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A MEASUREMENT COMPUTING COMPANY

UM-25309-E

DT9844 User's Manual

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Table of Contents

About this Manual

This manual describes how to install and set up your DT9844 module and device driver, and verify that your module is working properly.

This manual also describes the features of DT9844 modules, the capabilities of the DT9844 Device Driver, and how to program the DT9844 module using the DT-Open Layers for .NET Class Library™ software. Troubleshooting information is also provided.

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

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

Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for using and/or programming DT9844 modules for data acquisition operations in the Microsoft® Windows Vista®, Windows 7, or Windows 8 operating system. It is assumed that you have some familiarity with data acquisition principles and that you understand your application.

How this Manual is Organized

This manual is organized as follows:

- Chapter 1, "Overview," describes the major features of the DT9844 module, as well as the supported software and accessories for the modules.
- Chapter 2, "Setting Up and Installing the Module," describes how to install a DT9844 module, how to apply power to the module, and how to configure the device driver.
- Chapter 3, "Wiring Signals to the STP Connection Box," describes how to wire signals to an STP connection box.
- Chapter 4, "Verifying the Operation of a Module," describes how to verify the operation of the DT9844 module with the Quick DataAcq application.
- Chapter 5, "Principles of Operation," describes all of the features of the DT9844 module and how to use them in your application.
- Chapter 6, "Supported Device Driver Capabilities," lists the data acquisition subsystems and the associated features accessible using the DT9844 Device Driver.
- Chapter 7, "Troubleshooting," provides information that you can use to resolve problems with the DT9844 module and device driver, should they occur.

- Chapter 8, "Calibration," describes how to calibrate the analog I/O circuitry of the DT9844 modules.
- Appendix A, "Specifications," lists the specifications of the DT9844 module.
- Appendix B, "Connector Pin Assignments and LED Status Indicators," shows the pin assignments for the connectors and the screw terminal assignments for the screw terminals on the DT9844 module and accessory panels.
- Appendix C, "Ground, Power, and Isolation," describes the electrical characteristics of the DT9844 module.
- 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 DT9844 modules:

- *Benefits of the Universal Serial Bus for Data Acquisition.* This white paper describes why USB is an attractive alternative for data acquisition. It is available on the Data Translation web site (www.mccdaq.com).
- *QuickDAQ User's Manual* (UM-24774). This manual describes how to create a QuickDAQ application to acquire and analyze data from DT-Open Layers data acquisition devices.
- *DT-Open Layers for .NET User's Manual* (UM-22161). For programmers who are developing their own application programs using Visual C# or Visual Basic .NET, this manual describes how to use the DT-Open Layers for .NET Class Library to access the capabilities of Data Translation data acquisition devices.
- *DataAcq SDK User's Manual* (UM-18326). For programmers who are developing their own application programs using the Microsoft C compiler, this manual describes how to use the DT-Open Layers DataAcq SDK™ to access the capabilities of Data Translation data acquisition devices.

- *DAQ Adaptor for MATLAB* (UM-22024). This document describes how to use Data Translation's DAQ Adaptor to provide an interface between the MATLAB Data Acquisition subsystem from The MathWorks and Data Translation's DT-Open Layers architecture.
- *LV-Link Online Help*. This help file describes how to use LV-Link™ with the LabVIEW™ graphical programming language to access the capabilities of Data Translation data acquisition devices.
- Microsoft Windows Vista, Windows 7, or Windows 8 documentation.
- USB web site (http://www.usb.org).

Where To Get Help

Should you run into problems installing or using a DT9844 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).

1

Overview

DT9844 Hardware Features

The DT9844 is a high-performance, multifunction data acquisition module, shown in Figure 1, for the USB (Ver. 3.0 or Ver. 2.0) bus.

Figure 1: DT9844 Module (Shown in STP Connection Box)

Key hardware features of the DT9844 module are as follows:

- Installed in an STP connection box (DT9844-32-STP) or as a board-level OEM version (DT9844-32-OEM) that you can install in your own custom application.
- Simultaneous operation of analog input, digital I/O, and counter/timer subsystems.
- Analog input features:
  - 20-bit A/D converter.
  - Throughput rate up to 1 MSample/s.
  - Up to 32 single-ended/16 differential analog input channels.
  - Input range of ±10 V.
  - 1024-location channel-gain list. You can cycle through the channel-gain list using continuous scan mode or triggered scan mode.
  - Pre- and post-trigger continuous acquisition using programmable start and reference triggers.
  - Programmable trigger source for the start trigger and retrigger (software, external digital (TTL), or analog threshold trigger). Reference trigger can be programmed for either a positive or negative external (TTL) trigger.

- Digital I/O features:
  - One digital input port. You can program the resolution of the digital input subsystem to use 16 or 32 digital input lines. In addition, you can program any of the first eight digital input lines to perform interrupt-on-change operations. For modules that support analog input channels, you can read the value of the digital input port using the analog input channel-gain list.
  - One digital output port, consisting of 16 digital output lines. (The resolution of the digital input subsystem must be 16 to access the digital output lines.)
  - An additional dynamic digital output line that changes state whenever an analog input channel is read.
- Five 32-bit counter/timer (C/T) channels that perform event counting, up/down counting, frequency measurement, edge-to-edge measurement, continuous pulse output, one-shot, and repetitive one-shot operations. You can read the value of one or more of the C/T channels using the analog input channel-gain list.
- External or internal clock source.
- A 500 V galvanic isolation barrier that isolates all subsystems from each other and the host computer prevents ground loops to maximize analog signal integrity and protect your computer.

Supported Software

The following software is available for use with the DT9844 module and is on the Data Acquisition OMNI CD:

- **DT9844 Device Driver –** The device driver allows you to use a DT9844 module with any of the supported software packages or utilities.
- **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 Advanced FFT Analysis option includes all the features of 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.

- **Quick DataAcq application –** The Quick DataAcq application provides a quick way to get up and running using a DT9844 module. Using this application, you can verify key features of the modules, display data on the screen, and save data to disk.
- **DT-Open Layers for .NET Class Library** – Use this class library if you want to use Visual C# or Visual Basic for .NET to develop your own application software for a DT9844 module using Visual Studio 2003 to 2012; the class library complies with the DT-Open Layers standard.
- **DataAcq SDK –** Use the Data Acq SDK if you want to use Visual Studio 6.0 and Microsoft C or C++ to develop your own application software for a DT9844 module using Windows Vista, Windows 7, or Windows 8; the DataAcq SDK complies with the DT-Open Layers standard.
- **DAQ Adaptor for MATLAB –** Data Translation's DAQ Adaptor provides an interface between the MATLAB Data Acquisition (DAQ) subsystem from The MathWorks and Data Translation's DT-Open Layers architecture.
- **LV-Link –** A link to this software is included on the Data Acquisition OMNI CD. Use LV-Link if you want to use the LabVIEW graphical programming language to access the capabilities of DT9844 modules.

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

Accessories

You can purchase the following optional items from Data Translation for use with a DT9844 module:

Table 1: Accessories for the DT9844

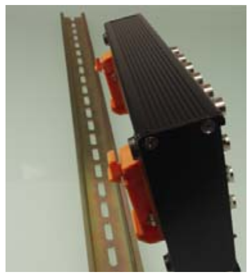
Accessory		Description
BNC DIN Rail Kit		Kit for mounting the DT9844 STP box to a DIN rail. Includes mounting clips, screws, and instructions. Rail not included.
EP361		For the DT9844-32-OEM version only, +5 V power supply and cable. This comes with the DT9844-32-STP version.
EP353		For the DT9844-32-OEM version only, accessory panel that provides one 37-pin, D-sub connector for attaching analog input signals and one 26-pin connector for attaching a 5B Series signal conditioning backplane. Refer to page 144 for connection information.
EP355		For the DT9844-32-OEM version only, screw terminal panel that provides 14-position screw terminal blocks for attaching analog input, counter/timer, digital I/O, trigger, and clock signals. Refer to page 152 for connection information.
EP356		For the DT9844-32-OEM version only, accessory panel that provides two 37-pin, D-sub connectors for attaching digital I/O, counter/timer, trigger, and clock signals. Refer to page 148 for connection information.

Table 1: Accessories for the DT9844

Accessory		Description
STP37		For the DT9844-32-OEM version only, connects to the EP353 accessory panel using the EP360 cable or to the EP356 accessory panel using the EP333 cable. Refer to page 146, page 149, and page 150 for connection information.
EP333		A 2-meter shielded cable with two 37-pin connectors, For the DT9844-32-OEM version only, connects the STP37 screw terminal panel to the EP356 accessory panel. Refer to page 149 and page 150 for connection information.
EP360		A 2-meter shielded cable with two 37-pin connectors. For the DT9844-32-OEM version only, connects the STP37 to the EP353 accessory panel. Refer to page 146 for connection information.

Getting Started Procedure

The flow diagram shown in Figure 2 illustrates the steps needed to get started using the DT9844 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.

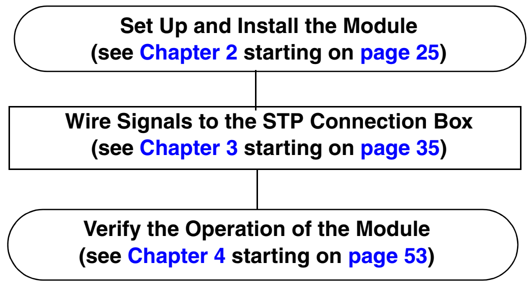
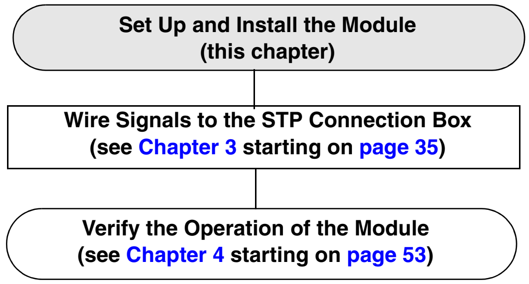


Figure 2: Getting Started Flow Diagram

Part 1: Getting Started

2

Setting Up and Installing the Module


Set Up and Install the Module
(this chapter)
Wire Signals to the STP Connection Box
(see Chapter 3 starting on page 35)
Verify the Operation of the Module
(see Chapter 4 starting on page 53)

Unpacking

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

- STP connection box, or OEM version of the DT9844 module
- Data Acquisition OMNI CD

Note that if you purchased an STP connection box, a USB cable and an EP361 power supply and power cable should also be included.

If an item is missing or damaged, contact Data Translation. If you are in the United States, call the Customer Service Department at (508) 956-5100. 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).

Note: The DT9844 module is factory-calibrated. If you decide that you want to recalibrate the analog input or analog output circuitry, refer to the instructions in Chapter 8.

System Requirements

For reliable operation, ensure that your computer meets the following system requirements:

- Processor: Pentium 4/M or equivalent
- RAM: 1 GB
- Screen Resolution: 1024 x 768 pixels
- Operating System: Windows 8, Windows 7, Windows Vista (32- and 64-bit)
- Disk Space: 4 GB

Applying Power to the Module

The STP connection box is shipped with an EP361 +5V power supply and cable. For the OEM version of the DT9844 module, you must provide your own +5 V power source or purchase the EP361 power supply and cable from Data Translation.

To apply power to the module, do the following:

1. Connect the +5 V power supply to the power connector on the DT9844 module. Refer to Figure 3.

Figure 3: Attaching a +5 V Power Supply to the DT9844 Module

2. Plug the power supply into a wall outlet.

For more detailed information about ground, power, and isolation connections on a DT9844 module, refer to Appendix C starting on page 157.

Attaching Modules to the Computer

This section describes how to attach DT9844 modules to the host computer.

Notes: Most computers have several USB ports that allow direct connection to USB devices. If your application requires more DT9844 modules than you have USB ports for, you can expand the number of USB devices attached to a single USB port by using expansion hubs. For more information, refer to page 31.

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

You must install the device driver before connecting your DT9844 module(s) to the host computer.

Connecting Directly to the USB Ports

To connect a DT9844 module directly to a USB port on your computer, do the following:

1. Make sure that you have attached a power supply to the module.
2. Attach one end of the USB cable to the USB port on the module.
3. Attach the other end of the USB cable to one of the USB ports on the host computer, as shown in Figure 4.
   The operating system automatically detects the USB module and starts the Found New Hardware wizard.

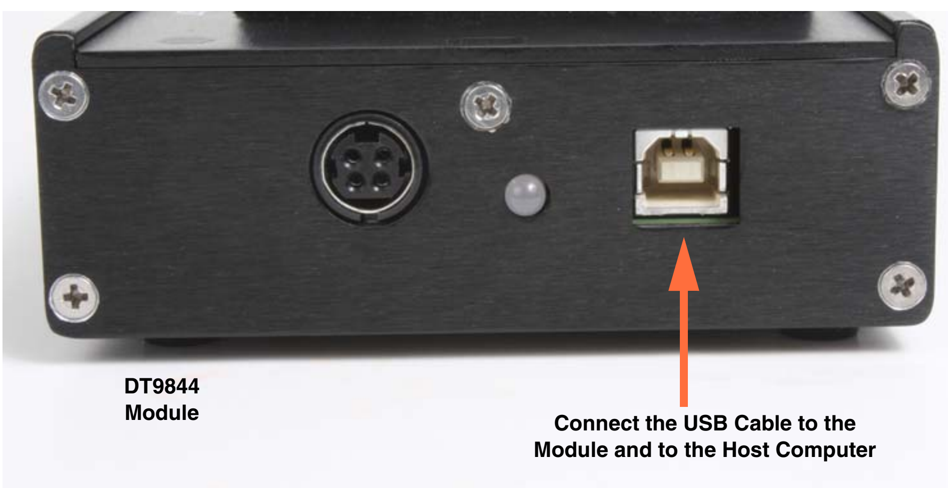


Figure 4: Attaching the Module to the Host Computer

4. For Windows Vista:

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

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

   c. Click **Install this driver software anyway**.
   The LED on the module turns green.

Note: Windows 7 and Windows 8 find the device automatically.

5. Repeat these steps to attach another DT9844 module to the host computer, if desired.

Connecting to an Expansion Hub

Expansion hubs are powered by their own external power supply. The practical number of DT9844 modules that you can connect to a single USB port depends on the throughput you want to achieve.

To connect multiple DT9844 modules to an expansion hub, do the following:

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

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

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

   c. Click **Install this driver software anyway**.
   The LED on the module turns green.

Note: Windows 7 and Windows 8 find the device automatically.

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

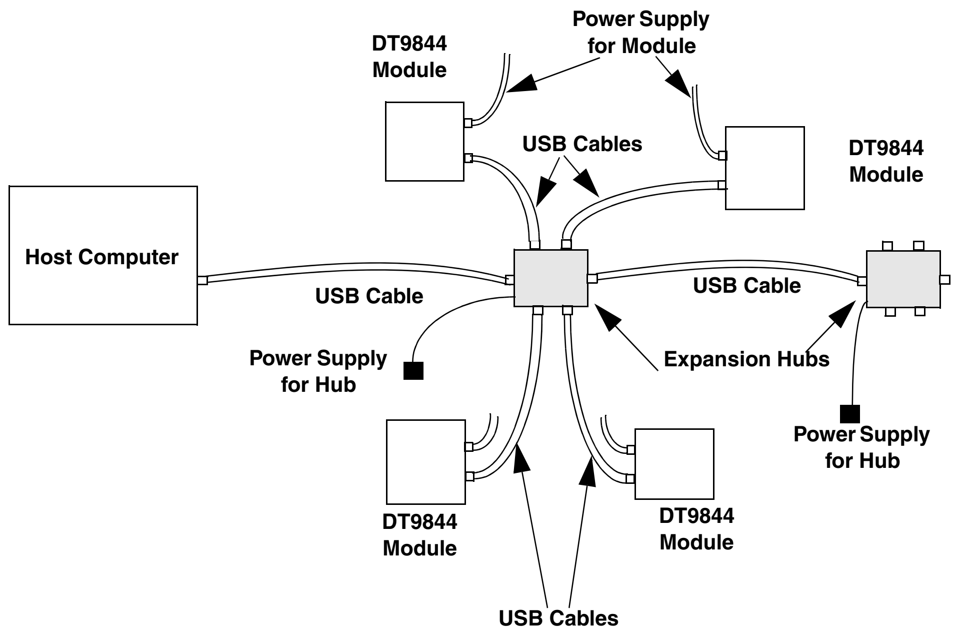


Figure 5: Attaching Multiple DT9844 Modules Using Expansion Hubs

Configuring the DT9844 Device Driver

Note: In Windows 7, Windows 8, and Vista, you must have administrator privileges to run the Open Layers Control Panel. When you double-click the Open Layers Control Panel icon, you may see the Program Compatibility Assistant. If you do, select **Open the control panel using recommended settings**. You may also see a Windows message asking you if you want to run the Open Layers Control Panel as a "legacy CPL elevated." If you get this message, click **Yes**.

If you do not get this message and have trouble making changes in the Open Layers Control Panel, right click the DTOLCPL.CPL file and select **Run as administrator**. By default, this file is installed in the following location:

<u>Windows 7, Windows 8, and Vista (32-bit)</u>
C:\Windows\System32\Dtolcpl.cpl

<u>Windows 7, Windows 8, and Vista (64-bit)</u>
C:\Windows\SysWOW64\Dtolcpl.cpl

To configure the device driver for the DT9844 module, do the following:

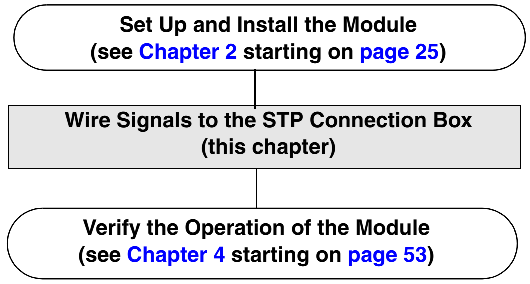
1. If you have not already done so, power up the host computer and all peripherals.
2. From the Windows Start menu, select **Settings | Control Panel**.
3. From the Control Panel, double-click **Open Layers Control Panel**.
   The Data Acquisition Control Panel dialog box appears.
4. Click the DT9844 module that you want to configure, and then click **Advanced**.
   The Configurable Board Options dialog box appears.
5. If you are using differential analog input channels, we recommend that you select the **10k Ohm Resistor Terminations** checkbox (the default setting). This ensures that 10 kΩ of bias return termination resistance is used for all of the analog input channels. Bias return termination resistance is particularly useful when your differential source is floating.

   If you are using single-ended analog input channels, this option is not used.
6. If required, select the digital input line(s) that you want to use for interrupt-on-change operations. When any of the selected lines changes state, the module reads the entire 16-bit digital input value and generates an interrupt.
7. Click **OK**.
8. If you want to rename the module, click **Edit Name**, enter a new name for the module, and then click **OK**. The name is used to identify the module in all subsequent applications.
9. Repeat steps 4 to 8 for the other modules that you want to configure.
10. When you are finished configuring the modules, click **Close**.

Continue with the instructions on wiring in Chapter 3 starting on page 35.

3

Wiring Signals to the STP Connection Box


Set Up and Install the Module
(see Chapter 2 starting on page 25)
Wire Signals to the STP Connection Box
(this chapter)
Verify the Operation of the Module
(see Chapter 4 starting on page 53)

Preparing to Wire Signals

This section provides recommendations and information about wiring signals to the STP connection box.

Note: If you are using the D-sub connectors on the OEM version of the DT9844 module, use this chapter for conceptual information, and then refer to Appendix C for connector pin assignments and accessory panel information.

Wiring Recommendations

Keep the following recommendations in mind when wiring signals to the STP connection box:

- Apply power to the DT9844 before powering on signal conditioning to the analog inputs.
- Follow standard ESD procedures when wiring signals to the module.
- Use individually shielded twisted-pair wire (size 14 to 26 AWG) in highly noisy electrical environments.
- Separate power and signal lines by using physically different wiring paths or conduits.
- To avoid noise, do not locate the box 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 box is operational.
- Connect all unused analog input channels to analog ground.

Screw Terminal Assignments

The STP connection box contains blocks of screw terminals that allow you to access all the signals of the module. Figure 6 shows the layout of the STP connection box.

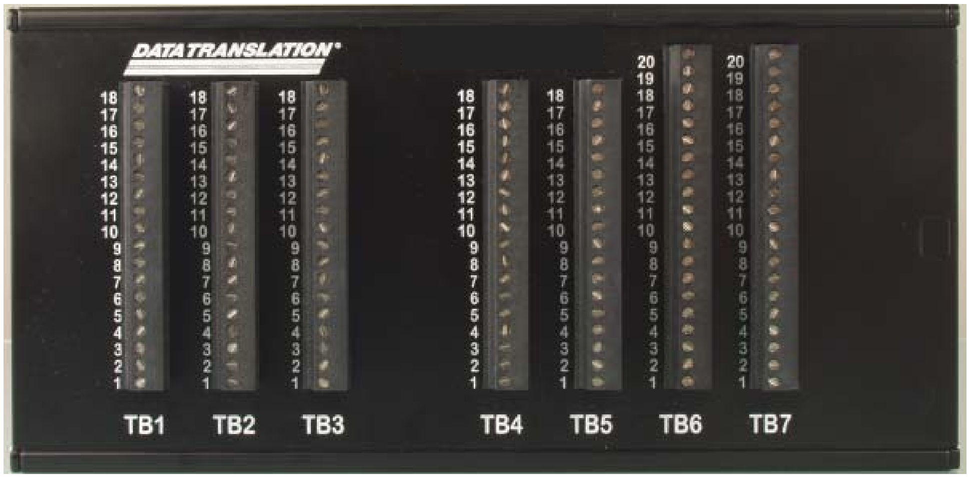


Figure 6: STP Connection Box

Table 2 lists the screw terminal assignments for screw terminal blocks TB1 through TB7.

Table 2: Screw Terminal Assignments for STP Connection Box

Terminal Block	Screw	Signal Description	Terminal Block	Screw	Signal Description
TB1	18	Analog Ground	TB2	18	Analog Ground
	17	Analog In 5 DI Return/ Analog In 13 SE[a]		17	Analog In 11 DI Return/ Analog In 27 SE[a]
	16	Analog In 5		16	Analog In 11 DI/ Analog In 19 SE[a]
	15	Analog Ground		15	Analog Ground
	14	Analog In 4 DI Return/ Analog In 12 SE[a]		14	Analog In 10 DI Return/ Analog In 26 SE[a]
	13	Analog In 4		13	Analog In 10 DI/ Analog In 18 SE[a]
	12	Analog Ground		12	Analog Ground
	11	Analog In 3 DI Return/ Analog In 11 SE[a]		11	Analog In 9 DI Return/ Analog In 25 SE[a]
	10	Analog In 3		10	Analog In 9 DI/ Analog In 17 SE[a]
	9	Analog Ground		9	Analog Ground
	8	Analog In 2 DI Return/ Analog In 10 SE[a]		8	Analog In 8 DI Return/ Analog In 24 SE[a]
	7	Analog In 2		7	Analog In 8 DI/ Analog In 16 SE[a]
	6	Analog Ground		6	Analog Ground
	5	Analog In 1 DI Return/ Analog In 9 SE[a]		5	Analog In 7 DI Return/ Analog In 15 SE[a]
	4	Analog In 1		4	Analog In 7
	3	Analog Ground		3	Analog Ground
	2	Analog In 0 DI Return/ Analog In 8 SE[a]		2	Analog In 6 DI Return/ Analog In 14 SE[a]
	1	Analog In 0		1	Analog In 6

Table 2: Screw Terminal Assignments for STP Connection Box (cont.)

Terminal Block	Screw	Signal Description	Terminal Block	Screw	Signal Description
TB3	18	5 V Analog	TB4	18	Digital Ground
	17	Digital Ground		17	Digital Ground
	16	Analog Ground		16	External ADC Trigger
	15	Analog Ground		15	Digital Ground
	14	Amplifier Low		14	External ADC Clock
	13	Amplifier Low		13	Digital Ground
	12	Analog Ground		12	Not Used
	11	Analog In 15 DI Return/ Analog In 31 SE[a]		11	Digital Ground
	10	Analog In 15 DI/ Analog In 23 SE[a]		10	Not Used
	9	Analog Ground		9	Digital Ground
	8	Analog In 14 DI Return/ Analog In 30 SE[a]		8	Not Used
	7	Analog In 14 DI/ Analog In 22 SE[a]		7	Not Used
	6	Analog Ground		6	Not Used
	5	Analog In 13 DI Return/ Analog In 29 SE[a]		5	Not Used
	4	Analog In 13 DI/ Analog In 21 SE[a]		4	Not Used
	3	Analog Ground		3	Not Used
	2	Analog In 12 DI Return/ Analog In 28 SE[a]		2	Not Used
	1	Analog In 12 DI/ Analog In 20 SE[a]		1	Not Used

Table 2: Screw Terminal Assignments for STP Connection Box (cont.)

Terminal Block	Screw	Signal Description	Terminal Block	Screw	Signal Description
TB5	18	Digital Ground	TB6	20	Digital Ground
	17	Digital Input 15		19	Dynamic Digital Output
	16	Digital Input 14		18	Digital Ground
	15	Digital Input 13		17	Digital Output 15 or Digital Input 31[b]
	14	Digital Input 12		16	Digital Output 14 or Digital Input 30[b]
	13	Digital Input 11		15	Digital Output 13 or Digital Input 29[b]
	12	Digital Input 10		14	Digital Output 12 or Digital Input 28[b]
	11	Digital Input 9		13	Digital Output 11 or Digital Input 27[b]
	10	Digital Input 8		12	Digital Output 10 or Digital Input 26[b]
	9	Digital Ground		11	Digital Output 9 or Digital Input 25[b]
	8	Digital Input 7		10	Digital Output 8 or Digital Input 24[b]
	7	Digital Input 6		9	Digital Ground
	6	Digital Input 5		8	Digital Output 7 or Digital Input 23[b]
	5	Digital Input 4		7	Digital Output 6 or Digital Input 22[b]
	4	Digital Input 3		6	Digital Output 5 or Digital Input 21[b]
	3	Digital Input 2		5	Digital Output 4 or Digital Input 20[b]
	2	Digital Input 1		4	Digital Output 3 or Digital Input 19[b]
	1	Digital Input 0		3	Digital Output 2 or Digital Input 18[b]
TB7	20	Counter 4 Gate		2	Digital Output 1 or Digital Input 17[b]
	19	Counter 4 Out		1	Digital Output 0 or Digital Input 16[b]
	18	Counter 4 Clock			
	17	Digital Ground			
	16	Counter 3 Gate			
	15	Counter 3 Out			
	14	Counter 3 Clock			
	13	Digital Ground			
	12	Counter 2 Gate			
	11	Counter 2 Out			
	10	Counter 2 Clock			
	9	Digital Ground			

Table 2: Screw Terminal Assignments for STP Connection Box (cont.)

Terminal Block	Screw	Signal Description	Terminal Block	Screw	Signal Description
TB7 (cont.)	8	Counter 1 Gate			
	7	Counter 1 Out			
	6	Counter 1 Clock			
	5	Digital Ground			
	4	Counter 0 Gate			
	3	Counter 0 Out			
	2	Counter 0 Clock			
	1	Digital Ground			

a. The first signal description (Return) applies to the differential configuration. The second signal description applies to the single-ended configuration.
b. Used as a digital input line if the resolution of the digital input subsystem is 32; otherwise, used as a digital output line.

Connecting Analog Input Signals

The STP connection box supports both voltage and current loop inputs. You can connect analog input signals to an STP connection box in the following ways:

- **Single-ended** – Choose this configuration when you want to measure high-level signals, noise is not significant, the source of the input is close to the module, and all the input signals are referred to the same common ground.
- **Pseudo-Differential** – Choose this configuration when noise or common-mode voltage (the difference between the ground potentials of the signal source and the ground of the screw terminal panel or between the grounds of other signals) exists and the differential configuration is not suitable for your application. This option provides less noise rejection than the differential configuration; however, the number of analog input channels available is the same as for single-ended configuration.
- **Differential** – Choose this configuration when you want to measure low-level signals, noise is a significant part of the signal, or common-mode voltage exists.

This section describes how to connect single-ended, pseudo-differential, and differential voltage inputs, as well as current loops, to an STP connection box.

Connecting Single-Ended Voltage Inputs

Note: If you are using single-ended inputs, make sure that bias return resistance is disabled in the Open Layers Control Panel applet. Refer to page 33 for more information.

Figure 7 shows how to connect single-ended voltage inputs (channels 0 and 1, in this case) to the STP connection box.

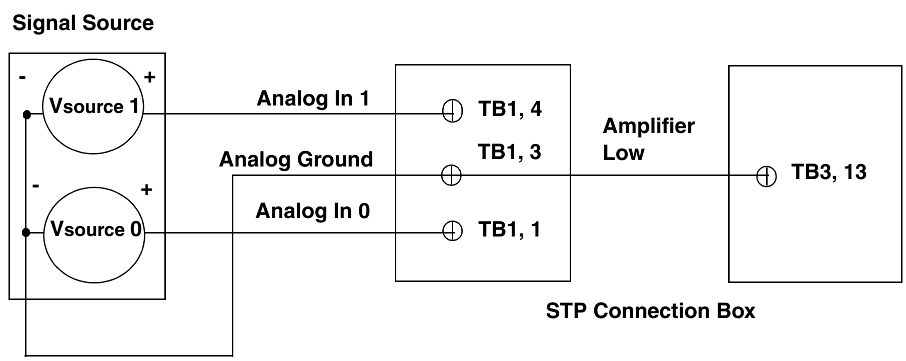


Figure 7: Connecting Single-Ended Inputs to the STP Connection Box

Connecting Pseudo-Differential Voltage Inputs

Figure 8 shows how to connect pseudo-differential voltage inputs (channels 0 and 1, in this case) to the STP connection box.

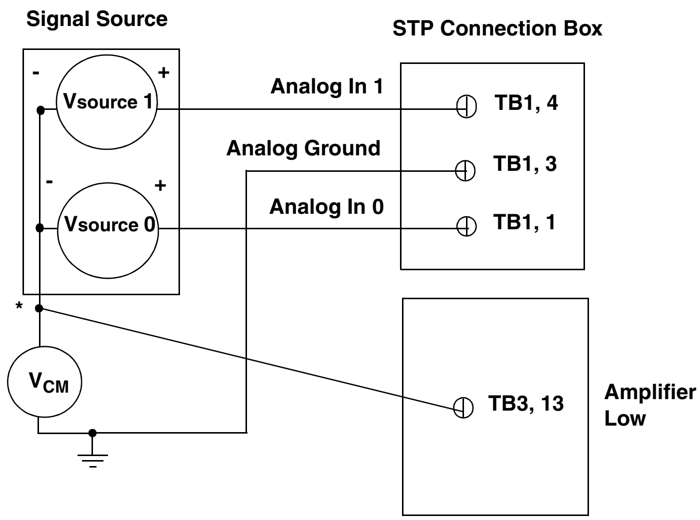


Figure 8: Connecting Pseudo-Differential Inputs to the STP Connection Box

Connecting Differential Voltage Inputs

Figure 9A shows how to connect a floating signal source to the STP connection box using differential inputs. (A floating signal source is a voltage source that has no connection with earth ground.)

Note: For floating signal sources, we recommend that you provide a bias return path for the differential channels by using the Open Layers Control Panel applet to enable 10 kΩ of termination resistance. For more information, refer to page 33.

Figure 9B illustrates how to connect a nonfloating signal source to the STP connection box using differential inputs. In this case, the signal source itself provides the bias return path; therefore, you do not need to provide bias return resistance through software.

R_S is the signal source resistance while R_V is the resistance required to balance the bridge. Note that the negative side of the bridge supply must be returned to analog ground.

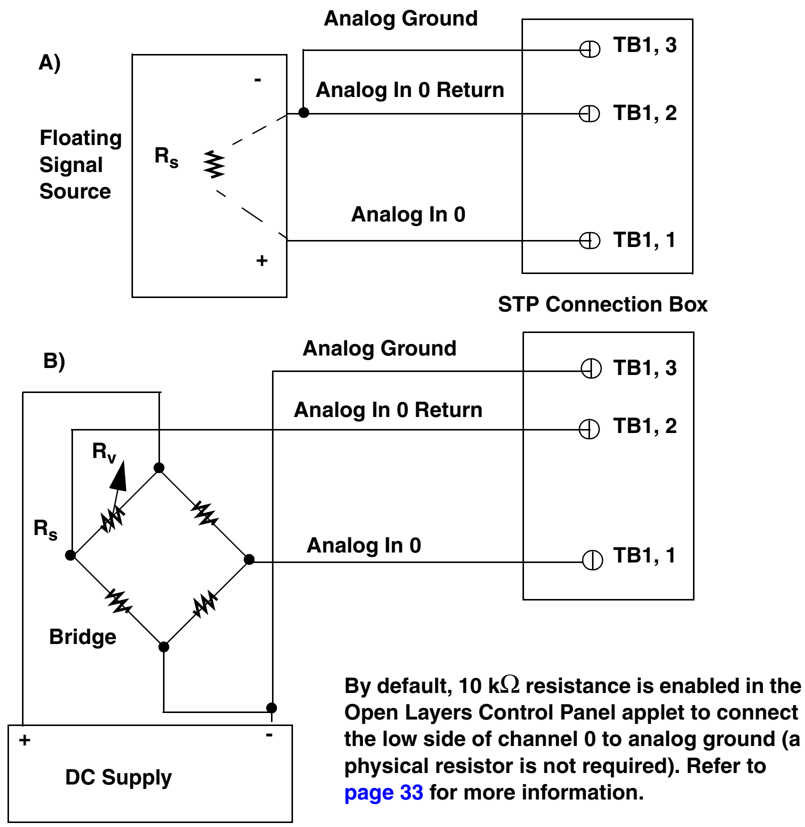


Figure 9: Connecting Differential Inputs to a Screw Terminal Panel

Note that since they measure the difference between the signals at the high (+) and low (–) inputs, differential connections usually cancel any common-mode voltages, leaving only the signal. However, if you are using a grounded signal source and ground loop problems arise, connect the differential signals as shown as Figure 10. In this case, make sure that the low side of the signal (–) is connected to ground at the signal source, not at the screw terminal panel, and do not tie the two grounds together.

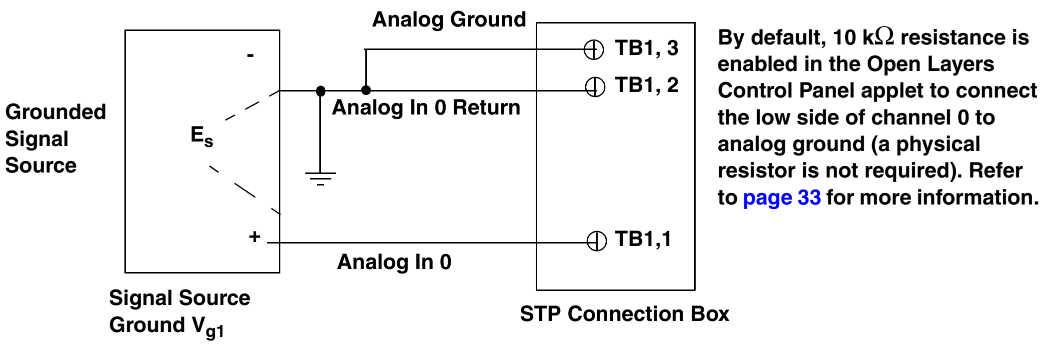


Figure 10: Connecting Differential Voltage Inputs from a Grounded Signal Source to an STP Connection Box

Connecting Current Loop Inputs

Figure 11 shows how to connect a current loop input (channel 0, in this case) to an STP connection box.

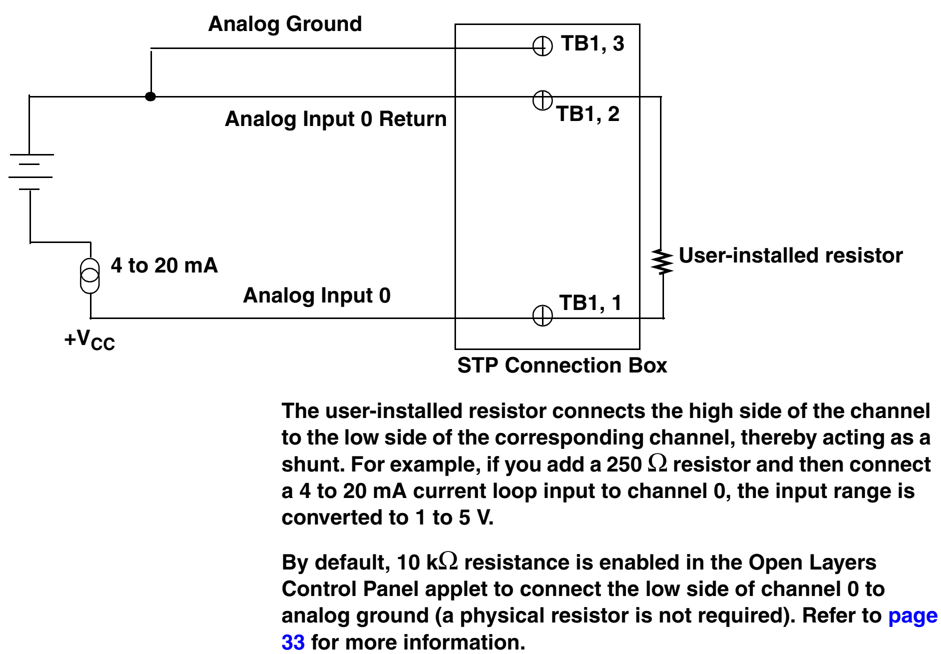


Figure 11: Connecting Current Inputs to the STP Connection Box

Connecting Digital I/O Signals

Figure 12 shows how to connect digital input signals (lines 0 and 1, in this case) to the STP connection box.

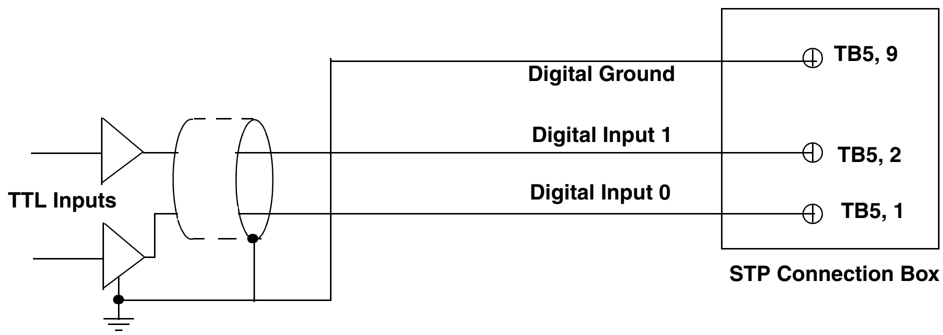
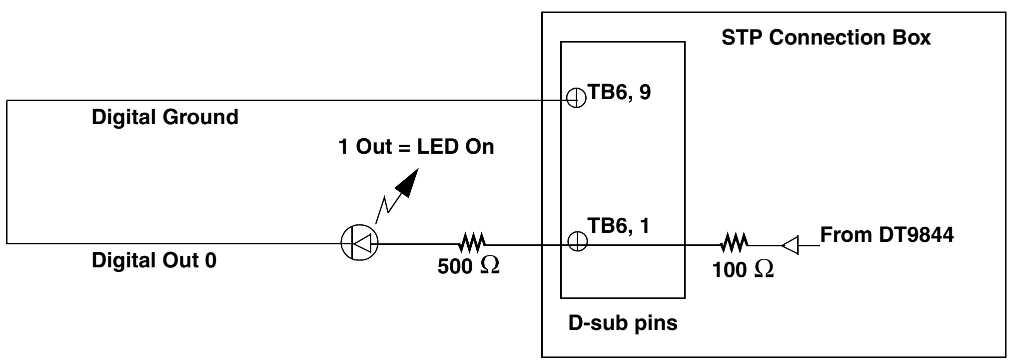


Figure 12: Connecting Digital Inputs to the STP Connection Box

Figure 13 shows how to connect a digital output (line 0, in this case) to the STP connection box.



The output current is determined using the following equation:

$$Current_{Out} = \frac{Voltage_{Out}}{R_{Internal} + R_{External}}$$

In this example, if the maximum output voltage is 3.3 V, the internal resistor is 100 Ω and the external resistor is 500 Ω, the maximum output current is 5.5 mA. Using the minimum output voltage of 2.0 V with the same resistor values, the minimum current output current is 3.3 mA

Figure 13: Connecting Digital Outputs to the STP Connection Box

Connecting Counter/Timer Signals

The DT9844 provides five counter/timer channels that you can use to perform the following operations:

- Event counting
- Up/down counting
- Frequency measurement
- Pulse width/period measurement
- Edge-to-edge measurement
- Continuous edge-to-edge measurement
- Pulse output (continuous, one-shot, and repetitive one-shot)

This section describes how to connect counter/timer signals. Refer to page 84 for more information about using the counter/timers.

Event Counting

Figure 14 shows how to connect counter/timer signals to the STP connection box to perform an event counting operation on counter/timer 0 using an external gate.

The counter counts the number of rising edges that occur on the Counter 0 Clock input when the Counter 0 Gate signal is in the active state (as specified by software). Refer to page 87 for more information.

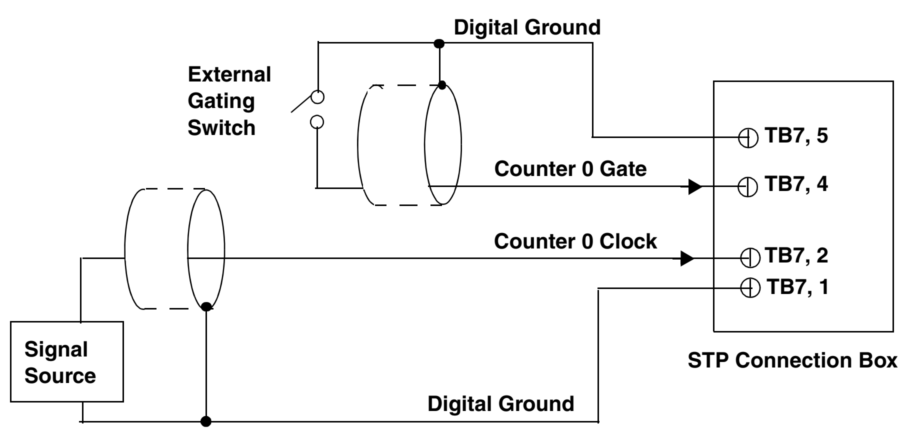


Figure 14: Connecting Counter/Timer Signals to the STP Connection Box for an Event Counting Operation Using an External Gate

Figure 15 shows how to connect counter/timer signals to the STP connection box to perform an event counting operation on counter/timer 0 without using a gate. The counter counts the number of rising edges that occur on the Counter 0 Clock input.

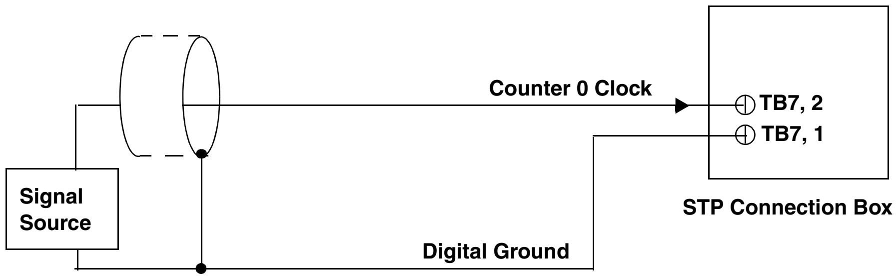


Figure 15: Connecting Counter/Timer Signals to the STP Connection Box for an Event Counting Operation Without Using a Gate

Up/Down Counting

Figure 16 shows how to connect counter/timer signals to an STP connection box to perform an up/down counting operation on counter/timer 0. The counter keeps track of the number of rising edges that occur on the Counter 0 Clock input. The counter increments when the Counter 0 Gate signal is high and decrements when the Counter 0 Gate signal is low.

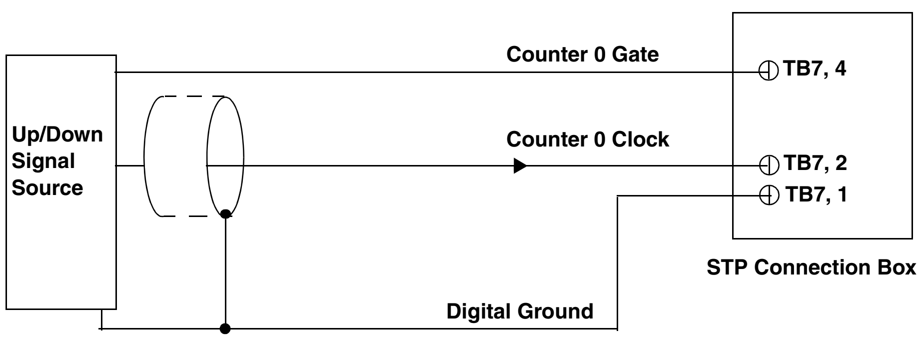


Figure 16: Connecting Counter/Timer Signals to the STP Connection Box for an Up/Down Counting Operation

Frequency Measurement

One way to measure frequency is to connect a pulse of a known duration (such as a one-shot output of counter/timer 1) to the Counter 0 Gate input.

Figure 17 shows how to connect counter/timer signals to the STP connection box. In this case, the frequency of the Counter 0 clock input is the number of counts divided by the period of the Counter 0 Gate input signal.

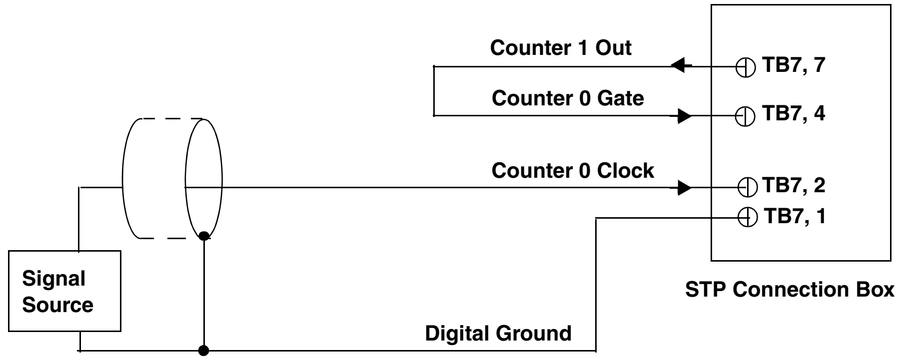


Figure 17: Connecting Counter/Timer Signals to the STP Connection Box for a Frequency Measurement Operation Using an External Pulse

Period/Pulse Width Measurement

Figure 18 shows how to connect counter/timer signals either to the STP connection box to perform a period/pulse width measurement operation on counter/timer 0. You specify the active pulse (high or low) in software. The pulse width is the percentage of the total pulse period that is active. Refer to Chapter 5 for more information about pulse periods and pulse widths.

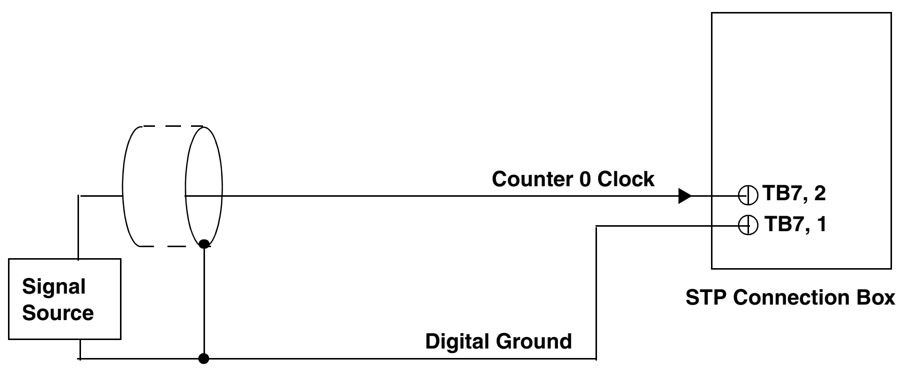


Figure 18: Connecting Counter/Timer Signals to the STP Connection Box for a Period/Pulse Width Measurement Operation

Edge-to-Edge Measurement

Figure 19 shows how to connect counter/timer signals to the STP connection box to perform an edge-to-edge measurement operation using two signal sources. The counter measures the number of counts between the start edge (in this case, a rising edge on the Counter 0 Clock signal) and the stop edge (in this case, a falling edge on the Counter 0 Gate signal).

You specify the start edge and the stop edge in software. Refer to page 88 for more information on edge-to-edge measurement mode.

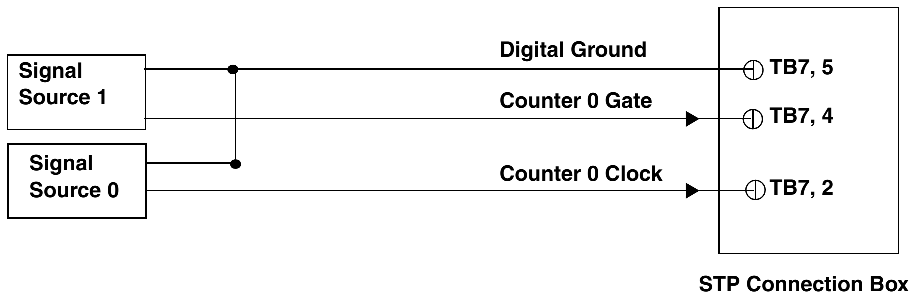


Figure 19: Connecting Counter/Timer Signals to the STP Connection Box for an Edge-to-Edge Measurement Operation

Continuous Edge-to-Edge Measurement

Figure 20 shows how to connect counter/timer signals to the STP connection box to perform a continuous edge-to-edge measurement operation. The counter measures the number of counts between two consecutive start edges (in this case, a rising edge on the Counter 0 Clock signal).

You specify the start edge in software. Refer to page 89 for more information on continuous edge-to-edge measurement mode.

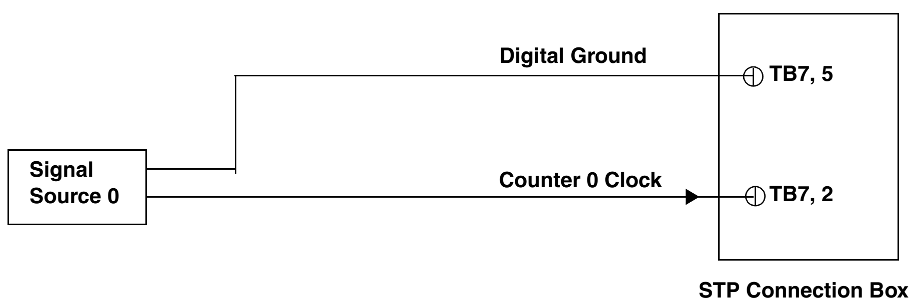


Figure 20: Connecting Counter/Timer Signals to the STP Connection Box for a Continuous Edge-to-Edge Measurement Operation

Pulse Output

Figure 21 shows how to connect counter/timer signals to perform a pulse output operation on counter/timer 0; in this example, an external gate is used.

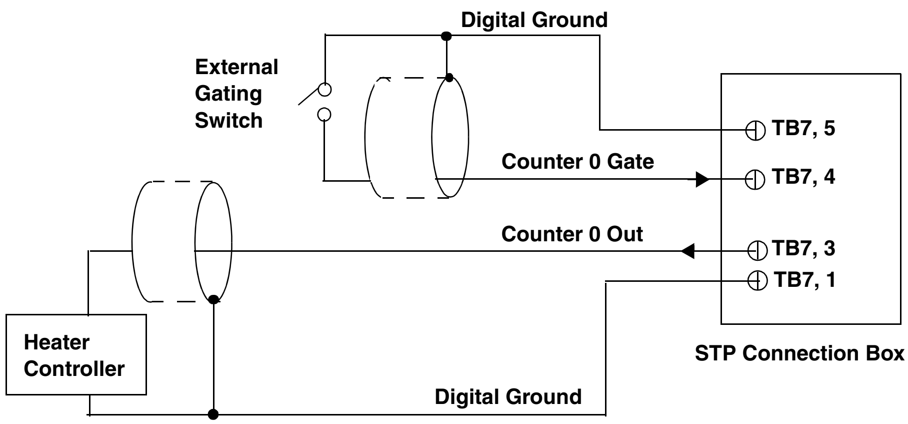
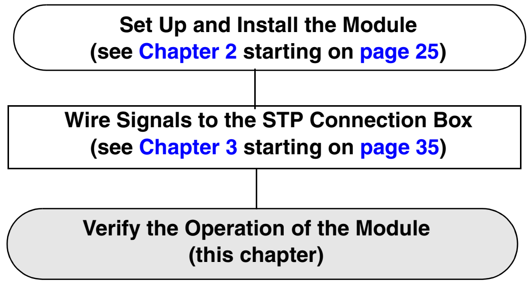


Figure 21: Connecting Counter/Timer Signals to the STP Connection Box for a Pulse Output Operation Using an External Gate

4

Verifying the Operation of a Module

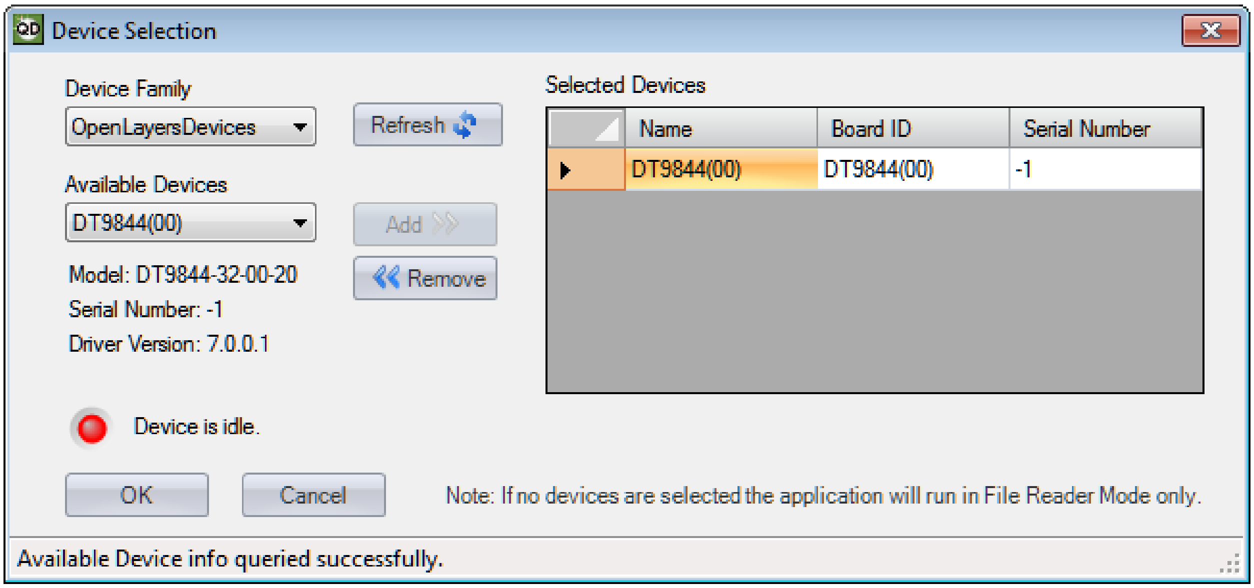


QuickDAQ allows you to acquire and analyze data from all Data Translation USB and Ethernet devices, except the DT9841 Series, DT9817, DT9835, and DT9853/54. This chapter describes how to verify the operation of a DT9844 Series module using the QuickDAQ base version.

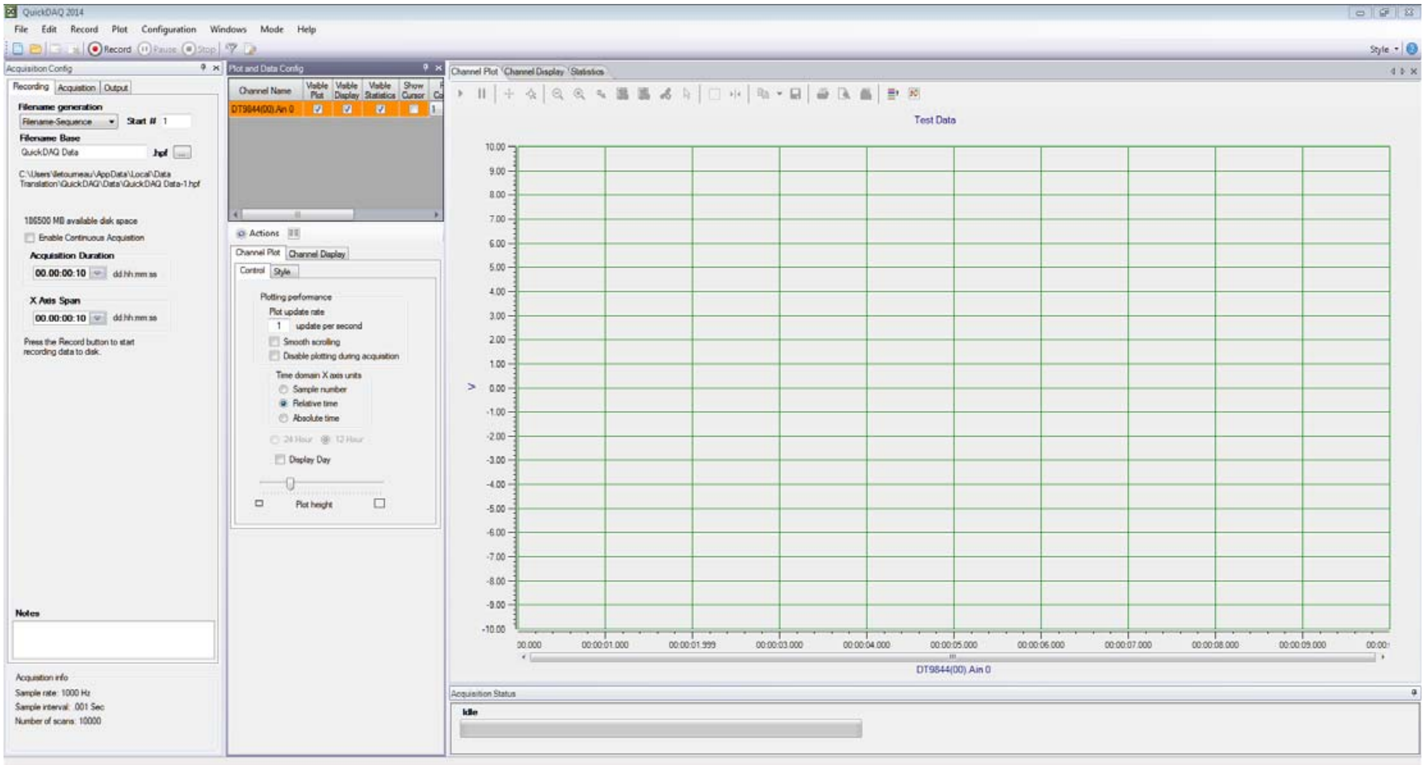
Selecting the Device

To get started with your DT9844 module and the QuickDAQ application, follow these steps:

1. Connect the DT9844 module to the USB port of your computer, and connect your signals to the module.
2. Start the QuickDAQ application.
   The Device Selection window appears.



3. For the Device Family selection, select **OpenLayersDevices**.
   By default, the application "discovers" all devices that are available for the specified device family and displays the module name for the USB devices in the drop-down list. If you want to refresh this list to determine if other devices are available, click **Refresh**.
4. Select the module name for the module that you want to use from the list of Available Devices, and click **Add**.
   Information about the device, including the model number, serial number, firmware version, driver version, and scanning status is displayed.
5. (Optional) If you want to remove a device from list of selected devices, click the Row Selector button for the device, and then click **Remove**.
6. Once you have added all the devices that you want to use with the application, click **OK**.
   The latest state is saved and used when the application is next run, and the interface of the QuickDAQ application is displayed.


QuickDAQ 2014
File Edit Record Plot Configuration Windows Mode Help
Record
Pause
Stop
Style
Acquisition Config
Recording
Acquisition
Output
Filename generation
Filename-Sequence
Start # 1
Filename Base
QuickDAQ Data
.hpf
186500 MB available disk space
Enable Continuous Acquisition
Acquisition Duration
00.00:00:10
dd.hh:mm:ss
X Axis Span
00.00:00:10
dd.hh:mm:ss
Press the Record button to start recording data to disk.
Notes
Acquisition info
Sample rate: 1000 Hz
Sample interval: .001 Sec
Number of scans: 10000
Plot and Data Config
Channel Name
Visible Plot
Visible Display
Visible Statistics
Show Cursor
DT9844(00) Ain 0
Actions
Channel Plot
Channel Display
Control
Style
Plotting performance
Plot update rate
1
update per second
Smooth scrolling
Disable plotting during acquisition
Time domain X axis units
Sample number
Relative time
Absolute time
24 Hour
12 Hour
Display Day
Plot height
Channel Plot
Channel Display
Statistics
Test Data
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
-6.00
-7.00
-8.00
-9.00
-10.00
00:00:01.000
00:00:01.999
00:00:03.000
00:00:04.000
00:00:05.000
00:00:06.000
00:00:07.000
00:00:08.000
00:00:09.000
DT9844(00) Ain 0
Acquisition Status
Idle

Voltage Input Measurement Example

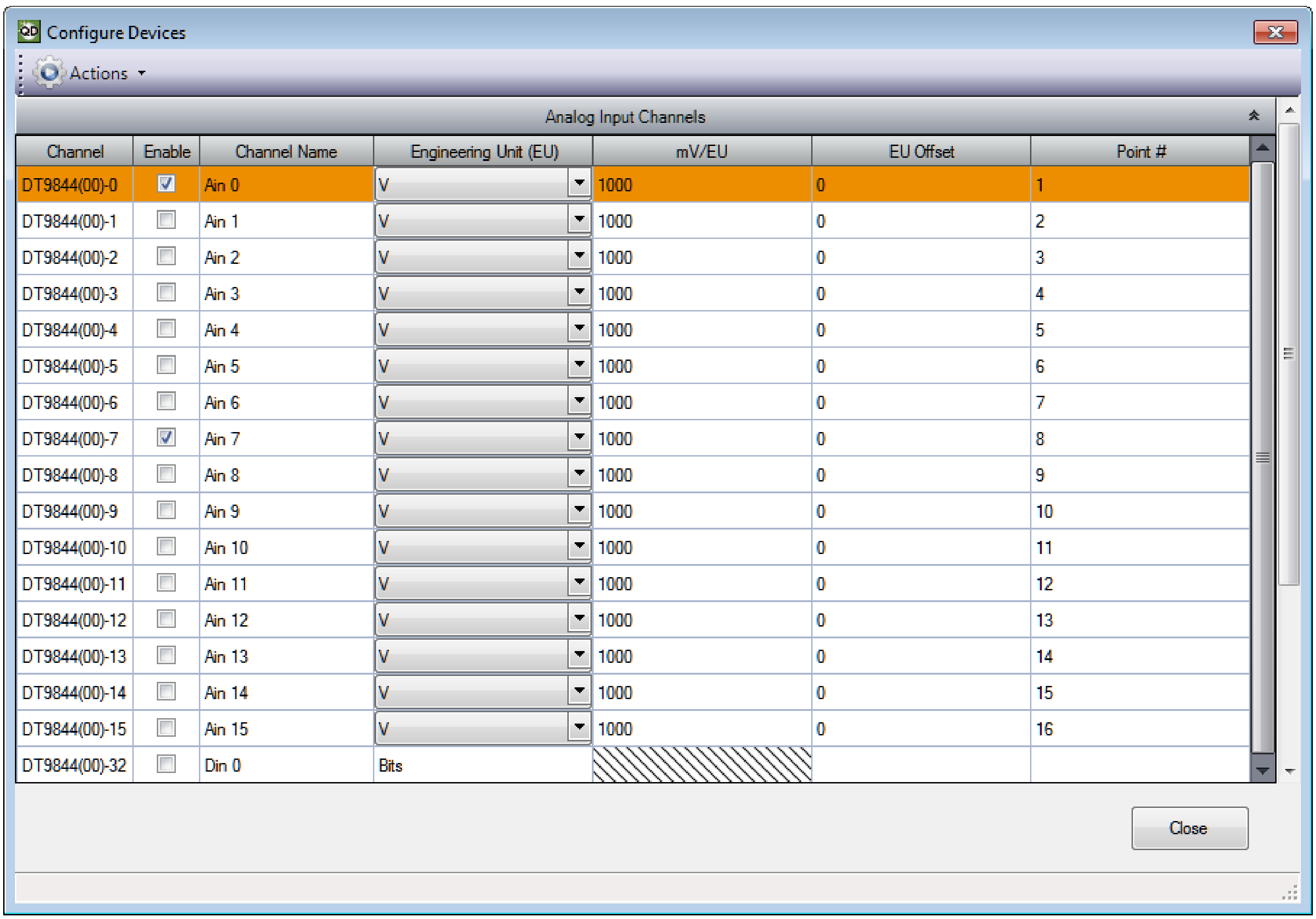
The following steps describe how to use the QuickDAQ application to measure voltages from two analog input channels.

This example uses a sine wave connected to analog input channels 0 and 7. The channels are configured as differential inputs.

Configure the Channels

Configure the channels as follows:

1. Configure each analog input channel by clicking the **Configuration** menu, and clicking **Input Channel Configuration**, or by clicking the **Input Channel Configuration** toolbar button ( ).
2. Enable analog input channels 0 and 7 by clicking the checkbox under the **Enable** column.

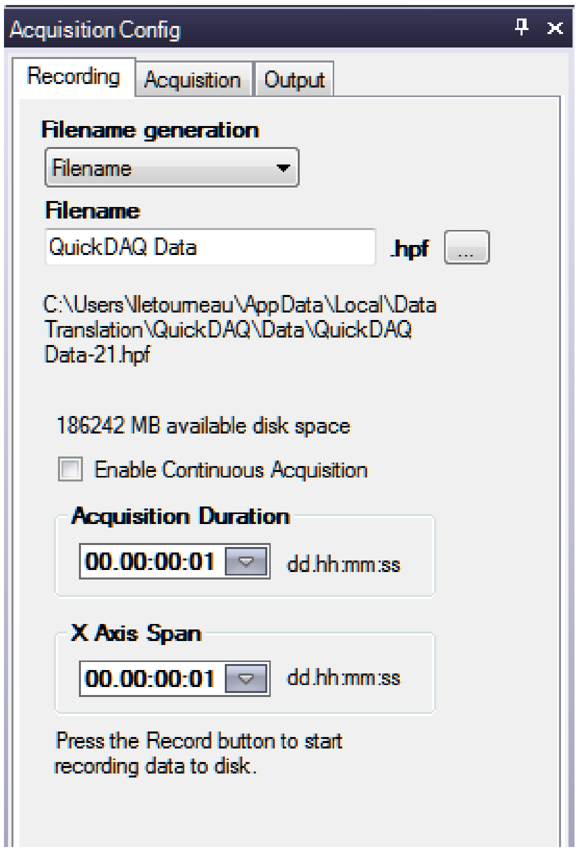


3. Leave the Channel Name, Engineering Unit, mV/EU, EU Offset, and Point# values unchanged for this example.
4. Click **Close** to close the Channel Configuration dialog box.

Configure the Parameters of the Acquisition Config Window

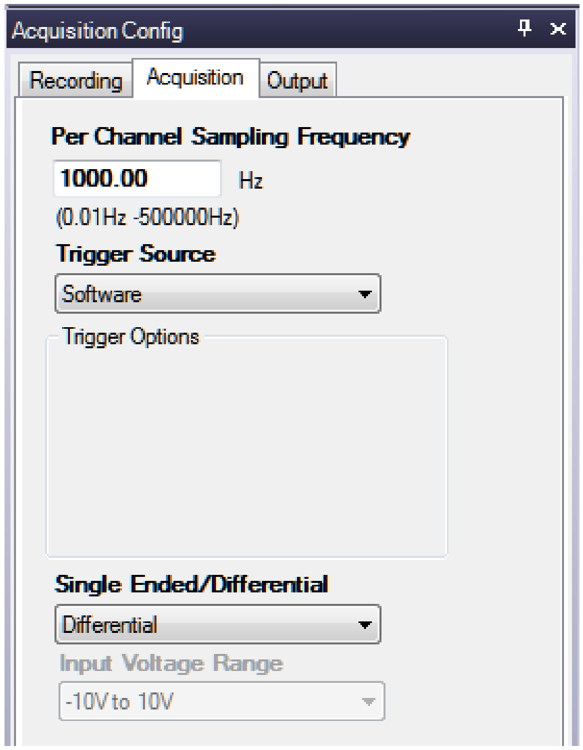
For this example, set the Acquisition Config parameters as follows:

1. Click the **Recording** tab.



2. For **Filename**, enter a meaningful name for the data file.
   *In this example, **QuickDAQ Data.hpf** is used.*
3. Leave the **Enable Continuous Acquisition** checkbox unchecked.
4. For **Acquisition Duration**, enter **01 seconds** as the time to acquire the measurement data.
   The amount of available disk space is shown; in addition, the number of scans in the Acquisition Info area is updated based on the acquisition duration that is selected.
5. For **X Axis Span**, enter **01 seconds** as the span for the x-axis.

6. Click the **Acquisition** tab.

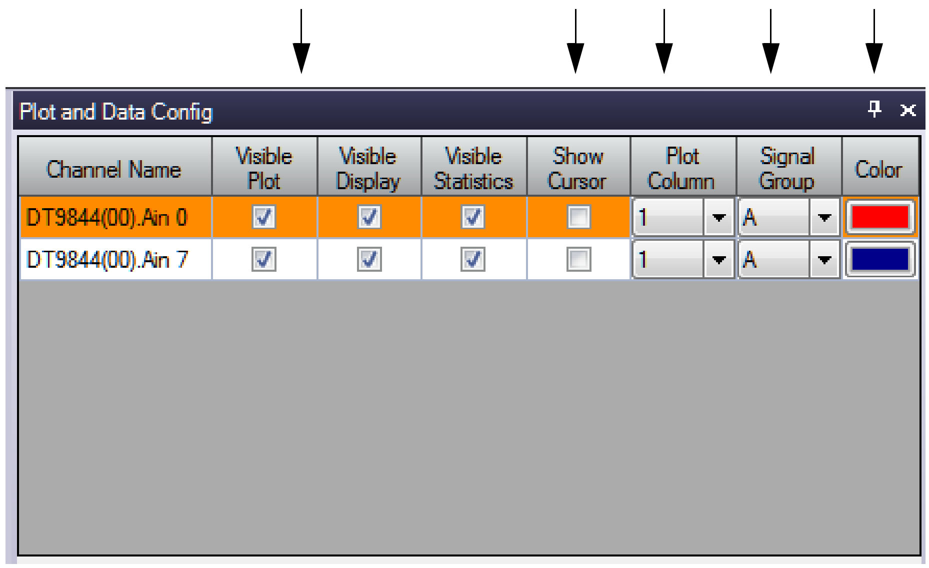


7. For this example, ensure that the following settings are used:
   – **Per Channel Sampling Frequency:** 1000 Hz
   – **Trigger Source:** Software
   – **Single Ended/Differential:** Differential
8. If desired, hide the **Acquisition Config** window by clicking the **Auto-Hide** pin ( ) in the top, right corner of the window.

Configure the Appearance of the Channel Plot Window

Configure the appearance of the Channel Plot window as follows:

1. In the **Plot and Data Config** window, set up the following parameters:
   - **a.** Ensure that the **Visible Plot column** is checked for both enabled channels.
   - **b.** Leave the **Show Cursor** column unchecked for both enabled channels.
   - **c.** Under **Plot Column**, use the default plot column setting of 1 for both enabled channels.
   - **d.** Under the **Signal Group** column, select **A** for both channels.
   - **e.** Under the **Color** column, assign a unique color to each trace.

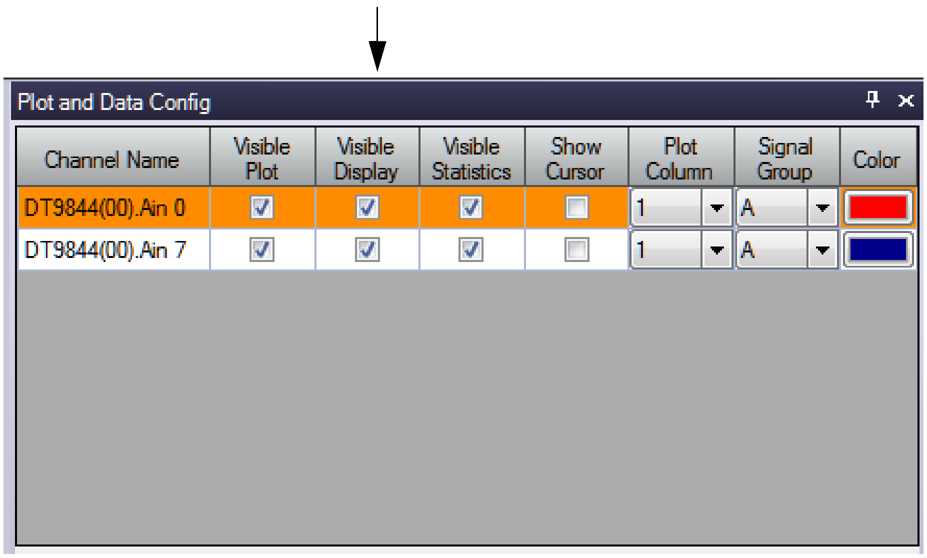


2. In the display area, click the tab for the **Channel Plot** window.
3. Change the text for the label on the x-axis, by doing the following:
   - **a.** Right-click on the label.
   - **b.** Select **Edit Label**.
   - **c.** Enter the following text: **Voltage Inputs Channels 0 and 7**.

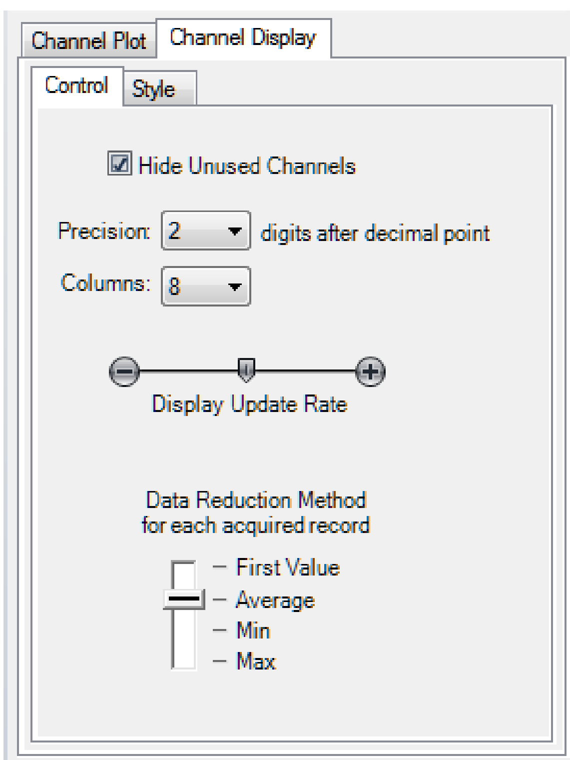
Configure the Appearance of the Channel Display Window

Configure the appearance of the Channel Display window as follows:

1. Ensure that the **Visible Display** column in the **Plot and Data Config** window is checked for both enabled channels.



2. Click the **Channel Display - Control** tab, and select the **Hide Unused Channels** checkbox so that only analog input channels 0 and 7 are displayed.

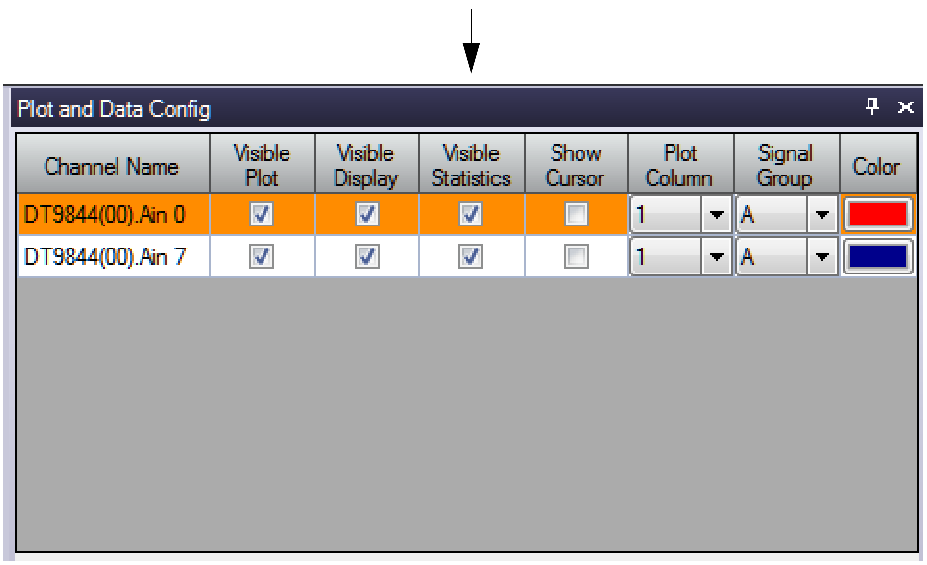


3. Leave the default values for the remaining parameters:
   – Precision = 2
   – Columns = 8
   – Display Update rate = middle of slider bar
4. For the Data Reduction Method, select **Average** so that the average value of the most recent buffer is displayed for each channel.

Configure the Appearance of the Statistics Window

Configure the appearance of the Statistics window as follows:

1. Ensure that the **Visible Statistics** column in the **Plot and Data Config** window is checked for both channels:



2. If desired, hide the **Plot and Data Config** window by clicking the **Auto-Hide** pin () in the top, right corner of the window.

Position the Windows

If you want see the data that is displayed in the Channel Display, Channel Plot, and Statistics windows at once, you need to move the windows to different locations in the display area.

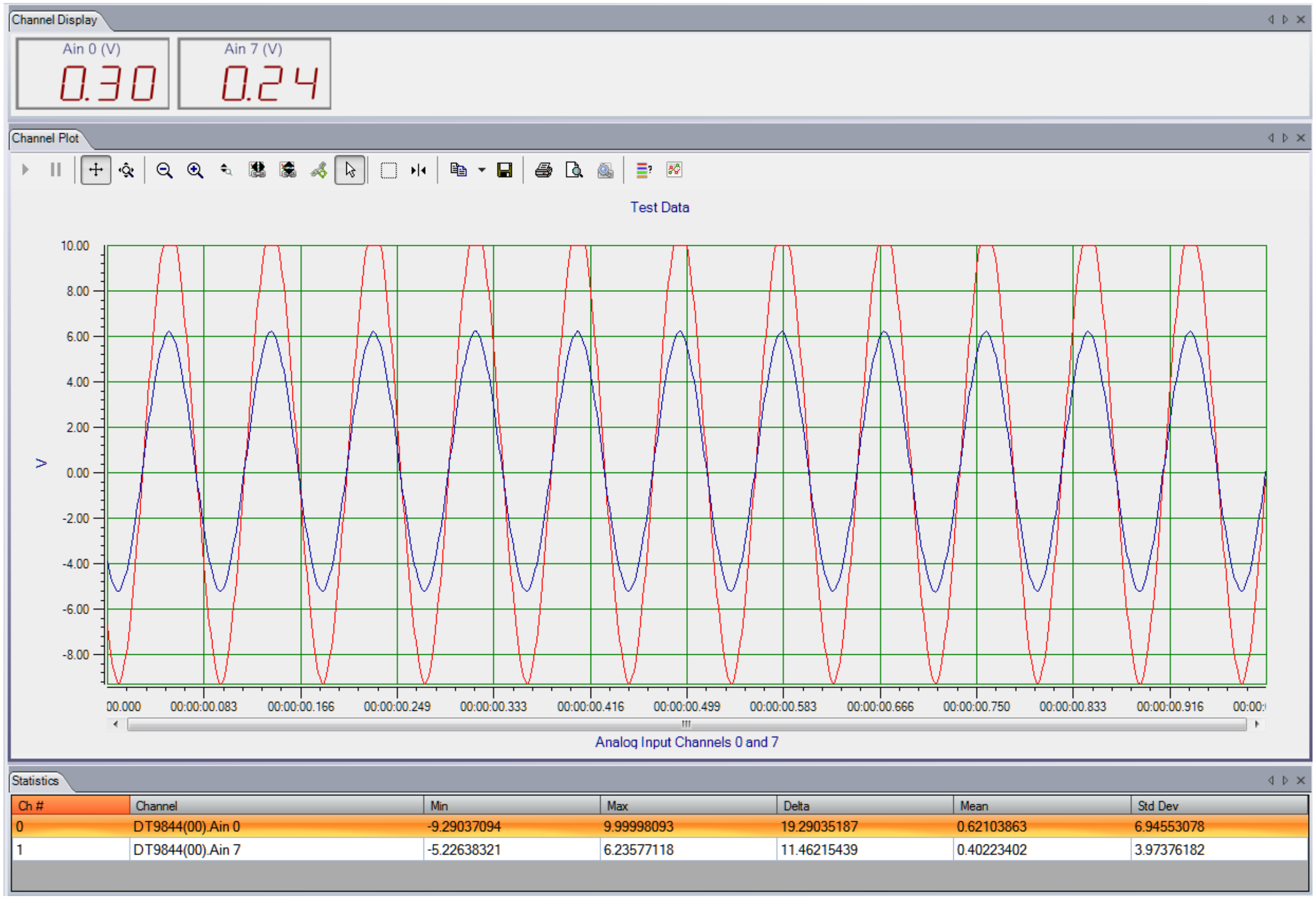
Perform the following steps to position the Channel Display window at the top of the display area, the Channel Plot window in the middle of the display area, and the Statistics window at the bottom of the display area:

1. Click the tab for the **Statistics** window, drag the window toward the middle of the display area, move the mouse over the guide on the bottom of the guide diamond, and then release the mouse button.
   The Statistics window is now placed at the bottom of the display area.
2. Click the tab for the **Channel Plot** window, drag the window toward the middle of the display area, move the mouse over the guide on the bottom of the guide diamond, and then release the mouse button.
   The Channel Plot window is now placed in the middle of the display area, revealing the Channel Display window at the top of the display area.
3. Resize each window, as desired.

Start the Measurement

Once you have configured the channels and the display area, start acquisition and log data to disk by clicking the **Record** toolbar button (

).
Results similar to the following are displayed in the display area.



If desired, you can view the data in Excel by clicking the **Open Current Data in Excel** toolbar button ().

Part 2: Using Your Module

5

Principles of Operation

Figure 22 shows a block diagram of the DT9844 module.

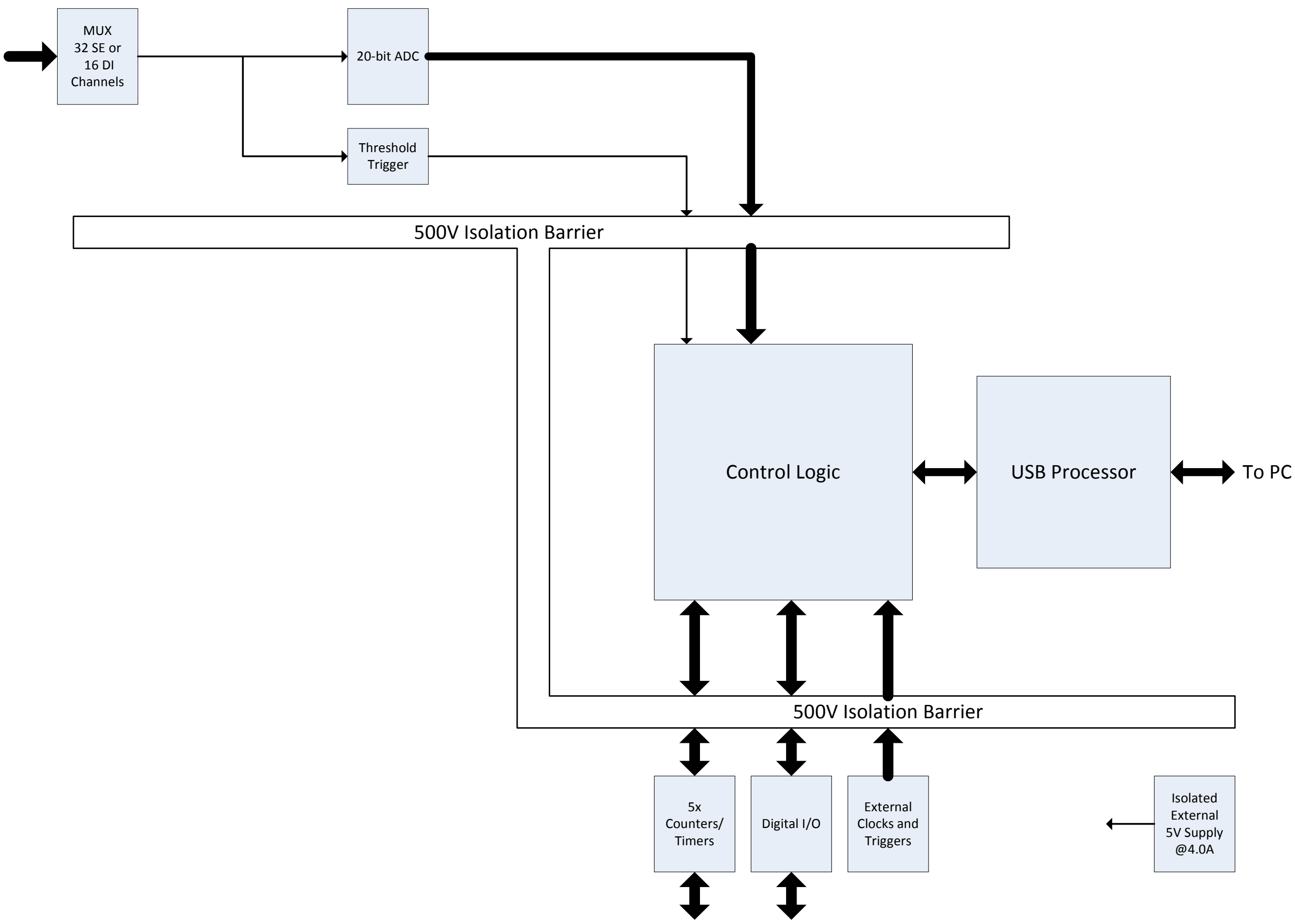


Figure 22: Block Diagram of the DT9844 Module

Analog Input Features

This section describes the following features of analog input (A/D) operations on the DT9844 module:

- Input resolution, described below
- Analog input channels, described on page 69
- Input range, described on page 73
- Input sample clock sources, described on page 73
- Analog input conversion modes, described on page 74
- Input triggers, described on page 79
- Data format and transfer, described on page 80
- Error conditions, described on page 81

Input Resolution

The input resolution of the DT9844 module is fixed at 20 bit; you cannot specify the resolution in software.

Analog Input Channels

The DT9844 module supports 32 single-ended/pseudo-differential channels (numbered 0 to 31) or 16 differential channels (numbered 0 to 15).

You can use the analog input channels in one of the following configurations:

- **Single-ended** – Single-ended channels are useful when you are measuring high-level signals, when noise is not significant, when the source of the input is close to the module, and when all the input signals are referred to the same common ground.
- **Pseudo-Differential** – Pseudo-differential channels are useful when noise or common-mode voltage (the difference between the ground potentials of the signal source and the ground of the screw terminal panel or between the grounds of other signals) exists and when the differential configuration is not suitable for your application. This option provides less noise rejection than the differential configuration; however, more analog input channels are available.
- **Differential** – Differential channels are useful when you want to measure low-level signals, when noise is a significant part of the signal, or when common-mode voltage exists.

You can configure the channel type as single-ended or differential through software.

Note: For pseudo-differential inputs, specify single-ended in software; in this case, how you wire these signals determines the configuration.

Using the Open Layers Control Panel applet, described on page 33, you can also select whether to use 10 kΩ termination resistance between the low side of each differential channel and isolated analog ground. This feature is particularly useful with floating signal sources. Refer to page 44 for more information about wiring to inputs and configuring the driver to use bias return termination resistance.

DT9844 modules can acquire data from a single analog input channel or from a group of analog input channels. The following subsections describe how to specify the channels.

Specifying a Single Analog Input Channel

The simplest way to acquire data from a single analog input channel is to specify the channel for a single-value analog input operation using software; refer to page 74 for more information about single-value operations.

You can also specify a single channel using the analog input channel list, described in the next section.

Specifying One or More Analog Input Channels

You can read data from one or more analog input channels using an analog input channel list. You can group the channels in the list sequentially (starting either with 0 or with any other analog input channel) or randomly. You can also specify a single channel or the same channel more than once in the list.

Using software, specify the channels in the order you want to sample them. You can enter up to 1,024 entries in the channel list. The channels are read in order (using continuously paced scan mode or triggered scan mode) from the first entry in the list to the last entry in the list. Refer to page 74 for more information about the supported conversion modes.

You can also use software to inhibit data collection from a specified entry in the channel list. This feature is useful if you want to discard acquired values from specific entries in the channel list. Using software, you can enable or disable inhibition for each entry in the channel list. If enabled, the value is discarded after the channel is read; if disabled, the value is not discarded after the channel is read.

Analog Threshold Trigger in Channel List

If you select an analog input channel as the analog threshold trigger source, the channel used for this trigger source must be the first channel specified in the channel list; refer to page 79 for more information about this trigger source.

Maximum Rate

The maximum rate at which the module can read the analog input channels depends on the total number of analog input channels, and/or counter/timer channels (see page 71) in the list, and whether or not you are reading the digital input port (see the next section).

If you are sampling only one channel, the maximum throughput rate of the analog input subsystem is 1 MSamples/s. If you are sampling more than one channel, the maximum throughput rate of the A/D subsystem is 640 kSamples/s. For example, if you want to read two channels at the maximum rate, the maximum throughput is 320 kSamples/s for each channel. Similarly, if you want to read four channels at the maximum rate, the maximum throughput is 160 kSamples/s.

Specifying the Digital Input Port in the Analog Input Channel List

The DT9844 module allows you to read the digital input port (all 16 or 32 digital input lines) using the analog input channel list. This feature is particularly useful when you want to correlate the timing of analog and digital events.

Note: To determine how many lines are in the digital port (16 or 32), specify the resolution of the digital input subsystem, as described on page 82.

To read the digital input port, specify channel 32 in the analog input channel list. You can enter channel 32 anywhere in the list, and you can enter it more than once, if desired.

The digital input port is treated like any other channel in the analog input channel list; therefore, all the clocking, triggering, and conversion modes supported for analog input channels are supported for the digital input port, if you specify them this way.

Specifying Counter/Timers in the Analog Input Channel List

On the DT9844, you can read the value of one or more of the five counter/timer channels using the analog input channel list. This feature is particularly useful when you want to correlate the timing of analog and counter/timer events.

To read a counter/timer channel, specify the appropriate channel number in the analog input channel list, as shown in Table 3. You can enter a channel number anywhere in the list, and you can enter it more than once, if desired. The 32-bit counter value is returned in a 32-bit word.

Table 3: Using Counter/Timers in Analog Input Channel List

Counter/Timer Channel	Channel to Specify in Channel List
C/T 0	Channel 33
C/T 1	Channel 34
C/T 2	Channel 35
C/T 3	Channel 36
C/T 4	Channel 37

For example, to read the value of C/T 0, specify channel 33 in the analog input channel list. To read the value of C/T 4, specify channel 37 in the analog input channel list.

The counter/timer channel is treated like any other channel in the analog input channel list; therefore, all the clocking, triggering, and conversion modes supported for analog input channels are supported for the counter/timers, if you specify them this way.

Performing Dynamic Digital Output Operations

Note: This feature is accessible using the DataAcq SDK. It is not supported in the DT-Open Layers for .NET Class Library.

Using software, you can enable a synchronous dynamic digital output operation for the analog input subsystem. This feature is particularly useful when you want to synchronize and control external equipment.

One dynamic digital output line is accessible through hardware. This line is set to a value of 0 on power up; a reset does not affect the value of the dynamic digital output line. Note that this line is provided in addition to the other 16 digital output lines; see page 82 for more information about the digital I/O features.

You specify the value (0 or 1) to write from the dynamic digital output line using the analog input channel list. A value of 0 indicates a low-level signal; a value of 1 indicates a high-level signal.

As each entry in the channel list is read, the corresponding value is output to the dynamic digital output line. For example, assume that dynamic digital output operations are enabled; that the channel list contains analog input channels 0, 1, 2, and 3; and that the channel list contains the dynamic digital output values 1, 0, 0, 1. Figure 23 shows this configuration.

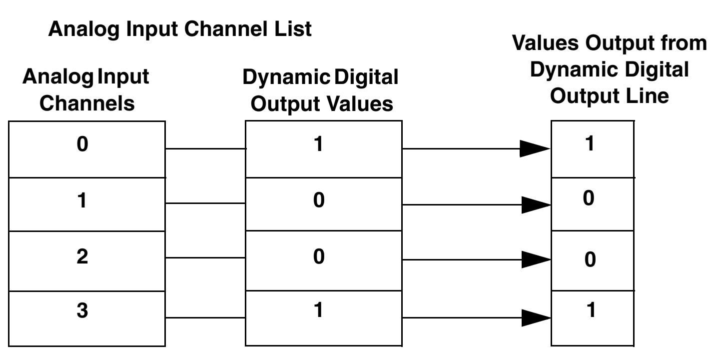


Figure 23: Example Using Dynamic Digital Outputs

As analog input channel 0 is read, a high-level signal is output to the dynamic digital output line. As analog input channels 1 and 2 are read, a low-level signal is output to the dynamic digital output line. As analog input channel 3 is read, a high-level signal is output to the dynamic digital output line.

Input Range

The DT9844 module supports an input range of ±10 V.

Through software, specify the range for the entire analog input subsystem as –10 V to +10 V, and the gain as 1.

Input Sample Clock Sources

The DT9844 module allows you to use one of the following clock sources to pace analog input operations:

- **Internal A/D clock –** Using software, specify the clock source as internal and the clock frequency at which to pace the operation. The minimum frequency supported is 0.0112 Hz; the maximum frequency supported is 1 MHz for a single channel or 640 kSamples/s for multiple channels. Conversions begin on the falling edge of the sample clock.

  Using software, specify the channels that you want to sample in the channel list, and then set the desired sampling frequency. The software sets the sampling frequency to the closest possible value. You can use software to return the actual frequency that is used.

  Note: In QuickDAQ, you specify the per channel sampling frequency. In the DT-Open Layers Class Library and the Data Acq SDK, you specify the aggregate (total) sampling frequency.

  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. Doing so avoids an error condition called *aliasing*, in which high frequency input components erroneously appear as lower frequencies after sampling.

  The per channel sample rate depends on the total throughput rate and the number of channels in the channel list. You can determine the data rate per channel as follows:

$$DataRatePerChannel = \frac{ThroughputRate}{NumberOfChannels}$$

  For example, to sample 8 analog input channels at the maximum rate, the data rate per channel is 640 kSamples/s divided by 8, or 80 kSamples/s. To sample 16 analog input channels at the maximum rate, the data rate per channel is 640 kSamples/s divided by 16, or 40 kSamples/s. To sample 32 analog input channels at the maximum rate, the data rate per channel is 640 kSamples/s divided by 32, or 20 kSamples/s.

Note: The driver will allow you to sample multiple channels at the maximum rate of 1 MSample/s, but the accuracy specifications are not guaranteed at rates above 640 kSamples/s for multiple channels.

The sample clock frequency is derived from the 48 MHz reference clock that is used by the A/D. The specified sampling frequency may not be achieved exactly. You can use software to determine the actual sampling frequency that the module could achieve.

- **External A/D clock –** An external A/D clock is useful when you want to pace acquisitions at rates not available with the internal A/D clock, when you want to pace at uneven intervals, or when you want to synchronize conversions with an external system.

  Connect an external A/D clock to the External ADC Clock input signal on the DT9844 module. Conversions start on the falling edge of the external A/D clock input signal.

  Using software, specify the clock source as external. The clock frequency is always equal to the frequency of the external A/D sample clock input signal that you connect to the module.

Note: If you specify channel 32 (the digital input port) and/or channels 33 through 37 (the counter/timer channels) in the channel list, the input sample clock (internal or external) also paces the acquisition of the digital input port and/or counter/timer channels.

Analog Input Conversion Modes

DT9844 modules support the following conversion modes:

- **Single-value operations** are the simplest to use. Using software, you specify the range, gain, and analog input channel. The module acquires the data from the specified channel and returns the data immediately. For a single-value operation, you cannot specify a clock source, trigger source, scan mode, or buffer.

  Single-value operations stop automatically when finished; you cannot stop a single-value operation.

- **Scan mode** takes full advantage of the capabilities of the DT9844 module. Two scan modes are supported: continuous scan mode and triggered scan mode (often called burst mode). These modes are described in the following subsections.

Continuous Scan Mode

Use continuous scan mode if you want to accurately control the period between conversions of individual channels in a scan. In this mode, you specify a channel list, clock source and frequency, start trigger, and buffer using software. Optionally, you can also specify a reference trigger and post-trigger scan count.

When it detects the start trigger, the module cycles through the channel list, acquiring data for each entry in the list.

If a reference trigger is not specified, data that is acquired after the start trigger is post-trigger data. The sampled data is placed in the allocated buffer(s). Refer to page 80 for more information about buffers. The operation continues until you stop it or until no more buffers are available.

If a reference trigger is specified, data that is acquired after the start trigger is pre-trigger data; when the reference trigger occurs, pre-trigger data acquisition stops and post-trigger acquisition starts at the next scan. The sampled data is placed in the allocated buffer(s). The operation continues until the number of scans that you specify for the post-trigger scan count have been acquired; at the point, the operation stops. Note that the scan at which the reference trigger occurs is not counted as a post-trigger scan. Refer to page 79 for more information about start and reference triggers.

The sample rate, which is the rate at which a single entry in the channel list is sampled, is determined by the frequency of the input sample clock divided by the number of entries in the channel list. Refer to page 73 for more information about the input sample clock.

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

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

- Specify the data flow as Continuous
- Specify the clock source as internal and specify the clock frequency (refer to page 73)
- Specify the start trigger; if you are using a reference trigger, the start trigger must be a software trigger (refer to page 79)
- If desired, specify the reference trigger as a TTL positive or TTL negative trigger (refer to page 80)
- Specify the post-trigger scan count (the number of post-trigger scans to perform after the reference trigger occurs)

Note: Because the channels on this module are multiplexed, the post-trigger scan count determines the number of scans per channel rather than the number of samples per channel to acquire after the reference trigger occurs.

Figure 24 illustrates continuous scan mode (using a start and reference trigger) with a channel list of three entries: channel 0, channel 1, and channel 2. In this example, pre-trigger input data is acquired when the start trigger is detected. When the reference trigger occurs, the specified number of post-trigger scans are acquired.

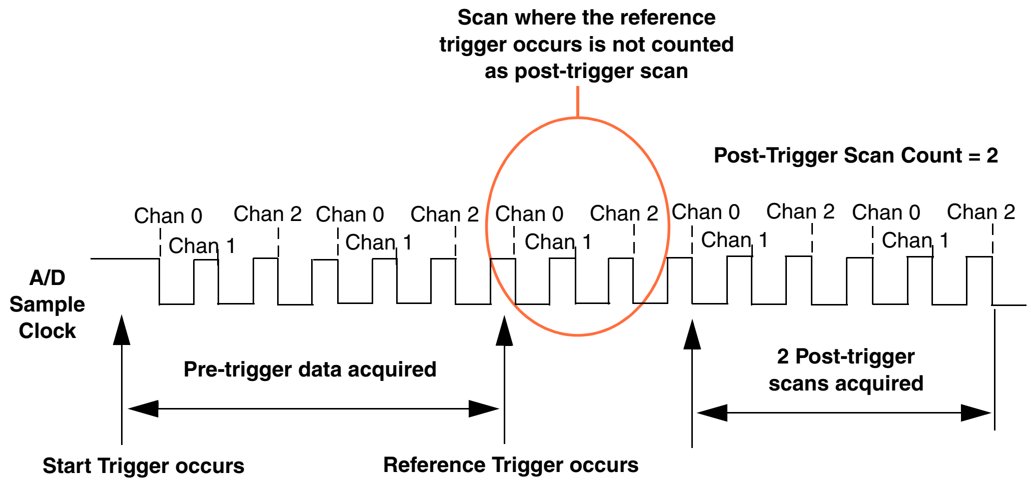


Figure 24: Continuous Scan Mode on a DT9844 Module Using a Start and Reference Trigger

Triggered Scan Mode

The DT9844 module supports two triggered scan modes: software retriggered and externally retriggered. These modes are described in the following subsections.

Note that triggered scan mode does not support a reference trigger. Therefore, in triggered scan mode, the start trigger starts post-trigger acquisition.

Software-Retriggered Scan Mode

Use software-retriggered scan mode if you want to accurately control both the period between conversions of individual channels in a scan and the period between each scan. This mode is useful when synchronizing or controlling external equipment, or when acquiring a buffer of data on each trigger or retrigger. Using this mode, you can acquire up to 262,144 samples per retrigger (256 times per trigger or retrigger x 1024-location channel list).

In software-retriggered scan mode, the module first waits for the start trigger to occur. When it detects the start trigger, the module scans the analog input channel list a specified number of times (up to 256), and then waits for a software retrigger to occur. When it detects a software retrigger, the module scans the channel list the specified number of times, and then waits for another software retrigger to occur.

The sample rate is determined by the frequency of the input sample clock divided by the number of entries in the channel list; refer to page 73 for more information about the input sample clock. The conversion rate of each scan is determined by the frequency of the retrigger clock on the module. The minimum frequency supported is 0.0112 Hz; the maximum frequency supported is 500 kHz.

Specify the frequency of the retrigger clock as follows:

$$MinRetriggerPeriod = \frac{NumberOfCGLEntries \times CGLsPerTrigger}{InputSampleClockFrequency} + 2\mu s$$

$$MaxRetriggerFrequency = \frac{1}{MinRetriggerPeriod}$$

For example, if you are using 512 channels in the channel list, scanning the channel list 256 times every start trigger or retrigger, and using an A/D sample clock with a frequency of 1 MHz, set the maximum retrigger frequency to 7.5147 Hz, since

$$7.5147Hz = \frac{1}{\left(\frac{512 \times 256}{1MHz}\right) + 2\mu s}$$

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

- Dataflow as Continuous
- Triggered scan mode as Enabled
- The start trigger source as any of the supported start trigger sources (see page 79)
- The retrigger source as Software
- The number of times to scan per trigger or retrigger (also called the multiscan count)
- The maximum frequency of the retrigger clock

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

Externally-Retriggered Scan Mode

Use externally-retriggered scan mode if you want to accurately control the period between conversions of individual channels and retrigger the scan based on an external event. Using this mode, you can acquire up to 262,144 samples per retrigger (256 times per trigger or retrigger x 1024-location channel list).

In externally-retriggered scan mode, the module waits for the start trigger to occur. When it detects the start trigger, the module scans the channel list up to 256 times, and then waits for an external retrigger to occur. When the retrigger occurs, the module scans the channel list the specified number of times, and then waits for another retrigger to occur.

The retrigger source depends on the start trigger that is specified. If the start trigger is configured as a software trigger, the retrigger source can be an external TTL trigger (positive or negative) or an analog threshold trigger (positive). If the start trigger is configured as a TTL trigger, the retrigger source must be a TTL trigger of the same polarity as the start trigger. If the start trigger source is configured as an analog threshold trigger, only a software retrigger is supported (see page 76 for more information on this mode).

The conversion rate of each channel is determined by the frequency of the input sample clock; refer to page 73 for more information about the input sample clock. The conversion rate of each scan is determined by the period between external retriggers; therefore, it cannot be accurately controlled. The module ignores external triggers that occur while it is acquiring data. Only external retrigger events that occur when the module is waiting for a retrigger are detected and acted on.

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

- Dataflow as Continuous
- Triggered scan mode as Enabled
- The start trigger as any of the supported trigger sources (see page 79)
- The retrigger source depends on the start trigger that is specified, as shown below:

Table 4: Supported Retrigger Sources

If Start Trigger[a] is...	Configure the Retrigger Source as...
Software	External positive TTL trigger, External negative TTL trigger, or Analog threshold trigger (positive)
External positive TTL trigger	External positive TTL trigger
External negative TTL trigger	External negative TTL trigger

a. If the start trigger is configured as an analog threshold trigger, only software-retriggered scan mode is supported. Refer to page 76 for more information on this mode.

- The number of times to scan per trigger or retrigger (also called the multiscan count)

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

Input Triggers

A trigger is an event that occurs based on a specified set of conditions.

If you are using continuous scan mode, described on page 75, you must specify a start trigger to start acquisition. If you want to acquire pre-trigger and post-trigger data, you must also specify a reference trigger. In this case, pre-trigger data is acquired when the start trigger occurs. When the reference trigger occurs, pre-trigger acquisition stops and post-trigger acquisition starts. The operation continues until the number of scans that you specify for the post-trigger scan count are acquired; at the point, the operation stops.

If you are using triggered scan mode, you must specify a start trigger to start post-trigger acquisition and a retrigger source to retrigger the scan. The reference trigger is not used in this mode. Refer to page 76 for detailed information on triggered scan mode and the supported retrigger sources.

The available sources for the start trigger and reference trigger are described in the following sections.

Start Trigger Sources

The DT9844 module supports the following sources for the start trigger:

- **Software trigger –** A software trigger event occurs when you start the analog input operation (the computer issues a write to the module to begin conversions). Using software, specify the trigger source as a software trigger.

Note: If you want to use a reference trigger, you must configure the start trigger as a software trigger.

- **External digital (TTL) trigger –** An external digital (TTL) trigger event occurs when the DT9844 module detects a transition (rising-edge or falling-edge) on the External ADC Trigger input signal connected to the module. Using software, specify the trigger source as an external, positive digital (TTL) trigger for a rising-edge digital trigger, or an external, negative digital (TTL) trigger for a falling-edge digital trigger.

- **Analog threshold trigger** – The start trigger event occurs when the signal attached to a specified analog input channel rises above or falls below a user-specified threshold value. Using software, specify the following parameters:
  - Start trigger source – For the DT9844 module, you can specify a positive (low-to-high transition) threshold trigger; the trigger occurs when the signal rises above a specified threshold level
  - Threshold channel – Specify any one of the analog input channels as the threshold input channel. However, this channel must be the first channel in the channel list.
  - Threshold level – Specify a value between 0 V and +10 V as the threshold level.

Note: For compatibility with the DT9834, you can also program the threshold trigger through the D/A subsystem, where a value of 0 equals 0 V and a value of 255 equals +10 V.

Reference Trigger Sources

The DT9844 module supports the external digital TTL trigger as the reference trigger. An external digital (TTL) trigger event occurs when the DT9844 module detects a transition (rising-edge or falling-edge) on the External ADC Trigger input signal connected to the module. Using software, specify the trigger source as an external, positive digital (TTL) trigger for a rising-edge digital trigger, or an external, negative digital (TTL) trigger for a falling-edge digital trigger.

Note: The reference trigger is supported only if the start trigger is configured as a software trigger.

Data Format and Transfer

The DT9844 module uses offset binary data encoding, where 00000 represents negative full-scale, and FFFFFh represents positive full-scale. Use software to specify the data encoding as binary.

The ADC outputs FFFFFh for above-range signals, and 00000 for below-range signals.

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

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

Error Conditions

The DT9844 module can report an error if one of the following conditions occurs:

- **A/D Over Sample –** The A/D sample clock rate is too fast. This error is reported if a new A/D sample clock pulse occurs while the ADC is busy performing a conversion from the previous A/D sample clock pulse. The host computer can clear this error. To avoid this error, use a slower sampling rate.
- **Input FIFO Overflow –** The analog input data is not being transferred fast enough to the host computer. The host computer can clear this error, but the error will continue to be generated if the Input FIFO, which can hold 4 kSamples, is still full. To avoid this error, close other applications that may be running while you are acquiring data. If this has no effect, try using a computer with a faster processor or reduce the sampling rate.

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

Digital I/O Features

This section describes the following features of digital I/O operations:

- Digital I/O lines
- Digital I/O resolution
- Operation modes

Digital I/O Lines

The DT9844 module supports one digital input port and one digital output port. Depending on the resolution of the digital input subsystem, you can have a 16 digital input lines and 16 digital output lines, or 32 digital input lines and 0 digital output lines.

Note: Programmable resolution for the digital inputs is supported on revision 5 or greater of the DT9844-32-STP or revision 4 or greater of the DT9844-32-OEM. On previous revisions, the digital input resolution was fixed at 16.

A digital line is high if its value is 1; a digital line is low if its value is 0. On power up or reset, a low value (0) is output from each of the digital output lines and a high value (1) is read from each of the digital input lines if the lines are not connected.

Digital I/O Resolution

You can configure the digital input subsystem (element 0) to use a resolution of 16 if you want to use 16 digital input lines (numbered 0 to 15), or 32 (the default value) if you want to use 32 digital input lines (numbered 0 to 31).

If the digital input subsystem is configured for a resolution of 16, the digital output subsystem also uses a resolution of 16 to provide 16 digital output lines (numbered 0 to 15). If you configure the digital input subsystem for a resolution of 32, no digital output lines are available; writing a digital output value to the digital output port in this case will have no affect.

Operation Modes

The DT9844 module supports the following digital I/O operation modes:

- **Single-value operations** are the simplest to use but offer the least flexibility and efficiency. You use software to specify the digital I/O port and a gain of 1 (the gain is ignored). Data is then read from or written to all the digital I/O lines of the specified port. For a single-value operation, you cannot specify a clock or trigger source.

  Single-value operations stop automatically when finished; you cannot stop a single-value operation.

- **Continuous digital input** takes full advantage of the capabilities of the DT9844 module. Using this mode, you can synchronize digital input and analog input measurements. Enter the digital input port as channel 32 in the analog input channel list; refer to page 71 for more information. You can specify a clock source, scan mode, trigger source, buffer, and buffer wrap mode for the operation. The input sample clock (internal or external) paces the reading of the digital input port (as well as the acquisition of the analog input and counter/timer channels).
- **Interrupt-on-change operations** – You can use the Open Layers Control Panel applet to select any of the first eight digital input lines to perform interrupt-on-change operations; refer to page 33 for more information.

  When any one of the specified digital input lines changes state, the module reads the entire digital input value and generates an interrupt. Using software, you can determine which digital input lines change state and the current value of the digital input port.

Note: If you are using the DataAcq SDK to perform a continuous digital input operation, use the *lParam* parameter of the **olDaSetWndHandle** or **olDaSetNotificationProcedure** function to determine which digital input line changed state and the status of the digital input port when the interrupt occurred.

The low byte of the first word of *lParam* contains the state of the digital input subsystem, where bit 0 corresponds to digital input line 0 and bit 7 corresponds to digital input line 7.

The high byte of the first word of *lParam* contains the digital lines (bits) that changed state causing the interrupt to occur, where bit 8 corresponds to digital input line 0 and bit 15 corresponds to digital input line 7.

- **Dynamic digital output** is useful for synchronizing and controlling external equipment and allows you to output data to the dynamic digital output line each time an analog input value is acquired. The dynamic digital output line is in addition to the 16 digital output lines. This mode is supported by the DataAcq SDK (not by the DT-Open Layers for .NET Class Library) and is programmed through the analog input subsystem; refer to page 72 for more information.

Counter/Timer Features

This section describes the following features of counter/timer (C/T) operations:

- C/T channels, described below
- C/T clock sources, described on page 85
- Gate types, described on page 85
- Pulse types and duty cycles, described on page 86
- C/T operation modes, described on page 86

C/T Channels

The DT9844 module provides five 32-bit counter/timers. The counters are numbered 0, 1, 2, 3, and 4. Each counter accepts a clock input signal and gate input signal and outputs a pulse (pulse output signal), as shown in Figure 25.

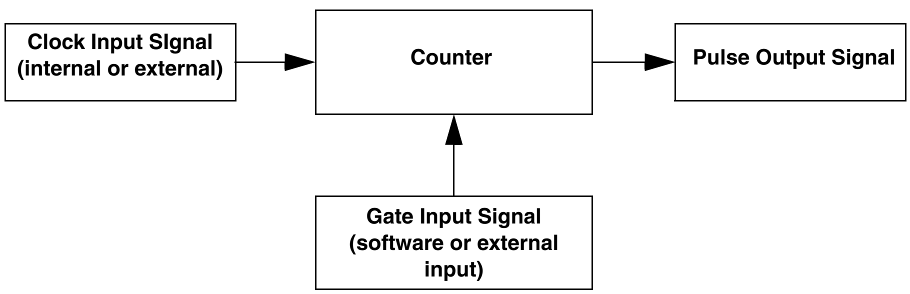


Figure 25: Counter/Timer Channel

To specify the counter/timer to use in software, specify the appropriate C/T subsystem. For example, counter/timer 0 corresponds to C/T subsystem element 0; counter/timer 3 corresponds to C/T subsystem element 3.

Using software, you can also specify one or more of the counter/timers in the analog input channel list. Refer to page 71 for more information about using C/Ts in the channel list.

C/T Clock Sources

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

- **Internal C/T clock** – The internal C/T clock always uses an 48 MHz time base. Through software, specify the clock source as internal, and specify the frequency at which to pace the operation (this is the frequency of the Counter *n* Out signal).
- **External C/T clock** – An external C/T clock is useful when you want to pace counter/timer operations at rates not available with the internal C/T clock or if you want to pace at uneven intervals. The frequency of the external C/T clock can range from 0.0112 Hz to 24 MHz. Note, however, that the integrity of the signal degrades at frequencies greater than 10 MHz.

  Connect the external clock to the Counter *n* Clock input signal on the DT9844 module. Counter/timer operations start on the rising edge of the clock input signal.

  Using software, specify the clock source as external and specify a clock divider between 2 and 4,924,967,296. Internally, the base frequency of C/T clock, which is 48 MHz, is divided by the specified clock divider to program the frequency of the external C/T clock.

Note: The external C/T clock (the clock connected to the Counter *n* Clock input signal) determines how often you want to count events, measure frequency, or measure the time interval between edges.

If you specify a counter/timer in the analog input channel list, the external A/D clock (the clock connected to the External ADC Clock input signal) determines how often you want to read the counter value. Refer to page 73 for more information about the external A/D clock.

Gate Types

The edge or level of the Counter *n* Gate signal determines when a counter/timer operation is enabled. The DT9844 module provides the following gate types:

- **None** – A software command enables any counter/timer operation immediately after execution.
- **Logic-low level external gate input** – Enables a counter/timer operation when the Counter *n* Gate signal is low, and disables the counter/timer operation when the Counter *n* Gate signal is high. Note that this gate type is used for event counting and rate generation modes; refer to page 86 for more information about these modes.
- **Logic-high level external gate input** – Enables a counter/timer operation when the Counter *n* Gate signal is high, and disables a counter/timer operation when the Counter *n* Gate signal is low. Note that this gate type is used for event counting and rate generation modes; refer to page 86 for more information about these modes.
- **Falling-edge external gate input** – Enables a counter/timer operation when a high-to-low transition is detected on the Counter *n* Gate signal. In software, this is called a low-edge gate type. Note that this gate type is used for edge-to-edge measurement, one-shot, and repetitive one-shot mode; refer to page 86 for more information about these modes.

- **Rising-edge external gate input –** Enables a counter/timer operation when a low-to-high transition is detected on the Counter *n* Gate signal. In software, this is called a high-edge gate type. Note that this gate type is used for edge-to-edge measurement, one-shot, and repetitive one-shot mode; refer to page 86 for more information about these modes.

Specify the gate type in software.

Pulse Output Types and Duty Cycles

The DT9844 module can output the following types of pulses from each counter/timer:

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

You specify the pulse output type in software.

The duty cycle (or pulse width) indicates the percentage of the total pulse output period that is active. For example, a duty cycle of 50 indicates that half of the total pulse output is low and half of the total pulse output is high. You specify the duty cycle in software.

Figure 26 illustrates a low-to-high pulse with a duty cycle of approximately 30%.

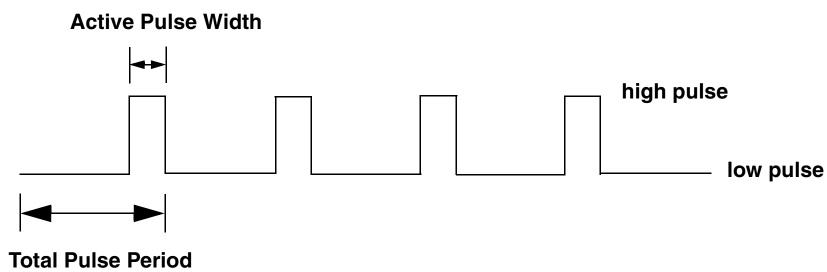


Figure 26: Example of a Low-to-High Pulse Output Type

Counter/Timer Operation Modes

DT9844 modules support the following counter/timer operation modes:

- Event counting
- Up/down counting
- Frequency measurement
- Edge-to-edge measurement
- Continuous edge-to-edge measurement
- Rate generation

- One-shot
- Repetitive one-shot

Note: The active polarity for each counter/timer operation mode is software-selectable.

Event Counting

Use event counting mode if you want to count the number of rising edges that occur on the Counter *n* Clock input when the Counter *n* Gate signal is active (low-level or high-level). Refer to page 85 for information about specifying the active gate type.

You can count a maximum of 4,294,967,296 events before the counter rolls over to 0 and starts counting again.

Using software, specify the counter/timer mode as event counting (count), the C/T clock source as external, and the active gate type as low-level or high-level.

Make sure that the signals are wired appropriately. Refer to page 48 for an example of connecting an event counting application.

Up/Down Counting

Use up/down counting mode if you want to increment or decrement the number of rising edges that occur on the Counter *n* Clock input, depending on the level of the Counter *n* Gate signal.

If the Counter *n* Gate signal is high, the C/T increments; if the specified gate signal is low, the C/T decrements.

Using software, specify the counter/timer mode as up/down counting (up/down), and the C/T clock source as external. Note that you do not specify the gate type in software.

Make sure that the signals are wired appropriately. Refer to page 49 for an example of connecting an up/down counting application.

Note: Initialize the counter/timer so that the C/T never increments above FFFFFFFFh or decrements below 0.

Frequency Measurement

Use frequency measurement mode if you want to measure the number of rising edges that occur on the Counter *n* Clock input over a specified duration.

You can connect a pulse of a known duration (such as a one-shot output of another user counter) to the Counter *n* Gate input signal. Use software to set up the counter/timers as follows:

1. Set up one of the counter/timers for one-shot mode, specifying the clock source as internal, the clock frequency, the gate type that enables the operation as rising edge or falling edge, and the polarity of the output pulse as high-to-low transition or low-to-high transition of the output pulse.
2. Set up the counter/timer that will measure the frequency for event counting mode, specifying the type of clock pulses to count and the gate type (this should match the pulse output type of the counter/timer set up for one-shot mode).
3. Start both counters (pulses are not counted until the active period of the one-shot pulse is generated).
4. Read the number of pulses counted. (Allow enough time to ensure that the active period of the one-shot occurred and that events have been counted.)
5. Determine the measurement period using the following equation:

$$MeasurementPeriod = \frac{1}{ClockFrequency} \times ActivePulseWidth$$

6. Determine the frequency of the clock input signal using the following equation:

$$FrequencyMeasurement = \frac{NumberofEvents}{MeasurementPeriod}$$

Edge-to-Edge Measurement

Use edge-to-edge measurement mode if you want to measure the time interval between a specified start edge and a specified stop edge.

The start edge and the stop edge can occur on the rising edge of the Counter *n* Gate input, the falling edge of the Counter *n* Gate input, the rising edge of the Counter *n* Clock input, or the falling edge of the Counter *n* Clock input. When the start edge is detected, the counter/timer starts incrementing, and continues incrementing until the stop edge is detected. The C/T then stops incrementing until it is enabled to start another measurement. When the operation is complete, you can read the value of the counter.

You can use edge-to-edge measurement to measure the following:

- Pulse width of a signal pulse (the amount of time that a signal pulse is in a high or a low state, or the amount of time between a rising edge and a falling edge or between a falling edge and a rising edge). You can calculate the pulse width as follows:
  - Pulse width = Number of counts/48 MHz
- Period of a signal pulse (the time between two occurrences of the same edge - rising edge to rising edge or falling edge to falling edge). You can calculate the period as follows:
  - Period = 1/Frequency
  - Period = Number of counts/48 MHz
- Frequency of a signal pulse (the number of periods per second). You can calculate the frequency as follows:
  - Frequency = 48 MHz/Number of Counts

Using software, specify the counter/timer mode as edge-to-edge measurement mode (measure), the C/T clock source as internal, the start edge type, and the stop edge type.

Make sure that the signals are wired appropriately. Refer to page 51 for an example of connecting an edge-to-edge measurement application.

Continuous Edge-to-Edge Measurement

In continuous edge-to-edge measurement mode, the counter starts incrementing when it detects the specified start edge. When it detects the next start edge type, the value of the counter is stored and the next edge-to-edge measurement operation begins automatically.

Every time an edge-to-edge measurement operation completes, the previous measurement is overwritten with the new value. When you read the counter as part of the analog input data stream, the current value (from the last edge-to-edge measurement operation) is returned and the value of the counter is reset to 0. Refer to page 88 for more information on edge-to-edge measurement mode.

Note: If you read the counter before the measurement is complete, 0 is returned.

To select continuous edge-to-edge measurement mode, use software to specify the counter/timer mode as continuous measure, the C/T clock source as internal, and the start edge type.

Rate Generation

Use rate generation mode to generate a continuous pulse output signal from the Counter *n* Out line; this mode is sometimes referred to as continuous pulse output or pulse train output. You can use this pulse output signal as an external clock to pace other operations, such as analog input, analog output, or other counter/timer operations.

The pulse output operation is enabled whenever the Counter *n* Gate signal is at the specified level. While the pulse output operation is enabled, the counter outputs a pulse of the specified type and frequency continuously. As soon as the operation is disabled, rate generation stops.

The period of the output pulse is determined by the C/T clock source (either internal using a clock divider, or external). You can output pulses using a maximum frequency of 24 MHz (this is the frequency of the Counter *n* Out signal). Refer to page 85 for more information about the C/T clock sources.

Using software, specify the counter/timer mode as rate generation (rate), the C/T clock source as either internal or external, the clock divider (for an internal clock), the polarity of the output pulses (high-to-low transition or low-to-high transition), the duty cycle of the output pulses, and the active gate type (low-level or high-level). Refer to page 86 for more information about pulse output signals and to page 85 for more information about gate types.

Make sure that the signals are wired appropriately. Refer to page 52 for an example of connecting a rate generation application.

One-Shot

Use one-shot mode to generate a single pulse output signal from the Counter *n* Out line when the specified edge is detected on the Counter *n* Gate signal. You can use this pulse output signal as an external digital (TTL) trigger to start other operations, such as analog input or analog output operations.

After the single pulse is output, the one-shot operation stops. All subsequent clock input signals and gate input signals are ignored.

The period of the output pulse is determined by the C/T clock source (either internal using a clock divider, or external). Note that in one-shot mode, the internal C/T clock is more useful than an external C/T clock; refer to page 85 for more information about the C/T clock sources.

Using software, specify the counter/timer mode as one-shot, the clock source as internal (recommended), the clock divider, the polarity of the output pulse (high-to-low transition or low-to-high transition), and the active gate type (rising edge or falling edge). Refer to page 86 for more information about pulse output types and to page 85 for more information about gate types.

Note: In the case of a one-shot operation, a duty cycle of 100% is set automatically.

Make sure that the signals are wired appropriately. Refer to page 52 for an example of connecting a one-shot application.

Repetitive One-Shot

Use repetitive one-shot mode to generate a pulse output signal from the Counter *n* Out line whenever the specified edge is detected on the Counter *n* Gate signal. You can use this mode to clean up a poor clock input signal by changing its pulse width, and then outputting it.

The module continues to output pulses until you stop the operation. Note that any Counter *n* Gate signals that occur while the pulse is being output are not detected by the module.

The period of the output pulse is determined by the C/T clock source (either internal using a clock divider, or external). Note that in repetitive one-shot mode, the internal C/T clock is more useful than an external clock; refer to page 85 for more information about the C/T clock sources.

Using software, specify the counter/timer mode as repetitive one-shot, the polarity of the output pulses (high-to-low transition or low-to-high transition), the C/T clock source as internal (recommended), the clock divider, and the active gate type (rising edge or falling edge). Refer to page 86 for more information about pulse output types and to page 85 for more information about gates.

Note: In the case of a repetitive one-shot operation, a duty cycle of 100% is set automatically.

Make sure that the signals are wired appropriately. Refer to page 52 for an example of connecting a repetitive one-shot application.

6

Supported Device Driver Capabilities

The DT9844 Device Driver provides support for the analog input (A/D), analog output (D/A), digital input (DIN), digital output (DOUT), and counter/timer (C/T) subsystems. For information on how to configure the device driver, refer to Chapter 2.

Table 5: DT9844 Subsystems

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Total Subsystems on Module	1	1[a]	1	1	5	0	0

a. The D/A subsystem (element 0) is used for the analog input threshold trigger (see page 79). The subsystem has a resolution of 8-bits and a range of 0 to 255, where 0 equals 0 V and 255 equals +10 V.

The tables in this chapter summarize the features available for use with the DT-Open Layers for .NET Class Library and the DT9844 module. The DT-Open Layers for .NET Class Library provides properties that return support information for specified subsystem capabilities.

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

Note: The following tables include the capabilities that can be queried. However, some capabilities may not be supported by your device. Blank fields represent unsupported options.

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

Data Flow and Operation Options

Table 6: Data Flow and Operation Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Single-Value Operation Support **SupportsSingleValue**	Yes		Yes	Yes			
Simultaneous Single-Value Output Operations **SupportsSetSingleValues**							
Continuous Operation Support **SupportsContinuous**	Yes		Yes[a]	Yes	Yes[b]		
Continuous Operation until Trigger **SupportsContinuousPreTrigger**							
Continuous Operation before & after Trigger **SupportsContinuousPrePostTrigger**							
Waveform Operations Using FIFO Only **SupportsWaveformModeOnly**							
Simultaneous Start List Support **SupportsSimultaneousStart**							
Supports Programmable Synchronization Modes **SupportsSynchronization**							
Synchronization Modes **SynchronizationMode**							
Interrupt Support **SupportsInterruptOnChange**			Yes[c]				
FIFO Size, in samples **FifoSize**	4 kSamples[d]						
Auto-Calibrate Support **SupportsAutoCalibrate**							

a. You can read the digital input port (all 16 digital input lines) through the analog input subsystem.
b. You can read the value of the C/T subsystem through the analog input subsystem.
c. The first 8 digital input lines of the digital input port can generate an interrupt-on-change event. You enable the interrupts on a line-by-line basis during driver configuration; refer to page 33 for more information on configuring the driver. If you are using the DataAcq SDK, refer to page 82 for more information about determining which digital input lines changed state.
d. The DT9844 device driver automatically adjusts the FIFO half-full flag based on the size of the first user buffer on the queue rather than on the size of the A/D FIFO on the module. This ensures that each sample is transferred from the hardware FIFO to the user buffer without any additional time delay. Therefore, you will always achieve timely buffer complete messages regardless of the sampling rate you choose.

Buffering

Table 7: Buffering Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Buffer Support **SupportsBuffering**	Yes						
Single Buffer Wrap Mode Support **SupportsWrapSingle**							
Inprocess Buffer Flush Support **SupportsInProcessFlush**	Yes						

Triggered Scan Mode

Table 8: Triggered Scan Mode Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Triggered Scan Support **SupportsTriggeredScan**	Yes						
Maximum Number of CGL Scans per Trigger **MaxMultiScanCount**	256[a]	0	0	0	0		0
Maximum Retrigger Frequency **MaxRetriggerFreq**	500 kHz	0	0	0	0		0
Minimum Retrigger Frequency **MinRetriggerFreq**	0.0112 Hz	0	0	0	0		0
Retrigger Source **RetriggerSource**	Software, TTLPos, TTLNeg, ThresholdPos[b]						

a. The channel list depth of 1024 entries in conjunction with a multiscan of 256 provides an effective channel list depth of up to 256K entries.

b. To use a TTLPos retrigger source, the start trigger source must be either a software trigger or a TTLPos trigger. To use a TTLNeg retrigger source, the start trigger source must be either a software trigger or a TTLNeg trigger. To use a ThresholdPos retrigger source, the start trigger must be a software trigger.

Data Encoding

Table 9: Data Encoding Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Binary Encoding Support **SupportsBinaryEncoding**	Yes		Yes	Yes	Yes		
Twos Complement Support **SupportsTwosCompEncoding**							
Returns Floating-Point Values **ReturnsFloats**							

Channels

Table 10: Channel Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Number of Channels **NumberOfChannels**	38[a]		1	1	1		0
SE Support **SupportsSingleEnded**	Yes						
SE Channels **MaxSingleEndedChannels**	32	0	0	0	0		0
DI Support **SupportsDifferential**	Yes		Yes	Yes	Yes		
DI Channels **MaxDifferentialChannels**	16	0	1	1	1		0
Maximum Channel-Gain List Depth **CGLDepth**	1024	0	1	1	0		0
Simultaneous Sample-and-Hold Support **SupportsSimultaneousSampleHold**							
Channel-List Inhibit **SupportsChannelListInhibit**	Yes						
Support MultiSensor Inputs **SupportsMultiSensor**							
Bias Return Termination Resistor Support[b] **SupportsInputTermination**							

a. Channels 0 to 31 are the analog input channels; channel 32 is the digital input port; and channels 33 to 37 are the C/T channels.

b. For differential analog input channels, you can use the Open Layers Control Panel, described on page 33, to apply 10 kΩ input termination. You cannot specify input termination per channel.

Gain

Table 11: Gain Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Programmable Gain Support **SupportsProgrammableGain**							
Number of Gains **NumberOfSupportedGains**	1		1	1	0		0
Gains Available **SupportedGains**	1		1	1			

Ranges

Table 12: Range Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Number of Voltage Ranges **NumberOfRanges**	1	1	0	0	0		0
Available Ranges **SupportedVoltageRanges**	±10 V	0 to 10 V[a]					

a. You can use the D/A subsystem to program the threshold voltage. The resolution is 0 to 10 V. A raw count of 0 corresponds to 0 V; a raw count of 255 corresponds to 10 V.

Resolution

Table 13: Resolution Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Software Programmable Resolution **SupportsSoftwareResolution**							
Number of Resolutions **NumberOfResolutions**	1	1	2[a]	1	1		
Available Resolutions **SupportedResolutions**	20	8[b]	16 or 32[c]	16[c]	32		

a. Programmable resolution for the digital inputs is supported on revision 5 or greater of the DT9844-32-STP or revision 4 or greater of the DT9844-32-OEM. On previous revisions, the digital input resolution was fixed at 16.
b. You can use the D/A subsystem to program the threshold voltage. It has a resolution of 8-bits.
c. You can configure the digital input subsystem (element 0) to use a resolution of 16 if you want to use 16 digital input lines (numbered 0 to 15), or 32 (the default value) if you want to use 32 digital input lines (numbered 0 to 31).

If the digital input subsystem is configured for a resolution of 16, the digital output subsystem also uses a resolution of 16 to provide 16 digital output lines (numbered 0 to 15). If you configure the digital input subsystem for a resolution of 32, no digital output lines are available; writing a digital output value to the digital output port in this case will have no affect.

Current and Resistance Support

Table 14: Current and Resistance Support Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Current Support **SupportsCurrent**							
Current Output Support **SupportsCurrentOutput**							
Resistance Support **SupportsResistance**							
Software Programmable External Excitation Current Source for Resistance **SupportsExternalExcitationCurrentSrc**							
Software Programmable Internal Excitation Current Source **SupportsInternalExcitationCurrentSrc**							
Available Excitation Current Source Values **SupportedExcitationCurrentValues**							

Thermocouple, RTD, and Thermistor Support

Table 15: Thermocouple, RTD, and Thermistor Support Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Thermocouple Support **SupportsThernocouple**							
RTD Support **SupportsRTD**							
Thermistor Support **SupportsThermistor**							
Voltage Converted to Temperature **SupportsTemperatureDataInStream**							
Supported Thermocouple Types **ThermocoupleType**							
Supports CJC Source Internally in Hardware **SupportsCjcSourceInternal**							
Supports CJC Channel **SupportsCjcSourceChannel**							
Available CJC Channels **CjcChannel**							
Supports Interleaved CJC Values in Data Stream **SupportsInterleavedCjcTemperaturesInStream**							
Supported RTD Types **RTDType**							
RTD R0 Coefficient **RtdR0**							
Supports Data Filters **SupportsTemperatureFilters**							
Temperature Filter Types **TemperatureFilterType**							

IEPE Support

Table 16: IEPE Support Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
IEPE Support **SupportsIEPE**							
Software Programmable AC Coupling **SupportsACCoupling**							
Software Programmable DC Coupling **SupportsDCCoupling**							
Software Programmable External Excitation Current Source **SupportsExternalExcitationCurrent Src**							
Software Programmable Internal Excitation Current Source **SupportsInternalExcitationCurrentSrc**							
Available Excitation Current Source Values **SupportedExcitationCurrentValues**							

Bridge and Strain Gage Support

Table 17: Bridge and Strain Gage Support Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Bridge Support **SupportsBridge**							
Supported Bridge Configurations **BridgeConfiguration**							
Strain Gage Support **SupportsStrainGage**							
Supported Strain Gage Bridge Configurations **StrainGageBridgeConfiguration**							
External Excitation Voltage **SupportsExternalExcitationVoltage**							
Internal Excitation Voltage **SupportsInternalExcitationVoltage**							
Shunt Calibration **SupportsShuntCalibration**							
Voltage Excitation Per Channel **SupportedPerChannelVoltageExcitation**							
Minimum Excitation Voltage **MinExcitationVoltage**							
Maximum Excitation Voltage **MaxExcitationVoltage**							

Start Triggers

Table 18: Start Trigger Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Software Trigger Support **SupportsSoftwareTrigger**	Yes[a]		Yes	Yes	Yes		
External Positive TTL Trigger Support **SupportsPosExternalTTLTrigger**	Yes				Yes		
External Negative TTL Trigger Support **SupportsNegExternalTTLTrigger**	Yes						
External Positive TTL Trigger Support for Single-Value Operations **SupportsSvPosExternalTTLTrigger**							
External Negative TTL Trigger Support for Single-Value Operations **SupportsSvNegExternalTTLTrigger**							
Positive Threshold Trigger Support **SupportsPosThresholdTrigger**	Yes						
Negative Threshold Trigger Support **SupportsNegThresholdTrigger**							
Digital Event Trigger Support **SupportsDigitalEventTrigger**							
Threshold Trigger Channel **SupportedThresholdTriggerChannel**	0 to 31[b]						

a. If you want to use a reference trigger, the start trigger must be a software trigger.
b. Any of the analog input channels can be used as the threshold channel for the start trigger; however, this channel must be the first entry in the channel list.

Reference Triggers

Table 19: Reference Trigger Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
External Positive TTL Trigger Support **SupportsPosExternalTTLTrigger**	Yes[a]						
External Negative TTL Trigger Support **SupportsNegExternalTTLTrigger**	Yes[a]						
Positive Threshold Trigger Support **SupportsPosThresholdTrigger**							
Negative Threshold Trigger Support **SupportsNegThresholdTrigger**							
Digital Event Trigger Support **SupportsDigitalEventTrigger**							
Sync Bus Support **SupportsSyncBusTrigger**							
Analog Input Channels Supported for the Threshold Trigger **SupportedThresholdTriggerChannels**							
Post-Trigger Scan Count Support **SupportsPostTriggerScanCount**							

a. If you specify a reference trigger, the start trigger must be a software trigger.

Clocks

Table 20: Clock Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Internal Clock Support **SupportsInternalClock**	Yes		Yes	Yes	Yes		
External Clock Support **SupportsExternalClock**	Yes				Yes		
Simultaneous Input/Output on a Single Clock Signal **SupportsSimultaneousClocking**							
Base Clock Frequency **BaseClockFrequency**	48 MHz		0	0	48 MHz		
Maximum Clock Divider **MaxExtClockDivider**	1		1	1	4,294,967,296		
Minimum Clock Divider **MinExtClockDivider**	1		1	1	2		
Maximum Frequency **MaxFrequency**	1 MHz[a]		0	0	24 MHz		
Minimum Frequency **MinFrequency**	0.0112 Hz		0	0	0.0112 Hz		

a. While the driver supports a maximum sampling rate of 1 MHz, it is recommended that you specify a maximum sampling rate of 640 kSamples/s when sampling multiple channels to achieve the stated accuracy specifications.

Counter/Timers

Table 21: Counter/Timer Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Cascading Support **SupportsCascading**							
Event Count Mode Support **SupportsCount**					Yes		
Generate Rate Mode Support **SupportsRateGenerate**					Yes		
One-Shot Mode Support **SupportsOneShot**					Yes		
Repetitive One-Shot Mode Support **SupportsOneShotRepeat**					Yes		
Up/Down Counting Mode Support **SupportsUpDown**					Yes		
Edge-to-Edge Measurement Mode Support **SupportsMeasure**					Yes		
Continuous Edge-to-Edge Measurement Mode Support **SupportsContinuousMeasure**					Yes		
High to Low Output Pulse Support **SupportsHighToLowPulse**					Yes		
Low to High Output Pulse Support **SupportsLowToHighPulse**					Yes		
Variable Pulse Width Support **SupportsVariablePulseWidth**					Yes[a]		
None (internal) Gate Type Support **SupportsGateNone**					Yes		
High Level Gate Type Support **SupportsGateHighLevel**					Yes[b]		
Low Level Gate Type Support **SupportsGateLowLevel**					Yes[b]		
High Edge Gate Type Support **SupportsGateHighEdge**					Yes[b]		
Low Edge Gate Type Support **SupportsGateLowEdge**					Yes[b]		
Level Change Gate Type Support **SupportsGateLevel**							
Clock-Falling Edge Type **SupportsClockFalling**					Yes		
Clock-Rising Edge Type **SupportsClockRising**					Yes		
Gate-Falling Edge Type **SupportsGateFalling**					Yes		

Table 21: Counter/Timer Options (cont.)

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Gate-Rising Edge Type **SupportsGateRising**					Yes		
Interrupt-Driven Operations **SupportsInterrupt**					Yes		

a. In one-shot and repetitve one-shot mode, the pulse width is set to 100% automatically.
b. High-edge and low-edge are supported for one-shot and repetitive one-shot modes. High-level and low-level are supported for event counting, up/down counting, frequency measurement, edge-to-edge measurement, continuous edge-to-edge measurement, and rate generation modes.

Tachometers

Table 22: Tachometer Options

DT9844	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Tachometer Falling Edges **SupportsFallingEdge**							
Tachometer Rising Edges **SupportsRisingEdge**							
Tachometer Stale Data Flag **SupportsStaleDataFlag**							

7

Troubleshooting

General Checklist

Should you experience problems using a DT9844 module, do the following:

1. Read all the documentation provided for your product, including any "Read This First" information.
2. Check the Data Acquisition OMNI CD for any README files and ensure that you have used the latest installation and configuration information available.
3. Check that your system meets the requirements stated on page 28.
4. Check that you have installed your hardware properly using the instructions in Chapter 2.
5. Check that you have configured the device driver properly using the instructions in Chapter 2.
6. Check that you have wired your signals properly using the instructions in Chapter 3.
7. Search the DT Knowledgebase in the Support section of the Data Translation web site (at www.mccdaq.com) for an answer to your problem.

If you still experience problems, try using the information in Table 23 to isolate and solve the problem. If you cannot identify the problem, refer to page 108.

Table 23: Troubleshooting Problems

Symptom	Possible Cause	Possible Solution
Module is not recognized	You plugged the module into your computer before installing the device driver.	From the Control Panel > System > Hardware > Device Manager, uninstall any unknown devices (showing a yellow question mark). Then, run the setup program on your OMNI CD to install the USB device drivers, and reconnect your USB module to the computer.
Module does not respond.	The module configuration is incorrect.	Check the configuration of your device driver.
	The module is damaged.	Contact Data Translation for technical support; refer to page 110.
Intermittent operation.	Loose connections or vibrations exist.	Check your wiring and tighten any loose connections or cushion vibration sources.
	The module is overheating.	Check environmental and ambient temperature; consult the module's specifications on page 126 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.

Table 23: Troubleshooting Problems (cont.)

Symptom	Possible Cause	Possible Solution
Device failure error reported.	The DT9844 module cannot communicate with the Microsoft bus driver or a problem with the bus driver exists.	Check your cabling and wiring and tighten any loose connections.
	The DT9844 module was removed while an operation was being performed.	Ensure that your DT9844 module is properly connected.
Data appears to be invalid.	An open connection exists.	Check your wiring and fix any open connections.
	A transducer is not connected to the channel being read.	Check the transducer connections.
	The module is set up for differential inputs while the transducers are wired as single-ended inputs or vice versa.	Check your wiring and ensure that what you specify in software matches your hardware configuration.
	The DT9844 module is out of calibration.	DT9844 modules are calibrated at the factory. If you want to readjust the calibration of the analog input circuitry, refer to Chapter 8 starting on page 113.
Computer does not boot.	The power supply of the computer is too small to handle all the system resources.	Check the power requirements of your system resources and, if needed, get a larger power supply; consult the module's specifications on page 126.
USB 2.0 is not recognized.	Your operating system does not have the appropriate Service Pack installed.	Ensure that you load the appropriate Windows Service Pack. If you are unsure of whether you are using USB 2.0 or USB 1.1, run the Open Layers Control Panel applet, described in Chapter 2.
	Standby mode is enabled on your PC.	For some PCs, you may need to disable standby mode on your system for proper USB 2.0 operation. Consult Microsoft for more information.

Technical Support

If you have difficulty using a DT9844 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 OMNI CD you are using
- Your contract number, if applicable

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

If Your 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).

8

Calibration

Using the Calibration Utility

DT9844 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 circuitry on the DT9844 module every six months using the DT9844 Calibration Utility.

Note: Ensure that you installed the DT9844 Device Driver prior to using the DT9844 Calibration Utility.

Start the DT9844 Calibration Utility as follows:

1. Click **Start** from the Task Bar, and then select **Programs | Data Translation, Inc | Calibration | DT9844 Calibration Utility**.
   The main menu of the DT9844 Calibration Utility appears.
2. Select the module to calibrate, and then click **OK**.

Once the DT9844 Calibration Utility is running, you can calibrate the analog input circuitry (either automatically or manually), described on page 115.

Calibrating the Analog Input Subsystem

This section describes how to use the DT9844 Calibration Utility to calibrate the analog input subsystem of aDT9844 module.

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 Configuration** tab of the DT9844 Calibration Utility.
2. Connect an external +9.3750 V precision voltage source to Analog In 0 (AD Ch0).
3. Set the voltage supply on AD Ch0 to 0 V.
4. Click **Start Auto Calibration**.
   A message appears notifying you to verify that 0 *V is applied to AD Ch0.*
5. Check that the supplied voltage to AD Ch0 is 0 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 AD Ch 0 to +9.375 V.
6. Check that the supplied voltage to AD Ch0 is +9.375V, and then click **OK**.
   The gain value is calibrated.
7. Click **OK** to finalize the analog input calibration process.

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:

1. Select the **A/D Configuration** tab of the DT9844 Calibration Utility.
2. Connect an external +9.3750 V precision voltage source to Analog In 0 (AD Ch0).
3. Adjust the offset as follows:
   a. Verify that 0 V is applied to AD Ch0, and that A/D Channel Select is set to Channel 0.
      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 V.
4. Adjust the gain as follows:
   a. Verify that +9.375 V is applied to AD Ch0, and that A/D Channel Select is set to Channel 0.
      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.

A

Specifications

Analog Input Specifications

Table 24 lists the analog input specifications for the DT9844 module.

Table 24: Analog Input Specifications

Feature	Specifications
Number of analog input channels Single-ended: Pseudo-differential: Differential:	 32 32 16
Resolution	20 bits
Number of gains	1
Range	±10 V
Coupling	DC
Data encoding	Offset binary
System accuracy, to % of FSR 50 Ω source impedance @ 500 kHz scan: 50 Ω source impedance @ 640 kHz scan: 1 kΩ source impedance @ 500 kHz scan: 1 kΩ source impedance @ 640 kHz scan:	 ±0.01% ±0.015% ±0.02% ±0.03%
Crosstalk[a]	–80 dB at 1 kHz –60 dB at 100 kHz
System noise	140 µV rms (see Figure 27)
Signal bandwidth	5 MHz
Nonlinearity	< 2 LSB
Differential nonlinearity	< 1 LSB
Inherent quantizing error	½ LSB
Transition noise	2.3 ppm rms
Drift Zero: Gain: Differential linearity:	 ±10 µV/°C ±20 ppm of FSR/°C ±0.5 ppm of FSR/°C
Input impedance Off channel: On channel single-ended: On channel differential:	 100 MΩ, 10 pF 100 MΩ, 150 pF typical 100 MΩ, 75 pF typical
Input bias current	±20 nA
Common mode voltage range	±10.5 V (±11 V typical)
Common mode rejection ratio	80 dB
Maximum input voltage (without damage) Power on: Power off:	 ±12 V ±12 V

Table 24: Analog Input Specifications (cont.)

Feature	Specifications
A/D conversion time	1.0 µs
Channel acquisition time (±½ LSB)[a]	0.5 µs, typical
Sample-and-hold aperture uncertainty	0.2 ns, typical
Throughput Single channel: Multiple channels:	 Up to 1 MSamples/s Up to 640 kSamples/s
ESD protection Arc: Contact:	 8 kV 4 kV
Reference	+4.096 V ±0.010 V
Monotonicity	1 LSB
Total Harmonic Distortion (THD)	0.0008%, –101 dB typical (see Figure 28)
Spurious Free Dynamic Range (SFDR)	>96 dB typical (see Figure 28)
Signal to Noise and Distortion (SINAD)	81 dB typical (see Figure 28)
Signal to Noise Ratio (SNR)	82 dB typical (see Figure 28)
Effective Number of Bits (ENOB) at full-scale	14 bits typical (see Figure 28)
Input FIFO	4 kSamples

a. Based on a 50 Ω signal source.

Figure 27 shows the typical system noise of the DT9844 module. (QuickDAQ was used to acquire and display the data.)

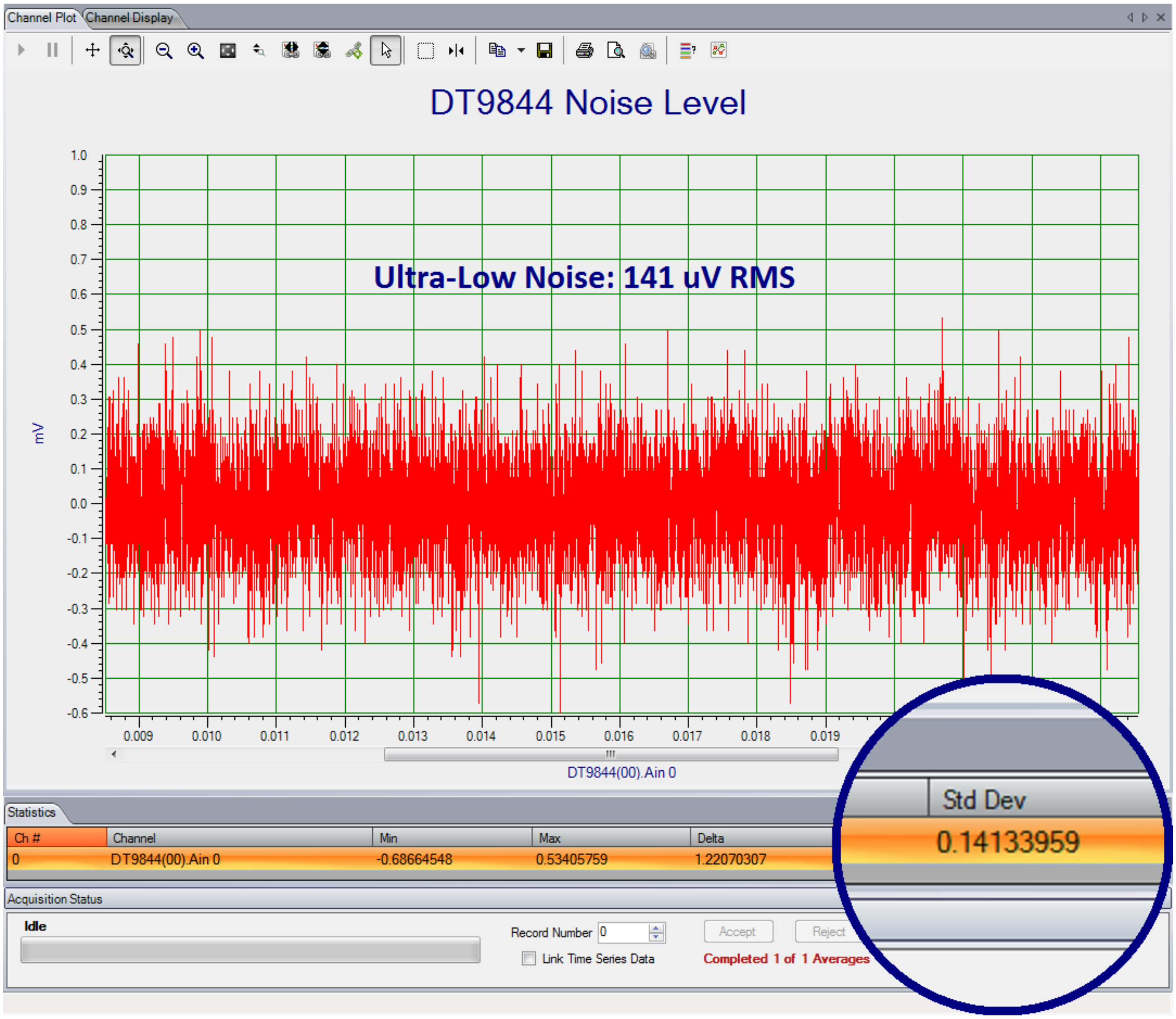


Figure 27: Typical System Noise of the DT9844

Figure 28 shows the dynamic performance of the DT9844 module when sampling a 1 kHz input signal at –6 dB using a 500 kSamples/s sampling rate. (QuickDAQ was used to acquire and display the data.)

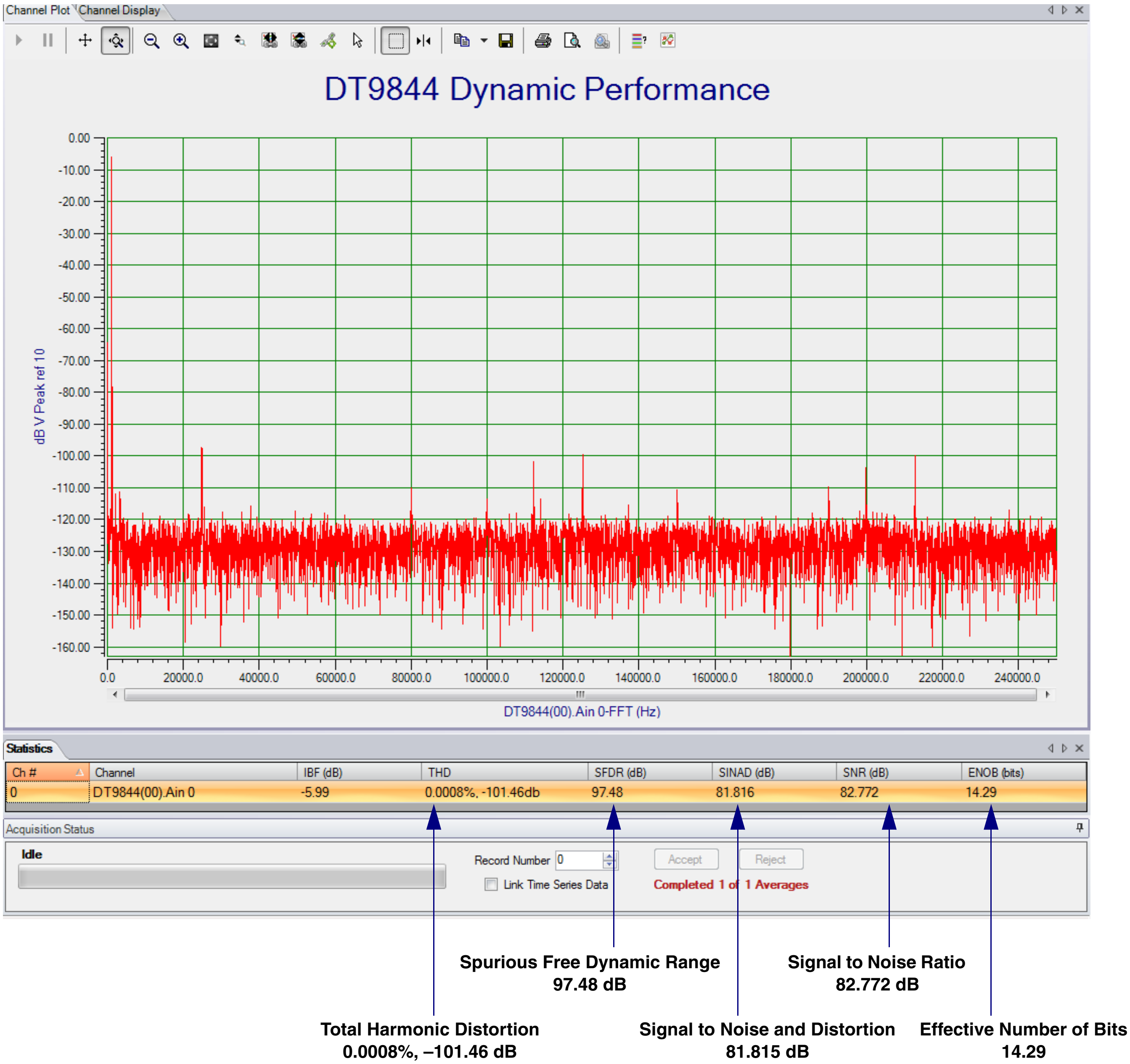


Figure 28: Dynamic Performance of the DT9844

Digital I/O Specifications

Table 25 lists the digital I/O specifications on the DT9844 module.

Table 25: Digital I/O Specifications

Feature	Specifications
Number of digital I/O lines	32 (16 or 32 digital input, 16 or 0 digital output)[a]
Number of ports	2[a]
Number of dynamic digital output lines	1
Input termination	Inputs tied to +3.3 V through 47 kΩ pull-up resistors
Logic family	LVTTL (+5 V tolerance)
Logic sense	Positive true
Inputs Input type: Input logic load: High input voltage: Low input voltage: Low input current:	 Level-sensitive 1 LVTTL 2.0 V minimum 0.8 V maximum –0.4 mA maximum
Outputs Fan out: High output: Low output: High output current: Low output current:	 5 mA 2.0 V minimum 0.8 V maximum –5 mA maximum 5 mA maximum
Interrupt on change	Yes
Clocked with sample clock	Yes
Software I/O selectable	No

a. You can configure the digital input subsystem to use a resolution of 16 if you want to use 16 digital input lines (numbered 0 to 15), or 32 (the default value) if you want to use 32 digital input lines (numbered 0 to 31).

If the digital input subsystem is configured for a resolution of 16, the digital output subsystem also uses a resolution of 16 to provide 16 digital output lines (numbered 0 to 15). If you configure the digital input subsystem for a resolution of 32, no digital output lines are available; writing a digital output value to the digital output port in this case will have no affect.

Counter/Timer Specifications

Table 26 lists the counter/timer specifications on the DT9844 module.

Table 26: Counter/Timer Specifications

Feature	Specifications
Number of counter/timers	5
Internal reference clock	48 MHz
Resolution	32 bits per channel
Clock divider Minimum: Maximum:	 2 4,294,967,296
Clock output Minimum: Maximum:	 0.0112 Hz 24 MHz
Maximum clock or gate input frequency	24 MHz[a]
Minimum pulse width (minimum amount of time it takes a C/T to recognize an input pulse)	Greater than 21 ns[a]
Maximum input frequency	23.8 MHz
Logic family	LVTTL (+5 V tolerance)
Inputs Input logic load: High input voltage: Low input voltage: Low input current:	 1 LVTTL 2.0 V minimum 0.8 V maximum –0.4 mA maximum
Outputs Fan out: High output: Low output: High output current: Low output current:	 5 mA 2.0 V minimum 0.8 V maximum –5 mA maximum 5 mA maximum

a. The integrity of the signal degrades at frequencies greater than 10 MHz.

Trigger Specifications

Table 27 lists the specifications for the external A/D trigger on the DT9844 module.

Table 27: External A/D Trigger Specifications

Feature	Specifications
Trigger sources Internal: External:	 Software-initiated Software-selectable
Input type	Edge-sensitive
Logic family	LVTTL (+5 V tolerance)
Inputs Input logic load: Input termination: High input voltage: Low input voltage: High input current: Low input current:	 1 LVTTL 2.2 kΩ pull-up to +3.3 V 2.0 V minimum 0.8 V maximum 25 µA maximum –0.25 mA maximum
Minimum pulse width High: Low:	 25 ns 25 ns
Triggering modes Single scan: Continuous scan: Triggered scan:	 Yes Yes Yes

Clock Specifications

Table 28 lists the specifications for the internal A/D clock on the DT9844 module.

Table 28: Internal A/D Clock Specifications

Feature	Specifications
Reference frequency	48 MHz
Divisor range	48 to 4,294,967,295
Frequency range	0.0112 Hz to 1 MHz
Period range	1 µs to 89.478 s
Oscillator accuracy (recording time error)	±50 ppm[a]

a. This specification is over time (1 year), temperature, and power supply variations.

Table 29 lists the specifications for the external A/D clock on the DT9844 module.

Table 29: External A/D Clock Specifications

Feature	Specifications
Input type	Edge sensitive, rising or falling edge programmable
Logic family	LVTTL (+5 V tolerance)
Inputs Input logic load: Input termination: High input voltage: Low input voltage:	 1 LVTTL 2.2 kΩ pull-up to +3.3 V 2.0 V minimum 0.8 V minimum
Frequency	DC to 1.0 MHz
Minimum pulse width High: Low:	 25 ns 25 ns

Power, Physical, and Environmental Specifications

Table 30 lists the power, physical, and environmental specifications for the DT9844 module.

Table 30: Power, Physical, and Environmental Specifications

Feature	Specifications
USB Power	+5 V at 300 mA maximum, 104 mA typical (without digital output loading)
OEM power[a] +5 V noise and ripple: +5 V tolerance: Earth ground connections[b]:	5 V at 2A maximum, 280 mA typical 50 mV pp maximum ±0.25 V 18 gauge stranded wire to earth ground
Physical Dimensions (OEM): Dimensions (STP): Weight (OEM): Weight (STP):	 190 mm x 100 mm x 20 mm 216 mm x 106 mm x 51 mm 4.6 ounces 2.1 lbs
Environmental Operating temperature range (OEM): Operating temperature range (STP): Storage temperature range: Relative humidity: Altitude	 0° C to 55° C 0° C to 45° C –25° C to 85° C To 95%, noncondensing to 10,000 feet

a. See page 158 for OEM power connections on TB1.
b. DC-isolated to earth ground; capacitance < 1000 pF.

Connector Specifications

Table 31 lists the mating cable connectors for the connectors on the OEM version of the DT9844 module, and the EP353 and EP356 accessory panels.

Table 31: Mating Cable Connectors

Module/Panel	Connector	Part Number on Module (or Equivalent)	Mating Cable Connector
DT9844-32-OEM version	J2	AMP/Tyco 6-104068-8	AMP/Tyco 3-111196-4[a]
	J3	AMP/Tyco 6-104068-8	AMP/Tyco 3-111196-4[a]
	TB1[b]	Phoenix Contact 1707434	Phoenix Contact 1839610
EP353 accessory panel	J1	AMP/Tyco 5102321-6	AMP/Tyco 1658622-6
	J2	AMP/Tyco 5747375-8	AMP/Tyco 5-747917-2
EP356 accessory panel	J1	AMP/Tyco 5747301-8	AMP/Tyco 5-747916-2
	J2	AMP/Tyco 5747301-8	AMP/Tyco 5-747916-2

a. The mating PCB receptacle is AMP/Tyco 6-104078-3.
b. Secondary power connector.

Regulatory Specifications

DT9844 modules are CE-compliant. Table 32 lists the regulatory specifications for DT9844 modules.

Table 32: Regulatory Specifications

Feature	Specifications
Emissions (EMI)	FCC Part 15, Class A EN55011:2007 (Based on CISPR-11, 2003/A2, 2006)
Immunity	EN61326-1:2006 Electrical Equipment for Measurement, Control, and Laboratory Use EMC Requirements EN61000-4-2:2009 Electrostatic Discharge (ESD) 4 kV contact discharge, 8 kV air discharge, 4 kV horizontal and vertical coupling planes EN61000-4-3:2006 Radiated electromagnetic fields, 3 V/m, 80 to 1000 MHz; 3 V/m, 1.4 GHz to 2 GHz; 1 V/m, 2 GHz to 2.7 GHz EN61000-4-4:2004 Electrical Fast Transient/Burst (EFT) 1 kV on data cables EN61000-4-6:2009 Conducted immunity requirements, 3 Vrms on data cables 150 kHz to 80 MHz
RoHS (EU Directive 2002/95/EG)	Compliant (as of July 1st, 2006)

External Power Supply Specifications

Table 33 lists the specifications for the EP361 +5 V external power supply that is used with the DT9844 module.

Table 33: 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

B

Connector Pin Assignments and LED Status Indicators

OEM Version Connectors

This section describes the pin assignments for the J2 and J3 connectors on the OEM version of the DT9844 module (DT9844-32-OEM), as well as the secondary power connector, TB1. Figure 29 shows the orientation of the pins on these connectors.

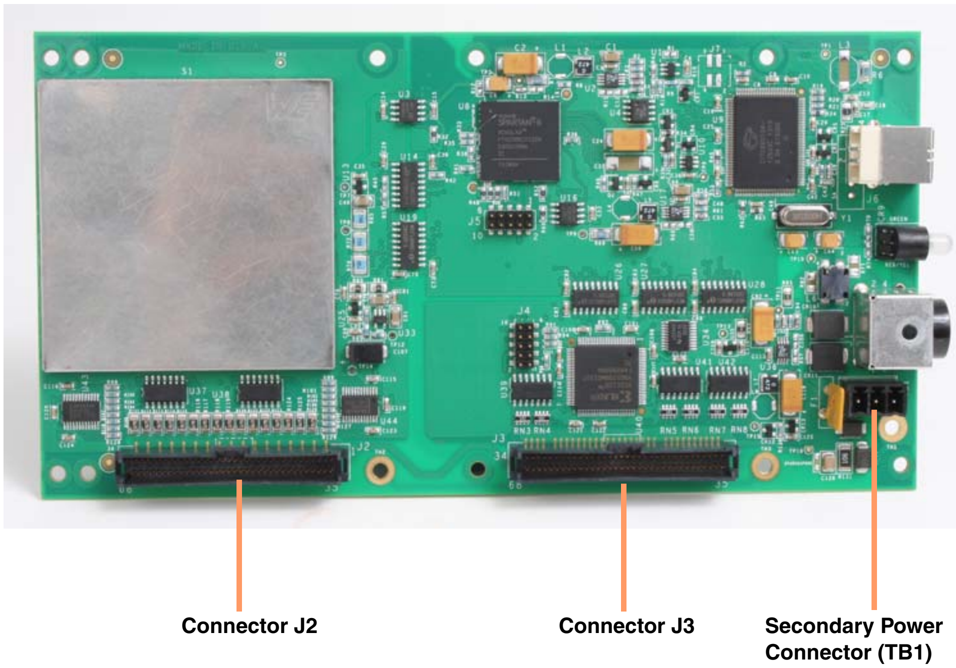


Figure 29: Orientation of Connectors J2 and J3 and TB1

Table 34 lists the pin assignments for connector J2 on the DT9844-32-OEM module. Table 35 lists the pin assignments for connector J3 on the DT9844-32-OEM module. Table 36 lists the pin assignments for connector TB1 on the DT9844-32-OEM module.

Table 34: Pin Assignments for Connector J2 on the DT9844-32-OEM

Pin	Signal Description	Pin	Signal Description
1	+5 V Analog	35	Digital Ground
2	Amplifier Low[a]	36	Analog Ground
3	Analog Ground	37	Analog Ground
4	Analog Input 15 DI/ Analog Input 23 SE[b]	38	Analog Input 15 DI Return / Analog In 31 SE[b]
5	Analog Ground	39	Analog Ground
6	Analog Input 14 DI/ Analog Input 22 SE[b]	40	Analog Input 14 DI Return / Analog In 30 SE[b]
7	Analog Ground	41	Analog Ground
8	Analog Input 13 DI/ Analog Input 21 SE[b]	42	Analog Input 13 DI Return/ Analog In 29 SE[b]
9	Analog Ground	43	Analog Ground
10	Analog Input 12 DI/ Analog Input 20 SE[b]	44	Analog Input 12 DI Return/ Analog In 28 SE[b]
11	Analog Ground	45	Analog Ground
12	Analog Input 11 DI/ Analog Input 19 SE[b]	46	Analog Input 11 DI Return/ Analog In 27 SE[b]
13	Analog Ground	47	Analog Ground
14	Analog Input 10 DI/ Analog Input 18 SE[b]	48	Analog Input 10 DI Return/ Analog In 26 SE[b]
15	Analog Ground	49	Analog Ground
16	Analog Input 9 DI/ Analog Input 17 SE[b]	50	Analog Input 9 DI Return/ Analog In 25 SE[b]
17	Analog Ground	51	Analog Ground
18	Analog Input 8 DI/ Analog Input 16 SE[b]	52	Analog Input 8 DI Return/ Analog In 24 SE[b]
19	Analog Ground	53	Analog Ground
20	Analog In 7	54	Analog In 7 DI Return/ Analog In 15 SE[b]
21	Analog Ground	55	Analog Ground
22	Analog In 6	56	Analog In 6 DI Return/ Analog In 14 SE[b]
23	Analog Ground	57	Analog Ground

Table 34: Pin Assignments for Connector J2 on the DT9844-32-OEM (cont.)

Pin	Signal Description	Pin	Signal Description
24	Analog In 5	58	Analog In 5 DI Return/ Analog In 13 SE[b]
25	Analog Ground	59	Analog Ground
26	Analog In 4	60	Analog In 4 DI Return/ Analog In 12 SE[b]
27	Analog Ground	61	Analog Ground
28	Analog In 3	62	Analog In 3 DI Return/ Analog In 11 SE[b]
29	Analog Ground	63	Analog Ground
30	Analog In 2	64	Analog In 2 DI Return/ Analog In 10 SE[b]
31	Analog Ground	65	Analog Ground
32	Analog In 1	66	Analog In 1 DI Return/ Analog In 9 SE[b]
33	Analog Ground	67	Analog Ground
34	Analog In 0	68	Analog In 0 DI Return/ Analog In 8 SE[b]

a. If you are using the single-ended or pseudo-differential configuration, ensure that you connect this signal to analog ground on the module and to analog ground from your signal source. Refer to Chapter 3 for more information.

b. The first signal applies to the differential (DI) configuration and the second signal description applies to the single-ended (SE) configuration.

Table 35: Pin Assignments for Connector J3 on the DT9844-32-OEM

Pin	Signal Description	Pin	Signal Description
1	Counter 4 Out	35	Counter 4 Gate
2	Counter 4 Clock	36	Digital Ground
3	Counter 3 Out	37	Counter 3 Gate
4	Counter 3 Clock	38	Digital Ground
5	Counter 2 Out	39	Counter 2 Gate
6	Counter 2 Clock	40	Digital Ground
7	Counter 1 Out	41	Counter 1 Gate
8	Counter 1 Clock	42	Digital Ground
9	Counter 0 Out	43	Counter 0 Gate
10	Counter 0 Clock	44	Digital Ground
11	Digital Ground	45	Dynamic Digital Out
12	Digital Input 15	46	Digital Out 15
13	Digital Input 14	47	Digital Out 14
14	Digital Input 13	48	Digital Out 13
15	Digital Input 12	49	Digital Out 12
16	Digital Input 11	50	Digital Out 11
17	Digital Input 10	51	Digital Out 10
18	Digital Input 9	52	Digital Out 9
19	Digital Input 8	53	Digital Out 8
20	Digital Input 7	54	Digital Out 7
21	Digital Input 6	55	Digital Out 6
22	Digital Input 5	56	Digital Out 5
23	Digital Input 4	57	Digital Out 4
24	Digital Input 3	58	Digital Out 3
25	Digital Input 2	59	Digital Out 2
26	Digital Input 1	60	Digital Out 1
27	Digital Input 0	61	Digital Out 0
28	External ADC Clock	62	External ADC Trigger
29	Reserved	63	Reserved
30	Digital Ground	64	Digital Ground
31	Reserved	65	Reserved

Table 35: Pin Assignments for Connector J3 on the DT9844-32-OEM (cont.)

Pin	Signal Description	Pin	Signal Description
32	Reserved	66	Reserved
33	Reserved	67	Reserved
34	Reserved	68	Reserved

Table 36: Pin Assignments for Connector TB1 on the DT9844-32-OEM

TB1 Pin Assignment	Signal Description
1	+5 V
2	Ground
3	Shield (Chassis Ground)

STP Connection Box Pin Assignments

This section describes the pin assignments for the screw terminals on the STP connection box. Note that the screw terminals are also labeled on the box.

Screw Terminal Block TB1

TB1 is used to connect analog input signals to the DT9844-32-STP module. Table 37 lists the screw terminal assignments for screw terminal block TB1.

Table 37: Screw Terminal Assignments for Terminal Block TB1

Screw Terminal	Signal Description
18	Analog Ground
17	Analog In 5 DI Return/Analog In 13 SE[a]
16	Analog In 5
15	Analog Ground
14	Analog In 4 DI Return/Analog In 12 SE[a]
13	Analog In 4
12	Analog Ground
11	Analog In 3 DI Return/Analog In 11SE[a]
10	Analog In 3
9	Analog Ground
8	Analog In 2 DI Return/Analog In 10 SE[a]
7	Analog In 2
6	Analog Ground
5	Analog In 1 DI Return/Analog In 9 SE[a]
4	Analog In 1
3	Analog Ground
2	Analog In 0 DI Return/Analog In 8 SE[a]
1	Analog In 0

a. The first signal description applies to differential (DI) signals; the second signal description applies to single-ended (SE) signals.

Screw Terminal Block TB2

TB2 is used to connect analog input signals to the DT9844-32-STP module. Table 38 lists the screw terminal assignments for screw terminal block TB2.

Table 38: Screw Terminal Assignments for Terminal Block TB2

Screw Terminal	Signal Description
18	Analog Ground
17	Analog In 11 DI Return/Analog In 27 SE[a]
16	Analog In 11 DI/Analog In 19 SE[a]
15	Analog Ground
14	Analog In 10 DI Return/Analog In 26 SE[a]
13	Analog In 10 DI/Analog In 18 SE[a]
12	Analog Ground
11	Analog In 9 DI Return/Analog In 25 SE[a]
10	Analog In 9 DI/Analog In 17 SE[a]
9	Analog Ground
8	Analog In 8 DI Return/Analog In 24 SE[a]
7	Analog In 8 DI/Analog In 16 SE[a]
6	Analog Ground
5	Analog In 7 DI Return/Analog In 15 SE[a]
4	Analog In 7
3	Analog Ground
2	Analog In 6 DI Return/Analog In 14 SE[a]
1	Analog In 6

a. The first signal description applies to differential (DI) signals; the second signal description applies to single-ended (SE) signals.

Screw Terminal Block TB3

TB 3 is used to connect analog input signals to the DT9844-32-STP module. Table 39 lists the screw terminal assignments for screw terminal block TB3.

Table 39: Screw Terminal Assignments for Terminal Block TB3

Screw Terminal	Signal Description
18	5 V Analog
17	Digital Ground
16	Analog Ground
15	Analog Ground
14	Amplifier Low
13	Amplifier Low
12	Analog Ground
11	Analog In 15 DI Return/Analog In 31SE[a]
10	Analog In 15 DI/Analog In 23 SE[a]
9	Analog Ground
8	Analog In 14 DI Return/Analog In 30 SE[a]
7	Analog In 14 DI/Analog In 22 SE[a]
6	Analog Ground
5	Analog In 13 DI Return/Analog In 29 SE[a]
4	Analog In 13 DI/Analog In 21 SE[a]
3	Analog Ground
2	Analog In 12 DI Return/Analog In 28 SE[a]
1	Analog In 12 DI /Analog In 20 SE[a]

a. The first signal description applies to differential (DI) signals; the second signal description applies to single-ended (SE) signals.

Screw Terminal Block TB4

TB4 is used for connecting the external clock and trigger signals to the DT9844-32-STP module. Table 40 lists the screw terminal assignments for screw terminal block TB4.

Table 40: Screw Terminal Assignments for Terminal Block TB4

Screw Terminal	Signal Description
18	Digital Ground
17	Digital Ground
16	External ADC Trigger
15	Digital Ground
14	External ADC Clock
13	Digital Ground
12	Not Used
11	Digital Ground
10	Not Used
9	Digital Ground
8	Not Used
7	Not Used
6	Not Used
5	Not Used
4	Not Used
3	Not Used
2	Not Used
1	Not Used

Screw Terminal Block TB5

TB5 is used to connect digital inputs signals to the DT9844-32-STP module. Table 41 lists the screw terminal assignments for screw terminal block TB5.

Table 41: Screw Terminal Assignments for Terminal Block TB5

Screw Terminal	Signal Description
18	Digital Ground
17	Digital Input 15
16	Digital Input 14
15	Digital Input 13
14	Digital Input 12
13	Digital Input 11
12	Digital Input 10
11	Digital Input 9
10	Digital Input 8
9	Digital Ground
8	Digital Input 7
7	Digital Input 6
6	Digital Input 5
5	Digital Input 4
4	Digital Input 3
3	Digital Input 2
2	Digital Input 1
1	Digital Input 0

Screw Terminal Block TB6

TB6 is used to connect digital output signals to the DT9844-32-STP module. Table 42 lists the screw terminal assignments for screw terminal block TB6.

Table 42: Screw Terminal Assignments for Terminal Block TB6

Screw Terminal	Signal Description
20	Digital Ground
19	Dynamic Digital Output
18	Digital Ground
17	Digital Output 15 or Digital Input 31[a]
16	Digital Output 14 or Digital Input 30[a]
15	Digital Output 13 or Digital Input 29[a]
14	Digital Output 12 or Digital Input 28[a]
13	Digital Output 11 or Digital Input 27[a]
12	Digital Output 10 or Digital Input 26[a]
11	Digital Output 9 or Digital Input 25[a]
10	Digital Output 8 or Digital Input 24[a]
9	Digital Ground
8	Digital Output 7 or Digital Input 23[a]
7	Digital Output 6 or Digital Input 22[a]
6	Digital Output 5 or Digital Input 21[a]
5	Digital Output 4 or Digital Input 20[a]
4	Digital Output 3 or Digital Input 19[a]
3	Digital Output 2 or Digital Input 18[a]
2	Digital Output 1 or Digital Input 17[a]
1	Digital Output 0 or Digital Input 16[a]

a. Used as a digital input line if the resolution of the digital input subsystem is 32; otherwise, used as a digital output line.

Screw Terminal Block TB7

TB7 is used to connect counter/timer signals to the DT9844-32-STP module. Table 43 lists the screw terminal assignments for screw terminal block TB7.

Table 43: Screw Terminal Assignments for Terminal Block TB7

Screw Terminal	Signal Description
20	Counter 4 Gate
19	Counter 4 Out
18	Counter 4 Clock
17	Digital Ground
16	Counter 3 Gate
15	Counter 3 Out
14	Counter 3 Clock
13	Digital Ground
12	Counter 2 Gate
11	Counter 2 Out
10	Counter 2 Clock
9	Digital Ground
8	Counter 1 Gate
7	Counter 1 Out
6	Counter 1 Clock
5	Digital Ground
4	Counter 0 Gate
3	Counter 0 Out
2	Counter 0 Clock
1	Digital Ground

EP353 Accessory Panel Connectors

To attach an EP353 accessory panel to the DT9844-32-OEM module, plug the EP353 panel into connector J2 on the DT9844-32-OEM, as shown in Figure 30.

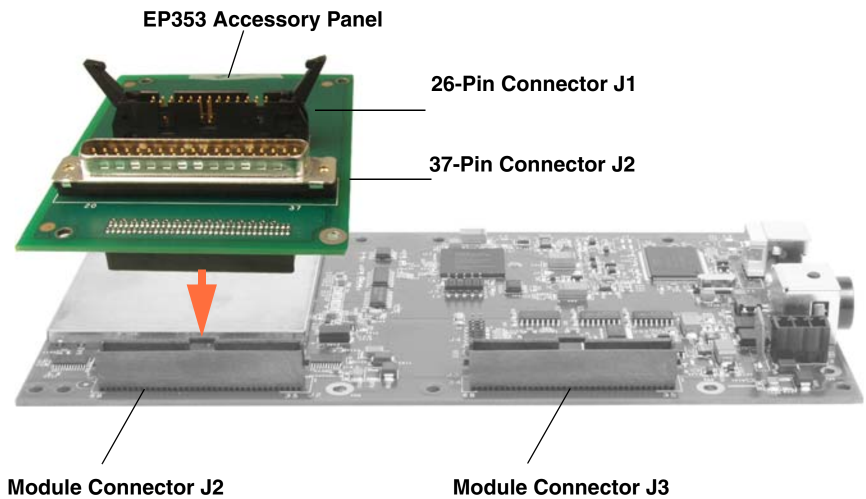


Figure 30: Connecting the EP353 Accessory Panel to Connector J2 of the DT9844-32-OEM

This section describes the pin assignments for the connectors on the EP353 accessory panel.

Connector J1

Figure 31 shows the orientation of the pins for connector J1 on the EP353 panel.

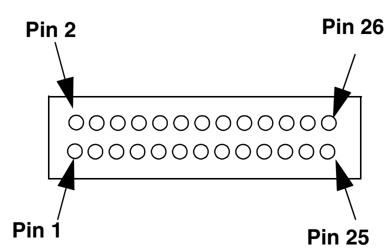


Figure 31: Orientation of the Pins for Connectors J1 on the EP353 Panel

Table 44 lists the pin assignments for connector J1 on the EP353 accessory panel.

Table 44: EP353 Connector J1 Pin Assignments

Pin	Signal Description	Pin	Signal Description
1	Analog Input 0	2	Analog Input 0 Return /Analog Input 8[a]
3	Analog Ground	4	Analog Input 1 Return /Analog Input 9[a]
5	Analog Input 1	6	Analog Ground
7	Analog Input 2	8	Analog Input 2 Return /Analog Input 10[a]
9	Analog Ground	10	Analog Input 3 Return /Analog Input 11[a]
11	Analog Input 3	12	Analog Ground
13	Analog Input 4	14	Analog Input 4 Return /Analog Input 12[a]
15	Analog Ground	16	Analog Input 5 Return /Analog Input 13[a]
17	Analog Input 5	18	Analog Ground
19	Analog Input 6	20	Analog Input 6 Return /Analog Input 14[a]
21	Analog Ground	22	Analog Input 7 Return /Analog Input 15[a]
23	Analog Input 7	24	Analog Ground
25	Amplifier Low	26	Reserved

a. The first signal description (Return) applies to the differential configuration for all modules. The second signal description applies to the single-ended configuration for all modules.

Connector J2

Figure 32 shows the orientation of the pins for connector J2 on the EP353 panel.

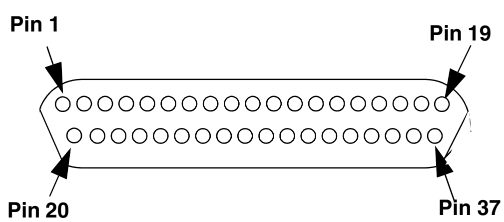


Figure 32: Orientation of the Pins for Connectors J2 on the EP353 Panel

You can access the pins on connector J2 either by using the EP360 cable and STP37 screw terminal panel (available from Data Translation), shown in Figure 33, or by building your own cable/panel. Refer to Appendix A for information about the required mating connectors.

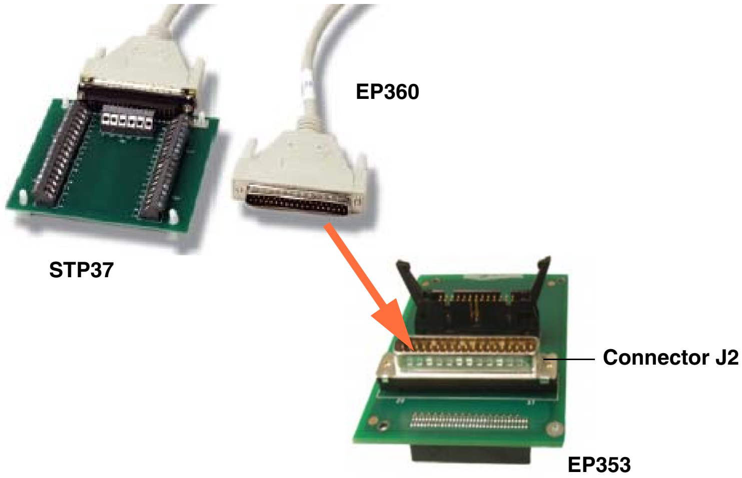


Figure 33: Connecting the STP37 Screw Terminal Panel to Connector J2 of the EP353 Accessory Panel Using the EP360 Cable

Table 45 lists the pin assignments for connector J2 on the EP353 accessory panel.

Table 45: EP353 Connector J2 Pin Assignments

Pin	Signal Description	Pin	Signal Description
1	Analog Input 0	20	Analog Input 0 DI Return/ Analog In 8 SE[a]
2	Analog Input 1	21	Analog Input 1 DI Return/ Analog In 9 SE[a]
3	Analog Input 2	22	Analog Input 2 DI Return/ Analog In 10 SE[a]
4	Analog Input 3	23	Analog Input 3 DI Return/ Analog In 11 SE[a]
5	Analog Input 4	24	Analog Input 4 DI Return/ Analog In 12 SE[a]
6	Analog Input 5	25	Analog Input 5 DI Return/ Analog In 13 SE[a]
7	Analog Input 6	26	Analog Input 6 DI Return/ Analog In 14 SE[a]
8	Analog Input 7	27	Analog Input 7 DI Return/ Analog In 15 SE[a]
9	Analog Input 8 DI/ Analog Input 16 SE[a]	28	Analog Input 8 DI Return/ Analog In 24 SE[a]
10	Analog Input 9 DI/ Analog Input 17 SE[a]	29	Analog Input 9 DI Return/ Analog In 25 SE[a]

Table 45: EP353 Connector J2 Pin Assignments (cont.)

Pin	Signal Description	Pin	Signal Description
11	Analog Input 10 DI/ Analog Input 18 SE[a]	30	Analog Input 10 DI Return / Analog In 26 SE[a]
12	Analog Input 11 DI/ Analog Input 19 SE[a]	31	Analog Input 11 DI Return/ Analog In 27 SE[a]
13	Analog Input 12 DI/ Analog Input 20 SE[a]	32	Analog Input 12 DI Return/ Analog In 28 SE[a]
14	Analog Input 13 DI/ Analog Input 21SE[a]	33	Analog Input 13 DI Return/ Analog In 29 SE[a]
15	Analog Input 14 DI/ Analog Input 22 SE[a]	34	Analog Input 14 DI Return/ Analog In 30 SE[a]
16	Analog Input 15 DI/ Analog Input 23 SE[a]	35	Analog Input 15 DI Return/ Analog In 31 SE[a]
17	Amplifier Low	36	Analog Ground
18	+5 V Analog	37	Digital Ground
19	Chassis Ground		

a. The first signal description applies to the differential (DI) configuration and the second signal description applies to the single-ended (SE) configuration on the DT9844-32-OEM module.

EP356 Accessory Panel Connectors

To attach an EP356 accessory panel to the DT9844-32-OEM module, plug the EP356 panel into connector J3 on the board, as shown in Figure 34.

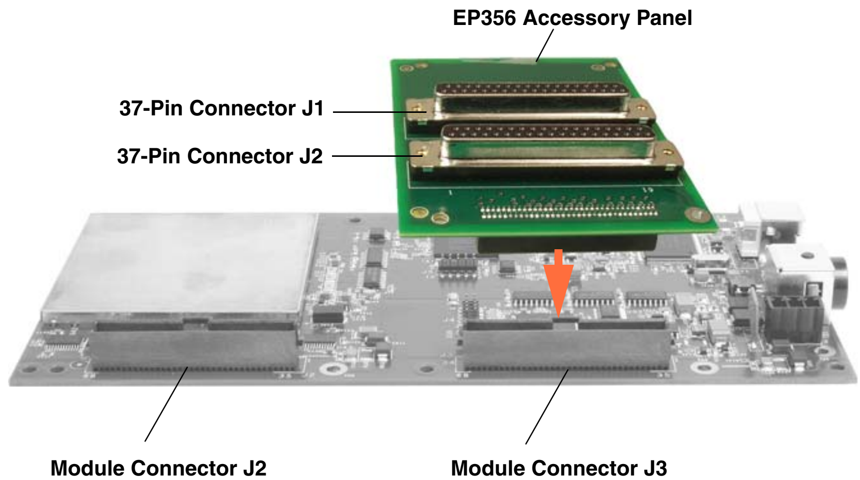


Figure 34: Connecting the EP356 Panel to the DT9844-32-OEM Module

Figure 35 shows the orientation of the pins for connectors J1 and J2 on the EP356 panel.

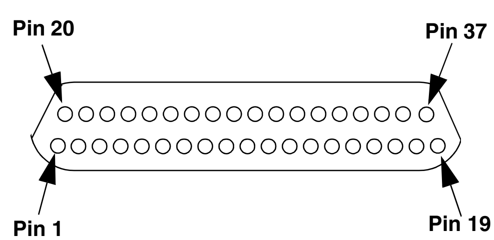


Figure 35: Orientation of the Pins for Connectors J1 and J2 of the EP356 Panel

Connector J1

Use connector J1 on the EP356 accessory panel to attach digital I/O signals. You can access the pins on connector J1 of the EP356 panel either by using the EP333 cable and STP37 screw terminal panel (available from Data Translation), shown in Figure 36, or by building your own cable/panel. Refer to Appendix A for information about the required mating connectors.

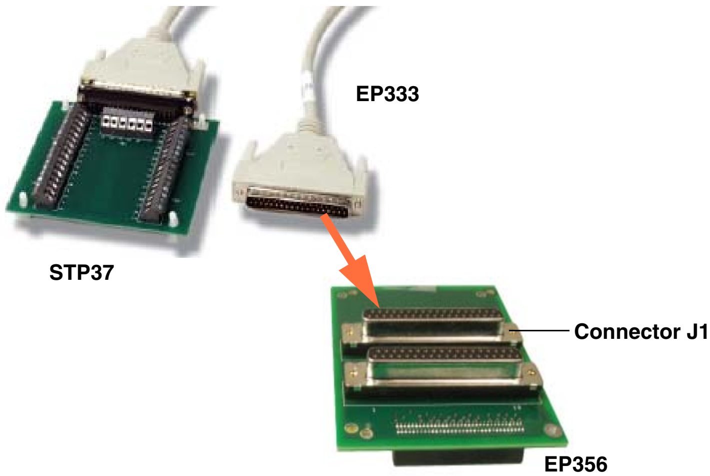


Figure 36: Connecting the STP37 Screw Terminal Panel to Connector J1 of the EP356 Accessory Panel Using the EP333 Cable

Table 46 lists the pin assignments for connector J1 on the EP356 accessory panel.

Table 46: EP356 Connector J1 Pin Assignments

Pin	Signal Description	Pin	Signal Description
1	Digital Input 0	20	Digital Output 0 or Digital Input 16[a]
2	Digital Input 1	21	Digital Output 1 or Digital Input 17[a]
3	Digital Input 2	22	Digital Output 2 or Digital Input 18[a]
4	Digital Input 3	23	Digital Output 3 or Digital Input 19[a]
5	Digital Input 4	24	Digital Output 4 or Digital Input 20[a]
6	Digital Input 5	25	Digital Output 5 or Digital Input 21[a]
7	Digital Input 6	26	Digital Output 6 or Digital Input 22[a]
8	Digital Input 7	27	Digital Output 7 or Digital Input 23[a]
9	Digital Input 8	28	Digital Output 8 or Digital Input 24[a]
10	Digital Input 9	29	Digital Output 9 or Digital Input 25[a]
11	Digital Input 10	30	Digital Output 10 or Digital Input 26[a]
12	Digital Input 11	31	Digital Output 11 or Digital Input 27[a]

Table 46: EP356 Connector J1 Pin Assignments (cont.)

Pin	Signal Description	Pin	Signal Description
13	Digital Input 12	32	Digital Output 12 or Digital Input 28[a]
14	Digital Input 13	33	Digital Output 13 or Digital Input 29[a]
15	Digital Input 14	34	Digital Output 14 or Digital Input 30[a]
16	Digital Input 15	35	Digital Output 15 or Digital Input 31[a]
17	Digital Ground	36	Dynamic Digital Output
18	Digital Ground	37	Digital Ground
19	Chassis Ground		

a. Used as a digital input line if the resolution of the digital input subsystem is 32; otherwise, used as a digital output line.

Connector J2

Use connector J2 on the EP356 accessory panel to attach counter/timer, trigger, and clock signals. You can access the pins on the connector J2 either by using the EP333 cable and STP37 screw terminal panel (available from Data Translation), shown in Figure 37, or by building your own cable/panel. To build your own cable/panel, refer to Appendix A for information about the required mating connectors.

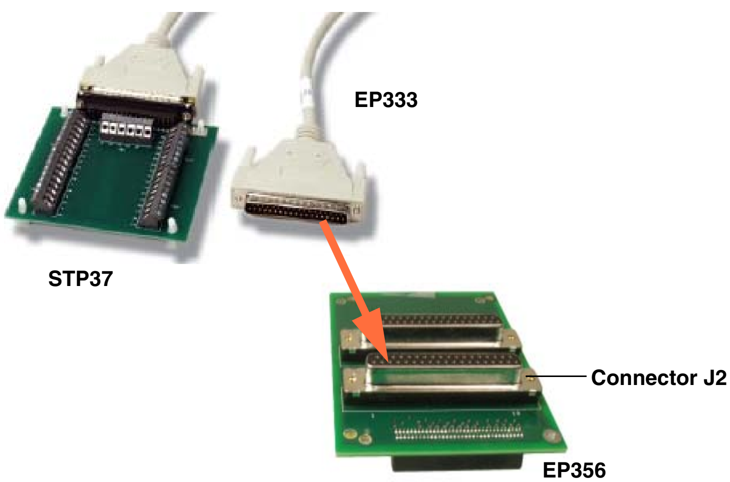


Figure 37: Connecting the STP37 Screw Terminal Panel to Connector J2 of the EP356 Accessory Panel Using the EP333 Cable

Table 47 lists the pin assignments for connector J2 on the EP356 accessory panel.

Table 47: EP356 Connector J2 Pin Assignments

Pin	Signal Description	Pin	Signal Description
1	Not Used	20	Not Used
2	Not Used	21	Not Used
3	Not Used	22	Not Used
4	Not Used	23	Not Used
5	Digital Ground	24	Digital Ground
6	Not Used	25	Not Used
7	External ADC Clock	26	External ADC Trigger
8	Counter 0 Clock	27	Digital Ground
9	Counter 0 Out	28	Counter 0 Gate
10	Counter 1 Clock	29	Digital Ground
11	Counter 1 Out	30	Counter 1 Gate
12	Counter 2 Clock	31	Digital Ground
13	Counter 2 Out	32	Counter 2 Gate
14	Counter 3 Clock	33	Digital Ground
15	Counter 3 Out	34	Counter 3 Gate
16	Counter 4 Clock	35	Digital Ground
17	Counter 4 Out	36	Counter 4 Gate
18	Digital Ground	37	Digital Ground
19	Chassis Ground		

EP355 Screw Terminal Assignments

To access analog input signals from the EP355 screw terminal panel, plug the EP355 panel into connector J2 on the DT9844-32-OEM module. To access digital I/O, counter/timer, external trigger, or external clock signals from the EP355 screw terminal panel, attach the EP355 panel to connector J3 on the DT9844-32-OEM module. Refer to Figure 38.

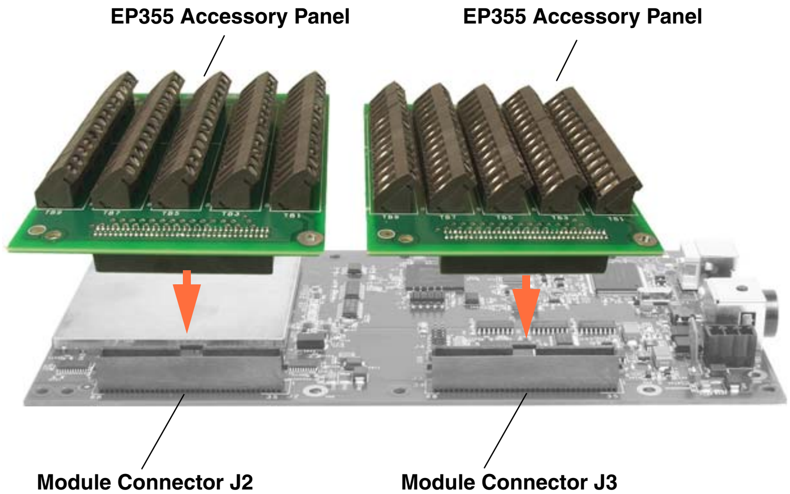


Figure 38: Connecting the EP355 Panel to the DT9844-32-OEM Module

Attached to Connector J2 on the DT9844-32-OEM Module

Attach the EP355 screw terminal panel to connector J2 on the DT9844-32-OEM module when you want to access the analog input signals. Table 48 lists the screw terminal assignments when the EP355 panel is attached to connector J2.

Table 48: Screw Terminal Assignments on the EP355 Screw Terminal Panel When Attached to Connector J2 of the Module

Screw Terminal	Terminal Block	Signal Description	Screw Terminal	Terminal Block	Signal Description
1	TB1	+5 V Analog	2	TB1	Amplifier Low
3	TB1	Analog Ground	4	TB2	Analog Input 15 DI/ Analog Input 23 SE[a]
5	TB2	Analog Ground	6	TB2	Analog Input 14 DI/ Analog Input 22 SE[a]
7	TB3	Analog Ground	8	TB3	Analog Input 13 DI/ Analog Input 21 SE[a]
9	TB3	Analog Ground	10	TB3	Analog Input 12 DI/ Analog Input 20 SE[a]
11	GND	Analog Ground	12	TB4	Analog Input 11 DI/ Analog Input 19 SE[a]
13	TB4	Analog Ground	14	TB5	Analog Input 10 DI/ Analog Input 18 SE[a]
15	TB5	Analog Ground	16	TB5	Analog Input 9 DI/ Analog Input 17 SE[a]
17	TB5	Analog Ground	18	TB6	Analog Input 8 DI/ Analog Input 16 SE[a]
19	TB6	Analog Ground	20	TB6	Analog In 7
21	TB7	Analog Ground	22	TB7	Analog In 6
23	TB7	Analog Ground	24	TB7	Analog In 5
25	TB8	Analog Ground	26	TB8	Analog In 4
27	TB8	Analog Ground	28	TB9	Analog In 3
29	TB10	Analog Ground	30	TB10	Analog In 2
31	TB10	Analog Ground	32	TB9	Analog In 1
33	TB9	Analog Ground	34	TB9	Analog In 0
35	TB1	Digital Ground	36	GND	Analog Ground
37	TB1	Analog Ground	38	TB2	Analog In 15 DI Return/Analog In 31 SE[a]
39	TB2	Analog Ground	40	TB2	Analog In 14 DI Return/Analog In 30 SE[a]
41	TB3	Analog Ground	42	TB3	Analog In 13 DI Return/Analog In 29 SE[a]
43	TB3	Analog Ground	44	TB3	Analog In 12 DI Return/Analog In 28 SE[a]
45	TB4	Analog Ground	46	TB4	Analog In 11 DI Return/Analog In 27 SE[a]
47	TB4	Analog Ground	48	TB5	Analog In 10 DI Return/Analog In 26 SE[a]
49	TB5	Analog Ground	50	TB5	Analog In 9 DI Return/Analog In 25 SE[a]
51	TB5	Analog Ground	52	TB6	Analog In 8 DI Return/Analog In 24 SE[a]
53	TB6	Analog Ground	54	TB6	Analog In 7 DI Return/Analog In 15 SE[a]
55	TB7	Analog Ground	56	TB7	Analog In 6 DI Return/Analog In 14SE[a]
57	TB7	Analog Ground	58	TB7	Analog In 5 DI Return/Analog In 13 SE[a]
59	TB8	Analog Ground	60	TB8	Analog In 4 DI Return/Analog In 12 SE[a]
61	TB8	Analog Ground	62	TB9	Analog In 3 DI Return/Analog In 11 SE[a]

Table 48: Screw Terminal Assignments on the EP355 Screw Terminal Panel When Attached to Connector J2 of the Module (cont.)

Screw Terminal	Terminal Block	Signal Description	Screw Terminal	Terminal Block	Signal Description
63	TB10	Analog Ground	64	TB10	Analog In 2 DI Return/Analog In 10 SE[a]
65	TB10	Analog Ground	66	TB9	Analog In 1 DI Return/Analog In 9 SE[a]
67	TB9	Analog Ground	68	TB9	Analog In 0 DI Return/Analog In 8 SE[a]

a. The first signal description applies to the differential (DI) configuration; the second signal description applies to the single-ended (SE) configuration on the DT9844-32-OEM module.

Attached to Connector J3 on the DT9844-32-OEM Module

Attach the EP355 screw terminal panel to connector J3 on the DT9844-32-OEM module when you want to access the counter/timer, digital I/O, trigger, and clock signals. Table 49 lists the screw terminal assignments when the EP355 panel is attached to connector J3.

Table 49: Screw Terminal Assignments on the EP355 Screw Terminal Panel When Attached to Connector J3 of the Module

Screw Terminal	Terminal Block	Signal Description	Screw Terminal	Terminal Block	Signal Description
1	TB1	Counter 4 Out	2	TB1	Counter 4 Clock
3	TB1	Counter 3 Out	4	TB2	Counter 3 Clock
5	TB2	Counter 2 Out	6	TB2	Counter 2 Clock
7	TB3	Counter 1 Out	8	TB3	Counter 1 Clock
9	TB3	Counter 0 Out	10	TB3	Counter 0 Clock
11	GND	Digital Ground	12	TB4	Digital Input 15
13	TB4	Digital Input 14	14	TB5	Digital Input 13
15	TB5	Digital Input 12	16	TB5	Digital Input 11
17	TB5	Digital Input 10	18	TB6	Digital Input 9
19	TB6	Digital Input 8	20	TB6	Digital Input 7
21	TB7	Digital Input 6	22	TB7	Digital Input 5
23	TB7	Digital Input 4	24	TB7	Digital Input 3
25	TB8	Digital Input 2	26	TB8	Digital Input 1
27	TB8	Digital Input 0	28	TB9	External ADC Clock
29	TB10	Not Used	30	TB10	Digital Ground
31	TB10	Not Used	32	TB9	Not Used
33	TB9	Not Used	34	TB9	Not Used

Table 49: Screw Terminal Assignments on the EP355 Screw Terminal Panel When Attached to Connector J3 of the Module (cont.)

Screw Terminal	Terminal Block	Signal Description	Screw Terminal	Terminal Block	Signal Description
35	TB1	Counter 4 Gate	36	GND	Digital Ground
37	TB1	Counter 3 Gate	38	TB2	Digital Ground
39	TB2	Counter 2 Gate	40	TB2	Digital Ground
41	TB3	Counter 1 Gate	42	TB3	Digital Ground
43	TB3	Counter 0 Gate	44	TB3	Digital Ground
45	TB4	Dynamic Digital Out	46	TB4	Digital Out 15
47	TB4	Digital Out 14	48	TB5	Digital Out 13
49	TB5	Digital Out 12	50	TB5	Digital Out 11
51	TB5	Digital Out 10	52	TB6	Digital Out 9
53	TB6	Digital Out 8	54	TB6	Digital Out 7
55	TB7	Digital Out 6	56	TB7	Digital Out 5
57	TB7	Digital Out 4	58	TB7	Digital Out 3
59	TB8	Digital Out 2	60	TB8	Digital Out 1
61	TB8	Digital Out 0	62	TB9	External ADC Trigger
63	TB10	Not Used	64	TB10	Digital Ground
65	TB10	Not Used	66	TB9	Not Used
67	TB9	Not Used	68	TB9	Not Used

LED Status Indicators

Each DT9844 module has a single bi-color LED that indicates the status of the module, as described in Table 50.

Table 50: LED Status Indicators on the DT9844 Modules

Color of the LED	Status Description
Green	Module is powered
Blinking amber	Module is acquiring data

C

Ground, Power, and Isolation

Secondary Power and Chassis Ground Connections

The DT9844-32-OEM module provides a secondary power connector, which is useful for embedded applications. The location of the secondary power connector and the chassis ground connections are shown in Figure 39.

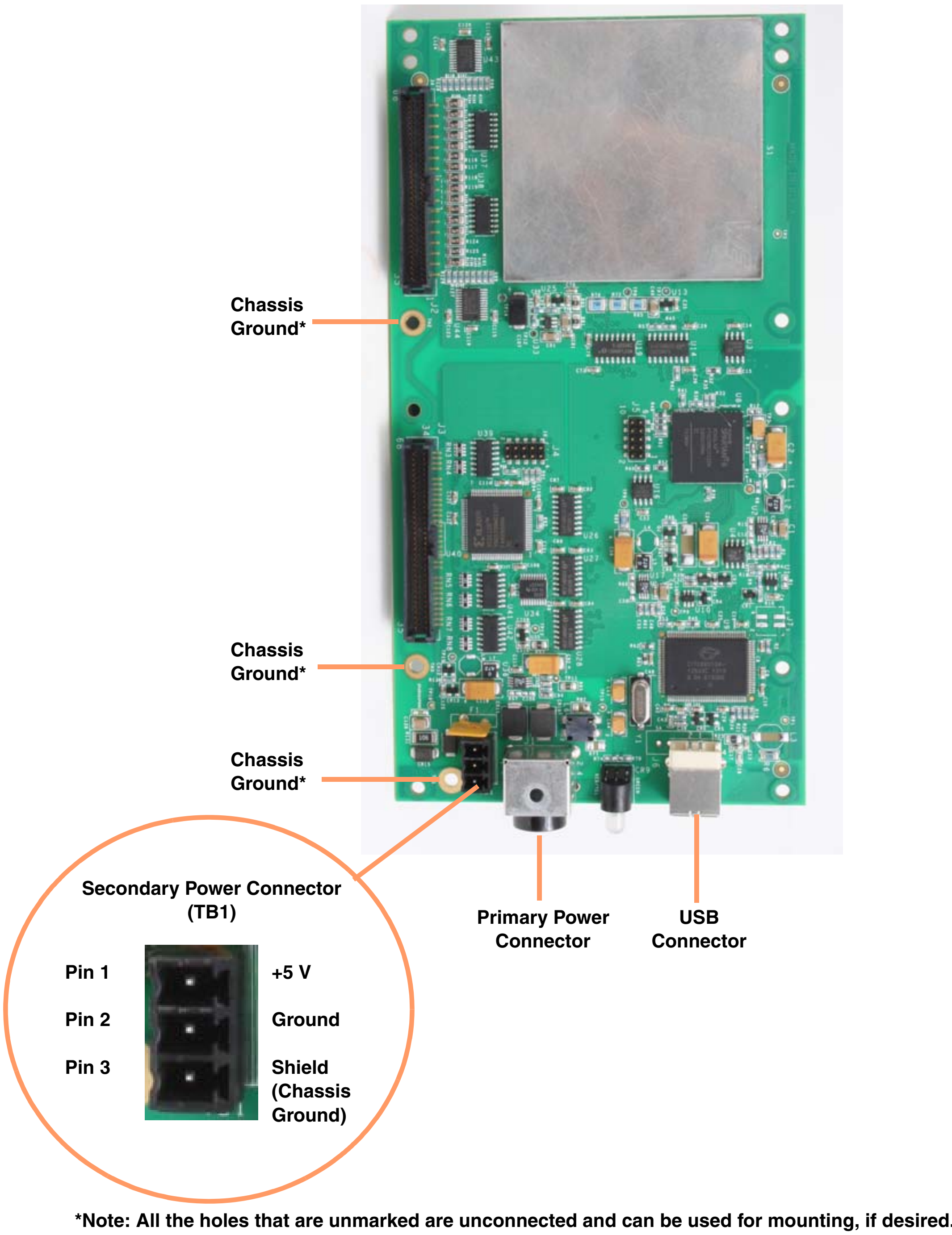


Figure 39: Secondary Power Connector and Chassis Ground Connections

The pin assignments for the secondary power connector (TB1) are as follows:

- **Pin 1** = +5 V
- **Pin 2** = Ground
- **Pin 3** = Shield (chassis ground)

Note: Connect pin 3 (chassis ground) to earth ground using 18 gauge stranded wire.

Ground, Power, and Isolation Connections

Figure 40 illustrates how ground, power, and isolation are connected on a DT9844 module.

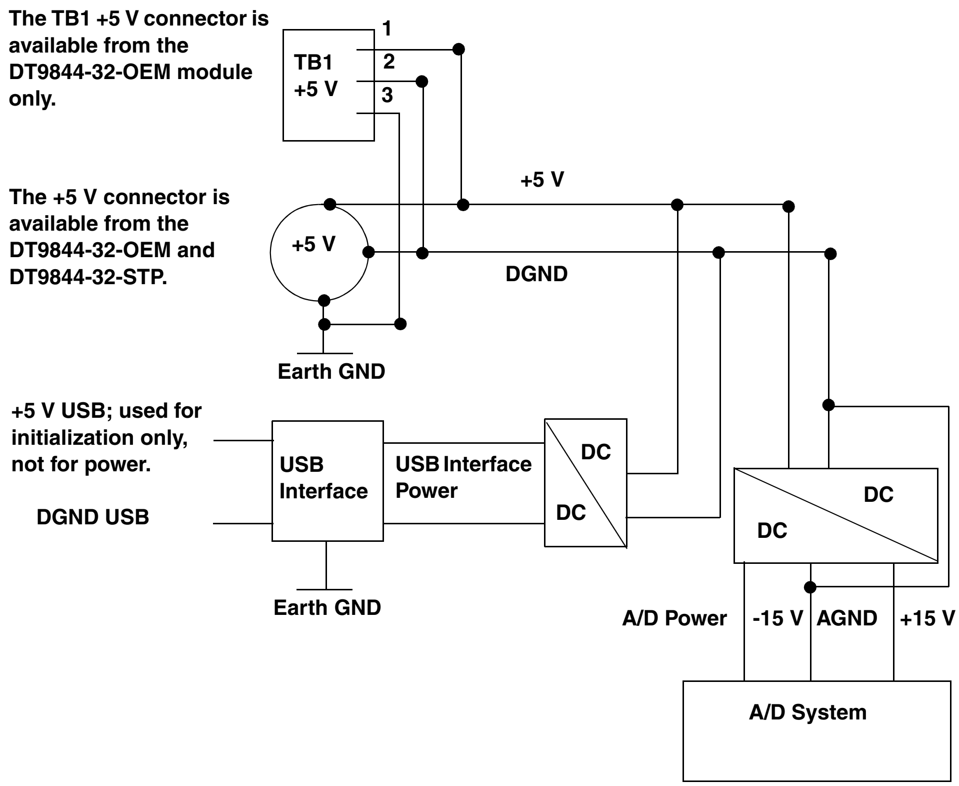


Figure 40: Ground, Power, and Isolation Connections

Keep the following in mind:

- Earth ground on the DT9844 module is not connected to DGND or AGND.
- Earth ground is connected to the aluminum case of the STP box.
- You should connect earth ground to the power supply earth.
- You should isolate the +5V/DGND input. Note that the EP361 power supply (shipped with the STP box and available from Data Translation for the OEM version of the module) has no connection between +5V/DGND and earth ground.
- The USB connector case is connected to earth ground.
- The USB data lines and USB GND are not connected to earth ground.
- The USB DGND is connected to the USB GND of the PC USB port.

Index

D

E

F

G

P

Q

R

S

T

U

V

W