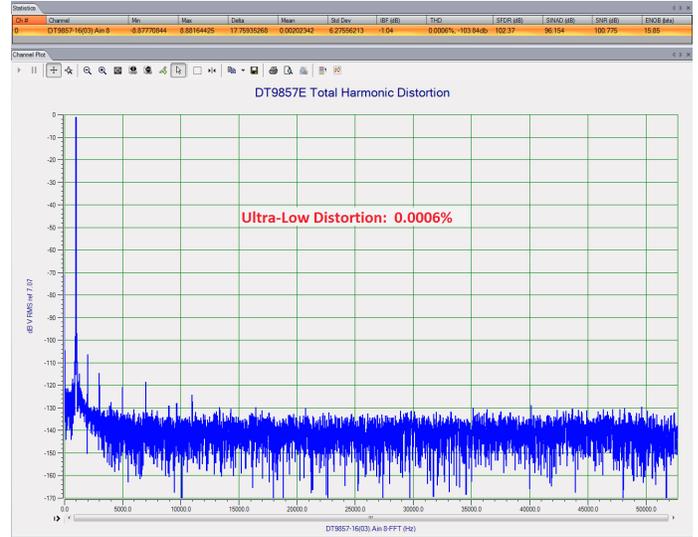

Figure 7b. The Sync Bus connection for the DT9857E is shown for 64 analog input channels and 8 analog output channels.

Below are images highlighting the superior dynamic performance characteristics of the DT9857E using QuickDAQ.
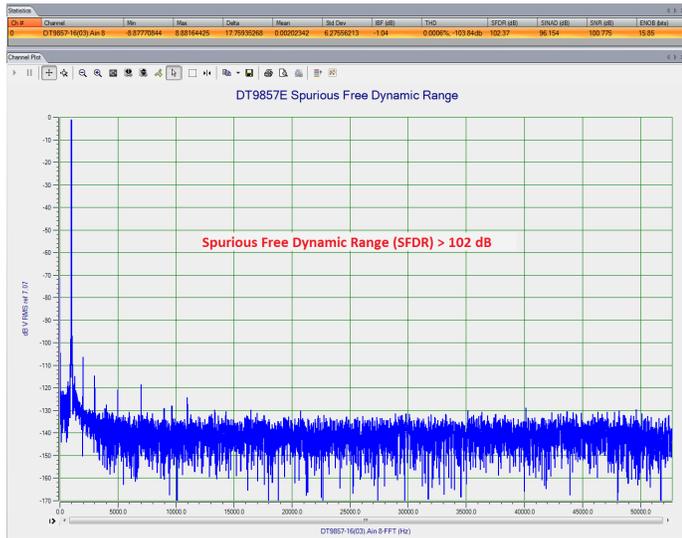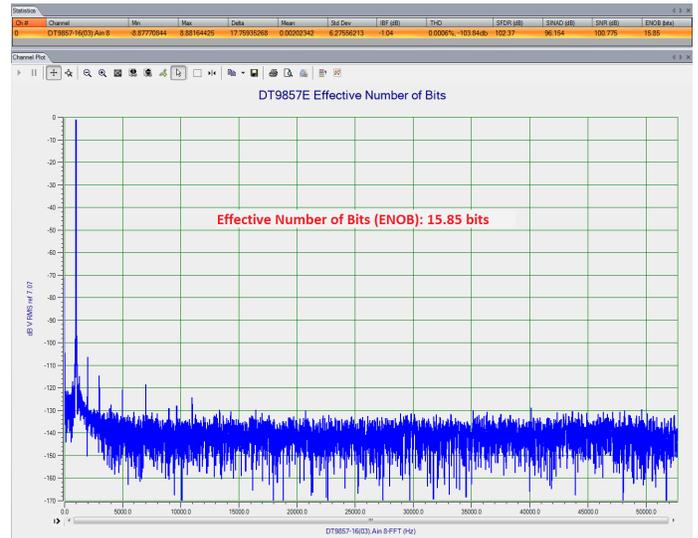
Noise Level
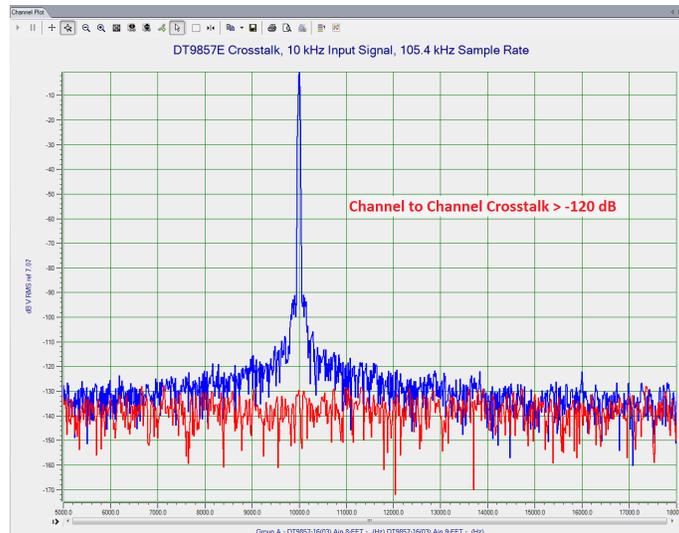

Total Harmonic Distortion (THD)

Spurious Free Dynamic Range (SFDR)

Effective Number of Bits (ENOB)
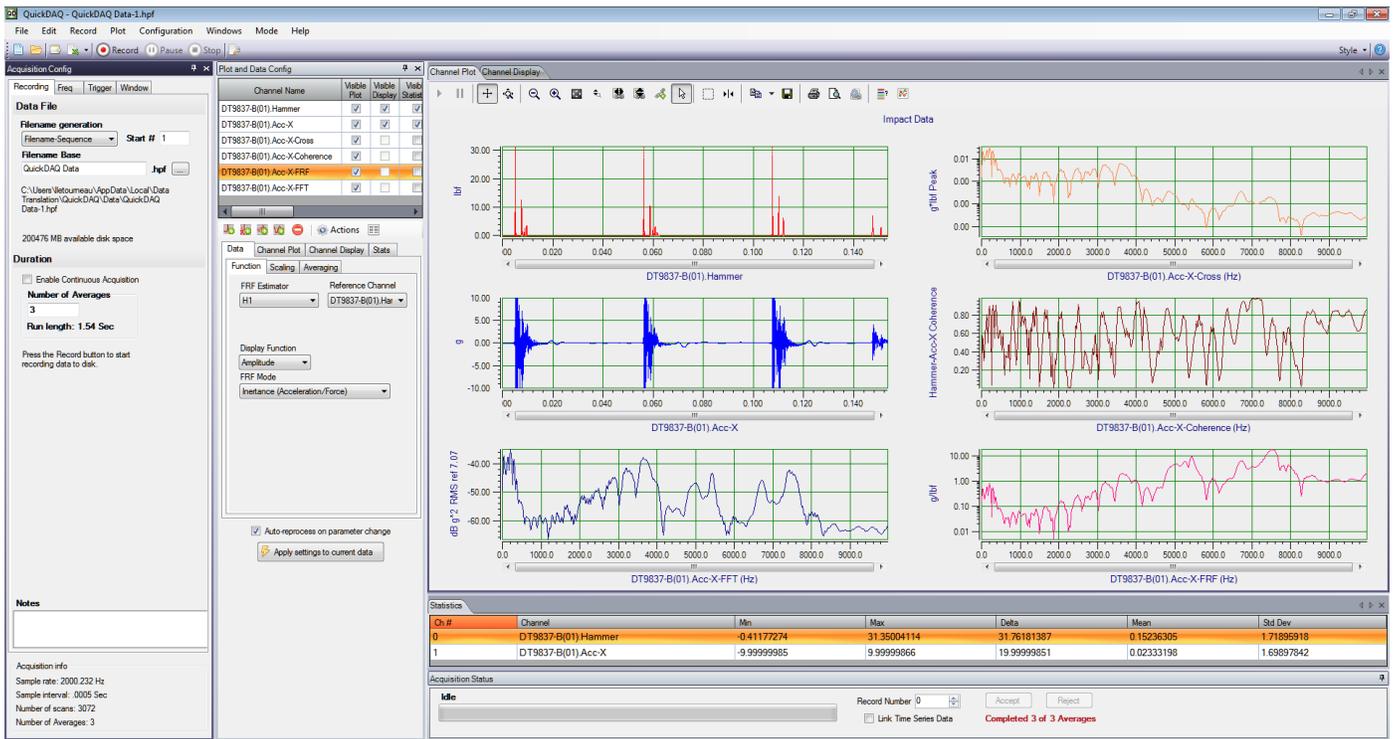

Crosstalk (@105kHz)

Figure 8. QuickDAQ with Advanced FFT Analysis Option.

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)**
  - Ready-to-measure application software
  - Configure, acquire, log, display, and analyze your data
  - Customize many aspects of the acquisition, display, and recording functions to suit your needs
- **FFT Analysis Option (License Required)**
  - Includes all the features of the QuickDAQ Base Package
  - Perform single-channel FFT operations including:
    - ◊ Auto Spectrum
    - ◊ Spectrum
    - ◊ Power Spectral Density
  - Configure and view dynamic performance statistics
  - Supports Hanning, Hamming, Bartlett, Blackman, Blackman Harris, and Flat Top response windows

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

Other Software Options

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

- **Device Driver** — The device driver allows you to use the DAQ module with any of the supported software packages or utilities.
- **Calibration Utility** — This utility allows you to calibrate features of the DAQ module.
- **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 a DAQ module using Visual Studio® 2003-2012; 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 a DAQ module using Windows® XP/Vista/7/8; 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.