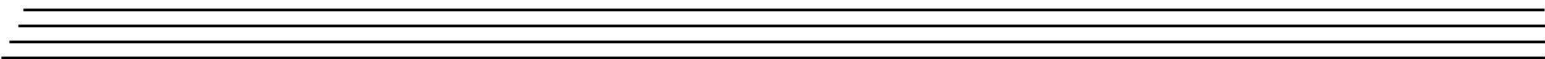
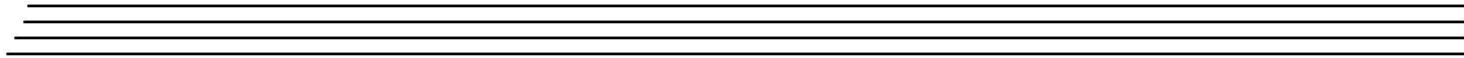
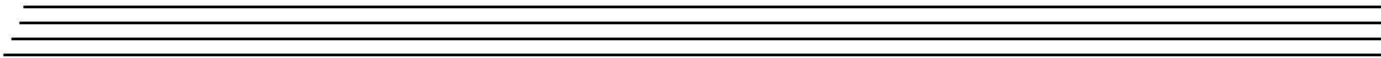




UM-21223-T

DT9810 and DT9817 Series User's Manual



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

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

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

Canadian Department of Communications Statement

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

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

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About this Manual

The first part of this manual describes how to install and set up your DT9810, DT9817, DT9817-H, or DT9817-R module and software, and verify that your module is working properly.

The second part of this manual describes the features of the DT9810, DT9817, DT9817-H, and DT9817-R modules and device drivers, and how to program these modules using the DT-Open Layers for .NET Class Library™ software. Troubleshooting information is also provided.

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

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

Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for using and/or programming the modules for analog input, digital I/O, or counter/timer operations in the Microsoft® Windows® XP, 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 DT9810, DT9817, DT9817-H, and DT9817-R modules, as well as the supported software and accessories for the modules.
- [Chapter 2, “Setting Up and Installing the Module,”](#) describes how to install the module and how to configure the device driver.
- [Chapter 3, “Wiring Signals to the Module,”](#) describes how to wire signals to the module.
- [Chapter 4, “Verifying the Operation of a Module,”](#) describes how to verify the operation of the module with the Quick DataAcq application.
- [Chapter 5, “Principles of Operation,”](#) describes all of the features of the modules and how to use them in your application.
- [Chapter 6, “Supported Device Driver Capabilities,”](#) lists the supported subsystems and the associated capabilities accessible using the device driver for the modules.

- [Chapter 7, “Troubleshooting,”](#) provides information that you can use to resolve problems with a module, should they occur.
- [Appendix A, “Specifications,”](#) lists the specifications of the DT9810, DT9817, DT9817-H, and DT9817-R modules.
- [Appendix B, “Screw Terminal Assignments,”](#) shows the screw terminal assignments of the modules.
- An index completes this manual.

Conventions Used in this Manual

The following conventions are used in this manual:

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

Related Information

Refer to the following documents for more information on using the DT9810, DT9817, DT9817-H, and DT9817-R 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 Digilent web site (www.digilent.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 XP, 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 module, the Digilent's 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 contact information is available on our web site (www.digilent.com).



Overview

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Key Hardware Features

The DT9810, DT9817, DT9817-H, and DT9817-R modules are economy, multifunction mini-instruments. [Figure 1](#) shows a DT9810 module.



Figure 1: DT9810 Module

[Table 1](#) lists the key features of each module.

Table 1: Key Features of the DT9810 and DT9817 Series Modules

Module	Analog Inputs	Analog Input Resolution	I/O Range	Analog Input Sample Rate	Digital I/O	C/T
DT9810	8 SE	10-bit	0 to 2.44 V	25 kS/s	20 I/O	1
DT9817	–	–	–	–	28 I/O	1
DT9817-H	–	–	–	–	28 I/O High Drive	1
DT9817-R	–	–	–	–	8 In/8 Out High Drive Functionally Isolated	1

Analog Inputs

The DT9810 module features a 16-location channel list that lets you cycle through a list of analog input channels continuously (continuous scan mode) using the internal clock.

Counter/Timer Channel

These modules support one 32-bit counter/timer channel. This counter/timer allows you to perform event counting, frequency measurement, edge-to-edge measurement, and continuous pulse output (rate generation) operations.

Digital I/O Lines

Some of the key digital I/O features are described below.

DT9817-H

The DT9817-H module sources up to 15 mA and sinks up to 64 mA of current on the digital I/O ports.

DT9817-R

The DT9817-R is a robust, industrial-grade module that provides the following additional features:

- 8 channel-to-channel opto-isolated digital inputs
- 8 channel-to-channel opto-isolated digital outputs
- AC or DC input signal sensing from ± 3 V to ± 32 V
- Switch up to ± 30 V at 400 mA peak (60 V PP) (AC or DC) at the digital output ports
- Functional isolation channel-to-channel

Supported Software

The following software is available for use with the DT9810 and DT9817 Series modules, and is provided on the OMNI CD:

- **DT9810 Device Driver** – The DT9810 Device Driver allows you to use a DT9810 or DT9817 Series module with any of the supported software packages or utilities. Refer to [page 30](#) for configuring the device driver.
- **Quick DataAcq application** – The Quick DataAcq application provides a quick way to get up and running using a DT9810 or DT9817 Series module. Using this application, you can verify key features of the modules, display data on the screen, and save data to disk. Refer to [Chapter 4](#) for more information on using the Quick DataAcq application.
- **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.
- **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 DT9810 or DT9817 Series module using Visual Studio 2003-2012; 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 DT9810 or DT9817 Series module using Windows XP, 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** – An evaluation version of LV-Link is included on the Data Acquisition OMNI CD. Use this software package if you want to use the LabVIEW graphical programming language to access the capabilities of the DT9810 and DT9817 Series modules.

Refer to the Digilent web site (www.digilent.com) for information about selecting the right software package for your needs.

Getting Started Procedure

The flow diagram shown in [Figure 2](#) illustrates the steps needed to get started using the DT9810, DT9817, DT9817-H, and DT9817-R modules. 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.

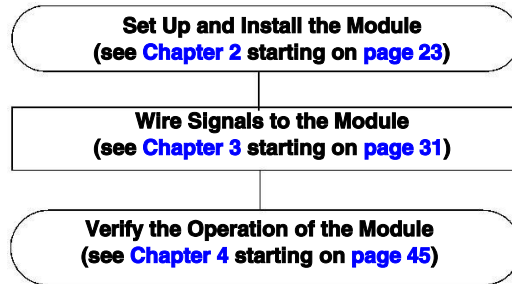


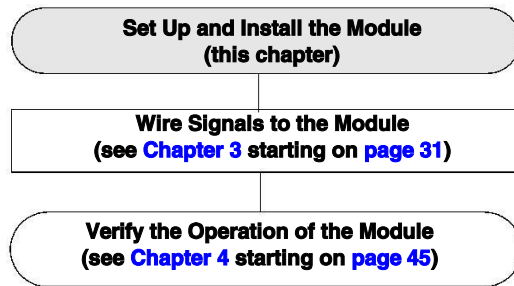
Figure 2: Getting Started Flow Diagram

Part 1: Getting Started



Setting Up and Installing the Module

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Unpacking

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

- DT9810, DT9817, DT9817-H or DT9817-R module
- USB cable

If an item is missing or damaged, contact Digilent. 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; see our web site (www.digilent.com) for contact information.

Note: The DT9810 module is factory-calibrated and requires no further adjustment.

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), or Windows XP SP3 (32-bit)
- Disk Space: 4 GB

Attaching Modules to the Computer

This section describes how to attach a DT9810, DT9817, DT9817-H, or DT9817-R module to the host computer.

Note: Most computers have several USB ports that allow direct connection to USB devices. If your application requires more 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 28](#).

You can unplug a module, and 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.

Connecting Directly to the USB Ports

To connect modules directly to the USB ports of your computer, do the following:

1. Attach one end of the USB cable to the USB port on the module.
2. Attach the other end of the USB cable to one of the USB ports on the host computer, as shown in [Figure 3](#).

The operating system automatically detects the USB module and starts the Found New Hardware wizard.

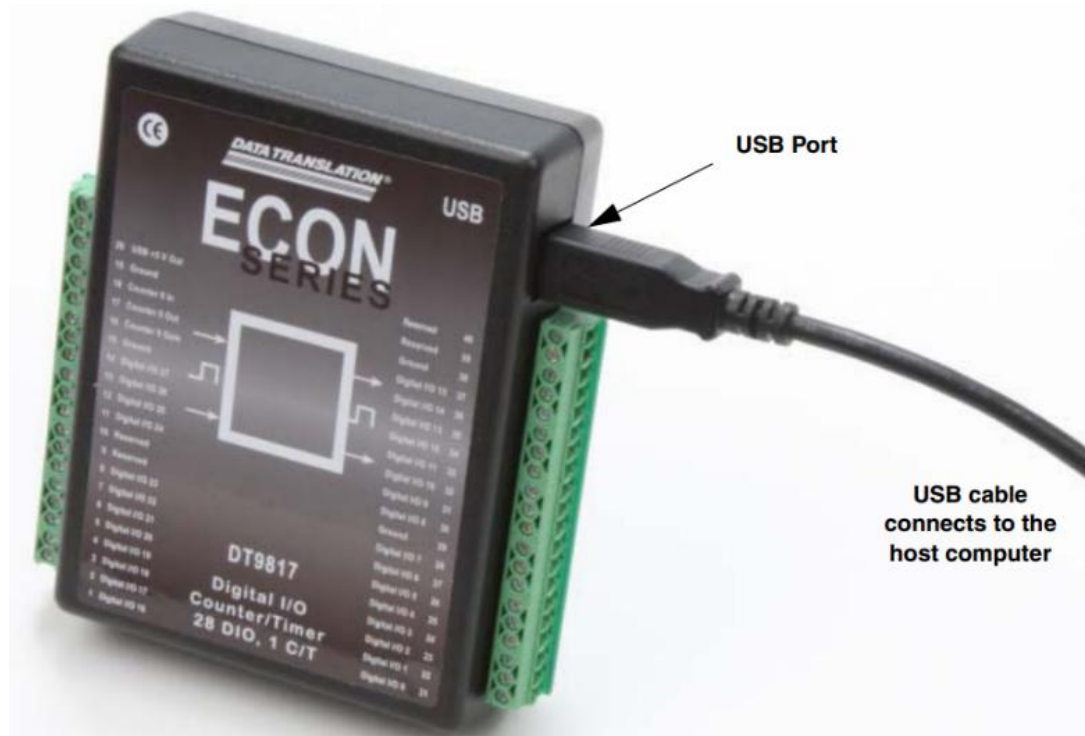


Figure 3: Attaching the Module to the Host Computer

3. For Windows Vista:

- a. Click **Locate and install driver software (recommended)**.
The popup message "Windows needs your permission to continue" appears.
- b. Click **Continue**.
The Windows Security dialog box appears.
- c. Click **Install this driver software anyway**.
The LED on the module turns green.

For Windows XP:

- a. Click **Next** and/or **Finish** as required in the wizard.
Once the firmware is loaded, the wizard restarts to initiate the firmware to accept commands.
- b. Click **Next** and/or **Finish** again.
The LED on the module turns green.

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

4. Repeat these steps to attach another 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 modules that you can connect to a single USB port depends on the throughput you want to achieve.

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

1. Attach one end of the USB cable to the module and the other end of the USB cable to an expansion hub.
2. Connect the power supply for the expansion hub to an external power supply.
3. Connect the expansion hub to the USB port on the host computer using another USB cable.
The operating system automatically detects the USB device and starts the Found New Hardware wizard.
4. For Windows Vista:
 - a. Click **Locate and install driver software (recommended)**.
The popup message "Windows needs your permission to continue" appears.
 - b. Click **Continue**.
The Windows Security dialog box appears.
 - c. Click **Install this driver software anyway**.
The LED on the module turns green.

For Windows XP:

- a. Click **Next** and/or **Finish** as required in the wizard.
Once the firmware is loaded, the wizard restarts to initiate the firmware to accept commands.
- b. Click **Next** and/or **Finish** again.
The LED on the module turns green.

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

5. Repeat these steps until you have attached the number of expansion hubs and modules that you require. Refer to [Figure 4](#).
The operating system automatically detects the USB devices as they are installed.

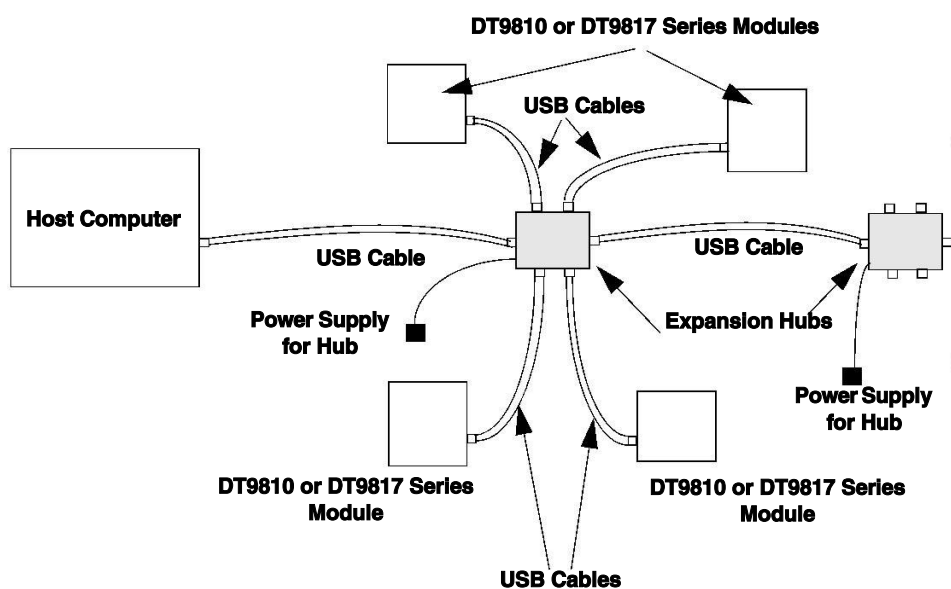


Figure 4: Attaching Multiple Modules Using Expansion Hubs

Changing the Name of a Module (Optional)

To change the name of a module, configure the device driver as follows:

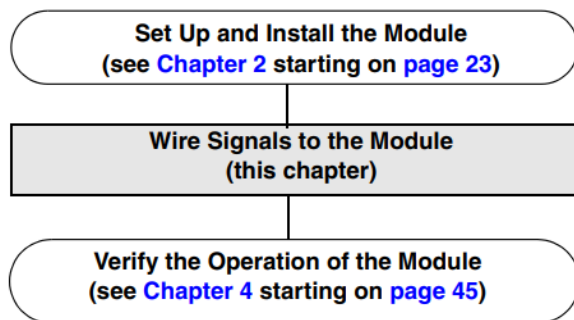
1. From the Windows **Start** menu, select **Settings | Control Panel**.
2. From the Control Panel, double-click **Open Layers Control Panel**.
The Data Acquisition Control Panel dialog box appears.
3. Click the module that you want to rename, and then click **Edit Name**.
4. Enter a new name for the module, and then click **OK**. The name is used to identify the module in all subsequent applications.
5. When you are finished configuring the module, click **Close**.
6. Repeat steps 3 to 5 for the other modules that you want to configure.
7. Close the Data Acquisition Control Panel dialog box.

Continue with the instructions on wiring in [Chapter 3](#) starting on [page 31](#).



Wiring Signals to the Module

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Preparing to Wire Signals

This section provides recommendations and information about wiring signals to a DT9810, DT9817, DT9817-H, or DT9817-R module.

Wiring Recommendations

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

- Follow standard ESD procedures when wiring signals to the module.
- Use individually shielded twisted-pair wire (size 16 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 metal shield.
- Prevent electrostatic discharge to the I/O while the box is operational.
- Connect all unused analog input channels to analog ground.

Wiring Locations

You wire signals to the DT9810, DT9817, DT9817-H, or DT9817-R module using the screw terminals on the module. [Figure 5](#) shows an example how to wire to the screw terminals of a DT9817 module.



Figure 5: Wiring to the Screw Terminals of a Module

[Table 2](#) lists the screw terminal assignments for the DT9810 module; [Table 3](#) lists the screw terminals for the DT9817 and DT9817-H modules; [Table 4](#) lists the screw terminals for the DT9817-R module.

Table 2: DT9810 Screw Terminal Assignments

Screw Terminal	Signal	Screw Terminal	Signal
20	USB +5 V Out	40	Reserved
19	Ground	39	Reserved
18	Counter 0 In	38	Ground
17	Counter 0 Out	37	Digital I/O 15
16	Counter 0 Gate	36	Digital I/O 14
15	Ground	35	Digital I/O 13
14	Digital I/O 19	34	Digital I/O 12
13	Digital I/O 18	33	Digital I/O 11
12	Digital I/O 17	32	Digital I/O 10
11	Digital I/O 16	31	Digital I/O 9
10	2.44 V Reference	30	Digital I/O 8
9	Analog Ground	29	Ground
8	Analog Input CH7	28	Digital I/O 7
7	Analog Input CH6	27	Digital I/O 6
6	Analog Input CH5	26	Digital I/O 5
5	Analog Input CH4	25	Digital I/O 4
4	Analog Input CH3	24	Digital I/O 3
3	Analog Input CH2	23	Digital I/O 2
2	Analog Input CH1	22	Digital I/O 1
1	Analog Input CH0	21	Digital I/O 0

Table 3: DT9817 and DT9817-H Screw Terminal Assignments

Screw Terminal	Signal	Screw Terminal	Signal
20	USB +5 V Out	40	Reserved
19	Ground	39	Reserved
18	Counter 0 In	38	Ground
17	Counter 0 Out	37	Digital I/O 15
16	Counter 0 Gate	36	Digital I/O 14
15	Ground	35	Digital I/O 13
14	Digital I/O 27	34	Digital I/O 12
13	Digital I/O 26	33	Digital I/O 11
12	Digital I/O 25	32	Digital I/O 10
11	Digital I/O 24	31	Digital I/O 9
10	Reserved	30	Digital I/O 8
9	Ground	29	Ground
8	Digital I/O 23	28	Digital I/O 7
7	Digital I/O 22	27	Digital I/O 6
6	Digital I/O 21	26	Digital I/O 5
5	Digital I/O 20	25	Digital I/O 4
4	Digital I/O 19	24	Digital I/O 3
3	Digital I/O 18	23	Digital I/O 2
2	Digital I/O 17	22	Digital I/O 1
1	Digital I/O 16	21	Digital I/O 0

Table 4: DT9817-R Screw Terminal Assignments

Screw Terminal	Signal	Screw Terminal	Signal
20	+5V Out @ 10mA isolated ^a	40	Reserved
19	Isolated Ground ^b	39	Counter 0 Out
18	Counter 0 In	38	Isolated Ground ^b
17	Counter 0 Gate	37	Reserved
16	Digital In 7 Low	36	Digital Out 7 Low
15	Digital In 7 High	35	Digital Out 7 High
14	Digital In 6 Low	34	Digital Out 6 Low
13	Digital In 6 High	33	Digital Out 6 High
12	Digital In 5 Low	32	Digital Out 5 Low
11	Digital In 5 High	31	Digital Out 5 High
10	Digital In 4 Low	30	Digital Out 4 Low
9	Digital In 4 High	29	Digital Out 4 High
8	Digital In 3 Low	28	Digital Out 3 Low
7	Digital In 3 High	27	Digital Out 3 High
6	Digital In 2 Low	26	Digital Out 2 Low
5	Digital In 2 High	25	Digital Out 2 High
4	Digital In 1 Low	24	Digital Out 1 Low
3	Digital In 1 High	23	Digital Out 1 High
2	Digital In 0 Low	22	Digital Out 0 Low
1	Digital In 0 High	21	Digital Out 0 High

a. Functionally isolated from USB +5V

b. Functionally isolated from USB GND

Connecting Single-Ended Analog Input Signals

Note: Skip this section if you are using a DT9817 Series module.

The DT9810 supports 8 single-ended analog input channels. [Figure 6](#) shows how to connect single-ended voltage input signals (channels 0 and 1, in this case) to the screw terminals of a DT9810 module.

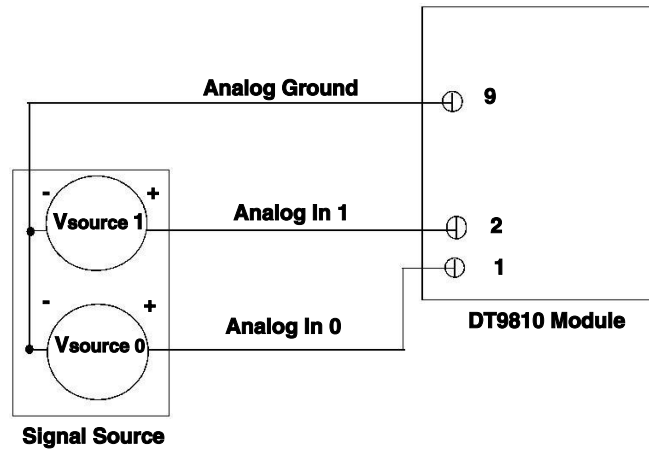


Figure 6: Connecting Single-Ended Inputs

Connecting Digital Input Signals

Figure 7 shows how to connect digital input signals (lines 0 and 1, in this case) to the screw terminals of a DT9810, DT9817, or DT9817-H module.

Note: Ensure that you also configure these lines for input using software.

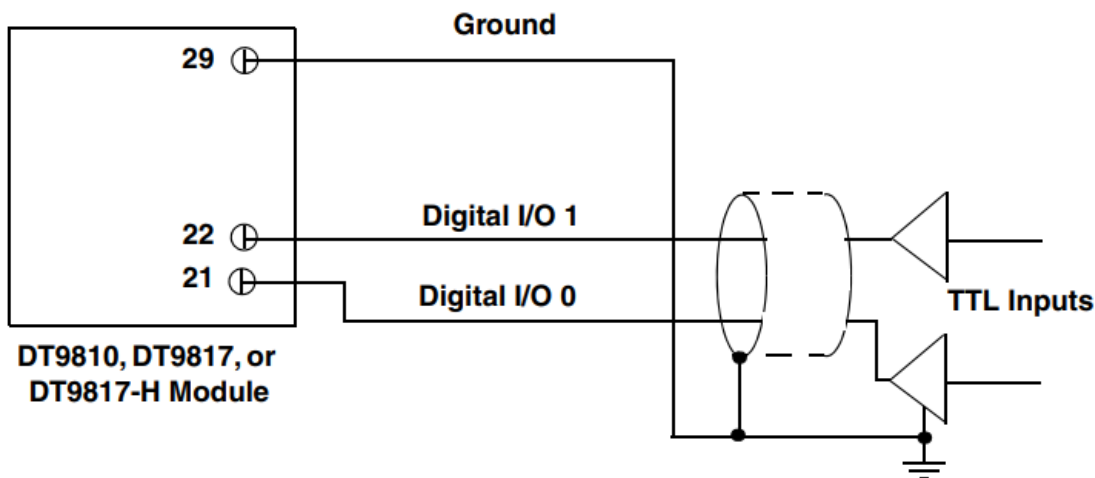
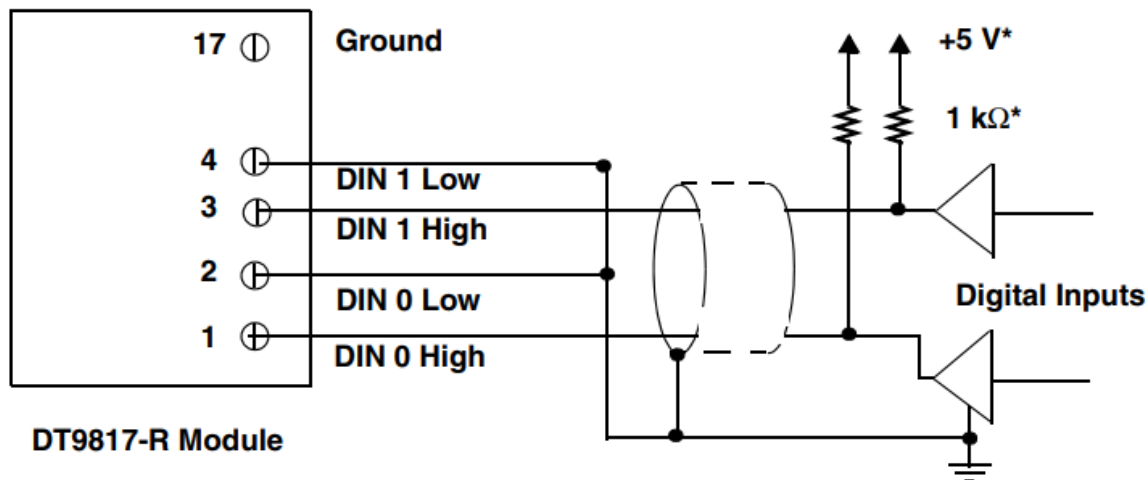


Figure 7: Connecting Digital Inputs

Figure 8 shows how to connect digital input signals (lines 0 and 1, in this case) to the screw terminals of a DT9817-R module.



*1 kΩ pull-up to +5 V required for TTL inputs.

Figure 8: Connecting Digital Inputs to a DT9817-R

Connecting Digital Output Signals

Figure 9 shows how to connect digital output signals (line 8, in this case) at the screw terminals of a DT9810, DT9817, or DT9817-H module.

Note: Ensure that you also configure this line for output using software.

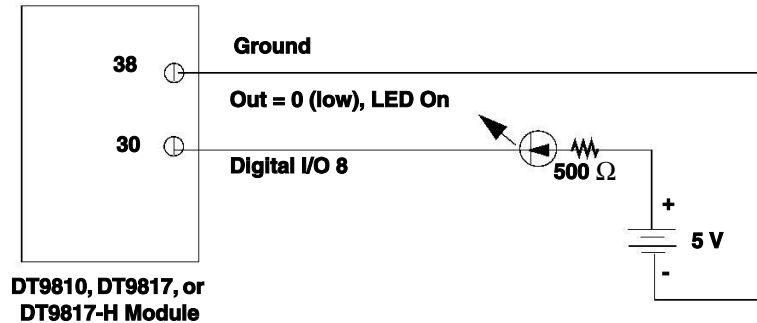


Figure 9: Connecting Digital Outputs

DT9817-H High-Drive Applications

For high-drive applications, use the DT9817-H module. Figure 10 shows how to connect DT9817-H digital output signals to sink up to 64 mA. Figure 11 shows how to connect DT9817-H digital outputs to source up to 15 mA.

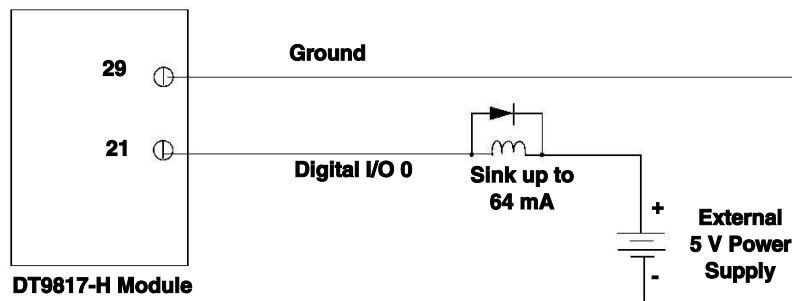


Figure 10: Sinking up to 64 mA with the DT9817-H Module

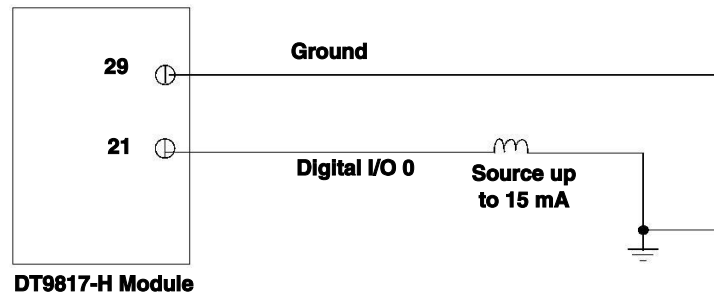


Figure 11: Sourcing up to 15 mA with the DT9817-H Module

DT9817-R

The digital output lines of the DT9817-R instrument act as a solid-state relay. The customer-supplied signal can be ± 30 V at up to 400 mA (peak) AC or DC.

You can use the digital output lines of the DT9817-R temperature instrument to control solid-state or mechanical relays or high-current electric motors. [Figure 12](#) shows how to connect DT9817-R digital output signals to control a device under test (DUT).

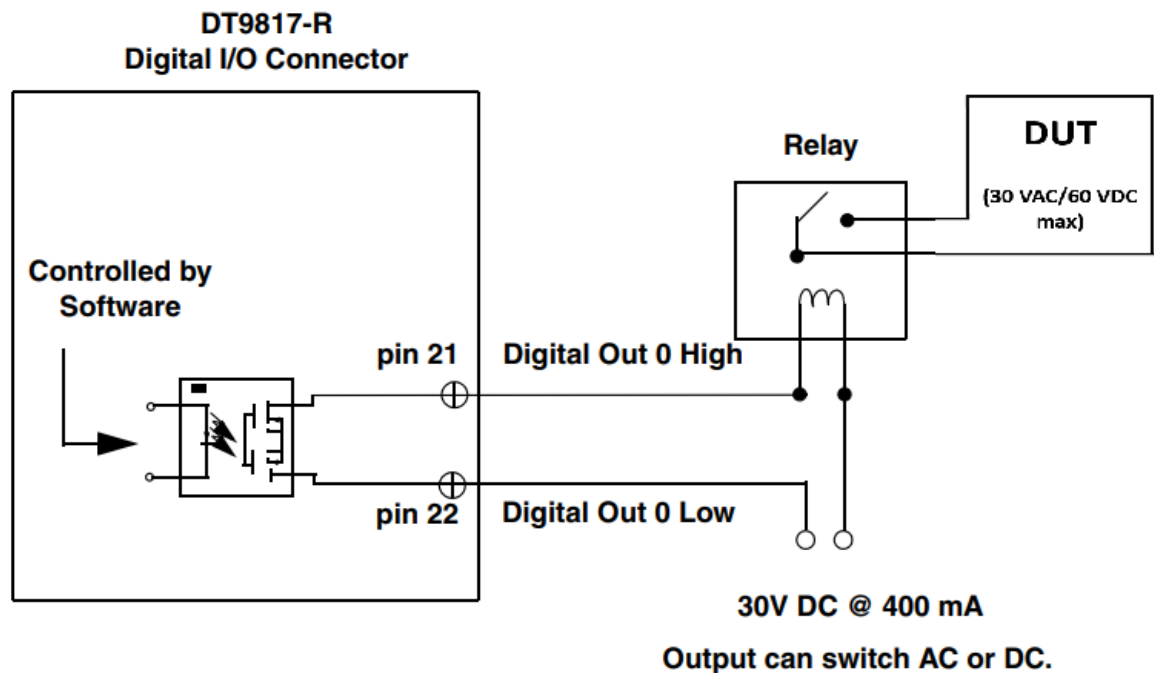


Figure 12: Switching up to 30 V at 400mA with the DT9817-R Module

Connecting Counter/Timer Signals

The DT9810, DT9817, DT9817-H, and DT9817-R modules provide one counter/timer that you can use for the following operations:

- Event counting
- Frequency measurement
- Edge-to-edge measurement
- Continuous pulse output (rate generation)

This section describes how to connect counter/timer signals for these operation modes. Refer to [page 68](#) for more information about using the counter/timers.

Event Counting

[Figure 13](#) shows how to connect counter/timer signals to the screw terminals on the module to perform an event counting operation using an external gate.

In this example, the counter counts the number of falling edges that occur on the Counter 0 In signal when the Counter 0 Gate signal is in the active state (as specified by software). Refer to [page 70](#) for more information.

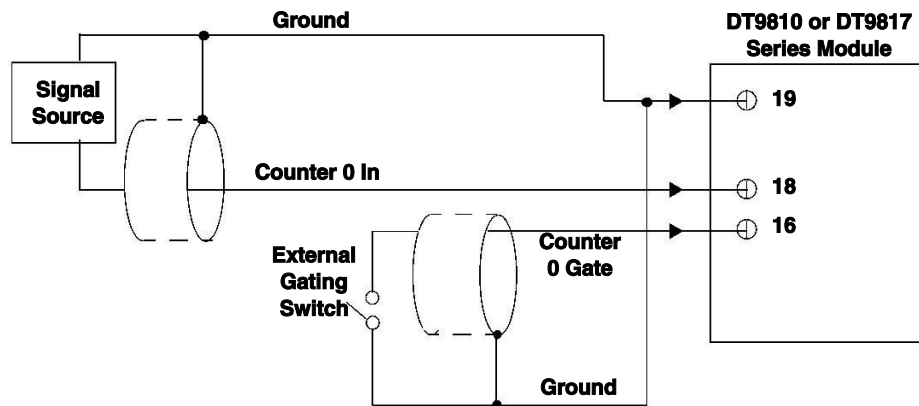


Figure 13: Connecting Counter/Timer Signals for an Event Counting Operation Using an External Gate

Figure 14 shows how to connect counter/timer signals to the screw terminals on the module to perform an event counting operation without using a gate (also called a software gate). The counter counts the number of falling edges that occur on the Counter 0 In signal.

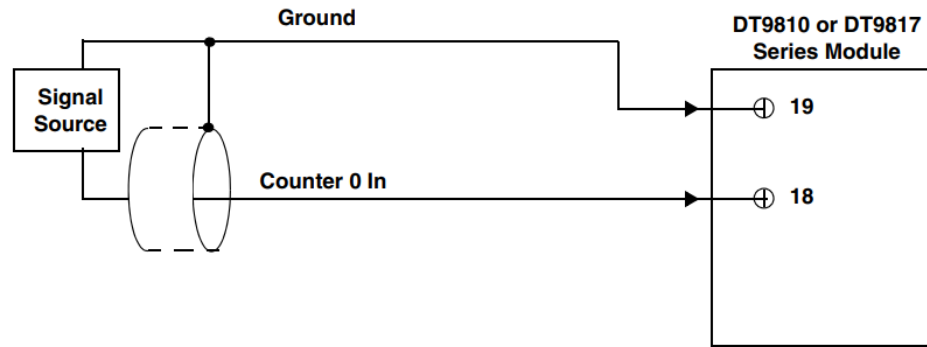


Figure 14: Connecting Counter/Timer Signals for an Event Counting Operation Without Using a Gate

Frequency Measurement

One way to measure frequency is to connect a pulse of a known duration to the Counter 0 Gate signal, as shown in Figure 15. In this case, the frequency of the Counter 0 In signal is the number of counts divided by the period of the signal connected to the Counter 0 Gate input.

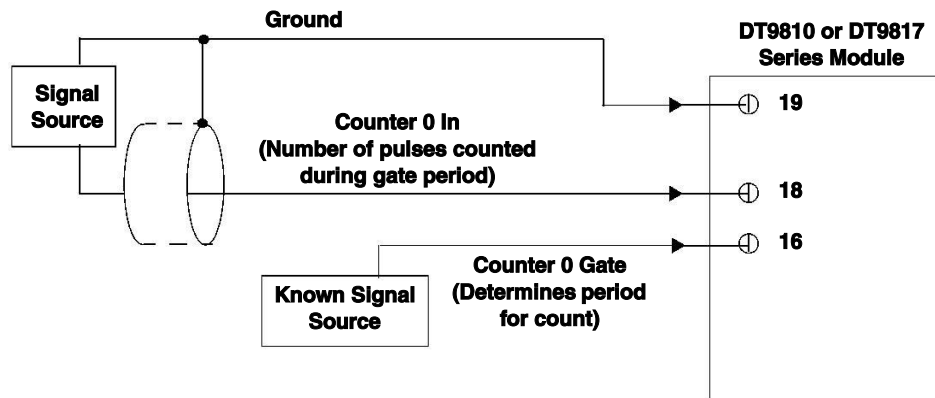


Figure 15: Connecting Counter/Timer Signals for a Frequency Measurement Operation Using an External Pulse

Edge-to-Edge Measurement

Figure 16 shows how to connect counter/timer signals to the module to perform an edge-to-edge measurement operation on one signal sources. The counter measures the number of counts between the start edge (in this case, a rising edge on the Counter 0 Gate signal) and the stop edge (in this case, another rising edge on the Counter 0 Gate signal).

You specify the start edge and the stop edge in software. Refer to [page 71](#) for more information.

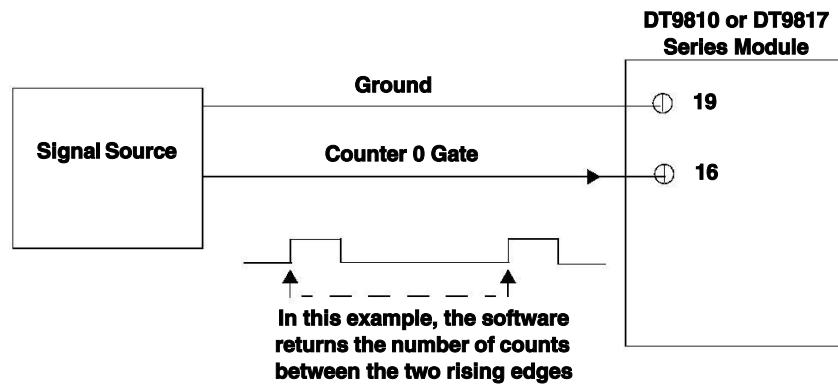


Figure 16: Connecting Counter/Timer Signals for an Edge-to-Edge Measurement Operation

You can use edge-to-edge measurement to measure the following characteristics of a signal:

- Pulse width – 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/24 MHz
- Period – 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/24 MHz
- Frequency – The number of periods per second. You can calculate the frequency as follows:
 - Frequency = 24 MHz/Number of Counts

Rate Generation

Figure 17 shows how to connect counter/timer signals to the screw terminals of a module to perform a rate generation (continuous pulse output) operation; in this example, an external gate is used.

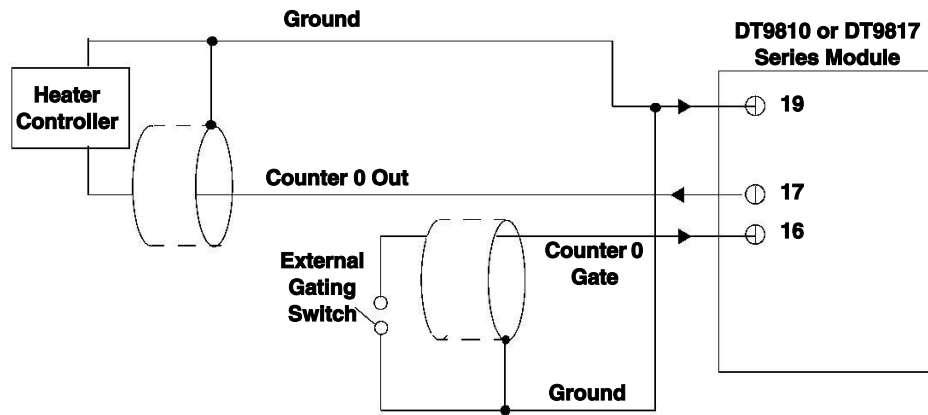
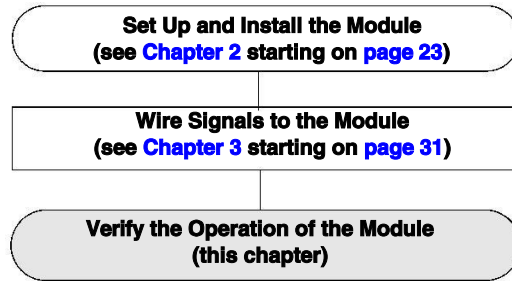


Figure 17: Connecting Counter/Timer Signals for a Rate Generation Operation Using an External Gate



Verifying the Operation of a Module

Running the Quick DataAcq Application.....	47
Testing Single-Value Analog Input	48
Testing Continuous Analog Input	49
Testing Single-Value Digital Input.....	50
Testing Single-Value Digital Output	51
Testing Frequency Measurement.....	52
Testing Pulse Output	53



Running the Quick DataAcq Application

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

To run the Quick DataAcq application, do the following:

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

The main menu appears.

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

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

Testing Single-Value Analog Input

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

1. Connect a voltage source, such as a function generator, to analog input channel 0 (single-ended mode) on the DT9810 module. Refer to [page 37](#) for an example of how to connect a single-ended analog input.
2. In the Quick DataAcq application, choose **Single Analog Input** from the **Acquisition** menu.
3. Select the appropriate DT9810 module from the **Board** list box.
4. In the **Channel** list box, select analog input channel 0.
5. In the **Range** list box, select the range for the channel (0 to 2.44 V).
6. Select **Single Ended**.
7. Click **Get** to acquire a single value from analog input channel 0.
The application displays the value on the screen in both text and graphical form.

Testing Continuous Analog Input

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

1. Connect known voltage sources, such as the outputs of a function generator, to analog input channels 0 and 1 on the DT9810 module (using the single-ended configuration). Refer to [page 37](#) for an example of how to connect a single-ended analog input.
2. In the Quick DataAcq application, choose **Scope** from the **Acquisition** menu.
3. Select the appropriate DT9810 module from the **Board** list box.
4. In the **Sec/Div** list box, select the number of seconds per division (.1 to .00001) for the display.
5. In the **Channel** list box, select analog input channel 1, and then click **Add** to add the channel to the channel list.
Note that, by default, channel 0 is included in the channel list.
6. Click **Config** from the Toolbar.
7. In the **Config** dialog, select **ChannelType**, and then select **Single Ended**.
8. In the **Config** dialog, select **Range**, and then select **Unipolar**.
9. From the **Scope** view, double-click the input range of the channel to change the input range of the module (0 to 2.44 V).
The display changes to reflect the selected range for all the analog input channels on the module.
10. In the Trigger box, select **Auto** to acquire data continuously from the specified channels or **Manual** to acquire a burst of data from the specified channels.
11. Click **Start** from the Toolbar to start the continuous analog input operation.
The application displays the values acquired from each channel in a unique color on the oscilloscope view.
12. Click **Stop** from the Toolbar to stop the operation.

Testing Single-Value Digital Input

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

1. Connect a digital input to digital input line 0 of port A on the DT9810 or DT9817 Series module. Refer to [page 38](#) for an example of how to connect a digital input.
2. In the Quick DataAcq application, choose **Digital Input** from the **Acquisition** menu.
3. Select the appropriate DT9810 or DT9817 Series module from the Board list box.
4. Select digital input port A by clicking **Port A**.
5. Click **Get**.
The application displays the value of each digital input line in port A on the screen in both text and graphical form.

Testing Single-Value Digital Output

To verify that the module can output a single digital output value, do the following:

1. Connect a digital output to digital output line 0 of port B on the DT9810 or DT9817 Series module. Refer to [page 39](#) for an example of how to connect a digital output.
2. In the Quick DataAcq application, select **Digital Output** from the **Control** menu.
3. Select the appropriate DT9810 or DT9817 Series module from the **Board** list box.
4. Select digital output port B by clicking **Port B**.
5. Click the appropriate bits to select the type of signal to write from the digital output lines. If the bit is selected, a high-level signal is output from the digital output line; if the bit is not selected, a low-level signal is output from the digital output line. Optionally, you can enter an output value in the **Hex** text box.
6. Click **Send**.

The application outputs and displays the value of each digital output line of digital port B on the screen in both text and graphical form.

Testing Frequency Measurement

To verify that the module can perform a frequency measurement operation, do the following:

1. Wire an external clock source to counter/timer 0 on the DT9810 or DT9817 Series module. Refer to [page 41](#) for an example of how to connect signals to a counter/timer for a frequency measurement operation.

Note: The Quick DataAcq application works only with counter/timer 0.

2. In the Quick DataAcq application, choose **Frequency Counter** from the **Acquisition** menu.
3. Select the appropriate DT9810 or DT9817 module from the **Board** list box.
4. In the **Count Duration** text box, enter the number of seconds during which events will be counted.
5. Click **Start** to start the frequency measurement operation.
The operation automatically stops after the number of seconds you specified has elapsed, and the application displays the frequency on the screen.

If you want to stop the frequency measurement operation when it is in progress, click **Stop**.

Testing Pulse Output

To verify that the module can perform a pulse output operation, do the following:

1. Connect a scope to counter/timer 0 on the DT9810 or DT9817 Series module. Refer to [page 41](#) for an example of how to connect a scope (a pulse output) to counter/timer 0.

Note: The Quick DataAcq application works only with counter/timer 0.

2. In the Quick DataAcq application, choose **Pulse Generator** from the **Control** menu.
3. Select the appropriate DT9810 or DT9817 Series module from the **Board** list box.
4. Select **Continuous** to output a continuous pulse stream.
5. Select **High-to-low** to output a falling-edge pulse (the low portion of the total pulse output period is the active portion of the signal).
6. Click **Start** to generate the pulse(s).
The application displays the results both in text and graphical form.
7. Click **Stop** to stop a continuous pulse output operation.

Part 2: Using Your Module



Principles of Operation

Analog Input Features.....	61
Digital I/O Features.....	65
Counter/Timer Features.....	68

Figure 18 shows a block diagram of the DT9810 module.

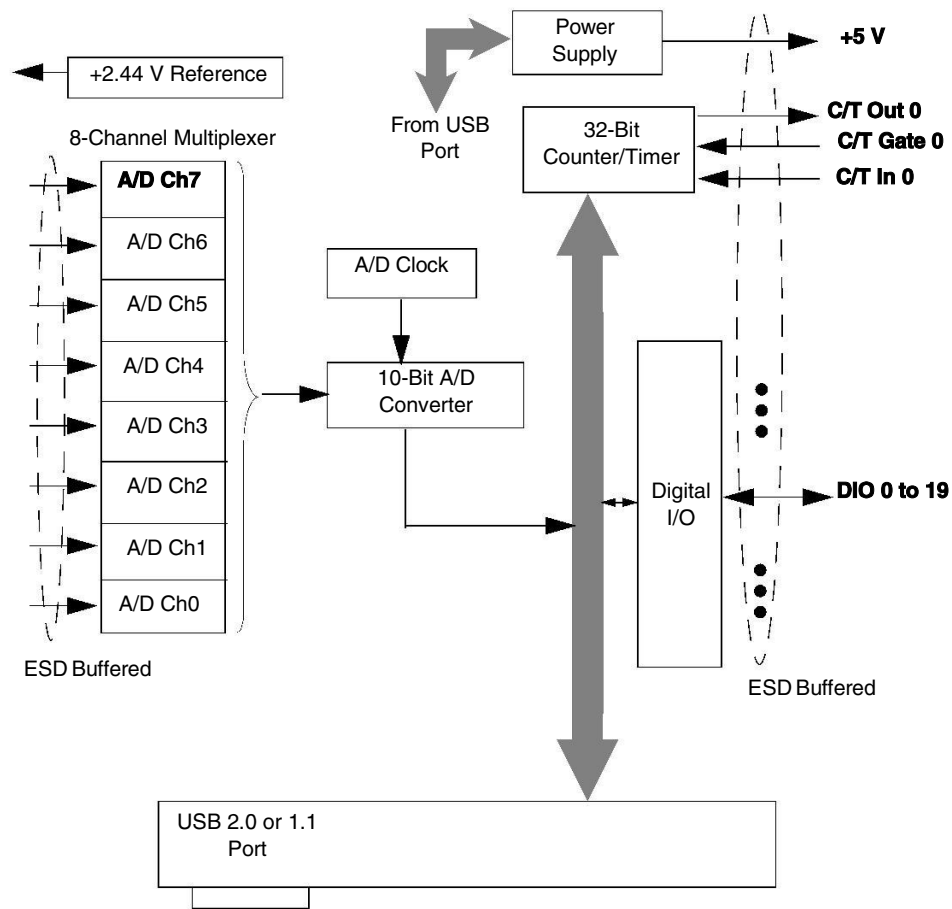


Figure 18: Block Diagram of the DT9810 Module

Figure 19 shows a block diagram of the DT9817 and DT9817-H modules.

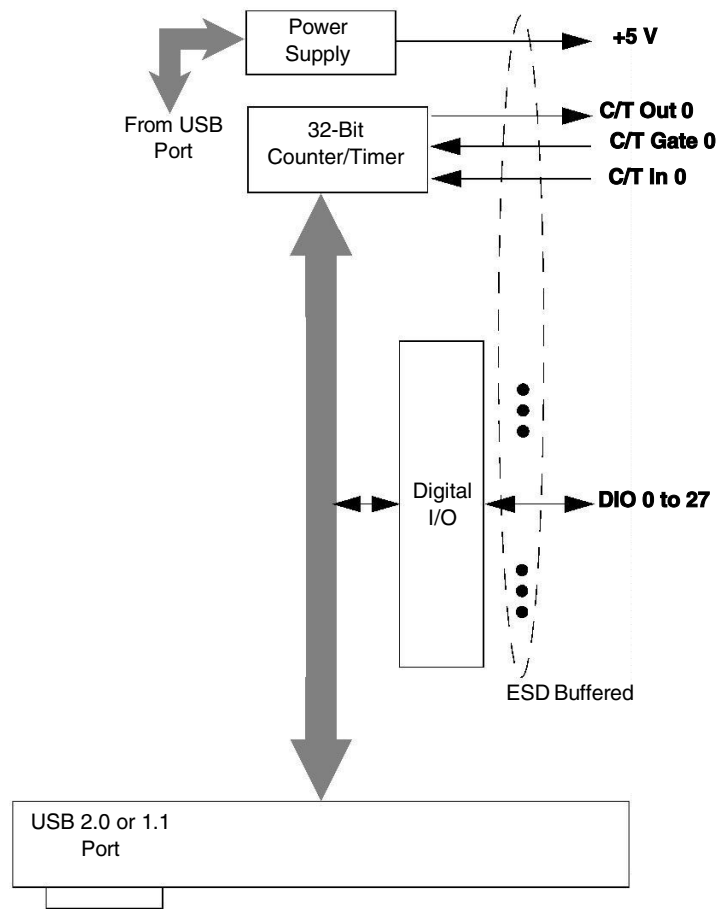


Figure 19: Block Diagram of the DT9817 and DT9817-H Modules

Figure 20 shows a block diagram of the DT9817-R module.

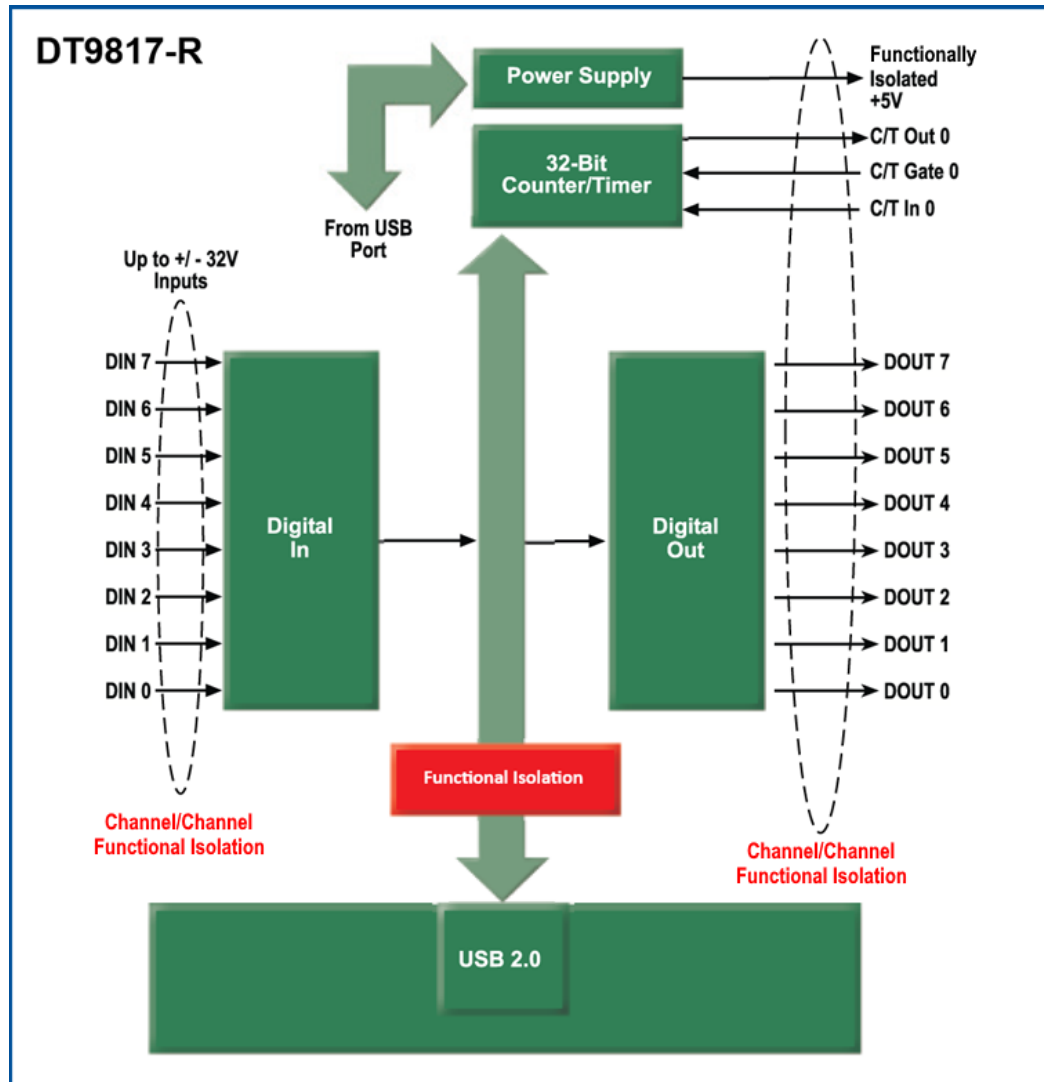


Figure 20: Block Diagram of the DT9817-R Module

Analog Input Features

This section describes the following features of analog input (A/D) operations on the DT9810 module:

Note: Skip this section if you are using a DT9817 Series module.

- Input resolution, described below
- Analog input channels, described on [page 61](#)
- Input ranges and gains, described on [page 62](#)
- Input sample clock sources, described on [page 62](#)
- Analog input conversion modes, described on [page 62](#)
- Input triggers, described on [page 64](#)
- Data format and transfer, described on [page 64](#)
- Error conditions, described on [page 64](#)

Input Resolution

The resolution of the A/D subsystem on the DT9810 module is 10-bits. This resolution is fixed; it cannot be programmed in software.

Analog Input Channels

The DT9810 provides eight single-ended analog input channels. You can acquire data from a single analog input channel or from a group of analog input channels on the module.

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 62](#) 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 16 entries in the channel list. The channels are read in order from the first entry in the list to the last entry in the list. Refer to [page 62](#) for more information about the supported conversion modes.

Note: The rate at which the module can read the analog input channels depends on the total number of analog input channels in the list. The DT9810 module supports a maximum A/D throughput of 25 kSamples/s. Therefore, if you specify two analog input channels in the channel list, the maximum sampling rate is 12.5 kSamples/s for each channel. Likewise, if you specify 16 analog input channels in the channel list, the maximum sampling rate is 1.5625 kSamples/s for each channel.

Input Ranges and Gains

The DT9810 provides a fixed input range of 0 to 2.44 V. Use software to specify the range as 0 to 2.44 V, and specify a gain of 1 for each entry in the channel list.

Note: This is the range for the entire analog input subsystem, not the range per channel.

Input Sample Clock Sources

You can pace an analog input operation on a DT9810 module using a software clock source. Using software, specify the clock source as internal, then specify the clock frequency at which to pace the operation. The DT9810 supports an A/D clock frequency of 30 Hz to 25 MHz.

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 2 kHz signal, specify a sampling frequency of at least 4 kHz. Doing so avoids an error condition called *aliasing*, in which high frequency input components erroneously appear as lower frequencies after sampling.

Analog Input Conversion Modes

The DT9810 supports the following conversion modes:

- Single-value operations
- Continuous scan operations

The following subsections describes the conversion modes in more detail.

Single-Value Operations

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.

Continuous Scan Mode

Use continuous scan mode if you want to accurately control the period between conversions of individual channels in a channel list.

When it receives a software trigger, the module cycles through the channel list, acquiring and converting the data for each entry in the list (this process is defined as the scan). The module then wraps to the start of the channel list and repeats the process continuously until either the allocated buffers are filled or until you stop the operation. Refer to [page 64](#) for more information about buffers.

The conversion rate is determined by the frequency of the internal sample clock; refer to [page 62](#) for more information about the internal sample clock. 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.

To select continuous scan mode, use software to specify the data flow as Continuous.

[Figure 21](#) illustrates continuous scan mode using a channel list with three entries: channel 0, channel 1, and channel 2. In this example, analog input data is acquired on each clock pulse of the input sample clock. When it reaches the end of the channel list, the module wraps to the beginning of the channel list and repeats this process. Data is acquired continuously.

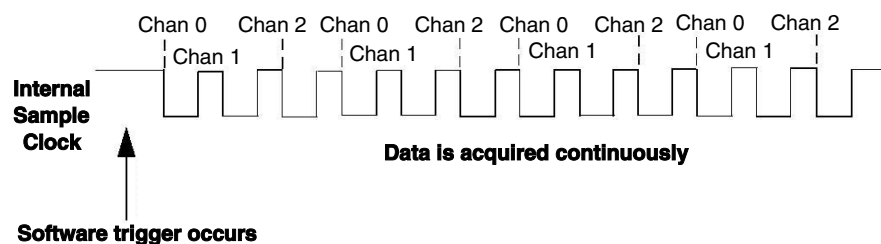


Figure 21: Continuous Scan Mode

Input Triggers

The DT9810 supports a software trigger for starting an analog input operation. When the computer issues a write to the DT9810 module, data acquisition begins. Acquisition stops when either all the buffers on the queue have been filled, or when you stop the operation. Note that when you stop the operation, the module finishes filling the current buffer.

Using software, specify the trigger source as a software trigger.

Data Format and Transfer

DT9810 modules use binary data encoding, where 0h represents 0 and 400h represents 2.44 V. Use software to specify the data encoding as binary. The ADC outputs 400h for above-range signals, and 0 for below-range signals.

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

We recommend that you allocate a minimum of two buffers for a continuous analog input operation. 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

An overrun condition is reported if 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.

Digital I/O Features

The DT9810, DT9817, DT9817-H, and DT9817-R modules provide a number of digital I/O lines that you can use to control external equipment. The DT9810 and DT9817 can source 4.5 mA and sink 10 mA.

The DT9817-H is a high-drive version of the DT9817, and can source 15 mA and sink 64 mA. The DT9817-R is a high-performance relay version of the DT9817, and can switch up to 30 V at 400 mA.

This section describes the following digital I/O features of the DT9810, DT9817, DT9817-H, and DT9817-R modules:

- Digital I/O lines, described below
- Resolution, described on [page 66](#)
- Operation modes, described on [page 67](#)

Digital I/O Lines

The number of digital I/O lines that are available depends on the module you are using, as shown in [Table 5](#).

Table 5: Number of Digital I/O Lines

Module	Digital I/O Lines
DT9810	20 programmable I/O lines
DT9817 and DT9817-H	28 programmable I/O lines
DT9817-R	8 DIN / 8 DOUT lines

The DT9817-R module features eight dedicated digital input lines and eight dedicated digital output lines. This module includes channel-to-channel functional isolation between digital input channels that are paired in an opto-isolator, such as 0 and 1, 2 and 3, etc..

On the DT9810, DT9817, and DT9817-H modules, you can configure the number of lines per port by specifying the resolution, as described in the next section.

Using software, you can specify the digital I/O line that you want to read or write in a single-value digital I/O operation. Refer to [page 67](#) for more information about single-value operations.

A digital line is high if its value is 1; a digital line is low if its value is 0. On the DT9817-R module, the digital output lines resemble a relay (switch); the switch is closed if the digital output bit is 1, and the switch is open if the digital output bit is 0.

On power up or reset of a DT9810, DT9817, or DT9817-H module, a low value (0) is output from each of the digital output lines. The DT9817-R module outputs a signal only if some voltage is connected to one side of the output.

Resolution

The DT9810 provides 20 digital lines that are shared by the DIN and DOUT subsystems. By default, these lines are organized as two 8-bit ports (elements 0 and 1) and one 4-bit port (element 2). By configuring the resolution of each element in software, you can combine all the digital lines into one or two ports, if you wish. [Table 6](#) shows the effect of resolution on the DIN and DOUT subsystems for the DT9810.

Table 6: DT9810 Digital I/O Lines and Resolution Settings

Configurations	Resolution	Digital I/O Lines	DIN or DOUT Subsystem
Three Separate Digital Ports (Default Configuration)	8	Port 0 (lines 0 to 7)	Element 0
	8	Port 1 (lines 0 to 7)	Element 1
	4	Port 2 (lines 0 to 3)	Element 2
All Digital Lines in One Port	20	Ports 0, 1, and 2 combined (lines 0 to 19)	Element 0
All Digital Lines in Two Ports	16	Ports 0 and 1 combined (lines 0 to 15)	Element 0
	4	Port 2 (lines 0 to 3)	Element 2
All Digital Lines in Two Ports	8	Port 0 (lines 0 to 7)	Element 0
	12	Ports 1 and 2 combined (lines 0 to 11)	Element 1

The DT9817 and DT9817-H provide 28 shared digital I/O lines. By default, these lines are organized as three 8-bit ports (elements 0, 1, and 2) and one 4-bit port (element 3). By configuring the resolution of each element in software, you can combine all the digital lines into one, two, or three ports, if you wish. [Table 7](#) shows the effect of resolution on the DIN and DOUT subsystems for the DT9817 and DT9817-H modules.

Table 7: DT9817 and DT9817-H Digital I/O Lines and Resolution Settings

Configurations	Resolution	Digital I/O Lines	DIN or DOUT Subsystem
Four Separate Digital Ports (Default Configuration)	8	Port 0 (lines 0 to 7)	Element 0
	8	Port 1 (lines 0 to 7)	Element 1
	8	Port 2 (lines 0 to 7)	Element 2
	4	Port 3 (lines 0 to 3)	Element 3
All Digital Lines in One Port	28	Ports 0, 1, 2, and 3 combined (lines 0 to 27)	Element 0

Table 7: DT9817 and DT9817-H Digital I/O Lines and Resolution Settings (cont.)

Configurations	Resolution	Digital I/O Lines	DIN or DOUT Subsystem
All Digital Lines in Two Ports	24	Ports 0, 1, and 2 combined (lines 0 to 23)	Element 0
	4	Port 3 (lines 0 to 3)	Element 3
All Digital Lines in Two Ports	8	Port 0 (lines 0 to 7)	Element 0
	20	Ports 1, 2, and 3 combined (lines 0 to 19)	Element 1
All Digital Lines in Three Ports	16	Ports 0 and 1 combined (lines 0 to 15)	Element 0
	8	Port 2 (lines 0 to 7)	Element 2
	4	Port 3 (lines 0 to 3)	Element 3
All Digital Lines in Three Ports	8	Port 0 (lines 0 to 7)	Element 0
	16	Ports 1 and 2 combined (lines 0 to 15)	Element 1
	4	Port 3 (lines 0 to 3)	Element 3

The DT9817-R provides a resolution of 8 for the digital input port to accommodate the 8 digital input lines and a resolution of 8 for the digital output port to accommodate the 8 digital output lines. These lines are organized as isolated, dedicated ports with 8 bits each. Each line has two inputs or outputs respectively for AC or DC operation. You cannot configure port resolution through software.

Operation Modes

The modules support single-value digital I/O operations only. For a single-value operation, use software to specify the digital I/O port (the gain is ignored). The module then reads data from or writes data to the digital lines associated with that port (determined by the resolution setting).

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

Counter/Timer Features

This section describes the following features of counter/timer (C/T) operations on the DT9810, DT9817, DT9817-H, and DT9817-R modules:

- C/T channel, described below
- C/T clock sources, described on [page 68](#)
- Gate types, described on [page 69](#)
- Pulse types and duty cycles, described on [page 69](#)
- C/T operation modes, described on [page 70](#)

C/T Channel

The modules provide one 32-bit counter/timer. The counter accepts a clock input signal and gate input signal and outputs a pulse (pulse output signal), as shown in [Figure 22](#).

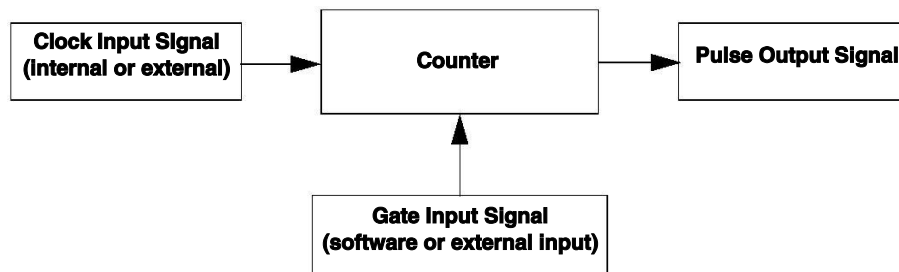


Figure 22: Counter/Timer Channel

C/T Clock Sources

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

- **Internal clock** – Through software, specify the clock source as internal, and specify the frequency at which to pace the counter/timer operation. The frequency of the internal C/T clock can range from 4 Hz to 2.5 kHz (DT9817-R) or 4 Hz to 12 MHz (all other modules).
- **External clock** – An external clock is useful when you want to pace counter/timer operations at rates not available with the internal clock or if you want to pace at uneven intervals.

Connect an external clock with a maximum recommended frequency of 6 MHz to the Counter 0 In signal on the module. Using software, specify the C/T clock source as external, and specify a clock divider between 9600 and 130050 (DT9817-R) or between 2 and 130050 (all other modules) to determine the actual frequency at which to pace the counter/timer operation. For example, if you connect a 6 MHz external C/T clock and use a clock divider of 2, the resulting C/T output frequency is 3 MHz. Counter/timer operations start on the falling edge of the Counter 0 In signal.

Gate Types

The edge or level of the Counter 0 Gate signal determines when a counter/timer operation is enabled. Using software, you can specify one of 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 Counter 0 Gate signal is low, and disables the counter/timer operation when the Counter 0 Gate signal is high. Note that this gate type is used for event counting and rate generation modes; refer to [page 70](#) for more information about these modes.
- **Logic-high level external gate input** – Enables a counter/timer operation when Counter 0 Gate is high, and disables a counter/timer operation when Counter 0 Gate is low. Note that this gate type is used for event counting and rate generation modes; refer to [page 70](#) 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 0 Gate signal. In software, this is called a low-edge gate type. Note that this gate type is used for edge-to-edge measurement mode; refer to [page 71](#) 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 0 Gate signal. In software, this is called a high-edge gate type. Note that this gate type is used for edge-to-edge measurement mode; refer to [page 71](#) for more information about these modes.

Pulse Duty Cycles

Counter/timer output signals from the modules are high-to-low going signals. The low portion of the total pulse output period is the active portion of the counter/timer clock output signal.

The duty cycle (or pulse width) indicates the percentage of the total pulse output period that is active. In rate generation mode, the duty cycle is fixed at 50% for the modules. [Figure 23](#) illustrates a high-to-low going output pulse with a duty cycle of 50%.

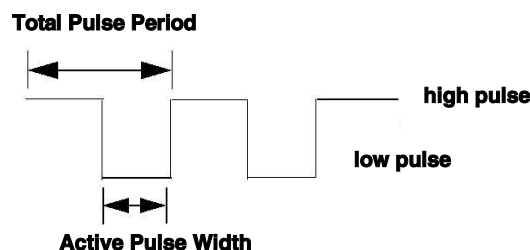


Figure 23: Example of a Pulse Output Signal with a 50% Duty Cycle (High-to-Low Going)

Counter/Timer Operation Modes

The modules support the following counter/timer operation modes:

- Event counting
- Frequency measurement
- Edge-to-edge measurement
- Rate generation

Event Counting

Use event counting mode if you want to count the number of falling edges that occur on Counter 0 In when the gate is active (low-level or high-level). Refer to [page 69](#) 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.

For event counting operations, use software to specify the counter/timer mode as 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 [Chapter 3](#) for an example of connecting an event counting application.

Frequency Measurement

Connect a pulse of a known duration to the Counter 0 Gate signal. Specify the active gate in software (high level). When the operation starts, read the number of counts that occurred when the gate was active.

You can determine the frequency of the clock input signal using the following equation:

$$\text{Frequency Measurement} = \frac{\text{Number of Events}}{\text{Measurement Period}}$$

Make sure that the signals are wired appropriately. Refer to [page 42](#) for an example of connecting a frequency measurement application.

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 can occur on the rising edge or the falling edge of the Counter 0 Gate signal, and the stop edge can occur on the rising edge or the falling edge of the Counter 0 Gate signal. 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 count a maximum of 4,294,967,296 events before the counter rolls over to 0 and starts counting again.

You can use edge-to-edge measurement to measure the following characteristics of a signal:

- Pulse width – 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:
 - $\text{Pulse width} = \text{Number of counts} / 24 \text{ MHz}$
- Period – 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:
 - $\text{Period} = 1 / \text{Frequency}$
 - $\text{Period} = \text{Number of counts} / 24 \text{ MHz}$
- Frequency – The number of periods per second. You can calculate the frequency as follows:
 - $\text{Frequency} = 24 \text{ MHz} / \text{Number of Counts}$

Using software, specify the counter/timer mode as measure, the C/T clock source as internal, the start edge as rising or falling gate, and the stop edge as rising or falling gate.

Make sure that the signals are wired appropriately. Refer to [page 43](#) for an example of connecting an edge-to-edge measurement application.

Rate Generation

Use rate generation mode to generate a continuous pulse output signal from Counter 0 Out; this mode is sometimes referred to as continuous pulse output or pulse train output.

The pulse output operation is enabled whenever the Counter 0 Gate signal is active (high level, low level, or software gate). While the pulse output operation is enabled, the counter outputs a high-to-low going pulse with a pulse width of 50% continuously. As soon as the operation is disabled, rate generation stops.

The frequency of the output is determined by the C/T clock source (either internal or external) and the clock divider used. You can generate an output signal from Counter 0 Out with a frequency of 4 Hz to 2.5 kHz (DT9817-R) or 4 Hz to 12 MHz (all other modules).

To specify rate generation mode, use software to specify the counter/timer mode as rate, the C/T clock source as either internal or external, the clock divider (9600 to 130050 (DT9817-R) or 2 to 130050 (all other modules), and the active gate type (low-level, high-level, or software gate). Refer to [page 69](#) for more information about gate types.

Make sure that the signals are wired appropriately. Refer to [page 44](#) for an example of connecting a rate generation application.

Supported Device Driver Capabilities

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The DT9810 and DT9817 Series Device Driver provides support for the analog input (A/D), digital input (DIN), digital output (DOOUT), and counter/timer (C/T) subsystems. For information on how to configure the device driver, refer to [page 30](#).

Table 8: DT9810 and DT9817 Series Subsystems

DT9810 and DT9817 Series	A/D	D/A	DIN	DOOUT	C/T	TACH	QUAD
Total Subsystems on Module	1 ^a	0	1 to 4 ^b	1 to 4 ^b	1	0	0

- a. The A/D subsystem is supported only on the DT9810.
- b. The DIN and the DOOUT subsystems share the same digital I/O lines on all modules except the DT9817-R. On the DT9810, 20 digital I/O lines are available (0 to 20) in 3 elements. On the DT9817 and DT9817-H, 28 digital I/O lines are available (0 to 27) in 4 elements. On the DT9817-R, 8 DIN lines and 8 DOOUT lines are available as a single subsystem each.

The tables in this chapter summarize the features available for use with the DT-Open Layers for .NET Class Library and the DT9810 and DT9817 Series modules. The DT-Open Layers for .NET Class Library provides properties that return support information for specified subsystem capabilities.

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

Note: 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 9: Data Flow and Operation Options

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Single-Value Operation Support SupportsSingleValue	Yes ^a		Yes	Yes	Yes		
Simultaneous Single-Value Output Operations SupportsSetSingleValues							
Continuous Operation Support SupportsContinuous	Yes ^a				Yes		
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							
FIFO Size, in Samples FifoSize							
Muting and Unmuting the Output Voltage SupportsMute							
Auto-Calibrate Support SupportsAutoCalibrate							

a. The A/D subsystem is supported only on the DT9810.

Buffering

Table 10: Buffering Options

DT9810 and DT9817 Series	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 11: Triggered Scan Mode Options

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Triggered Scan Support SupportsTriggeredScan							
Maximum Number of CGL Scans per Trigger MaxMultiScanCount	1	0	0	0	0		
Maximum Retrigger Frequency MaxRetriggerFreq	0	0	0	0	0		
Minimum Retrigger Frequency MinRetriggerFreq	0	0	0	0	0		

Data Encoding

Table 12: Data Encoding Options

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Binary Encoding Support SupportsBinaryEncoding	Yes						
Twos Complement Support SupportsTwosCompEncoding							
Returns Floating-Point Values ReturnsFloats							

Channels

Table 13: Channel Options

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Number of Channels NumberOfChannels	8 ^a	0	1	1	1		0
SE Support SupportsSingleEnded	Yes						
SE Channels MaxSingleEndedChannels	8	0	0	0	0		0
DI Support SupportsDifferential			Yes	Yes	Yes		
DI Channels MaxDifferentialChannels	0	0	1	1	1		0
Maximum Channel-Gain List Depth CGLDepth	16 ^b	0	0	0	0		0
Simultaneous Sample-and-Hold Support SupportsSimultaneousSampleHold							
Channel-List Inhibit SupportsChannelListInhibit							
Support MultiSensor Inputs SupportsMultiSensor							
Bias Return Termination Resistor Support SupportsInputTermination							

a. The DT9810 provides analog input channels 0 to 7.

b. Supported only on the DT9810.

Gain

Table 14: Gain Options

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Programmable Gain Support SupportsProgrammableGain							
Number of Gains NumberOfSupportedGains	1	0	1	1	0		0
Gains Available SupportedGains	1						

Ranges

Table 15: Range Options

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Number of Voltage Ranges NumberOfRanges	1	0	0	0	0		0
Available Ranges SupportedVoltageRanges	0 to 2.44 V						

Resolution

Table 16: Resolution Options

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Software Programmable Resolution SupportsSoftwareResolution			Yes ^a	Yes ^a			
Number of Resolutions NumberOfResolutions	1	0	4, 5 or 1 ^b	4, 5, or 1 ^b	1		0
Available Resolutions SupportedResolutions	10		See notes b and c below	See notes b and c below	32		

a. Not supported on the DT9817-R module.

b. On the DT9810, the DIN and DOUT subsystems (elements 0, 1, and 2) are configured as two 8-bit ports and one 4-bit port, by default. If you want to combine all the digital lines into one port, you can configure the resolution of element 0 for 20-bits. If you want to combine all the digital lines into two ports, you have two choices: configure element 0 for 8-bit resolution and element 1 for 12-bit resolution (element 2 would not be used), or configure element 0 for 16-bit resolution and element 2 for 4-bit resolution (element 1 would not be used).

On the DT9817 and DT9817-H, the DIN and DOUT subsystems (elements 0, 1, 2, and 3) are configured as three 8-bit ports and one 4-bit port, by default. If you want to combine all the digital lines into one port, you can configure the resolution of element 0 for 28-bits. If you want to combine all the digital lines into two ports, you have two choices: configure element 0 for 24-bit resolution and element 3 for 4-bit resolution (elements 1 and 2 would not be used), or configure element 0 for 8-bit resolution and element 1 for 20-bit resolution (elements 2 and 3 would not be used). If you want to combine all the digital lines into three ports, you have two choices: configure element 0 for 16-bit resolution, element 2 for 8-bit resolution, and element 3 for 4-bit resolution (element 1 would not be used), or configure element 0 for 8-bit resolution, element 1 for 16-bit resolution, and element 3 for 4-bit resolution (element 2 would not be used).

On the DT9817-R, the DIN and DOUT subsystems are configured as separate, dedicated 8-bit ports for DIN and DOUT respectively.

Current and Resistance Support

Table 17: Current and Resistance Support Options

DT9810 and DT9817 Series	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 18: Thermocouple, RTD, and Thermistor Support Options

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Thermocouple Support SupportsThermocouple							
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							

Table 18: Thermocouple, RTD, and Thermistor Support Options

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Supports Data Filters SupportsTemperatureFilters							
Temperature Filter Types TemperatureFilterType							

IEPE Support

Table 19: IEPE Support Options

DT9810 and DT9817 Series	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 SupportsExternalExcitationCurrentSrc							
Software Programmable Internal Excitation Current Source SupportsInternalExcitationCurrentSrc							
Available Excitation Current Source Values SupportedExcitationCurrentValues							

Bridge and Strain Gage Support

Table 20: Bridge and Strain Gage Support Options

DT9810 and DT9817 Series	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							

Table 20: Bridge and Strain Gage Support Options (cont.)

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Minimum Excitation Voltage MinExcitationVoltage							
Maximum Excitation Voltage MaxExcitationVoltage							

Start Triggers

Table 21: Start Trigger Options

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Software Trigger Support SupportsSoftwareTrigger	Yes				Yes		
External Positive TTL Trigger Support SupportsPosExternalTTLTrigger					Yes		
External Negative TTL Trigger Support SupportsNegExternalTTLTrigger							
External Positive TTL Trigger Support for Single-Value Operations SupportsSvPosExternalTTLTrigger							
External Negative TTL Trigger Support for Single-Value Operations SupportsSvNegExternalTTLTrigger							
Positive Threshold Trigger Support SupportsPosThresholdTrigger							
Negative Threshold Trigger Support SupportsNegThresholdTrigger							
Digital Event Trigger Support SupportsDigitalEventTrigger							

Reference Triggers

Table 22: Reference Trigger Options

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
External Positive TTL Trigger Support SupportsPosExternalTTLTrigger							
External Negative TTL Trigger Support SupportsNegExternalTTLTrigger							
Positive Threshold Trigger Support SupportsPosThresholdTrigger							
Negative Threshold Trigger Support SupportsNegThresholdTrigger							
Digital Event Trigger Support SupportsDigitalEventTrigger							

Table 22: Reference Trigger Options (cont.)

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Sync Bus Support SupportsSyncBusTrigger							
Threshold Trigger Channel SupportedThresholdTriggerChannel							
Post-Trigger Scan Count SupportsPostTriggerScanCount							

Clocks

Table 23: Clock Options

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Internal Clock Support SupportsInternalClock	Yes				Yes		
External Clock Support SupportsExternalClock					Yes		
Simultaneous Input/Output on a Single Clock Signal SupportsSimultaneousClocking							
Base Clock Frequency BaseClockFrequency	24 MHz		0	0	24 MHz		
Maximum Clock Divider MaxExtClockDivider	1	1	1	1	130050		
Minimum Clock Divider MinExtClockDivider	1		1	1	2 or 9600 ^a		
Maximum Frequency MaxFrequency	25 kHz	0	0	0	12 MHz or 2.5 kHz ^b		
Minimum Frequency MinFrequency	30 Hz		0	0	4 Hz		

a. The DT9817-R value is 9600; for all other modules the value is 2.

b. The DT9817-R value is 2.5 kHz; for all other modules the value is 12 MHz.

Counter/Timers

Table 24: Counter/Timer Options

DT9810 and DT9817 Series	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							
Repetitive One-Shot Mode Support SupportsOneShotRepeat							
Up/Down Counting Mode Support SupportsUpDown							
Edge-to-Edge Measurement Mode Support SupportsMeasure					Yes		
Continuous Edge-to-Edge Measurement Mode Support SupportsContinuousMeasure							
High to Low Output Pulse Support SupportsHighToLowPulse					Yes		
Low to High Output Pulse Support SupportsLowToHighPulse							
Variable Pulse Width Support SupportsVariablePulseWidth					No ^a		
None (internal) Gate Type Support SupportsGateNone					Yes		
High Level Gate Type Support SupportsGateHighLevel					Yes		
Low Level Gate Type Support SupportsGateLowLevel					Yes		
High Edge Gate Type Support SupportsGateHighEdge					Yes		
Low Edge Gate Type Support SupportsGateLowEdge					Yes		
Level Change Gate Type Support SupportsGateLevel							
Clock-Falling Edge Type SupportsClockFalling							
Clock-Rising Edge Type SupportsClockRising							
Gate-Falling Edge Type SupportsGateFalling					Yes ^b		

Table 24: Counter/Timer Options (cont.)

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Gate-Rising Edge Type SupportsGateRising					Yes ^b		
Interrupt-Driven Operations SupportsInterrupt					Yes		

a. The pulse width (duty cycle) is fixed at 50% when rate generation mode is used.

b. Edge-to-edge measurement is supported on the gate signal only; both rising and falling edges are supported.

Tachometers

Table 25: Tachometer Options

DT9810 and DT9817 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Tachometer Falling Edges SupportsFallingEdge							
Tachometer Rising Edges SupportsRisingEdge							
Tachometer Stale Data Flag SupportsStaleDataFlag							



Troubleshooting

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General Checklist

Should you experience problems using a DT9810, DT9817, DT9817-H, or DT9817-R module, do the following:

1. Read all the documentation provided for your product, including any “Read This First” information.
2. Check the OMNI CD for any README files and ensure that you have used the latest installation and configuration information available.
3. Check that your system meets the requirements stated on [page 26](#).
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 Reference section and forum on Digilent’s web site (www.digilent.com) for an answer to your problem.

If you still experience problems, try using the information in [Table 26](#) to isolate and solve the problem. If you cannot identify the problem, refer to [page 88](#).

Table 26: Troubleshooting Problems

Symptom	Possible Cause	Possible Solution
Module is not recognized	You plugged the module into your computer before installing the device driver.	From the Control Panel > System > Hardware > Device Manager, uninstall any unknown devices (showing a yellow question mark). Then, run the setup program on your OMNI CD to install the USB device drivers, and reconnect your USB module to the computer.
Module does not respond.	The module configuration is incorrect.	Check the configuration of your device driver; see the instructions in Chapter 2 .
	The module is damaged.	Contact Digilent for technical support; refer to page 88 .
Intermittent operation.	Loose connections or vibrations exist.	Check your wiring and tighten any loose connections or cushion vibration sources; see the instructions in Chapter 3 .
	The module is overheating.	Check environmental and ambient temperature; consult the module’s specifications on page 96 of this manual and the documentation provided by your computer manufacturer for more information.
	Electrical noise exists.	Check your wiring and either provide better shielding or reroute unshielded wiring; see the instructions in Chapter 3 .

Table 26: Troubleshooting Problems (cont.)

Symptom	Possible Cause	Possible Solution
Device failure error reported.	The module cannot communicate with the Microsoft bus driver or a problem with the bus driver exists.	Check your cabling and wiring and tighten any loose connections; see the instructions in Chapter 3 .
	The module was removed while an operation was being performed.	Ensure that your module is properly connected; see the instructions in Chapter 2 .
Data appears to be invalid.	An open connection exists.	Check your wiring and fix any open connections; see the instructions in Chapter 3 .
	A transducer is not connected to the channel being read.	Check the transducer connections; see the instructions in Chapter 3 .
	The transducer is set up for differential inputs.	Check your wiring and ensure that your transducer is set up for single-ended inputs (required by the DT9810 module); see the instructions in Chapter 3 .
	The DT9810 module is out of calibration.	The DT9810 module is calibrated at the factory and should not require recalibration. If you want to readjust the calibration of the analog input or analog output circuitry, refer to the instructions on the Digilent web site (www.digilent.com).
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 96 of this manual.
USB 2.0 is not recognized.	Your operating system does not have the appropriate Service Pack installed.	Ensure that you load the appropriate Windows Service Pack (version 2 for Windows XP). If you are unsure of whether you are using USB 2.0 or USB 1.1, run the Open Layers Control Panel applet, described in Chapter 2 .
	Standby mode is enabled on your PC.	For some PCs, you may need to disable standby mode on your system for proper USB 2.0 operation. Consult Microsoft for more information.

Technical Support

If you have difficulty using a DT9810, DT9817, DT9817-H, or DT9817-R module, Digilent's Technical Support is available to provide technical assistance.

To request technical support, go to our forum: <https://forum.digilent.com>

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

- Your product's serial number
- The hardware/software product you need help on
- The version of the OMNI CD you are using

If you are located outside the USA, contact your local distributor; see our web site (www.digilent.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 Digilent. 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).



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Analog Input Specifications

Table 27 lists the specifications for the A/D subsystem on the DT9810 module.

Table 27: A/D Subsystem Specifications

Feature	DT9810 Specifications
Number of analog input channels	8 single-ended
Number of gains	—
Resolution	10-bit
Data encoding	binary
System accuracy, to % of FSR (gain = 1) (Averaged over 50 readings)	0.1%
Range	0 to 2.44 V
Nonlinearity	0.1%
Differential nonlinearity	$\pm 1/2$ LSB
Inherent quantizing error	1 LSB
Drift Zero: Gain:	$\pm 20 \mu\text{V}$ $\pm 50 \text{ ppm}$
Differential linearity:	monotonic
Input impedance ^a Off channel: On channel:	10 M Ω , 10 pF 10 M Ω , 100 pF
Input bias current	$\pm 10 \text{ nA}$
Maximum input voltage (without damage) Power on: Power off:	$\pm 35 \text{ V}$ $\pm 20 \text{ V}$
A/D conversion time	40 μs
Channel acquisition time ($\pm 1/2$ LSB)	40 μs
Sample-and-hold Aperture uncertainty: Aperture delay:	2 ns 200 ns
Throughput	25 kHz
ESD protection (per spec) Arc: Contact:	8 kV 4 kV
Reference	2.44 V
Monotonicity	Yes
Input FIFO	—

a. Very high input impedance minimizes any source error.

Digital I/O Specifications

Table 28 lists the specifications for the digital input (DIN) and digital output (DOUT) subsystems on the DT9810, DT9817, and DT9817-H modules.

Table 28: DIN/DOUT Subsystem Specifications

Feature	DT9810	DT9817	DT9817-H
Number of digital I/O lines	20	28	28
Number of ports	2, 8-bit & 1, 4-bit	3, 8-bit & 1, 4-bit	3, 8-bit & 1, 4-bit
Input termination	No	No	No
Logic family	TTL	TTL	TTL
Logic sense	Positive true	Positive true	Positive true
Inputs Input type: Input logic load: High input voltage: Low input voltage: Low input current:	Level sensitive 1 TTL Load 2.4V min 0.8 V max –0.4 mA max	Level sensitive 1 TTL Load 2.4 V min 0.8 V max –0.4 mA max	Level sensitive 1 TTL Load 2.4 V min 0.8 V max –0.4 mA max
Outputs High output: Low output: High output current (source), typical: Low output current (sink), typical:	2.8 V min 0.6 V max 4.5 mA 10 mA	2.8 V min 0.6 V max 4.5 mA 10 mA	2.8 V min 0.6 V max 15 mA 64 mA
Software I/O selectable	Yes	Yes	Yes
ESD protection (per spec) Arc: Contact:	8 kV 4 kV	8 kV 4 kV	8 kV 4 kV

Table 29 lists the specifications for the digital input (DIN) and digital output (DOUT) subsystems on the DT9817-R module.

Table 29: DT9817-R DIN/DOUT Subsystem Specifications

Feature	DT9817-R
Number of digital I/O lines	16 (8 In, 8 Out)
Number of ports	2, 8-bit (1 In, 1 Out)
Inputs Input type: High input voltage: Low input voltage: High input current: Low input current: Termination	AC or DC ± 3 to 32 V ¹ $< \pm 1.5$ V 2.2 k Ω resistor to 1.2 V 2.2 k Ω resistor to 1.2 V Series 2.2 k Ω
Outputs Output type: Output driver: High output: Low output: Breakdown voltage: Contact impedance:	Solid-state Relay CMOS ± 30 V 0.4 V @ 400 mA ± 60 V 1 Ω
Isolation To computer ground: Input across pairs Output channel to channel	Functional isolation Functional isolation Functional isolation
Software I/O selectable	Yes
ESD protection (per spec) Arc: Contact:	8 kV 4 kV

¹ AC signals connected to the DT9817-R should not exceed 30 VAC.

Counter/Timer Specifications

Table 30 lists the specifications for the C/T subsystem on the DT9810, DT9817, DT9817-H, and DT9817-R modules.

Table 30: C/T Subsystem Specifications

Feature	Specifications
Number of counter/timers	1
Counter/timer modes	Event counting, frequency measurement, edge-to-edge measurement, rate generation
Resolution	32-bit
Minimum pulse width: (minimum amount of time it takes a C/T to recognize an input pulse)	200 μ s (DT9817-R) 200 ns (other modules)
Logic family	TTL
Inputs Input logic load: High input voltage: Low input voltage: Low input current:	Level sensitive 1 TTL Load 2.4 V min 0.8 V max –0.4 mA max
Outputs High output DT9817-R: Other modules: Low output DT9817-R: Other modules:	3.0 V min @ 0.1 mA Source 2.8 V min @ 2 mA Source 0.4 V max @ 2 mA Sink 0.6 V max @ 12 mA Sink
Isolation (DT9817-R)	Functional isolation to computer ground
ESD protection (per spec) Arc: Contact:	8 kV 4 kV
Internal clock frequency DT9817-R: Other modules:	4 Hz to 2.5 kHz 4 Hz to 12 MHz
External clock divider DT9817-R: Other modules:	9600 to 130050 2 to 130050

Power, Physical, and Environmental Specifications

Table 31 lists the power, physical, and environmental specifications for the DT9810, DT9817, DT9817-H, and DT9817-R modules.

Table 31: Power, Physical, and Environmental Specifications

Feature	DT9810, DT9817, DT9817-H, and DT9817-R
Power +5 V Enumeration: Operation:	< 100 mA < 100 mA (DT9810, DT9817, and DT9817-R) < 150 mA (DT9817-H)
Physical Dimensions (board): Dimensions (box with screw terminals and feet): Weight (board): Weight (box with screw terminals and feet):	100 mm (L) x 100 mm (W) x 15.5 mm (H) 107.7 mm (L) x 100 mm (W) x 33.5 mm (H) 60.3 g 133.4 g
Environmental Operating temperature range: Storage temperature range: Relative humidity: Altitude:	0 to 45° C –40 to 85° C to 95% non-condensing 10,000 feet

Regulatory Information

For regulatory information on DT9810-17 products, refer to <https://ni.com/certification>.



Screw Terminal Assignments

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Screw Terminal Assignments for the DT9810

Table 33 lists the screw terminal assignments for the DT9810 module.

Table 33: DT9810 Screw Terminals

Screw Terminal	Signal	Screw Terminal	Signal
20	USB +5 V Out	40	Reserved
19	Ground	39	Reserved
18	Counter 0 In	38	Ground
17	Counter 0 Out	37	Digital I/O 15
16	Counter 0 Gate	36	Digital I/O 14
15	Ground	35	Digital I/O 13
14	Digital I/O 19	34	Digital I/O 12
13	Digital I/O 18	33	Digital I/O 11
12	Digital I/O 17	32	Digital I/O 10
11	Digital I/O 16	31	Digital I/O 9
10	2.44 V Reference	30	Digital I/O 8
9	Analog Ground	29	Ground
8	Analog Input CH7	28	Digital I/O 7
7	Analog Input CH6	27	Digital I/O 6
6	Analog Input CH5	26	Digital I/O 5
5	Analog Input CH4	25	Digital I/O 4
4	Analog Input CH3	24	Digital I/O 3
3	Analog Input CH2	23	Digital I/O 2
2	Analog Input CH1	22	Digital I/O 1
1	Analog Input CH0	21	Digital I/O 0

Screw Terminal Assignments for the DT9817 and DT9817-H

Table 34 lists the screw terminal assignments for the DT9817 and DT9817-H modules.

Table 34: DT9817 and DT9817-H Screw Terminals

Screw Terminal	Signal	Screw Terminal	Signal
20	USB +5 V Out	40	Reserved
19	Ground	39	Reserved
18	Counter 0 In	38	Ground
17	Counter 0 Out	37	Digital I/O 15
16	Counter 0 Gate	36	Digital I/O 14
15	Ground	35	Digital I/O 13
14	Digital I/O 27	34	Digital I/O 12
13	Digital I/O 26	33	Digital I/O 11
12	Digital I/O 25	32	Digital I/O 10
11	Digital I/O 24	31	Digital I/O 9
10	Reserved	30	Digital I/O 8
9	Ground	29	Ground
8	Digital I/O 23	28	Digital I/O 7
7	Digital I/O 22	27	Digital I/O 6
6	Digital I/O 21	26	Digital I/O 5
5	Digital I/O 20	25	Digital I/O 4
4	Digital I/O 19	24	Digital I/O 3
3	Digital I/O 18	23	Digital I/O 2
2	Digital I/O 17	22	Digital I/O 1
1	Digital I/O 16	21	Digital I/O 0

Screw Terminal Assignments for the DT9817-R

Table 35 lists the screw terminal assignments for the DT9817-R module.

Table 35: DT9817-R Screw Terminals

Screw Terminal	Signal	Screw Terminal	Signal
20	+5 V Out @ 10mA isolated ^a	40	Reserved
19	Isolated Ground ^b	39	Counter 0 Out
18	Counter 0 In	38	Isolated Ground ^b
17	Counter 0 Gate	37	Reserved
16	Digital In 7 Low	36	Digital Out 7 Low
15	Digital In 7 High	35	Digital Out 7 High
14	Digital In 6 Low	34	Digital Out 6 Low
13	Digital In 6 High	33	Digital Out 6 High
12	Digital In 5 Low	32	Digital Out 5 Low
11	Digital In 5 High	31	Digital Out 5 High
10	Digital In 4 Low	30	Digital Out 4 Low
9	Digital In 4 High	29	Digital Out 4 High
8	Digital In 3 Low	28	Digital Out 3 Low
7	Digital In 3 High	27	Digital Out 3 High
6	Digital In 2 Low	26	Digital Out 2 Low
5	Digital In 2 High	25	Digital Out 2 High
4	Digital In 1 Low	24	Digital Out 1 Low
3	Digital In 1 High	23	Digital Out 1 High
2	Digital In 0 Low	22	Digital Out 0 Low
1	Digital In 0 High	21	Digital Out 0 High

- a. Functionally isolated from USB +5V**
- b. Functionally isolated from USB GND**

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