DATA TRANSLATION

UM-22417-L

DT9837 Series User's Manual

Eleventh Edition
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Radio and Television Interference

This equipment has been tested and found to comply with CISPR EN55022 Class A and EN61000-6-1 requirements and also with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Changes or modifications to this equipment not expressly approved by Data Translation could void your authority to operate the equipment under Part 15 of the FCC Rules.

Note: This product was verified to meet FCC requirements under test conditions that included use of shielded cables and connectors between system components. It is important that you use shielded cables and connectors to reduce the possibility of causing interference to radio, television, and other electronic devices.

Canadian Department of Communications Statement

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la class A prescrites dans le Règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.

Table of Contents

About this Manual

The DT9837 Series includes the DT9837, DT9837A, and DT9837B modules. The first part of this manual describes how to install and set up your DT9837 Series module and device driver, and verify that your module is working properly.

The second part of this manual describes the features of the DT9837 Series modules, the capabilities of the DT9837 Series Device Drivers, and how to program the DT9837 Series modules using the DT-Open Layers for .NET Class Library™ software. Troubleshooting information is also provided.

Note: For information on checking system requirements, installing the software, and viewing the documentation, refer to the README file on the OMNI CD.

For more information on the class library, refer to the *DT-Open Layers for .NET Class Library User's Manual*. If you are using the DataAcq SDK or a software application to program your device, refer to the documentation for that software for more information.

Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for using and/or programming a DT9837 Series module for data acquisition operations in the Microsoft® Windows® XP, Windows Vista®, or Windows 7 operating system. It is assumed that you have some familiarity with data acquisition principles and that you understand your application.

How this Manual is Organized

This manual is organized as follows:

- Chapter 1, "Overview," describes the major features of the DT9837 Series modules, as well as the supported software and accessories for the modules.
- Chapter 2, "Setting Up and Installing the Module," describes how to install a DT9837 Series module, how to apply power to the module, and how to configure the DT9837 Series Device Drivers.
- Chapter 3, "Wiring Signals," describes how to wire signals to a DT9837 Series module.
- Chapter 4, "Verifying the Operation of a Module," describes how to verify the operation of a DT9837 Series module with the Quick DataAcq application.
- Chapter 5, "Principles of Operation," describes all of the features of the DT9837 Series modules and how to access them in your application.
- Chapter 6, "Supported Device Driver Capabilities," lists the data acquisition subsystems and the associated features accessible using the DT9837 Series Device Drivers.

- Chapter 7, "Using the VIBpoint Framework Application," provides information about using the VIBpoint Framework application with the DT9837 Series modules.
- Chapter 8, "Troubleshooting," provides information that you can use to resolve problems with the DT9837 Series modules and DT9837 Series Device Drivers, should they occur.
- Chapter 9, "Calibration," describes how to calibrate the analog I/O circuitry of the DT9837 Series modules.
- Appendix A, "Specifications," lists the specifications of the DT9837 Series modules.
- An index completes this manual.

Conventions Used in this Manual

The following conventions are used in this manual:

- Notes provide useful information or information that requires special emphasis, cautions provide information to help you avoid losing data or damaging your equipment, and warnings provide information to help you avoid catastrophic damage to yourself or your equipment.
- Items that you select or type are shown in **bold**.

Related Information

Refer to the following documents for more information on using the DT9837 Series modules:

- *Benefits of the Universal Serial Bus for Data Acquisition.* This white paper describes why USB is an attractive alternative for data acquisition. It is available on the Data Translation web site (www.datatranslation.com).
- *Measure Foundry Manual* (UM-19298) and online help. These documents describe how to use Measure Foundry™ to build drag-and-drop test and measurement applications for Data Translation data acquisition devices.
- *DT-Open Layers for .NET User's Manual* (UM-22161). For programmers who are developing their own application programs using Visual C# or Visual Basic .NET, this manual describes how to use the DT-Open Layers for .NET Class Library to access the capabilities of Data Translation data acquisition devices.
- *DataAcq SDK User's Manual* (UM-18326). For programmers who are developing their own application programs using the Microsoft C compiler, this manual describes how to use the DT-Open Layers DataAcq SDK™ to access the capabilities of Data Translation data acquisition devices.
- *LV-Link Online Help*. This help file describes how to use LV-Link™ with the LabVIEW™ graphical programming language to access the capabilities of Data Translation data acquisition devices.
- Microsoft Windows XP, Windows Vista, or Windows 7 documentation.
- USB web site (http://www.usb.org).

Where To Get Help

Should you run into problems installing or using a DT9837 Series module, the Data Translation Technical Support Department is available to provide technical assistance. Refer to Chapter 8 for more information. If you are outside the United States or Canada, call your local distributor, whose number is listed on our web site (www.datatranslation.com).

Overview

Hardware Features

The DT9837, DT9837A, and DT9837B are high-performance, multifunction data acquisition modules for the USB (Ver. 2.0 or Ver. 1.1) bus. Table 1 lists the major differences among the modules.

Table 1: Major Differences Among the DT9837 Series Modules

Feature	DT9837	DT9837A	DT9837B
Maximum A/D Throughput	52.734 kHz	52.734 kHz	105.469 kHz
A/D Threshold Trigger[a]	Fixed	Programmable	Programmable
Number of Tachometer Counters	1	2 (C/T 0 and 1)	2 (C/T 0 and 1)
Number of Gate Inputs	0	1[b] (C/T 2)	1[c] (C/T 2)
Number of Analog Output Channels	1	1	0
Analog Output Readback Capability	No	Yes	No
Analog Output Trigger Types	Software trigger only	Software trigger, external digital trigger, or analog threshold trigger	None
RJ45 Synchronization Connector	No	Yes	Yes

a. On the DT9837, the threshold level is fixed at 1.0 V. On the DT9837A and DT9837B, the analog threshold level is programmable from 0.2 V to 9.8 V with 0.1 V of hysteresis.
b. Available on the DT9837A-OEM version.
c. Available through a BNC connector on the DT9837B module.

Key Features of the DT9837

The key hardware features of the DT9837 module are as follows:

- Simultaneous analog input and waveform analog output operations
- Analog input subsystem:
  - Four, simultaneous 24-bit A/D converters
  - Throughput rate up to 52.734 kSamples/s for simultaneous, high-resolution measurements
  - Input range of ±10 V with software-selectable gains of 1 and 10 for an effective input range of ±10 V and ±1 V
  - Support for IEPE (Integrated Electronic Piezoelectric) inputs, including use of a 4 mA current source and AC or DC coupling
  - The ability to return the value of tachometer counter 0 in the analog input data stream, allowing you to measure the period or frequency of the tachometer input signal synchronously with analog input measurements

  - Software-programmable trigger type (software, external digital trigger, or analog threshold trigger) to start the analog input operation.
- Analog output subsystem:
  - One 24-bit D/A converter
  - Waveform capability of up to 8,192 sample
  - Output rate of 46.875 kSamples/s
  - Output range of ±10 V
  - A software trigger starts the analog output operation
- Internal clock source (shared between the analog input and analog output subsystems)

Key Features of the DT9837A

The key hardware features of the DT9837A module are as follows:

- Simultaneous analog input and waveform analog output operations
- Analog input subsystem:
  - Four, simultaneous 24-bit A/D converters
  - Throughput rate up to 52.734 kSamples/s for simultaneous, high-resolution measurements
  - Input range of ±10 V with software-selectable gains of 1 and 10 for an effective input range of ±10 V and ±1 V
  - Support for IEPE (Integrated Electronic Piezoelectric) inputs, including use of a 4 mA current source and AC or DC coupling
  - The ability to return the value of tachometer counter 0 in the analog input data stream, allowing you to measure the period or frequency of the tachometer input signal synchronously with analog input measurements
  - The ability to read the value of tachometer counter 1 in the analog input data stream, allowing you to precisely correlate tachometer measurements with analog input measurements
  - Optional OEM version of this module, called the DT9837A-OEM, supports the ability to read the value of gate counter 2 in the analog input data stream, allowing you to precisely correlate gate input measurements with analog input measurements
  - Supports reading analog output values in the analog input data stream, allowing you to correlate input and output values
  - Software-programmable trigger type (software, external digital trigger, or analog threshold trigger) to start the analog input operation. You can also program the analog input threshold value.
- Analog output subsystem:
  - One 24-bit D/A converter
  - Single value, waveform, and continuous streaming output
  - Programmable output rate from 10 kSamples/s to 52.734 kSamples/s

  - Output range of ±10 V
  - Software-programmable trigger type (software trigger, external digital trigger, or analog threshold trigger) to start the analog output operation. You can also program the threshold value.
- Internal clock source (shared between the analog input and analog output subsystems)
- RJ45 synchronization (LVDS) connector for synchronizing acquisition on up to four DT9837A modules

Key Features of the DT9837B

The key hardware features of the modules are as follows:

- Four, simultaneous 24-bit A/D converters
- Internal clock source with a throughput rate up to 105.469 kSamples/s for simultaneous, high-resolution analog input measurements
- Input range of ±10 V with software-selectable gains of 1 and 10 for an effective input range of ±10 V and ±1 V
- Support for IEPE (Integrated Electronic Piezoelectric) inputs, including use of a 4 mA current source and AC or DC coupling
- The ability to return the value of tachometer counter 0 in the analog input data stream, allowing you to measure the period or frequency of the tachometer input signal synchronously with analog input measurements
- The ability to read the value of tachometer counter 1 in the analog input data stream, allowing you to precisely correlate tachometer measurements with analog input measurements
- The ability to read the value of gate counter 2 in the analog input data stream, allowing you to precisely correlate gate input measurements with analog input measurements
- Software-programmable trigger type (software, external digital trigger, or analog threshold trigger) to start the analog input operation. You can also program the analog input threshold value.
- RJ45 synchronization (LVDS) connector for synchronizing acquisition on up to four DT9837B modules

Supported Software

The following software is available for use with the DT9837 Series modules and is included on the Data Acquisition OMNI CD:

- **DT9837 Series Device Drivers** – Two device drivers are provided in the DT9837 Series: one for the DT9837 module and one for the DT9837A and DT9837B module. The DT9837 Series Device Drivers allow you to use a DT9837, DT9837A, or DT9837B module with any of the supported software packages or utilities.
- **VIBpoint Framework application** – A 14-day trial version of this application is shipped with the DT9837 Series modules. This application, described in Chapter 7, lets you do the following:
  - Discover and select available DT9837 Series modules
  - Configure your DT9837 Series modules
  - Acquire data from multiple DT9837A, DT9837A-OEM, and DT9837-B modules
  - Display acquired data during acquisition
  - Perform FFTs (Fast Fourier Transforms) on the acquired analog input data
  - Use a chart recorder to display snapshot or snapshots of data and log it to disk for later analysis
  - Use the channel overview to view data from your instrument module as a digital display
- **Quick DataAcq application** – The Quick DataAcq application provides a quick way to get up and running using a DT9837 Series module. Using this application, you can verify key features of the modules, display data on the screen, and save data to disk. (Note that this application does not support configuring AC/DC coupling or the excitation current source for IEPE inputs.)
- **The quickDAQ application –** An evaluation version of this .NET application is included on the Data Acquisition OMNI CD. quickDAQ lets you acquire analog data from all devices supported by DT-Open Layers for .NET software at high speed, plot it during acquisition, analyze it, and/or save it to disk for later analysis.
- **Measure Foundry** – An evaluation version of this software is included or provided via a link on the Data Acquisition OMNI CD. Measure Foundry is a drag-and-drop test and measurement application builder designed to give you top performance with ease-of-use development. Order the full development version of this software package to develop your own application using real hardware.
- **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 your own application software for a DT9837 Series module using Visual Studio 2003 or Visual Studio 2005; the class library complies with the DT-Open Layers standard.
- **DataAcq SDK** – Use the Data Acq SDK if you want to use Visual Studio 6.0 and Microsoft C or C++ to develop your own application software for a DT9837 Series module using Windows XP, Windows Vista, or Windows 7; 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) subsystem from The MathWorks and Data Translation's DT-Open Layers architecture.
- **LV-Link** – An evaluation version of LV-Link is included on the Data Acquisition OMNI CD. Use LV-Link if you want to use the LabVIEW graphical programming language to access the capabilities of the DT9837 Series module.

Refer to the Data Translation web site (www.datatranslation.com) for information about selecting the right software package for your needs.

Supported Accessories

The following accessory is available for use with the DT9837A and DT9837B modules:

- **EP386 panel** – This RJ45 distribution panel contains four RJ45 connectors that are wired in parallel, making it useful when attaching up to four DT9837A or DT9837B modules together. Refer to page 69 for more information on using this panel.

Note: You must have revision H or later of the DT9837A module or revision F or later of the DT9837A-OEM module to be able to attach four modules together. You can identify the revision of your module by looking at the serial number label on your module.

If you have revision G or earlier of the DT9837A or revision E or earlier of the DT9837A-OEM, you can attach a maximum of two modules together.

Getting Started Procedure

The flow diagram shown in Figure 1 illustrates the steps needed to get started using a DT9837 Series module. This diagram is repeated in each Getting Started chapter; the shaded area in the diagram shows you where you are in the getting started procedure.

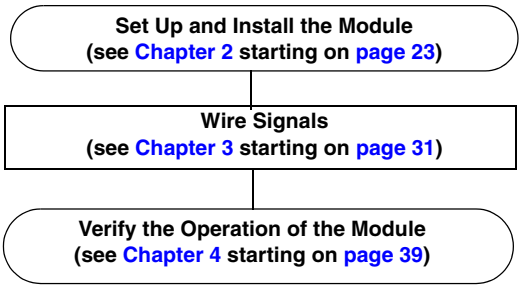
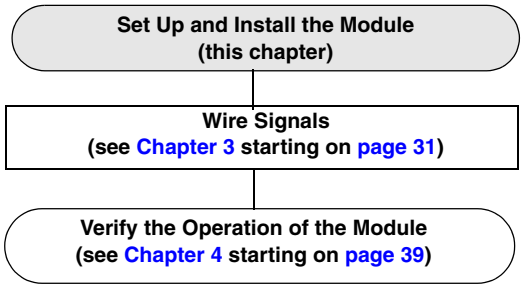


Figure 1: Getting Started Flow Diagram

Part 1: Getting Started

Setting Up and Installing the Module


Set Up and Install the Module
(this chapter)
Wire Signals
(see Chapter 3 starting on page 31)
Verify the Operation of the Module
(see Chapter 4 starting on page 39)

Unpacking

Open the shipping box and verify that the following items are present:

- DT9837, DT9837A, or DT9837B module
- EP365 USB cable
- Data Acquisition OMNI CD-ROM

If an item is missing or damaged, contact Data Translation. If you are in the United States, call the Customer Service Department at (508) 481-3700, ext. 1323. An application engineer will guide you through the appropriate steps for replacing missing or damaged items. If you are located outside the United States, call your local distributor, listed on Data Translation's web site (www.datatranslation.com).

Note: The DT9837 Series modules are factory-calibrated. If you decide that you want to recalibrate the analog input or analog output circuitry, refer to the instructions in Chapter 9.

Attaching Modules to the Computer

This section describes how to attach a DT9837 Series module to the host computer.

Note: Most computers have several USB ports that allow direct connection to USB devices. If your application requires more DT9837 Series modules than you have USB ports for, you can expand the number of USB devices attached to a single USB port by using expansion hubs. For more information, refer to page 27.

You can unplug a module, then plug it in again, if you wish, without causing damage. This process is called hot-swapping. Your application may take a few seconds to recognize a module once it is plugged back in.

The DT9837 Series modules use less than 500 mA; therefore, they do not require an external power supply.

You must install the device driver for your module before connecting the module(s) to the host computer. Run the installation program on your Data Acquisition OMNI CD to install the device driver and other software for the module.

Connecting Directly to the USB Ports

To connect a DT983 Series module directly to a USB port on your computer, do the following:

1. Attach one end of the USB cable to the USB port on the module.
2. Attach the other end of the USB cable to one of the USB ports on the host computer, as shown in Figure 2.
   The operating system automatically detects the USB module and starts the Found New Hardware wizard.

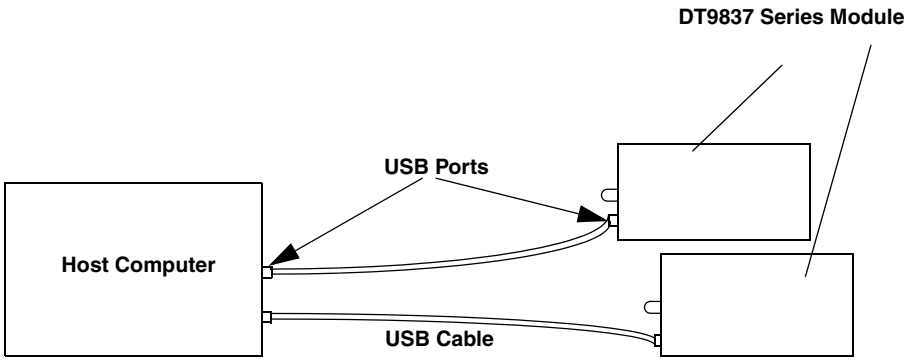


Figure 2: Attaching the Module to the Host Computer

3. *For Windows Vista:*

   a. Click **Locate and install driver software (recommended**).
   The popup message "Windows needs your permission to continue" appears.

   b. Click **Continue**.
   The Windows Security dialog box appears.

   c. Click **Install this driver software anyway**.

   For Windows XP:

   a. Click **Next** and/or **Finish** as required in the wizard.
   Once the firmware is loaded, the wizard restarts to initiate the firmware to accept commands.

   b. Click **Next** and/or **Finish** again.

Note: Windows 7 finds the device automatically.

4. Repeat these steps to attach another DT9837 Series module to the host computer, if desired.

Note: Once you have connected your module to the host computer, power is turned on to the module when your application program opens the module. The LED on the module turns green to indicate that power is turned on.

Power is turned off to the module when your application program terminates its connection to the module.

Connecting to an Expansion Hub

Expansion hubs are powered by their own external power supply. The practical number of DT9837 Series modules that you can connect to a single USB port depends on the throughput you want to achieve.

To connect multiple DT9837 Series modules to an expansion hub, do the following:

1. Attach one end of the USB cable to the module and the other end of the USB cable to an expansion hub.
2. Connect the power supply for the expansion hub to an external power supply.
3. Connect the expansion hub to the USB port on the host computer using another USB cable.
   The operating system automatically detects the USB module and starts the Found New Hardware wizard.
4. *For Windows Vista:*

   a. Click **Locate and install driver software (recommended**).
   The popup message "Windows needs your permission to continue" appears.

b. Click **Continue**.
The Windows Security dialog box appears.

c. Click **Install this driver software anyway**.

For Windows XP:

a. Click **Next** and/or **Finish** as required in the wizard.
Once the firmware is loaded, the wizard restarts to initiate the firmware to accept commands.

b. Click **Next** and/or **Finish** again.

Note: Windows 7 finds the device automatically.

5. Repeat these steps until you have attached the number of expansion hubs and modules that you require. Refer to Figure 3.
The operating system automatically detects the USB devices as they are installed.

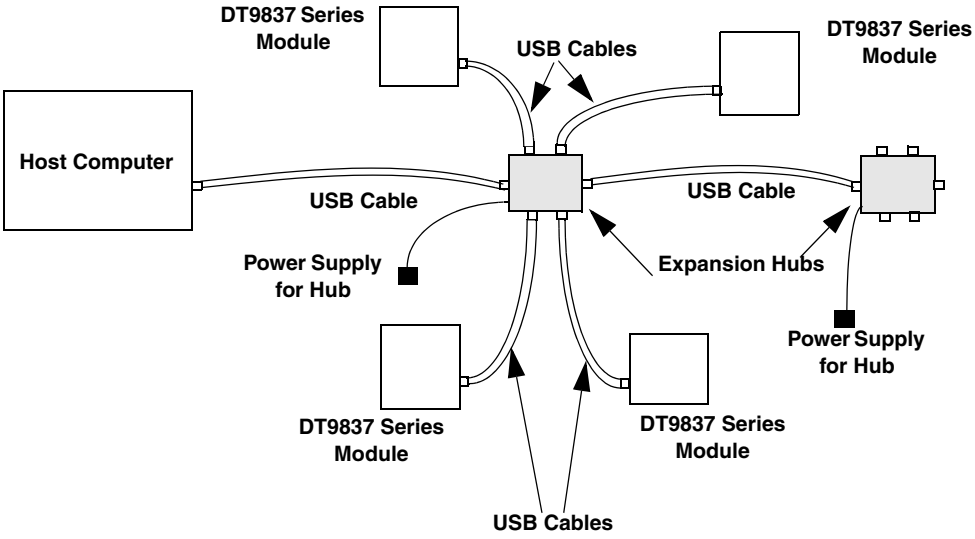


Figure 3: Attaching Multiple Modules Using Expansion Hubs

Note: Once you have connected your module to the host computer, power is turned on to the DT9837 Series module when your application program opens the module. The LED on the module turns green to indicate that power is turned on.

Power is turned off to the module when your application program terminates its connection to the module.

Configuring the DT9837 Series Device Drivers

To configure the device driver for the DT9837, DT9837A, or DT9837B module, do the following:

1. If you have not already done so, power up the host computer and all peripherals.
2. From the Windows Start menu, select **Settings | Control Panel**.
3. From the Control Panel, double-click **Open Layers Control Panel**.
   The Data Acquisition Control Panel dialog box appears.
4. If you want to rename the module, click the name of the module that you want to rename, click **Edit Name**, enter a new name for the module, and then click **OK**. The name is used to identify the module in all subsequent applications.
5. Select the module that you want to configure, and then click **Advanced**.
   The Measurement Options dialog box appears.
6. For the Coupling type, select **AC** for AC coupling or **DC** for DC coupling.
7. For the Current Source, select **Enabled** to enable the 4 mA current source or **Disabled** to disable the 4 mA current source.

Note: If you enable the use of the internal 4 mA excitation current source, it is recommended that you choose AC coupling. Refer to page 35 for more information on wiring IEPE inputs.

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8. You can read the number of counts between two consecutive starting edges of the tachometer input signal by including channel 4 (tachometer counter 0) in the analog input channel list. On the DT9837 module, the starting edge is always rising; on the DT9837A and DT9837B module, the starting edge is programmable (either rising or falling). See page 63 for more information.

   For the DT9837, skip to step 11. For the DT9837A and DT9837B, configure the Tach.CT0 measurement parameters as follows:

   a. From the **Start Select** combo box, select the edge (**Rising Edge** or **Falling Edge**) of the tachometer input signal that you want to use to start the measurement.
   b. From the Measure Mode combo box, select **Zeros** (the default) if you want to read a value of 0 between measurements, or select **Previous Measurement** if you want to read the previous measurement value if the new measurement value is not yet complete.
   c. From the **Stale Data** combo box, select **Used** (the default value) if you want to indicate whether or not the measurement value if new, or select **Not Used** if you do not want to indicate whether the measurement value is new. If you select **Used**, the most significant bit (MSB) of the measurement value is set to 0 when the value is new and set to 1 when the measurement is not yet complete. If you select **Not Used**, the MSB of the measurement value is always 0.

9. On the DT9837A and DT9837B modules, you can measure the time from the stopping edge of the tachometer input signal to the A/D sample or from the A/D sample to the stopping edge of the tachometer input signal by specifying channel 5 (tachometer counter 1) in the analog input channel list; see page 64 for more information. Configure the Tach.CT1 measurement parameters as follows:

   a. From the **Start Select** combo box, select the signal that you want to use to start the measurement (**A/D Sample**, **Tach Input Rising Edge**, or **Tach Input Falling Edge**).

   b. From the **Stop Select** combo box, select the signal that you want to use to stop the measurement (**A/D Sample**, **Tach Input Rising Edge**, or **Tach Input Falling Edge**).

      Note that if you choose to start the measurement using the A/D sample, choose a tachometer edge to stop the measurement. Likewise, if you choose to stop the measurement using the A/D sample, choose a tachometer edge to start the measurement.

   c. From the **Self Clear** combo box, select **Clear to zero** (the default value) if you want to return a value of 0 between measurements, or select **Keep last Value** if you want to return the previous measurement value between readings.

10. For the DT9837A-OEM module and DT9837B modules only, you can also measure the time between the A/D sample to the specified edge of the gate input signal, the time between two gate input signals, or the time between the specified edge of the gate input signal to the A/D sample by specifying channel 6 (gate counter 2) in the analog input channel list; see page 66 for more information. Configure the Gate.CT2 measurement parameters as follows:

    a. From the **Start Select** combo box, select the signal that you want to use to start the measurement (**A/D Sample**, **Gate Rising Edge**, or **Gate Falling Edge**).

    b. From the **Stop Select** combo box, select the signal that you want to use to stop the measurement (**A/D Sample**, **Gate Rising Edge**, or **Gate Falling Edge**).

       Note that if you choose to start the measurement using the A/D sample, choose a gate edge to stop the measurement. Likewise, if you choose to stop the measurement using the A/D sample, choose a gate edge to start the measurement.

    c. From the **Self Clear** combo box, select **Clear to zero** (the default value) if you want to return a value of 0 between measurements, or select **Keep last Value** if you want to return the previous measurement value between readings.

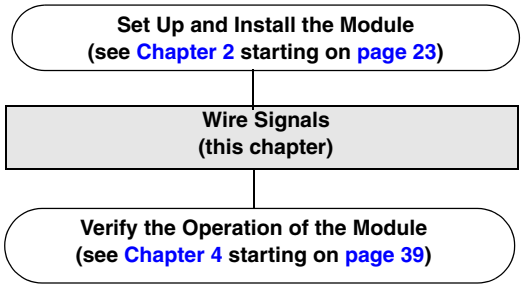
11. When you are finished, click **OK** to close the Measurement Options dialog box.

12. Repeat steps 4 to 11 for the other modules that you want to configure.

13. When you are finished configuring the modules, click **Close** to close the Control Panel.

Note: If you need to configure these settings programmatically instead of using the Open Layers Control Panel, you can write to the registers of the module. Refer to Appendix C starting on page 127 for more information.

Wiring Signals


Set Up and Install the Module
(see Chapter 2 starting on page 23)
Wire Signals
(this chapter)
Verify the Operation of the Module
(see Chapter 4 starting on page 39)

Preparing to Wire Signals

This section provides recommendations and information about wiring signals to a DT9837 Series module.

Wiring Recommendations

Keep the following recommendations in mind when wiring signals to a DT9837 Series module:

- Follow standard ESD procedures when wiring signals to the module.
- Separate power and signal lines by using physically different wiring paths or conduits.
- To avoid noise, do not locate the module and cabling next to sources that produce high electromagnetic fields, such as large electric motors, power lines, solenoids, and electric arcs, unless the signals are enclosed in a mumetal shield.
- Prevent electrostatic discharge to the I/O while the module is operational.
- Connect all unused analog input channels to analog ground.

Wiring Signals to the Module

The DT9837 module contains five BNC connectors on one end of the module, and two BNC connectors and a USB connector on the other end of the module as shown in Figure 4.

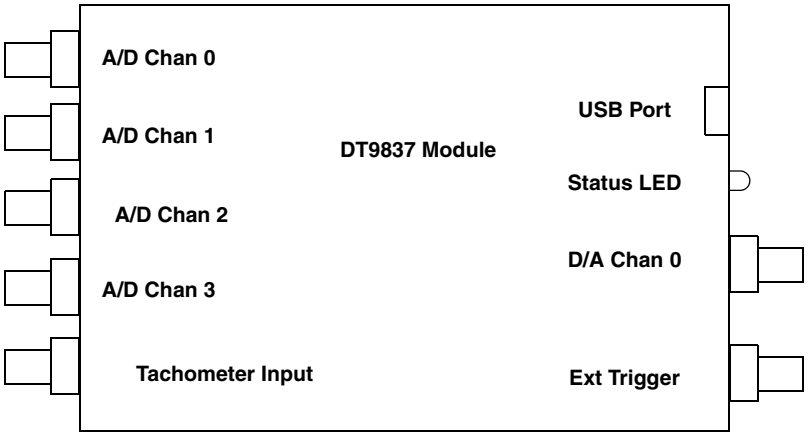


Figure 4: Connectors on the DT9837 Module

The DT9837A module provides all of these connectors and an additional RJ45 LVDS connector for connecting multiple DT9837A modules, as shown in Figure 5.

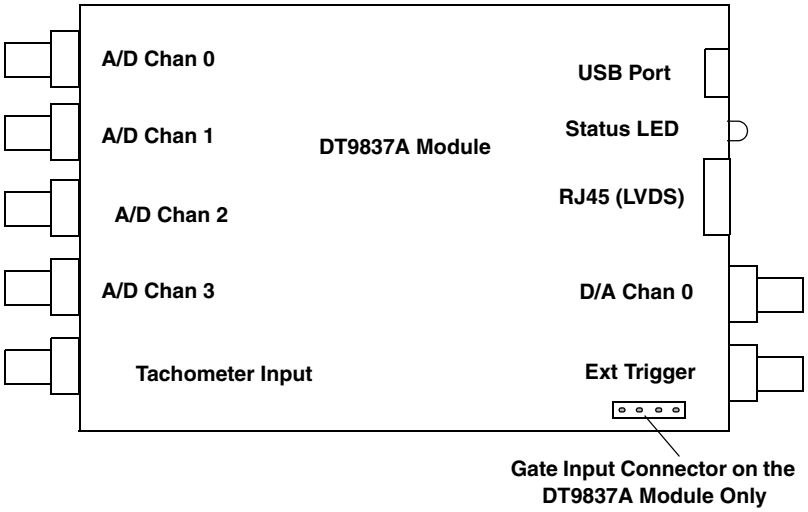


Figure 5: Connectors on the DT9837A Module

The DT9837B module provides all of the connectors as on the DT9837A module, except the analog output connector, as shown in Figure 6.

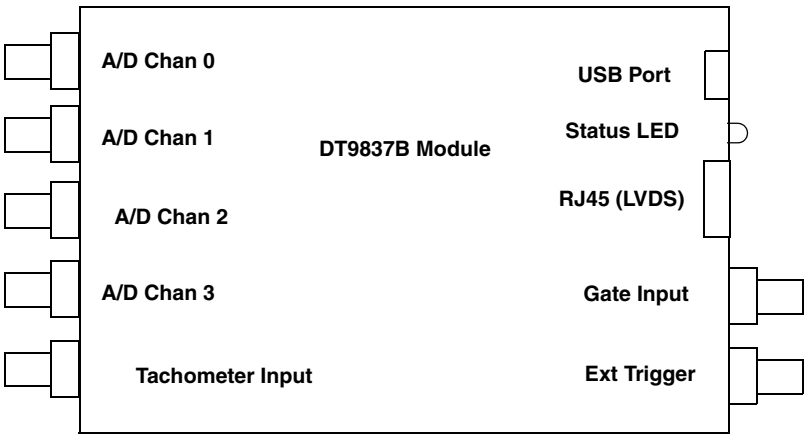


Figure 6: Connectors on the DT9837B Module

The remaining sections of this chapter describe how to attach signals to these connectors.

Connecting Analog Input Signals

You can connect up to four analog input signals (or IEPE sensors) to the BNC connectors on a DT9837 Series module. Internally, these signals are connected in single-ended mode. The DT9837 Series modules support an input signal range of ±10 V (using a gain of 1) or ±1 V (using a gain of 10).

Note: If you enable the use of the internal 4 mA excitation current source for IEPE inputs, it is recommended that you choose AC coupling. Refer to page 51 for more information on IEPE inputs.

Figure 7 shows how to connect analog inputs (channels 0 and 1, in this case) to the BNC connectors on the DT9837 Series modules.

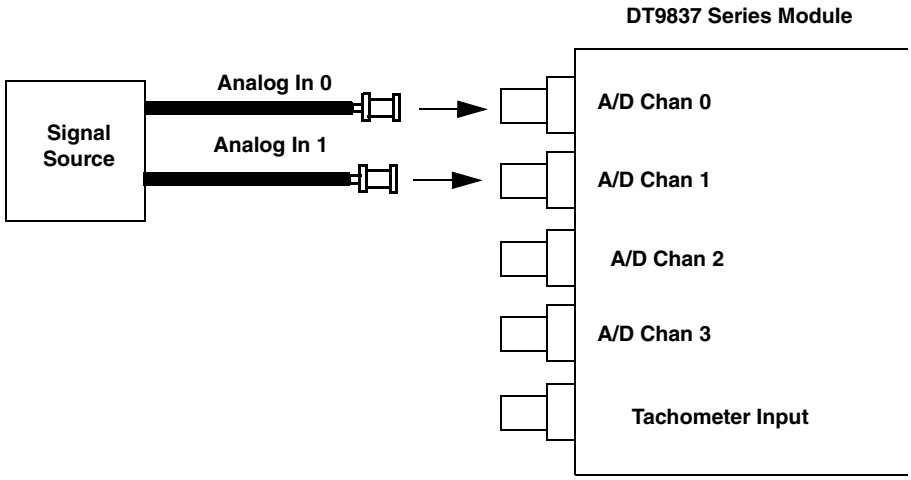


Figure 7: Connecting Analog Inputs to a DT9837 Series Module

Connecting an Analog Output Signal

The DT9837 and DT9837A modules provide one analog output channel with an output range of ±10 V. Figure 8 shows how to connect an analog output signal to the DT9837 or DT9837A module.

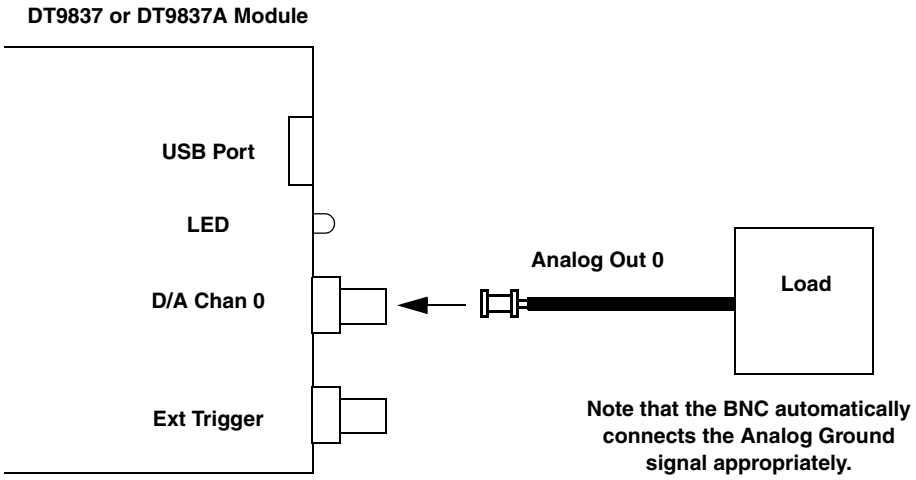


Figure 8: Connecting an Analog Output Signal to a DT9837 or DT9837A Module

Connecting a Tachometer Input Signal

You can connect a ±30 V tachometer input signal to the tachometer input BNC on a DT9837 Series module, as shown in Figure 9.

Note: In software, you can read tachometer measurements as part of the analog input channel list. Refer to page 63 for more information on tachometer measurements.

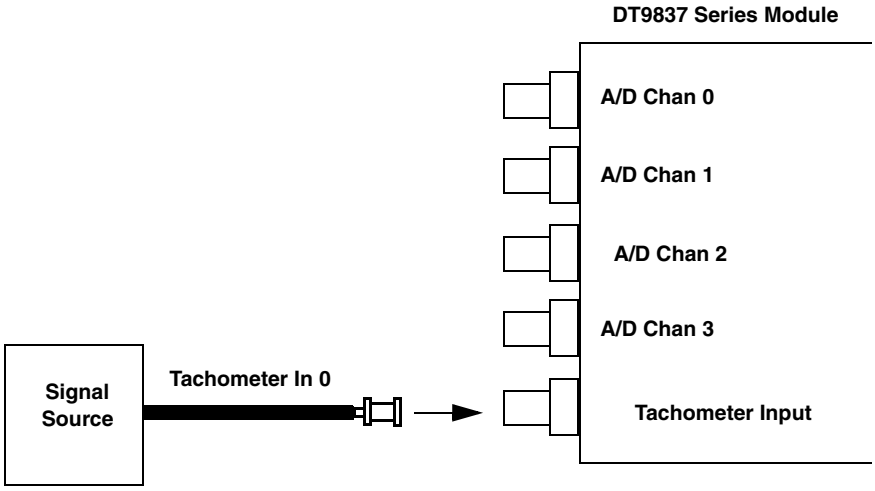


Figure 9: Connecting a Tachometer Input Signal to a DT9837 Series Module

Connecting a Gate Input Signal

The DT9837A-OEM module provides a 4-pin Gate Input connector for measuring period, frequency, and pulse width values. The DT9837B provides a BNC connector for attaching a gate input signal. Figure 10 shows how to connect a TTL gate input signal to the DT9837A-OEM module.

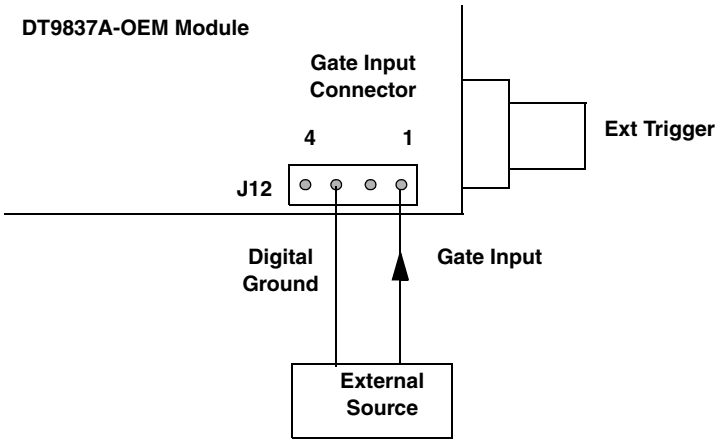


Figure 10: Connecting a Gate Input Signal to the DT9837A-OEM Module

Figure 11 shows how to attach TTL gate input signal to a DT9837B module.

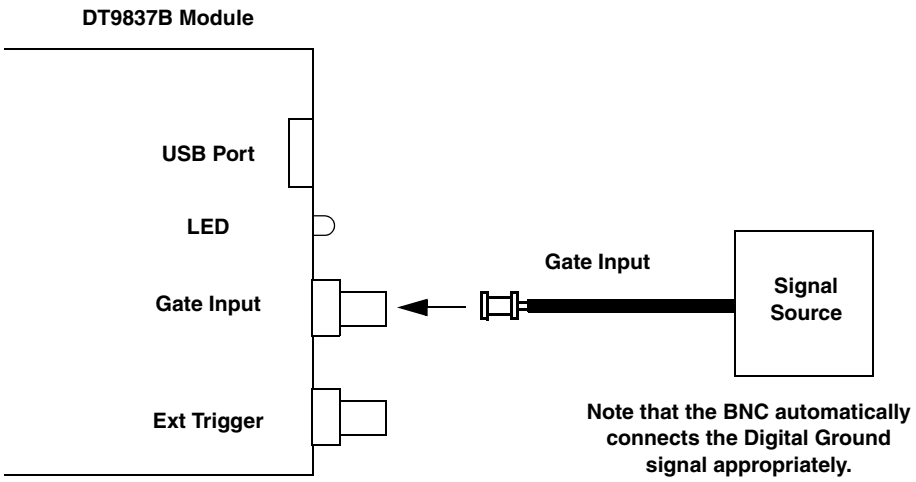
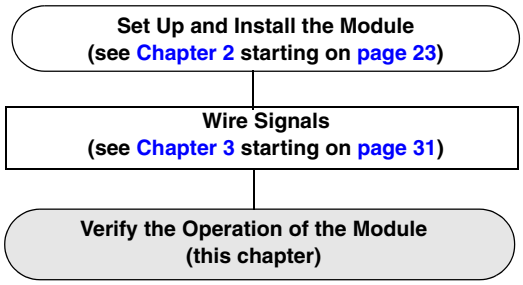


Figure 11: Connecting a Gate Input Signal to a DT9837B Module

Note: In software, you can read the gate measurements as part of the analog input channel list. Refer to page 66 for more information on gate input measurements.

Verifying the Operation of a Module



You can verify the operation of a DT9837 Series module using the Quick DataAcq application. Quick DataAcq lets you do the following:

- Acquire data from a single analog input channel
- Acquire data continuously from one or more analog input channels using the strip chart or Fast Fourier Transform (FFT) view
- Output a single value from the analog output channel (on the DT9837 and DT9837A)

Note: This application does not support configuring AC/DC coupling or the excitation current source for IEPE inputs.

Running the Quick DataAcq Application

The Quick DataAcq application is installed automatically when you install the driver software.

To run the Quick DataAcq application, do the following:

1. If you have not already done so, power up your computer and any attached peripherals.
2. Click **Start** from the Task Bar.
3. Browse to **Programs | Data Translation, Inc | DT-Open Layers for Win32 | QuickDataAcq**.
   The main menu appears.

Note: The Quick DataAcq application allows you to verify basic operations on the board; however, it may not support all of the board's features.

For information on each of the features provided, use the online help for the Quick DataAcq application by pressing F1 from any view or selecting the **Help** menu. If the system has trouble finding the help file, navigate to C:\Program Files\Data Translation\Win32\dtdataacq.hlp, where C: is the letter of your hard disk drive.

Testing Single-Value Analog Input

To verify that the module can read a single analog input value, do the following:

1. Connect a voltage source, such as a function generator, to analog input channel 0 on the DT9837 Series module. Refer to page 35 for an example of how to connect an analog input.
2. In the Quick DataAcq application, choose **Single Analog Input** from the **Acquisition** menu.
3. Select the appropriate module from the **Board** list box.
4. In the **Channel** list box, select analog input channel 0.
5. In the **Range** list box, select the range for the channel. *The default is ±10 V.*
6. Select **Single-Ended**.
7. Click **Get** to acquire a single value from analog input channel 0.
   The application displays the value on the screen in both text and graphical form.

Testing Continuous Analog Input

To verify that the module can perform a continuous analog input operation, do the following:

1. Connect known voltage sources, such as the outputs of a function generator, to analog input channels 0 and 1 on the DT9837 Series module.
2. In the Quick DataAcq application, choose **Strip Chart** from the **Acquisition** menu.
3. Select the module from the **Board** list box.
4. In the **V/Div** list box, select the number of volts per division (.1 to 5) for the display, and in the **Rate** list box, select the update rate for the display (.1 to 10).
5. In the **Channel** list box, select analog input channel 1, and then click **Add** to add the channel to the channel list. *Note that, by default, channel 0 is included in the channel list*.
6. Click **Config** from the Toolbar.
7. In the **Config** dialog, select **ChannelType**, and then select **Single-Ended**.
8. In the **Config** dialog, select **Range,** and then select **Bipolar**.
9. Click **OK** to close the dialog box
10. From the Strip Chart view, double-click the input range of the channel to see the input range of the module. *The default is ±10 V.*
    The display reflects the selected range for all the analog input channels on the module.
11. Click **Start** from the Toolbar to start the continuous analog input operation.
    The application displays the values acquired from each channel in a unique color on the strip chart view.
12. Click **Stop** from the Toolbar to stop the operation.

Testing Single-Value Analog Output

To verify that the module can output a single analog output value on the DT9837 or DT9837A, do the following:

1. Connect an oscilloscope or voltmeter to analog output channel 0 on the module. Refer to page 36 for an example of how to connect analog output signals.
2. In the Quick DataAcq application, choose **Single Analog Output** from the **Control** menu.
3. Select the appropriate module from the **Board** list box.
4. In the **Channel** list box, select analog output channel 0.
5. In the **Range** list box, select the output range of DAC0. *The default is ±10 V.*
6. Enter an output value or use the slider to select a value to output from DAC0.
7. Click **Send** to output a single value from analog output channel 0.
   The application displays the output value both on the slider and in the text box.

Part 2: Using Your Module

Principles of Operation

Figure 12 shows a block diagram of the DT9837 module.

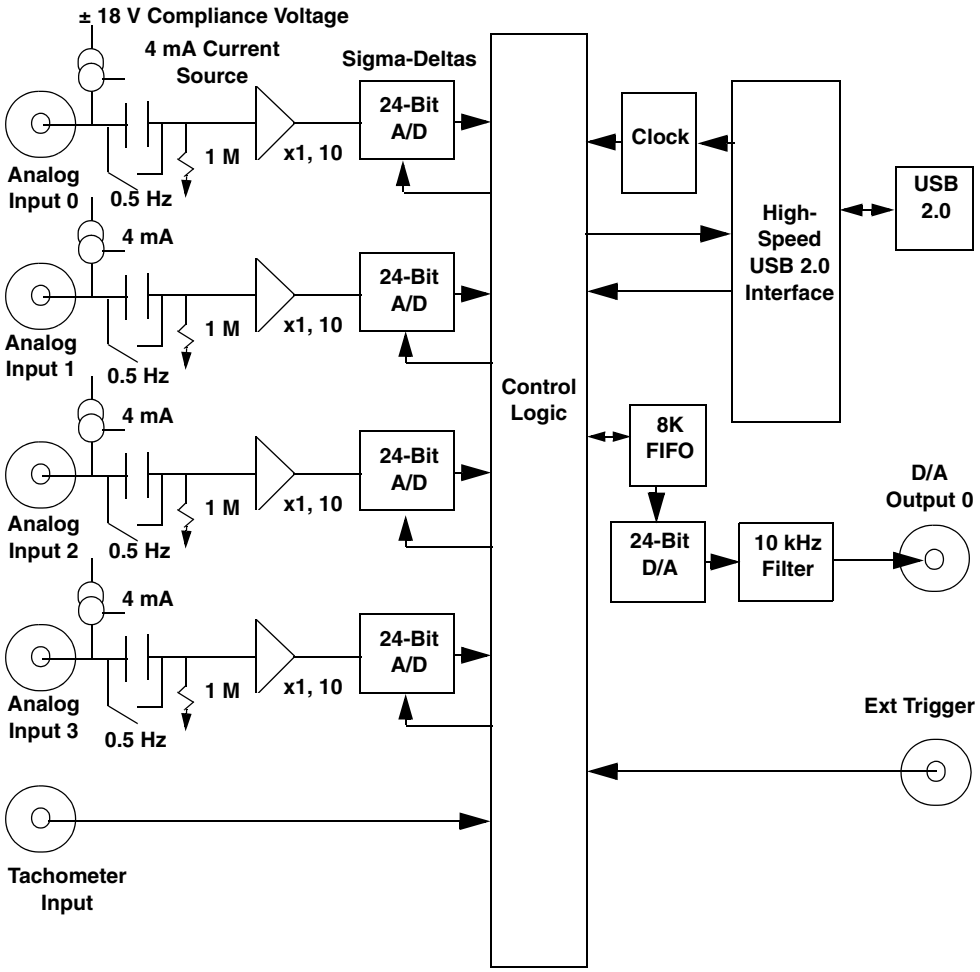


Figure 12: Block Diagram of the DT9837 Module

Figure 13 shows a block diagram of the DT9837A module.

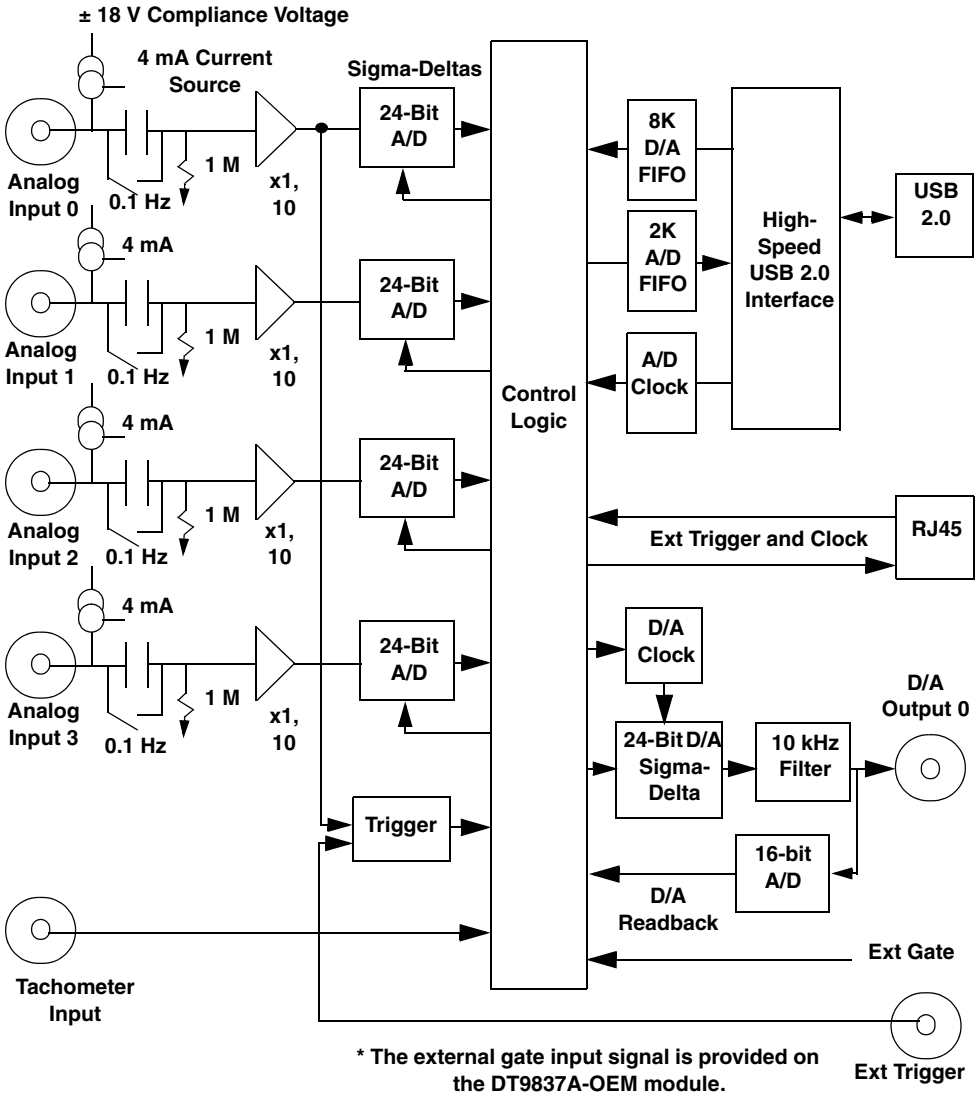


Figure 13: Block Diagram of the DT9837A Module

Figure 14 shows a block diagram of the DT9837B module.

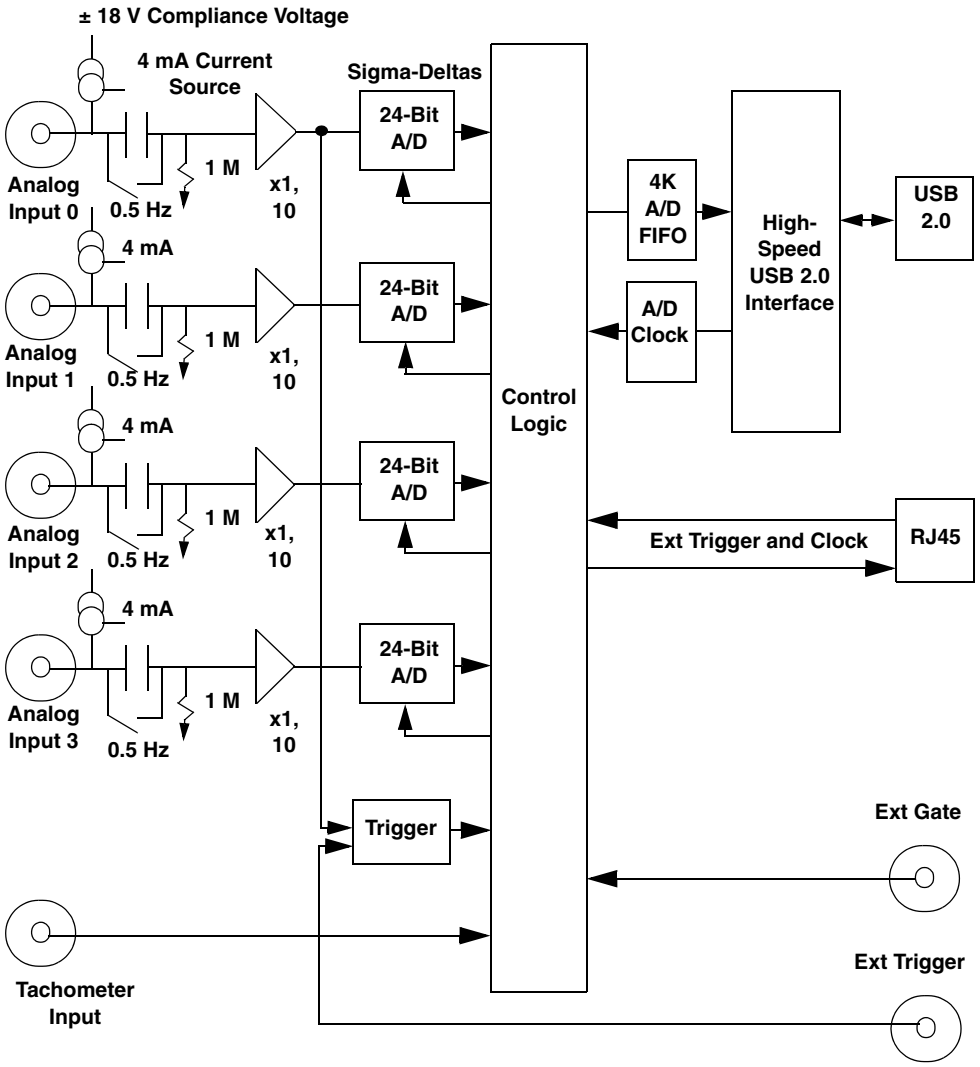


Figure 14: Block Diagram of the DT9837B Module

Analog Input Features

This section describes the following features of analog input (A/D) subsystem on the DT9837 Series modules:

- Analog input channels, described on this page
- IEPE functions, described on page 52
- Input resolution, described on page 52
- Input ranges and gains, described on page 51
- Input sample clock sources, described on page 52
- Analog input conversion modes, described on page 53
- Input triggers, described on page 55
- Data format and transfer, described on page 56
- Error conditions, described on page 57

Analog Input Channels

The DT9837 Series modules support four, single-ended analog input channels (numbered 0 to 3). All analog input channels are simultaneously clocked. If desired, you can connect IEPE sensors to these inputs; refer to page 52 for more information on IEPE functions.

Note: To maintain simultaneous operation, all analog input connections must have the same lead lengths.

The DT9837 Series modules use Delta-Sigma analog-to-digital converters (ADCs) that provide anti-aliasing filters based on the clock rate. These filters remove *aliasing*, which is a condition where high frequency input components erroneously appear as lower frequencies after sampling.

DT9837 Series modules can acquire a single value from a single analog input channel, a single value from all the analog input channels simultaneously, or multiple values from a group of analog input channels, as well as the data tachometer counter 0. On the DT9837A and DT9837B module, you can also acquire data from tachometer counter 1 and gate counter 2. Additionally, the DT9837A allows you to read the value of the analog output readback channel. Refer to"Analog Input Conversion Modes" on page 53 for more information on specifying and reading data from these channels.

Input Ranges and Gains

The DT9837 Series modules provide an input range of ±10 V and software-selectable gains of 1 and 10. This provides effective input ranges of ±10 V (when the gain is 1) and ±1 V (when the gain is 10).

IEPE Functions

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 DT9837 Series modules. The modules support the following software-programmable IEPE functions for each of the four analog inputs:

- Excitation current source – You can enable or disable the use of a 4 mA, internal excitation current source. By default, the excitation current source is disabled.
- Coupling type – You can select whether AC coupling or DC coupling is used. By default, DC coupling is selected for the DT9837 and DT9837A modules, and AC coupling is selected for the DT9837B module.

You can change the IEPE settings using the Open Layers Control Panel applet, described on page 29, or by writing to the registers of the module, as described on Appendix C starting on page 127. For information on wiring IEPE inputs, refer to page 35.

Note: If you enable the use of the internal 4 mA excitation current source, it is recommended that you choose AC coupling.

Input Resolution

The resolution of the analog input channels is fixed at 24 bits; you cannot specify the resolution in software.

Input Clock Source

The DT9837 Series modules support an internal clock, which is derived from the USB clock.

Use software to specify the internal clock source and the frequency at which to pace the input and output operations and to start the sample clock. For the DT9837 and DT9837A, the sampling frequency ranges from 195.3 Hz to 52.734 kHz. For the DT9837B, the sampling frequency ranges from 195.3 Hz to 105.469 kHz.

Note: According to sampling theory (Nyquist Theorem), specify a frequency that is at least twice as fast as the input's highest frequency component. For example, to accurately sample a 20 kHz signal, specify a sampling frequency of at least 40 kHz to avoid aliasing.

The modules support a wide pass band of 0.5 Hz (0.1 Hz for the DT9837A) to 25.8 kHz (0.49 x sampling frequency) to eliminate aliasing, allowing you to measure low frequency signals accurately at the Nyquist sampling rate.

The actual frequency that the module can achieve may be slightly different than the frequency you specified due to the accuracy of the clock. You can determine the actual clock frequency using software.

Internally, the value that you specify for the internal clock frequency is multiplied by 512 (for frequencies of 52.734 kHz or less) or 256 (for frequencies greater than 52.734 kHz) to set the oscillator on the module. For example, if you specify an internal clock frequency of 50 kHz, the module sets the internal oscillator for the A/D converters to 25.6 MHz. The maximum timebase is 27 MHz.

Once the sample clock is started, the module requires 39 clock pulses before the first A/D conversion is completed (39/sample rate) due to the group delay of the converters. The software automatically adjusts for the group delay to provide only valid data in each buffer.

The tachometer data (which does not have the 39 sample group delay) is synchronized with the analog data stream. This is done through the firmware and device driver by caching the tachometer data and aligning it in time with the analog data in the user's data buffers.

Analog Input Conversion Modes

DT9837 Series modules support single-value, single-values, and continuous scan conversion modes. This section describes each of these conversion modes.

Single-Value Operations

Single-value operations are simpler to use than continuous operations. Using software, you specify the analog input channel (0, 1, 2, or 3) and the gain that you want to use. The module acquires the data from the specified channel and returns the data immediately.

For single-value operations, you cannot specify a clock source, trigger source, scan mode, or buffer. Single-value operations stop automatically when finished; you cannot stop a single-value operation.

Note: You cannot read the value of tachometer counter 0 (described on page 63), tachometer counter 1 (described on page 64), gate counter 2 (described on page 66), or the analog output readback channel (described on page 61) using a standard single-value operation. To read these values, specify the channels as part of the analog input channel list using continuous scan mode, described on page 54.

Single-Values Operations

If you prefer to read a single value from all the analog input channels simultaneously using one software call, use a single-values operation. You specify the analog input subsystem and the gain that you want to use for the channels (not the channels themselves). The module then acquires a value from each input channel simultaneously; the data is returned as an array of input values.

Note: For the DT9837, a single values operation also returns a valid value from tachometer counter 0 (analog input channel 4), described on page 63.

For the DT9837A or DT9837B, a single values operation returns values from the analog input channels as well as from tachometer counter 0 (described on page 63), tachometer counter 1 (described on page 64), gate counter 2 (described on page 66), and the analog output readback channel (for the DT9837A; described on page 61), but only the data from analog input channels 0 through 3 is valid. Use continuous scan mode, described next, to read valid data from the tachometer counters, gate counter, and analog output readback channel.

For single-values operations, you cannot specify a clock source, trigger source, scan mode, or buffer. Single-values operations stop automatically when finished; you cannot stop a single-values operation.

Continuous Scan Mode

Continuous scan mode takes full advantage of the capabilities of the DT9837 Series modules. You can specify a channel list, clock source, trigger source, and buffer using software.

On the DT9837 module, you can enter up to 5 entries in the channel list, including four analog input channels (A/D channel 0 to 3) and tachometer counter 0 (A/D channel 4), described on page 63.

On the DT9837A module, you can enter up to 8 entries in the channel list, including four analog input channels (A/D channels 0 to 3), tachometer counter 0 (A/D channel 4), described on page 63, tachometer counter 1 (A/D channel 5), described on page 64, gate counter 2 (A/D channel 6), described on page 66, and the analog output readback value (A/D channel 7), described on page 61. mode). Using software, specify the channels you want to sample in sequential order.

On the DT9837B module, you can enter up to 7 entries in the channel list, including four analog input channels (A/D channels 0 to 3), tachometer counter 0 (A/D channel 4), described on page 63, tachometer counter 1 (A/D channel 5), described on page 64, and gate counter 2 (A/D channel 6), described on page 66. Using software, specify the channels you want to sample in sequential order.

When it detects an initial trigger, the module simultaneously samples all of the input channels specified in the channel list and converts the analog input data. The sampled data is placed in the allocated buffer(s) and the operation continues until the allocated buffers are filled or until you stop the operation. Refer to page 56 for more information about buffers.

The conversion rate is determined by the frequency of the input sample clock; refer to page 52 for more information about the input sample clock.

Using software, you can stop a scan by performing either an orderly stop or an abrupt stop. In an orderly stop, the module finishes acquiring the current buffer, stops all subsequent acquisition, and transfers the acquired data to host memory; any subsequent triggers are ignored. In an abrupt stop, the module stops acquiring samples immediately; the current buffer is not completely filled, it is returned to the application only partially filled, and any subsequent triggers are ignored.

To select continuous scan mode, use software to specify the following parameters:

- Specify the data flow as Continuous
- Specify the clock source as internal and specify the clock frequency (refer to page 52)
- Specify the trigger source as any of the supported trigger sources (refer to page 55)

Figure 15 illustrates continuous scan mode using a channel list with five entries: channel 0, 1, 2, 3, and 4. In this example, data is acquired simultaneously on all channels on each clock pulse of the input sample clock. Data is acquired continuously until all the queued buffers have been filled or you stop the operation.

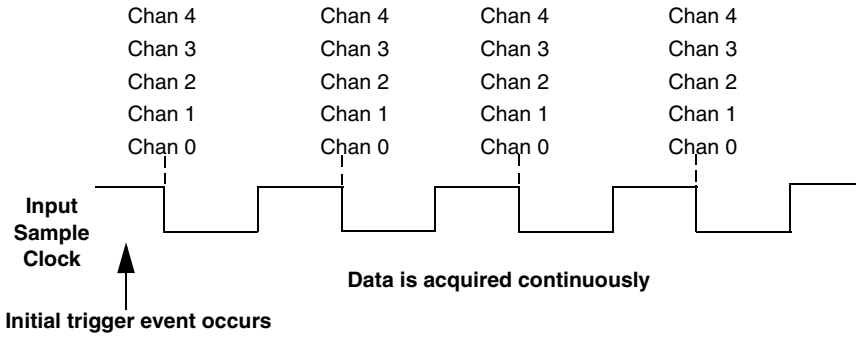


Figure 15: Continuous Scan Mode

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 either all the buffers that have been queued to the subsystem have been filled or you stop the operation.

The DT9837 Series modules support the following trigger sources for starting analog input operations:

- **Software trigger** – A software trigger event occurs when you start the analog input operation (the computer issues a write to the module to begin conversions). Using software, specify the trigger source as a software trigger.
- **External digital (TTL) trigger** – An external digital (TTL) trigger event occurs when the module detects a rising-edge transition on the signal connected to the Ext Trig BNC connector on the module. Using software, specify the trigger source as an external, positive digital (TTL) trigger.

Note: On the DT9837A and DT9837B modules, if you configure the synchronization mode as slave, the RJ45 connector accepts trigger and clock signals from the master; you cannot use the Ext Trig BNC connector on the slave module. Refer to page 68 for more information.

- **Analog threshold trigger** – For the DT9837 module only, an analog threshold trigger event occurs when the signal attached to analog input channel 0 rises above 1.0 V (the fixed threshold level). Using software, specify the trigger source as a positive threshold trigger.

  For the DT9837A and DT9837B modules, an analog threshold trigger event occurs when the signal attached to analog input channel 0 rises above a user-specified threshold value from 0.2 V to 9.8 V with 0.1 V of hysteresis. Using software, specify the trigger source as a positive threshold trigger.

Note: Channel 0 does not have to be included in the channel list for the analog threshold trigger to work.

On the DT9837A and DT9837B modules, if you configure the synchronization mode as slave, the RJ45 connector accepts trigger and clock signals from the master; you cannot use the analog threshold trigger on the slave module. Refer to page 68 for more information.

Data Format and Transfer

DT9837 Series modules use offset binary data encoding, where 000000 represents negative full-scale, and FFFFFFh represents positive full-scale. Use software to specify the data encoding as binary. The ADC outputs FFFFFFh for above-range signals, and 000000 for below-range signals.

Before you begin acquiring data, you must allocate buffers to hold the data. A Buffer Done event is returned whenever a buffer is filled. This allows you to move and/or process the data as needed.

We recommend that you allocate a minimum of two buffers for continuous analog input operations. Data is written to multiple allocated input buffers continuously; when no more empty buffers are available, the operation stops. The data is gap-free.

Error Conditions

DT9837 Series modules report any overrun errors by sending an overrun event to the application program. This event indicates that data buffers are not being sent from the module to the host fast enough, and the A/D converter ran out of buffers. To avoid this error, try one or more of the following:

- Reduce the clock rate of the A/D
- Increase the size of the buffers
- Increase the number of buffers
- Close any other applications that are running
- Run the program on a faster computer

If one of these error conditions occurs, the module stops acquiring and transferring data to the host computer.

Analog Output Features

This section describes the following features of analog output operations:

- Analog output channels, described below
- Output ranges and gains, described below
- Output resolution, described on page 58
- Output conversion mode, described on page 59
- Output clocks, described on page 58
- Output triggers, described on page 61
- Data format and transfer, described on page 62
- Error conditions, described on page 62

Analog Output Channels

The DT9837 and DT9837A modules support one analog output channel through analog output subsystem 0. Note that on the DT9837A module only, you can read back the value of the analog output channel through the analog input channel list; refer to page 61 for more information.

A two-pole, 10 kHz Butterworth filter is applied to prevent noise from interfering with the output signal. The analog output channel powers up to a value of 0 V ±10 mV.

Output Ranges and Gains

The DT9837 and DT9837A modules can output bipolar analog output signals in the range of ±10 V, with a gain of 1.

Output Resolution

The resolution of the analog output channel is fixed at 24-bits; you cannot specify the resolution in software.

Output Clocks

The output clock on the DT9837 and DT9837A modules is derived from the USB clock to produce the output clock frequency.

On the DT9837 module, the clock frequency is fixed at 46.875 kHz. On the DT9837A module, you can program the clock frequency to value between 10 kHz and 52.734 kHz. Use software to specify an internal clock source and to specify the clock frequency for the analog output subsystem.

Internally, the value that you specify for the analog output clock frequency is multiplied by 512 to set the oscillator on the module. The maximum timebase for the DT9837 is 24 MHz; the maximum timebase for the DT9837A is 27 MHz.

Due to the group delay of the Delta-Sigma D/A converter, the DT9837 requires 34 clock pulses and the DT9837A requires 29 clock pulses once the analog output sample clock is started before the first D/A conversion is completed.

Output Conversion Modes

The DT9837 and DT9837A modules support single-value and waveform analog output operations. The DT9837A module also supports continuous analog output operations. This section describes each of these conversion modes.

Note: The DT9837A also provides the ability to read the value of the analog output channel in the analog input data stream. Refer to page 61 for more information.

Single-Value Mode

Single-value mode is the simplest to use but offers the least flexibility and efficiency. Use software to specify the analog output channel that you want to update, and the value to output from that channel. The value is output from the specified channel immediately.

For a single-value operation, you cannot specify a clock source, trigger source, or buffer. Single-value operations stop automatically when finished; you cannot stop a single-value operation.

Note: On the DT9837 module, ensure that no analog input operations are running before performing an analog output operation or an error will be reported.

Waveform Generation Mode

Waveform generation mode is supported on both the DT9837 and DT9837A modules. In this mode, a waveform, which is specified in a single buffer, is output repetitively.

On the DT9837, allocate a buffer less than or equal to 8192 samples, and then fill the buffer with the waveform that you want to output. On the DT9837A, you can allocate a buffer of any size, and then fill the buffer with the waveform that you want to output.

When it detects a software trigger, the host computer transfers the entire waveform pattern to the FIFO on the module, and the module starts writing output values to the analog output channel at the specified clock rate. The module recycles the data, allowing you to output the same pattern continuously without any further CPU or USB bus activity.

When it reaches the end of the FIFO, the module returns to the first location of the FIFO and continues outputting the data. This process continues indefinitely until you stop it.

To select waveform generation mode, use software to specify the following parameters:

- Specify the data flow as Continuous
- Specify WrapSingleBuffer as True to use a single buffer
- Specify the clock source as internal and specify the clock frequency. Refer to page 58 for more information about the clock source and frequency.
- Specify a software trigger source, described in the next section

---

Note: On the DT9837, an error will be reported if you specify a buffer with greater than 8192 samples (the size of the FIFO on the module).

If you want to output data from the analog output channel on the DT9837 module while acquiring analog input data, ensure that you set up and start the analog output operation before starting the analog input operation, or an error will be reported.

Continuous Analog Output Operations

Continuous analog output operations are supported on the DT9837A module only. Use continuously paced analog output mode to continuously output buffered values to the analog output channel at a specified clock frequency.

Use software to fill multiple output buffers with the values that you want to write to the analog output channel. When it detects the specified trigger, the module starts writing the values from the output buffer to the analog output channel at the specified clock frequency. The operation repeats continuously until either all the data is output from the buffers or you stop the operation.

Note: Make sure that the host computer transfers data to the output channel list fast enough so that the list does not empty completely; otherwise, an underrun error results.

To select continuously paced analog output mode, use software to specify the following parameters:

- Specify the data flow as Continuous
- Specify WrapSingleBuffer as False to use multiple buffers
- Specify the clock source as internal and specify the clock frequency. Refer to page 58 for more information about the clock source and frequency.
- Specify the trigger source as any of the supported trigger sources. Refer to page 61 for more information about the supported trigger sources.

We recommend that you allocate a minimum of two buffers for a continuously paced analog output operation. Data is written from multiple output buffers continuously; when no more buffers of data are available, the operation stops. The data is gap-free.

To stop a continuously paced analog output operation, you can stop queuing buffers for the analog output system, letting the module stop when it runs out of data, or you can perform either an orderly stop or an abrupt stop using software. In an orderly stop, the module finishes outputting the specified number of samples, and then stops; all subsequent triggers are ignored. In an abrupt stop, the module stops outputting samples immediately; all subsequent triggers are ignored.

Reading the Analog Output Value in the Analog Input Data Stream (DT9837A Module Only)

On the DT9837A module, you can read back the value of the analog output channel in the analog input data stream. Specify channel 7 in the analog input channel list to read back the value of the analog output channel.

When the analog input operation is started, the value of the analog output channel is returned in the analog input data stream. (An analog value is returned.) The software automatically synchronizes the value of the analog output channel with the analog input measurements, so that all measurements are correlated in time.

Output Trigger

The DT9837 and DT9837A modules support the following trigger sources for starting analog output operations:

- **Software trigger** – A software trigger event occurs when you start the analog output operation (the computer issues a write to the module to begin conversions). Using software, specify the trigger source for D/A subsystem 0 as a software trigger.
- **External digital (TTL) trigger** – This trigger source is supported on the DT9837A only. An external digital (TTL) trigger event occurs when the module detects a rising-edge transition on the signal connected to the Ext Trig BNC connector on the module. Using software, specify the trigger source for D/A subsystem 0 as an external, positive digital (TTL) trigger.

Note: If you configure the synchronization mode as slave, the RJ45 connector accepts trigger and clock signals from the master; you cannot use the Ext Trig BNC connector on the slave module. Refer to page 68 for more information.

- **Analog threshold trigger** – This trigger source is supported on the DT9837A only. An analog threshold trigger event occurs when the signal attached to analog input channel 0 rises above a user-specified threshold value from 0.2 V to 9.8 V with 0.1 V of hysteresis. Using software, specify the trigger source for D/A subsystem 0 as a positive threshold trigger. Use D/A subsystem 1 to program the threshold value.

Note: If you configure the synchronization mode as slave, the RJ45 connector accepts trigger and clock signals from the master; you cannot use the analog threshold trigger on the slave module. Refer to page 68 for more information.

Data Format and Transfer

Data from the host computer must use offset binary data encoding for analog output signals, where 000000 represents –10 V, and FFFFFFh represents +10 V. Using software, specify the data encoding as binary.

Error Conditions

The DT9837 and DT9837A modules report any underrun errors by sending an underrun event to the application. This event indicates that the data buffers are not being sent from the host to the module fast enough, and the D/A converter ran out of data. To avoid this error, try one or more of the following:

- Reduce the clock rate of the analog output operation
- For the DT9837, ensure that you allocate a single buffer with 8192 or fewer samples
- Close any other applications that are running
- Run the program on a faster computer

Tachometer Input Features

You can connect a tachometer signal with a range of ±30 V to the DT9837 Series modules. On the DT9837, this signal has a maximum frequency of 380 kHz and a minimum pulse width of 1.3 µs. On the DT9837A and DT9837B, this signal has a maximum frequency of 1 MHz and a minimum pulse width of 0.4 µs. The threshold voltage is fixed at ±2 V with 0.5 V of hysteresis.

You can measure the frequency or period of the tachometer input signal using tachometer counter 0. On the DT9837A and DT9837B modules, you can also measure the phase of the tachometer input signal in relation to the A/D sample using tachometer counter 1. These measurements are described in more detail in the following subsections.

Frequency or Period Measurements – Tachometer Counter 0

Use frequency or period measurements to calculate the rotation speed for high-level (±30 V) tachometer input signals. An internal 12 MHz counter (tachometer counter 0) is used for the measurement, yielding a resolution of 83 ns (1/12 MHz).

You can read the number of counts between two consecutive starting edges of the tachometer input signal by including channel 4 in the analog input channel list. On the DT9837 module, the starting edge is always rising; on the DT9837A and DT9837B modules, the starting edge is programmable (either rising or falling).

You can specify the following parameters for tachometer counter 0 using the Open Layers Control Panel applet, described on page 29, or by writing to the registers of the module, as described in Appendix C starting on page 127:

- The starting edge of the tachometer input signal to use for the measurement (rising or falling edge). On the DT9837 module, the starting edge is always the rising edge.
- The value read between measurements (either zero, the default value, or the previous measurement value). On the DT9837 module, this value is always the previous measurement value.
- A flag (called Stale) indicating whether or not the data is new. If the Stale flag is set as Used (the default value), the most significant bit (MSB) of the value is set to 0 to indicate new data; reading the value before the measurement is complete returns an MSB of 1. If the Stale flag is set to Not Used, the MSB is always set to 0.

  On the DT9837 module, the MSB is always 0 (not used).

When the operation is started, the internal 12 MHz counter starts incrementing when it detects the first starting edge of the tachometer input and stops incrementing when it detects the next starting edge of the tachometer input. When the measurement is complete, the counter/timer remains idle until it is read. On the next read, either 0 or the current value of the tachometer input (from the previous measurement operation) is returned depending on the module and the Control Panel settings, described above, and the next operation is started automatically.

The software automatically synchronizes the value of the tachometer input with the analog input measurements, so that all measurements are correlated in time. The tachometer input is treated like any other channel in the analog input channel list; therefore, all the triggering and conversion modes supported for analog input channels are supported for the tachometer input.

When you read the value of the tachometer input as part of the analog input data stream, you might see results similar to the following (note that this assumes that the previous measurement value is returned between new measurement values):

Table 2: An Example of Reading the Tachometer Input as Part of the Analog Input Data Stream

Time	A/D Value	Tachometer Input Value	Status of Operation
10	5002	0	Operation started, but is not complete
20	5004	0	Operation not complete
30	5003	0	Operation not complete
40	5002	12373	Operation complete
50	5000	12373	Next operation started, but is not complete
60	5002	12373	Operation not complete
70	5004	12373	Operation not complete
80	5003	14503	Operation complete
90	5002	14503	Next operation started, but is not complete

Using the count that is returned from the tachometer input, you can determine the following:

- Frequency of a signal pulse (the number of periods per second). You can calculate the frequency as follows:
  - Frequency = 12 MHz/(Number of counts – 1)
    where 12 MHz is the internal counter/timer clock frequency

    For example, if the count is 21, the measured frequency is 600 kHz (12 MHz/20).
- Period of a signal pulse. You can calculate the period as follows:
  - Period = 1/Frequency
  - Period = (Number of counts – 1)/12 MHz
    where 12 MHz is the internal counter/timer clock frequency

Phase Measurements – Tachometer Counter 1

On the DT9837A and DT9837B modules, you can measure the phase of the tachometer input in relation to the A/D sample by reading tachometer counter 1. To read the value of this counter, specify channel 5 in the analog input channel list.

An internal 48 MHz clock (with 21 ns resolution) is used to calculate the measurement, which allows you to precisely correlate tachometer measurements with the analog input data.

You can specify the following parameters for tachometer counter 1 using the Open Layers Control Panel applet, described on page 29, or by writing to the registers of the module, as described in Appendix C starting on page 127:

- The signal that starts the measurement: A/D sample, rising edge of the tachometer input signal, or falling edge of the tachometer input signal
- The signal that stops the measurement: A/D sample, rising edge of the tachometer input signal, or falling edge of the tachometer input signal

Note: Note that if you choose to start the measurement using the A/D sample, choose a tachometer edge to stop the measurement. Likewise, if you choose to stop the measurement using the A/D sample, choose a tachometer edge to start the measurement.

- The value of the Self-Clear flag, which determines the value that is read between measurements (either 0 or the previous measurement value)

Gate Input Features

The DT9837A-OEM module provides a 4-pin gate input connector for connecting a TTL gate input signal; see page 125 for connector pin assignments. The DT9837B module provides a BNC connector for connecting a gate input signal.

You can read the value of gate counter 2 to measure the time between the following signals:

- Completion of the A/D sample to the rising or falling edge of the gate input signal
- Rising or falling edge of the gate input signal to the rising or falling edge of the gate input signal, which you can use to determine the pulse width of the gate signal
- Rising or falling edge of the gate input signal to the completion of the A/D sample

For these measurements, specify channel 6 in the analog input channel list. An internal 48 MHz clock (with 21 ns resolution) is used for the measurements, which allows you to precisely correlate analog input data with measurements from the gate input signal.

You can specify the following parameters for gate counter 2 using the Open Layers Control Panel applet, described on page 29, or by writing to the registers of the module, as described in Appendix C starting on page 127:

- The signal that starts the measurement: A/D sample, gate rising edge, or gate falling edge
- The signal that stops the measurement: A/D sample, gate rising edge, or gate falling edge

---

Note: Note that if you choose to start the measurement using the A/D sample, choose a gate input edge to stop the measurement. Likewise, if you choose to stop the measurement using the A/D sample, choose a gate input edge to start the measurement.

If you choose the start and stop the measurement using the same gate edge, be aware that the stopping edge does not restart the measurement; the next starting edge will start the next measurement.

- The value of the Self-Clear flag, which determines the value that is read between measurements (either 0 or the previous measurement value)

Triggering Acquisition on Multiple Modules

Note: For DT9837A and DT9837B modules, you can synchronize acquisition on multiple modules using the RJ45 (LVDS) synchronization connector, described on page 68.

The internal clock on the DT9837 module and on the DT9837A and DT9837B modules when the synchronization mode is none (see page 68), is derived from the USB clock and provides the timing for both the analog input and analog output subsystems on the module.

You can start acquisition on multiple modules by connecting all modules to a shared external trigger input, as shown in Figure 16. When triggered, the modules start acquiring data at the same time.

Using this connection scheme, the measurements of one module may not be synchronous with the measurements of another module due to logic delays in the clocking and USB circuitry.

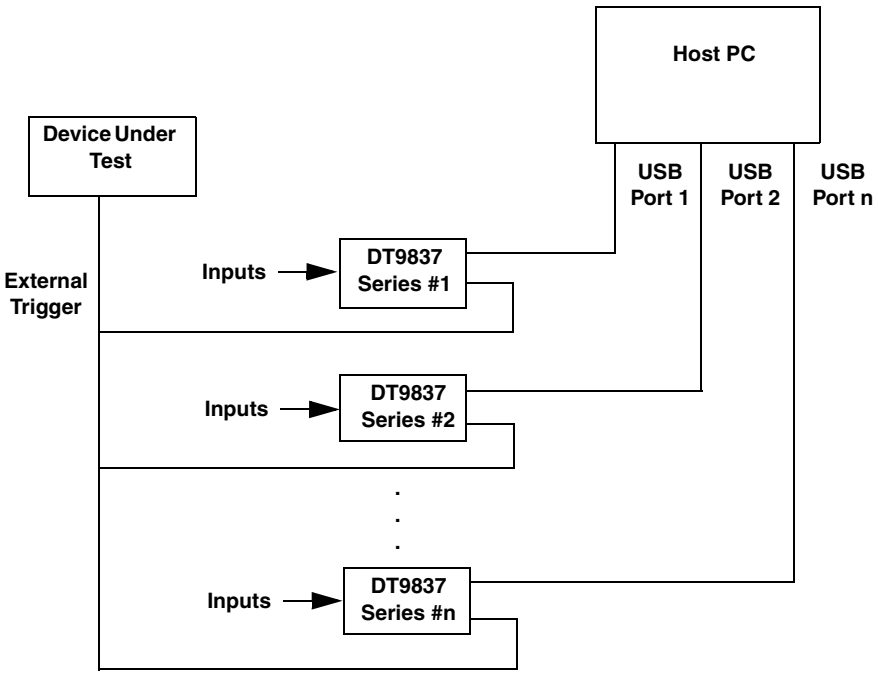


Figure 16: Triggering Multiple Modules Using an External Trigger Source

Synchronizing Acquisition on Multiple DT9837A or DT9837B Modules

DT9837A and DT9837B modules provide an RJ45 (LVDS) synchronization connector that you can use to connect and synchronize multiple DT9837A or DT9837B modules. In this scheme, one module is the master and the other modules are the slave. You specify the synchronization mode (master, slave, or none) of the RJ45 connector using software.

When configured as a master, the RJ45 synchronization connector outputs trigger and clock signals. When configured as a slave, the RJ45 connector accepts trigger and clock signals from the master; you cannot use the Ext Trig BNC connector or the analog threshold trigger on the slave module in this configuration. When configured as none (the default mode), the DT9837A or DT9837B module uses the USB clock instead of the RJ45 synchronization connector. The synchronization mode remains set until changed or until the application exits.

You can connect multiple modules in one of two ways. Figure 17 shows how to connect a maximum of two DT9837A or DT9837B modules by daisy chaining them together through the RJ45 connector. Figure 18 shows how to connect a maximum of four DT9837A or DT9837B modules by using an RJ45 distribution panel, such as the EP386, where the panel contains four RJ45 connectors that are wired in parallel.

Note: You must have revision H or later of the DT9837A module or revision F or later of the DT9837A-OEM module to be able to attach four modules together. You can identify the revision of your module by looking at the serial number label on your module.

If you have revision G or earlier of the DT9837A or revision E or earlier of the DT9837A-OEM, you can attach a maximum of two modules together.

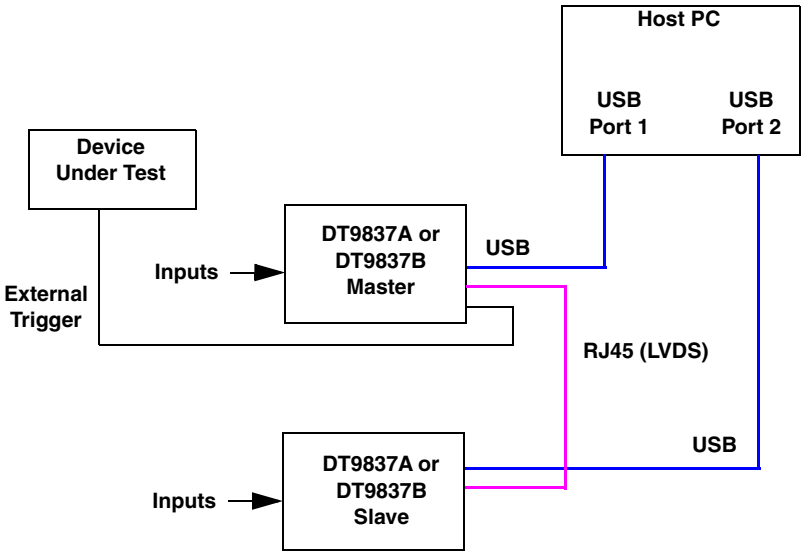


Figure 17: Synchronizing Two DT9837A or DT9837B Modules by Daisy Chaining the RJ45 Connectors (Shown Using an External Trigger)

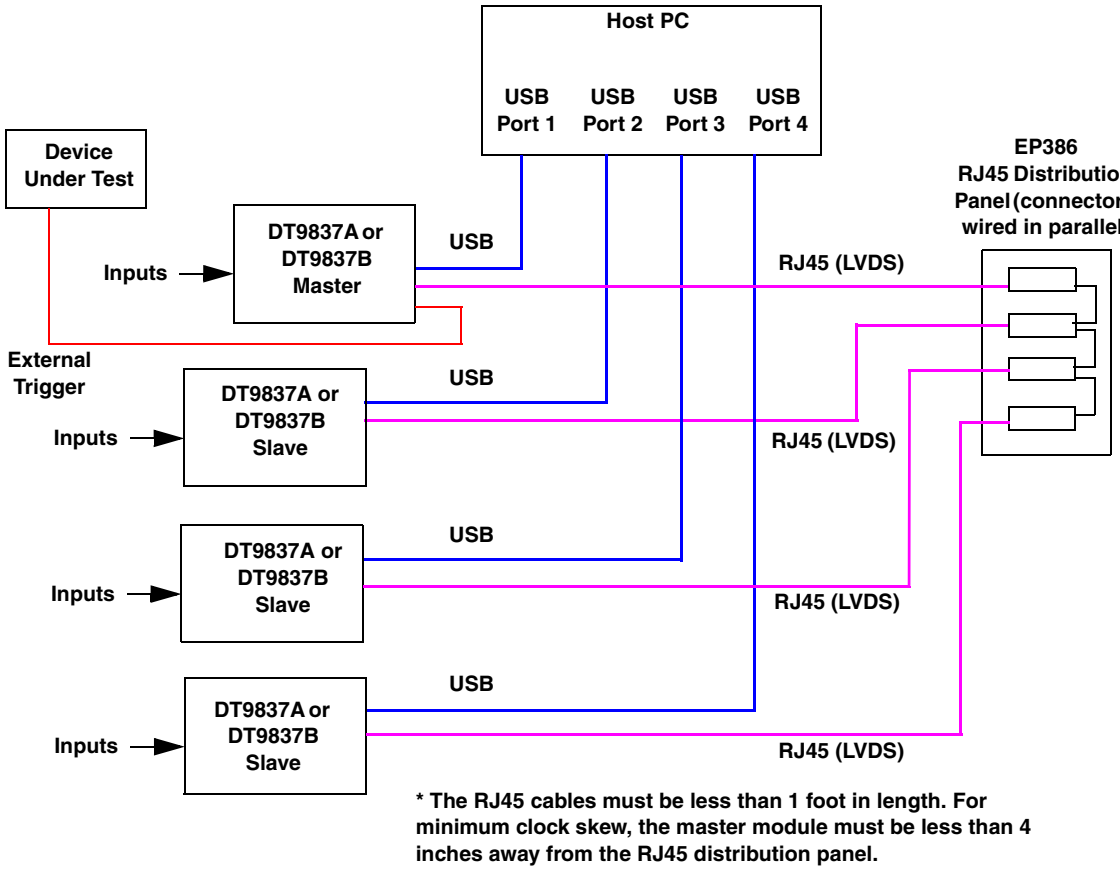


Figure 18: Synchronizing Four DT9837A or DT9837B Modules Using the EP386 RJ45 Distribution Panel (Shown Using an External Trigger)

When synchronizing multiple modules, start the slave modules before starting the master module. When the master module is triggered (using any of the supported trigger sources), both the master and the slave modules start acquiring data at the same time (within one A/D conversion of the clock). Note that you can set the clock rate to be the same or different on each module.

Note: It is important that you start the slave modules first, followed by the master module so that the slave receives the appropriate clock and trigger signals from the master.

If you start the master module before the slaves, the slaves never start; you will see a delay of approximately 20 seconds if you try to stop or abort the analog input operation on a slave module that is waiting for a trigger.

When you stop the master module, the slaves continue to run and return data until you stop the analog input subsystem on the slave modules. Be sure to stop the analog input subsystems on all DT9837A or DT9837B modules before disconnecting the cable from the RJ45 connectors.

Supported Device Driver Capabilities

The DT9837 Series Device Drivers provide support for the analog input (A/D) and analog output (D/A) subsystems. For information on how to configure the device drivers, refer to page 29.

Table 3: DT9837 Series Subsystems

DT9837 Series Modules	A/D	D/A	DIN	DOUT	C/T	QUAD
Total Subsystems on Module	1	1[a] or 2[b]	0	0	0	0

a. The DT9837 supports D/A subsystem 0 to access the capabilities of the analog output subsystem. The DT9837B supports D/A subsystem 0 to program the threshold value for the analog threshold trigger.
b. The DT9837A supports two D/A subsystem (0 and 1). Use D/A subsystem 0 to access the capabilities of the analog output subsystem; use D/A subsystem 1 to program the threshold value for the analog threshold trigger.

The tables in this chapter summarize the features available for use with the DT-Open Layers for .NET Class Library and the DT9837 Series modules. The DT-Open Layers for .NET Class Library provides properties that return support information for specified subsystem capabilities.

The first row in each table lists the subsystem types. The first column in each table lists all possible subsystem capabilities. A description of each capability is followed by the property used to describe that capability in the DT-Open Layers for .NET Class Library.

Note: Blank fields represent unsupported options.

For more information, refer to the description of these properties in the DT-Open Layers for .NET Class Library online help or *DT-Open Layers for .NET Class Library User's Manual*.

Data Flow and Operation Options

Table 4: DT9837 Series Data Flow and Operation Options

DT9837 Series Modules	A/D	D/A[a]	DIN	DOUT	C/T	QUAD
Single-Value Operation Support **SupportsSingleValue**	Yes	Yes[b]				
Simultaneous Single-Value Output Operations **SupportsSetSingleValues**						
Continuous Operation Support **SupportsContinuous**	Yes	Yes[c]				
Continuous Operation until Trigger **SupportsContinuousPreTrigger**						
Continuous Operation before & after Trigger **SupportsContinuousPrePostTrigger**						
Waveform Operations Using FIFO Only SupportsWaveformModeOnly		Yes[d]				
Simultaneous Start List Support **SupportsSimultaneousStart**						
Supports Programmable Synchronization Modes **SupportsSynchronization**	Yes					
Synchronization Modes **SynchronizationMode**	None, Master, Slave					
Interrupt Support **SupportsInterruptOnChange**						
Output FIFO Size **FifoSize**		8K				
Auto-Calibrate Support **SupportsAutoCalibrate**						

a. The D/A subsystem is not supported by the DT9837B module.
b. To perform a single value analog output operation, ensure that no analog input operations are running or an error will be reported.
c. For the DT9837, if you want to output data from the analog output channel while acquiring analog input data, ensure that you set up and start the analog output operation before starting the analog input operation, or an error will be reported.
d. The DT9837A supports continuous analog output operations in addition to waveform mode.

Buffering

Table 5: DT9837 Series Buffering Options

DT9837 Series Modules	A/D	D/A[a]	DIN	DOUT	C/T	QUAD
Buffer Support **SupportsBuffering**	Yes	Yes				
Single Buffer Wrap Mode Support **SupportsWrapSingle**		Yes				
Inprocess Buffer Flush Support **SupportsInProcessFlush**	Yes					

a. The D/A subsystem is not supported by the DT9837B module.

Triggered Scan Mode

Table 6: DT9837 Series Triggered Scan Mode Options

DT9837 Series Modules	A/D	D/A	DIN	DOUT	C/T	QUAD
Triggered Scan Support **SupportsTriggeredScan**						
Maximum Number of CGL Scans per Trigger **MaxMultiScanCount**	1	0	0	0	0	0
Maximum Retrigger Frequency **MaxRetriggerFreq**	0	0	0	0	0	0
Minimum Retrigger Frequency **MinRetriggerFreq**	0	0	0	0	0	0

Data Encoding

Table 7: DT9837 Series Data Encoding Options

DT9837 Series Modules	A/D	D/A[a]	DIN	DOUT	C/T	QUAD
Binary Encoding Support **SupportsBinaryEncoding**	Yes	Yes				
Twos Complement Support **SupportsTwosCompEncoding**						
Returns Floating-Point Values **ReturnsFloats**						

a. The D/A subsystem is not supported by the DT9837B module.

Channels

Table 8: DT9837 Series Channel Options

DT9837 Series Modules	A/D	D/A[a]	DIN	DOUT	C/T	QUAD
Number of Channels **NumberOfChannels**	5[b] or 8[c]	1	0	0	0	0
SE Support **SupportsSingleEnded**	Yes	Yes				
SE Channels **MaxSingleEndedChannels**	4	1	0	0		0
DI Support **SupportsDifferential**						
DI Channels **MaxDifferentialChannels**	0	0	0	0	0	0
Maximum Channel-Gain List Depth **CGLDepth**	5[b], 7[c], or 8[d]	1	0	0	0	0
Simultaneous Sample-and-Hold Support **SupportsSimultaneousSampleHold**	Yes					
Channel-List Inhibit **SupportsChannelListInhibit**						

a. The D/A subsystem is not supported by the DT9837B module.
b. On the DT9837, channels 0 to 3 correspond to the analog input channels; channel 4 corresponds to tachometer counter 0.
c. On the DT9837B, channels 0 to 3 correspond to the analog input channels; channel 4 corresponds to tachometer counter 0; channel 5 corresponds to tachometer counter 1, and channel 6 corresponds to gate counter 2.
d. On the DT9837A, channels 0 to 3 correspond to the analog input channels; channel 4 corresponds to tachometer counter 0; channel 5 corresponds to tachometer counter 1, channel 6 corresponds to gate counter 2 on the DT9837A-OEM module only, and channel 7 corresponds to the analog output readback channel.

Gain

Table 9: DT9837 Series Gain Options

DT9837 Series Modules	A/D	D/A[a]	DIN	DOUT	C/T	QUAD
Programmable Gain Support **SupportsProgrammableGain**	Yes					
Number of Gains **NumberOfSupportedGains**	2	1	0	0	0	0
Gains Available **SupportedGains**	1 and 10	1				

a. The D/A subsystem is not supported by the DT9837B module.

Ranges

Table 10: DT9837 Series Range Options

DT9837 Series Modules	A/D	D/A[a]	DIN	DOUT	C/T	QUAD
Number of Voltage Ranges **NumberOfRanges**	1	1	0	0	0	0
Available Ranges **SupportedVoltageRanges**	±10 V[b]	±10 V				
Current Output Support **SupportsCurrentOutput**						

a. The D/A subsystem is not supported by the DT9837B module.
b. By applying a gain of 1, the effective input range is ±10 V. By applying a gain of 10, the effective input range is ±1 V.

Resolution

Table 11: DT9837 Series Resolution Options

DT9837 Series Modules	A/D	D/A[a]	DIN	DOUT	C/T	QUAD
Software Programmable Resolution **SupportsSoftwareResolution**						
Number of Resolutions **NumberOfResolutions**	1	1	0	0	0	0
Available Resolutions **SupportedResolutions**	24	24	0	0	0	0

a. The D/A subsystem is not supported by the DT9837B module.

Thermocouple and RTD Support

Table 12: DT9837 Series Thermocouple and RTD Support Options

DT9837 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Thermocouple Support **SupportsThernocouple**						
RTD Support **SupportsRTD**						
Resistance Support **ReturnsOhms**						
Voltage Converted to Temperature in Hardware **SupportsTemperatureDataInStream**						
Supported Thermocouple Types **ThermocoupleType**						
Supported RTD Types **RTDType**						
Supports CJC Source Internally in Hardware **SupportsCjcSourceInternal**						
Supports CJC Channel **SupportsCjcSourceChannel**						
Available CJC Channels **CjcChannel**						
Supports Interleaved CJC Values in Data Stream **SupportsInterleavedCjcTemperaturesInStream**						
Supports Programmable Filters **SupportsTemperatureFilters**						
Programmable Filter Types **TemperatureFilterType**						

IEPE Support

Table 13: DT9837 Series IEPE Support Options

DT9837 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Software Programmable AC Coupling **SupportsACCoupling**	Yes					
Software Programmable DC Coupling **SupportsDCCoupling**	Yes					
Software Programmable External Excitation Current Source **SupportsExternalExcitationCurrentSrc**						
Software Programmable Internal Excitation Current Source **SupportsInternalExcitationCurrentSrc**	Yes					
Available Excitation Current Source Values **SupportedExcitationCurrentValues**	.004 A					

Triggers

Table 14: DT9837 Series Trigger Options

DT9837 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Software Trigger Support **SupportsSoftwareTrigger**	Yes	Yes[a]				
External Positive TTL Trigger Support **SupportsPosExternalTTLTrigger**	Yes	Yes[b]				
External Negative TTL Trigger Support **SupportsNegExternalTTLTrigger**						
External Positive TTL Trigger Support for Single-Value Operations **SupportsSvPosExternalTTLTrigger**						
External Negative TTL Trigger Support for Single-Value Operations **SupportsSvNegExternalTTLTrigger**						
Positive Threshold Trigger Support **SupportsPosThresholdTrigger**	Yes[c]	Yes[d]				
Negative Threshold Trigger Support **SupportsNegThresholdTrigger**						
Digital Event Trigger Support **SupportsDigitalEventTrigger**						

a. This trigger is option is not supported for the DT9837B module.
b. On the DT9837A only, you can use the external trigger to trigger D/A subsystem 0.
c. On the DT9837, the threshold level is fixed at 1.0 V. On the DT9837A and DT9837B, you can program the threshold level from 0.2 V to 9.8 V using the appropriate D/A subsystem (D/A subsystem 1 for the DT9837A or D/A subsystem 0 for the DT9837B).
d. This trigger option is not supported on the DT9837B module. On the DT9837A only, you can use the threshold trigger to trigger D/A subsystem 0; you can program the threshold level from 0.2 V to 9.8 V using D/A subsystem 1 (set the value of channel 0 of D/A subsystem 1 to a value from 0 to 255 using a single value call).

Clocks

Table 15: DT9837 Series Clock Options

DT9837 Series	A/D	D/A[a]	DIN	DOUT	C/T	QUAD
Internal Clock Support **SupportsInternalClock**	Yes	Yes				
External Clock Support **SupportsExternalClock**						
Simultaneous Input/Output on a Single Clock Signal **SupportsSimultaneousClocking**	Yes					
Base Clock Frequency **BaseClockFrequency**	27 MHz	24 MHz or 27 MHz[b]	0	0		
Maximum Clock Divider **MaxExtClockDivider**	1.0	1.0	1	1	1	1
Minimum Clock Divider **MinExtClockDivider**	1.0	1.0	1	1	1	1
Maximum Frequency **MaxFrequency**	52.734 kHz or 105.469 kHz[c]	46.875 kHz or 52.734 kHz[d]	0	0	0	0
Minimum Frequency **MinFrequency**	195.3 Hz	46.875 kHz or 10 kHz[d]	0	0	0	0

a. The D/A subsystem is not supported by the DT9837B module.
b. The base clock for the D/A subsystem on the DT9837 is fixed at 24 MHz; the base clock for the D/A subsystem on the DT9837A has a maximum frequency of 27 MHz.
c. The DT9837 and DT9837A support a maximum sampling frequency of 52.734 kHz; the DT9837B supports a maximum sampling frequency of 105.469 kHz.
d. The DT9837 supports a fixed clock frequency of 46.875 kHz for D/A subsystem 0; the DT9837A supports a programmable clock frequencies from 10 kHz to 52.734 kHz for D/A subsystem 0.

Counter/Timers

Table 16: DT9837 Series Counter/Timer Options

DT9837 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Cascading Support **SupportsCascading**						
Event Count Mode Support **SupportsCount**						
Generate Rate Mode Support **SupportsRateGenerate**						
One-Shot Mode Support **SupportsOneShot**						
Repetitive One-Shot Mode Support **SupportsOneShotRepeat**						
Up/Down Counting Mode Support **SupportsUpDown**						
Edge-to-Edge Measurement Mode Support **SupportsMeasure**						
Continuous Edge-to-Edge Measurement Mode Support **SupportsContinuousMeasure**						
High to Low Output Pulse Support **SupportsHighToLowPulse**						
Low to High Output Pulse Support **SupportsLowToHighPulse**						
Variable Pulse Width Support **SupportsVariablePulseWidth**						
None (internal) Gate Type Support **SupportsGateNone**						
High Level Gate Type Support **SupportsGateHighLevel**						
Low Level Gate Type Support **SupportsGateLowLevel**						
High Edge Gate Type Support **SupportsGateHighEdge**						
Low Edge Gate Type Support **SupportsGateLowEdge**						
Level Change Gate Type Support **SupportsGateLevel**						
Clock-Falling Edge Type **SupportsClockFalling**						
Clock-Rising Edge Type **SupportsClockRising**						
Gate-Falling Edge Type **SupportsGateFalling**						
Gate-Rising Edge Type **SupportsGateRising**						
Interrupt-Driven Operations **SupportsInterrupt**						

7

Using the VIBpoint Framework Application

Overview

The VIBpoint Framework application allows you to acquire and analyze data from up to 4 synchronized DT9837A or DT9837B modules or one DT9837 module. A 14-day trial version of this application is provided with the module. After the trial period has elapsed, you must purchase a license to continue using this application.

Note: The VIBpoint Framework application also supports the DT8837 LXI instrument module.

The VIBpoint Framework application lets you perform the following functions:

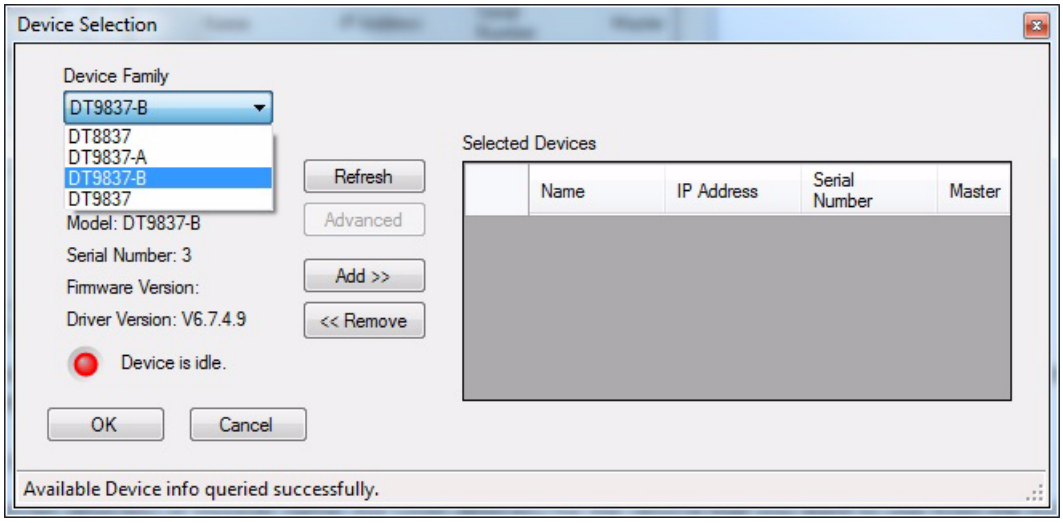
- Discover and select your modules.
- Configure all input channel settings, such as the enable state, AC/DC coupling, input ranges, and edges for tachometer 0, tachometer counter 1, and gate counter 2, as well as the clock and trigger settings.
- Load/save multiple hardware configurations.
- On each module, acquire data from all channels specified in the input channel list.
- Display acquired data during acquisition.
- Perform FFTs (Fast Fourier Transforms) on the acquired analog input data. You can select the FFT size and window type, and choose one of the following FFT averaging modes, if desired: Linear, Exponential, and Peak Hold.
- Use the Chart Recorder to display a snapshot of data, plot the FFT results from the selected analog input channels, and log the data to disk in a tab-separated file.
- Open recorded data in Excel for further analysis.
- Use the Channel Overview window to view the data from your device as a digital display.

You can customize many aspects of the acquisition, display, and recording functions to suit your needs, including which channels are recorded are displayed in the Chart Recorder and Channel Overview windows, which units to use for the data (such as voltage, frequency, or time), the frequency of your input analog input signals, and the trigger type used.

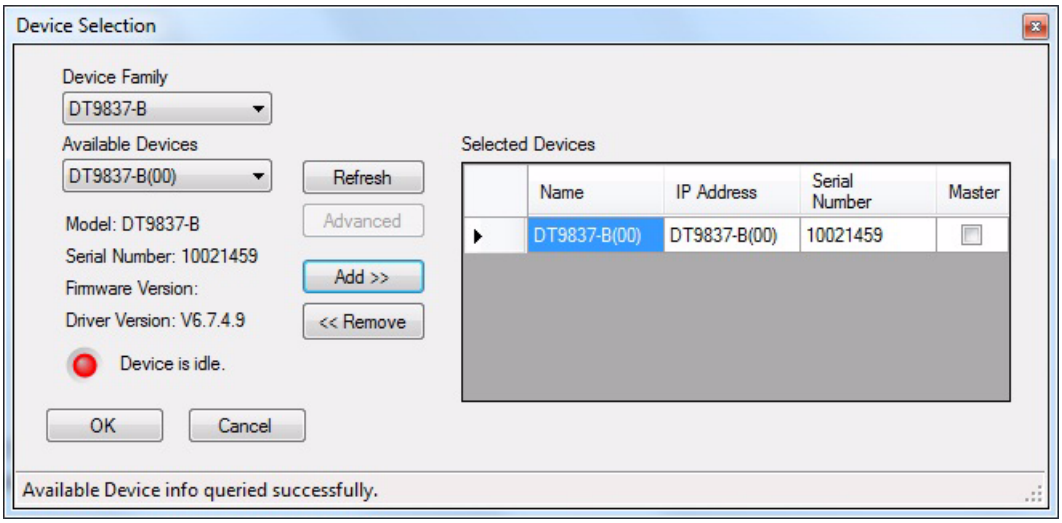
Running the VIBpoint Framework Application

To run the VIBpoint Framework application, perform the following steps:

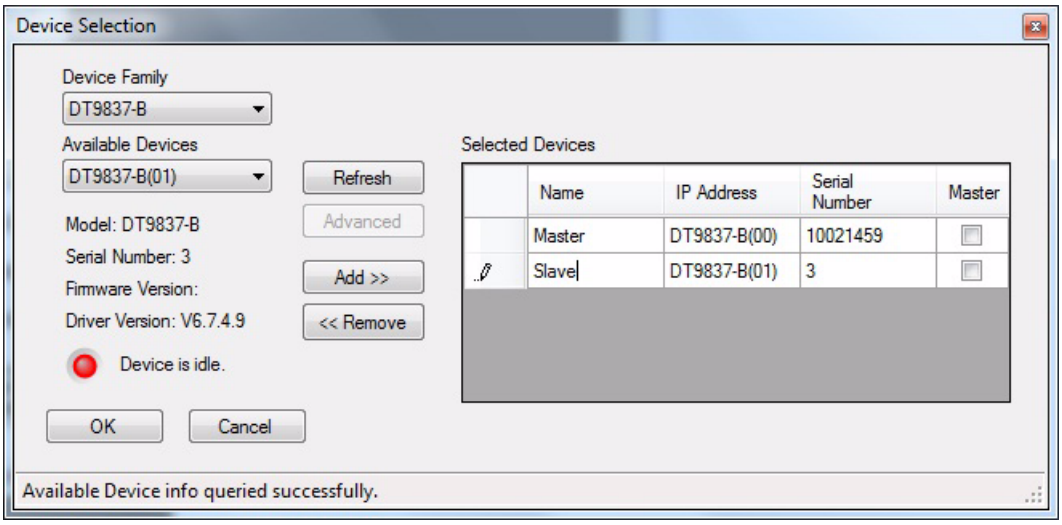
1. Click **Start -> Programs -> Data Translation, Inc -> VIBpoint Framework -> VIBpoint Framework Application**
   The Device Selection screen is displayed:



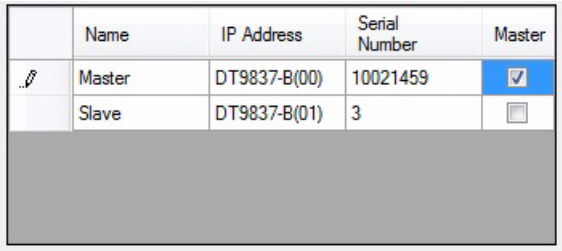
2. Select **DT9837**, **DT9837A**, or **DT9837B** from the Device Family list.
3. By default, the application "discovers" all modules that are available for the selected Device Family and displays their names in the drop-down list. If you want to refresh this list to determine if other modules are available, click **Refresh**.
4. If your module is included in the list of available devices and you want to connect to it, select the name of the module that you want to use from the list of available devices, and click **Add**.
   Information about the device, including the model number, serial number, firmware version, driver version, and scanning status is displayed.



5. (Recommended) If you want to rename your DT9837 Series module, do the following:
   a. Click the **Row Selector** button for the module.
   b. Click the name of the module in the **Name** column to highlight it and enter a meaningful name to represent each available module.



6. If you are using multiple modules, you must set up one module as the clock and trigger master as follows:
   a. Click the **Row Selector** button for the module that you want to be the clock and trigger master.
   b. For the clock and trigger master module, check the box under the **Master** column.



Note: Only one module can be the clock and trigger master. If you are using a single module, the application automatically configures the module as the master.

7. (Optional) If you want to remove a module from the selected list of modules, click the **Row Selector** button for the module, and then click **Remove**.
8. Once you have added all the DT9837 Series modules you want to use with the application, click **OK**.
   The latest state is saved and used when the application is next run, and the main window of the VIBpoint Framework application is displayed.

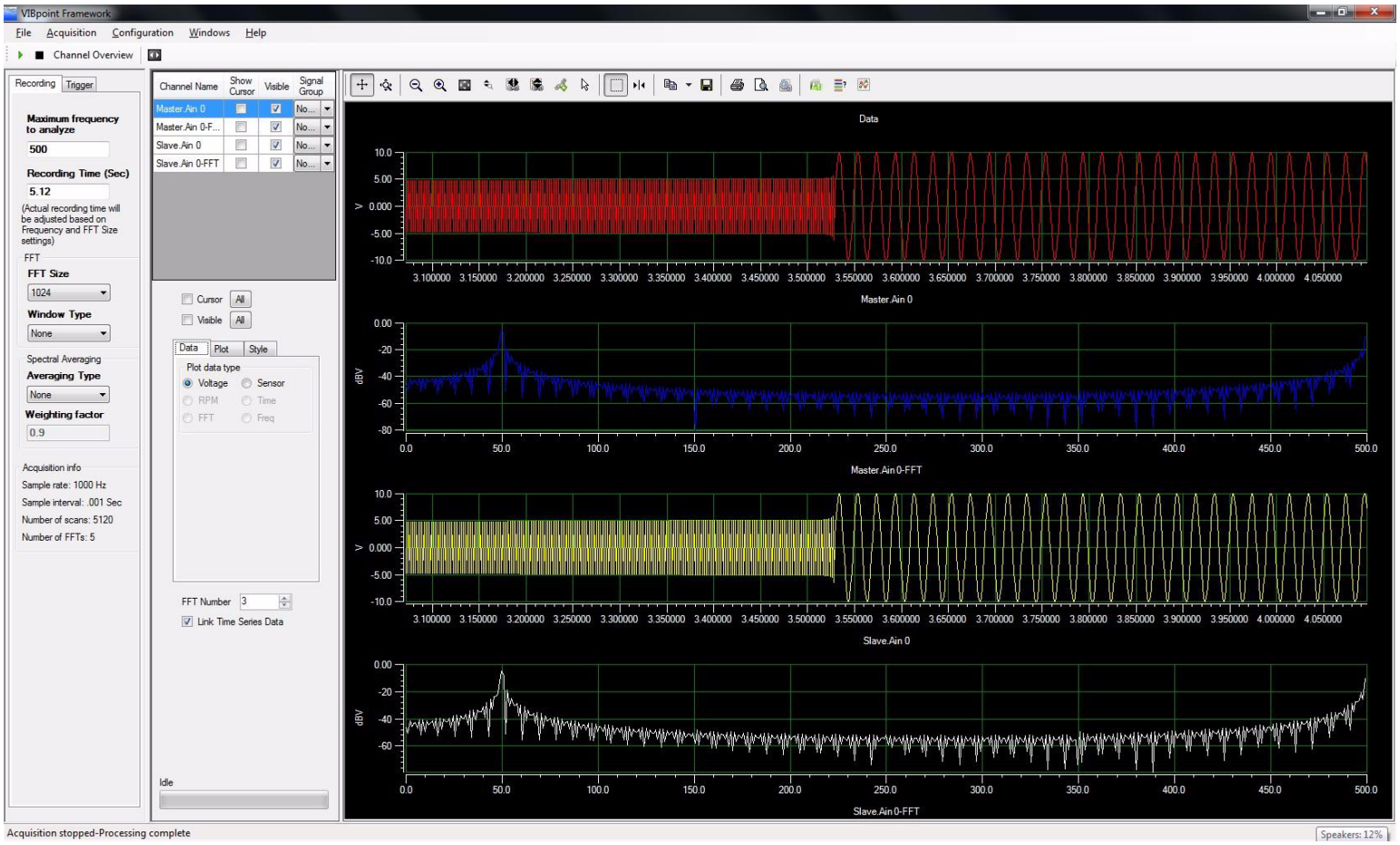


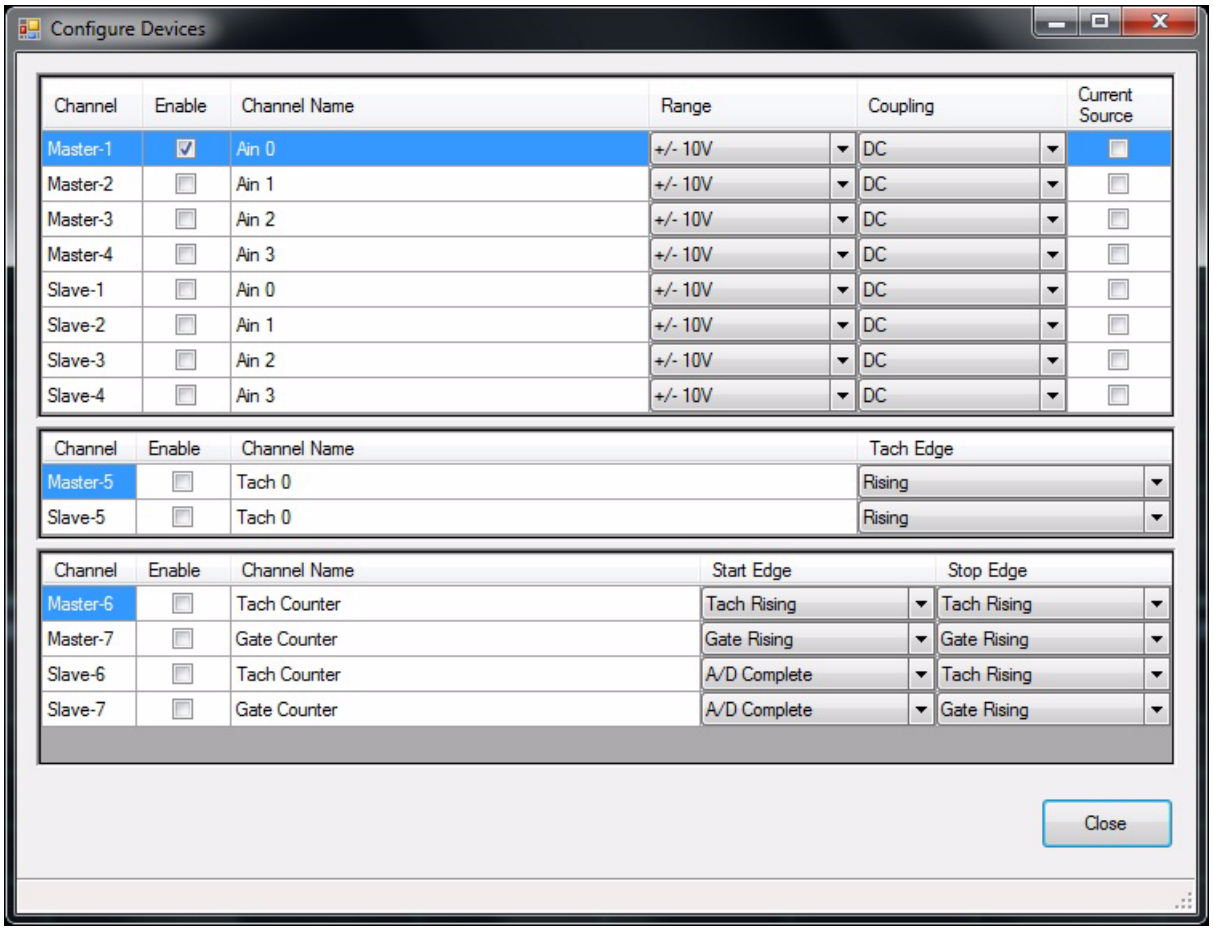
Figure 19: VIBpoint Framework Application

Changing the Configuration of Your Module

You must choose **Stop** from the Acquisition menu or click the stop button on the main window before you can make changes to your module configuration.

To change the configuration of your module, follow these steps:

1. Click the **Configuration** menu, and then click **Change Configuration**.
   The Change Configuration screen is displayed:



2. Select the channels that you want to enable for acquisition by clicking the **Enable** checkbox for those channels. Only data from enabled channels is included in the analog input data stream.
3. Under **Channel Name**, specify a meaningful name to represent each channel, if desired.
4. For analog input channels, configure the input signal range for each channel as ±10 V or ±1 V.

5. For analog input channels, configure the following IEPE settings:
   - **4mA current source** – Enable use of the 4 mA current source by checking the **Current Source** checkbox, or disable use of the 4 mA current source by unchecking the **Current Source** checkbox.
   - **Coupling type** – Select **AC** for AC coupling or **DC** for DC coupling.
6. For the tachometer 0, select which period of the tachometer input signal (CT 0 for the DT9837 Series) to measure:
   - Rising – Measures from the rising-to-rising edge of the tachometer input signal.
   - Falling – Measures from the falling-to-falling edge of the tachometer input signal.

Note: On the DT9837, the period of the tachometer input signal is not programmable; it is always measured from rising-to-rising edge.

7. For tachometer counter 1, select the signal edge that will start and stop the measurement: Tach Falling, Tach Rising, or A/D Complete. Note that this counter is not supported on the DT9837.
8. For gate counter 2, select the signal edge that will start and stop the measurement: Gate Rising, Gate Falling, or A/D Complete. Note that this counter is used differently depending on the module, as shown in Table 17.

Table 17: Use of Gate Counter 2 on the DT9837 Series Modules

DT9837	DT9837A	DT9837A-OEM	DT9837B
Gate Counter 2 is not supported.	Gate Counter 2 is not accessible on the module.	Gate Counter 2 measures the pulse width of the gate input signal or the phase between the gate signal and the A/D completion signal.	Gate Counter 2 measures the pulse width of the gate input signal or the phase between the gate signal and the A/D completion signal.

9. When you are finished configuring the VIBpoint Framework application, click **Close**.
   The latest state is saved and used when the application is next run.
10. To save the configuration settings to a file, click the **Configuration** menu, and then click **Save Configuration**.
11. Enter a name for the configuration file, select the directory in which to save the file, and then click **Save**.
    This file has the extension (.xml).*

Note: If you are using a US version of Windows Vista or Windows 7, the default configuration file (with the extension *.xml) is saved to the following location: C:\Program Data\Data Translation\VIBpoint Framework\Config.

If you are using a US version of Windows XP, the default configuration file is saved to this location: C:\Documents and Settings\All Users\Application Data\Data Translation\VIBpoint Framework\Config.

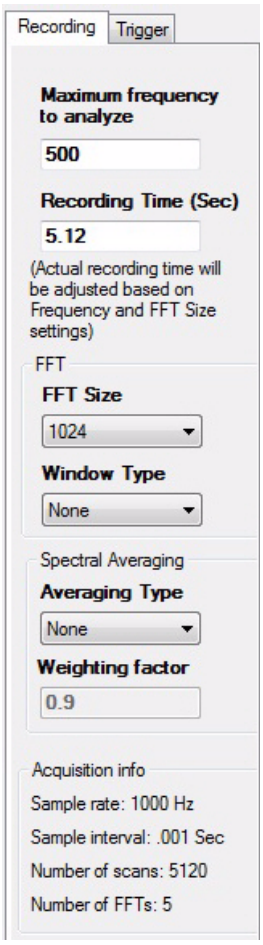
You can save numerous configuration settings, if desired. To load a previously saved configuration, click the **Configuration** menu, and then click **Load Configuration**.

12. Start acquisition by clicking **Start** from the **Acquisition** menu or by clicking the **Start** ( ) button from the main window.

Acquire, Display, and Record Data

Before you start acquisition, set up the Recording and Trigger settings. You can use the Chart Recorder and Channel Overview windows to view the acquired data. This section describes how to acquire, display, and record data to disk.

Recording Settings



To specify how data is acquired by the DT9837 Series module, configure the following Recording settings:

- **Maximum frequency to analyze** – Specify the bandwidth or span of the input signals that you want to analyze. Internally, the software multiplies this value by 2 to set the sampling rate of the module. This information is shown in the Acquisition info section of the Recording tab.
- **Recording Time (Sec)** – Specify the amount of time, in seconds, that you want the application to acquire data before stopping. This value must be a multiple of the FFT size. The software automatically adjusts this value based on the values you enter for **Maximum frequency to analyze** and the **FFT size**.

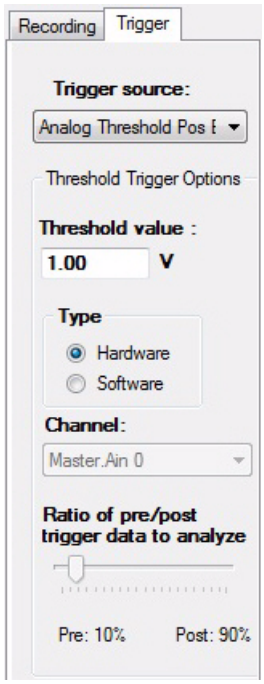
- **FFT Size** – Specify how many data points are used to generate the FFTs for the analog input channels.
- **Window Type** – Specify the type of windowing function to use for the FFT: Hamming, Hanning, Bartlett, Blackman, or None.
- **Averaging Type** – If you want to average FFTs rather than showing an FFT for each scan, choose one of the following spectral averaging modes; otherwise, choose None:
  - **Linear** – With linear averaging, data from each FFT is averaged with the data from the other FFTs; all data contributes equally to the average.
  - **Exponential** – With exponential averaging, new FFT data is weighted differently than older FFT data. You specify the weighting factor to apply, which either increases or decreases the effect of the new FFT data on the average. This is a continuous averaging mode.
  - **PeakHold** – With PeakHold averaging, each new FFT data point is compared with the current FFT data point, and the highest amplitude (peaks) from each FFT are retained. This is a continuous operation that combines the results of several measurements into a final FFT measurement.
- **Weighting Factor** – If you choose **Exponential** as the spectral averaging type, enter the weighting factor to apply. The weighting factor either increases or decreases the effect of new FFT data on the resultant average using on the following formula:

  Result = ((New FFT Data) * Weighting Factor) + (Old Average * (1 – Weighting Factor))

Based on the information that you enter, the software configures the hardware and displays the following configuration settings used by the device:

- The actual sample rate used by the device.
- The actual sample interval used by the device.
- The actual number of scans to acquire.
- The actual number of FFTs to calculate.

Trigger Settings



The trigger source starts acquisition on the module. In multiple device configurations, this is the trigger source that starts acquisition on the master module.

The following trigger sources are supported for the DT9837 Series modules:

- **IMMediate** – A software trigger event occurs immediately when you start acquisition.
- **External TTL Pos Edge** – An external digital (TTL) trigger event occurs when the device detects a rising-edge transition on the signal connected to the Trigger In input. This trigger provides a threshold voltage of 2 V with 0.5 V of hysteresis.
- **Analog Threshold Pos Edge** – A positive edge, analog threshold trigger event. When you choose the analog threshold trigger source, the following additional options are available:
  - **Threshold Value** – Enter the user-specified threshold value. If you select a **Hardware** trigger type, enter a value between 0.2 V and 9.8 V as the threshold value. If you select a **Software** trigger type, select the appropriate threshold value for that input type.
  - **Type** – If you select **Hardware**, the threshold event occurs when the signal attached to analog input channel 1 on the master module rises above the user-specified threshold (with 0.1 V of hysteresis).

    If you select **Software**, you can select any of the channels as the input trigger source. The threshold event occurs when the signal attached to this input channel rises above the user-specified threshold value.

– **Ratio of pre/post trigger data to analyze** – If you select a **Software** trigger type, you can specify how much data to analyze before the threshold trigger occurs (pre-trigger data) and how much data to analyze after the threshold trigger occurs (post-trigger data) by using the slider bar.

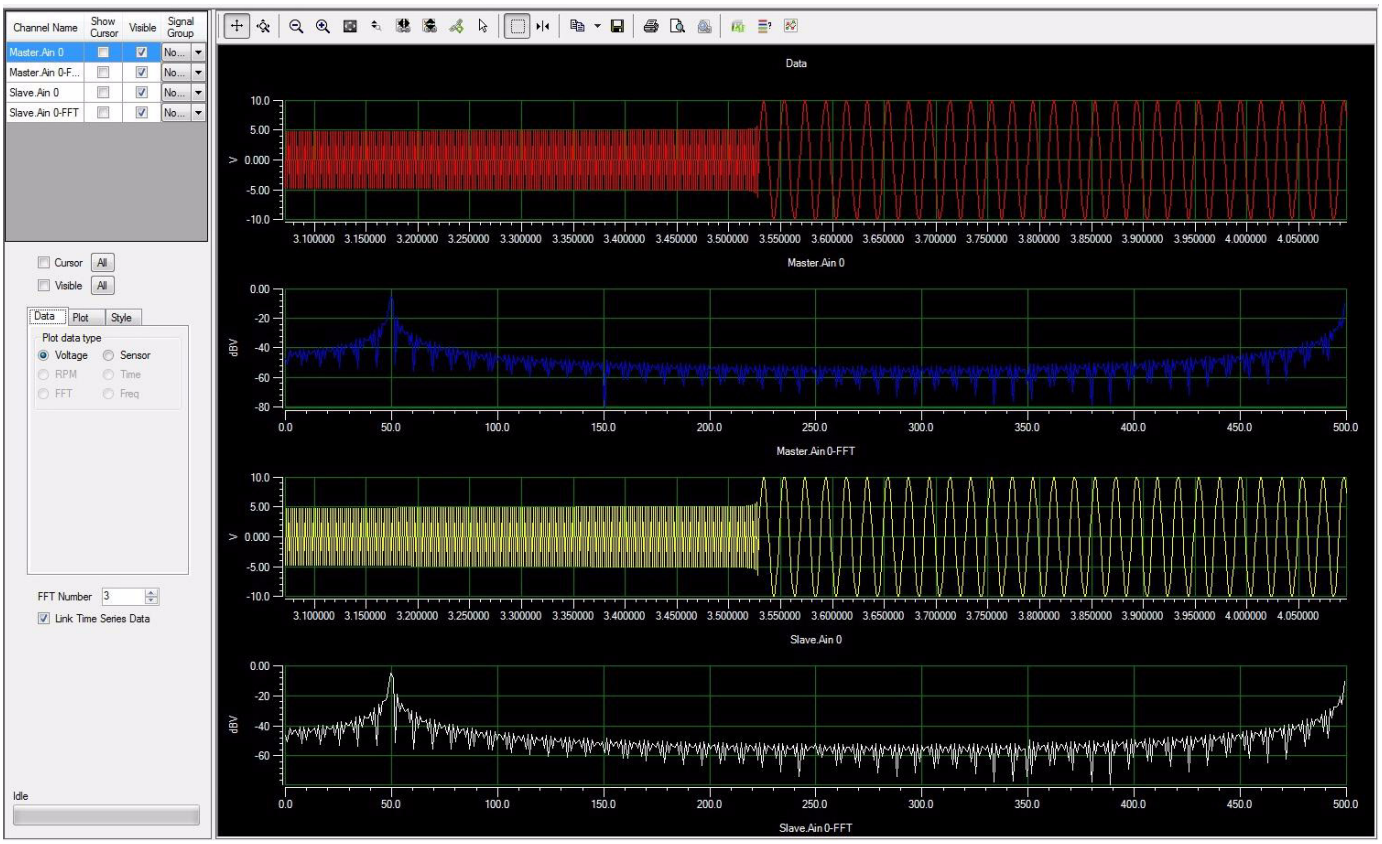
Start acquisition by clicking the Start button from the main window or, from the **Acquisition** menu, by selecting **Start**.

You can display the data in the Chart Recorder provided in the main window, or as numerical data using the Channel Overview window.

Chart Recorder

The Chart Recorder allows you to log data to disk and display data from the channels that you enabled. You can choose to display data from a subset of the enabled channels. The Chart Recorder shows data only from the set of channels that are being recorded to memory.

Note that you collapse or expand the view of the Chart Recorder using the button on the main window.



Channel Name

The Chart Recorder shows the names of the channels that you enabled when you configured the DT9837 Series module. Only data from the list of enabled channels is recorded to memory. (Use the **Save** chart control to save the recorded data to disk.)

Channel Visibility

For each enabled channel listed under the Channel Name column, you can control which channels are displayed using the **Visible** checkbox. If a box is checked under the **Visible** column, a graph for the associated channel is displayed in the Chart Recorder. If a box under the Visible column is unchecked, the graph for the associated channel is not displayed in the Chart Recorder.

Note: Data for all enabled channels is recorded to memory regardless of whether the channel is visible in the Chart Recorder.

For convenience, you can also make all channels visible at once by checking the **Visible** checkbox under the channel configuration section of this page, and then clicking the **All** button. If you do not want any of the channels to be visible, clear the **Visible** checkbox under the channel configuration section of this page, and then click the **All** button.

Show Cursor

You can choose to display a data cursor for each of the enabled channels using the **Show Cursor** column. If a box is checked under the **Show Cursor** column, a data cursor for the associated channel is displayed in the Chart Recorder. If a box under the **Show Cursor** column is unchecked, a data cursor for the associated channel is not displayed in the Chart Recorder.

For convenience, you can also display the data cursor for all channels at once by checking the **Cursor** checkbox under the channel configuration section of this page, and then clicking the **All** button. If you do not want to display the data cursor on any channel, clear the **Cursor** checkbox under the channel configuration section of this page, and then click the **All** button.

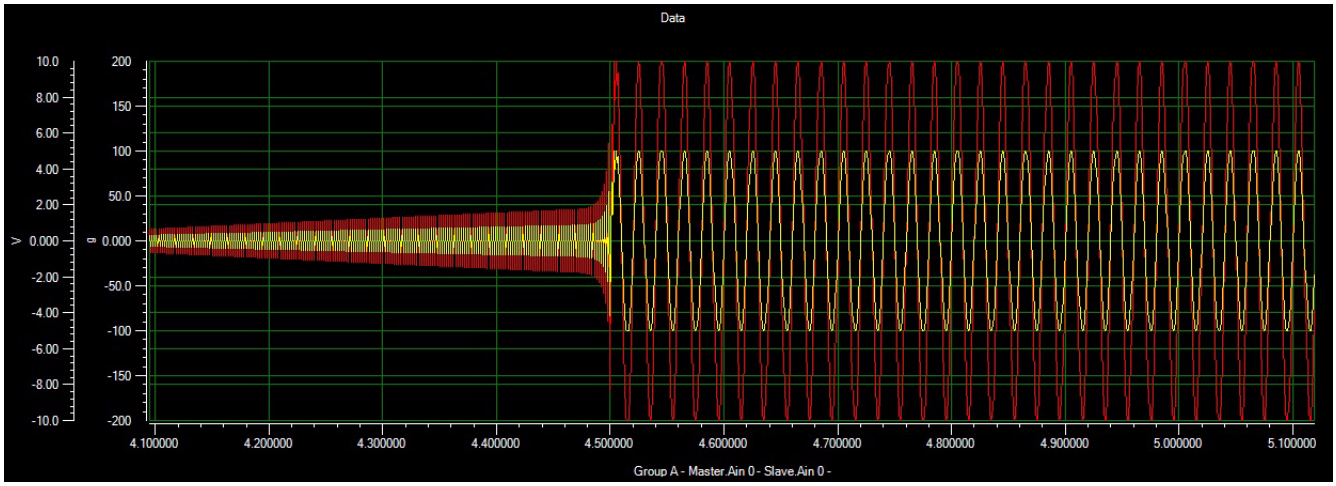
You can enable the capability of moving the data cursor using the data-cursor chart control. Various options are available for changing the cursor style, line style, and cursor color. Refer to the online help for more information.

Signal Group

You can choose to display multiple signals in the same band by assigning the same **Signal Group** letter to them. For each signal in the time domain, you can specify one of the following values for the **Signal Group**: None, A, B, C, D, E, or F. Likewise, you can specify one of these values for the signals in the frequency domain. If you specify None, the signal is displayed in its own band.

For example, to see the data from analog input signals 1 and 2 (in the time domain) in the same band, you could set the **Signal Group** for both channels to letter A.

If two channels have a different plot data type (that is, one is voltage and the other is a sensor), two Y-axes are displayed for the band. Note that the Signal Group letter is shown in the legend beneath the x-axis:



Data Tab

The Data tab options allow you to select the units in which the data is plotted in the Chart Recorder and Channel Overview windows.

The choices vary depending on the channel type selected under the Channel Names:

- Analog input and output channels – You can choose either **Voltage** (the default choice) to plot the voltage data unaltered, or **Sensor** if you want to specify a linear conversion to change the voltage to a sensor value, such as acceleration.

  If you select **Sensor**, enter the **Unit** in which to display the data (such as V or g), the number of millivolts per unit (**mV/Unit**) by which to scale the raw voltage, and an **Offset** value to add to the scaled signal.

- Tachometer channels – Choose **RPM** if you want to plot the data from the tachometer in RPMs. When you select this option, enter values in the **Device Ticks Per Revolution** and **Device Max RPM** fields for your particular tachometer. The application can then calibrate to the characteristics of your tachometer and yield a meaningful result.

  Choose **Time** if you want to plot the data from the tachometer in seconds. You can enter the maximum value for the Y axis in the **Maximum expected time** field.

  Choose **Freq** if you want to plot the data from the tachometer in Hertz. You can enter the maximum value for the Y axis in the **Maximum expected frequency** field.

- Counter/timer channels – Choose **Time** if you want to plot the data from the counter/timer in seconds. You can enter the maximum value for the Y axis in the **Maximum expected time** field.

Choose **Freq** if you want to plot the data from the counter/timer in Hertz. You can enter the maximum value for the Y axis in the **Maximum expected frequency** field.

Plot Tab

The Plot tab, along with the Style tab, allows you to control how the plots look in the Chart Recorder window. You can change the following attributes of the Chart Recorder using the Plot tab:

- For the **Plot update rate**, enter a value between 1 and 50 to indicate how often you want the display to be refreshed per second.
- You can adjust how the plot scrolls to the left using the **Smooth scrolling** checkbox. If **Smooth scrolling** is checked, the plot attempts to scroll after each data point is added. However, scrolling is limited by the actual update rate. For example, if the **Plot update rate** is set to 50, and 100 points are added per second (determined by the Recording settings), the plot scrolls to the left by 2 samples, 50 times per second.

  If the **Smooth scrolling** checkbox is unchecked, the plot does not attempt to scroll after every point is added; instead, it scrolls after each buffer is plotted. The buffer size is set to the FFT size.
- In the **Chart Header Text** box, enter the text that you want to display at the top of the Chart Recorder.
- Under **Time domain X axis units**, select the units for the x-axis as either the number of samples (0 to the maximum number of samples acquired) or the relative time (0 to the total recording time).

Style Tab

The Style tab, along with the Plot tab, allows you to control how the plots look in the Chart Recorder window. You can change the following attributes of the Chart Recorder using the Plot tab:

- Use the **Current trace color** drop-down box to choose a different color for the trace on the Chart Recorder for the currently selected channel.
- Use the **Background** color drop-down box to choose a different color for the background of the Chart Recorder.
- Use the **Foreground** color drop-down box to choose a different color for the foreground (axes and label text) of the Chart Recorder.
- Use the **Grid line** color drop-down box to choose a different color for the grid lines of the Chart Recorder.
- In the **Trace thickness** box, enter the value between 1 and 5 to set the thickness of the line used by the trace on the Chart Recorder.

FFTs

If the FFT averaging type is **None**, you can use the FFT Number box to scroll through the FFTs that were done for the corresponding analog input channel once data is acquired. For example, if 10 FFTs were done for the analog input channels, and you are interested in looking at FFT number 4, set the FFT number to 4 and the plot for that FFT is displayed in the Chart Recorder.

If you want to see the actual analog input data that corresponds to a particular FFT number, click the **Link Time Series Data** checkbox. The data plot for the corresponding analog input channels is then displayed for the selected FFT number.

Chart Controls

The toolbar of the Chart Recorder provides a number of controls for viewing the data (including scrolling and zooming), as well as printing and saving the data.

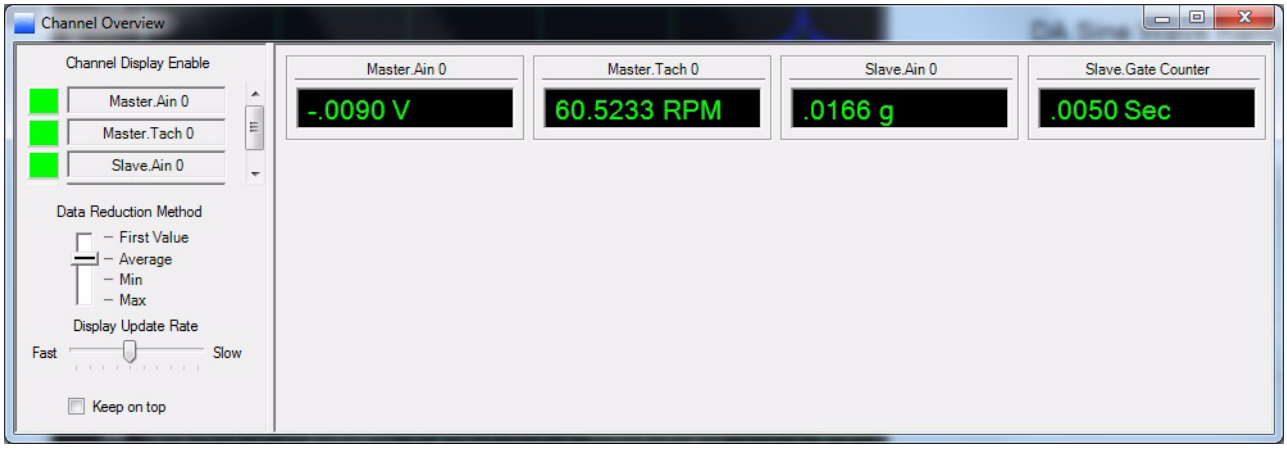
Refer to the online help for more information about using the controls provided with the Chart Recorder.

Device Status

The status of the device is shown at the bottom of the Chart Recorder.

Channel Overview

The Channel Overview displays the data from your modules in numerical form. Open the Channel Overview by selecting the button on the Main screen.
The Channel Overview screen is displayed.



1. Select the channels that you want to be visible on the right side of the window by clicking to the right of the green channel indicator. You configure the channel names using the **Change Configuration** menu option.

   If display is enabled, the channel indicator is bright green; if display is disabled, the channel indicator is dark green.

2. You can select from the following data reduction methods:

   – First value – Displays the first value in the buffer for each of the selected channels.

   – Average – Displays the average value in the buffer for each of the selected channels (this is the default value).

   – Min – Displays the minimum value in the buffer for each of the selected channels.

   – Max – Displays the maximum value in the buffer for each of the selected channels.

3. Choose how fast you want the Channel Overview display to be updated. Slide the bar to the left for faster update rates, or slide the bar to the right for slower update rates.

4. If you want the Channel Overview window to appear on top of the other windows of the VIBpoint Framework application, click the **Keep on top** checkbox. If this box is unchecked, the window will appear behind the other windows of the VIBpoint Framework application.

   If you move or resize the Channel Overview window, the application remembers this information and displays the window in the same location the next time you open the application.

Exiting from the VIBpoint Framework Application

When you are finished using the VIBpoint Framework application, exit from the application by selecting the **File** menu and clicking **Exit**.

Troubleshooting

General Checklist

Should you experience problems using a DT9837 Series module, do the following:

1. Read all the documentation provided for your product. Make sure that you have added any "Read This First" information to your manual and that you have used this information.
2. Check the OMNI CD for any README files and ensure that you have used the latest installation and configuration information available.
3. Check that your system meets the requirements stated in the README file on the OMNI CD.
4. Check that you have installed your hardware properly using the instructions in Chapter 2.
5. Check that you have installed and configured the device driver for your module using the instructions in Chapter 2.
6. Check that you have wired your signals properly using the instructions in Chapter 3.
7. Search the DT Knowledgebase in the Support section of the Data Translation web site (at www.datatranslation.com) for an answer to your problem.

If you still experience problems, try using the information in Table 18 to isolate and solve the problem. If you cannot identify the problem, refer to page 102.

Table 18: Troubleshooting Problems

Symptom	Possible Cause	Possible Solution
Module is not recognized	You plugged the module into your computer before installing the device driver.	From the Control Panel > System > Hardware > Device Manager, uninstall any unknown devices (showing a yellow question mark). Then, run the setup program on your OMNI CD to install the USB device drivers, and reconnect your USB module to the computer.
Module does not respond	The module configuration is incorrect.	Check the configuration of your device driver; see the instructions in Chapter 2.
	The module is damaged.	Contact Data Translation for technical support; refer to page 102.
Intermittent operation	Loose connections or vibrations exist.	Check your wiring and tighten any loose connections or cushion vibration sources; see the instructions in Chapter 3.
	The module is overheating.	Check environmental and ambient temperature; consult the module's specifications on page 119 of this manual and the documentation provided by your computer manufacturer for more information.
	Electrical noise exists.	Check your wiring and either provide better shielding or reroute unshielded wiring; see the instructions in Chapter 3.

Table 18: Troubleshooting Problems (cont.)

Symptom	Possible Cause	Possible Solution
Device failure error reported	The DT9837 Series module cannot communicate with the Microsoft bus driver or a problem with the bus driver exists.	Check your cabling and wiring and tighten any loose connections; see the instructions in Chapter 3.
	The DT9837 Series module was removed while an operation was being performed.	Ensure that your module is properly connected; see the instructions in Chapter 2.
Data appears to be invalid	An open connection exists.	Check your wiring and fix any open connections; see the instructions in Chapter 3.
	A transducer is not connected to the channel being read.	Check the transducer connections; see the instructions in Chapter 3.
	The module is set up for differential inputs while the transducers are wired as single-ended inputs or vice versa.	Check your wiring and ensure that what you specify in software matches your hardware configuration; see the instructions in Chapter 3.
	The module is out of calibration.	DT9837 Series modules are calibrated at the factory. If you want to readjust the calibration of the analog input or analog output circuitry, refer to Chapter 9 starting on page 105.
USB 2.0 is not recognized	Your operating system does not have the appropriate Service Pack installed.	Ensure that you load the appropriate Windows Service Pack (version 2 for Windows XP). If you are unsure of whether you are using USB 2.0 or USB 1.1, run the Open Layers Control Panel applet, described in Chapter 2.
	Standby mode is enabled on your PC.	For some PCs, you may need to disable standby mode on your system for proper USB 2.0 operation. Consult Microsoft for more information.

Technical Support

If you have difficulty using a DT9837 Series module, Data Translation's Technical Support Department is available to provide technical assistance.

To request technical support, go to our web site at http://www.datatranslation.com and click on the Support link.

When requesting technical support, be prepared to provide the following information:

- Your product serial number
- The hardware/software product you need help on
- The version of the OMNI CD you are using
- Your contract number, if applicable

If you are located outside the USA, contact your local distributor; see our web site (www.datatranslation.com) for the name and telephone number of your nearest distributor.

If Your Module Needs Factory Service

If your module must be returned to Data Translation, do the following:

1. Record the module's serial number, and then contact the Customer Service Department at (508) 481-3700, ext. 1323 (if you are in the USA) and obtain a Return Material Authorization (RMA).

   If you are located outside the USA, call your local distributor for authorization and shipping instructions; see our web site (www.datatranslation.com) for the name and telephone number of your nearest distributor. All return shipments to Data Translation must be marked with the correct RMA number to ensure proper processing.

2. Using the original packing materials, if available, package the module as follows:

   – Wrap the module in an electrically conductive plastic material. Handle with ground protection. A static discharge can destroy components on the module.

   – Place in a secure shipping container.

3. Return the module to the following address, making sure the RMA number is visible on the outside of the box.

   Customer Service Dept.
   Data Translation, Inc.
   100 Locke Drive
   Marlboro, MA 01752-1192

Calibration

DT9837 Series modules are calibrated at the factory and should not require calibration for initial use. We recommend that you check and, if necessary, readjust the calibration of the analog input and analog output circuitry every six months using the DT9837 Calibration Utility, DT9837-A Calibration Utility or DT9837-B Calibration Utility.

Note: Ensure that you installed the device driver for your module using the Data Acquisition OMNI CD prior to using the calibration utility.

This chapter describes how to calibrate the analog input and output subsystems of a DT9837 Series module using the calibration utility.

Using the Calibration Utility

Start the DT9837, DT9837-A, or DT9837-B Calibration Utility as follows:

1. Click **Start** from the Task Bar.
2. For the DT9837 module, select **Programs | Data Translation, Inc | Calibration | DT9837 Calibration Utility.**

   For the DT9837A module, select **Programs | Data Translation, Inc | Calibration | DT9837-A Calibration Utility**
   The main menu of the calibration utility appears.

   For the DT9837B module, select **Programs | Data Translation, Inc | Calibration | DT9837-B Calibration Utility**
   The main menu of the calibration utility appears.
3. Select the module to calibrate, and then click **OK**.

Once the calibration utility is running, you can calibrate the analog input circuitry (either automatically or manually), described on page 108, or the analog output circuitry of the module, described on page 110.

Calibrating the Analog Input Subsystem

This section describes how to use the calibration utility to calibrate the analog input subsystem of a DT9837 Series module.

DT9837 Series modules have separate calibration for each A/D input channel.

Connecting a Precision Voltage Source

To calibrate the analog input circuitry, you need to connect an external +9.3750 V precision voltage source to the DT9837 Series module. Connect the precision voltage source to the first channel you want to calibrate; for example, Analog In 0 (AD Ch0).

Using the Auto-Calibration Procedure

Auto-calibration is the easiest to use and is the recommended calibration method. To auto-calibrate the analog input subsystem, do the following:

1. From the **A/D Calibration** tab of the calibration utility, select the channel that you want to calibrate from the **Type of Calibration** drop-down list box in the **Automatic Calibration** area.
2. For the DT9837A and DT9837B modules, enter the sampling frequency that you want to calibrate to in the **Sample Frequency** text box.
3. Click the Auto Calibration **Start** button.
   A message appears notifying you to verify that 0.000 V is applied to the channel.
4. Verify that the supplied voltage to your selected channel is 0.000 V, and then click **OK**.
   The offset value is calibrated. When the offset calibration is complete, a message appears notifying you to set the input voltage of the channel to +9.375 V.
5. Check that the supplied voltage to your selected channel is +9.375 V, and then click **OK**.
   The gain value is calibrated and a completion message appears.
6. Repeat these steps for each analog input channel on the module.

Note: At any time, you can click **Restore Factory Settings** to reset the A/D calibration values to their original factory settings. This process will undo any auto or manual calibration settings.

Using the Manual Calibration Procedure

If you want to manually calibrate the analog input circuitry instead of auto-calibrating it, do the following for each channel:

1. From the **A/D Calibration** tab of the calibration utility, select the channel that you want to calibrate in the **Manual Calibration** area.
2. For the DT9837A and DT9837B modules, enter the sampling frequency that you want to calibrate to in the **Sample Frequency** text box.

3. Click the Manual Calibration **Start** button.
   A message appears notifying you to verify that 0.000 V is applied to the channel.

Note: If you do not want the application to continue to read the voltage, click **Stop**.

4. Adjust the offset as follows:
   a. Verify that 0.000 V is applied to the channel that you want to calibrate.
      The current voltage reading for this channel is displayed in the A/D Value window.
   b. Adjust the offset by entering values between 0 and 255 in the Offset edit box, or by clicking the up/down buttons until the A/D Value is 0.000 V.
5. Adjust the gain as follows:
   a. Verify that +9.375 V is applied to the channel that you want to calibrate.
      The current voltage reading for this channel is displayed in the A/D Value window.
   b. Adjust the gain by entering values between 0 and 255 in the Gain edit box, or by clicking the up/down buttons until the A/D Value is 9.3750 V.
6. Repeat these steps for each analog input channel on the module.

Note: At any time, you can click **Restore Factory Settings** to reset the A/D calibration values to their original factory settings. This process will undo any auto or manual calibration settings.

Once you have finished this procedure, continue with "Calibrating the Analog Output Subsystem."

Calibrating the Analog Output Subsystem

This section describes how to use the calibration utility to calibrate the analog output subsystem of a DT9837 or DT9837A module.

To calibrate the analog output circuitry, you need to connect an external precision voltmeter to analog output channel 0 of the DT9837 or DT9837A module.

Do the following to calibrate the analog output circuitry:

1. Select the **D/A Calibration** tab of the calibration utility.
2. Connect an external precision voltmeter to Analog Output 0 (DAC Ch0) of the DT9837 module.
3. In the DAC Output Voltage box, select **–9.375 V**.
4. Adjust the offset by entering values between 0 and 255 in the DAC 0 Offset edit box or by clicking the up/down buttons until the voltmeter reads –9.375 V.
5. In the DAC Output Voltage box, select **9.375 V**.
6. Adjust the gain by entering values between 0 and 255 in the DAC 0 Gain edit box or by clicking the up/down buttons until the voltmeter reads 9.375 V.

Note: At any time, you can click **Restore Factory Settings** to reset the D/A calibration values to their original factory settings. This process will undo any D/A calibration settings.

Once you have finished this procedure, the analog output circuitry is calibrated. To close the calibration utility, click the close box in the upper right corner of the window.

Specifications

Analog Input Specifications

Table 19 lists the specifications for the analog input subsystem on the DT9837 Series modules.

Table 19: Analog Input Subsystem Specifications

Feature	DT9837 Specifications	DT9837A Specifications	DT9837B Specifications
Number of analog input channels	4, single-ended, simultaneous	4, single-ended, simultaneous	4, single-ended, simultaneous
Resolution	24 bits	24 bits	24 bits
Ranges and gains Gain of 1: Gain of 10:	 ±10 V ±1 V	 ±10 V ±1 V	 ±10 V ±1 V
Gain error Gain of 1: Gain of 10:	 ±0.02% ±0.5%	 ±0.02% ±0.5%	 ±0.02% ±0.5%
A/D type	Delta-Sigma	Delta-Sigma	Delta-Sigma
Maximum sample rate	52.734 kHz[a]	52.734 kHz[a]	105.469 kHZ[a]
Minimum sample rate	195.3 Hz	195.3 Hz	195.3 Hz
Group delay	39/Sample Frequency	39/Sample Frequency	39/Sample Frequency
Pass band at –3 dB: at –100 dB:	 0.49 x Sample Frequency 0.55 x Sample Frequency	 0.49 x Sample Frequency 0.55 x Sample Frequency	 0.49 x Sample Frequency 0.55 x Sample Frequency
Pass band ripple	±0.005 dB	±0.005 dB	±0.005 dB
Signal/noise (typical)	106 dB	106 dB	106 dB
Total harmonic distortion (–0.5 dB) using 1 kHz sine wave, sampled at 50 kHz	–90 dB typical	–92 dB typical	–92 dB typical
Spurious free dynamic range (SFDR) using a 1 kHz sine wave, sampled at 50 kHz 10 V full-scale signal (–0.5 dB): 1 V signal (–20 dB): 100 mV signal (–40 dB): 0 V signal:	 –90 dB typical –105 dB typical –115 dB typical –115 dB typical	 –92 dB typical –115 dB typical –115 dB typical –118 dB typical	 –92 dB typical –115 dB typical –115 dB typical –118 dB typical
Data encoding	Offset binary	Offset binary	Offset binary
Maximum input voltage (without damage) Power on: Power off:	 ±30 V ±20 V	 ±40 V ±40 V	 ±40 V ±40 V
Input impedance	1 MΩ, 20 pF[b]	1 MΩ, 20 pF[b]	1 MΩ, 20 pF[b]
Overvoltage protection (power on/off)	±40 V	±40 V	±40 V

Table 19: Analog Input Subsystem Specifications (cont.)

Feature	DT9837 Specifications	DT9837A Specifications	DT9837B Specifications
ESD protection Arc: Contact:	 8 kV 4 kV	 8 kV 4 kV	 8 kV 4 kV
Current source	4 mA	4 mA	4 mA
Compliance voltage	18 V	18 V	18 V
Current noise @ 1 kHz bandwidth	5 nA rms	5 nA rms	5 nA rms
Current source accuracy	±1.0%	±1.0%	±1.0%
DC offset	1.5 mV	1.5 mV	1.5 mV
AC coupling at –3 dB	0.5 Hz	0.1 Hz	0.5 Hz
D/A Readback in A/D Stream A/D resolution: Zero error: Full-scale error: Clock on input A/D Done	 – – – –	 16 bits ±15 mV +0, –2% 42 ns to 83 ns	 – – – –

a. The conversion rate = Sample rate * 512.
b. Cable capacitance of typically 30 pF per foot must be added.

Analog Output Specifications

Table 20 lists the specifications for the analog output subsystem on the DT9837 and DT9837A modules.

Table 20: Analog Output Subsystem Specifications

Feature	DT9837 Specifications	DT9837A Specifications
Number of analog output channels	1	1
Resolution	24 bits	24 bits
Output range	±10 V	±10 V
Data encoding	Offset binary	Offset binary
Output current	±1 mA maximum load (10 V across 10 K)	±3 mA maximum load (10 V across 3.3 K)
FIFO	8192 Samples, total	8192 Samples, total
ESD protection Arc: Contact:	 8 kV 4 kV	 8 kV 4 kV
DC offset	±1.5 mV	±1.5 mV
Gain error	±3.0%	±0.03%
2-pole, low-pass Butterworth filter	10 kHz	10 kHz
Time delay (typical)	34/output frequency	29/output frequency
Power fault and reset	Goes to 0 V ±10 mV if the USB cable is removed or the power fails	
Total harmonic distortion (typical at 1 kHz)	0.0015%	0.0015%
Internal clock	output frequency x 256	output frequency x 512
Minimum sample frequency	46.875 kHz	10 kHz
Maximum sample frequency	46.875 kHz	52.734 kHz
Pass band ripple (typical ±0.002 dB)	0.454 x output frequency	0.454 x output frequency
Pass band (typical)	0.454 x output frequency	0.49 x output frequency
Stop band (typical)	0.546 x output frequency	0.567 x output frequency

Tachometer Input Specifications

Table 21 lists the specifications for the tachometer input on the DT9837 Series modules.

Table 21: Tachometer Input Specifications

Feature	DT9837 Specifications	DT9837A Specifications	DT9837B Specifications
Number of channels	1		
Resolution	31 bits per channel		
Input voltage range	±30 V		
Threshold voltage	±2 V with 0.5 V hysteresis		
Maximum input frequency	380 kHz	1 MHz	1 MHz
Minimum pulse width high/low (minimum amount of time it takes a C/T to recognize an input pulse)	1.3 µs	0.4 µs	0.4 µs
Clock frequency for tachometer counter 0 measurements	12 MHz (83 ns resolution)	12 MHz (83 ns resolution)	12 MHz (83 ns resolution)
Clock frequency for tachometer counter 1 measurements	–	48 MHz (21 ns resolution)	48 MHz (21 ns resolution)

Gate Input Specifications

Table 22 lists the specifications for the gate input on the DT9837A-OEM and DT9837B modules.

Table 22: Gate Input Specifications

Feature	DT9837A-OEM and DT9837B Specifications
Signal type	LVTTL
Input voltage range for gate input signal	0 to 5 V
Threshold voltage	±2 V with 0.5 V hysteresis
Maximum input frequency	1 MHz
Minimum pulse width (high/low)	0.4 µs
Counter resolution	32 bits
Clock frequency for gate counter 2 measurements	48 MHz (21 ns resolution)

Trigger Specifications

Table 23 lists the specifications for the trigger on the DT9837 Series modules.

Table 23: Trigger Specifications

Feature	DT9837 Specifications	DT9837A and DT9837B Specifications
Trigger sources Internal software trigger: External digital trigger: Analog threshold trigger:	 Software-initiated Software-selectable Software-selectable	
External digital trigger Input type: Logic family: Input logic load: Lower threshold: Upper threshold: Hysteresis: Input sink current: Minimum pulse width high/low: Maximum input signal: Input configuration:	 Edge-sensitive, positive trigger LVTTL inputs 1 LVTTL 1.1 V 1.3 V 0.2 V 33 µA 1.3 µA ±30 V Pulled high with 100 kΩ resistor	
Analog threshold trigger Type: Threshold level: Hysteresis:	 Positive threshold trigger on analog input channel 0 1.0 V 100 mV	 Positive threshold trigger on analog input channel 0 +0.2 to +9.8 V 100 mV
Trigger delay	1 conversion period maximum	1 conversion period maximum

Master Oscillator Specifications

Table 24 lists the specifications for the master oscillator on the DT9837A and DT9837B module.

Table 24: Master Oscillator Specifications

Feature	DT9837A and DT9837B Specifications
Frequency	48 MHz
Accuracy at 25° C	±30 ppm
Drift over temperature 0 to 70° C (Total)	±50 ppm
Aging (first year)	±5 ppm
Maximum error (first year)	±85 ppm

Power, Physical, and Environmental Specifications

Table 25 lists the power, physical, and environmental specifications for the DT9837 Series modules.

Table 25: Power, Physical, and Environmental Specifications

Feature	DT9837 Specifications	DT9837A Specifications	DT9837B Specifications
Power, +5 V	±0.5 V@ 0.5 A	±0.30 V@ 0.5 A	±0.30 V @ 425 mA
Physical Dimensions of enclosure: Dimensions of PCB only: Weight: PCB assembly with enclosure: PCB assembly:	Width = 100 mm Length = 188.98 mm Height = 17.29 mm Width: 100 mm Length: 146.56mm Thickness: 1.57 mm 490.74 g 153.09 g		
Environmental Operating temperature range: Storage temperature range: Relative humidity: Altitude:	0° C to 55° C –25° C to 85° C to 95%, noncondensing up to 10,000 feet		

Regulatory Specifications

Table 26 lists the regulatory specifications for the DT9837 Series modules.

Table 26: Regulatory Specifications

Feature	DT9837 Series Specifications
Emissions (EMI)	FCC Part 15, EN55022:1994 + A1:1995 + A2:1997 VCCI, AS/NZS 3548 Class A
Immunity	EN 61000-6-1:2001
RoHS (EU Directive 2002/95/EG)	Compliant (as of July 1st, 2006)

Connector Specifications

Table 27 lists the connector specifications for the DT9837A, DT9837A-OEM, and DT9837B modules.

Table 27: Connector Specifications

Feature	DT9837A, DT9837A-OEM, and DT9837B Specifications
RJ45 (LVDS) Connector	Molex part number 44661-0001
Gate Input Connector[a]	AMP/Tyco part number 5-146282-4

a. This connector is available on the DT9837A-OEM module only.

Connector Pin Assignments

RJ45 (LVDS) Connector

Figure 20 shows the RJ45 (LVDS) synchronization connector.

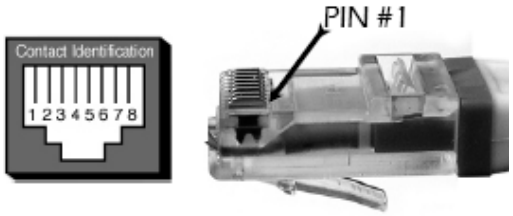


Figure 20: RJ45 (LVDS) Synchronization Connector

Table 28 lists the pin assignments for the RJ45 (LVDS) synchronization connector on the DT9837A, DT9837A-OEM, and DT9837B modules.

Table 28: RJ45 (LVDS) Synchronization Connector Pin Assignments

Pin	Description
1	Clock + (An LVDS signal for synchronizing data collection between two modules.)
2	Clock –
3	Trigger + (An LVTTL signal that is asserted low for triggering between modules.)
4	Sync + (An LVTTL signal that is asserted low for synchronizing all the analog input signals between modules for simultaneous sample-and-hold applications.)
5	Sync – (Connected to digital ground through a 100 Ω resistor.)
6	Trigger – (Connected to digital ground through a 100 Ω resistor.)
7	No Connect
8	No Connect

Gate Input Connector

The 4-pin Gate Input connector is available on the DT9837A-OEM module only. (The DT9837B module uses a BNC for the gate input signal). Figure 21 shows the orientation of the Gate Input connector on the DT9837A-OEM module.

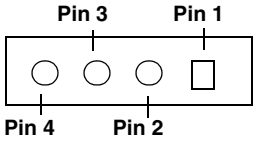


Figure 21: Gate Input Connector

Table 29 lists the pin assignments for the Gate Input connector on the DT9837A-OEM module.

Table 29: Gate Input Connector Pin Assignments

Pin	Description
1	Gate Input
2	No Connect
3	Digital Ground
4	No Connect

Register-Level Programming

DT9837 Register-Level Programming

If you need to change the settings of the Open Layers Control Panel for the DT9837 programmatically, you can use the Data Acq SDK function **olDiagWriteReg** to write to the following registers of the DT9837 module:

- General Control Register 2 – Write to this memory location to change the tachometer settings.
- EEPROM – Write to this memory location to change the coupling and current source settings.

The following subsections describe writing to these memory locations in more detail.

Writing to the General Control Register 2

The following example shows how to update the bits of General Control Register 2 on the DT9837 module using the value specified in the *RegValueToWrite* variable:

```
#define LOCAL_BUS_BASE 0x400000
#define GENERAL_CNTRL_REG2 (LOCAL_BUS_BASE | 0x2)
olDiagWriteReg (m_hDev, GENERAL_CONTROL_REG2, RegValueToWrite,2);
General Control Register 2 (ControlReg2) Offset: 0x2
```

Note: The contents of the registers are reset once the application exits.

Table 30 describes the bits of General Control Register 2 on the DT9837 module that relate to the programmable settings in the Open Layers Control Panel, described on page 29.

Table 30: DT9837 General Control Register 2

Bits	Type	Default	Name	Description
[7]	RW	0	Tach Counter 0 Start Select	Select the starting edge for the period measurement on Tach Counter 0: 0 – Tach Input Rising Edge 1 – Tach Input Falling Edge
[5]	RW	0	Tach Counter 0 Mode Select	Select the value read in between measured values on Tach Counter 0: 0 – Previous measurement 1 – Zeros
[4]	RW	0	Tach Counter 0 Flag Select	Select whether or not to use the Stale Data flag: 0 – Stale Data flag not used 1 – Stale Data flag used

Writing to EEPROM

The Open Layers Control Panel has controls for setting the coupling type and current source for analog input channels 0, 1, 2, and 3. You can change these settings programmatically by writing to a single byte location in EEPROM on the DT9837 module.

Table 31 describes the bit values in EEPROM that are used to store the coupling type and current source values on the DT9837 module.

Table 31: DT9837 EEPROM Byte

Bits	Type	Default	Name	Description
[0]	RW	1	ADC 0 Coupling	Select the coupling type for analog input channel 0: 0 – AC 1 – DC
[1]	RW	1	ADC 1 Coupling	Select the coupling type for analog input channel 1: 0 – AC 1 – DC
[2]	RW	1	ADC 2 Coupling	Select the coupling type for analog input channel 2: 0 – AC 1 – DC
[3]	RW	1	ADC 3 Coupling	Select the coupling type for analog input channel 3: 0 – AC 1 – DC
[4]	RW	1	ADC 0 Current Source	Select whether or not to use the 4 mA current source for analog input channel 0: 0 – Enabled 1 – Disabled
[5]	RW	1	ADC 1 Current Source	Select whether or not to use the 4 mA current source for analog input channel 1: 0 – Enabled 1 – Disabled
[6]	RW	1	ADC 2 Current Source	Select whether or not to use the 4 mA current source for analog input channel 2: 0 – Enabled 1 – Disabled
[7]	RW	1	ADC 3 Current Source	Select whether or not to use the 4 mA current source for analog input channel 3: 0 – Enabled 1 – Disabled

Programmatically, you can read the EEPROM location using the **olDiagReadReg()** function, and write to the EEPROM location using the **olDiagWriteReg()** function. To change a single bit requires a read/modify/write operation.

The following constants define the location of the register in EEPROM:

```
#define EEPROM_MEM_BASE 0x100000
const ULONG EEPROM_OFFSET_SETTINGS = 15;
```

This example shows how to read this EEPROM location:

```
ULONG olddata;
OLSTATUS  olStatus = olDiagReadReg(m_hDev, EEPROM_MEM_BASE +
   EEPROM_OFFSET_SETTINGS, &olddata, 1);
```

This example shows how to write values to this EEPROM location:

```
ULONG newdata;
OLSTATUS  olStatus = olDiagWriteReg(m_hDev, EEPROM_MEM_BASE +
  EEPROM_OFFSET_SETTINGS, newdata, 1);
```

Note that the data must be read and written as a 32-bit value, but only the lower 8-bits of this value is actually transferred.

DT9837A and DT9837B Register-Level Programming

If you need to change the settings of the Open Layers Control Panel for the DT9837A or DT9837B programmatically, you can use the Data Acq SDK function **olDiagWriteReg** to write to the following registers of the DT9837A or DT9837B module:

- General Control Register 4 – Write to this memory location to change the tachometer and gate settings.
- EEPROM – Write to this memory location to change the coupling and current source settings.

The following subsections describe writing to these memory locations in more detail.

Writing to the General Control Register 4

The following example shows how to update the bits of General Control Register 4 on the DT9837A module using the value specified in the *RegValueToWrite* variable:

```
#define LOCAL_BUS_BASE 0x400000
#define GENERAL_CNTRL_REG4 (LOCAL_BUS_BASE | 0x8)
olDiagWriteReg (m_hDev, GENERAL_CONTROL_REG4,RegValueToWrite,2);
General Control Register 4 (ControlReg4) Offset: 0x8
```

Note: The contents of the registers are reset once the application exits.

Table 32 describes the bits of General Control Register 4 on the DT9837A module that relate to the tachometer and gate settings in the Open Layers Control Panel, described on page 29.

Table 32: DT9837A and DT9837B General Control Register 4

Bits	Type	Default	Name	Description
[15:14]	RW	0	Tach Counter 1 Start Select	Select the starting edge for the Tach Counter 1 measurement function: 00 – A/D Ready Falling Edge 01 – Reserved 10 – Tach Input Falling Edge 11 – Tach Input Rising Edge
[13:12]	RW	0	Gate Counter 2 Start Select	Select the starting edge for the Gate Counter 2 measurement function: 00 – A/D Ready Falling Edge 01 – Reserved 10 – Gate Falling Edge 11 – Gate Rising Edge

Table 32: DT9837A and DT9837B General Control Register 4 (cont.)

Bits	Type	Default	Name	Description
[11:10]	RW	0	Gate Counter 2 Stop Select	Select the stopping edge for the Gate Counter 2 measurement function: 00 – A/D Ready Falling Edge 01 – Reserved 10 – Gate Falling Edge 11 – Gate Rising Edge
[8]	RW	0	Gate Counter 2 Self Clear	Select the value read in between measured values on Gate Counter 2: 0 – Keep the last value 1 – Clear to 0 on write to Input FIFO
[7:6]	RW	0	Tach Counter 1 Stop Select	Select the stopping edge for the Tach Counter 1 measurement function: 00 – A/D Ready Falling Edge 01 – Reserved 10 – Tach Input Falling Edge 11 – Tach Input Rising Edge
[4]	RW	0	Tach Counter 1 Self Clear	Select the value read in between measured values on Tach Counter 1: 0 – Keep the last value 1 – Clear to 0 on write to Input FIFO
[3]	RW	0	Tach Counter 0 Start Select	Select the starting edge for the period measurement on Tach Counter 0: 0 – Tach Input Rising Edge 1 – Tach Input Falling Edge
[1]	RW	0	Tach Counter 0 Mode Select	Select the value read in between measured values on Tach Counter 0: 0 – Previous measurement 1 – Zeros
[0]	RW	0	Tach Counter 0 Flag Select	Select whether or not to use the Stale Data flag: 0 – Stale Data flag not used 1 – Stale Data flag used

Writing to EEPROM

On the DT9837A and DT9837B modules, the Open Layers Control Panel has controls for setting the following parameters, which are stored in 8 consecutive bytes of EEPROM:

- Channel 0, 1, 2 and 3 Coupling type. The values AC or DC are stored as constants for these controls.
- Channel 0, 1, 2 and 3 Current Source. The values INTERNAL, EXTERNAL or DISABLED are stored as constants for these controls. Note that while the control panel has only two states (Enabled and Disabled), three states are actually defined, as follows:
  - INTERNAL = Enabled (used by the control panel)
  - EXTERNAL = Disabled
  - DISABLED = Disabled (used by the control panel)

These controls may also be "uninitialized" if for some reason, the module skipped the post-manufacturing initialization process.

To access the storage locations programmatically, use the **olDiagReadReg()** and **olDiagWriteReg()** functions. The following code shows the location of these controls in the register map:

```
#define EEPROM_MEM_BASE           0x100000
// Coupling storage offsets relative to the base address for the
// four analog input channels
const EEPROM_OFFSET_COUPLING_0 = 0x0020;
const EEPROM_OFFSET_COUPLING_1 = 0x0021;
const EEPROM_OFFSET_COUPLING_2 = 0x0022;
const EEPROM_OFFSET_COUPLING_3 = 0x0023;
// Current source storage offsets relative to the base address for
// the four analog input channels
const EEPROM_OFFSET_CURRENT_SOURCE_0 = 0x0024;
const EEPROM_OFFSET_CURRENT_SOURCE_1 = 0x0025;
const EEPROM_OFFSET_CURRENT_SOURCE_2 = 0x0026;
const EEPROM_OFFSET_CURRENT_SOURCE_3 = 0x0027;
```

Note: **olDiagReadReg()** and **olDiagWriteReg()** require a ULONG value for the data parameter, but we are reading and writing only a single byte (last parameter).

```
// To read the current source power-up default for channel 2,
// use the following code:
ULONG Channel_2_Current_Source;
OLSTATUS olStatus = olDiagReadReg(m_hDev, EEPROM_MEM_BASE +
   EEPROM_OFFSET_CURRENT_SOURCE_2, &Channel_2_Current_Source, 1);

// To set the coupling power-up default for channel 0 to AC,
// use the following code:
OLSTATUS olStatus = olDiagWriteReg(m_hDev, EEPROM_MEM_BASE +
   EEPROM_OFFSET_COUPLING_0, (ULONG) AC, 1);
```

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