UM-24412-A

DT9826
User's Manual

First Edition
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Radio and Television Interference

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

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

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

Canadian Department of Communications Statement

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

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

Table of Contents

About this Manual

The first part of this manual describes how to install and set up your DT9826 module and device driver, and verify that your module is working properly.

The second part of this manual describes the features of the DT9826 module, the capabilities of the DT9826 Device Driver, and how to program the DT9826 module using 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 installing, setting up, using, and/or programming a DT9826 module for data acquisition operations.

It is assumed that you are familiar with the requirements of your application. It is also assumed that you have some familiarity with data acquisition principles, that you understand your application, and that you are familiar with the Microsoft® Windows® XP, Windows Vista®, or Windows 7 operating system.

How this Manual is Organized

This manual is organized as follows:

- Chapter 1, "Overview," describes the major features of the DT9826 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 module, how to apply power to the module, and how to configure the device driver.
- Chapter 3, "Wiring Signals to the BNC Connection Box," describes how to wire signals to a DT9826 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 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 DT9826 Device Driver.

- Chapter 7, "Troubleshooting," provides information that you can use to resolve problems with the module and device driver, should they occur.
- Chapter 8, "Calibration," describes how to calibrate the analog input circuitry of the module.
- Appendix A, "Specifications," lists the specifications of the DT9826 module.
- Appendix B, "Connector Pin Assignments," lists the pin assignments of the connectors on the DT9826 BNC connection box and on the OEM version of the DT9826 module.
- Appendix C, "Wiring Signals to the OEM Version of the Module," describes how to wire signals to the OEM version of the DT9826 module, and lists the pin assignments of the connectors on the accessory panels that are used with the OEM version of the module.
- An index completes this manual.

Conventions Used in this Manual

The following conventions are used in this manual:

- Notes provide useful 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**.
- `Courier font` is used to represent source code.

Related Information

Refer to the following documents for more information on using the DT9826 module:

- *Benefits of the Universal Serial Bus for Data Acquisition.* This white paper describes why USB is an attractive alternative for data acquisition. It is available on the Data Translation® web site (www.datatranslation.com).
- *Measure Foundry Manual* (UM-19298) and online help. These documents describe how to use Measure Foundry™ to build drag-and-drop test and measurement applications for Data Translation data acquisition devices.
- *DT-Open Layers for .NET User's Manual* (UM-22161). For programmers who are developing their own application programs using Visual C# or Visual Basic .NET, this manual describes how to use the DT-Open Layers for .NET Class Library to access the capabilities of Data Translation data acquisition devices.
- *DataAcq SDK User's Manual* (UM-18326). For programmers who are developing their own application programs using the Microsoft C compiler, this manual describes how to use the DT-Open Layers™ DataAcq SDK™ to access the capabilities of Data Translation data acquisition devices. This manual is included on the Data Acquisition OMNI CD.
- *DTx-EZ Getting Started Manual* (UM-15428). This manual describes how to use the ActiveX controls provided in DTx-EZ™ to access the capabilities of Data Translation data acquisition devices in Microsoft Visual Basic® or Visual C++®.

- *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.
- *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.
- Microsoft Windows XP, Windows Vista, or Windows 7 documentation.
- USB web site (http://www.usb.org).

Where To Get Help

Should you run into problems installing or using a DT9826 module, our Technical Support Department is available to provide technical assistance. Refer to Chapter 7 starting on page 93 for information on how to contact the Technical Support Department. If you are outside the U.S. or Canada, call your local distributor, whose number is listed on Data Translation's web site (www.datatranslation.com).

1

Overview

DT9826 Hardware Features

The DT9826, shown in Figure 1, is a high-performance, multifunction data acquisition module for the USB (Ver. 2.0 or Ver. 1.1) bus.

Figure 1: DT9826 Module

The key hardware features of the DT9826 module are as follows:

- Available either installed in a metal BNC connection box or as a board-level OEM version that you can install in your own custom application
- Powered by the USB bus
- Simultaneous operation of analog input, digital I/O, counter/timer, and tachometer subsystems
- Analog input subsystem:
  - 16 single-ended, simultaneous analog input channels
  - 24-bit Delta-Sigma A/D converter per channel
  - Input range of ±10 V
  - A 20-location channel list. You can read the tachometer input, counter/timers, and the digital input port in the A/D data stream. This synchronizes the tachometer, counter/timer, and digital input data with the analog input measurements.
  - Throughput rate up to 41.666 kSamples/s per channel (total throughput of up to 833.32 kSamples/s to sample all 20 input channels)

- Digital I/O subsystem:
  - One digital input port, consisting of 8 digital input lines; you can read the value of the digital input port using the analog input channel list
  - One digital output port, consisting of 8 digital output lines
- Two 32-bit counter/timer (C/T) channels that perform event counting, up/down counting, frequency measurement, edge-to-edge measurement, continuous 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 list.
- One tachometer input channel that accepts a signal in the range of ±30 V. You can read the value of the tachometer input in the analog input data stream, allowing you to measure the period or frequency of the tachometer synchronously with analog input measurements.
- Internal clock source
- Software-programmable trigger source (software, external digital trigger, or analog threshold trigger) for the start trigger; analog threshold trigger for the reference trigger
- 500 V galvanic isolation barrier that prevents ground loops to maximize analog signal integrity and protect your computer

Supported Software

The following software is available for use with the DT9826 module and is on the Data Acquisition OMNI CD:

- **DT9826 Device Driver –** The device driver allows you to use a DT9826 module with any of the supported software packages or utilities. Refer to page 29 for more information on configuring the device driver.
- **Quick DataAcq application –** The Quick DataAcq application provides a quick way to get up and running using a DT9826 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 starting on page 47 for more information on using the Quick DataAcq application.
- **The quickDAQ application –** An evaluation version of this .NET application is included on the Data Acquisition OMNI CD. quickDAQ lets you acquire analog data from all devices supported by DT-Open Layers for .NET software at high speed, plot it during acquisition, analyze it, and/or save it to disk for later analysis.
- **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 DT9826 module using Visual Studio 2003 or Visual Studio 2005; the class library complies with the DT-Open Layers standard.
- **DataAcq SDK** – Use the Data Acq SDK if you want to use Visual Studio 6.0 and Microsoft C or C++ to develop your own application software for a DT9826 module using Windows XP, Windows Vista, or Windows 7; the DataAcq SDK complies with the DT-Open Layers standard.
- **Measure Foundry –** An evaluation version of this software is included or provided via a link on the Data Acquisition OMNI CD. Measure Foundry is a drag-and-drop test and measurement application builder designed to give you top performance with ease-of-use development. Order the full development version of this software package to develop your own application using real hardware.
- **DTx-EZ –** DTx-EZ provides ActiveX controls, which allow you to access the capabilities of the DT9826 module using Microsoft Visual Basic or Visual C++; DTx-EZ 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 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 Data Translation modules.

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

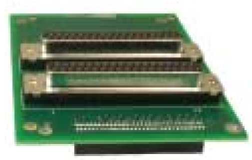
Accessories

Table 1 lists the following optional accessories for use with the DT9826 module. Refer to Chapter 3 starting on page 31 for information on using these accessories with the BNC box; refer Appendix C starting on page 129 for information on using these accessories with the OEM version of the DT9826 module.

Table 1: Accessories for the DT9826 Module

Accessory		Description
STP37		Screw terminal panel that provides 37 screw terminal blocks for attaching analog input, digital I/O, counter/timer, tachometer, and trigger signals. **BNC Box Usage** You can use up to three STP37 screw terminal panels, if desired, with the BNC box. To access analog input signals from the Analog Input connector, you can use an STP37 with an EP360 cable. To access the digital I/O signals from the Digital In/Out connector, you can use an STP37 with an EP333 cable. To access the counter/timer, tachometer, or trigger signals from the Cntr/Timer, Analog Out, Clk/Trig connector, you can use an STP37 with an EP333 cable. **EP353 Usage** To access the analog input signals from the EP353, you can use an STP37 with an EP360 cable. **EP356 Usage** You can use up to two STP37 screw terminal panels, if desired, with the EP356. To access the digital I/O signals from the EP356, you can use an STP37 with an EP333 cable. To access the counter/timer, tachometer, or trigger signals from the EP356, you can use an STP37 with an EP333 cable.
EP353		Accessory panel for the OEM version of the DT9826 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. You can connect an optional STP37 accessory panel and EP360 cable to the 37-pin connector for easier wiring.

Table 1: Accessories for the DT9826 Module (cont.)

Accessory		Description
EP355		Screw terminal panel for the OEM version of the DT9826 that provides 14-position screw terminal blocks for attaching analog input, digital I/O, counter/timer, tachometer, and trigger signals. You can use up to two EP355 accessory panels with the OEM version of the DT9826.
EP356		Accessory panel for the OEM version of the DT9826 that provides two 37-pin, D-sub connectors for attaching digital I/O, counter/timer, tachometer, and trigger signals. You can connect an optional STP37 accessory panel and EP333 cable to each 37-pin connector for easier wiring.
EP333		2-meter shielded cable with two 37-pin connectors that connect the Digital I/O connector on the BNC connection box to an STP37 screw terminal panel, the Cntr/Timer, Analog Out, Clk/Trig connector on the BNC connection box to an STP37 screw terminal panel, or the connectors on the EP356 accessory panel to an STP37 screw terminal panel.
EP360		2-meter shielded cable with two 37-pin connectors that connect either the Analog Input connector on the BNC connection box to an STP37 screw terminal panel or an EP353 accessory panel to an STP37 screw terminal panel.

Getting Started Procedure

The flow diagram shown in Figure 2 illustrates the steps needed to get started using the DT9826 module. This diagram is repeated in each Getting Started chapter; the shaded area in the diagram shows you where you are in the procedure.

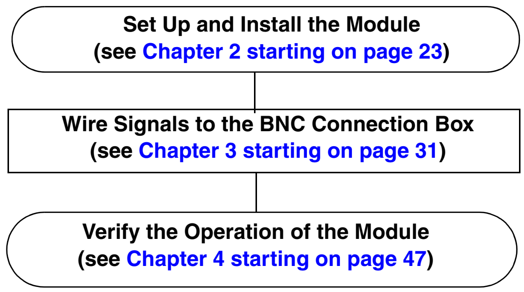
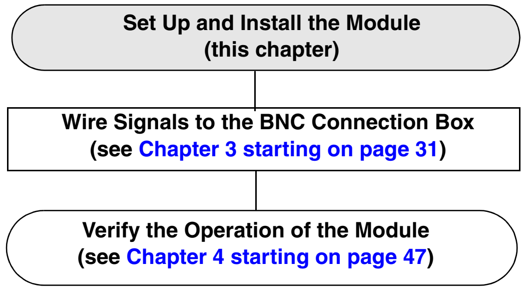


Figure 2: Getting Started Flow Diagram

Part 1: Getting Started

2

Setting Up and Installing the Module



Note: The DT9826 module is factory-calibrated. If you decide that you want to recalibrate the analog input circuitry, refer to the instructions on Chapter 8.

Unpacking

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

- BNC connection box or OEM version of the DT9826 module
- Data Acquisition OMNI CD

Note that if you purchased a BNC connection box, a USB cable and EP361 power supply should also be included. Additionally, the BNC box includes an analog input mating connector (Tyco #5-747917-2).

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

Attaching Modules to the Computer

This section describes how to attach DT9826 modules to the host computer.

Note: Most computers have several USB ports that allow direct connection to USB devices. If your application requires more DT9826 modules than you have USB ports for, you can expand the number of USB devices attached to a single USB port by using expansion hubs. For more information, refer to page 27.

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

You must install the device driver before connecting your DT9826 module(s) to the host computer. Run the installation program on your Data Acquisition OMNI CD to install the device driver and other software for the module.

Connecting Directly to the USB Ports

To connect a DT9826 module directly to a USB port on your computer, do the following:

1. Attach one end of the USB cable to the USB port on the module.
2. Attach the other end of the USB cable to one of the USB ports on the host computer, as shown in Figure 3.
   The operating system automatically detects the USB module and starts the Found New Hardware wizard.

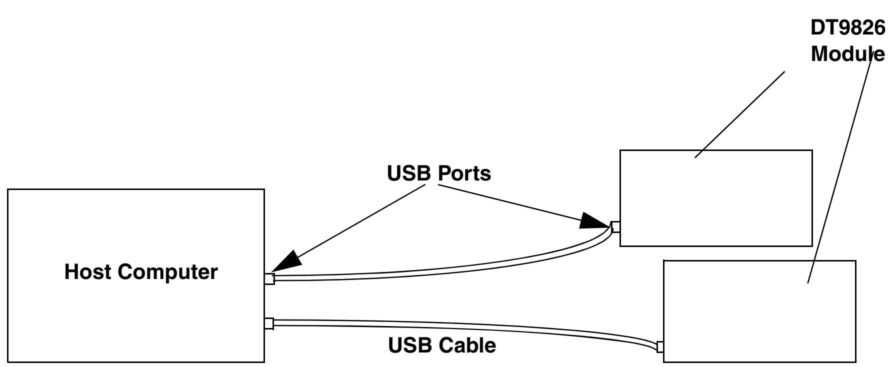


Figure 3: Attaching the Module to the Host Computer

3. <u>*For Windows Vista*</u>:

   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.

   <u>*For Windows XP:*</u>

   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 finds the device automatically.

4. Repeat these steps to attach another DT9826 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 DT9826 modules that you can connect to a single USB port depends on the throughput you want to achieve.

To connect multiple DT9826 modules to an expansion hub, do the following:

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

   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.

<u>*For Windows XP:*</u>

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 finds the device automatically.

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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.

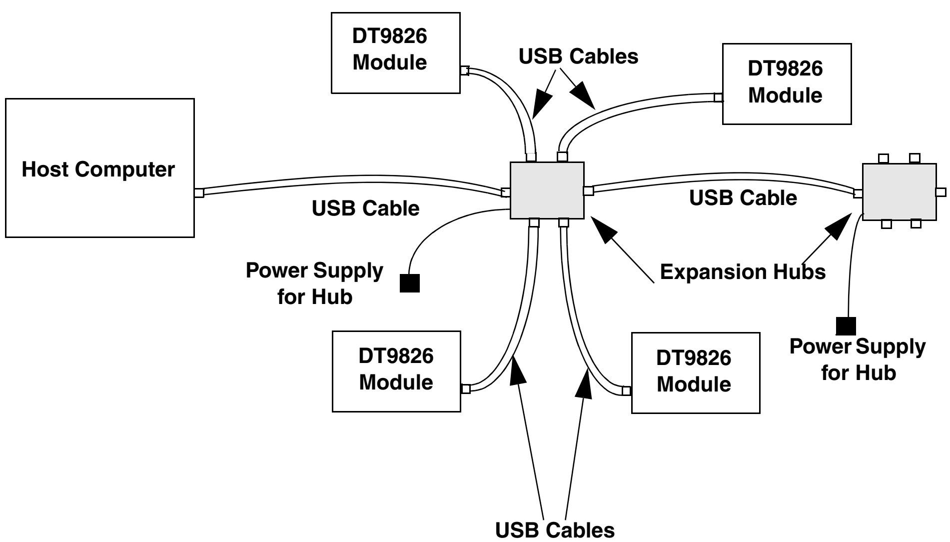


Figure 4: Attaching Multiple Modules Using Expansion Hubs

Configuring the DT9826 Device Driver

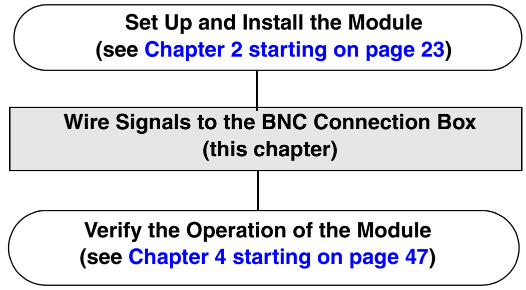
You can rename the DT9826 module by configuring the device driver for the DT9826 module, as follows:

1. If you have not already done so, power up the host computer and all peripherals.
2. From your Windows start menu, select the **Control Panel**.
3. From the Control Panel, double-click **Open Layers Control Panel**.
   (In some operating systems, you must view the Control Panel by icons to see the Open Layers Control Panel.) The Data Acquisition Control Panel dialog box appears.
4. If you want to rename the module, click the name of the module that you want to rename, click **Edit Name**, enter a new name for the module, and then click **OK**. The name is used to identify the module in all subsequent applications.
5. Repeat steps 4 for the other modules that you want to rename.
6. When you are finished renaming the modules, click **Close** to close the Control Panel.

Continue with the instructions on wiring in Chapter 3.

3

Wiring Signals to the BNC Connection Box


Set Up and Install the Module
(see Chapter 2 starting on page 23)
Wire Signals to the BNC Connection Box
(this chapter)
Verify the Operation of the Module
(see Chapter 4 starting on page 47)

Preparing to Wire Signals

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

Note: If you are using the OEM version of the DT9826 module, use this chapter for conceptual information, and then refer to Appendix C starting on page 129 for connector pin assignments and accessory panel information.

Wiring Recommendations

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

- 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.

Wiring to the BNC Box

The BNC connection box contains BNC connectors and three 37-pin, D-sub connectors, as shown in Figure 5.

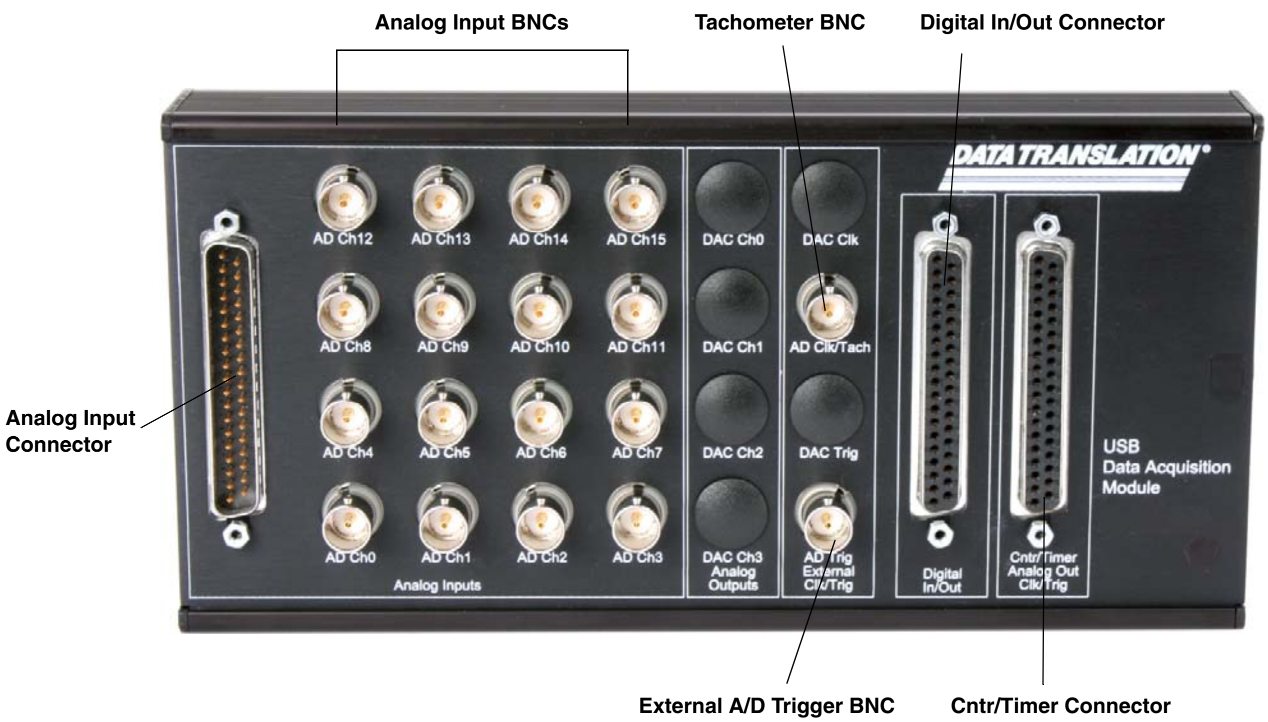


Figure 5: DT9826 BNC Connection Box

You can wire signals to the BNC connection box as follows:

- **Analog input signals –** You can wire analog input signals in one of the following ways:
  - Using the BNC connectors labelled AD Ch0 to AD Ch15.
  - Using the appropriate pins on the Analog Input connector. You can access the pins either by using the EP360 cable and STP37 screw terminal panel (available from Data Translation), by plugging in the supplied 37-mating connector (Tyco #5-747917-2), or by building your own cable/panel. Refer to page 36 for connector pin assignments.
- **Tachometer signal –** You can wire a tachometer signal in one of the following ways:
  - Using the BNC connector labelled AD Clk/Tach.
  - Using the Tachometer pin on the Cntr/Timer, Analog Out, Clk/Trig connector. You can access this pin either by using the EP333 cable and STP37 screw terminal panel (available from Data Translation) or by building your own cable/panel. Refer to page 38 for connector pin assignments.
- **Digital I/O signals –** To wire digital I/O signals, use the Digital In/Out connector. You can access the pins either by using the EP333 cable and STP37 screw terminal panel (available from Data Translation) or by building your own cable/panel. Refer to page 37 for connector pin assignments.

- **Counter/timer signals** – To wire counter/timer signals, use the Cntr/Timer, Analog Out, Clk/Trig connector. You can access the pins either by using the EP333 cable and STP37 screw terminal panel (available from Data Translation) or by building your own cable/panel. Refer to page 38 for connector pin assignments.
- **External A/D trigger signal** – You can wire an external digital trigger signal in one of the following ways:
  – Using the BNC connector labelled AD Trig.
  – Using the External ADC Trigger pin on the Cntr/Timer, Analog Out, Clk/Trig connector. You can access this pin either by using the EP333 cable and STP37 screw terminal panel (available from Data Translation) or by building your own cable/panel. Refer to page 38 for connector pin assignments.

Wiring Signals to the BNC Connectors

To wire signals using the BNC connectors, connect the input signals to the appropriate BNC connectors on the BNC connector box using a BNC cable.

Seventeen BNC connectors are available on the box (16 BNC connectors for single-ended analog inputs, and one BNC connector for the external A/D trigger).

Wiring Signals to the D-Sub Connectors

If you do not want to use the BNC connectors or if you want to connect digital I/O or counter/timer signals to the BNC connection box, you can use the 37-pin, D-sub connectors on the BNC box. These connectors are described in the following sections.

Note that you can attach up to three STP37 screw terminal panels to the connectors on the BNC box to make wiring easier. Figure 6 shows the layout of the STP37 screw terminal panel.

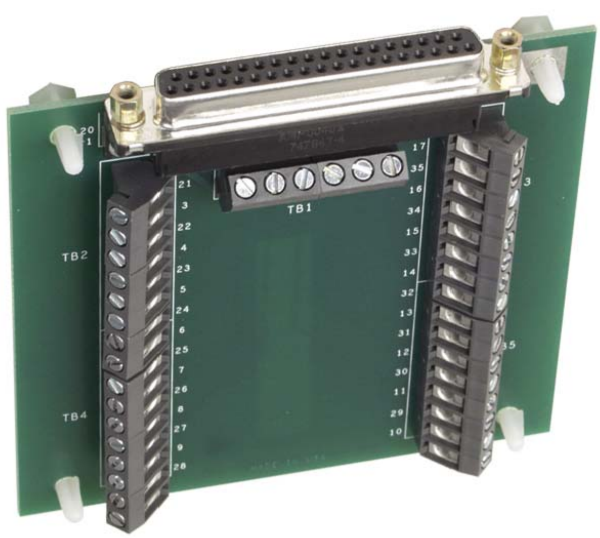


Figure 6: STP37 Layout

Analog Input Connector

The Analog Input connector allows you to access the analog input signals. Table 2 lists the pin assignments for the Analog Input connector on the BNC box. You can use the STP37 screw terminal panel and EP360 cable with the Analog Input connector to make wiring easier.

Table 2: Analog Input Connector and STP37 Pin Assignments

Pin	Signal Description	Pin	Signal Description
19	No Connect	37	Reserved
18	Reserved	36	Analog Ground
17	Analog Ground	35	Reserved
16	Reserved	34	Reserved
15	Reserved	33	Reserved
14	Reserved	32	Reserved
13	Reserved	31	Reserved
12	Reserved	30	Reserved
11	Reserved	29	Reserved
10	Reserved	28	Reserved
9	Reserved	27	Analog In 15
8	Analog Input 7	26	Analog In 14
7	Analog Input 6	25	Analog In 13
6	Analog Input 5	24	Analog In 12
5	Analog Input 4	23	Analog In 11
4	Analog Input 3	22	Analog In 10
3	Analog Input 2	21	Analog In 9
2	Analog Input 1	20	Analog In 8
1	Analog Input 0		

Digital I/O Connector

The Digital In/Out connector allows you to access the digital I/O signals. Table 3 lists the pin assignments for the Digital In/Out connector on the BNC connection box. You can use the STP37 screw terminal panel and EP333 cable with the Digital In/Out connector to make wiring easier.

Table 3: Digital In/Out Connector and STP37 Pin Assignments

Pin	Signal Description	Pin	Signal Description
1	Digital Input 0	20	Digital Output 0
2	Digital Input 1	21	Digital Output 1
3	Digital Input 2	22	Digital Output 2
4	Digital Input 3	23	Digital Output 3
5	Digital Input 4	24	Digital Output 4
6	Digital Input 5	25	Digital Output 5
7	Digital Input 6	26	Digital Output 6
8	Digital Input 7	27	Digital Output 7
9	Reserved	28	Reserved
10	Reserved	29	Reserved
11	Reserved	30	Reserved
12	Reserved	31	Reserved
13	Reserved	32	Reserved
14	Reserved	33	Reserved
15	Reserved	34	Reserved
16	Reserved	35	Reserved
17	Digital Ground	36	Reserved
18	Digital Ground	37	Digital Ground
19	No Connect		

Cntr/Timer, Analog Output, Clk/Trig Connector

The Cntr/Timer, Analog Out, Clk/Trig connector allows you to access the counter/timer, tachometer, and external trigger signals on the BNC connection box. Table 4 lists the pin assignments for the Cntr/Timer, Analog Output, Clk/Trig connector on the BNC connection box. You can use the STP37 screw terminal panel and EP333 cable with this connector to make wiring easier.

Table 4: Cntr/Timer, Analog Out, Clk/Trig Connector and STP37 Pin Assignments

Pin	Signal Description	Pin	Signal Description
1	Reserved	20	Reserved
2	Reserved	21	Reserved
3	Reserved	22	Reserved
4	Reserved	23	Reserved
5	Digital Ground	24	Digital Ground
6	Reserved	25	Reserved
7	Tachometer	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	Reserved	31	Digital Ground
13	Reserved	32	Reserved
14	Reserved	33	Digital Ground
15	Reserved	34	Reserved
16	Reserved	35	Digital Ground
17	Reserved	36	Reserved
18	Digital Ground	37	Digital Ground
19	No Connect		

Connecting Analog Input Signals

The BNC connection box supports voltage inputs. You can connect analog input signals to a BNC connection box in **single-ended** mode. In this mode, the source of the input should be close to the module; all the input signals are referred to the same common ground.

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

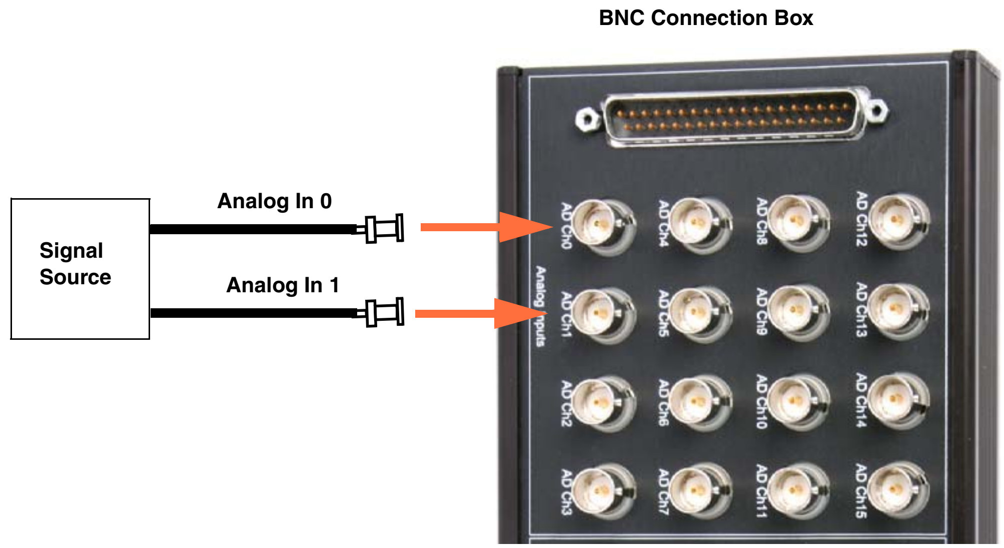


Figure 7: Connecting Single-Ended Inputs to the BNC Connection Box

Figure 8 shows how to connect single-ended voltage inputs (channels 0 and 1, in this case) to the Analog Input connector on the BNC connection box.

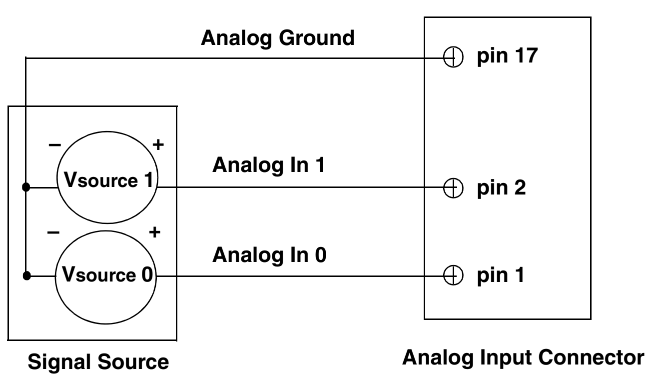


Figure 8: Connecting Single-Ended Voltage Inputs to the Analog Input D-Sub Connector on the BNC Connection Box

Connecting Digital I/O Signals

Figure 9 shows how to connect digital input signals (lines 0 and 1, in this case) to the Digital In/Out connector.

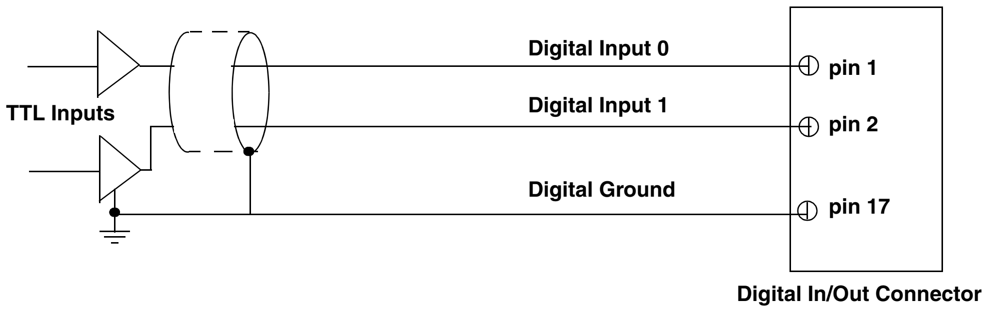


Figure 9: Connecting Digital Inputs to the Digital In/Out Connector on the BNC Connection Box

Figure 10 shows how to connect a digital output (line 0, in this case) to the Digital In/Out connector.

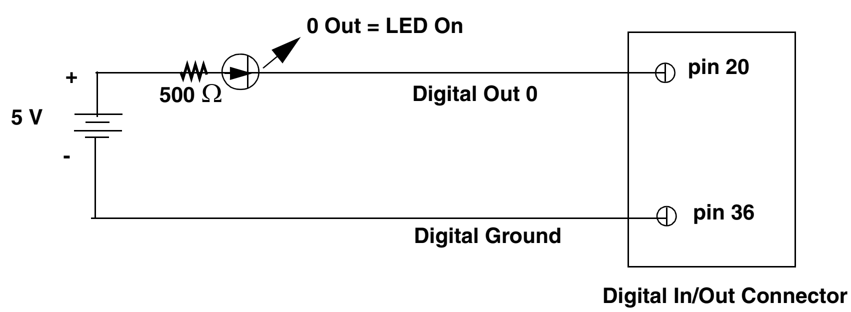


Figure 10: Connecting Digital Outputs to the Digital In/Out Connector on the BNC Connection Box

Connecting Counter/Timer Signals

The BNC connection box provides two 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 72 for more information about using the counter/timers.

Event Counting

Figure 11 shows how to connect counter/timer signals to the Cntr/Timer, Analog Out, Clk/Trig connector on the BNC connection box to perform an event counting operation. This example uses counter/timer 0 with 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 Chapter 5 for more information.

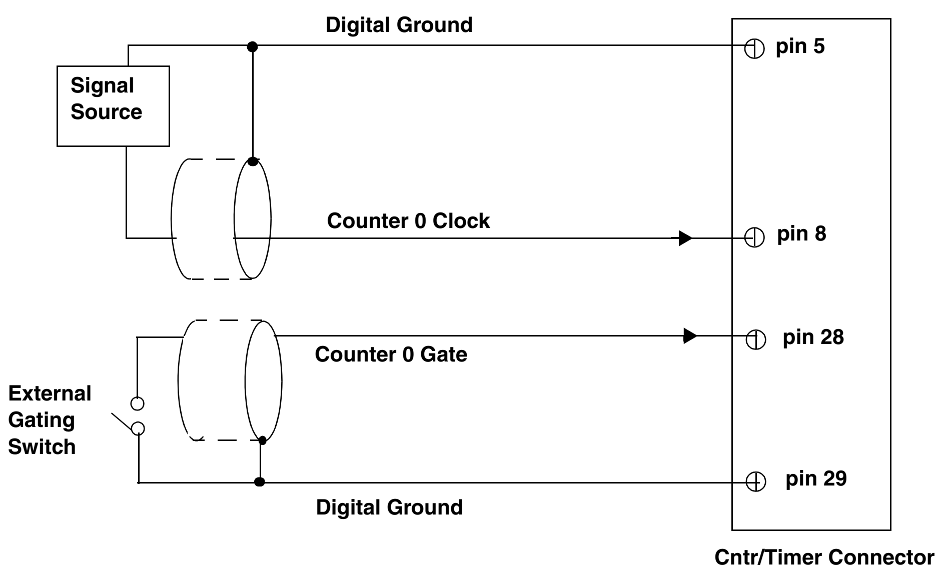


Figure 11: Connecting Counter/Timer Signals to the BNC Connection Box for an Event Counting Operation Using an External Gate

Figure 12 shows how to connect counter/timer signals to the Cntr/Timer, Analog Out, Clk/Trig connector on the BNC connection box to perform an event counting operation without using a gate. The counter counts the number of rising edges that occur on the Counter 0 Clock input.

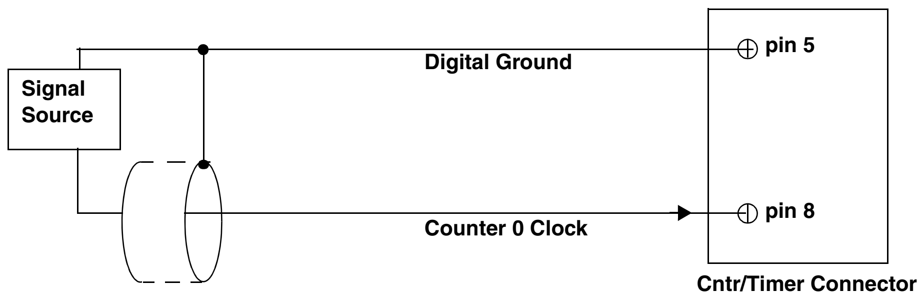


Figure 12: Connecting Counter/Timer Signals to the BNC Connection Box for an Event Counting Operation Without Using a Gate

Up/Down Counting

Figure 13 shows how to connect counter/timer signals to the Cntr/Timer, Analog Out, Clk/Trig connector on the BNC connection box to perform an up/down counting operation. In this example, counter/timer 0 is used. 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.

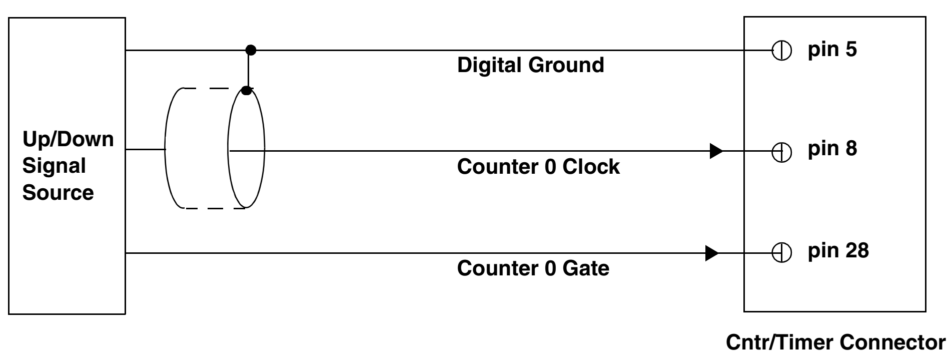


Figure 13: Connecting Counter/Timer Signals to the BNC Connection Box for an Up/Down Counting Operation

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 14 shows how to connect counter/timer signals to the Cntr/Timer, Analog Out, Clk/Trig connector on the BNC 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.

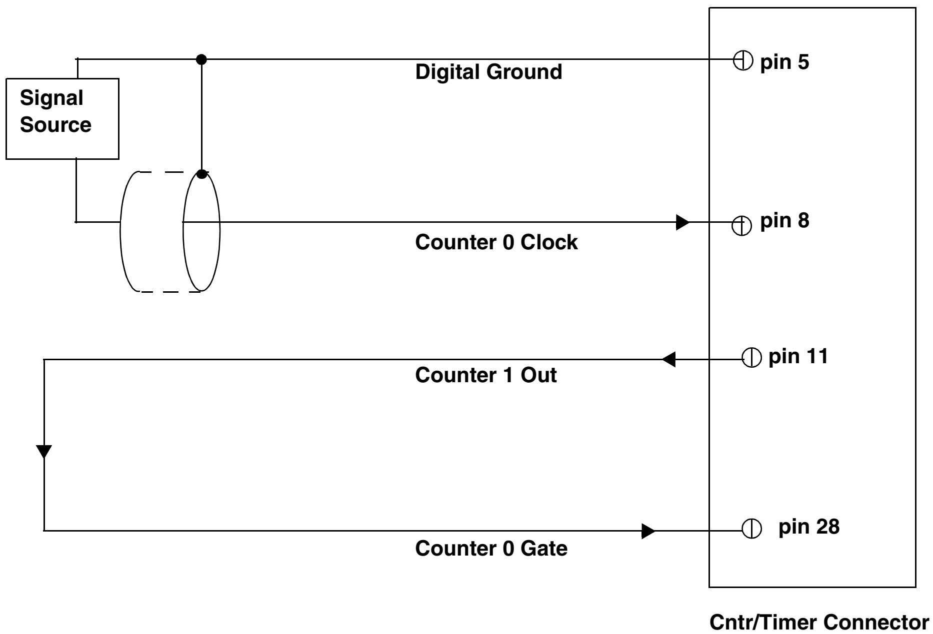


Figure 14: Connecting Counter/Timer Signals to the BNC Connection Box for a Frequency Measurement Operation Using an External Pulse

Period/Pulse Width Measurement

Figure 15 shows how to connect counter/timer signals to the Cntr/Timer, Analog Out, Clk/Trig connector on the BNC connection box to perform a period/pulse width measurement operation. This example uses 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 page 74 for more information about pulse periods and pulse widths.

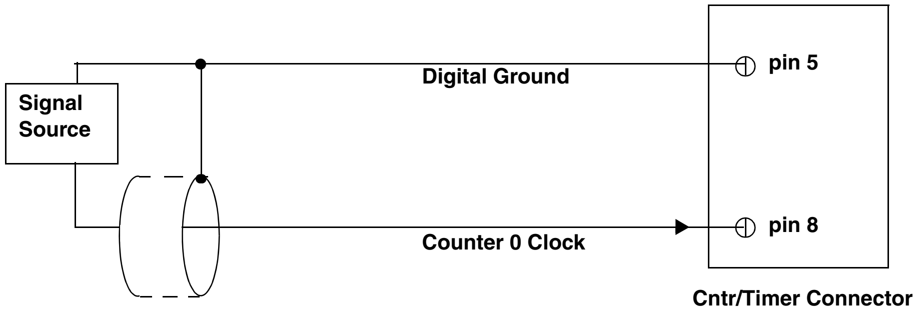


Figure 15: Connecting Counter/Timer Signals to the BNC Connection Box for a Period/Pulse Width Measurement Operation

Edge-to-Edge Measurement

Figure 16 shows how to connect counter/timer signals to the Cntr/Timer, Analog Out, Clk/Trig connector of the BNC 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 76 for more information on edge-to-edge measurement mode.

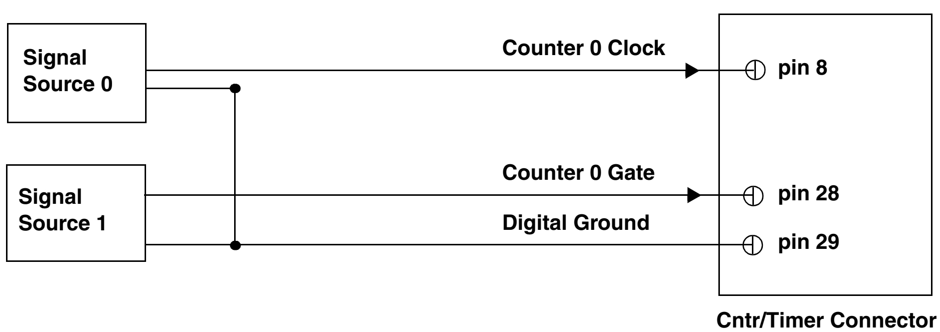


Figure 16: Connecting Counter/Timer Signals to the BNC Connection Box for an Edge-to-Edge Measurement Operation

Continuous Edge-to-Edge Measurement

Figure 17 shows how to connect counter/timer signals to the Cntr/Timer, Analog Out, Clk/Trig connector of the BNC 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 77 for more information on continuous edge-to-edge measurement mode.

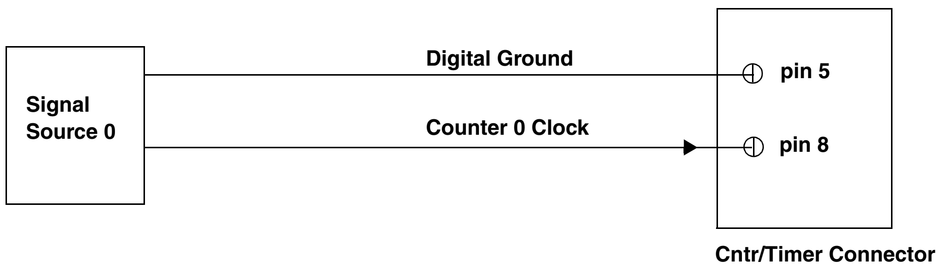


Figure 17: Connecting Counter/Timer Signals to the BNC Connection Box for a Continuous Edge-to-Edge Measurement Operation

Pulse Output

Figure 18 shows how to connect counter/timer signals to the Cntr/Timer, Analog Out, Clk/Trig connector of the BNC connection box to perform a pulse output operation; in this example, counter/timer 0 and an external gate are used.

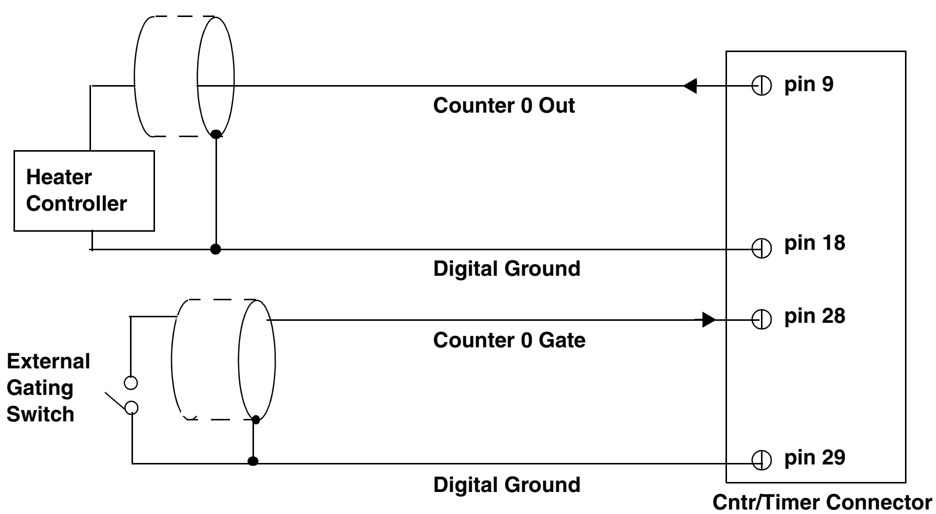


Figure 18: Connecting Counter/Timer Signals to the BNC Connection Box for a Pulse Output Operation Using an External Gate

Connecting a Tachometer Input Signal

You can connect a ±30 V tachometer input signal to the AD Clk/Tach BNC on a DT9826 BNC connection box, as shown in Figure 19.

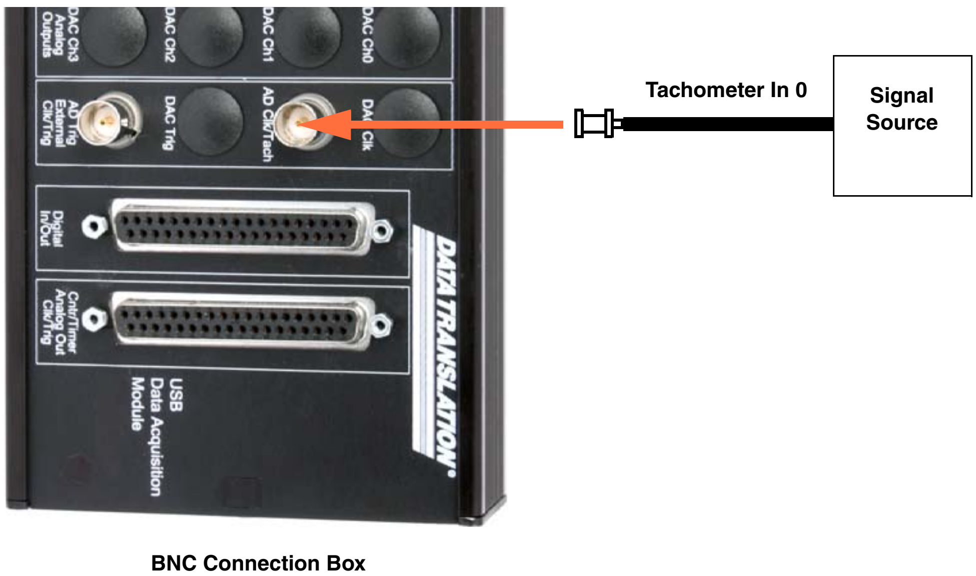


Figure 19: Connecting a Tachometer Input Signal to the DT9826 BNC Connection Box

Figure 20 shows how to connect a tachometer signal to the Cntr/Timer, Analog Out, Clk/Trig connector on the BNC connection box.

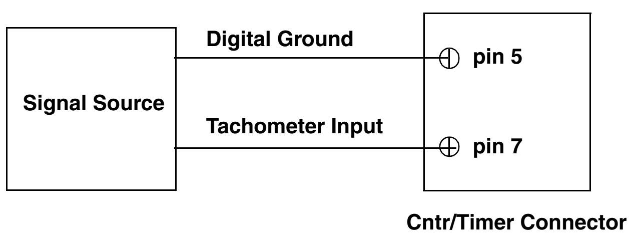
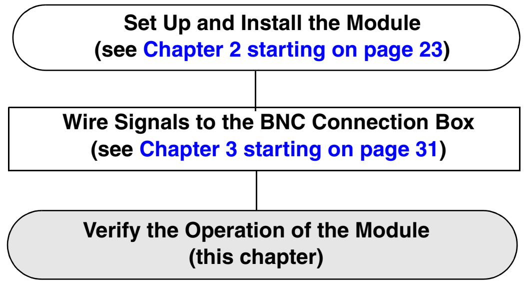


Figure 20: Connecting a Tachometer to the Cntr/Timer Connector on the BNC Connection Box

4

Verifying the Operation of a Module



You can verify the operation of a DT9826 module using the Quick DataAcq application. Quick DataAcq lets you do the following:

- Acquire data from a single analog input channel or digital input port
- Acquire data continuously from one or more analog input channels using an oscilloscope, strip chart, or Fast Fourier Transform (FFT) view
- Read the value of the digital input port
- Output data from the digital output port
- Measure the frequency of events
- Output pulses either continuously or as a one-shot
- Save the input data to disk

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 module; however, it may not support all of the module’s features.

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

Testing Single-Value Analog Input

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

1. Connect a voltage source, such as a function generator, to analog input channel 0 on the DT9826 module. Refer to page 39 for an example of how to connect an analog input.
2. In the Quick DataAcq application, choose **Single Analog Input** from the **Acquisition** menu.
3. Select the appropriate DT9826 module from the **Board** list box.
4. In the **Channel** list box, select analog input channel 0.
5. In the **Range** list box, select the range for the channel. *The default is ±10 V.*
6. Select **Single Ended**.
7. Click **Get** to acquire a single value from analog input channel 0.
   The application displays the value on the screen in both text and graphical form.

Testing Continuous Analog Input

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

1. Connect known voltage sources, such as the outputs of a function generator, to analog input channels 0 and 1 on the DT9826 module.
2. In the Quick DataAcq application, choose **Scope** from the **Acquisition** menu.
3. Select the DT9826 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 **Bipolar**.
9. Click **OK** to close the dialog box.
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 on the DT9826 module. Refer to page 40 for information about how to connect a digital input.
2. In the Quick DataAcq application, choose **Digital Input** from the **Acquisition** menu.
3. Select the appropriate DT9826 module from the **Board** list box.
4. Click **Get**.
   The application displays the digital input value in both the Data box and the Digital Input box. If an indicator light is lit (red), the line is high; if an indicator light is not lit (black), the line is low.

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 on the DT9826 module. Refer to page 40 for information about how to connect a digital output.
2. In the Quick DataAcq application, choose **Digital Output** from the **Control** menu.
3. Select the appropriate DT9826 module from the **Board** list box.
4. Click the appropriate indicator lights to select the types of signals to write from the digital output lines. If you select a light, the module outputs a high-level signal; if you do not select a light, the module outputs a low-level signal. You can also enter an output value for the eight digital output lines (0 to FF) in the **Hex** text box.
5. Click **Send**.
The values of the digital output lines are updated appropriately.

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 DT9826 module. Refer to page 43 for an example of how to connect an external clock.

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

---

2. In the Quick DataAcq application, choose **Measure Frequency** from the **Acquisition** menu.
3. Select the appropriate DT9826 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 frequency is displayed on the screen.
6. Click **Stop** to stop the frequency measurement operation.

Testing Pulse Output

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

1. Connect a scope to counter/timer 0 on the DT9826 module. Refer to page 45 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.

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2. In the Quick DataAcq application, choose **Pulse Generator** from the **Control** menu.
3. Select the appropriate DT9826 module from the **Board** list box.
4. Select either **Continuous** to output a continuous pulse stream or **One Shot** to output one pulse.
5. Select either **Low-to-high** to output a rising-edge pulse (the high portion of the total pulse output period is the active portion of the signal) or **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. Under **Pulse Width**, enter a percentage or use the slider to select a percentage for the pulse width. The percentage determines the duty cycle of the pulse.
7. Click **Start** to generate the pulse(s).
   The application displays the results both in text and graphical form.
8. Click **Stop** to stop a continuous pulse output operation. One-shot pulse output operations stop automatically.

Part 2: Using Your Module

5

Principles of Operation

Figure 21 shows a block diagram of the DT9826 module.

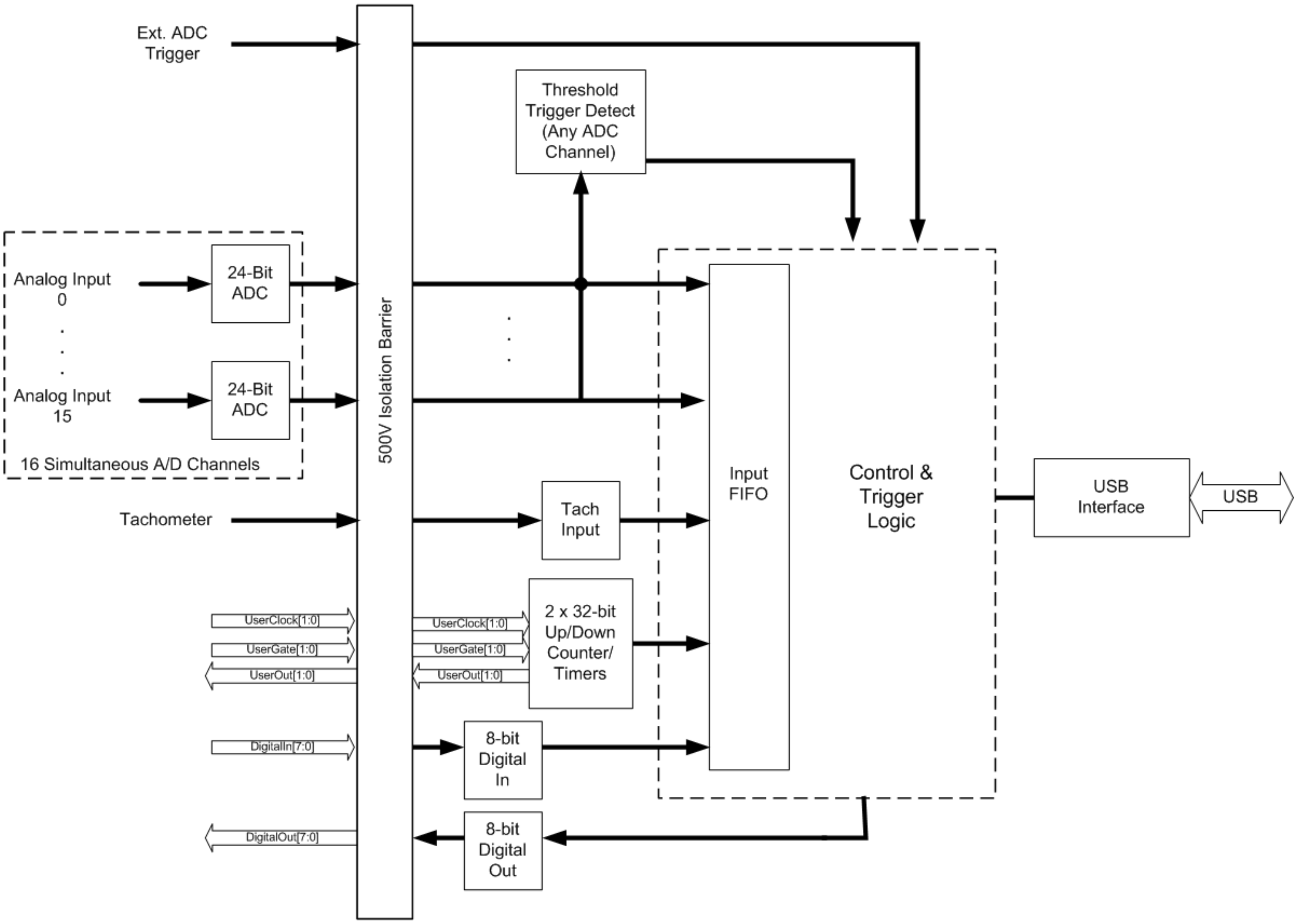

Figure 21: Block Diagram of the DT9826 Module

Analog Input Features

This section describes the following features of analog input (A/D) operations on the DT9826 module:

- Input resolution, described below
- Analog input channels, described below
- Input ranges, described on page 63
- Input sample clock sources, described on page 63
- Analog input conversion modes, described on page 64
- Input triggers, described on page 66
- Data format and transfer, described on page 67
- Error conditions, described on page 68

Input Resolution

Input resolution is fixed at 24 bits; you cannot specify the resolution in software.

Analog Input Channels

The DT9826 supports 16 analog inputs with a Delta-Sigma converter per channel. You can connect the analog input channels in single-ended mode. In this mode the source of the input should be close to the module, and all the input signals are referred to the same common ground.

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

The DT9826 module can acquire data from a single analog input channel or from a group of analog input channels. Analog input channels are numbered 0 to 15.

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 64 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 by specifying the channel (0 to 15) in the analog input channel list. Because these modules feature simultaneous sampling, the order of the channels in the channel list does not matter. You cannot specify the same channel more than once in the list.

Using software, specify the channels that you want to sample. You can enter up to 20 entries in the analog channel list for the DT9826, including the analog input channels (0 to 15), the tachometer input (16), two 32-bit counter/timers (17 and 18), and the digital input port (channel 19).

Specifying the Tachometer Input Channel in the Analog Input Channel List

The DT9826 module allows you to read the value of the tachometer input using the analog input channel list. This feature is particularly useful when you want to correlate the analog input measurements with tachometer data.

To read the value of the tachometer, specify channel 16 in the analog input channel list. Refer to page 70 for more information about the tachometer input channel.

Specifying Counter/Timers in the Analog Input Channel List

The DT9826 module allows you to read the value of the 32-bit 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 counter/timer channel 0, specify channel 17 in the analog input channel list. To read counter/timer 1, specify channel 18 in the analog input channel list. You can enter the channel number anywhere in the 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.

Refer to page 72 for more information about counter/timer operations.

Specifying the Digital Input Port in the Analog Input Channel List

The DT9826 module allows you to read the digital input port using the analog input channel list. This feature is particularly useful when you want to correlate the timing of analog and digital events.

To read the digital input port, specify channel 19 in the analog input channel list. You can enter this channel anywhere in the list.

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.

Input Ranges

The DT9826 module provides an input range of ±10 V. Use software to specify the range as ±10 V.

You cannot set a gain value for DT9826 module. The gain is preset at 1.

Input Sample Clock Sources

The DT9826 module provides an internal A/D clock source for pacing analog input operations.

Using software, specify the clock source as internal and the clock frequency at which to pace the operation. The minimum clock frequency is 10 Hz. The maximum supported clock frequency is 41.666 kHz. All input channels, including the tachometer, counter/timers, and/or digital input port are clocked simultaneously at the specified rate, if you specify them in the analog input channel list.

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

The tachometer, counter/timer, and digital input data is synchronized with the analog data stream. This is done through the firmware and device driver by caching this data and aligning it in time with the analog data in the user's data buffers.

About the Delta-Sigma Converters

The DT9826 provides 16 Delta-Sigma A/D converters (ADCs). If you sample the data at a frequency of 41.666 kHz, the ADCs actually sample the input signal at 2.66 MHz (64 times the sample rate) and produce 1-bit samples that are applied to the digital filter. The filter expands the data to 24-bits and rejects signal parts greater than 20.833 kHz. It also resamples the data at 41.666 kHz.

A 1-bit quantizer introduces many quantization errors to the signal. The 1-bit, 2.66 MHz data from the ADC carries all information to produce 24-bit samples at 41.666 kHz. The Delta-Sigma ADC converts from high-speed to high-resolution by adding much random noise to the signal. In this way, the resulting quantization noise is restricted to frequencies above 41.666 kHz. This noise is not correlated with the useful signal and is rejected by the digital filter.

Nyquist Frequency and Bandwidth

ADCs can represent signals of limited bandwidth only. According to sampling theory (the Nyquist Theorem), you must specify a frequency that is at least twice as fast as the input's highest frequency component (called the Nyquist frequency). For example, to accurately sample a 5 kHz signal, specify a sampling frequency of at least 10 kHz. Doing so avoids an error condition called *aliasing*, in which high frequency input components erroneously appear as lower frequencies after sampling.

The bandwidth between 0 Hz and the Nyquist frequency is called the Nyquist bandwidth. On the DT9826, –3 dB bandwidth is 0.216 x the sample frequency, or 8.99 kHz at the maximum sample frequency. Signals exceeding this frequency will be filtered by the ADC.

Normal Mode Rejection and the Digital Filter

The digital filter of the ADC passes only signal components within the Nyquist bandwidth or within multiples of the Nyquist bandwidth. The sample rate determines the location of the resulting notches in the digital filter. The first notch is located at the sample frequency and subsequent notches are located at integer multiples of the sample frequency to allow for rejection of the fundamental frequency as well as harmonic frequencies. Due to the digital filter design of the Delta-Sigma ADCs, the DT9826 can achieve high normal mode rejection at 50 Hz and 60 Hz power line frequencies by using a sample frequency of 10 Hz, as shown in Figure 22.

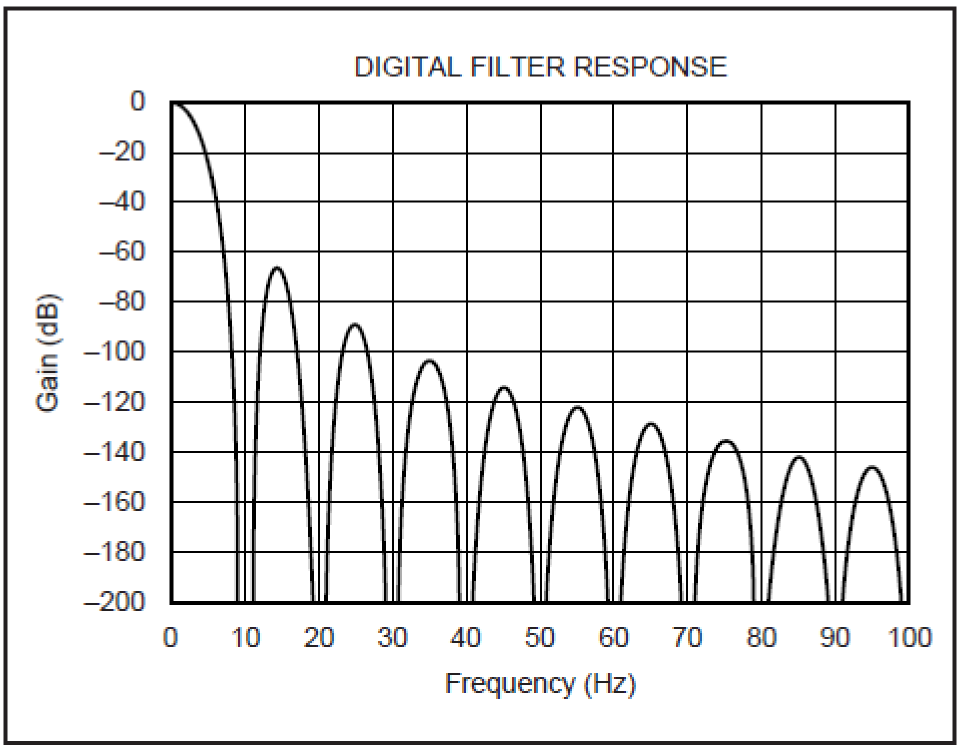

Figure 22: Digital Filter Response (10 Hz Multiples)

Analog Input Conversion Modes

The DT9826 module supports the following conversion modes:

- Single-value mode, described below
- Continuous scan mode, described on page 65

Single-Value Mode

Single value operations are the simplest to use. Using software, you specify the 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.

Note: You cannot read the value of the counter/timers or the tachometer using a standard single-value operation. To read these values, specify the channels as part of the analog input channel list using continuous scan mode, described next.

Continuous Scan Mode

Continuous scan mode takes full advantage of the capabilities of the DT9826 module. Use continuous scan mode if you want to accurately control the period between successive simultaneous conversions of all channels in a channel list. You can specify a channel list, clock source, start trigger, reference trigger, post-trigger scan count, and buffer using software.

You can enter up to 20 entries in the channel list, including the sixteen analog input channels (A/D channels 0 to 15), the tachometer (A/D channel 16), the counter/timers (A/D channels 17 and 18) and the digital input port (A/D channel 19), described on page 80.

When it detects the start trigger, the module simultaneously acquires pre-trigger data from all of the input channels specified in the channel list, including the tachometer, counter/timers, and digital input port, and converts the data from the analog input channels. The sampled data is placed in the allocated buffer(s). When the reference trigger occurs, pre-trigger data acquisition stops and post-trigger acquisition starts. The operation continues until the number of samples you specify for the post-trigger scan count are acquired; at the point, the operation stops. Refer to page 66 for more information about triggers.

The conversion rate is determined by the frequency of the input sample clock; refer to page 63 for more information about the input sample clock. The sample rate, which is the rate at which a single entry in the channel list is sampled, is the same as the conversion rate due to the simultaneous nature of the module.

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 63)

- Specify the start trigger (refer to page 66)
- Specify the reference trigger (refer to page 67).
- Specify the post-trigger scan count (the number of post-trigger samples to acquire after the reference trigger occurs).

Figure 23 illustrates continuous scan mode (using a start and reference trigger) with a channel list of four entries: channel 0 through channel 3. In this example, pre-trigger analog input data is acquired when the start trigger is detected. When the reference trigger occurs, the specified number of post-trigger samples (3, in this example) are acquired.

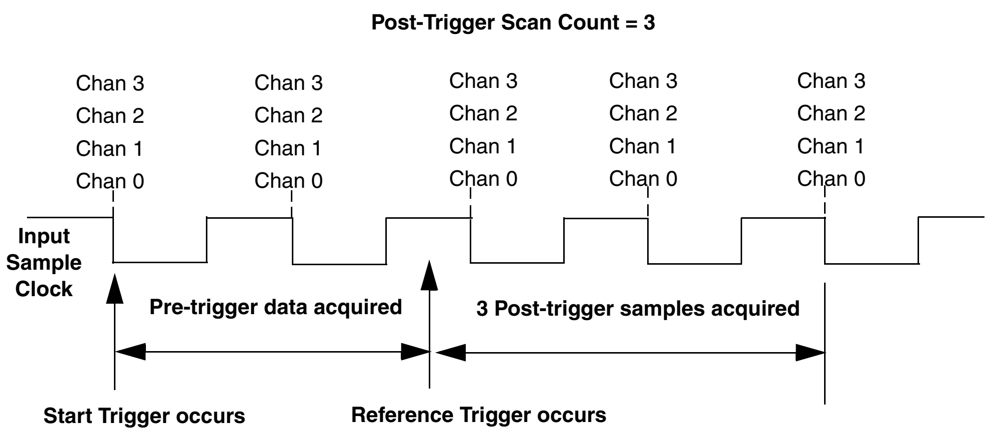

Figure 23: Continuous Scan Mode

Input Triggers

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

On the DT9826 modules, you can specify a start trigger source and a reference trigger source. Pre-trigger data acquisition starts when the start trigger event occurs. When the reference trigger event occurs, pre-trigger data acquisition stops and post-trigger acquisition starts. Post-trigger acquisition stops when the number of samples you specify for the post-trigger scan count has been reached. Refer to page 65 for more information.

Start Trigger Sources

The DT9826 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 start trigger source as a software trigger.

- **External digital (TTL) trigger** – An external digital (TTL) trigger event occurs when the DT9826 module detects either a rising-edge (positive) or falling-edge (negative) transition on the signal connected to the AD Trig connector on the module. Using software, specify the start trigger source as an external, positive digital (TTL) trigger or an external, negative digital (TTL) trigger.
- **Analog threshold trigger** – An analog threshold trigger event occurs when the signal on a specified analog input channel rises above or falls below a programmable threshold level. Using software, specify the following parameters:
  - Start trigger source – Specify a positive (low-to-high transition) threshold trigger if you want to trigger when the signal rises above a threshold level, or a negative (high-to-low transition) threshold trigger if you want to trigger when the signal falls below a threshold level.
  - Threshold channel – Specify any one of the analog input channels as the threshold input channel.
  - Threshold level – Specify a value between –10 V and 10 V as the threshold level.

Reference Trigger Sources

DT9826 module supports an analog threshold trigger for the reference trigger.

The reference trigger event occurs when the signal attached to a specified analog input channel rises above a user-specified threshold value. Using software, specify the following parameters:

- Reference trigger source – Specify a positive (low-to-high transition) threshold trigger if you want to trigger when the signal rises above a threshold level, or a negative (high-to-low transition) threshold trigger if you want to trigger when the signal falls below a threshold level.
- Threshold channel – Specify any one of the analog input channels as the threshold input channel.
- Threshold level – Specify a value between –10 V and 10 V as the threshold level.

Data Format and Transfer

The DT9826 module uses offset binary data encoding, where 000000 represents –10 V and FFFFFFh represents +10 V. Use software to specify the data encoding as binary. The ADC outputs FFFFFFh for above-range signals, and 000000 for below-range signals.

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

Note: We recommend that you allocate a minimum of two buffers that can contain even multiples of 256 samples.

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 DT9826 module can report the following errors:

- Input over sample – Indicates that the input sample clock rate is too fast. This error is reported if a new sample clock occurs while the ADC is busy performing a conversion from the previous input sample clock.
- Input FIFO overflow – Indicates that the input data is not being transferred fast enough from the Input FIFO on the module through the USB interface to the host. This error is reported if the Input FIFO is full.

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

To avoid these errors, try one or more of the following:

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

Tachometer Input Features

You can connect a tachometer signal with a range of ±30 V to the DT9826 module. This signal has a maximum frequency of 1 MHz and a minimum pulse width of 0.4 μs. The threshold voltage is fixed at +2 V with 0.5 V of hysteresis.

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

You can read the number of counts between two consecutive starting edges of the tachometer input signal by including channel 16 in the analog input channel list. The starting edge is programmable (either rising or falling).

Using software commands, you can specify the following parameters for the tachometer input:

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

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

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

When you read the value of the tachometer input as part of the analog input data stream, you might see results similar to the following:

Table 5: An Example of Reading the Tachometer Input as Part of the Analog Input Data Stream

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

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

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

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

Counter/Timer 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 73
- Gate types, described on page 73
- Pulse types and duty cycles, described on page 74
- C/T operation modes, described on page 74

C/T Channels

The DT9826 modules provide two 32-bit counter/timers (numbered 0 and 1). Each counter accepts a clock input signal and gate input signal and outputs a pulse (pulse output signal), as shown in Figure 24.

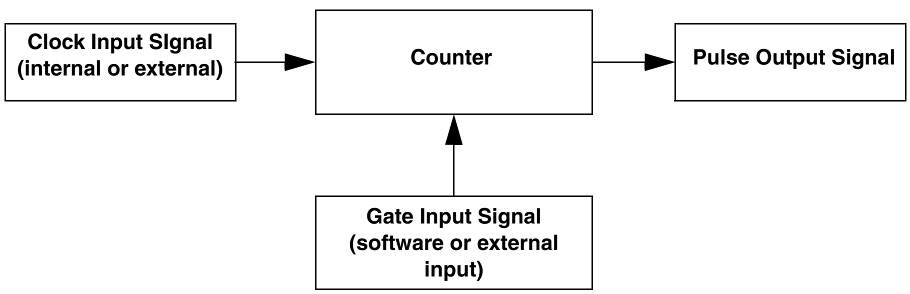

Figure 24: Counter/Timer Channel

To specify the counter/timer to use in software, specify the appropriate C/T subsystem. Counter/timer 0 corresponds to C/T subsystem element 0; counter/timer 1 corresponds to C/T subsystem element 1.

Using software, you can also specify one or both of the counter/timers in the analog input channel list. To read counter/timer 0, specify channel 17 in the analog input channel list; to read counter/timer 1, specify channel 18 in the analog input 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's output 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 0.011176 Hz to 24 MHz.

  Connect the external clock to the counter 0 or counter 1 clock input signal on the DT9826 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 4294967296.

  The external C/T clock (the clock connected to the counter's clock input signal) determines how often you want to count events, measure frequency, or measure the time interval between edges.

Gate Types

The edge or level of the counter gate signal determines when a counter/timer operation is enabled. DT9826 modules provide 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's gate signal is low, and disables the counter/timer operation when the counter's gate signal is high. Note that this gate type is used for event counting and rate generation modes; refer to page 74 for more information about these modes.
- **Logic-high level external gate input** – Enables a counter/timer operation when the counter's gate signal is high, and disables a counter/timer operation when the counter's gate signal is low. Note that this gate type is used for event counting and rate generation modes; refer to page 74 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's 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 74 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's 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 74 for more information about these modes.

Specify the gate type in software.

Pulse Output Types and Duty Cycles

The DT9826 modules 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 25 illustrates a low-to-high pulse with a duty cycle of approximately 30%.

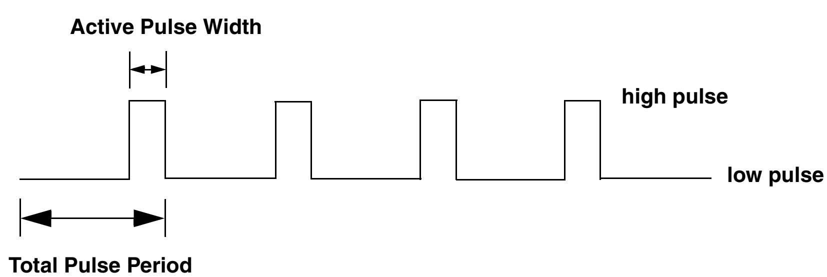

Figure 25: Example of a Low-to-High Pulse Output Type

Counter/Timer Operation Modes

DT9826 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.

You can read the value of the counter/timer in the analog input stream by specifying channels 17 and 18; refer to page 62 for more information.

The following subsections describe these modes in more detail.

Event Counting

Use event counting mode if you want to count the number of rising edges that occur on the counter's clock input when the counter's gate signal is active (low-level or high-level). Refer to page 73 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 41 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's clock input, depending on the level of the counter's gate signal.

If the gate signal is high, the C/T increments; if the 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 42 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's 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's 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:

$$\text{Measurement period} = \frac{1}{\text{Clock Frequency}} * \text{Active Pulse Width}$$

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

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

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's gate input, the falling edge of the counter's gate input, the rising edge of the counter's clock input, or the falling edge of the counter's 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 44 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 76 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's output 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's 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 (if using the internal C/T clock) or 12 MHz (if using the external C/T clock). Refer to page 73 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 74 for more information about pulse output signals and to page 73 for more information about gate types.

Make sure that the signals are wired appropriately. Refer to page 45 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's output line when the specified edge is detected on the counter's 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 73 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 74 for more information about pulse output types and to page 73 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 45 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's output line whenever the specified edge is detected on the counter's 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 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 73 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 74 for more information about pulse output types and to page 73 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 45 for an example of connecting a repetitive one-shot application.

Digital I/O Features

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

- Digital I/O lines
- Operation modes

Digital I/O Lines

DT9826 modules support one digital input port, consisting of 8 digital input lines (lines 0 to 7) and one digital output port, consisting of 8 digital output lines (lines 0 to 7). The resolution is fixed at 8 bits.

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 80 for more information about single-value operations.

In addition, you can perform a continuous digital input operation by specifying the entire digital input port in the analog input channel list.

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.

Note: Pin 2 on connector J3 is available if you want to supply your own +5 V power supply to the digital output circuit. This allows you to maintain the state of the digital output lines if the USB cable is disconnected.

Operation Modes

The DT9826 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. 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 DT9826 module. Enter the digital input port (all 8 digital input lines) as channel 19 in the analog input channel list; refer to page 80 for more information. You can specify a clock source, scan mode, trigger source, buffer, and buffer wrap mode for the digital input 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, tachometer input, and counter/timer channels); refer to page 63 for more information.

6

Supported Device Driver Capabilities

The DT9826 Device Driver provides support for the analog input (A/D), digital input (DIN), digital output (DOUT), counter/timer (C/T), and tachometer (TACH) subsystems. For information on how to configure the device driver, refer to page 29.

Table 6: DT9826 Subsystems

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
Total Subsystems on Module	1	0	1	1	2	0	1

The tables in this chapter summarize the features available for use with the DT-Open Layers for .NET Class Library and the DT9826 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: 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 7: DT9826 Data Flow and Operation Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
Single-Value Operation Support **SupportsSingleValue**	Yes		Yes	Yes	Yes		
Simultaneous Single-Value Output Operations **SupportsSetSingleValues**							
Continuous Operation Support **SupportsContinuous**	Yes		Yes[a]		Yes[b]		
Continuous Operation until Trigger **SupportsContinuousPreTrigger**							
Continuous Operation before & after Trigger **SupportsContinuousPrePostTrigger**							
Waveform Operations Using FIFO Only **SupportsWaveformModeOnly**							
Simultaneous Start List Support **SupportsSimultaneousStart**	Yes						
Supports Programmable Synchronization Modes **SupportsSynchronization**							
Synchronization Modes **SynchronizationMode**							
Interrupt Support **SupportsInterruptOnChange**							
Output FIFO Size **FifoSize**							
Auto-Calibrate Support **SupportsAutoCalibrate**							

a. The DIN subsystem supports continuous mode by allowing you to read the digital input port (all 8 digital input lines) using the analog input channel list.

b. The C/T subsystem supports continuous mode by allowing you to read the value of one or more of the two general-purpose counter/timer channels using the analog input channel list.

Buffering

Table 8: DT9826 Buffering Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
Buffer Support **SupportsBuffering**	Yes						
Single Buffer Wrap Mode Support **SupportsWrapSingle**							
Inprocess Buffer Flush Support **SupportsInProcessFlush**	Yes						

Triggered Scan Mode

Table 9: DT9826 Triggered Scan Mode Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
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 10: DT9826 Data Encoding Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
Binary Encoding Support **SupportsBinaryEncoding**	Yes	Y	Yes	Yes	Yes		
Twos Complement Support **SupportsTwosCompEncoding**							
Returns Floating-Point Values **ReturnsFloats**							

Channels

Table 11: DT9826 Channel Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
Number of Channels **NumberOfChannels**	20[a]		1	1	1	1	1
SE Support **SupportsSingleEnded**	Yes						
SE Channels **MaxSingleEndedChannels**	2		0	0	0		
DI Support **SupportsDifferential**			Yes	Yes	Yes		
DI Channels **MaxDifferentialChannels**	0		1	1	1		
Maximum Channel-Gain List Depth **CGLDepth**	20[a]		1	1	0		
Simultaneous Sample-and-Hold Support **SupportsSimultaneousSampleHold**	Yes						
Channel-List Inhibit **SupportsChannelListInhibit**							

a. Analog input channels are numbered 0 to 15. You can read the tachometer input by specifying channel 16 in the input channel list. You can read counter/timer 0 by specifying channel 17 in the input channel list. You can read counter/timer 1 by specifying channel 18 in the input channel list. You can read the digital input port by specifying channel 19 in the input channel list.

Gain

Table 12: DT9826 Gain Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
Programmable Gain Support **SupportsProgrammableGain**	Yes						
Number of Gains **NumberOfSupportedGains**	1		1	1	0		
Gains Available **SupportedGains**	1		1	1			

Ranges

Table 13: DT9826 Range Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
Number of Voltage Ranges **NumberOfRanges**	1		0	0	0		
Available Ranges **SupportedVoltageRanges**	±10 V						
Current Output Support **SupportsCurrentOutput**							

Resolution

Table 14: DT9826 Resolution Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
Software Programmable Resolution **SupportsSoftwareResolution**							
Number of Resolutions **NumberOfResolutions**	1		1	1	1		
Available Resolutions **SupportedResolutions**	24		8	8	32		

Thermocouple and RTD Support

Table 15: DT9826 Thermocouple and RTD Support Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
Thermocouple Support **SupportsThernocouple**							
RTD Support **SupportsRTD**							
Resistance Support **ReturnsOhms**							
Voltage Converted to Temperature in Hardware **SupportsTemperatureDataInStream**							
Supported Thermocouple Types **ThermocoupleType**							
Supported RTD Types **RTDType**							
Supports CJC Source Internally in Hardware **SupportsCjcSourceInternal**							
Supports CJC Channel **SupportsCjcSourceChannel**							
Available CJC Channels **CjcChannel**							
Supports Interleaved CJC Values in Data Stream **SupportsInterleavedCjcTemperaturesInStream**							
Supports Programmable Filters **SupportsTemperatureFilters**							
Programmable Filter Types **TemperatureFilterType**							

IEPE Support

Table 16: DT9826 IEPE Support Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
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**							

Triggers

Table 17: DT9826 Trigger Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
Software Trigger Support **SupportsSoftwareTrigger**	Yes		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**	Yes						
Digital Event Trigger Support **SupportsDigitalEventTrigger**							
Threshold Trigger Channel **SupportedThresholdTriggerChannel**	0 to 15						
Post-Trigger Scan Count **SupportsPostTriggerScanCount**							

Clocks

Table 18: DT9826 Clock Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
Internal Clock Support **SupportsInternalClock**	Yes		Yes	Yes			
External Clock Support **SupportsExternalClock**					Yes		
Simultaneous Input/Output on a Single Clock Signal **SupportsSimultaneousClocking**	Yes						
Base Clock Frequency **BaseClockFrequency**	48 MHz		0	0	48 MHz		
Maximum Clock Divider **MaxExtClockDivider**	0		1	1	4294967296		
Minimum Clock Divider **MinExtClockDivider**	0		1	1	2		
Maximum Frequency **MaxFrequency**	41.666 kHz		0	0	24 MHz		
Minimum Frequency **MinFrequency**	10 Hz		0	0	0.011176 Hz		

Counter/Timers

Table 19: DT9826 Counter/Timer Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
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 19: DT9826 Counter/Timer Options (cont.)

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
Gate-Rising Edge Type **SupportsGateRising**					Yes		
Interrupt-Driven Operations **SupportsInterrupt**							

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.

Tachometer

Table 20: DT9826 Tachometer Options

DT9826	A/D	D/A	DIN	DOUT	C/T	QUAD	TACH
Rising Edge Type **SupportsRisingEdge**							Yes
Falling Edge Type **SupportsFallingEdge**							Yes
Stale Data Flag **SupportsStaleDataFlag**							Yes

7

Troubleshooting

General Checklist

Should you experience problems using a DT9826 module, do the following:

1. Read all the documentation provided for your product. Make sure that you have added any “Read This First” information to your manual and that you have used this information.
2. Check the OMNI CD for any README files and ensure that you have used the latest installation and configuration information available.
3. Check that your system meets the requirements stated in the README file on the OMNI CD.
4. Check that you have installed your hardware properly using the instructions in Chapter 2.
5. Check that you have installed and configured the device driver 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.datatranslation.com) for an answer to your problem.
8. Visit the product’s page on the Data Translation web site for the latest tips, white papers, product documentation, and software fixes.

If you still experience problems, try using the information in Table 21 to isolate and solve the problem. If you cannot identify the problem, refer to page 96.

Table 21: Troubleshooting Problems

Symptom	Possible Cause	Possible Solution
Module is not recognized	You plugged the module into your computer before installing the device driver.	From the Control Panel > System > Hardware > Device Manager, uninstall any unknown devices (showing a yellow question mark). Then, run the setup program on your OMNI CD to install the USB device drivers, and reconnect your USB module to the computer.
Module does not respond.	The module configuration is incorrect.	Check the configuration of your device driver; see the instructions in Chapter 2.
	The module is damaged.	Contact Data Translation for technical support; refer to page 96.
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 114 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 21: Troubleshooting Problems (cont.)

Symptom	Possible Cause	Possible Solution
Device failure error reported.	The DT9826 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 DT9826 module was removed while an operation was being performed.	Ensure that your DT9826 module is properly connected; see the instructions in Chapter 2.
Data appears to be invalid.	An open connection exists.	Check your wiring and fix any open connections; see the instructions in Chapter 3.
	A transducer is not connected to the channel being read.	Check the transducer connections; see the instructions in Chapter 3.
	The module is set up for single-ended inputs while the software is set up for differential inputs.	Check your wiring and ensure that what you specify in software matches your hardware configuration; see the instructions in Chapter 3.
	The DT9826 module is out of calibration.	DT9826 modules are calibrated at the factory. If you want to readjust the calibration of the analog input or analog output circuitry, refer to Chapter 8 starting on page 99.
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 DT9826 module, Data Translation's Technical Support Department is available to provide technical assistance.

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

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

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

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

If Your Module Needs Factory Service

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

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

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

2. Using the original packing materials, if available, package the module as follows:
   - Wrap the module in an electrically conductive plastic material. Handle with ground protection. A static discharge can destroy components on the module.
   - Place in a secure shipping container.

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

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

8

Calibration

Using the Calibration Utility

The DT9826 module is 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 DT9826 module every six months using the DT9826 Calibration Utility.

Note: Ensure that you installed the DT9826 Device Driver prior to using the DT9826 Calibration Utility.

Start the DT9826 Calibration Utility as follows:

1. Click **Start** from the Task Bar.
2. Select **Programs | Data Translation, Inc | Calibration |DT9826 Calibration Utility.**
   The main menu of the DT9826 Calibration Utility appears.
3. Select the module to calibrate, and then click **OK**.

Once the DT9826 Calibration Utility is running, you can calibrate the analog input circuitry (either automatically or manually), described on page 101.

Calibrating the Analog Input Subsystem

This section describes how to use the DT9826 Calibration Utility to calibrate the analog input subsystem of a DT9826 module.

The DT9826 module has separate calibration for each A/D input channel. You can choose to calibrate either an individual channel or all channels on the module.

Connecting a Precision Voltage Source

To calibrate the analog input circuitry, you need to connect an external +9.3750 V precision voltage source to the DT9826 module. Connect the precision voltage source to the first channel you want to calibrate; for example, Analog In 0 (AD Ch0).

Using the Auto-Calibration Procedure

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

1. Select the **A/D Calibration** tab of the DT9826 Calibration Utility.
2. Choose either a single channel or all channels from the **Type of Calibration** drop-down list box in the **Automatic Calibration** area.
3. Set the voltage supply on your selected channel to 0.000V.
4. Click the Auto Calibration **Start** button.
   A message appears notifying you to verify that 0.000 V is applied to the channel.
5. Verify that the supplied voltage to your selected channel is 0.000 V, and then click **OK**.
   The offset value is calibrated. When the offset calibration is complete, a message appears notifying you to set the input voltage of the channel to +9.375 V.
6. Check that the supplied voltage to your selected channel is +9.375 V, and then click **OK**.
   The gain value is calibrated and a completion message appears.
7. If you chose to calibrate all channels, repeat the proceeding four steps for all other A/D channels on the module (the calibration utility prompts you to attach the precision voltage source to the next channel). Follow the on-screen prompts to proceed through the rest of the channels.

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

Using the Manual Calibration Procedure

If you want to manually calibrate the analog input circuitry instead of auto-calibrating it, do the following for each channel (substitute the appropriate channel number as you go):

1. Adjust the offset as follows:
   a. Verify that 0.000 V is applied to AD 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 0.000 V.
2. 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 22 lists the specifications for the analog input subsystem on the DT9826 module.

Table 22: Analog Input Specifications

Feature	Specifications
Number of analog input channels	16 single-ended, simultaneous
ADC Type	Delta-Sigma converter per channel
Resolution	24 bits
Range	±10 V
Gain	1
Throughput per channel	41.666 kHz
System accuracy, to % of FSR @ 20 kHz System accuracy, to % of FSR @ 41.666 kHz	±0.01% ±0.015%
Data encoding	Offset binary
Coupling	DC
Input voltage	±11 V maximum
Maximum input voltage (without damage) Power on: Power off:	 ±30 V ±20 V
Input impedance	10 MΩ Series 2 kΩ ,1000 pf Filter
Input bias current	±20 nA
Nonlinearity 20 kHz 40 kHz	 ±3 LSB ±5 LSB
Inherent quantizing error	0.5 LSB
Drift Zero: Gain:	 ±10 µV per °C ±30 ppm per °C
Differential linearity drift (of FSR/° C)	±2 ppm
Monotonicity	1 LSB
ESD protection Arc: Contact:	 8 kV 4 kV
Reference	+1.250 V (internal)

Table 22: Analog Input Specifications (cont.)

Feature	Specifications
–3 dB Frequency	A/D sample frequency * 0.216
Effective Number of Bits (ENOB)[a] (Sampling at 40 kHz with a 1 kHz sine wave at –0.37 dB below full-scale (IBF))	14.1 bits
Signal-to-noise plus distortion (SINAD) (Spurious free dynamic range (SFDR) referenced to full scale)	86.48 dB

a. ENOB = (SINAD – 1.76 – IBF)/6.02. Refer to page 106 for more information about ENOBs.

Measuring Dynamic Performance

FFT plots show the dynamic performance of the DT9826. Many users believe that a 24-bit A/D device provides 24-bit accuracy or at least close to that accuracy. But, when measuring a dynamic signal (with frequency components above DC), factors such as noise, harmonic distortion, and phase shift (particularly at low bandwidths), as well as the accuracy of the signal generator itself, degrade the accuracy of the measurement.

Layout of the critical circuit etch, spacing between noise-generating and noise-sensitive devices as well as analog and digital etch patterns, and thermal effects from one circuit to another are all culprits in degrading accuracy. Through careful design, these effects are minimized.

DC specifications are useful. When measuring a 0 V input signal, you can see the system's base-line noise. Under these conditions, the DT9826 yields the highest ENOB (Effective Number of Bits) value of 16 bits. Figure 26A shows the FFT plot when measuring a 0 V signal with a 40 kHz sample frequency. Figure 26A shows the FFT plot when measuring a 0 V signal with a 20 kHz sample frequency.

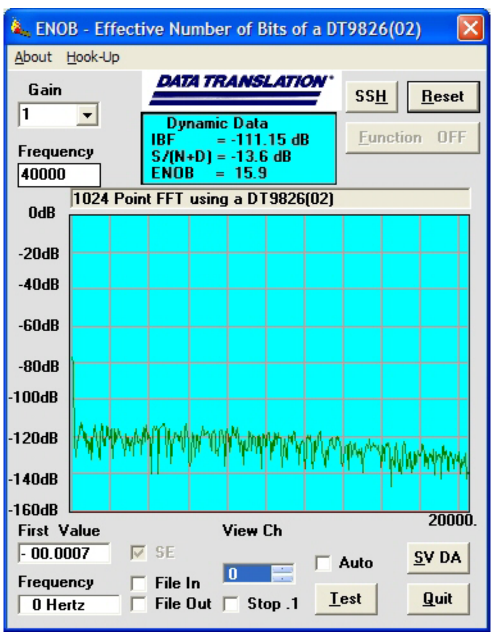

Figure 26A. ENOB of 15.9 bits when measuring a 0 V signal with a 40 kHz sample frequency

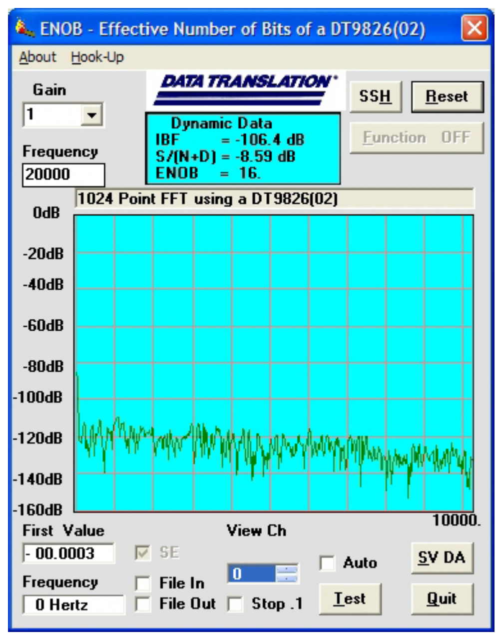

Figure 26B. ENOB of 16 bits when measuring a 0 V signal with a 20 kHz sample frequency

Figure 26: ENOB Value When Measuring a 0 V Input Signal

Dynamic FFT plots at higher input voltages and operating frequencies give the best indicator of accuracy under real-world conditions. For example, when measuring a ±5 V, 1 kHz sine wave (a signal at 1/2 full-scale or –6 dB), the DT9826 can achieve ENOB values of 15 bits. Figure 27A shows the FFT plot when measuring a ±5 V, 1 kHz sine wave with a 40 kHz sample frequency; Figure 27B shows the FFT plot when measuring a ±5 V, 1 kHz sine wave with a 20 kHz sample frequency.

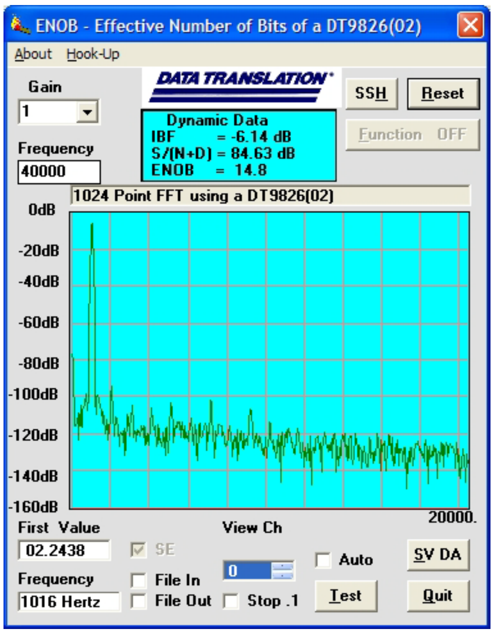

Figure 27A. ENOB of 14.8 bits when measuring a ±5 V, 1 kHz signal with a 40 kHz sample frequency

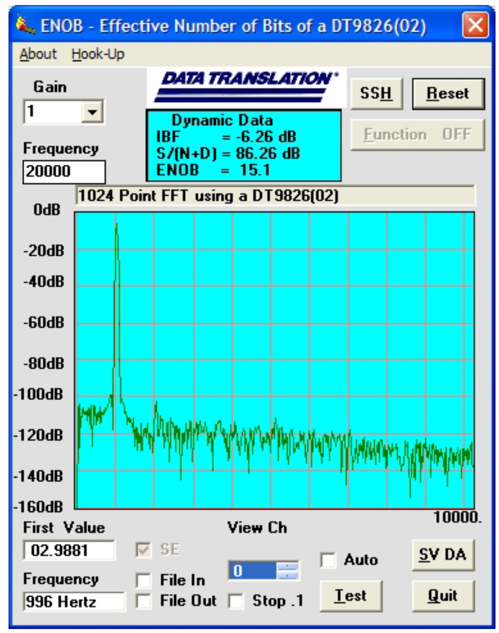

Figure 27B. ENOB of 15.1 bits when measuring a ±5 V, 1 kHz signal with a 20 kHz sample frequency

Figure 27: ENOB Value When Measuring a 1/2 Full-Scale (–6 dB) Input Signal

The ENOB value further degrades at the maximum input signal voltage (full-scale) and the fastest throughput frequency. Under these conditions, the DT9826 yields an ENOB value of 14.3 bits; you can see the full range of the A/D without distortion at the peaks. Figure 28A shows the FFT plot when measuring a ±10 V, 1 kHz sine wave with a 40 kHz sample frequency. Figure 28B shows the FFT plot when measuring a ±10 V, 1 kHz sine wave with a 20 kHz sample frequency.

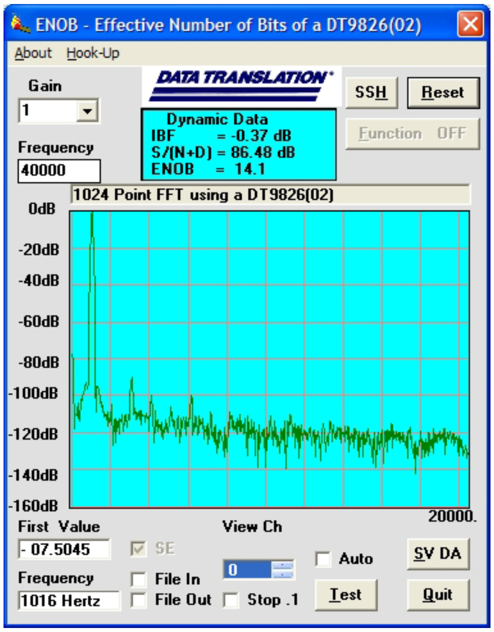

Figure 28A. ENOB of 14.1 bits when measuring a ±10 V, 1 kHz sine wave with a 40 kHz sample frequency

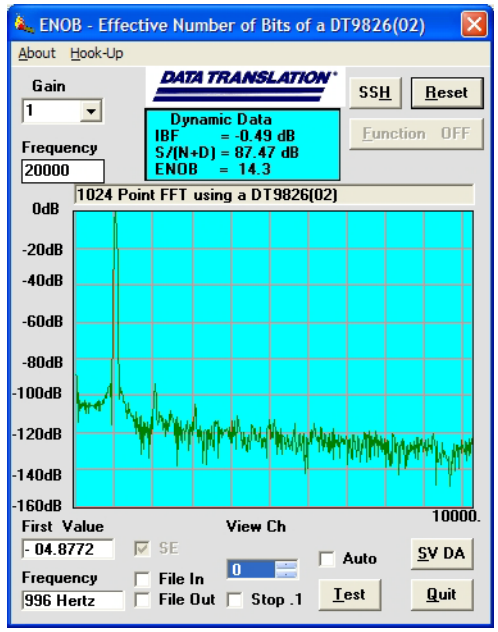

Figure 28B. ENOB of 14.3 bits when measuring a ±10 V, 1 kHz sine wave with a 20 kHz sample frequency

Figure 28: ENOB Value When Measuring a Full-Scale Input Signal

Conditions of use determine the accuracy of dynamic measurements. While ENOB values can be higher when you measure input signals that are less than full-scale, the results may be misleading for many users. ENOB values at full-scale and at the full throughput of the device give the best indicator of accuracy under real-world conditions.

Digital I/O Specifications

Table 23 lists the specifications for the digital I/O subsystems on the DT9826 module.

Table 23: Digital I/O Specifications

Feature	Specifications
Number of digital I/O lines	16 (8 in, 8 out)
Number of ports	2 (8 bits each)
Logic family	LVTTL (5 V tolerant)
Logic sense	Positive true
Inputs Input type: Input logic load: High input voltage: Low input voltage: Low input current: Termination:	 Level-sensitive 1 LVTTL 2.0 V minimum 0.8 V maximum 0.4 mA maximum Inputs tied to +5 V through 22 kΩ pullup resistors
Outputs High output: Low output: High output current: Low output current:	 3.84 V minimum 0.33 V maximum –2 mA maximum 6 mA maximum
Interrupt on change	No
Clocked with sample clock	Yes
Software I/O selectable	No

Counter/Timer Specifications

Table 24 lists the specifications for the counter/timer subsystem on the DT9826 module.

Table 24: Counter/Timer Specifications

Feature	Specifications
Number of channels	2
Resolution	32 bits per channel
Logic family	LVTTL (5 V tolerant)
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 High output: Low output: High output current: Low output current:	 2.0 V minimum 0.8 V maximum –2 mA maximum 8 mA maximum

Tachometer Input Specifications

Table 24 lists the specifications for the tachometer input on the DT9826 module.

Table 25: Tachometer Input Specifications

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

External Trigger Specifications

Table 26 lists the specifications for the external A/D trigger on the DT9826 module.

Table 26: External A/D Trigger Specifications

Feature	Specifications
Trigger sources Internal: External:	 Software-initiated Software-selectable
Input type	Edge-sensitive
Logic family	LVTTL (5 V tolerant)
Inputs Input logic load: Input termination: High input voltage: Low input voltage: Low input current:	 1 LVTTL 22 kΩ pull-up to +3.3 V 2.0 V minimum 0.8 V maximum –0.25 mA maximum
Minimum pulse width High: Low:	 500 ns 500 ns
Triggering modes Single scan: Continuous scan:	 Yes Yes

Internal Clock Specifications

Table 27 lists the specifications for the internal A/D clock on the DT9826 module.

Table 27: Internal A/D Clock Specifications

Feature	Specifications
Reference frequency	48 MHz
A/D master clock frequency range	0.011176 Hz to 16 MHz
A/D clock frequency	(Master Clock Frequency/6)/64
–3 dB frequency	A/D Clock Frequency * 0.216

Power, Physical, and Environmental Specifications

Table 28 lists the power, physical, and environmental specifications for the DT9826 module.

Table 28: Power, Physical, and Environmental Specifications

Feature	Specifications
Power, +5 V	±5% @ 500 mA maximum
Dimensions OEM: BNC:	 8.230 inches x 3.937 inches x 0.753 inches 209.04 mm x 100 mm x 19.13 mm 8.500 inches x 4.170 inches x 1.968 inches 215.9 mm x 105.92 mm x 50 mm
Weight OEM: BNC:	 0.294 lbs (133.4 g) 1.949 lbs (884.4 g)
Environmental Operating temperature range: Storage temperature range: Relative humidity: Altitude:	 0° C to 55° C –25° C to 85° C to 95%, noncondensing to 10,000 feet

Mating Connector Specifications

Table 29 lists the mating cable connectors for the connectors on the DT9826 module.

Table 29: Mating Cable Connectors

Module/Panel	Connector	Part Number on Module (or Equivalent)	Mating Cable Connector
BNC connection box	Analog input	AMP/Tyco AMP 5747375-8	AMP/Tyco 5-747917-2
	Digital In/Out	AMP/Tyco 5747301-8	AMP/Tyco 5-747916-2
	Cntr/Timer, Analog Out, Clk/Trig	AMP/Tyco 5747301-8	AMP/Tyco 5-747916-2
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]
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.

Regulatory Specifications

Table 30 lists the regulatory specifications for the DT9826 module.

Table 30: Regulatory Specifications

Feature	Specifications
Emissions (EMI)	FCC Part 15, EN55022:1994 + A1:1995 + A2:1997 VCCI, AS/NZS 3548 Class A
Immunity	EN61000-6-1:2001
RoHS (EU Directive 2002/95/EG)	Compliant (as of July 1st, 2006)
Safety	UL, CSA

B

Connector Pin Assignments

External USB Connector

Figure 29 shows the layout of the external USB connector (J1) on the DT9826 BNC connection box and on the OEM version of the DT9826 module.

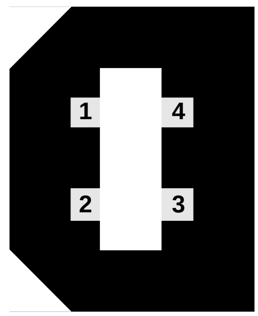

Figure 29: Layout of the USB Connector

Table 31 lists the pin assignments for the USB connector (J1) on the DT9826 module.

Table 31: Pin Assignments for the USB Connector (J1) on the DT9826 Module

J1 Pin Assignment	Signal Description	J1 Pin Assignment	Signal Description
1	USB +5 V	3	USB Data +
2	USB Data –	4	USB Ground

Analog Input Connector

The following sections describe the analog input connector on the DT9826 BNC connection box and on the OEM version of the DT9826 module.

DT9826 BNC Connection Box

Table 32 lists the pin assignments for the Analog Input connector on the DT9826 BNC connection box.

Table 32: Pin Assignments of the Analog Input Connector on the DT9826 BNC Connection Box

Pin	Signal Description	Pin	Signal Description
19	No Connect	37	Reserved
18	Reserved	36	Analog Ground
17	Analog Ground	35	Reserved
16	Reserved	34	Reserved
15	Reserved	33	Reserved
14	Reserved	32	Reserved
13	Reserved	31	Reserved
12	Reserved	30	Reserved
11	Reserved	29	Reserved
10	Reserved	28	Reserved
9	Reserved	27	Analog In 15
8	Analog Input 7	26	Analog In 14
7	Analog Input 6	25	Analog In 13
6	Analog Input 5	24	Analog In 12
5	Analog Input 4	23	Analog In 11
4	Analog Input 3	22	Analog In 10
3	Analog Input 2	21	Analog In 9
2	Analog Input 1	20	Analog In 8
1	Analog Input 0		

OEM Version of DT9826 Module

Figure 30 shows the layout of the 68-pin Analog Input connector (J2) on the OEM version of the DT9826 module.

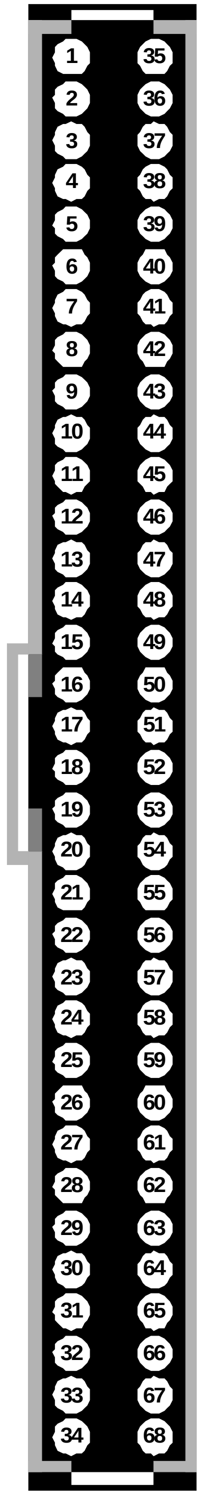

Figure 30: Layout of the 68-Pin Analog Input Connector

Table 33 lists the pin assignments of the Analog Input connector (J2) on the OEM version of the DT9826 module.

Table 33: Pin Assignments of the Analog Input Connector (J2) on the OEM Version of the DT9826 Module

J2 Pin Assignment	Signal Description	J2 Pin Assignment	Signal Description
1	Reserved	35	Reserved
2	Analog Ground	36	Analog Ground
3	Analog Ground	37	Analog Ground
4	Reserved	38	Reserved
5	Analog Ground	39	Analog Ground
6	Reserved	40	Reserved
7	Analog Ground	41	Analog Ground
8	Reserved	42	Reserved
9	Analog Ground	43	Analog Ground
10	Reserved	44	Reserved
11	Analog Ground	45	Analog Ground
12	Reserved	46	Reserved
13	Analog Ground	47	Analog Ground
14	Reserved	48	Reserved
15	Analog Ground	49	Analog Ground
16	Reserved	50	Reserved
17	Analog Ground	51	Analog Ground
18	Reserved	52	Reserved
19	Analog Ground	53	Analog Ground
20	Analog Input 7	54	Analog Input 15
21	Analog Ground	55	Analog Ground
22	Analog Input 6	56	Analog Input 14
23	Analog Ground	57	Analog Ground
24	Analog Input 5	58	Analog Input 13
25	Analog Ground	59	Analog Ground
26	Analog Input 4	60	Analog Input 12
27	Analog Ground	61	Analog Ground
28	Analog Input 3	62	Analog Input 11
29	Analog Ground	63	Analog Ground

Table 33: Pin Assignments of the Analog Input Connector (J2) on the OEM Version of the DT9826 Module (cont.)

J2 Pin Assignment	Signal Description	J2 Pin Assignment	Signal Description
30	Analog Input 2	64	Analog Input 10
31	Analog Ground	65	Analog Ground
32	Analog Input 1	66	Analog Input 9
33	Analog Ground	67	Analog Ground
34	Analog Input 0	68	Analog Input 8

Digital I/O Connector

The following sections describe the digital In/Out connector on the DT9826 BNC connection box and on the OEM version of the DT9826 module.

DT9826 BNC Connection Box

Table 34 lists the pin assignments for the Digital In/Out connector on the DT9826 BNC connection box.

Table 34: Pin Assignments of the Digital In/Out Connector on the DT9826 BNC Connection Box

Pin	Signal Description	Pin	Signal Description
1	Digital Input 0	20	Digital Output 0
2	Digital Input 1	21	Digital Output 1
3	Digital Input 2	22	Digital Output 2
4	Digital Input 3	23	Digital Output 3
5	Digital Input 4	24	Digital Output 4
6	Digital Input 5	25	Digital Output 5
7	Digital Input 6	26	Digital Output 6
8	Digital Input 7	27	Digital Output 7
9	Reserved	28	Reserved
10	Reserved	29	Reserved
11	Reserved	30	Reserved
12	Reserved	31	Reserved
13	Reserved	32	Reserved
14	Reserved	33	Reserved
15	Reserved	34	Reserved
16	Reserved	35	Reserved
17	Digital Ground	36	Reserved
18	Digital Ground	37	Digital Ground
19	No Connect		

OEM Version of the DT9826 Module

Figure 31 shows the layout of the 68-pin Digital I/O connector (J3) on the OEM version of the DT9826 module.

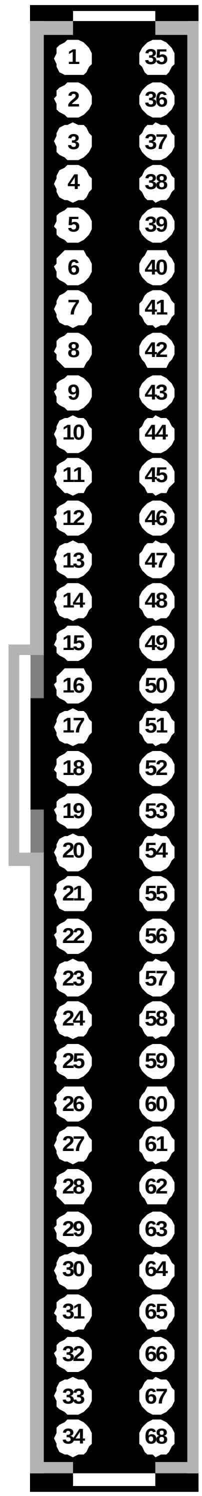

Figure 31: Layout of the 68-Pin Digital I/O Connector

Table 33 lists the pin assignments of the Digital I/O connector (J3) on the OEM version of the DT9826 module.

Table 35: Pin Assignments of the Digital I/O Connector (J3) on the OEM Version of the DT9826 Module

J3 Pin Assignment	Signal Description	J3 Pin Assignment	Signal Description
1	Reserved	35	Reserved
2	Reserved	36	Digital Ground
3	Reserved	37	Reserved
4	Reserved	38	Digital Ground
5	Reserved	39	Reserved
6	Reserved	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	Reserved
12	Reserved	46	Reserved
13	Reserved	47	Reserved
14	Reserved	48	Reserved
15	Reserved	49	Reserved
16	Reserved	50	Reserved
17	Reserved	51	Reserved
18	Reserved	52	Reserved
19	Reserved	53	Reserved
20	Digital Input 7	54	Digital Output 7
21	Digital Input 6	55	Digital Output 6
22	Digital Input 5	56	Digital Output 5
23	Digital Input 4	57	Digital Output 4
24	Digital Input 3	58	Digital Output 3
25	Digital Input 2	59	Digital Output 2
26	Digital Input 1	60	Digital Output 1
27	Digital Input 0	61	Digital Output 0
28	Tachometer	62	External ADC Trigger
29	Reserved	63	Reserved

Table 35: Pin Assignments of the Digital I/O Connector (J3) on the OEM Version of the DT9826 Module (cont.)

J3 Pin Assignment	Signal Description	J3 Pin Assignment	Signal Description
30	Digital Ground	64	Digital Ground
31	Reserved	65	Reserved
32	Reserved	66	Reserved
33	Reserved	67	Reserved
34	Reserved	68	Reserved

Cntr/Timer, Analog Out, Clk/Trig Connector

Table 36 lists the pin assignments of the Cntr/Timer, Analog Out, Clk/Trig connector on the DT9826 BNC connection box.

Note: To access these signals on the OEM version of the DT9826 module, use the Digital I/O connector, described on page 125.

Table 36: Pin Assignments of the Cntr/Timer, Analog Out, Clk/Trig Connector on the DT9826 BNC Connection Box

Pin	Signal Description	Pin	Signal Description
1	Reserved	20	Reserved
2	Reserved	21	Reserved
3	Reserved	22	Reserved
4	Reserved	23	Reserved
5	Digital Ground	24	Digital Ground
6	Reserved	25	Reserved
7	Tachometer	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	Reserved	31	Digital Ground
13	Reserved	32	Reserved
14	Reserved	33	Digital Ground
15	Reserved	34	Reserved
16	Reserved	35	Digital Ground
17	Reserved	36	Reserved
18	Digital Ground	37	Digital Ground
19	No Connect		

C

Wiring Signals to the OEM Version of the Module

Preparing to Wire Signals

This section provides recommendations and information about wiring signals to the OEM version of the DT9826 module.

Note: If you are using the BNC connection box, refer to Chapter 3 starting on page 31 for wiring information.

Wiring Recommendations

Keep the following recommendations in mind when wiring signals to a DT9826 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 module and cabling next to sources that produce high electromagnetic fields, such as large electric motors, power lines, solenoids, and electric arcs, unless the signals are enclosed in a mumetal shield.
- Prevent electrostatic discharge to the I/O while the module is operational.
- Connect all unused analog input channels to analog ground.

Wiring Methods

You can connect signals directly through the J2 and J3 connectors on the OEM version of the DT9826 module, or you can connect signals using the connectors and screw terminals on the following accessories:

- **EP353** – This accessory panel plugs into connector J2 of the OEM version of the DT9826 module. It provides one 37-pin, D-sub connector for attaching analog input signals and one 26-pin connector for attaching a AC1315 cable/5B Series signal conditioning backplane.

  Refer to page 133 for more information about attaching the EP353 to the OEM version of the DT9826 module and for information about the connector pin assignments.

- **EP355** – When plugged into connector J2 of the OEM version of the DT9826 module, this screw terminal panel provides 14-position screw terminal blocks for attaching analog input signals. When plugged into connector J3 of the OEM version of the DT9826 module, this screw terminal panel provides 14-position screw terminal blocks for attaching counter/timer, tachometer, digital I/O, and trigger signals.

  Refer to page 136 for more information about attaching the EP355 to the OEM version of the DT9826 module and for information about the screw terminal assignments.

- **EP356 –** This accessory panel plugs into connector J3 of the OEM version of the DT9826 module. It provides two 37-pin, D-sub connectors. Use connector J1 of the EP356 to attach digital I/O signals, and use connector J2 of the EP356 to attach counter/timer, tachometer, and trigger signals.

  Refer to page 141 for more information about attaching the EP356 to the OEM version of the DT9826 module and for information about the connector pin assignments.

Using the Connectors on the OEM Module

You can connect I/O signals directly through the J2 and J3 connectors on the OEM version of the DT9826 module. You access the pins on connectors J2 and J3 by building your own cable and screw terminal panel; refer to page 115 for information about the required mating connectors. The locations of the connectors are shown in Figure 32.

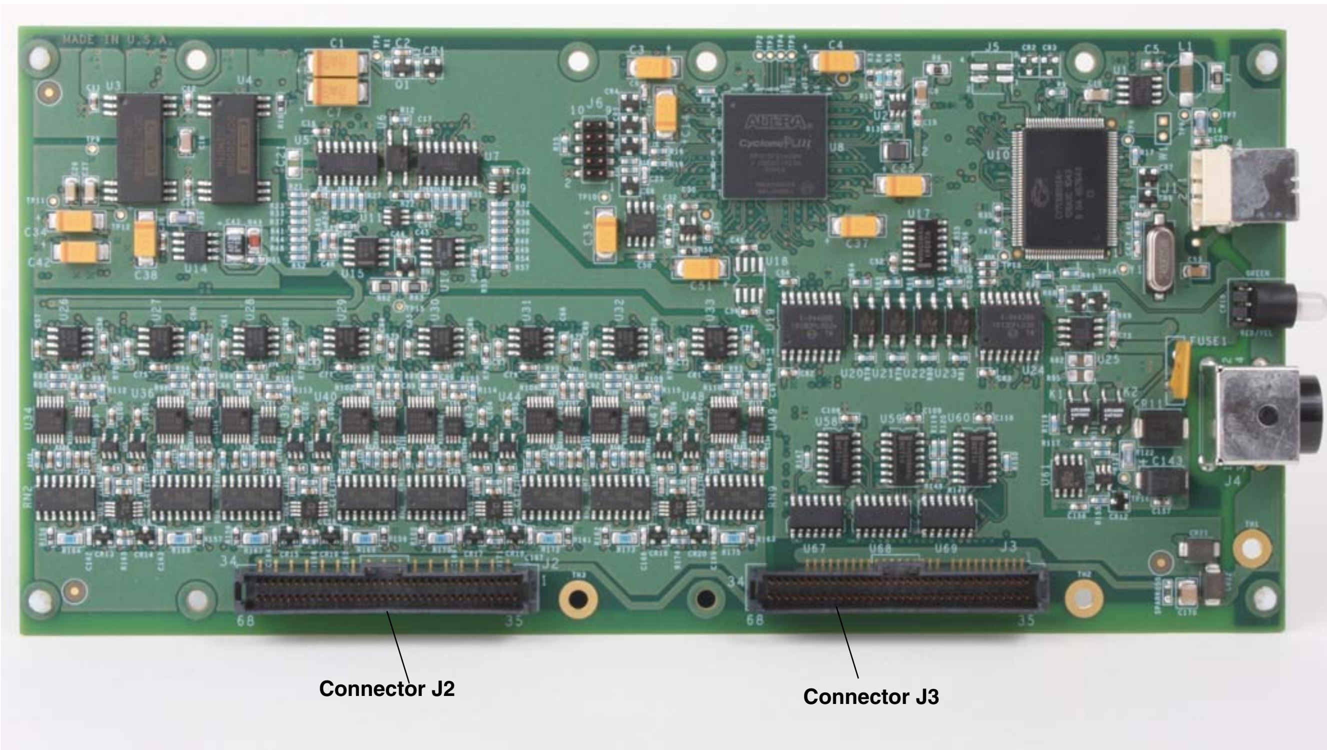

Figure 32: Connectors on OEM Version of DT9826 Module

Appendix B starting on page 117 lists the pin assignments for connectors J2 and J3 on the OEM version of the DT9826 module.

Using an EP353 Accessory Panel

To attach an EP353 accessory panel to the OEM version of the DT9826 module, plug the EP353 panel into connector J2 on the module, as shown in Figure 33.

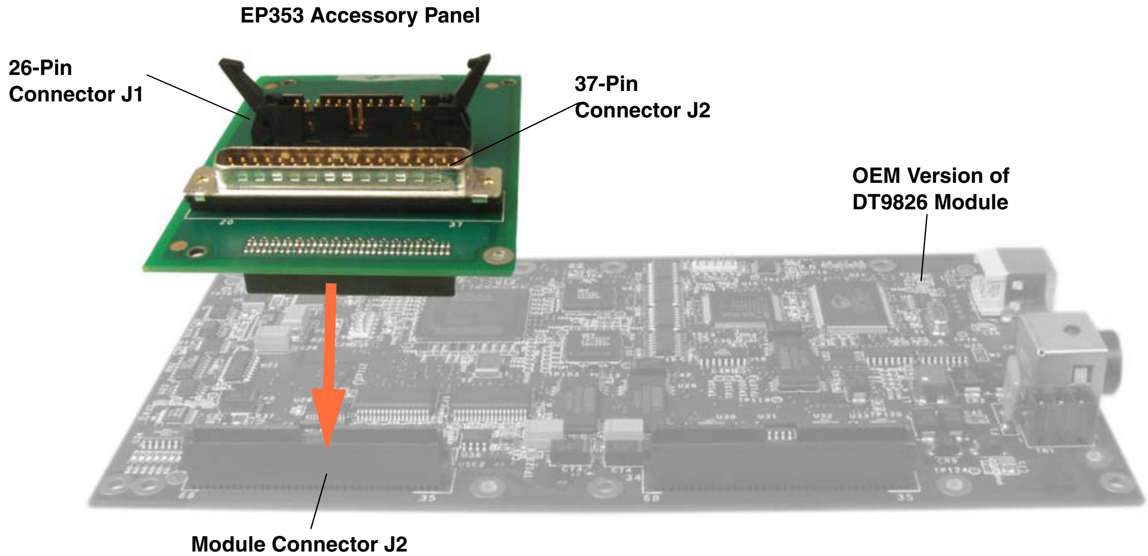

Figure 33: Connecting the EP353 Accessory Panel to Connector J2 on the OEM Version of the DT9826 Module

Using Connector J1 on the EP353

Use connector J1 to attach a 5B Series signal conditioning backplane to the EP353 accessory panel. To attach the backplane, you also need an AC1315 cable.

To attach a 5B Series signal conditioning backplane to the EP353 accessory panel, do the following:

1. Plug one end of an AC1315 cable into connector J1 on the EP353 panel, as shown in Figure 34.

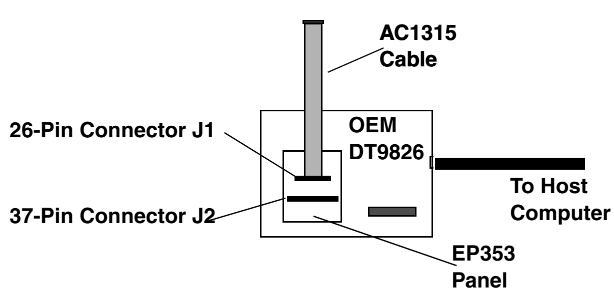

Figure 34: Connecting the AC1315 Cable to the EP353 Panel

2. Plug the other end of the AC1315 cable into the 26-pin connector on the 5B Series backplane, as shown in Figure 35.

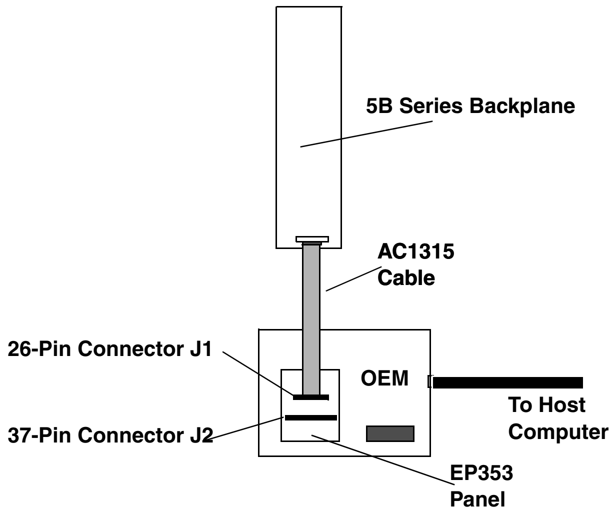

Figure 35: Connecting the AC1315 Cable to the 5B Series Backplane

Table 37 lists the pin assignments for connector J1 on the EP353 accessory panel.

Table 37: EP353 Connector J1 Pin Assignments

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

Using Connector J2 on the EP353

Use EP353 connector J2 to attach analog input signals to the EP353 accessory panel. You can access the pins on connector J2 either by using the EP360 cable and STP37 screw terminal panel (available from Data Translation) or by building your own cable/panel.

Refer to page 115 for information about the required mating connectors. Table 38 lists the pin assignments for connector J2 on the EP353 accessory panel.

Table 38: EP353 Connector J2 Pin Assignments

Pin	Signal Description	Pin	Signal Description
1	Analog Input 0	20	Analog In 8
2	Analog Input 1	21	Analog In 9
3	Analog Input 2	22	Analog In 10
4	Analog Input 3	23	Analog In 11
5	Analog Input 4	24	Analog In 12
6	Analog Input 5	25	Analog In 13
7	Analog Input 6	26	Analog In 14
8	Analog Input 7	27	Analog In 15
9	Reserved	28	Reserved
10	Reserved	29	Reserved
11	Reserved	30	Reserved
12	Reserved	31	Reserved
13	Reserved	32	Reserved
14	Reserved	33	Reserved
15	Reserved	34	Reserved
16	Reserved	35	Reserved
17	Reserved	36	Analog Ground
18	Reserved	37	Digital Ground
19	No Connect		

Using an EP355 Screw Terminal Panel

To access analog input signals from the EP355 screw terminal panel, plug the EP355 panel into connector J2 on the OEM version of the DT9826 module. To access the digital I/O, counter/timer, tachometer, digital I/O, or the external trigger signals from the EP355 screw terminal panel, attach the EP355 panel to connector J3 on the OEM version of the DT9826 module. Refer to Figure 36.

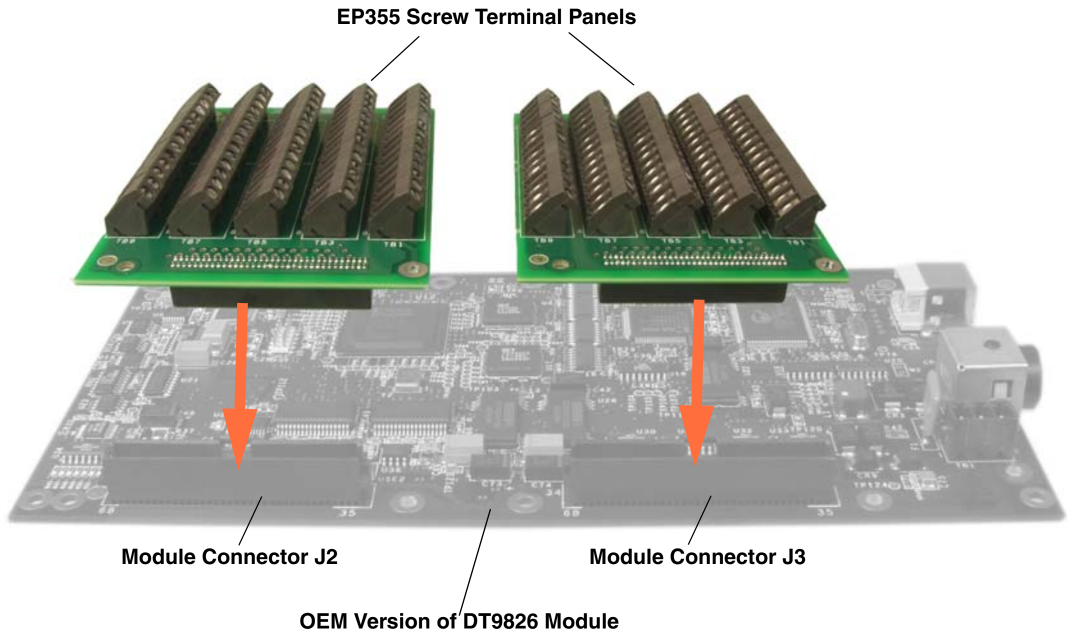

Figure 36: Connecting EP355 Panels to Connector J2 and Connector J3 on the OEM Version of the DT9826 Module

EP355 Screw Terminal Blocks

Figure 37 shows the locations of the 14-position screw terminal blocks on the EP355 screw terminal panel.

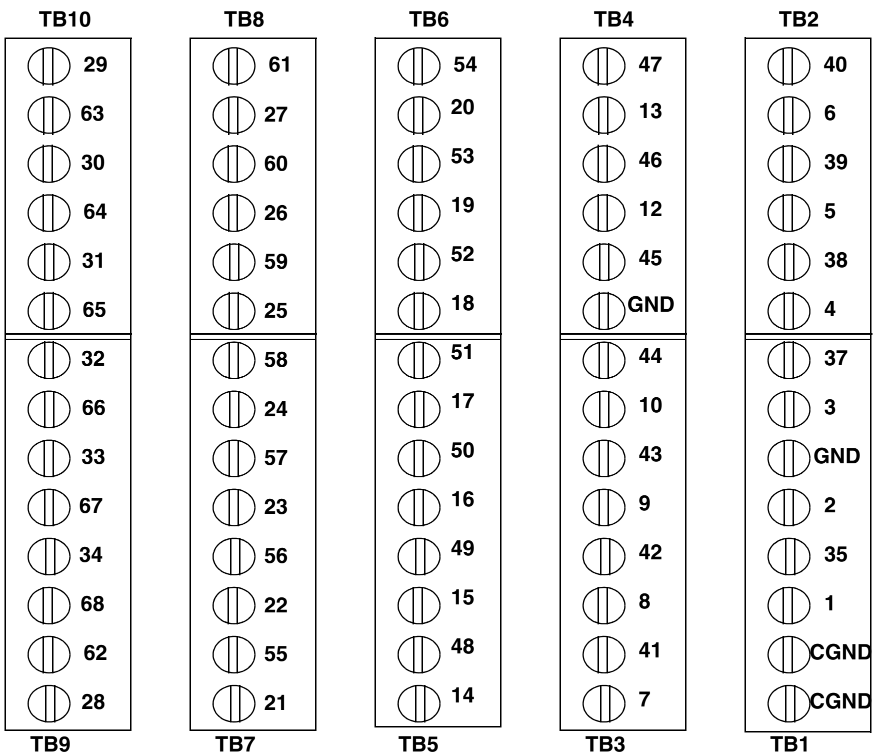

Figure 37: EP355 Screw Terminal Blocks

EP355 Screw Terminal Assignments when Attached to Connector J2

Attach the EP355 screw terminal panel to connector J2 on the OEM version of the DT9826 module when you want to access the analog input signals. Table 39 lists the screw terminal assignments when the EP355 panel is attached to connector J2.

Table 39: Screw Terminal Assignments on the EP355 Screw Terminal Panel When Attached to Connector J2

Screw Terminal	Terminal Block	Signal Description	Screw Terminal	Terminal Block	Signal Description
1	TB1	Reserved	2	TB1	Reserved
3	TB1	Analog Ground	4	TB2	Reserved
5	TB2	Analog Ground	6	TB2	Reserved
7	TB3	Analog Ground	8	TB3	Reserved
9	TB3	Analog Ground	10	TB3	Reserved
11	GND	Analog Ground	12	TB4	Reserved
13	TB4	Analog Ground	14	TB5	Reserved
15	TB5	Analog Ground	16	TB5	Reserved
17	TB5	Analog Ground	18	TB6	Reserved
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	Reserved	36	GND	Analog Ground
37	TB1	Analog Ground	38	TB2	Reserved
39	TB2	Analog Ground	40	TB2	Reserved
41	TB3	Analog Ground	42	TB3	Reserved
43	TB3	Analog Ground	44	TB3	Reserved
45	TB4	Analog Ground	46	TB4	Reserved
47	TB4	Analog Ground	48	TB5	Reserved
49	TB5	Analog Ground	50	TB5	Reserved
51	TB5	Analog Ground	52	TB6	Reserved
53	TB6	Analog Ground	54	TB6	Analog In 15
55	TB7	Analog Ground	56	TB7	Analog In 14
57	TB7	Analog Ground	58	TB7	Analog In 13
59	TB8	Analog Ground	60	TB8	Analog In 12
61	TB8	Analog Ground	62	TB9	Analog In 11

Table 39: Screw Terminal Assignments on the EP355 Screw Terminal Panel When Attached to Connector J2 (cont.)

Screw Terminal	Terminal Block	Signal Description	Screw Terminal	Terminal Block	Signal Description
63	TB10	Analog Ground	64	TB10	Analog In 10
65	TB10	Analog Ground	66	TB9	Analog In 9
67	TB9	Analog Ground	68	TB9	Analog In 8

EP355 Screw Terminal Assignments when Attached to Connector J3

Attach the EP355 screw terminal panel to connector J3 on the OEM version of the DT9826 module when you want to access the counter/timer signals, tachometer, digital I/O signals, and the external trigger signal. Table 40 lists the screw terminal assignments when the EP355 panel is attached to connector J3.

Table 40: Screw Terminal Assignments on the EP355 Screw Terminal Panel When Attached to Connector J3

Screw Terminal	Terminal Block	Signal Description	Screw Terminal	Terminal Block	Signal Description
1	TB1	Reserved	2	TB1	Reserved
3	TB1	Reserved	4	TB2	Reserved
5	TB2	Reserved	6	TB2	Reserved
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	Reserved
13	TB4	Reserved	14	TB5	Reserved
15	TB5	Reserved	16	TB5	Reserved
17	TB5	Reserved	18	TB6	Reserved
19	TB6	Reserved	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	Tachometer
29	TB10	Reserved	30	TB10	Digital Ground
31	TB10	Reserved	32	TB9	Reserved
33	TB9	Reserved	34	TB9	Reserved

Table 40: Screw Terminal Assignments on the EP355 Screw Terminal Panel When Attached to Connector J3 (cont.)

Screw Terminal	Terminal Block	Signal Description	Screw Terminal	Terminal Block	Signal Description
35	TB1	Reserved	36	GND	Digital Ground
37	TB1	Reserved	38	TB2	Digital Ground
39	TB2	Reserved	40	TB2	Digital Ground
41	TB3	Counter 1 Gate	42	TB3	Digital Ground
43	TB3	Counter 0 Gate	44	TB3	Digital Ground
45	TB4	Reserved	46	TB4	Reserved
47	TB4	Reserved	48	TB5	Reserved
49	TB5	Reserved	50	TB5	Reserved
51	TB5	Reserved	52	TB6	Reserved
53	TB6	Reserved	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	Reserved	64	TB10	Digital Ground
65	TB10	Reserved	66	TB9	Reserved
67	TB9	Reserved	68	TB9	Reserved

Using an EP356 Accessory Panel

To attach an EP356 accessory panel to the OEM version of the DT9826 module, plug the EP356 panel into connector J3 on the module, as shown in Figure 38.

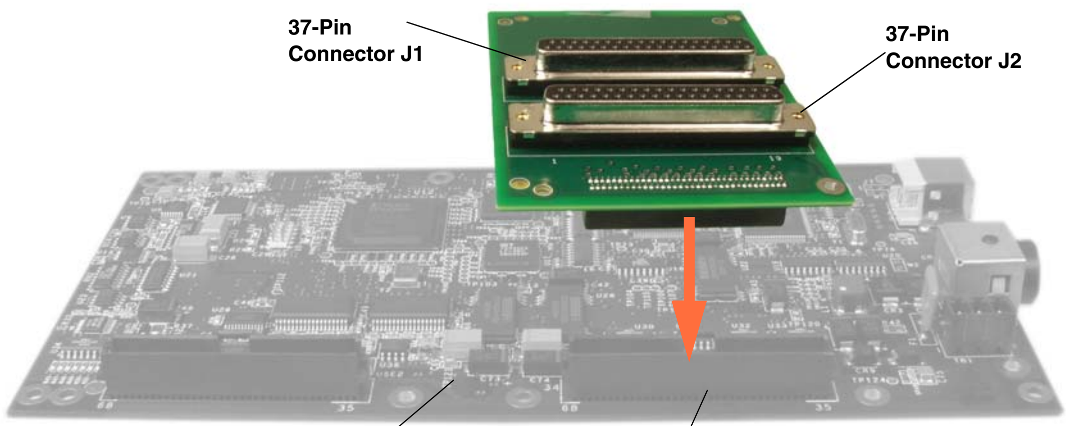

Figure 38: Connecting the EP356 Panel to Connector J3 on the OEM Version of the DT9826 Module

Using Connector J1 on the EP356

Use connector J1 on the EP356 accessory panel to attach digital I/O signals. You can access the pins on the connector J1 either by using the STP37 screw terminal panel and EP333 cable (available from Data Translation) or by building your own cable/panel.

To build your own cable/panel, refer to page 115 for information about the required mating connectors. Table 41 lists the pin assignments for connector J1 on the EP356 accessory panel.

Table 41: EP356 Connector J1 Pin Assignments

Pin	Signal Description	Pin	Signal Description
1	Digital Input 0	20	Digital Output 0
2	Digital Input 1	21	Digital Output 1
3	Digital Input 2	22	Digital Output 2
4	Digital Input 3	23	Digital Output 3
5	Digital Input 4	24	Digital Output 4
6	Digital Input 5	25	Digital Output 5

Table 41: EP356 Connector J1 Pin Assignments (cont.)

Pin	Signal Description	Pin	Signal Description
7	Digital Input 6	26	Digital Output 6
8	Digital Input 7	27	Digital Output 7
9	Reserved	28	Reserved
10	Reserved	29	Reserved
11	Reserved	30	Reserved
12	Reserved	31	Reserved
13	Reserved	32	Reserved
14	Reserved	33	Reserved
15	Reserved	34	Reserved
16	Reserved	35	Reserved
17	Digital Ground	36	Reserved
18	Digital Ground	37	Digital Ground
19	No Connect		

Using Connector J2 on the EP356

Use connector J2 on the EP356 accessory panel to attach counter/timer, tachometer, or external trigger signals. You can access the pins on the connector J1 either by using the STP37 screw terminal panel and EP333 cable (available from Data Translation) or by building your own cable/panel.

To build your own cable/panel, refer to page 115 for information about the required mating connectors. Table 42 lists the pin assignments for connector J2 on the EP356 accessory panel.

Table 42: EP356 Connector J2 Pin Assignments

Pin	Signal Description	Pin	Signal Description
1	Reserved	20	Reserved
2	Reserved	21	Reserved
3	Reserved	22	Reserved
4	Reserved	23	Reserved
5	Digital Ground	24	Digital Ground
6	Reserved	25	Reserved
7	Tachometer	26	External ADC Trigger
8	Counter 0 Clock	27	Digital Ground
9	Counter 0 Out	28	Counter 0 Gate

Table 42: EP356 Connector J2 Pin Assignments (cont.)

Pin	Signal Description	Pin	Signal Description
10	Counter 1 Clock	29	Digital Ground
11	Counter 1 Out	30	Counter 1 Gate
12	Reserved	31	Digital Ground
13	Reserved	32	Reserved
14	Reserved	33	Digital Ground
15	Reserved	34	Reserved
16	Reserved	35	Digital Ground
17	Reserved	36	Reserved
18	Digital Ground	37	Digital Ground
19	No Connect		

Index

D

E

F

G

H

I

R

S

T

U

V

W