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A MEASUREMENT COMPUTING COMPANY

UM-23331-G

DT8837 Instrument Module for LXI User's Manual

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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.

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About this Manual

The first part of this manual describes how to install and set up your DT8837 instrument module, and verify that the DT8837 is working properly.

The second part of this manual describes the features and capabilities of the DT8837 using the IVI-COM instrument module driver software. Troubleshooting information is also provided.

Note: If you are programming the instrument module using the IVI-COM driver, refer to the DT8837 IVI-COM driver online help for more information.

If you are using Standard Commands for Programmable Instruments (SCPI) to program your instrument module, refer to the *SCPI Programmer's Manual for the DT8837* for more information.

Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for using and/or programming the DT8837 instrument module for data acquisition operations. 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 DT8837 instrument module, as well as the supported software and accessories for the instrument module.
- Chapter 2, "Preparing to Use the DT8837," describes how to unpack the instrument module, check the system requirements, install the DT8837 software, and view the DT8837 documentation online.
- Chapter 3, "Setting Up and Installing the Instrument Module," describes how to install the DT8837 instrument module, how to apply power to the instrument module, and connect the DT8837 to the network.
- Chapter 4, "Wiring Signals," describes how to wire signals to the DT8837 instrument module.
- Chapter 5, "Verifying the Operation of an Instrument Module," describes how to verify the operation of the DT8837 instrument module.
- Chapter 6, "Principles of Operation," describes all of the features of the DT8837 instrument module in detail.
- Chapter 7, "Troubleshooting," provides information that you can use to resolve problems with the DT8837 instrument module and device driver, should they occur.

- Chapter 8, "Calibration," describes how to calibrate the analog I/O circuitry of the DT8837 instrument module.
- Appendix A, "Specifications," lists the specifications of the DT8837 instrument module.
- Appendix B, "Connector Pin Assignments," lists the pins for each of the connectors on the DT8837 instrument module.
- Appendix C, "Configuring Network Settings on Your PC," describes how to configure the network settings of your PC to use Auto-IP or a static IP address.
- 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 DT8837 instrument module:

- DT8837 IVI-COM Driver online help. For programmers who are developing their own application programs, this document describes how to use the IVI-COM driver to access the capabilities of the DT8837 instrument module. The DT8837 IVI-COM driver works with any development environment that supports COM programming, including MATLAB® from The MathWorks™, Microsoft® Visual C#®.NET or Visual Basic®.NET, Agilent® VEE Pro, National Instruments™ LabVIEW™ or LabWindows™, and so on.
- *SCPI Programmer's Manual for the DT8837(UM-23333).* For programmers who want to use the SCPI interface to program DT8837 instrument modules, this document describes the supported SCPI commands and example programs for the DT8837 instrument module.
- IVI foundation (www.ivifoundation.org)
- LXI Consortium (www.lxistandard.org)

Where To Get Help

Should you run into problems installing or using a DT8837 instrument module, the Data Translation Technical Support Department is available to provide technical assistance. Refer to Chapter 7 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.mccdaq.com).

Overview

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DT8837 Hardware Features

The DT8837 instrument module is a high-performance, multifunction data acquisition device for the Ethernet (LXI) bus. It is a class C device and complies with LXI version 1.1.

The key hardware features of the DT8837 instrument module are as follows:

- Simultaneous analog input and waveform analog output operations
- ISO-Channel™ protection eliminates noise and ground loops
  - ±500 V galvanic isolation channel-to-channel on all input/output signals and to the host computer to protect signal integrity
- 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 with 24 V compliance voltage, and AC or DC coupling
  - The ability to return the value of the tachometer 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 return the value of the counter/timer channels in the analog input data stream, allowing you to measure the period or frequency of the tachometer and/or gate input signal synchronously with analog input measurements
  - The ability to measure the analog input sample to the tachometer or gate input or the tachometer or gate input to the analog input sample to correlate analog data with an external event
  - Support for 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, analog threshold trigger, or Trigger Bus 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 and waveform output mode
  - Programmable output rate from 10 kSamples/s to 52.734 kSamples/s
  - Output range of ±10 V
  - You can select a software trigger, external digital trigger, analog threshold trigger, or Trigger Bus trigger to start the analog output operation

- Common 48 MHz reference clock used to create the individual master clocks (which determine actual sample rates) for the analog input and analog output subsystems
- One digital output port, consisting of 4 isolated digital output lines

Supported Software

The following software is available for use with the DT8837 instrument module:

- **Eureka Discovery Utility** – This utility helps you locate or "discover" all LXI (Ethernet) instruments that are connected to your system and provides the following information about your instrument: the IP address, manufacturer, model number, serial number, and version of the firmware that is running on your instrument. In addition, you can use this utility to configure Windows firewall settings and update the firmware for your Data Translation LXI instrument.
- **Instrument Module Web Interface** – This built-in interface, described in Chapter 5, allows you to verify the operation of your DT8837 instrument module and perform basic functions with Internet Explorer and no additional software. Using it, you can configure your instrument module, control output signals, measure input signals, and save results to disk.
- **QuickDAQ Base Version** – The base version of QuickDAQ is free-of-charge and allows you to acquire and analyze data from all Data Translation USB and Ethernet devices, except the DT9841 Series, DT9817, DT9835, and DT9853/54. Using the base version of QuickDAQ, you can perform the following functions:
  - Discover and select your devices.
  - Configure all input channel settings for the attached sensors.
  - Load/save multiple hardware configurations.
  - Generate output stimuli (fixed waveforms, swept sine waves, or noise signals).
  - On each supported data acquisition device, acquire data from all channels supported in the input channel list.
  - Choose to acquire data continuously or for a specified duration.
  - Choose software or triggered acquisition.
  - Log acquired data to disk in an .hpf file.
  - Display acquired data during acquisition in either a digital display using the Channel Display window or as a waveform in the Channel Plot window.
  - Choose linear or logarithmic scaling for the horizontal and vertical axes.
  - View statistics about the acquired data, including the minimum, maximum, delta, and mean values and the standard deviation in the Statistics window.
  - Export time data to a .csv or .txt file; you can open the recorded data in Microsoft Excel® for further analysis.
  - Read a previously recorded .hpf data file.
  - Customize many aspects of the acquisition, display, and recording functions to suit your needs, including the acquisition duration, sampling frequency, trigger settings, filter type, and temperature units to use.

- **QuickDAQ FFT Analysis Option** – When enabled with a purchased license key, the QuickDAQ FFT Analysis option includes all the features of the QuickDAQ Base version plus basic FFT analysis features, including the following:
  - The ability to switch between the Data Logger time-based interface and the FFT Analyzer block/average-based interface.
  - Supports software, freerun, or triggered acquisition with accept and reject controls for impact testing applications.
  - Allows you to perform single-channel FFT (Fast Fourier Transform) operations, including AutoSpectrum, Spectrum, and Power Spectral Density, on the acquired analog input data. You can configure a number of parameters for the FFT, including the FFT size, windowing type, averaging type, integration type, and so on.
  - Allows you to display frequency-domain data as amplitude or phase.
  - Supports dB or linear scaling with RMS (root mean squared), peak, and peak-to-peak scaling options
  - Supports linear or exponential averaging with RMS, vector, and peak hold averaging options.
  - Supports windowed time channels.
  - Supports the following response window types: Hanning, Hamming, Bartlett, Blackman, Blackman Harris, and Flat top.
  - Supports the ability to lock the waveform output to the analysis frame time.
  - Allows you to configure and view dynamic performance statistics, including the input below full-scale (IBF), total harmonic distortion (THD), spurious free dynamic range (SFDR), signal-to-noise and distortion ratio (SINAD), signal-to-noise ratio (SNR), and the effective number of bits (ENOB), for selected time-domain channels in the Statistics window.
  - Supports digital IIR (infinite impulse response) filters.
- **QuickDAQ Advanced FFT Analysis Option** – When enabled with a purchased software license, the QuickDAQ Base version with the FFT Analysis option plus advanced FFT analysis features, including the following:
  - Allows you to designate a channel as a Reference or Response channel.
  - Allows you to perform two-channel FFT analysis functions, including Frequency Response Functions (Inertance, Mobility, Compliance, Apparent Mass, Impedance, Dynamic Stiffness, or custom FRF) with H1, H2, or H3 estimator types, Cross-Spectrum, Cross Power Spectral Density, Coherence, and Coherent Output Power.
  - Supports the Exponential response window type.
  - Supports the following reference window types: Hanning, Hamming, Bartlett, Blackman, Blackman Harris, FlatTop, Exponential, Force, and Cosine Taper windows.
  - Supports real, imaginary, and Nyquist display functions.
  - Allows you to save data in the .uff file format.

- **DT8837 IVI-COM driver** – This driver provides access to the DT8837 instrument module functions through a COM server. The IVI-COM driver works in any development environment that supports COM programming, including MATLAB, Visual Basic.NET, Visual C#.NET, Agilent VEE Pro, LabVIEW, LabWindows, and others.
- **SCPI commands** – Use SCPI commands to program DT8837 LXI instrument modules. Refer to the *SCPI Programmer's Manual for the DT8837* (UM-23333) for information on the supported SCPI commands and example programs.

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

Accessories

The following optional accessories are available for the DT8837 instrument module:

- **STP8837 DIN Rail Mountable Screw Terminal Panel** (includes EP378 cable)
- **EP377 Trigger Bus cables** (25-pin, .5M)
- **EP380 Single Rack-mount kit** –To rack mount a single DT8837 instrument module.
- **EP379 Dual Rack-mount kit** – To rack mount two DT8837 instrument modules side by side.

Getting Started Procedure

The flow diagram shown in Figure 1 illustrates the steps needed to get started using the DT8837 instrument 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.

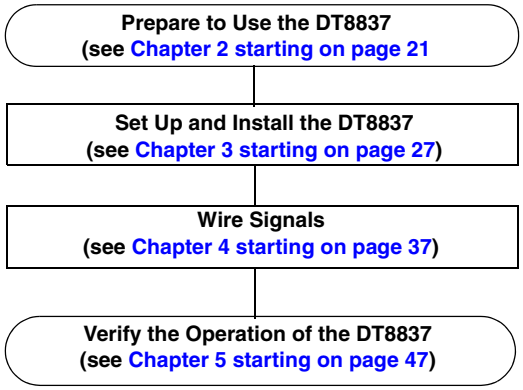

Figure 1: Getting Started Flow Diagram

Part 1: Getting Started

Preparing to Use the DT8837

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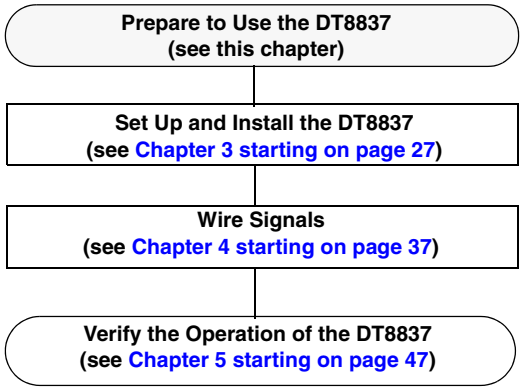
Prepare to Use the DT8837
(see this chapter)
Set Up and Install the DT8837
(see Chapter 3 starting on page 27)
Wire Signals
(see Chapter 4 starting on page 37)
Verify the Operation of the DT8837
(see Chapter 5 starting on page 47)

Unpacking

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

- DT8837 instrument module
- EP372 Ethernet cable
- EP361 +5V power supply and cable
- Trigger Bus Terminators
- DT8837 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) 946-5100. 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.mccdaq.com).

Once you have unpacked your DT8837 instrument module, check the system requirements, as described in the next section.

Checking the System Requirements

For reliable operation, the computer that accesses your DT8837 instrument module requires the following configuration:

- PC with Pentium 4 or equivalent processor
- Screen resolution of 1024 x 768 (or higher)
- 1 GB of RAM recommended
- 1.5 GB of hard disk space
- Ethernet port
- CD-ROM drive
- Administrator privileges for software installation
- For access to the instrument module web interface:
  - Java Version 6, Update 5 or greater
  - Internet Explorer web browser, preferably version 8.0

  Refer to page 49 for more information on installing Java and configuring your browser settings
- Acrobat Reader 5.0 or later for viewing documentation

Once you have verified that your system meets the system requirements, install the software, as described in the next section.

Installing the Software

This section describes how to install the software you need to use the DT8837 instrument module.

Prerequisite Software

No prerequisite software is required if you are using a single client to access the DT8837 instrument module on the LXI bus, or if you are managing how multiple clients concurrently access a DT8837 instrument module on the LXI bus. (In these cases, your application can use sockets to communicate with the DT8837 instrument module.)

If, however, you want multiple clients to access the DT8837 instrument module on the LXI bus, and you want to "lock" access to the instrument module so that one client cannot change the configuration of the instrument module that another client is accessing, you need to install VISA; we recommend either Agilent VISA or NI-VISA from National Instruments. You can then use the VISA methods viLock/viUnlock to prevent other clients from accessing the instrument module.

To install Agilent VISA, do the following:

1. Go to **www.agilent.com**, enter **IO Libraries Suite** in the search field, and select **Agilent IO Libraries Suite 15.0** from the search results.
2. Follow the instructions on Agilent's web site to download and install the Agilent IO Libraries, which include VISA support, VISA COM support, and the Agilent Connection Expert tool.

We recommend that you run Data Translation's Eureka Discovery Utility that is provided with the DT8837 software to locate your DT8837 LXI instrument module on the network (see page 54 for more information).

Installing the DT8837 Software

To install the DT8837 software (including the DT8837 IVI-COM driver, Eureka Discovery Utility, DT8837 SCPI Support, and DT8837 Calibration Utility) and related documentation, perform the following steps:

1. Insert the DT8837 CD into your CD-ROM or DVD drive.
   The installation program should automatically start, and the DT8837 installation program should appear.
2. If the installation program does not automatically start, double-click **Setup.exe** from the CD.
   The DT8837 installation program appears.
3. Click **Install from Web (recommended)** to get the latest version of the software or **Install from CD** to install the software from the CD.
4. If you are installing from the web, click **DT8837 Software** to install the DT8837 software.
5. If you are installing from the DT8837 CD, click **Install Features**. When you are finished with the DT8837 CD, click **Quit Installer**.

Viewing the Documentation

Note: To view the documentation, you must have Adobe Reader 5.0 or greater installed on your system.

You can access the documentation for your DT8837 instrument module from the Windows Start menu as follows:

- For documentation about the DT8837, click **Programs -> Data Translation, Inc -> Instruments -> DT8837 -> DT8837 User's Manual**.
- For documentation on the DT8837 IVI-COM driver, click **Programs -> Data Translation, Inc -> IVI-> DT8837 -> Documentation**.
- For documentation on the Eureka Discovery Utility, click **Programs -> Data Translation, Inc -> Instrument Support -> Eureka LXI Instrument Discovery**.
- For documentation about SCPI support for the DT8837, click **Programs -> Data Translation, Inc -> Instruments -> DT8837 -> DT8837 SCPI Support**.

The following may be helpful when using Adobe Reader:

- To navigate to a specific section of the document, click a heading from the table of contents on the left side of the document.
- Within the document, click the text shown in blue to jump to the appropriate reference (the pointer changes from a hand to an index finger).
- To go back to the page from which the jump was made, click the right mouse button and **Go Back,** or from the main menu, click **Document**, and then **Go Back.**
- To increase or decrease the size of the displayed document, from the main menu, click **View**, and then **Zoom**.
- By default, Adobe Reader smooths text and monochrome images, sometimes resulting in blurry images. If you wish, you can turn smoothing off by clicking **File**, and then **Preferences/General**, and unchecking **Smooth Text and Images**.

Setting Up and Installing the Instrument Module

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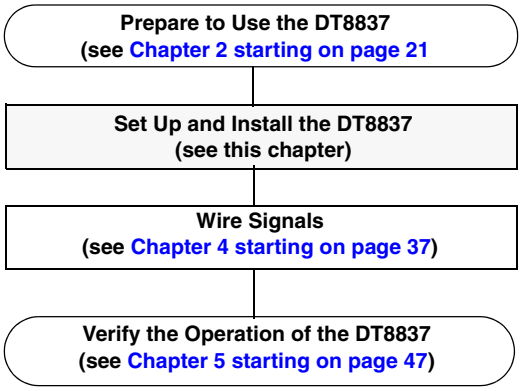

Prepare to Use the DT8837
(see Chapter 2 starting on page 21
Set Up and Install the DT8837
(see this chapter)
Wire Signals
(see Chapter 4 starting on page 37)
Verify the Operation of the DT8837
(see Chapter 5 starting on page 47)

Connecting the DT8837 to the LAN

This section describes how to connect the DT8837 instrument module to the LAN (Local Area Network). Two connection schemes are shown:

- Site LAN connections, described on this page
- Private LAN connections, described on page 41

Note: It is recommended that you consult with your network administrator to ensure that all network security, performance, and reliability issues are considered when using connecting DT8837 instrument modules to the LAN.

Connecting to a Site LAN

A site LAN is useful in applications that require access by many users or access by users at distributed sites. In this connection scheme, a DHCP (Dynamic Host Configuration Protocol) server is used to assign an IP address to the DT8837 instrument module.

Figure 2 shows a typical site LAN connections using a dedicated Ethernet hub, switch, or router. Figure 3 shows typical site LAN connections without using a dedicated Ethernet hub, switch, or router.

Note: Use standard LAN cables for network connections. The DT8837 instrument module ships with a standard LAN cable (EP372) for connecting to the LAN (RJ45) connector on the rear panel of the DT8837 instrument module.

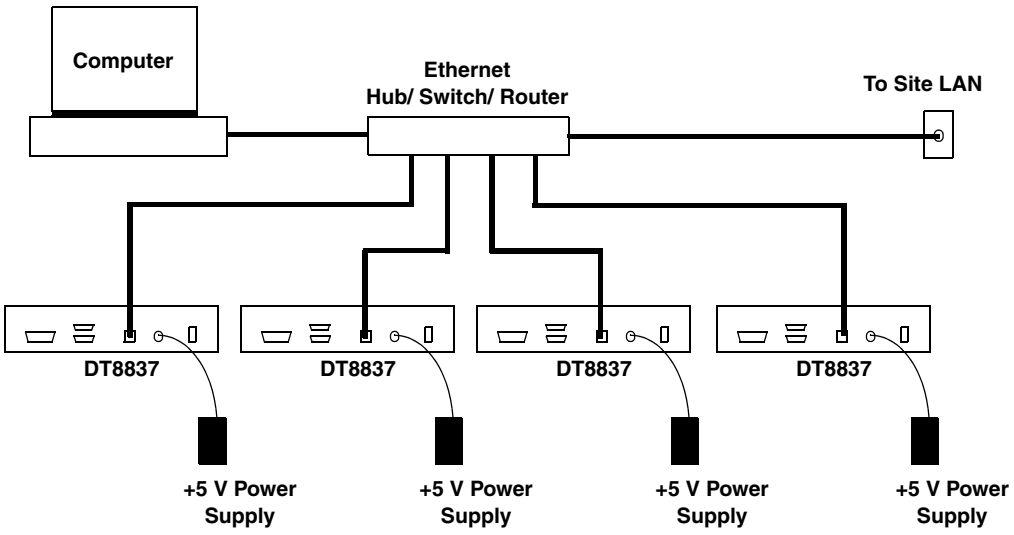


Figure 2: Typical Site LAN Connections using a Hub, Switch, or Router

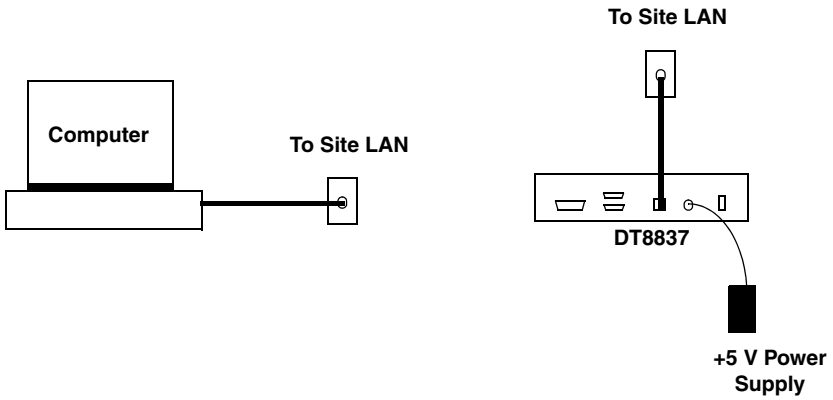


Figure 3: Typical Site LAN Connections Without Using a Hub, Switch, or Router

Connecting to a Private LAN

A private LAN (or subnet) generally involves the direct connection of the instrument modules to the computer, and may include Ethernet hubs or switches. Access to the instrument modules is limited to users that are directly connected to the private LAN; therefore, security, performance, and reliably are generally better on a private LAN than on a site LAN.

In this connection scheme, the DHCP (Dynamic Host Configuration Protocol) server is typically not available; therefore, Auto-IP is used to assign an IP address to the DT8837 instrument module.

Note: If no DHCP server exists and your PC is set up to use a static IP address, you must temporarily reconfigure your PC to use Auto-IP, as described in Appendix C on page 126.

Connecting Using a Hub or Switch

Figure 4 shows a typical connection scheme when connecting DT8837 instrument modules to a private LAN using a dedicated Ethernet hub or switch.

Note: Use standard LAN cables for network connections. The DT8837 instrument module ships with a standard LAN cable (EP372) for connecting to the LAN (RJ45) connector on the rear panel of the DT8837 instrument module.

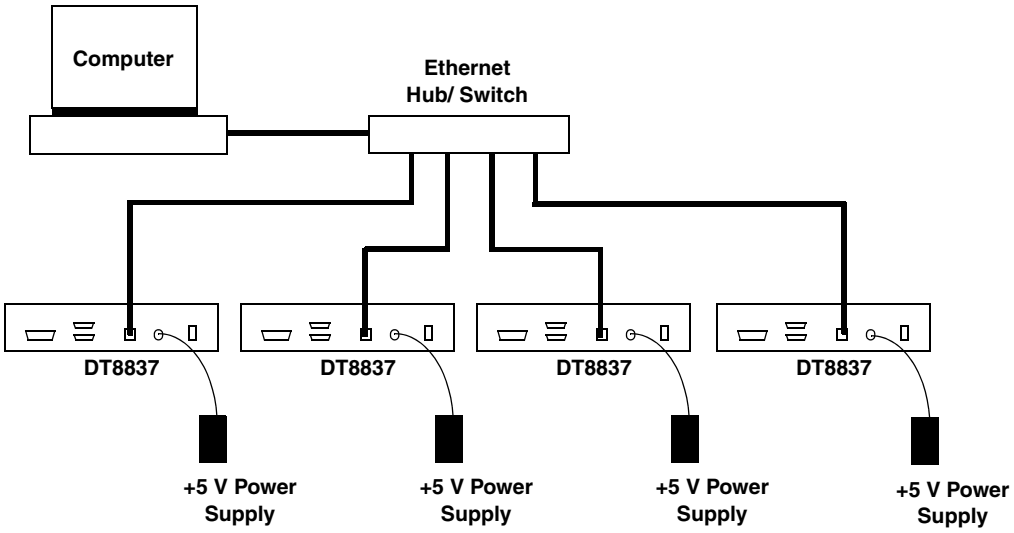


Figure 4: Typical Private LAN Connections using a Hub or Switch

Connecting Directly to a Computer

Optionally, you can connect the DT8837 instrument module directly to your computer, creating an ad hoc network, as shown in Figure 5. Be aware that the time and date settings of the instrument module will not be updated using this connection method. Therefore, this connection scheme is generally recommended for quick set up and verification only.

Note: DT8837 instrument modules do not support the Auto-MDIX function; therefore, use a crossover cable rather than a standard LAN cable to connect your DT8837 instrument module unless your computer has enabled the Auto-MDIX function.

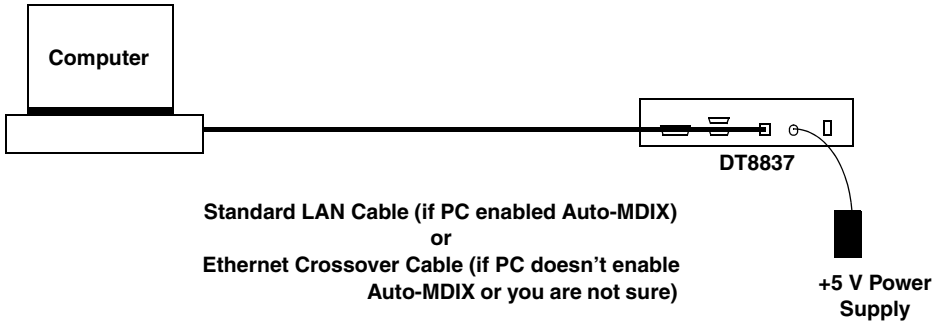


Figure 5: Typical Private LAN Connections when Connecting Directly to a Computer

Applying Power

The DT8837 instrument module is shipped with an EP361 +5V power supply and cable. To apply power to the DT8837, do the following:

1. Connect the +5 V power supply to the power connector on the rear panel of the DT8837. Refer to Figure 6.

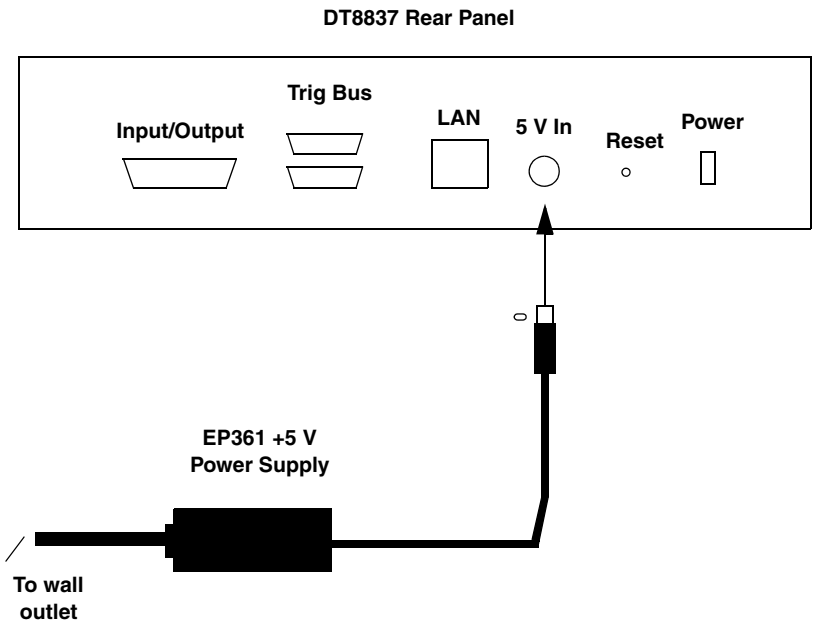


Figure 6: Attaching a +5 V Power Supply to the DT8837 Instrument Module

2. Plug the power supply into a wall outlet.
3. Press the Power switch on the rear panel of the instrument module, shown in Figure 6, to turn on the DT8837 instrument module.
   The Power LED on the front panel lights to indicate that power is on.

Figure 7 shows the front panel of the DT8837, including the locations of the LEDs.

Figure 7: Front Panel of the DT8837

Getting an IP Address and Host Name

Once your DT8837 instrument module is connected to the LAN and powered on, the instrument module automatically requests an Ethernet address from a DHCP (Dynamic Host Configuration Protocol) server, if available, and a host name from a DNS (Dynamic Domain Name Service) server, if available.

If these services are not available on the LAN, the DT8837 instrument module uses Auto-IP to set up its TCP/IP configuration. In this case, the IP address will be in the range of 169.254.0.0 to 169.254.255.255 with a subnet mask of 255.255.0.0.

Note: If no DHCP server exists and your PC is set up to use a static IP address, you must temporarily reconfigure your PC to use Auto-IP, then configure your DT8837 instrument module to use a static IP address, as described in Appendix C on page 129.

You can use the instrument module's web interface, described in Chapter 5 starting on page 47, to see the IP address and host name that is assigned to your DT8837 instrument module.

Notes: When programming a DT8837 instrument module, you access the instrument module through its address string, which consists of an IP address or host name, such as **TCPIP0::192.43.218.69::inst0::INSTR** or **TCPIP0::192.43.218.69::SOCKET**. If a host name was returned by the DNS server, you can also address the instrument module using its host name, such as **TCPIP0::arrakis.datx.com::inst0::INSTR.**

For IVI-COM programmers, you can also assign a VISA alias to the instrument module. For example, rather than addressing the instrument module as **TCPIP0::192.43.218.69::inst0::INSTR**, you can use the VISA alias **DT8837_1** instead. See your VISA documentation for more information on VISA resource strings and creating VISA aliases.

Determining Ethernet Activity

You can use the ENet Link and ENet Activity LEDs on the rear of the DT8837 instrument module, shown in Figure 8, with the LAN LED on the front of the DT8837 instrument module, shown in Figure 7, to determine the Ethernet activity on your DT8837 instrument module. Table 1 describes the meaning of these LEDs.

Figure 8: Rear Panel of the DT8837

Table 1: Using DT8837 LEDs to Determine Ethernet Activity

LEDs	Color	Description
LAN LED (on front panel)	Solid Green	DT8837 instrument module has valid IP address.
	Blinking Green	DT8837 instrument module identified using the Web interface; see page 54 for more information.
	Red	If the Ethernet link is operational, the instrument module does not have a valid IP address. Otherwise, the Ethernet link is not operational.
ENet Link LED (on rear panel)	Yellow	Ethernet link operational.
	Off	Ethernet link not operational.
ENet Activity LED (on rear panel)	Green	Network traffic detected.
	Off	No network traffic detected.

Resetting the Instrument Module

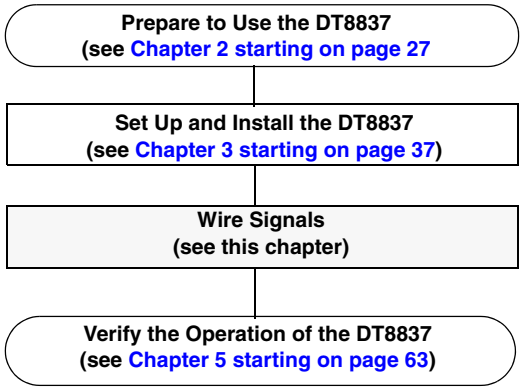
If needed, you can restore the default configuration of your DT8837 instrument module by pressing the Reset pin on the rear panel of the instrument module, shown in Figure 8 on page 34, until the LAN LED on the front panel turns off (which takes approximately 5 seconds), and then releasing the Reset pin.

The instrument module reboots automatically using the factory-default LAN configuration (DHCP and auto-IP enabled); this process typically takes up to 40 seconds to complete. This forces the instrument module to re-acquire an IP address from the DHCP server, or if that fails, to use Auto-IP to get an IP address.

Note: The default configuration overwrites any changes that you have made to the LAN configuration using the instrument module's web interface.

Wiring Signals

Preparing to Wire Signals 53
Connecting Analog Input Signals 55
Connecting an Analog Output Signal 57
Connecting to the Input/Output Connector 58


Prepare to Use the DT8837
(see Chapter 2 starting on page 27
Set Up and Install the DT8837
(see Chapter 3 starting on page 37)
Wire Signals
(see this chapter)
Verify the Operation of the DT8837
(see Chapter 5 starting on page 63)

Preparing to Wire Signals

This section provides recommendations and information about wiring signals to the DT8837 instrument module.

Wiring Recommendations

Keep the following recommendations in mind when wiring signals to a DT8837 instrument module:

- Follow standard ESD procedures when wiring signals to the instrument module.
- Separate power and signal lines by using physically different wiring paths or conduits.
- To avoid noise, do not locate the instrument 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 instrument module is operational.
- Connect all unused analog input channels to analog ground.

Wiring Signals to the Instrument Module

The DT8837 instrument module contains five BNC connectors on one end of the instrument module, and a 15-pin input/output connector, two 25-pin Trigger Bus connectors, and a LAN connector on the other end of the instrument module as shown in Figure 9.

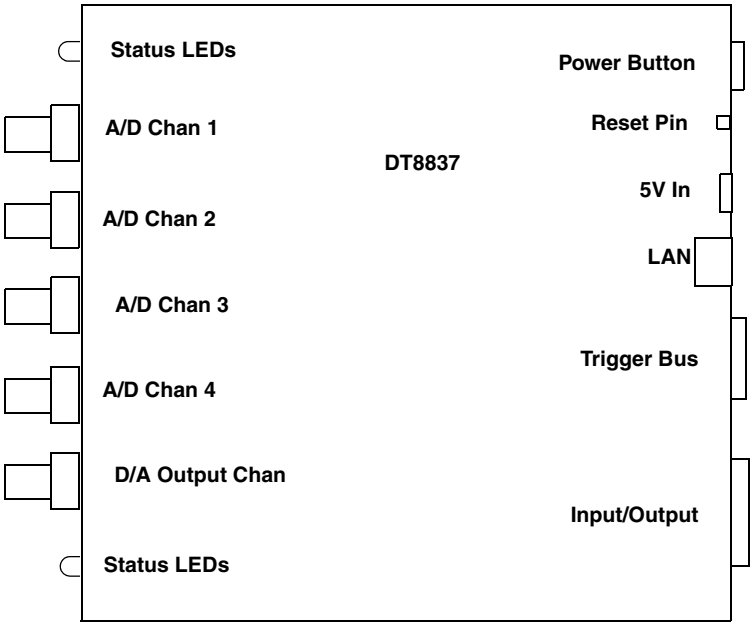


Figure 9: Connectors of the DT8837

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 the DT8837 instrument module. Internally, these signals are connected in differential mode. The DT8837 instrument module supports 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 102 for more information on IEPE inputs.

Figure 10 shows how to connect analog inputs (channels 1 and 2, in this case) to the BNC connectors on the DT8837 instrument module.

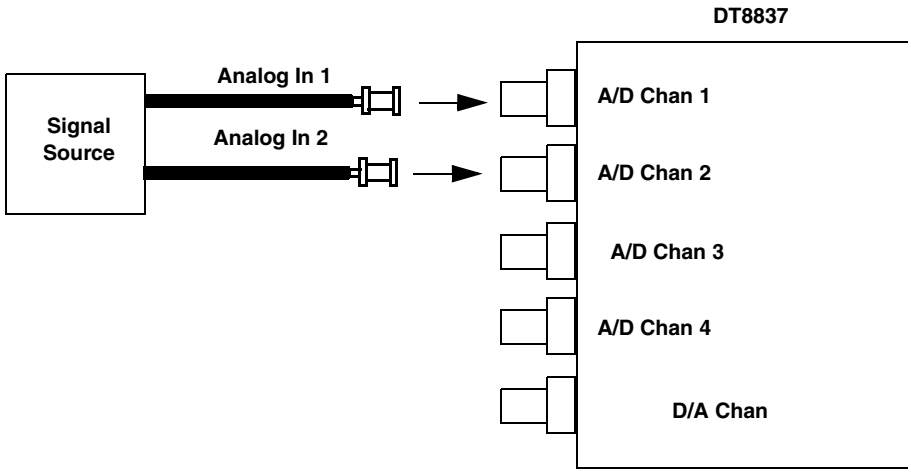


Figure 10: Connecting Analog Inputs to the DT8837

Connecting an Analog Output Signal

The DT8837 instrument module provides one analog output channel with an output range of ±10 V. Figure 11 shows how to connect an analog output signal to the DT8837 instrument module.

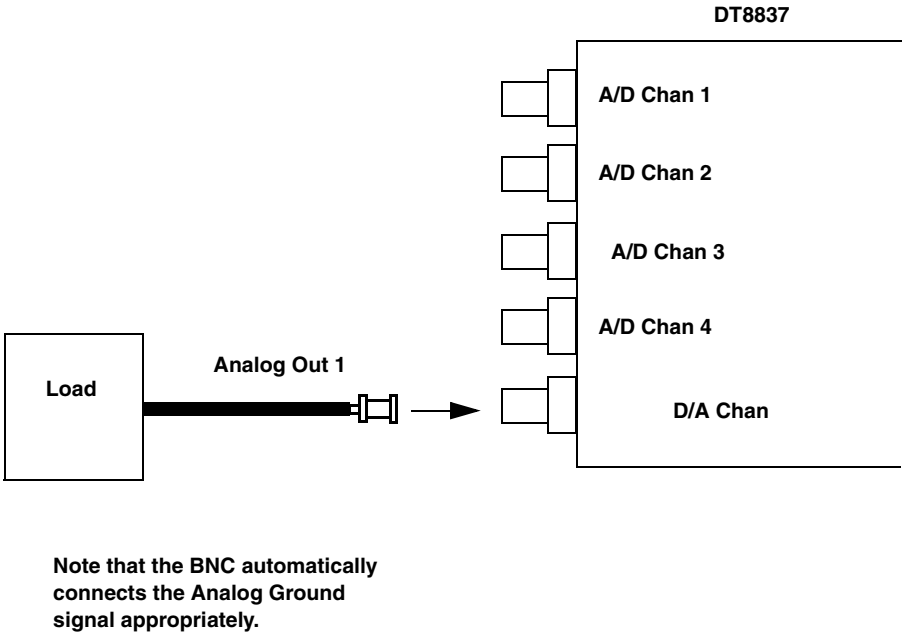


Figure 11: Connecting an Analog Output Signal to the DT8837

Connecting to the Input/Output Connector

To make I/O connections easier, you can use the optional STP8837 screw terminal panel and EP378 cable with your DT8837 instrument module to connect the tachometer, gate, and digital output signals to the DT8837 instrument module. Connect the STP8837 to the I/O connector of the instrument as shown in Figure 12:

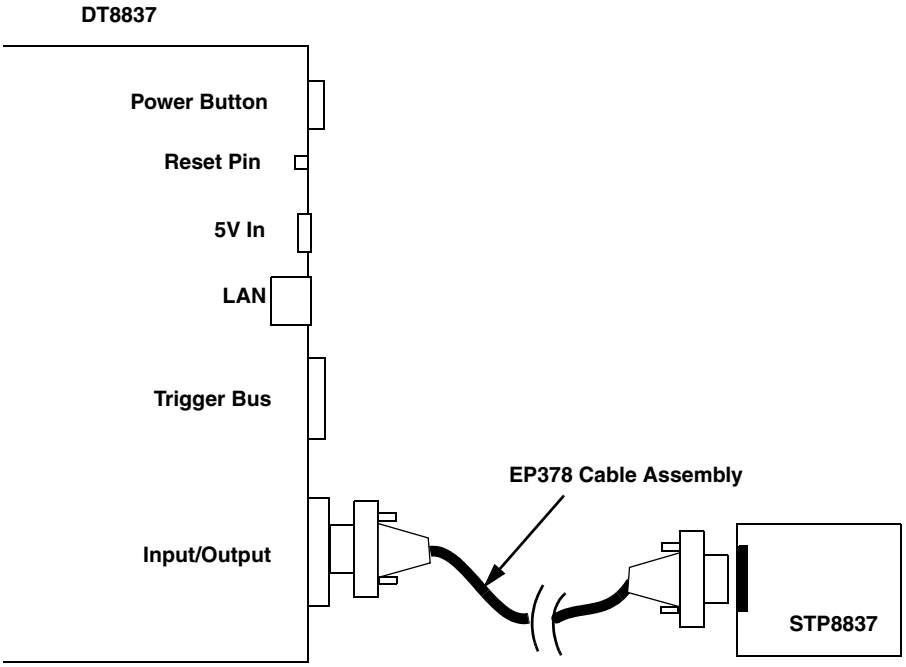


Figure 12: Connecting the Instrument Module to the STP8837

Figure 13 shows the layout of the STP8837 screw terminal panel and lists the assignments of each screw terminal.

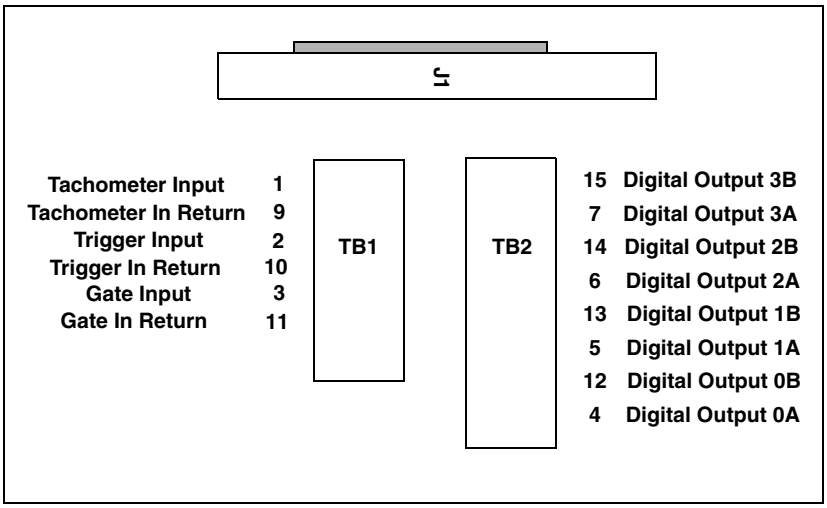


Figure 13: STP8837 Screw Terminal Panel

Connecting a Tachometer Input Signal

You can connect a tachometer input signal with a range of up to ±30 V to the tachometer input pins on the STP8837, as shown in Figure 14.

Note: In software, you can read tachometer measurements as part of the analog input channel list. Refer to page 85 for more information on tachometer measurements.

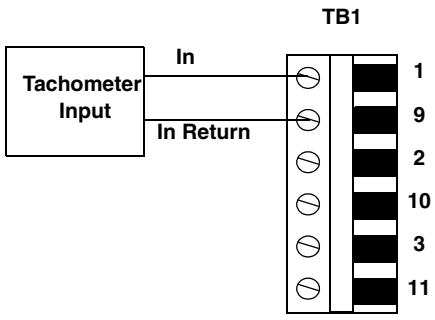


Figure 14: Connecting a Tachometer Input Signal to the STP8837

Connecting a Gate Input Signal

You can connect a TTL gate input signal to the gate input pins on the STP8837, as shown in Figure 15.

Note: In software, you can read gate measurements as part of the analog input channel list. Refer to page 87 for more information on gate measurements.

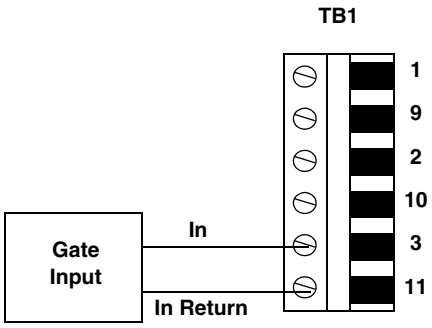


Figure 15: Connecting a Gate Input Signal to the STP8837

Connecting Digital Output Signals

The isolated digital output lines of a DT8837 instrument module act as solid-state relays. The customer-supplied signal can be ±30 V at up to 400 mA (peak) AC or DC.

You can use the digital output lines of the instrument module to control solid-state or mechanical relays or high-current electric motors. Figure 16 shows how to connect digital output signals to line 0 of the instrument to control a motor relay.

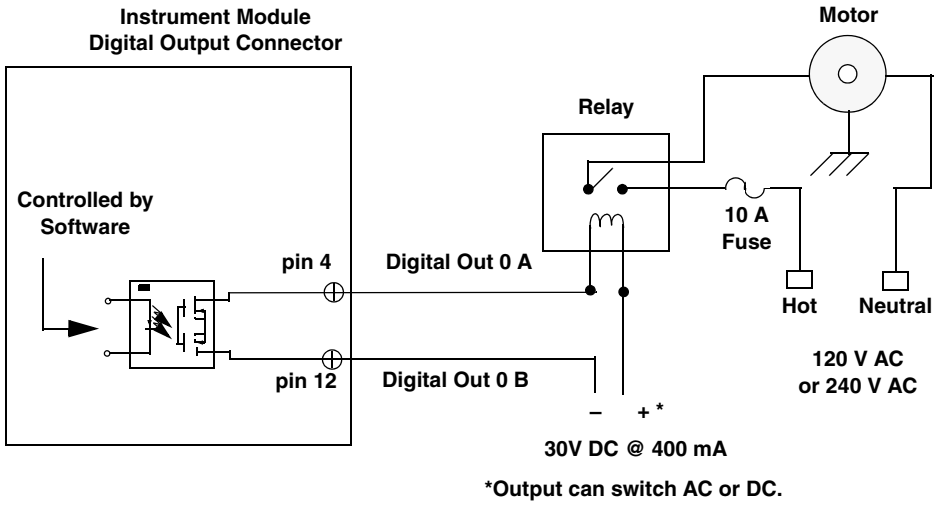
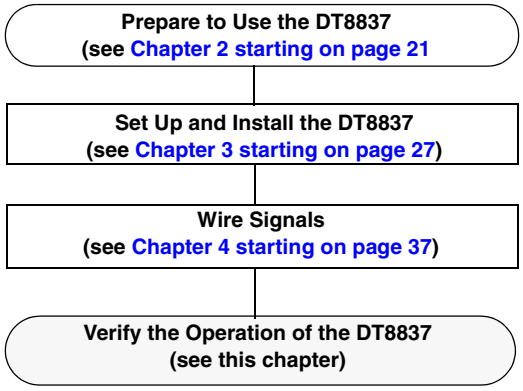


Figure 16: Switching up to 30V at 400 mA

Verifying the Operation of an Instrument Module

Before Using the Web Interface 49
Locating Your Instrument Module on the LAN 54
Configuring the DT8837 Instrument Module 58
Measuring Data and Controlling the Instrument 69



You can verify the operation of the DT8837 instrument module using the instrument module's web interface.

You can configure, measure, and control the DT8837 instrument module either locally or remotely using this interface.

Alternatively, you can use the QuickDAQ application to configure the instrument module and acquire data from the analog inputs, tachometer, and counters, and perform FFTs on the analog input data. This chapter focuses on verifying your instrument module using the web interface; refer to the documentation provided with the QuickDAQ application for information on using QuickDAQ.

Before Using the Web Interface

This section describes system requirements and browser settings for proper operation of the instrument module's web interface.

Note: At any instant, up to 8 clients can access the DT8837 instrument modules concurrently using the web interface.

Up to 12 additional clients can access the DT8837 instrument modules concurrently using SCPI commands over VISA or sockets. Of these, 4 can be VXI-11 clients, which use the ::SOCKETS or VISA::INSTR resource to access the instrument module.

At this time, the web and SCPI interfaces cannot be "locked;" therefore, one client can change the configuration of the instrument module that another client is accessing. However, you can optionally lock the VXI-11 interface using the VISA APIs viLock/viUnlock; this prevents other VXI-11 clients (including VXI-11 discovery) from accessing the instrument module. Refer to the SCPI documentation for your instrument module for more information on supported SCPI commands.

Java Requirements

Before using the instrument web interface, ensure that your computer has Version 6, Update 5 or greater of Java installed; this version of Java installs version 1.6 of the Java plug-in. You can verify Java versions and settings by accessing the Java Control Panel, select Windows **Start** -> **Control Panel** and open the **Java** dialog**.** To download or upgrade Java, go to www.java.com.

Internet Explorer Browser Settings

For proper operation of the instrument module's web interface, ensure that your Internet Explorer browser is configured as follows:

- JavaScript (Active Scripting) must be enabled
- Security level of the DT8837 instrument module IP address must be Medium-high or lower
- Pop-up blockers must be disabled

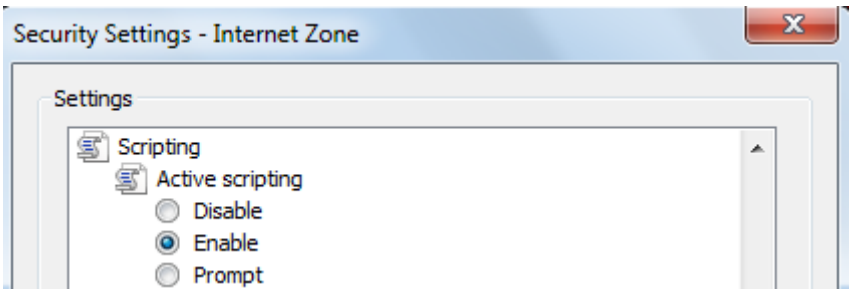
The following sections describe how to configure these settings.

JavaScript

To enable JavaScript (also referred to as Active Scripting), perform the following steps:

1. From the Internet Explorer browser, select **Tools** -> **Internet Options**.
2. Click the **Security** tab.
3. Select **Internet**, and then click **Custom Level**.

4. Scroll down to the **Scripting** section.



5. Under **Active Scripting**, select **Enable**, and then click **OK**.

Security Levels

By default, the IP address of the DT8837 instrument module is added to the Internet zone. If you'd rather leave the settings of the Internet zone at a level higher than Medium-high, then you can add the IP address of the DT8837 to either the Local intranet or Trusted sites zone and configure the security level of that zone to Medium-high or lower.

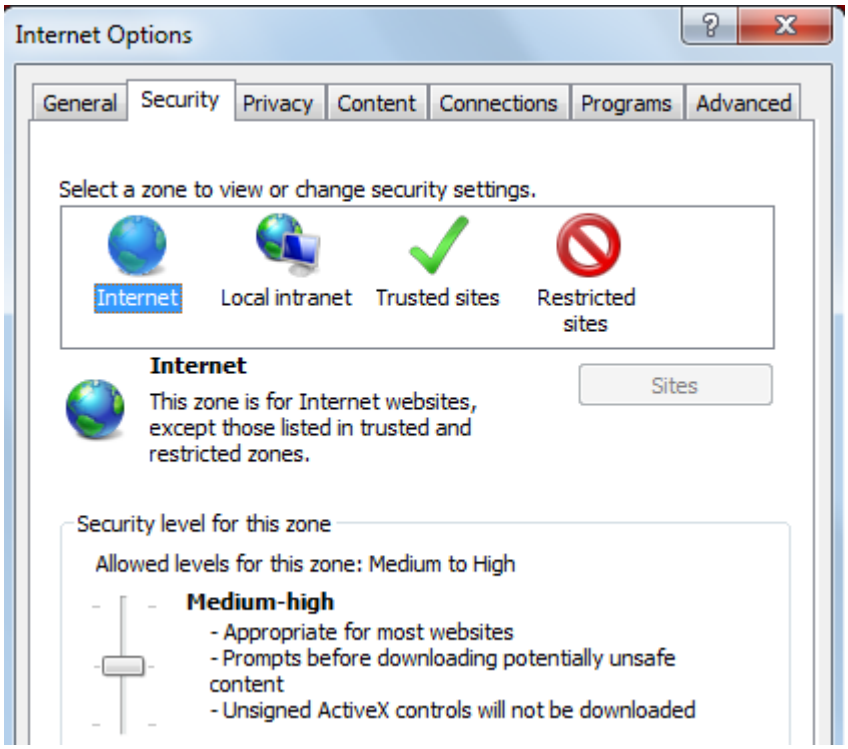
The following section describe how to configure each zone.

Internet Zone

To configure the security level of the DT8837 instrument module's IP address in the Internet zone, perform the following steps:

1. From the Internet Explorer browser, select **Tools** -> **Internet Options**.

2. Click the **Security** tab.

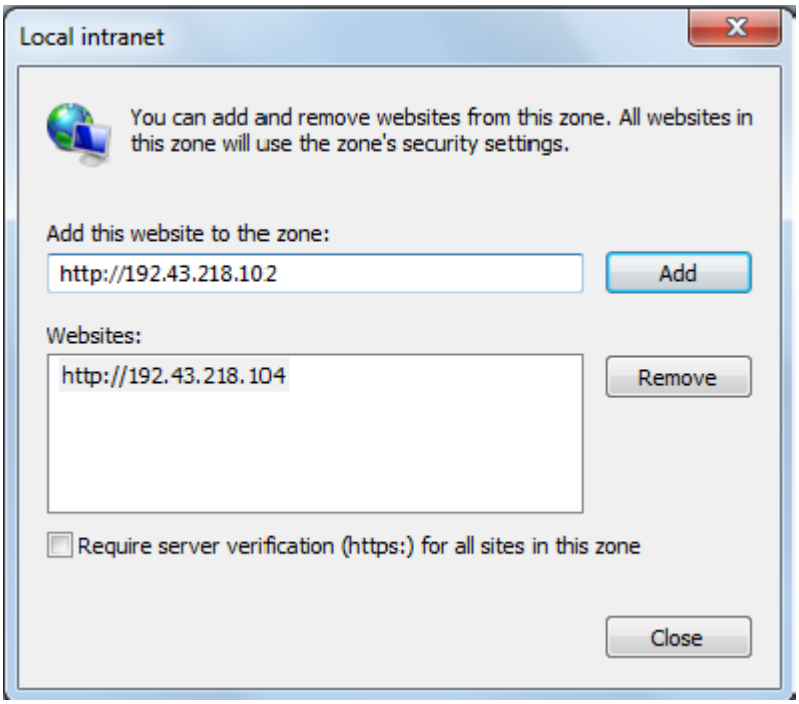


3. Select **Internet** and move the slide bar to select a security level of Medium-high or lower.
4. Click **OK**.

Local Intranet Zone

To add the IP address of the DT8837 to the **Local intranet** zone and configure its security level, do the following:

1. From the Internet Explorer browser, select **Tools** -> **Internet Options**.
2. Click the **Security** tab.
3. Click **Local intranet**, and click **Sites**.
4. Select which web sites to add to the zone, and then click **Advanced**.
5. Enter the IP address of the DT8837 instrument module to the zone, and click **Add**.

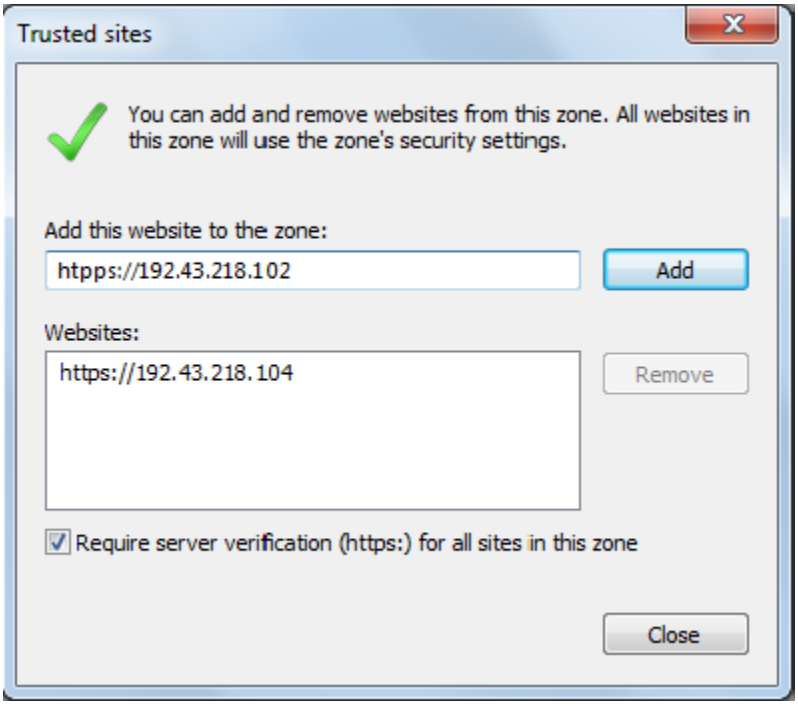


6. Click **Close**.
7. Move the slide bar to select a security level of Medium-high or lower.
8. Click **OK**.

Trusted Sites Zone

To add the IP address of the DT8837 to the **Trusted sites** zone and configure its security level, do the following:

1. From the Internet Explorer browser, select **Tools** -> **Internet Options**.
2. Click the **Security** tab.
3. Click **Trusted sites**, and click **Sites**.
4. Enter the IP address of the DT8837 instrument module to the zone (note that the address must be prefaced by (https://), and click **Add**.



5. Click C**lose**.
6. Move the slide bar to select a security level of Medium-high or lower.
7. Click **OK**.

Pop-up Blockers

To disable pop-up blockers, perform the following steps:

a. From the Internet Explorer browser, select **Tools** ->**Pop-up Blocker**.

b. Select **Turn Off Pop-up Blocker**.

Locating Your Instrument Module on the LAN

To access the web interface of your instrument module, you must determine its IP address on your TCP/IP network.

Note: Discovery will work only for devices on the same subnet.

We recommend that you run Data Translation's Eureka Discovery Utility that is provided with the DT8837 software to locate your DT8837 instrument module quickly. Alternatively, you can use other LXI discovery tools, such as Agilent Connection Expert, if you have them installed on your computer. Or you can check your router's address assignments or locate the instrument module's MAC (Ethernet hardware) address in your DHCP server log.

Running the Eureka Discovery Utility

To use the Eureka Discovery Utility, from the Windows Start menu, click **Programs -> Data Translation, Inc -> Instrument Support -> Eureka LXI Instrument Discovery**.
A screen similar to the one shown in Figure 17 appears.

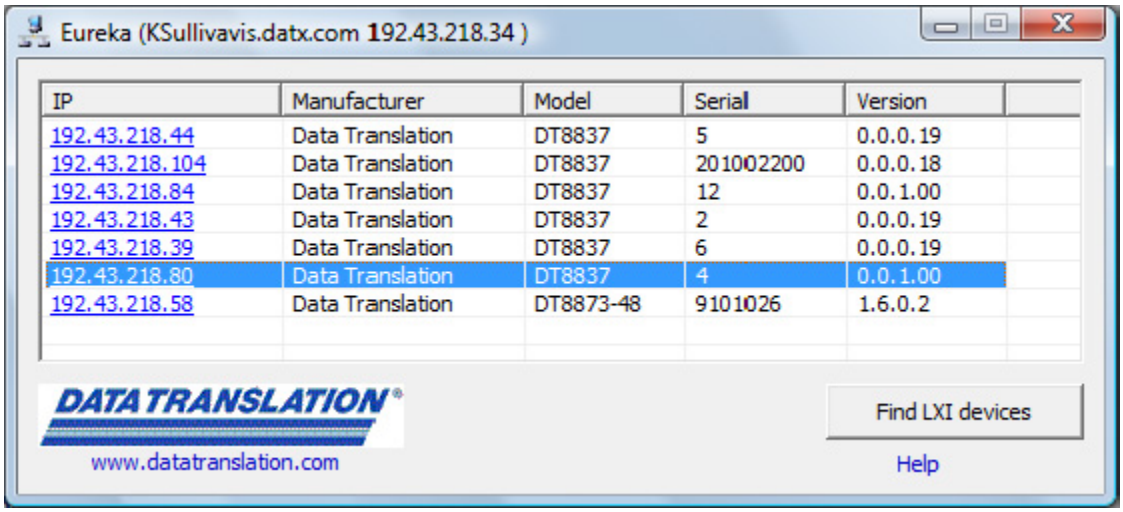


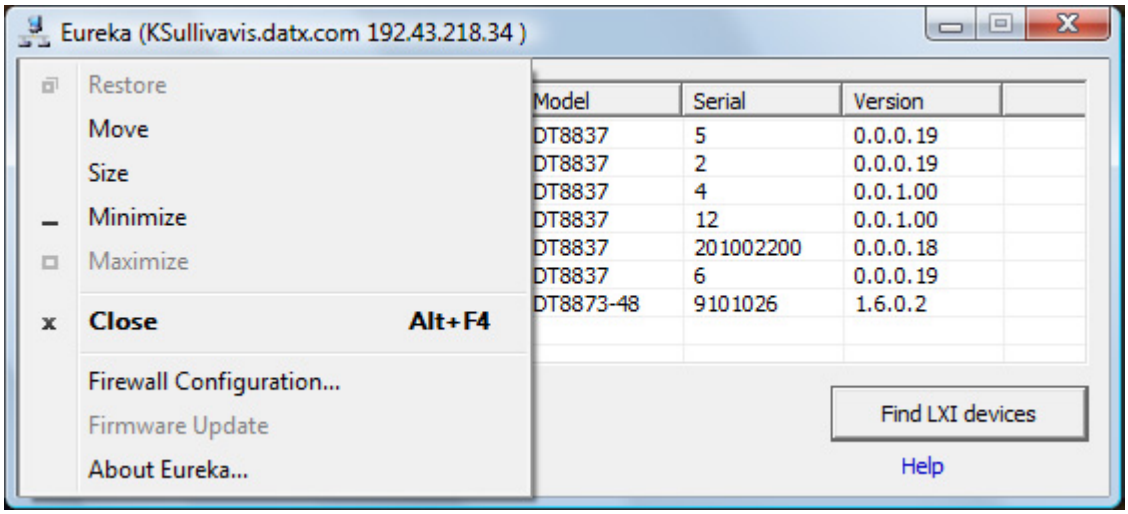
Figure 17: Eureka LXI Discovery Utility

If you are having trouble seeing your instrument module in this list, check your Windows firewall settings using the information in the next section; otherwise, skip this section and continue with "Launching the Web Interface" on page 57.

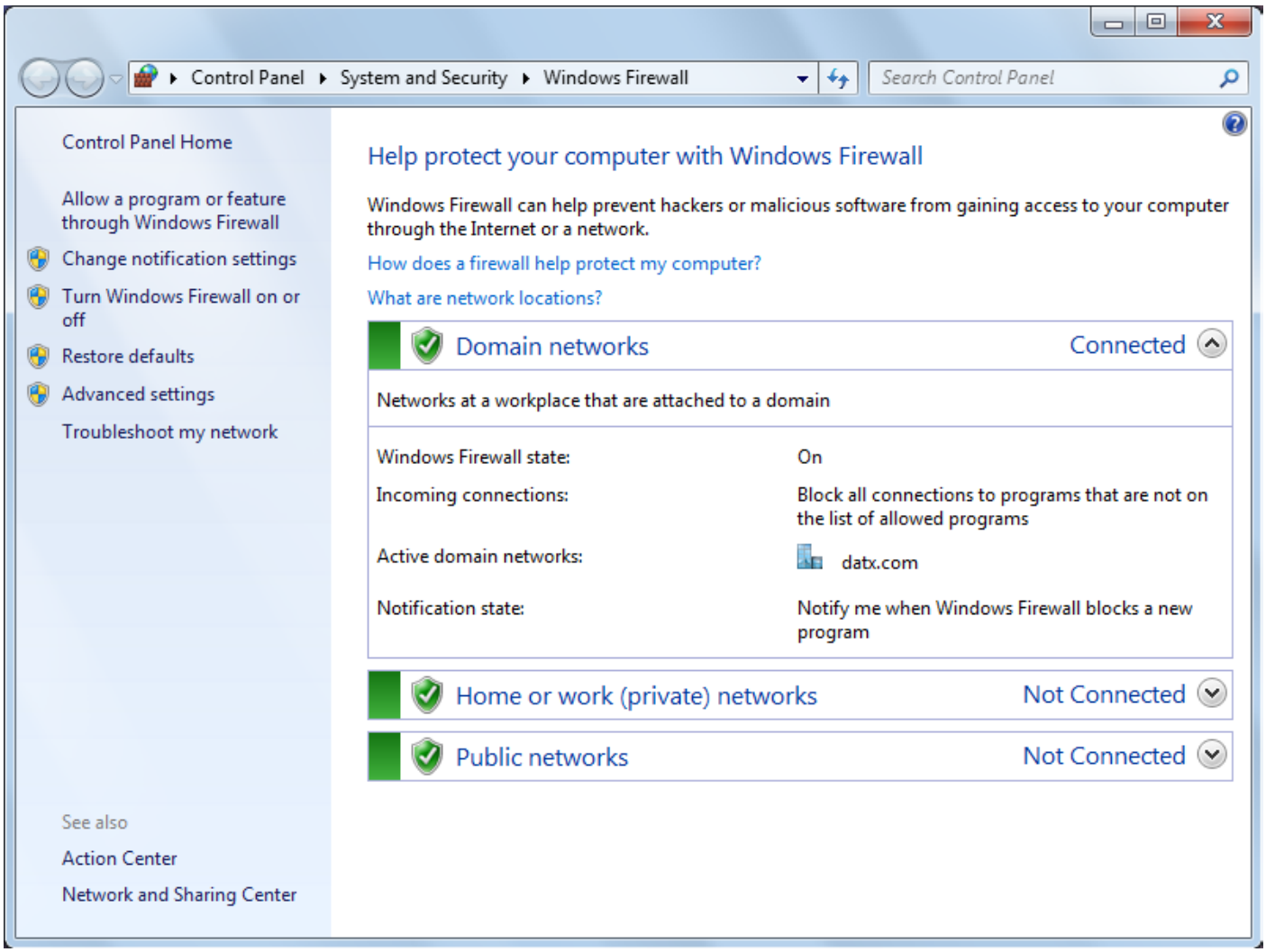
Configuring Windows Firewall Settings

If you are having trouble seeing your instrument module using the Eureka Discovery Utility, check your Windows firewall settings by doing the following:

1. Right click in the tile bar of the Eureka Discovery Utility.
   The following menu options appear:



2. Click the **Firewall Configuration...** option.
   The following window appears:



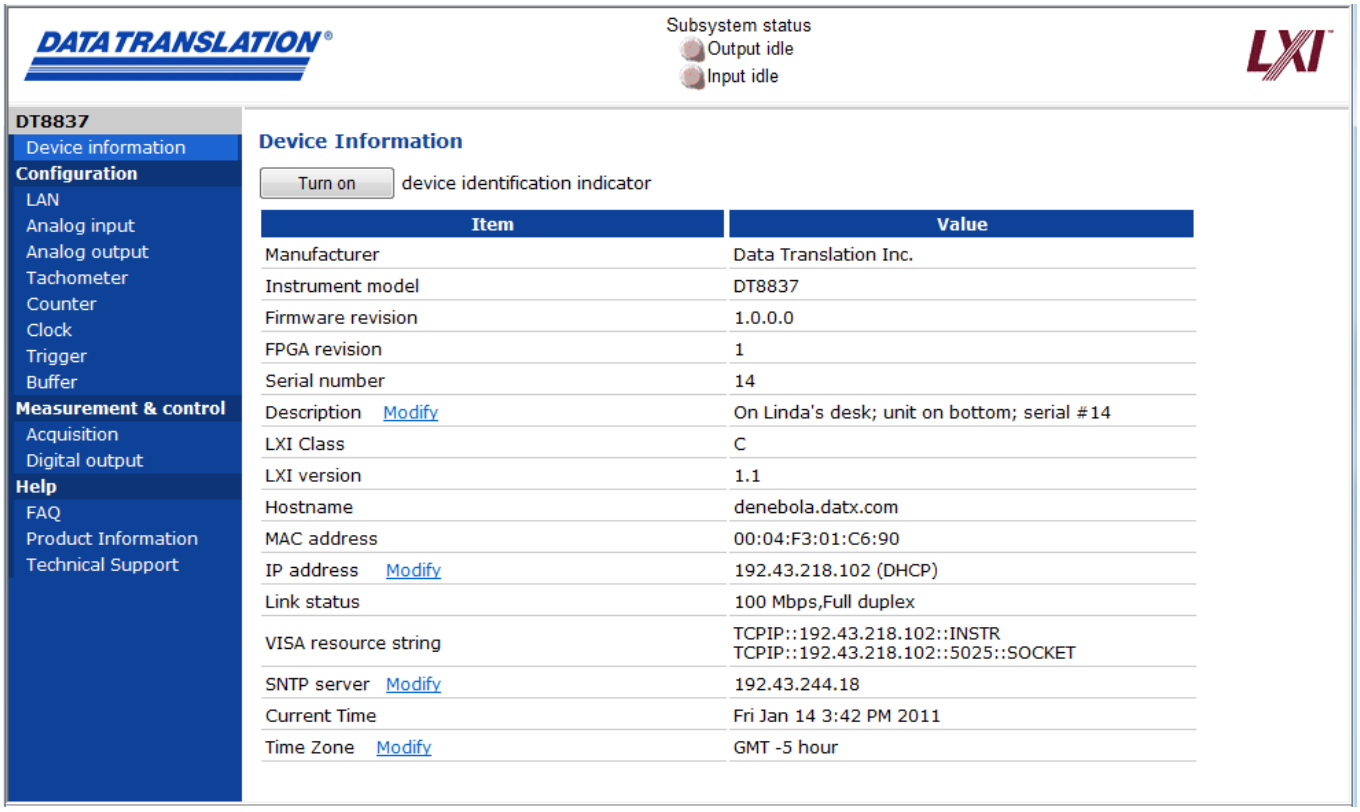
3. On the left side of the window, select **Turn Windows Firewall on or off**, select **Turn On Windows Firewall** setting for proper operation of the Eureka Discovery Utility, and cliek OK.
4. On the left side of the window, select **Allow a program or feature through Windows Firewall**, ensure that Eureka LXI Instrument Discovery is included in the list of exceptions, and click **OK**.
5. If Eureka LXI Instrument Discovery is not included in the exception list, add the utility to the list of exceptions by doing the following:
   a. Click **Allow another program...**
   b. Browse to **C:\Program Files\Data Translation\Instrument Support\Eureka.exe**, and click **Open**.
   The Eureka LXI Instrument Discovery utility appears in the window.
   c. Click **Add** to add the utility to the list of exceptions.
   d. Click **OK** to exit from the Windows Firewall Configuration menu.

Launching the Web Interface

From the Eureka utility, double-click the appropriate IP address to open the web pages for your instrument module using your default web browser.

Alternatively, you can enter the IP address of your instrument module directly in your Internet Explorer address bar to see the instrument module's web interface.

The main web page shows information about your DT8837 instrument module on the network:



If you have multiple DT8837 instrument modules, you can click "Turn **ON** front panel identification indicator" to light the LAN LED on the instrument module, described on page 34, to indicate the device you are using.

To change the description, IP address, or time source associated with the DT8837 instrument module, click the **Modify** links to navigate to the LAN Configuration page, described on page 58.

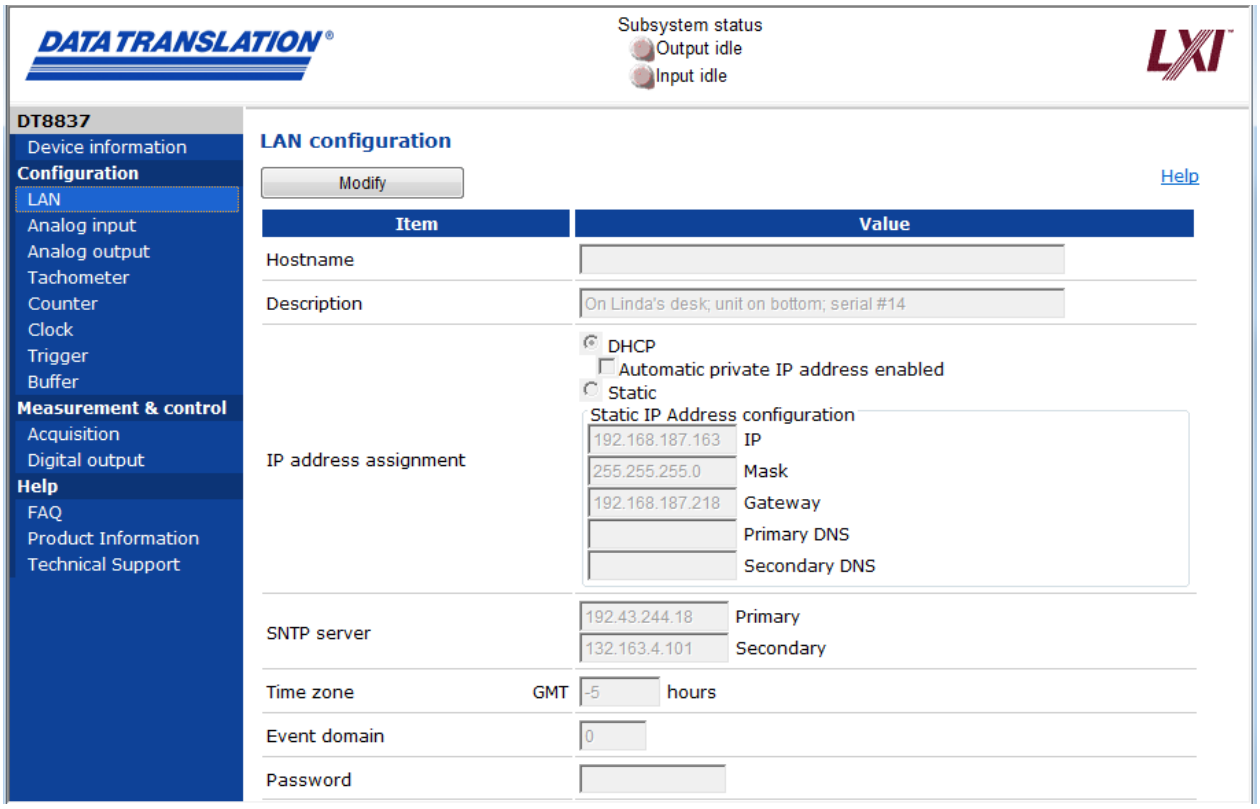
Configuring the DT8837 Instrument Module

Web pages are provided for configuring the following aspects of your DT8837 instrument module:

- Local Area Network (LAN) settings
- Analog input channels
- Analog output channels
- Tachometer settings
- Counter settings
- Clock frequency
- Trigger settings
- Analog input and analog output buffer mode

LAN Configuration

Use the **Configuration** -> **LAN** web page to configure the Local Area Network (LAN) settings for the DT8837 instrument module:



When you first access your DT8837 instrument module, the LAN settings that the instrument module obtained through DHCP or AutoIP should be sufficient. If you need to make changes later, click the **Modify** button to enable changes.

Note: If you want to assign a static IP address, ensure that you uncheck the checkbox called **Automatic private IP address enabled**.

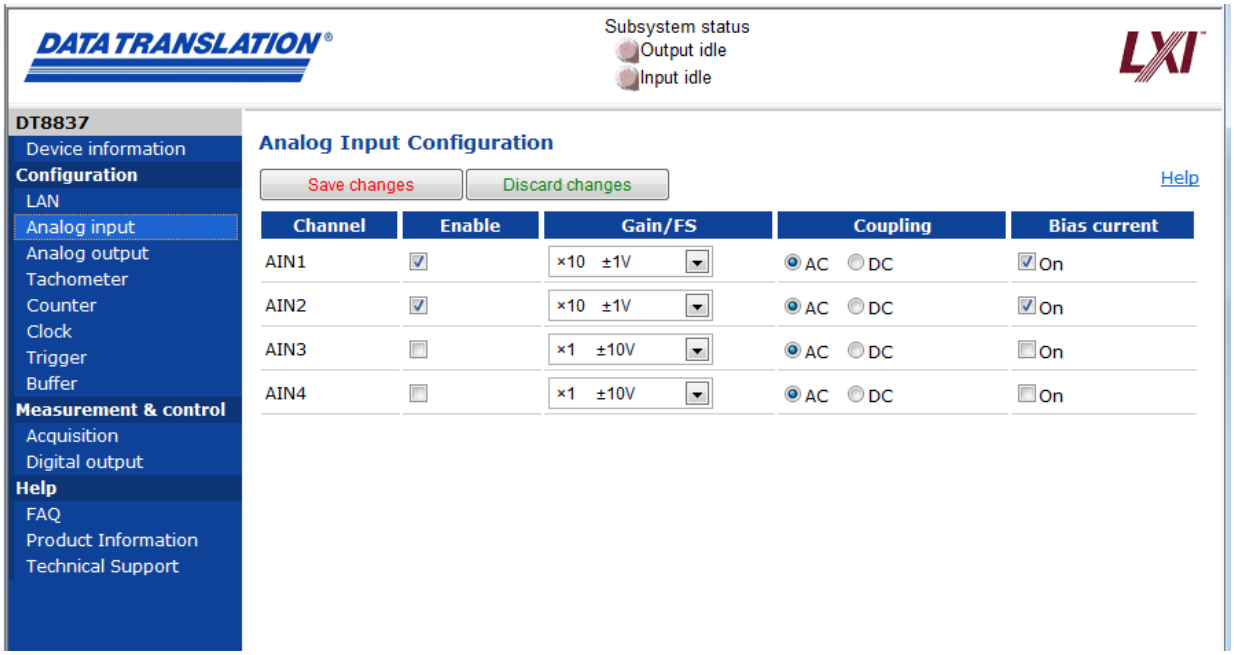
When you click **Modify,** you must supply a password for the instrument module. The username is **admin;** it cannot be changed. The default password is **admin.** You can change the password on this page. Note that the new password goes into effect after the device reboots. If you are prompted for a password before the device reboots, you must enter your original password.

Contact your system administrator and view the instrument module's built-in help pages to determine the correct LAN settings.

Note: If needed, you can restore the default configuration of your DT8837 instrument module by pressing the Reset pin on the rear panel of the instrument module. For more information, refer to "Resetting the Instrument Module" on page 35. Contact your system administrator to determine the correct LAN settings for your device on the network.

Analog Input Configuration

Use the **Configuration** -> **Analog input** web page to enable the analog input channels that you want to measure, specify the gain for each channel, specify AC/DC coupling, and enable Bias current, if desired:



To change your channel configuration, do the following:

1. Under **Enable Channel,** check the boxes next to the channels whose data you want to acquire.
2. Under **Gain/FS,** select x1 (for a gain of 1 and a full-scale range of ±10 V) or x10 (for a gain of 10 and a full-scale range of ±1 V) for each analog input channel.
3. Under **Coupling,** select AC for AC coupling or DC for DC coupling for each analog input channel.
4. Under **Bias current,** check ON to turn on the 4 mA current source for each analog input channel. If the box is unchecked, the current source is turned off.
5. Click **Save changes** to apply your changes. If you do not save before leaving this page, your changes are lost.

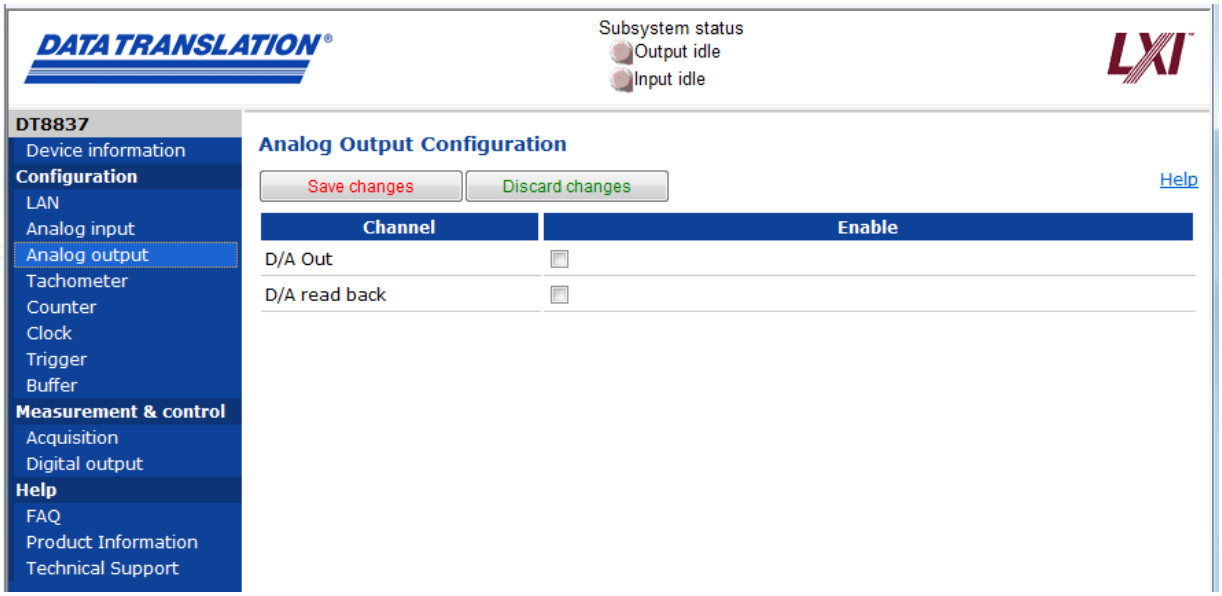
You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

Analog Output Configuration

If you want to output data from the analog output channel, select the **Configuration** -> **Analog output** web page and check the D/A Out box.

If you want to read the value of the analog output channel in the analog input data stream (useful for correlating input and output data), select the **Configuration** -> **Analog output** web page and check the D/A read back box.

The hardware aligns the value of the analog output readback channel with the analog input measurements, so that all measurements are correlated in time. The analog output readback channel is treated like any other channel in the analog input subsystem; therefore, all the triggering and clocking options supported for analog input channels are supported for the readback channel.



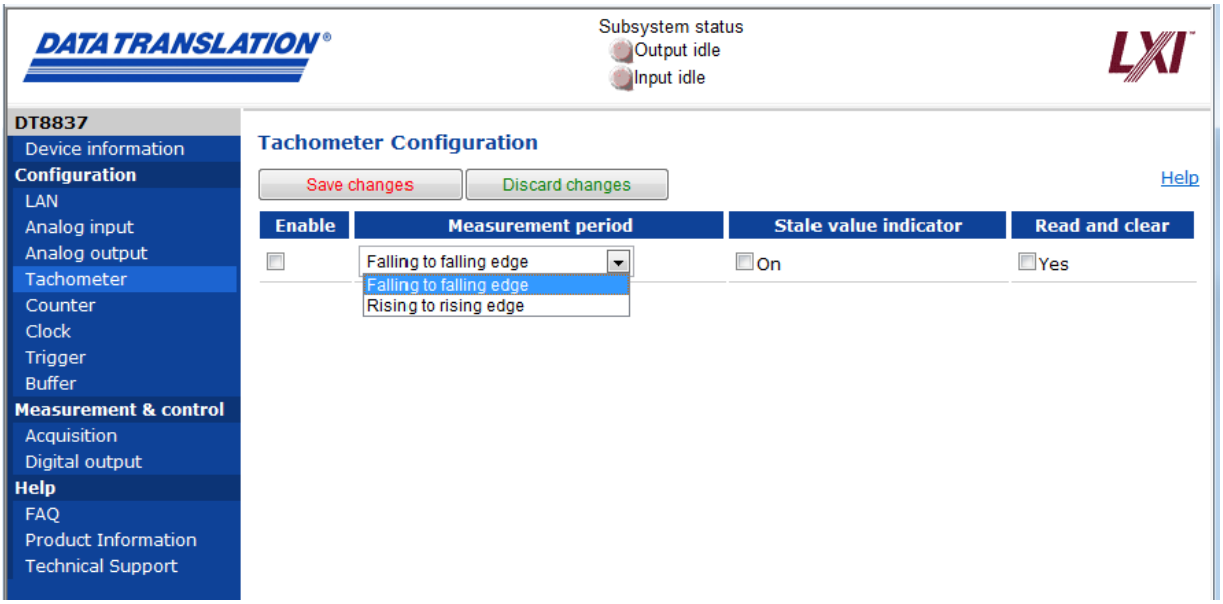
Tachometer Configuration

You can measure the frequency or period of the tachometer input signal by reading the value of the tachometer input channel in the analog input stream. The frequency or period measurement allows you to calculate the rotation speed of tachometer input signals.

An internal 12 MHz counter is used for the measurement, yielding a resolution of 83 ns (1/12 MHz).

Note: You can also measure the phase of the tachometer input signal in relation to the analog input samples using one of the counter/timer channels.

To configure the tachometer, use the **Configuration** -> **Tachometer** web page:



1. Enable reading the tachometer input in the analog input data stream by selecting the **Configuration** -> **Tachometer** web page and checking the Enable box.
2. Under **Measurement period**, select whether to measure from a rising-to-rising edge of the tachometer signal or a falling-to-falling edge of the tachometer signal.
3. Under **Stale value** indicator, check the box if you want to use the most-significant bit (MSB) of the value to indicate whether the measurement is new or old; when checked, the MSB of the value is set to 0 to indicate new data or 1 to indicate old data. Reading the value before the measurement is complete returns an MSB of 1 to indicate old data. If you are not interested in whether the data is new or old, uncheck the Stale Value indicator; in this case, the MSB is always set to 0.
4. Under the **Read and clear** indicator, check this box if you want to clear the value to zero between measurements. To retain the previous measurement value until the next measurement is complete, uncheck this box.

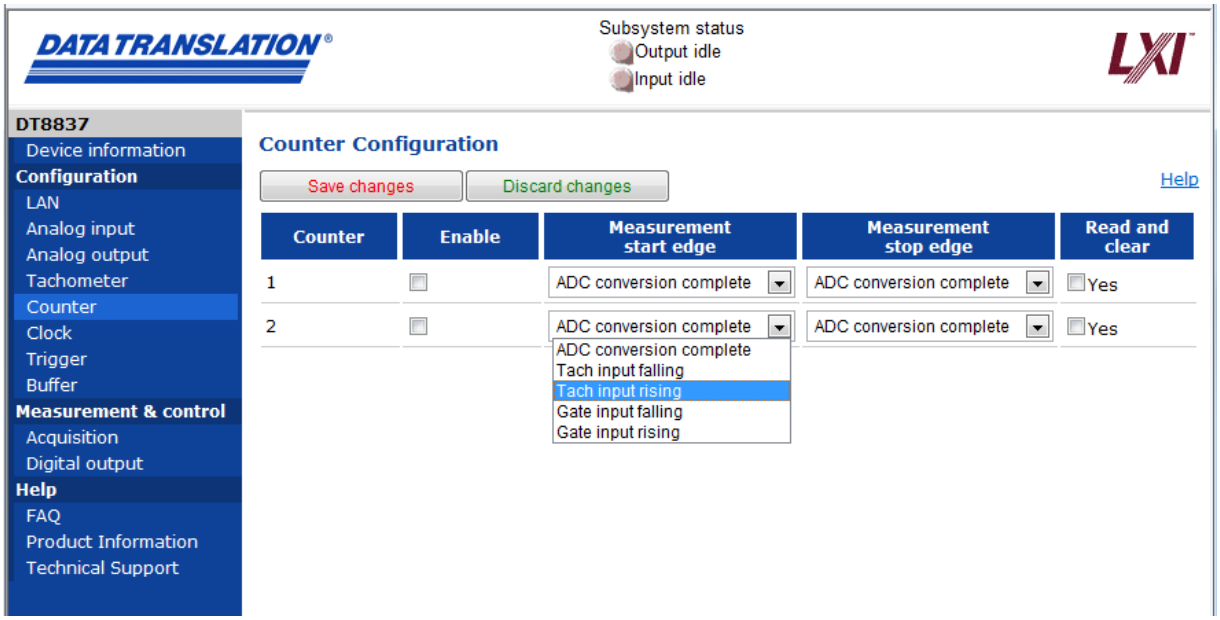
5. Click **Save changes** to apply your changes. If you do not save your changes before leaving this web page, your changes are lost.

You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

The hardware aligns 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 subsystem; therefore, all the triggering and clocking options supported for analog input channels are supported for the tachometer input.

Counter Configuration

DT8837 instrument modules provide two 32-bit counter/timer channels for measuring the frequency, period, or phase between two signals. Use the **Configuration** -> **Counter** web page to configure the counters:



1. To enable reading counter 1 and/or counter 2 in the analog input data stream, check the **Enable** box for each counter that you want to read.
2. Under **Measurement start edge** for each counter, select one of the following signals to start the measurement: ADC conversion complete, Tach input falling, Tach input rising, Gate input falling, or Gate input rising.
3. Under **Measurement stop edge** for each counter, select one of the following signals to stop the measurement: ADC conversion complete, Tach input falling, Tach input rising, Gate input falling, or Gate input rising.
4. Under **Read and clear** for each counter, check this box if you want to clear the value to zero between measurements. To retain the previous measurement value until the next measurement is complete, uncheck this box.

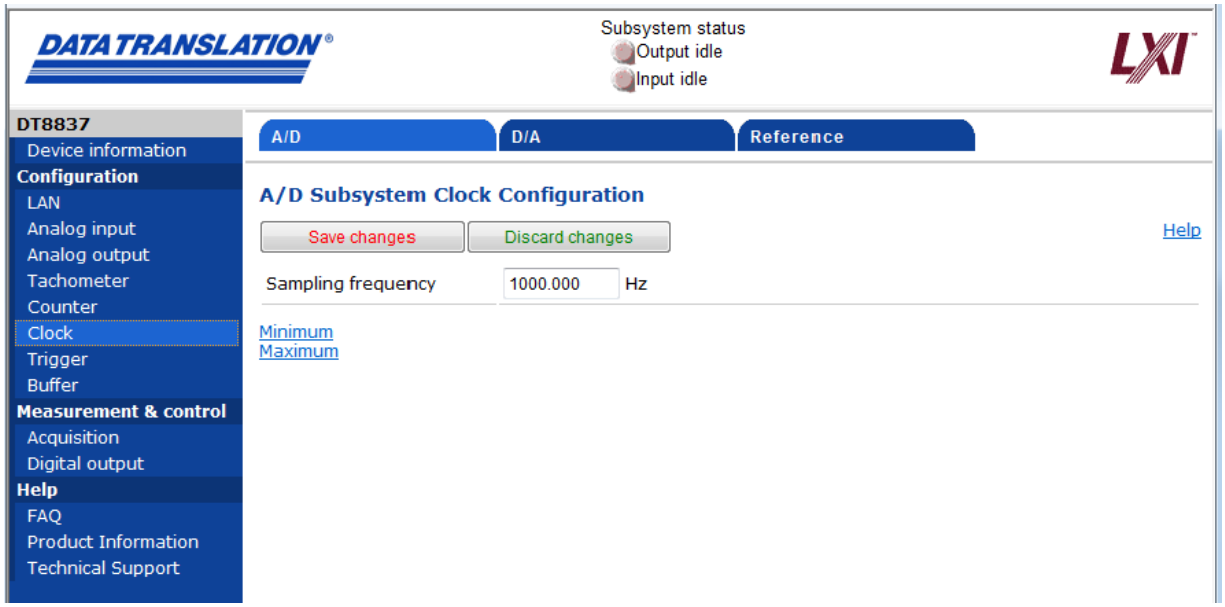
5. Click **Save changes** to apply your changes. If you do not save your changes before leaving this web page, your changes are lost.

You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

The hardware aligns the value of the counters with the analog input measurements, so that all measurements are correlated in time. The counters are treated like any other channel in the analog input subsystem; therefore, all the triggering and clocking options supported for analog input channels are supported for the counters.

Clock Frequency

Use the **Configuration** -> **Clock** web page to configure the scan frequency of the analog input subsystem, the output frequency of the analog output subsystem, and the reference clock.



Configuring the Scan Frequency

To configure the scan frequency of the analog input subsystem, do the following:

1. Select the **A/D** tab of the Clock web page.
2. Enter a value, in Hertz, between the minimum and maximum shown in the A/D Subsystem **Clock Frequency** field.

Note: The scan frequency that you specify is rounded to the closest "correct" value that the instrument module can accept without error. When you save the A/D clock configuration, the actual scan frequency is shown.

---

3. Click **Save changes** to apply your changes. If you do not save before leaving this page, your changes are lost.

You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

Configuring the Output Frequency

To configure the output frequency of the analog output subsystem, do the following:

1. Select the **D/A** tab of the Clock web page.
2. Enter a value, in Hertz, between the minimum and maximum shown in the D/A Subsystem **Clock Frequency** field.

Note: The output frequency that you specify is rounded to the closest "correct" value that the instrument module can accept without error. When you save the D/A clock configuration, the actual output frequency is shown.

---

3. Click **Save changes** to apply your changes. If you do not save before leaving this page, your changes are lost.

You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

Configuring the Reference Clock

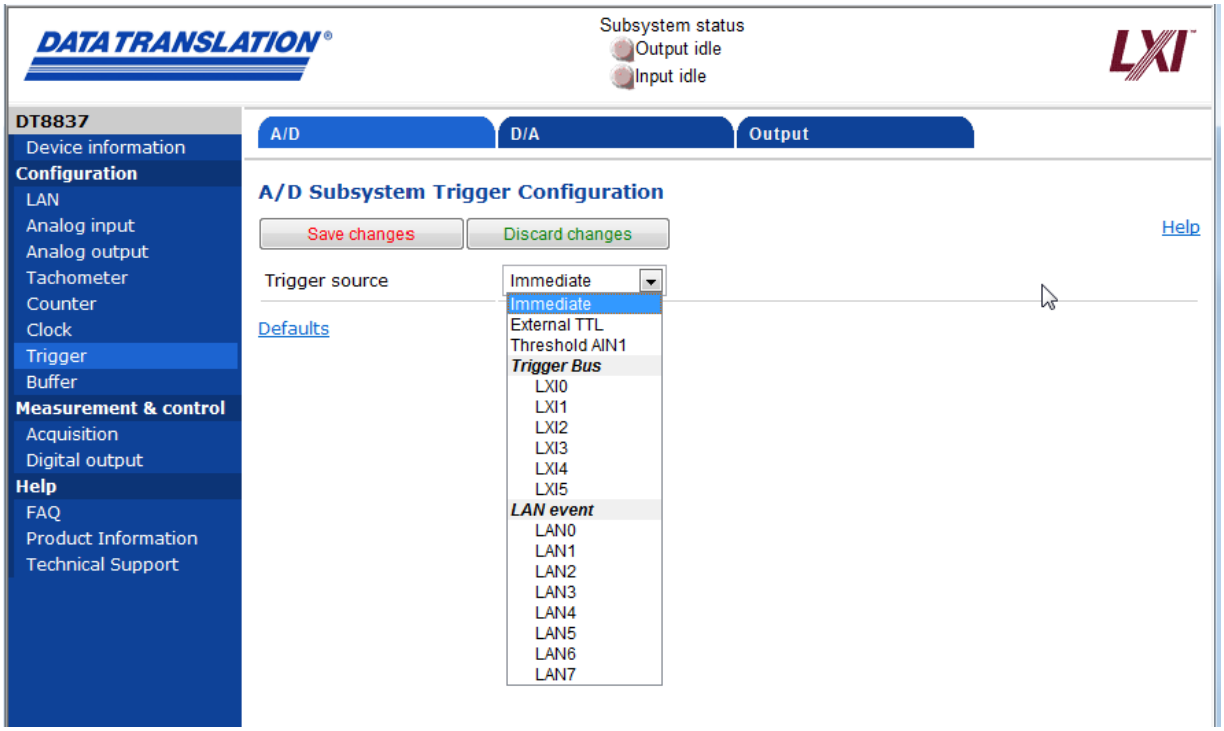
To configure the reference clock used by the instrument module, do the following:

1. Select the **Reference** tab of the Clock web page.
2. Set the source of the reference clock for the instrument module to **Internal** (the default setting) to use the internal reference clock on the instrument module, or **LXI7** to use the clock from the Trigger Bus.
3. If you want to drive out the clock on the Trigger Bus, select **LXI7**. If you do not want to drive out the clock signal on the Trigger Bus, select **Disabled** (the default setting).
4. Click **Save changes** to apply your changes. If you do not save before leaving this page, your changes are lost.

You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

Trigger Configuration

Use the **Configuration** -> **Trigger** web page to configure the trigger type used by the instrument module for starting analog input and analog output subsystems, and to drive out a Trigger Bus LXI trigger or send a LAN trigger packet.



You can choose one of the following trigger sources:

- **Immediate** – A software trigger event occurs when you start the analog input operation (the computer issues a write to the instrument module to begin conversions).
- **External TTL** – An external digital (TTL) trigger event occurs when the instrument module detects a rising-edge transition on the signal connected to the Trigger In input on the instrument module. This trigger provides a threshold voltage of 2V with 0.5V of hysteresis.
- **Threshold AIN1** – An analog threshold trigger event occurs when the signal attached to analog input channel 1 rises above a user-specified threshold value from 0.2 V to 9.8 V with 0.1 V of hysteresis.
- **Trigger Bus** – When multiple DT8837 instrument modules are connected together using the Trigger Bus, you can synchronize the start of acquisition using one of six LXI trigger signals: LXI0 to LXI5.
- **Lan Event** – When multiple DT8837 instrument modules are connected together over the local area network (LAN), you can synchronize the start of analog input operations by using a LAN trigger packet (0 to 7).

Configuring the Trigger Source for the Analog Input Subsystem

To configure the trigger source for the analog input subsystem, do the following:

1. Select the **A/D** tab of the Trigger web page.
2. Select one of the available trigger sources.
3. Click **Save changes** to apply your changes. If you do not save before leaving this web page, your changes are lost.

You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

Configuring the Trigger Source for the Analog Output Subsystem

To configure the trigger source for the analog output subsystem, do the following:

1. Select the **D/A** tab of the Trigger web page.
2. Select one of the available trigger sources.
3. Click **Save changes** to apply your changes. If you do not save before leaving this web page, your changes are lost.

You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

Configuring the Trigger Bus LXI Trigger or LAN Trigger Packet Output

To drive out a Trigger Bus LXI trigger or send a LAN trigger packet, do the following:

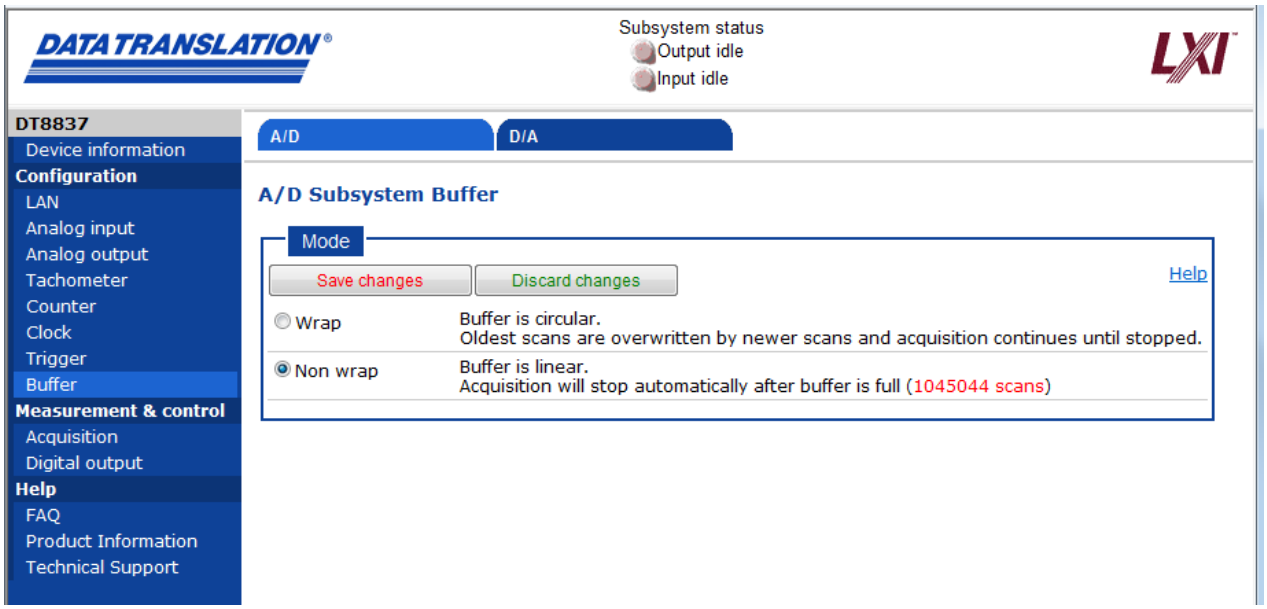
1. Select the **Output** tab of the Trigger web page.
2. If you want to drive out a signal on the Trigger Bus, select the LXI line that you want to drive out: **LXI0 to LXI5**.
3. If you want to send out a LAN trigger packet, select the LAN event (**LAN0 to LAN7**) to broadcast.
4. Click **Save changes** to apply your changes. If you do not save before leaving this web page, your changes are lost.

You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

Buffer Configuration

Use the **Configuration -> Buffer** web page to configure the buffering mode used by the instrument module for analog input and analog output operations.

Configuring the Buffer Mode for Analog Input Operations

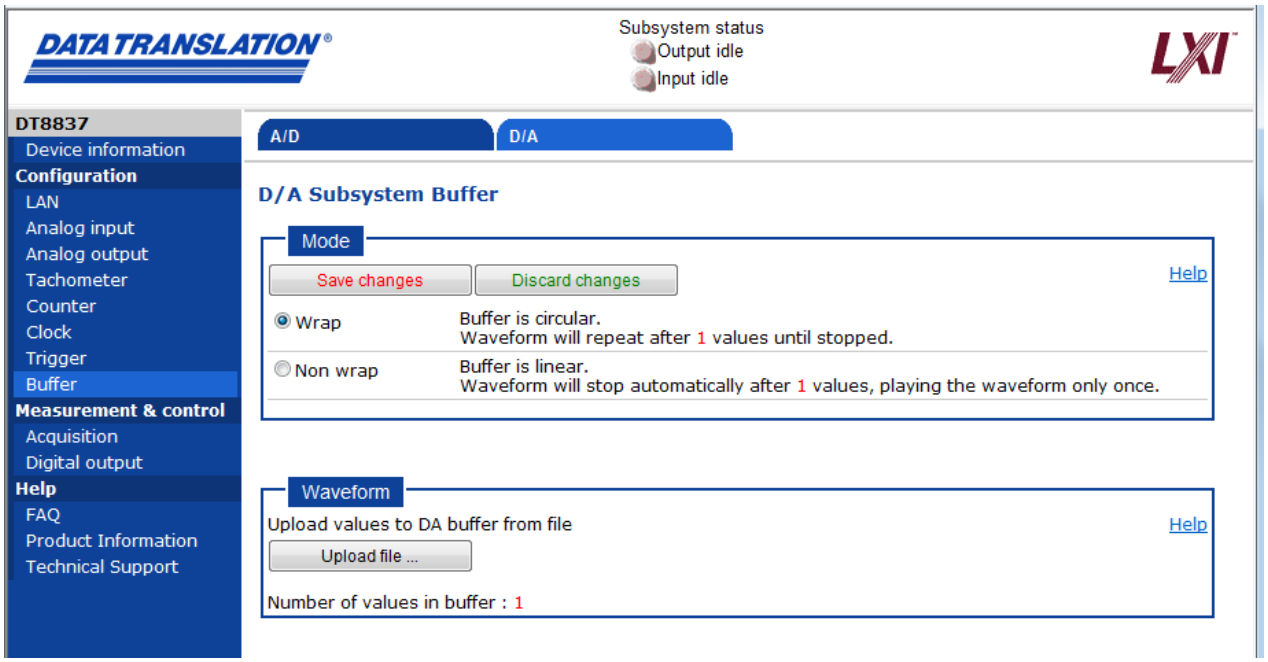


To configure the buffer mode for analog input operations, do the following:

1. Select the **A/D** tab of the Buffer web page.
2. Select one of the following buffer modes:
   - **Wrap** – Use this mode if you want the input operation to continue indefinitely. In this case, when the end of the input buffer is reached, the operation wraps to the beginning of the input buffer overwriting the oldest scan data with the latest scan data.
   - **Non wrap** – Use this mode if you want the input operation to stop automatically when the input buffer is filled.
3. Click **Save changes** to apply your changes. If you do not save before leaving this web page, your changes are lost.

You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.

Configuring the Buffer Mode for Analog Output Operations



To configure the buffer mode for analog output operations, do the following:

1. Select the **D/A** tab of the Buffer web page.
2. Select one of the following buffer modes:
   - **Wrap** – Use this mode if you want the output operation to continue indefinitely. In this case, when the end of the output buffer is reached, the operation wraps to the beginning of the output buffer so that the waveform is output continuously.
   - **Non wrap** – Use this mode if you want the output operation to stop automatically when the end of the output buffer is reached.
3. Click **Save changes** to apply your changes. If you do not save before leaving this web page, your changes are lost.

   You can also click the **Discard changes** button (before you save) to return to the previous configuration, if desired.
4. Click **Upload File** to upload the file that contains the waveform values that you want to output. Plain text file (e.g., .TXT or .CSV) should include one voltage per line, with the number of lines representing the number of points/values that will be entered in the buffer. Voltage values should be within ±10 V range.

Measuring Data and Controlling the Instrument

Use the Measurement & control web pages to perform the following functions:

- Start and stop acquisition on A/D and D/A subsystems
- View data in oscilloscope
- Download measurements
- Save data to disk
- Control digital outputs

Starting and Stopping a Scan

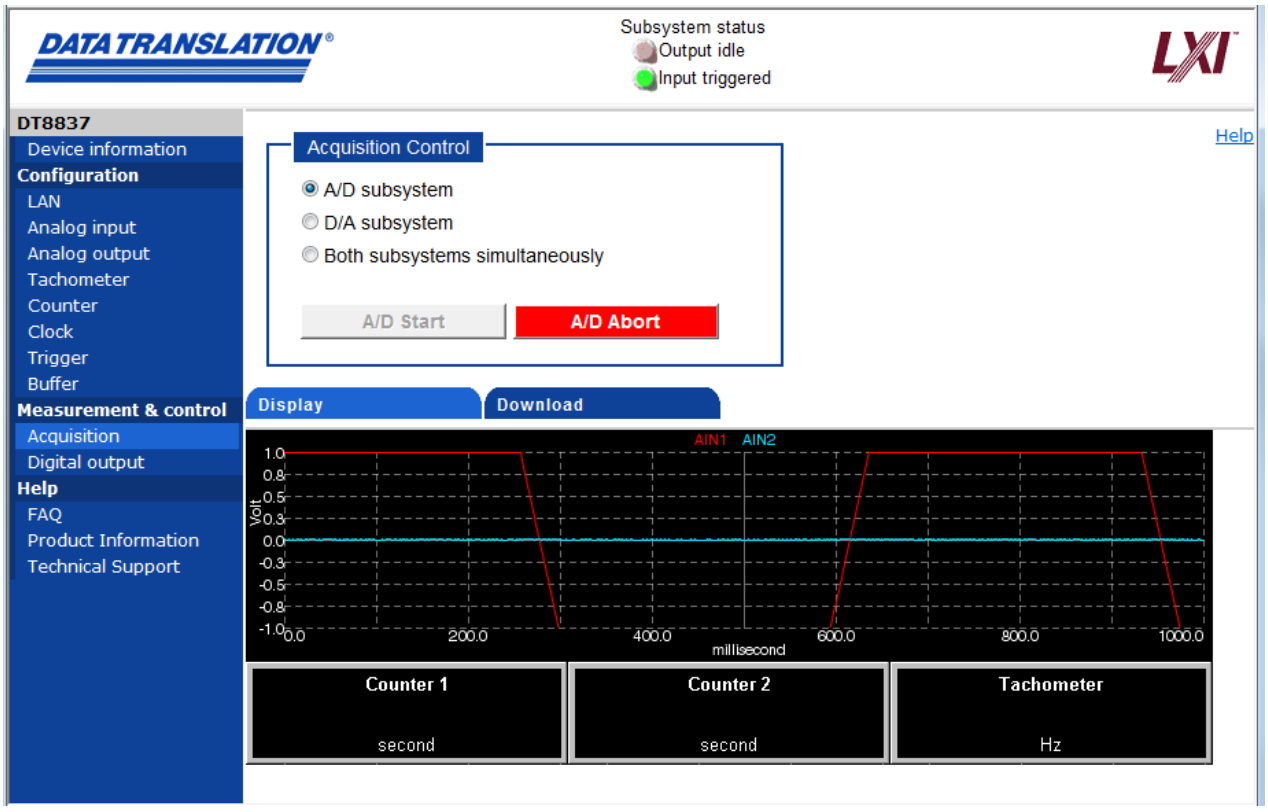
Use the **Measurement & control** -> **Acquisition** web page and click the appropriate radio button to start the A/D subsystem only, the D/A subsystem only, or both subsystems simultaneously.

Note: You can manually begin simultaneous subsystems using the A/D subsystem and D/A subsystem radio buttons. However, the D/A subsystem must be enabled and started before acquisition on the A/D subsystem may be triggered.

Displaying Measurements

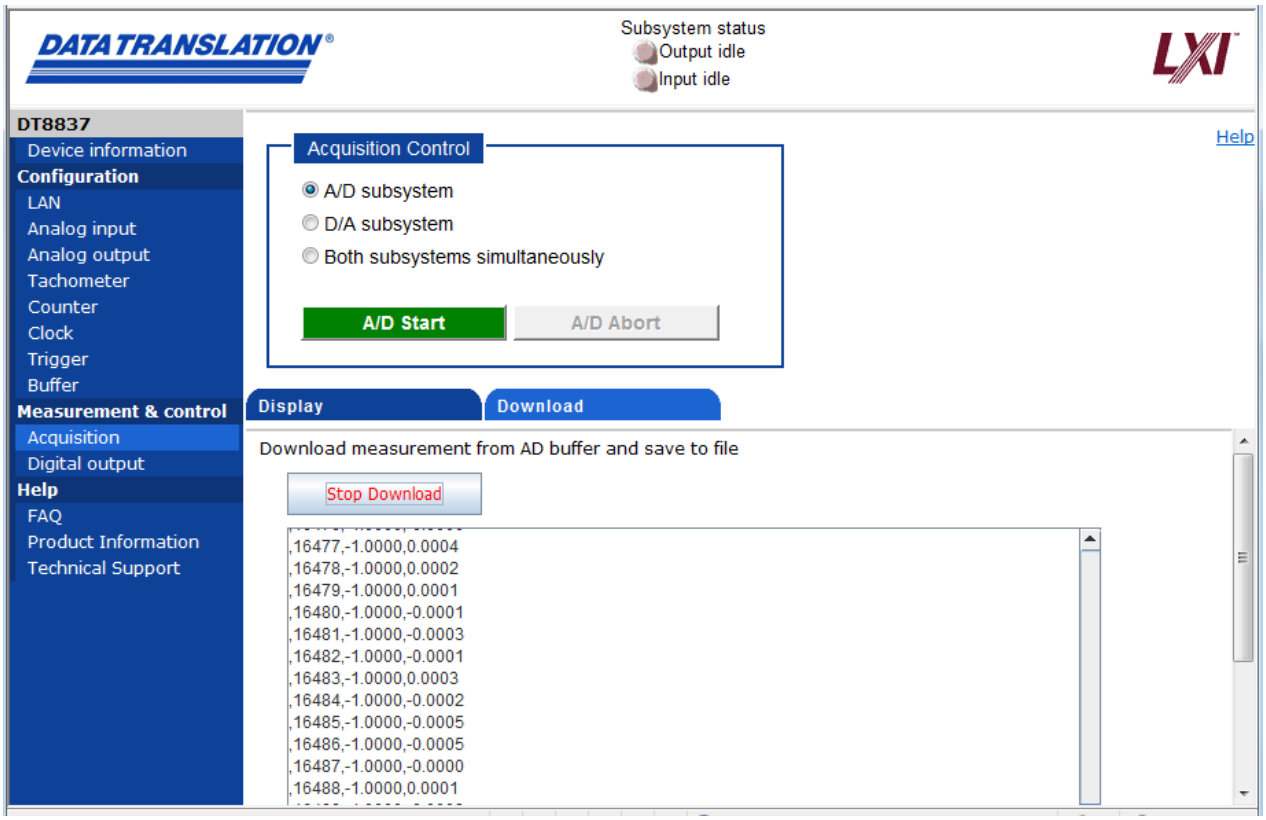
To display your measurement results, use the **Measurement & control** -> **Acquisition** web page and select the **Display** tab.

If you start the analog input subsystem, you can see the results of your measurements in the Oscilloscope view. Data from the counters and tachometer are shown in a digital display.



Downloading Measurements

To download your measurement results to disk, use the **Measurement & control** -> **Acquisition** web page and select the **Download** tab.



1. Click the **Start Download** button on this page. Data is fetched from the beginning of the buffer and is formatted and displayed in the text area as comma-separated values (CSV). This process continues until either you click **Stop Download** or the end of the buffer is reached.

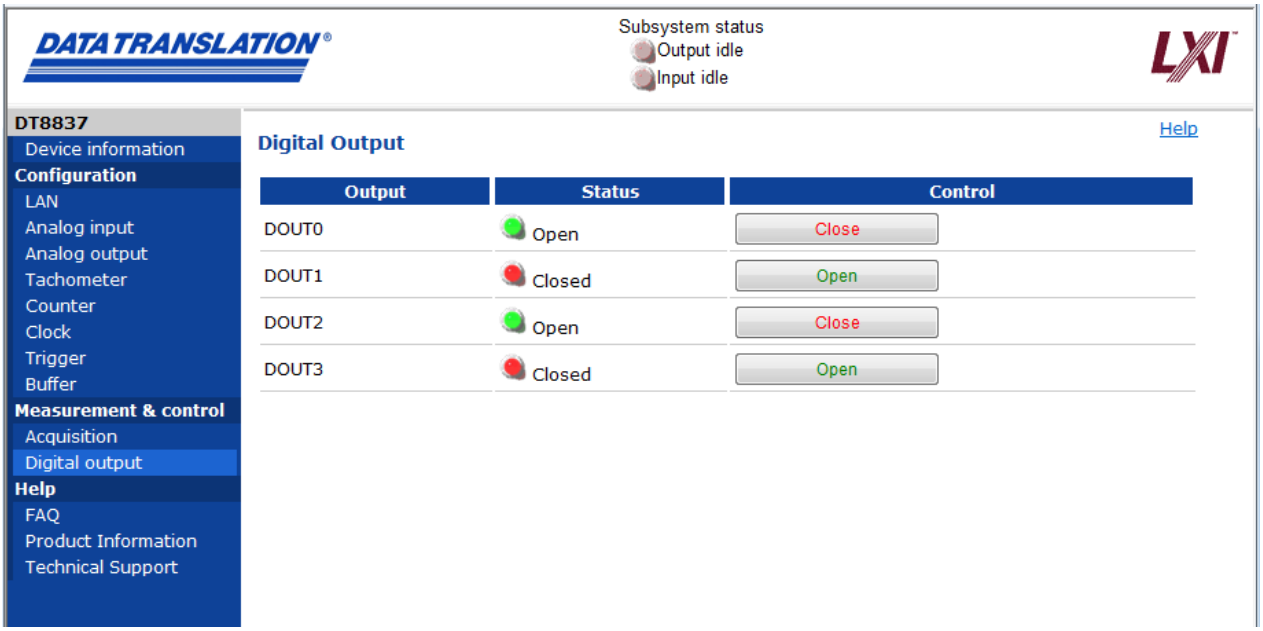
Note: Before you click **Start Download**, there must be data in the A/D buffer; acquisition must be in progress or has been started and aborted.

---

2. Once download is stopped, click the **Save As...** button to save this CVS formatted text file to a local directory on your computer. You can specify the name of the file and give it any extension you want; the contents of the text area are written to the file.

Controlling the Digital Outputs

Use the **Measurement & control -> Digital output** web page to view the current state of the digital output lines, and manually change them if desired. A screen similar to the following appears:



Green indicates that the digital output line/relay is closed; red indicates that the digital output line/relay is open.

To change the status of a digital output line/relay, click the **Open/Close** toggle buttons under the **Control** heading for the digital output lines that you want to change.

Part 2: Using Your Instrument Module

Principles of Operation

Analog Input Features 77
Analog Output Features 82
Tachometer Input Features 85
Counter/Timer Channels 87
Digital Output Features 89
Synchronizing Operations on Multiple Instrument Modules 90

Figure 18 shows a block diagram of the DT8837 instrument module.

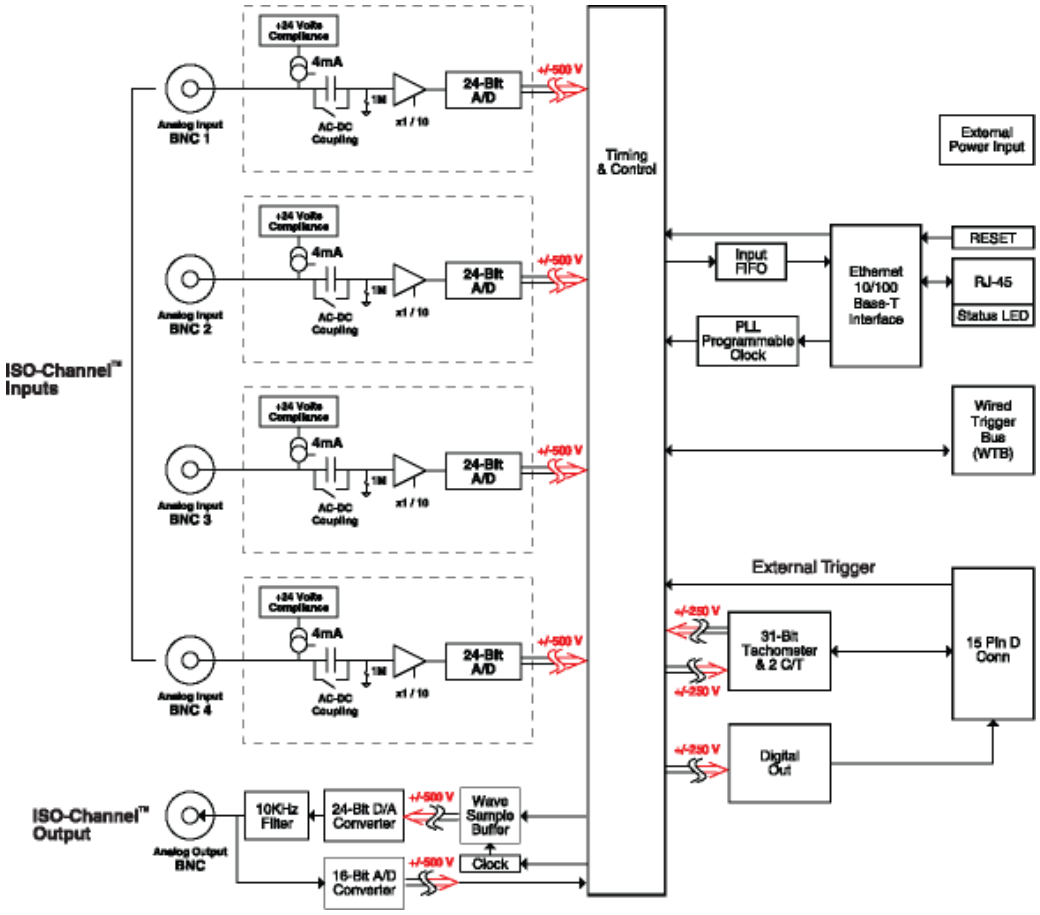


Figure 18: Block Diagram of the DT8837 Instrument Module

Analog Input Features

This section describes the following features of analog input (A/D) subsystem on the DT8837 instrument module:

- Analog input channels, described below
- Input ranges and gains, described on page 77
- IEPE functions, described on page 78
- Input resolution, described on page 78
- Input clock source, described on page 78
- Input buffer, described on page 79
- Input triggers, described on page 80

Analog Input Channels

The DT8837 instrument module supports four, differential analog input channels (numbered 1 to 4). Using software, you enable the channels that you want to sample. All analog input channels are simultaneously clocked. If desired, you can connect IEPE sensors to these inputs; refer to page 78 for more information on IEPE functions.

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

The DT8837 instrument module uses 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.

In addition to the analog input channels, the DT8837 instrument module can acquire data from a tachometer, two counter/timers, and the analog output readback channel, depending on whether these channels are enabled for sampling. Refer to"Input Buffer" on page 79 for more information on reading data from these channels. For information on the tachometer, refer to page 85. For information on the counter/timers, refer to page 87. For information on the analog output readback channel, refer to page 83.

Input Ranges and Gains

The DT8837 instrument module provides 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 DT8837 instrument module. The instrument module supports 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 with 24 V compliance voltage to allow wide dynamic range without distortion. By default, the excitation current source is disabled.
- Coupling type – You can select whether AC coupling or DC coupling is used. By default, AC coupling is selected.

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 40 for more information on wiring IEPE inputs.

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 DT8837 instrument module supports an internal master clock and an internal sync signal that synchronizes all the analog-to-digital converters on the instrument module.

Use software to specify the internal clock source, the internal A/D sync signal, and the frequency at which to pace the input and output operations and to start the sample clock. The sampling frequency ranges from 195.3 Hz to 52.734 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 DT8837 instrument module supports a wide pass band of 0.1 Hz 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 instrument 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.

The value that you specify for the internal clock frequency is multiplied by 512 internally to set the oscillator on the instrument module. For example, if you specify an internal clock frequency of 50 kHz, the instrument 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 instrument 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 hardware adjusts for the group delay to provide only valid data. The first sample returned is the sample corresponding to the analog input signal at the time of the trigger.

Note: The tachometer, counter/timer, and analog output readback data (which does not have the 39 sample group delay) is fed through a hardware queue to realign it with the adjusted analog input data stream.

If you are synchronizing analog input operations on multiple DT8837 instrument modules using the Trigger Bus, refer to "Synchronizing Operations on Multiple Instrument Modules" on page 90.

Input Buffer

DT8837 instrument modules use an 8 MB input buffer for storing data from each of up to 8 enabled input channels (analog input channels 1, 2, 3, 4, tachometer input channel (5), counter/timer 1 (6), counter/timer 2 (7), and the analog output readback channel (8)). One sample from each of the enabled input channels is called a scan.

You can specify one of the following wrap modes for the input buffer in software:

- Continuous wrap mode – Use this mode if you want the input operation to continue indefinitely. In this case, when the end of the input buffer is reached, the operation wraps to the beginning of the input buffer overwriting the oldest scan data with the latest scan data.
- No wrap mode – Use this mode if you want the input operation to stop automatically when the input buffer is filled.

Note: Since the maximum input buffer size is 8 MB and each sample is 4 bytes, you can store a maximum of 2 M samples in the input buffer. If you sample each input channel at the maximum input frequency (52.734 kHz), the input buffer will fill in approximately 5 seconds (52 ksamples/s per channel).

The maximum size of data transfer over Ethernet is 32 kB. Since each sample is 4 bytes, the maximum number of samples is 8 ksamples. Therefore, if you are using continuous wrap mode, ensure that you use a tight loop to ensure that you retrieve all the samples in the input buffer before the buffer is overwritten.

Figure 19 illustrates continuous wrap mode using a channel list with five entries: analog input channel 1, 2, 3, 4, and the tachometer (5). 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.

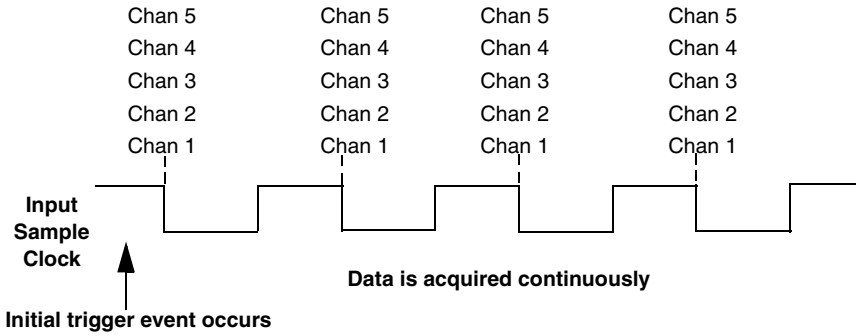


Figure 19: Continuous Wrap Mode

Input Triggers

A trigger is an event that occurs based on a specified set of conditions. Once the analog input subsystem is armed using software (and if the trigger source is immediate, and started using software), acquisition starts when the instrument module detects the initial trigger event and stops when either the input buffer has been filled (if no wrap mode was selected), or you stop the operation (if continuous mode is selected).

Note: The Input Trigger LED on the front panel of the DT8837 instrument module turns solid amber when the analog input subsystem is armed and solid green when the analog input subsystem is triggered. When the analog input subsystem is idle, the Input Trigger LED is off.

The DT8837 instrument module supports the following trigger sources for starting analog input operations:

- **Immediate software trigger** – A software trigger event occurs when you start the analog input operation (the computer issues a write to the instrument module to begin conversions). Using software, specify the trigger source as an immediate trigger and initiate the operation.
- **External digital (TTL) trigger** – An external digital (TTL) trigger event occurs when the instrument module detects a rising-edge transition on the signal connected to the Trigger In input on the instrument module. This trigger provides a threshold voltage of 2 V with 0.5 V of hysteresis. Using software, specify the trigger source as an external.

- **Analog threshold trigger** – An analog threshold trigger event occurs when the signal attached to analog input channel 1 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 threshold trigger.
- **Trigger Bus** – When multiple DT8837 instrument modules are connected together using the Trigger Bus, you can synchronize the start of acquisition using one of six LXI trigger signals: LXI0 to LXI5. Refer to"Synchronizing Operations on Multiple Instrument Modules" on page 90 for more information.
- **LAN Trigger Packet** – When multiple DT8837 instrument modules are connected together over the local area network (LAN), you can synchronize the start of analog input operations by using LAN trigger packets. Refer to page 93 for more information.

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 82
- Output clock, described on page 82
- Output buffer, described on page 83
- Analog output readback channel, described on page 83
- Output triggers, described on page 83

Analog Output Channels

The DT8837 instrument module supports one 24-bit analog output channel. To update the analog output channel, you must enable the channel in software. You can also read back the value of the analog output channel through the analog input data stream; refer to page 83 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.

Output Ranges and Gains

The DT8837 instrument module 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 Clock

The output clock on the DT8837 instrument module is derived from an internal master clock.

You can program the output 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.

Due to the group delay of the Delta-Sigma D/A converter, the DT8837 requires 29 sample clock pulses once the analog output has been triggered before the analog output reflects the first value in the output buffer.

If you are synchronizing multiple DT8837 instrument modules using the Trigger Bus, refer to "Synchronizing Operations on Multiple Instrument Modules" on page 90.

Output Buffer

DT8837 LXI instrument modules use an 128K sample output buffer (also known as a hardware FIFO) for storing analog output data to write to the analog output channel.

You can specify the number of samples to output to the analog output channel using software. This value can range between 1 and 131072.

Using software, load the output buffer with the values that you want to write to the analog output channel. Each value in the buffer corresponds to a sample that you want to output to the analog output channel. Values are written to the analog output channel starting with the first sample in the buffer.

You can specify one of the following wrap modes for the output buffer in software:

- Continuous wrap mode – Use this mode if you want the output operation to continue indefinitely. In this case, when the end of the output buffer is reached, the operation wraps to the beginning of the output buffer and continues updating the analog output channel with the values stored in the buffer.
- No wrap mode – Use this mode if you want the output operation to stop automatically when the number of samples specified has been output.

Reading the Analog Output Value in the Analog Input Data Stream

If desired, you can read back the value of the analog output channel in the analog input data stream by enabling the DAC readback channel (8) in software.

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 hardware aligns the value of the analog output channel with the analog input measurements, so that all measurements are correlated in time.

Output Triggers

A trigger is an event that occurs based on a specified set of conditions. Once the analog output subsystem is armed using software (and if the trigger source is immediate, and started using software), the analog output operation starts after the trigger is received and stops when either the specified number of samples have been output (if no wrap mode is selected) or you stop the operation (if continuous wrap mode is selected).

Note: The Output Trigger LED on the front panel of the DT8837 instrument module turns solid amber when the analog output subsystem is armed and solid green when the analog output subsystem is triggered. When the analog output subsystem is idle, the Output Trigger LED is off.

The DT8837 instrument module supports the following trigger sources for starting analog output operations:

- **Immediate software trigger** – A software trigger event occurs when you start the analog output operation (the computer issues a write to the instrument module to begin conversions). Using software, specify the trigger source for the D/A subsystem as a software trigger and initiate the operation.
- **External digital (TTL) trigger** – An external digital (TTL) trigger event occurs when the instrument module detects a rising-edge transition on the signal connected to the Trigger In input on the instrument module. This trigger provides a threshold voltage of 2 V with 0.5 V of hysteresis. Using software, specify the trigger source for the D/A subsystem as an external.
- **Analog threshold trigger** – An analog threshold trigger event occurs when the signal attached to analog input channel 1 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 the D/A subsystem as a threshold trigger.
- Trigger Bus – When multiple DT8837 instrument modules are connected together using the Trigger Bus, you can synchronize the start of analog output operations using one of six LXI trigger signals: LXI0 to LXI5. Refer to"Synchronizing Operations on Multiple Instrument Modules" on page 90 for more information.
- **LAN Trigger Packet** – When multiple DT8837 instrument modules are connected together over the local area network (LAN), you can synchronize the start of analog output operations by using LAN trigger packets. Refer to page 93 for more information.

Tachometer Input Features

DT8837 instrument modules accept one tachometer input signal on the J6 input/output connector. You can measure the frequency or period of the tachometer input signal by reading the value of the tachometer input channel in the analog input stream. The frequency or period measurement allows you to calculate the rotation speed of tachometer input signals. An internal 12 MHz counter is used for the measurement, yielding a resolution of 83 ns (1/12 MHz).

Note: You can also measure the phase of the tachometer input signal in relation to the analog input samples using one of the counter/timer channels, described on page 87.

To read the number of counts between two edges of the tachometer input signal, enable the tachometer input (channel 5) in the analog input data stream.

Using software, you can specify the following parameters for tachometer frequency and/or period measurement:

- Period type – Specifies which period of the tachometer input signal to measure (rising-to-rising edge or falling-to-falling edge).
- Self Clear flag – Indicates whether the value read between measurements is cleared or retained. To clear the value to zero between measurements, set this flag to 1. To retain the previous measurement value until the next measurement is complete, set this value to 0.
- Stale Value flag – Determines whether to use the most significant bit (MSB) of the returned 32-bit value to indicate new or old data. The count is the bottom 31 bits and the stale flag is the 32nd bit or MSB. To use the MSB of the value to indicate whether the measurement is new or old, set the Stale Value flag to active (1). When this flag is active, the MSB of the value is set to 0 to indicate new data or 1 to indicate old data. Reading the value before the measurement is complete returns an MSB of 1 to indicate old data.

  If you are not interested in whether the data is new or old, set the Stale Value flag to 0. In this case, the MSB is always set to 0.

When the tachometer is enabled, the internal 12 MHz counter starts incrementing when it detects the first specified edge of the tachometer input. When the specified edge is detected, the count is stored in a holding register and the counter resets and starts counting again. The tachometer holding register is read at the input sample rate and included as part of the input scan data. Tachometer counting is independent of the input sample rate. On the next read, either 0 or the current value of the tachometer input (from the previous measurement operation) is returned depending on the value of the Self Clear flag, described above, and the next operation is started automatically.

The hardware aligns 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 subsystem; therefore, all the triggering and clocking options 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

Counter/Timer Channels

DT8837 instrument modules provide two 32-bit counter/timer channels for measuring the frequency, period, or phase between any of the following signals:

- Completion of the A/D sample to the rising or falling edge of the tachometer input signal (on the J6 connector)
- Completion of the A/D sample to the rising or falling edge of the gate input signal (on the J6 connector)
- Rising or falling edge of the gate input signal to the rising or falling edge of the tachometer 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 or period of the gate signal
- Rising or falling edge of the tachometer input signal to the rising or falling edge of the tachometer input signal, which you can use to determine the pulse width or period of the tachometer signal
- Rising or falling edge of the tachometer input signal to the completion of the A/D sample
- Rising or falling edge of the gate input signal to the completion of the A/D sample

Using the count that is returned from the counter/timer, you can determine the following:

- Frequency of a signal pulse (the number of periods per second). You can calculate the frequency as follows:
  - Frequency = 48 MHz/(Number of counts – 1)
    where 48MHz is the internal counter/timer clock frequency

    For example, if the count is 81, the measured frequency is 600 kHz (48 MHz/20).
- Period of a signal pulse. You can calculate the period as follows:
  - Period = 1/Frequency
  - Period = (Number of counts – 1)/48 MHz
    where 48 MHz is the internal counter/timer clock frequency

To read the value of the counter in the analog input data stream, enable the counter/timer in software. Counter/timer 1 is returned as channel 6 in the analog input stream; counter/timer 2 is returned as channel 7 in the analog input stream

When a counter is enabled, the internal 48 MHz counter starts incrementing when it detects the first specified start edge. When the specified stop edge is detected, the count is stored in a holding register and the counter resets and waits for the next start edge. The counter holding register is read at the input sample rate and included as part of the input scan data. The counter/timer counting is independent of the input sample rate so depending on the input sample rate and the counter input rate, you could either always read a new count value or depending on the value of the Self Clear flag, described below, read several old count values or 0. Since these counters have a selectable start and stop edge, if the same edge is selected as the start and stop edge, the counter will count every other signal period, not every period like the tachometer counter.

Using software, you can specify the following parameters for the measurement:

- The signal that starts the measurement: ADC conversion complete, rising edge of the tachometer input signal, falling edge of the tachometer input signal, rising edge or the gate input signal, or falling edge of the gate input signal
- The signal that stops the measurement: ADC conversion complete, rising edge of the tachometer input signal, falling edge of the tachometer input signal, rising edge or the gate input signal, or falling edge of the gate input signal

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

- Self Clear flag – Indicates whether the value read between measurements is cleared or retained. To clear the value to zero between measurements, set this flag to 1. To retain the previous measurement value until the next measurement is complete, set this value to 0.

Digital Output Features

DT8837 instrument modules feature four, isolated digital output lines. The digital outputs are solid-state relays that operate at ±30 V and 400 mA peak (AC or DC). Switching time is 2 ms maximum. Digital outputs resemble a switch; the switch is closed if the state of the digital output line is 1, and the switch is open if the state of the digital output line is 0. On power up or reset, the digital outputs are disabled.

Using software, you can close or open a digital relay.

You can also change the value of specific digital output lines without affecting all of the digital output lines by performing the following bitwise operations:

- Using software, you can compare the binary representations of a specified value between 0 and 15 and the current value of the digital output port, and perform a logical AND operation on each pair of corresponding bits. If both bits are 1, the result is 1. If both bits are 0, the result is 0. If one bit is 1 and the other bit 0, the result is 0.

  The following example shows the result of a logical OR operation:

Table 3:

	0101
AND	0011
=	0001

- OR – Using software, you can compare the binary representations of a specified value between 0 and 15 and the current value of the digital output port, and perform a logical OR operation on each pair of corresponding bits. If both bits are 1, the result is 1. If both bits are 0, the result is 0. If one bit is 1 and the other bit 0, the result is 1.

  The following example shows the result of a logical AND operation:

Table 4:

	0101
OR	0011
=	0111

You can query the current configuration of the digital output port in software.

Synchronizing Operations on Multiple Instrument Modules

You can synchronize the start of acquisition on multiple instrument modules using LXI triggers on the Trigger Bus or LAN trigger packets. If you want the clock to be synchronous, you need to use the Trigger Bus.

Using the Trigger Bus

Up to 16 LXI devices can be connected together using the Trigger Bus. DT8837 instrument modules may be connected using a daisy-chain configuration, as shown in Figure 20, using the 25-pin J7 Trigger Bus connectors. Both the first device and the last device in the chain must have Trigger Bus terminators installed. Terminators must also be installed on both J7 connectors if you are using only one instrument module.

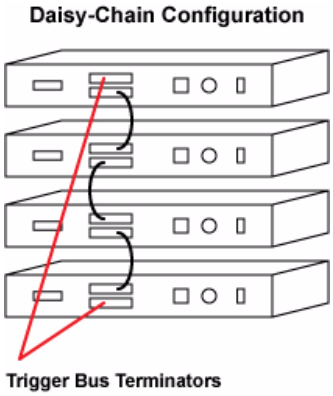


Figure 20: DT8837 Instrument Modules in Daisy-Chain Configuration

When multiple DT8837 instrument modules are connected together using the Trigger Bus, as shown in Figure 21, you can synchronize the start of acquisition using one of six LXI trigger signals: LXI0 to LXI5. One DT8837 is the clock master, responsible for driving out the clock signal (LXI7) and sync signal (LXI6) for use by the other slave instrument modules. The slave instrument modules must be configured to accept these signals.

Internally, the trigger signals from the Trigger Bus are wired to the analog input subsystem. Therefore, choosing an LXI trigger for analog output operations is appropriate only if you want to trigger both the analog input and analog output subsystem of multiple instrument modules at the same time.

Note: The order in which you set up the clock and triggers is important; refer to your software documentation for more information. While the clock frequencies can be different on each instrument module, we recommend that you chooses the same clock frequency for all instrument modules. However, the analog input and output clock frequencies can be different from each other.

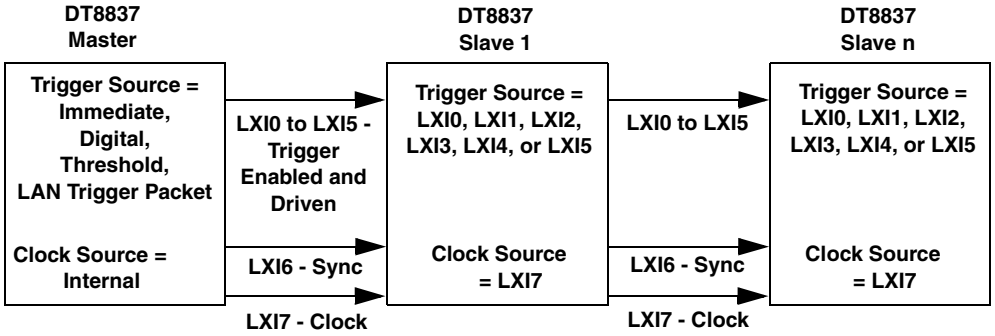


Figure 21: Synchronizing the Start of Acquisition When Connecting Multiple Instrument Modules to the Trigger Bus

Note: When using LXI triggers, the timing from device to device is guaranteed to be within one sample pulse.

Unlike when synchronizing the clock of multiple instrument modules, which requires one instrument module dedicated as the clock master, you can have more than one trigger master, if desired, to trigger multiple instrument modules. Additionally, the trigger master need not be the clock master. Figure 22 shows an example of using two trigger masters on the Trigger Bus.

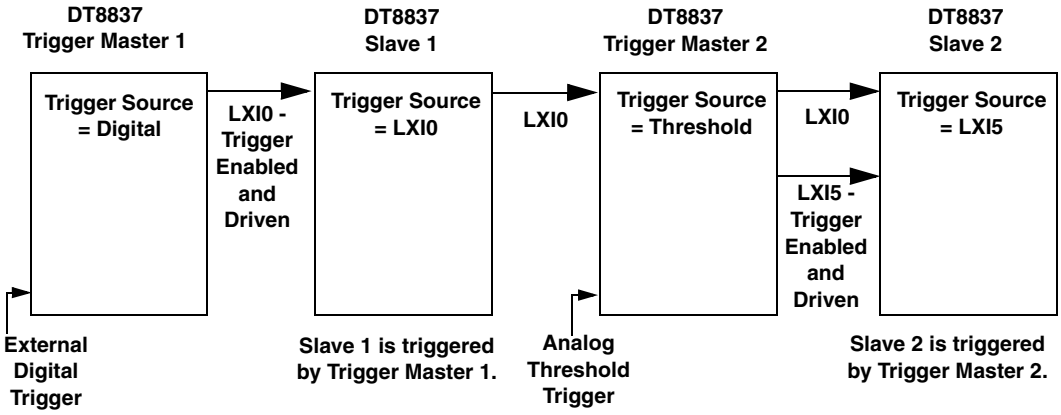


Figure 22: An Example of Using Two Trigger Masters on the Trigger Bus

On the trigger master, use software to set the trigger source to software trigger, external digital trigger, analog threshold trigger, or LAN trigger packet (LAN0 to LAN7). Then, use software to drive out the LXI trigger signal (LXI0 to LXI5) on the Trigger Bus.

Note: While a trigger master can drive out more than one trigger signal on the Trigger Bus, the slave can accept only one trigger signal to start the analog input operation.

On each slave, use software to select the trigger signal (LXI0 to LXI5) that was driven out by the trigger master on the Trigger Bus and arm the analog input subsystem.

Once the master is armed and triggered, the specified LXI trigger signal is driven out on the Trigger Bus to all slaves that were configured to accept it. Acquisition starts on the first sample after the trigger is received.

Using LAN Trigger Packets

When multiple DT8837 instrument modules are connected together over the local area network (LAN), as shown in Figure 23, you can synchronize the start of analog input and output operations by transmitting one of eight LAN trigger packets (LAN0 to LAN7) over the network.

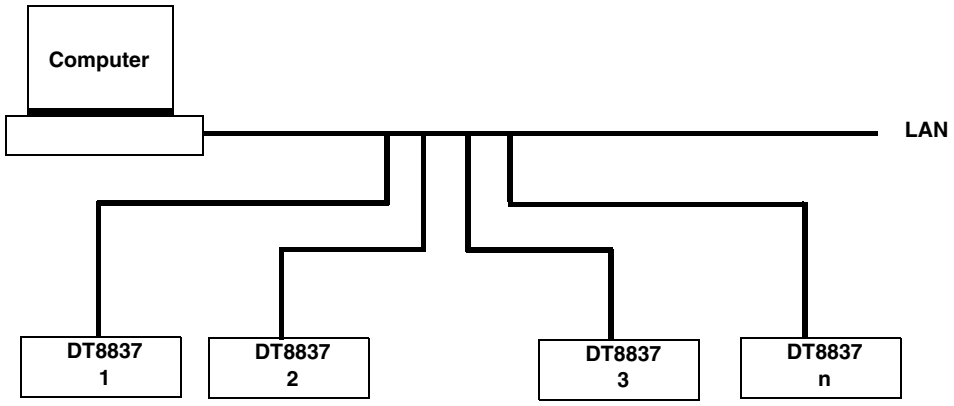


Figure 23: Synchronizing the Start of Analog I/O Operations When Triggering Instruments Modules Over the LAN

The timing of the trigger packets from device to device is dependent on the network traffic on the LAN.

The DT8837 supports multicast transmission of LAN trigger packets using UDP (User Datagram Protocol) port 5044 and UDP multicast address 224.0.23.159. The DT8837 does not support unicast LAN events transmitted via TCP connections.

Figure 24 shows the format of a LAN trigger packet:

HW Detect (3 bytes)	Domain (1 byte)	Event ID (16 bytes)	Sequence (UInt32)	Time stamp (10 bytes)	Epoch (UInt16)	Flags (UInt16)	Data Fields	0 (2 Bytes)

Figure 24: Format of a LAN Trigger Packet

The fields of the LAN trigger packet are described as follows:

- HW Detect – Identifies valid packets and is reserved for future hardware detection of LAN events. This field should be set to *LXI*. Note that the third byte, ASCII "I", is also used as a version identifier; future revisions to the LXI standard may change this value.

- Domain – This field represents a group of devices that are managed by a single directory and use shared resources. Values for the LXI domain range from 0 to 255. The default value is 0. This field is treated as an unsigned byte.

  To transmit LAN trigger packets to or from a DT8837 instrument module, ensure that you set the domain field of each DT8837 instrument module to the same value using software.

- Event ID – This field contains the first 16 bytes of the event name (a string). By default, the LAN event names are defined as LAN0 to LAN7.

  To transmit LAN trigger packets to or from a DT8837 instrument module, ensure that you set the event ID of each DT8837 instrument module to the same value using software.

- Sequence – Each instrument module maintains its own sequence; the sequence number is incremented every time a unique packet is transmitted. (Note that if packets are retransmitted to enhance reliability, re-transmitted packets contain the same sequence number as the original.)

- Time stamp – For DT8837 instrument modules, the time stamp of received LAN event packets is ignored, while generated LAN event packets have a time stamp of 0.

- Epoch – For DT8837 instrument modules, this value is 0.

- Flags – Contains data about the packet. This value is generated automatically by DT8837 instrument modules.

- Data Fields – Arbitrary number of bytes, up to the capacity of the data packet. This field is generated automatically by DT8837 instrument modules.

To trigger analog input or analog output operations on a DT8837 instrument module using a LAN trigger packet, set up the domain and the event ID of the LAN trigger packet, as described on page 93, and then do the following:

1. Use software to set the trigger source for the analog input or analog output subsystem of each DT8837 instrument module to the enabled LAN trigger packet (LAN0 to LAN7).
2. Enable the LAN event (LAN0 to LAN7) for transmission using software.
3. Specify the destination or source address for the enabled LAN event (LAN0 to LAN7) using software.
4. Arm the analog input or analog output subsystem.

Acquisition starts with the first sample after the specified LAN trigger packet is received.

Troubleshooting

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General Checklist

Should you experience problems using a DT8837 instrument module, do the following:

1. Read all the documentation provided for your product, including any “Read This First” information.
2. Check the DT8837 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 as stated in the README file on the DT8837 CD.
4. Check that you have installed your hardware properly using the instructions in Chapter 3.
5. Check that you have wired your signals properly using the instructions in Chapter 4.
6. Check that you have installed Java and configured your web browser appropriately using the instructions on page 49.
7. Search the DT Knowledgebase in the Support section of the Data Translation web site (at www.mccdaq.com) for an answer to your problem.

If you still experience problems, try using the information in Table 5 to isolate and solve the problem. If you cannot identify the problem, refer to page 98.

Table 5: Troubleshooting Problems

Symptom	Possible Cause	Possible Solution
DT8837 is not found.	The DT8837 cannot communicate with the network.	Ensure that your DT8837 is properly connected; see the instructions in Chapter 3.
		If your PC has a static IP address, reconfigure it for Auto-IP using the instructions on page 126.
		Check your DT8837 LAN configuration; see the instructions on page 58.
		Check the IP address of the instrument module by opening a Command Prompt window (Start -> Programs -> Accessories -> Command Prompt) and entering the command "ipconfig /all". The IP settings of your instrument module are returned.
		Ping the instrument module by opening a Command Prompt window (Start -> Programs -> Accessories -> Command Prompt) and entering the command "ping address", where *address* is the IP address of your instrument module. If a timeout message is returned, the IP address is incorrect. If a "no host" error message is returned, the subnet mask is incorrect. Refer to Appendix C for more information on IP and subnet addresses.
		If needed, reset the instrument module using the instructions on page 35.

Table 5: Troubleshooting Problems (cont.)

Symptom	Possible Cause	Possible Solution
DT8837 does not respond.	The DT8837 configuration is incorrect.	Check your DT8837 LAN configuration; see the instructions on page 58.
		Check the IP address of the instrument module by opening a Command Prompt window (Start -> Programs -> Accessories -> Command Prompt) and entering the command "ipconfig /all". The IP settings of your instrument module are returned.
		Ping the instrument module by opening a Command Prompt window (Start -> Programs -> Accessories -> Command Prompt) and entering the command "ping address", where *address* is the IP address of your instrument module. If a timeout message is returned, the IP address is incorrect. If a "no host" error message is returned, the subnet mask is incorrect. Refer to Appendix C for more information on IP and subnet addresses.
		If needed, reset the instrument module using the instructions on page 35.
	The DT8837 is damaged.	Contact Data Translation for technical support; refer to page 99.
Intermittent operation.	Loose connections or vibrations exist.	Check your wiring and tighten any loose connections or cushion vibration sources; see the instructions in Chapter 4.
	The DT8837 is overheating.	Check environmental and ambient temperature; consult the specifications on page 117 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 4.
Data appears to be invalid.	An open connection exists.	Check your wiring and fix any open connections; see the instructions in Chapter 4.
	A transducer is not connected to the channel being read.	Check the transducer connections; see the instructions in Chapter 4.
	The channel configuration does not match the software configuration for that channel.	Check your wiring and ensure that what you specify in software matches your hardware configuration; see the instructions in Chapter 4.
	Your DT8837 instrument module may need recalibration.	The DT8837 instrument module is calibrated at the factory. Thereafter, yearly calibration is recommended. Contact Data Translation at 508-946-5100 (if you are in the USA) for information on DT8837 factory recalibration. If you are located outside the USA, call your local distributor for information; see our web site (www.mccdaq.com) for the name and telephone number of your nearest distributor.

Technical Support

If you have difficulty using a DT8837 instrument 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.mccdaq.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 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.mccdaq.com) for the name and telephone number of your nearest distributor.

If Your Instrument Module Needs Factory Service

Most hardware models can be functionally tested, evaluated for repairs (if needed), and calibrated to factory specifications. An RMA # must be obtained from Application Engineering in advance of sending any product back to Measurement Computing. Customers outside the USA must contact their local distributor for a return procedure. Calibration certificates for most analog models can be obtained for a fee (certificate must be requested at time of RMA # assignment).

Calibration

Using the Calibration Utility 103
Calibrating the Analog Input Subsystem 104
Calibrating the Analog Output Subsystem 106

DT8837 instrument 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 on the DT8837 instrument modules every six months using the DT8837 Calibration Utility.

This chapter describes how to calibrate the analog input and output subsystems of DT8837 instrument modules using the DT8837 Calibration Utility.

Using the Calibration Utility

Start the DT8837 Calibration Utility as follows:

1. Click **Start** from the Task Bar.
2. Select **Programs | Data Translation, Inc | Calibration | DT8837 Calibration Utility.**
   The main menu of the calibration utility appears.
3. Select the instrument 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 104, or the analog output circuitry of the DT8837 instrument module, described on page 106.

Calibrating the Analog Input Subsystem

This section describes how to use the DT8837 Calibration Utility to calibrate the analog input subsystem of a DT8837 instrument module.

The DT8837 instrument module has separate calibration for each A/D input channel. You can choose to calibrate either an individual channel or all channels on the instrument module.

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 DT8837 instrument module. Connect the precision voltage source to the first channel you want to calibrate; for example, Analog In 1(AD Ch1).

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. Select the **A/D Calibration** tab of the calibration utility.
2. Choose either a single channel or all channels from the **Type of Calibration** drop-down list box in the **Automatic Calibration** area.
3. Set the voltage supply on your selected channel to 0.000V.
4. Click the Auto Calibration **Start** button.
   A message appears notifying you to verify that 0.000 V is applied to the channel.
5. 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.
6. 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.
7. If you choose to calibrate all channels, then repeat steps 3 to 6 for all other A/D channels on the instrument module (the calibration utility prompts you to attach the precision voltage source to the next channel). Follow the on-screen prompts to proceed through the rest of the channels.

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 (substitute the appropriate channel number as you go):

1. Adjust the offset as follows:
   a. Verify that 0.000 V is applied to AD Ch1, and that A/D Channel Select is set to Channel 1.
   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.
2. Adjust the gain as follows:
   a. Verify that +9.375 V is applied to AD Ch1, and that A/D Channel Select is set to Channel 1.
   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.

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 DT8837 Calibration Utility to calibrate the analog output subsystem of a DT8837 instrument module.

To calibrate the analog output circuitry, you need to connect an external precision voltmeter to analog output channel 1 of the DT8837 instrument 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 1 (DAC Ch1) of the DT8837 instrument 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 108
Analog Output Specifications. 110
Tachometer Input Specifications 111
Gate Input Specifications 112
Counter Input Specifications 113
Digital Output Specifications 114
Master Oscillator Specifications. 116
Power, Physical, and Environmental Specifications 117
Regulatory Specifications 118
Connector Specifications 119
External Power Supply Specifications. 120

Analog Input Specifications

Table 6 lists the specifications for the analog input subsystem on the DT8837.

Table 6: Analog Input Subsystem Specifications

Feature	DT8837 Specifications
Number of analog input channels	4, differential, simultaneous
Resolution	24 bits
Ranges and gains	±10 V (gain of 1), ±1 V (gain of 10)
Gain error Gain of 1: Gain of 10:	 ±0.02% ±0.5%
A/D type	Delta-Sigma
Maximum sample rate	52.734 kS/s[a]
Minimum sample rate	195.3 S/s
Group delay	39/data rate, in s
FIFO	2 M Samples, total
Pass band at –3 dB: at –100 dB:	 0.49 x data rate 0.55 x data rate
Pass band ripple	±0.005 dB
Signal/noise (typical)	106 dB
Total harmonic distortion (–0.5 dB) using 1 kHz sine wave, sampled at 50 kHz	–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:	 –92 dB typical –115 dB typical –115 dB typical –118 dB typical
Data encoding	Offset binary
Maximum input voltage (without damage) Power on: Power off:	 ±40 V ±40 V
Input impedance	1 MΩ, 20 pF[b]
Overvoltage protection (power on/off)	±40 V
ESD protection Arc: Contact:	 8 kV 4 kV
Current source	4 mA

Table 6: Analog Input Subsystem Specifications (cont.)

Feature	DT8837 Specifications
Compliance voltage	24 V
Current noise @ 1 kHz bandwidth	5 nA rms
Current source accuracy	±1.0%
DC offset	1.5 mV
AC coupling at –3 dB	0.1 Hz
D/A Readback in A/D Stream A/D resolution: Zero error: Full-scale error:	 16 bits ±15 mV +0, –2%

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

Analog Output Specifications

Table 7 lists the specifications for the analog output subsystem on the DT8837 instrument module.

Table 7: Analog Output Subsystem Specifications

Feature	DT8837 Specifications
Number of analog output channels	1
Resolution	24 bits
Output range	±10 V
Data encoding	Offset binary
Output current	±3 mA maximum load (10 V across 3.3 K)
FIFO	128K Samples, total
ESD protection Arc: Contact:	 8 kV 4 kV
DC offset	±1.5 mV
Gain error	±0.03%
2-pole, low-pass Butterworth filter	10 kHz
Time delay (typical)	29/data rate, in s
Power fault and reset	Goes to 0 V ±10 mV if power is removed
Total harmonic distortion (typical at 1 kHz)	0.0015%
Internal clock	output frequency x 512
Minimum sample frequency	10 kHz
Maximum sample frequency	52.734 kHz
Pass band ripple (typical ±0.002 dB)	0.454 x data rate
Pass band (typical)	0.49 x data rate
Stop band (typical)	0.567 x data rate

Tachometer Input Specifications

Table 8 lists the specifications for the tachometer input on the DT8837 instrument module.

Table 8: Tachometer Input Specifications

Feature	DT8837 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	1 MHz
Minimum pulse width high/low (minimum amount of time it takes a C/T to recognize an input pulse)	0.4 µs
Clock frequency for tachometer measurements	12 MHz (83 ns resolution)

Gate Input Specifications

Table 9 lists the specifications for the gate input on the DT8837 instrument module.

Table 9: Gate Input Specifications

Feature	DT8837 Specifications
Signal type	LVTTL
Input voltage range for gate input signal	0 to 5 V
Maximum input frequency	1 MHz
Minimum pulse width (high/low)	0.4 µs
Rise time	≤ 20 ns

Counter Input Specifications

Table 10 lists the specifications for the counter input on the DT8837 instrument module.

Table 10: Counter Input Specifications

Feature	DT8837 Specifications
Counter resolution	32 bits
Clock frequency for counter measurements	48 MHz (21 ns resolution)

Digital Output Specifications

Table 11 lists the specifications for the digital output on the DT8837 instrument module.

Table 11: Digital Output Specifications

Feature	DT8837 Specifications
Output type	Solid state relay
Maximum voltage	±30 V
Maximum current	±400 mA
Maximum switching time	2 ms
Adjacent output isolation	250 V (limited by connector)
Non-adjacent output isolation	500 V
Closed contact resistance	0.8 Ω (maximum)

Trigger Specifications

Table 12 lists the specifications for the trigger on the DT8837 instrument module.

Table 12: Trigger Specifications

Feature	DT8837 Specifications
Trigger sources	
Internal software trigger:	Software-selectable
External digital trigger:	Software-selectable
Analog threshold trigger:	Software-selectable
Trigger Bus:	Software-selectable
LAN Trigger Packet:	Software-selectable
External digital trigger	
Input type:	Edge-sensitive, positive trigger
Logic family:	LVTTL inputs
Input logic load:	1 LVTTL
Lower threshold:	1.1 V
Upper threshold:	1.3 V
Hysteresis:	0.2 V
Input sink current:	33 µA
Minimum pulse width high/low:	1.3 µs
Maximum input signal:	±30 V
Input configuration:	Pulled to ground with 100 kΩ resistor
Analog threshold trigger	
Type:	Positive threshold trigger on analog input channel 0
Threshold level:	+0.2 to +9.8 V
Hysteresis:	100 mV
Trigger delay	1 conversion period maximum

Master Oscillator Specifications

Table 13 lists the specifications for the master oscillator on the DT8837 instrument module.

Table 13: Master Oscillator Specifications

Feature	DT8837 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 14 lists the power, physical, and environmental specifications for the DT8837 instrument module.

Table 14: Power, Physical, and Environmental Specifications

Feature	DT8837 Specifications
Power, +5 V	±0.30 V@ 0.5 A
Physical Dimensions Length: Width: Height: Weight:	 9.319 inches (236.7 mm) 8.380 inches (212.85 mm) 1.720 inches (43.69 mm) 2.373 lbs (1076.63 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 15 lists the regulatory specifications for the DT8837 instrument module.

Table 15: Regulatory Specifications

Feature	DT8837 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 16 lists the connector specifications for the DT8837 instrument module.

Table 16: Connector Specifications

Feature	DT8837 Specifications
RJ45 Ethernet Connector	Bothhand part number LU1S041C-43-LF
Input/Output Connector	Tyco part number 5747845-4
Trigger Bus Connectors	Molex part number 83619-9011

External Power Supply Specifications

Table 17 lists the specifications for the EP361 +5 V external power supply that is used with the DT8837 instrument module.

Table 17: External Power Supply (EP361) Specifications

Feature	Specifications
Type	Total Power medical power supply (TPES22-050400 or TPEMG24-S050400-7)
Input voltage	Typical 90 - 264 V AC
Input current TPES22-050400 TPEMG24-S050400-7	 Typical 0.38 A at 115 V AC, 0.15 A at 230 V AC Typical 0.347 A at 115 V AC, 0.215 A at 230 V AC
Frequency	47 to 63 Hz
Inrush current TPES22-050400 TPEMG24-S050400-7	 35 A at 230 V AC typical or less than 30 A by adding thermistor 6.274 A RMS at 230 V AC
Output voltage	5 V DC
Output current	4.0 A
Output wattage TPES22-050400 TPEMG24-S050400-7	 Typical 22 - 24 W Typical 20 - 24 W
Noise and ripple	1% peak to peak
Regulatory specifications TPES22-050400 TPEMG24-S050400-7	 UL, N, CE, FCC Class B UL, ITE, CE, FCC Class B, Energy Star compliant

Connector Pin Assignments

RJ45 Ethernet Connector 122
Input/Output Connector 123
Trigger Bus Connector 124

RJ45 Ethernet Connector

Figure 25 shows the RJ45 Ethernet connector.

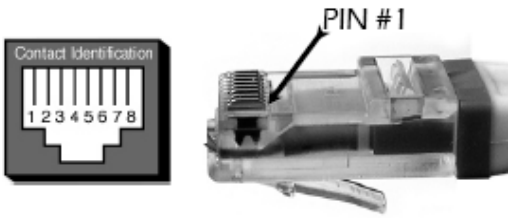


Figure 25: RJ45 Ethernet Connector

Table 18 lists the pin assignments for the RJ45 ethernet connector on the DT8837 instrument module.

Table 18: Pin Assignments of the RJ45 Ethernet Connector

Pin	Signal Name	Description
1	TXD+	Transmit Data+
2	TXD–	Transmit Data–
3	RXD+	Receive Data+
4	EPWR+	Power from Switch+
5	EPWR+	Power from Switch+
6	RXD–	Receive Data–
7	EPWR–	Power from Switch–
8	EPWR–	Power from Switch–

Input/Output Connector

The Input/Output connector, as shown in Figure 26, is a 15-pin mini D-shell connector that is available on the DT8837 instrument module for making tachometer, gate, and digital output connections.

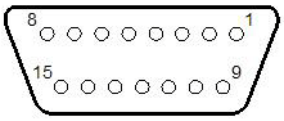


Figure 26: Input/Output Connector

Table 19 lists the pin assignments for the Input/Output connector on the DT8837 instrument module.

Table 19: Input/Output Connector Pin Assignments

Pin	Description	Pin	Description
1	Tachometer Input	9	Tachometer Input Return
2	Trigger In	10	Trigger In Return
3	Gate In	11	Gate In Return
4	Digital Out 0 A	12	Digital Out 0 B
5	Digital Out 1 A	13	Digital Out 1 B
6	Digital Out 2 A	14	Digital Out 2 B
7	Digital Out 3 A	15	Digital Out 3 B
8	No Connect		

Trigger Bus Connector

Figure 27 shows the Trigger Bus connector. There are two Trigger Bus connectors on each DT8837.

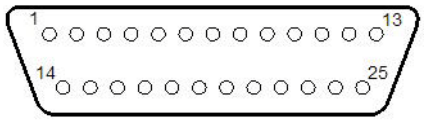


Figure 27: Trigger Bus Connector

Table 20 lists the pin assignments for the Trigger Bus connector on the DT8837 instrument module.

Table 20: Trigger Bus Connector Pin Assignments

Pin	Description	Pin	Description
1	+3.3V	14	Signal0p
2	+3.3V Return	15	Signal0n
3	Signal1p	16	Reserved
4	Signal1n	17	Signal2p
5	GND	18	Signal2n
6	Signal3p	19	GND
7	Signal3n	20	Signal4p
8	GND	21	Signal4n
9	Signal5p	22	GND
10	Signal5n	23	Signal6p
11	Reserved	24	Signal6n
12	Signal7p	25	Reserved
13	Signal7n		

Configuring Network Settings on Your PC

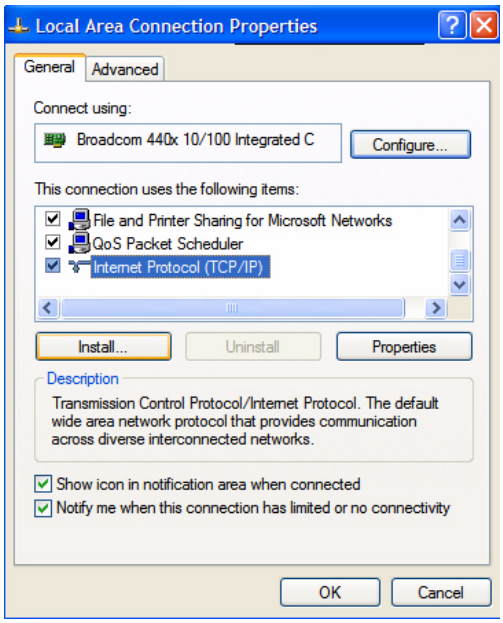
Configuring the PC to Use Auto-IP 126
Specifying a Static IP Address for your Instrument Module 129
Reconfiguring the PC to Use a Static IP Address 130

Configuring the PC to Use Auto-IP

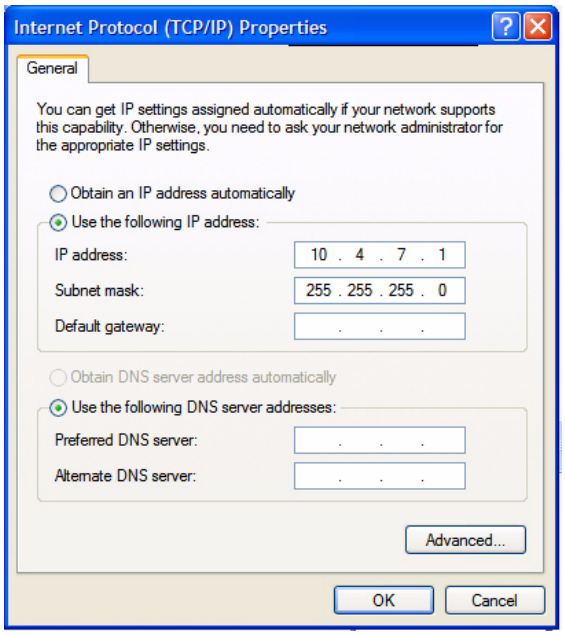
To set up the DT8837 instrument module when the LAN does not support a DHCP server and your PC is configured to use a static IP address, you must temporarily reconfigure the PC to use Auto-IP by performing the following steps:

Note: This procedure may differ slightly depending on your computer and the version of Windows you are using. Windows XP instructions are shown here.

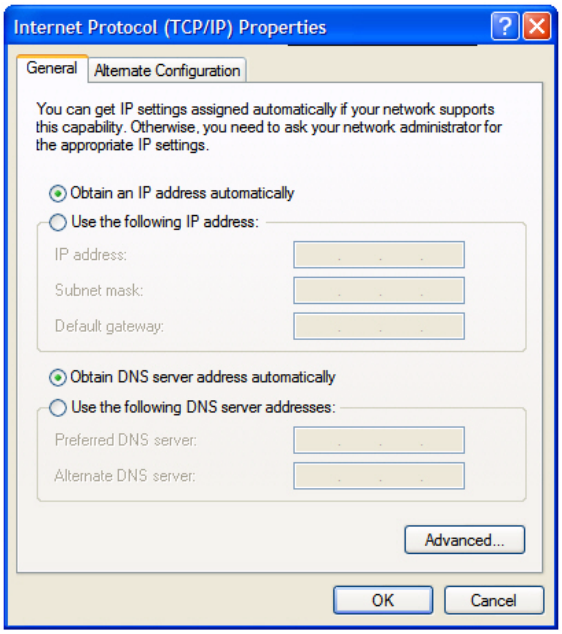
1. From the Windows Start menu, click **Settings**, and then click **Network Connections**.
2. Right-click **Local Area Connection**, and select **Properties.**



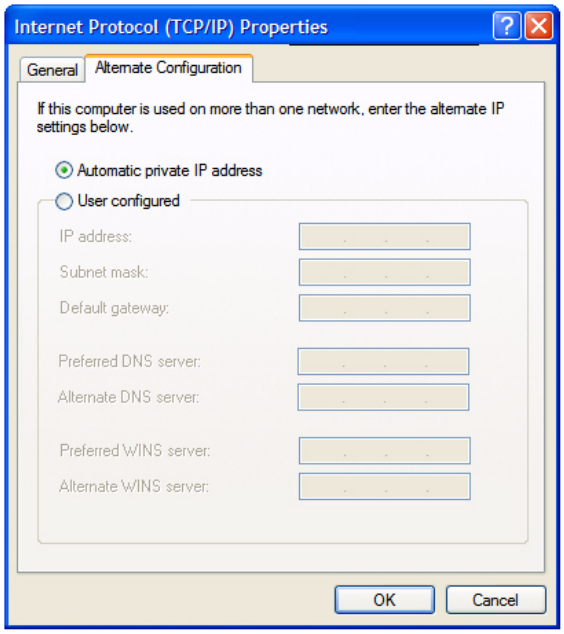
3. In the General tab window, double-click **Internet protocol (TCP/IP)**.
   (If a TCP/IP selection is not listed, click **Install**, select **Protocol**, click **Add**, select the TCP/IP protocol, and click **Install**, and repeat step 3).



4. **IMPORTANT: Write down the IP address and subnet mask that is displayed!** You will need this information later.
5. Select **Obtain an IP address automatically**, and then click **OK**.



6. Select the **Alternate Configuration** tab, and ensure that **Automatic private IP address** is selected.



7. Renew the IP address of the computer. From the Windows Start menu, click **Settings ->Network Connections -> Local Area Connection -> Support -> Repair**.

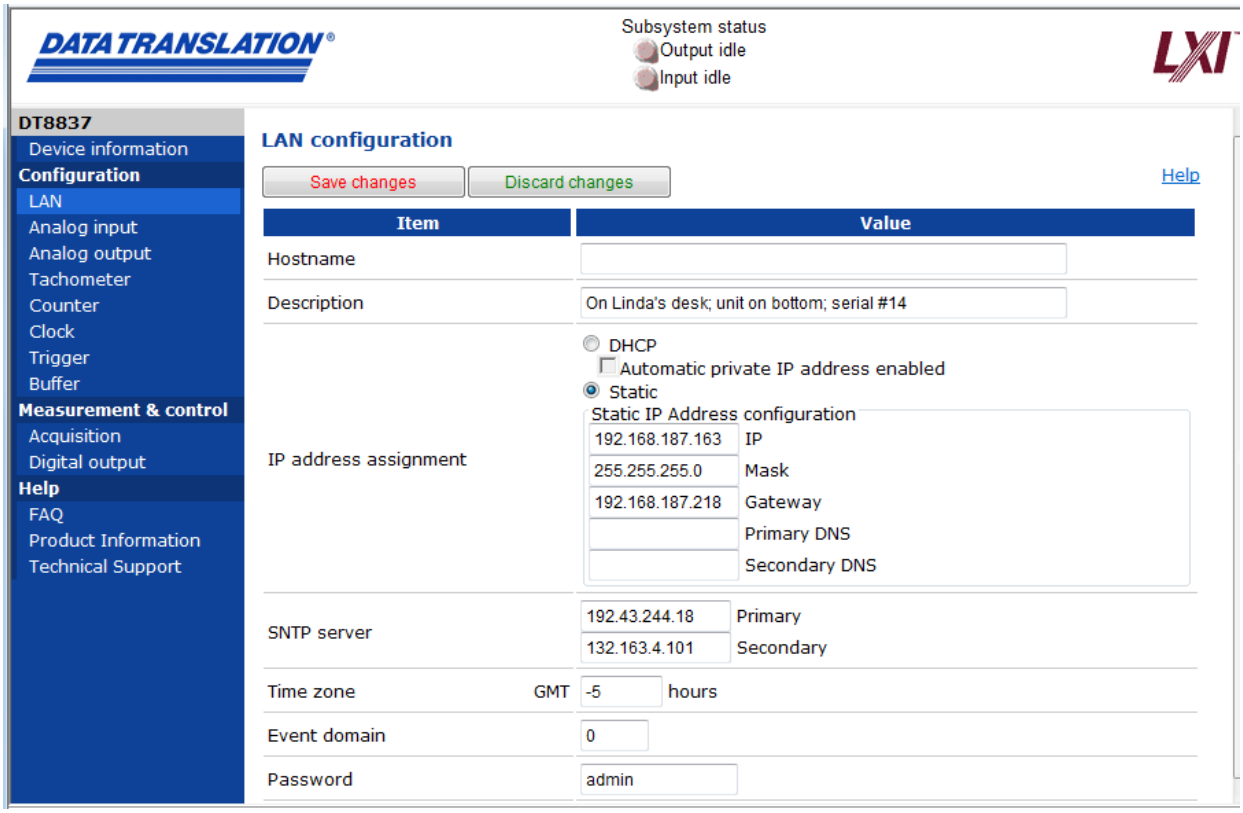
   Or, if you prefer to do this from the command prompt window, click **Run** from the Windows Start menu, enter **cmd**, and click **OK** to bring up the command prompt window. Then, from the command prompt window, enter:

   `ipconfig /renew` *renews the IP address*
   `ipconfig /all` *checks the IP address*

Specifying a Static IP Address for your Instrument Module

To specify a static IP address for your DT8837 instrument module, use the LAN Configuration page of the web interface as follows:

1. From the LAN Configuration page, click **Modify**.
2. Specify the username as **admin**, and specify the password (the default password is **admin**). You can change the password, if you desire.
3. Uncheck the checkbox called **Automatic private IP address enabled**.
4. Click **Static**.
5. Specify a static IP address for the DT8837 instrument module, so that is will be on the same subnet as your PC:

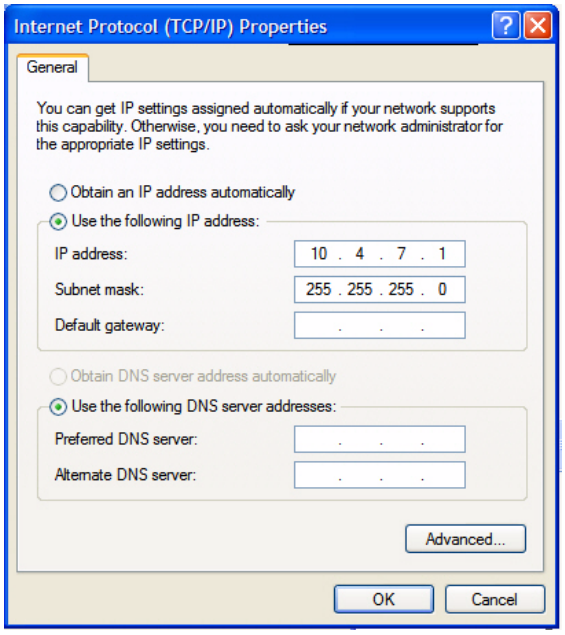


Note: You need a Simple Network Time Protocol (SNTP) time server on the LAN; otherwise, you need to provide a gateway. See your network administrator for more details.

Reconfiguring the PC to Use a Static IP Address

After you have set up your DT8837 instrument module, you can reconfigure your PC to use a static IP address using this procedure:

1. From the Windows Start menu, click **Settings**, and then click **Network Connections**.
2. Right-click **Local Area Connection**, and select **Properties.**
3. In the General tab window, double-click **Internet protocol (TCP/IP)**.
4. Select **Use the following IP address:**, specify the static IP address and subnet mask that was initially assigned to the PC (see page 126), and click **OK**.



5. Renew the IP address of the computer. From the Windows Start menu, click **Settings ->Network Connections** -> **Local Area Connection** -> **Support** -> **Repair**.

   Or, if you prefer to do this from the command prompt window, click **Run** from the Windows Start menu, enter **cmd**, and click **OK** to bring up the command prompt window. Then, from the command prompt window, enter:

   `ipconfig /renew` *renews the IP address*
   `ipconfig /all` *checks the IP address*

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