DATA TRANSLATION

UM-18221-L

DT9820 Series User's Manual

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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

This manual describes how to install and set up your DT9820 Series module and DT9820 Series device driver, and verify that your module is working properly.

This manual also describes the features of the DT9820 Series modules, the capabilities of the DT9820 Series Device Driver, and how to program the DT9820 Series modules using the DT-Open Layers for .NET Class Library™ software. Troubleshooting and calibration information is also provided.

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

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

Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for using and/or programming the DT9820 Series modules for data acquisition operations in the Microsoft® Windows® XP, Windows Vista®, or Windows 7 operating systems. It is assumed that you have some familiarity with data acquisition principles and that you understand your application.

How this Manual is Organized

This manual is organized as follows:

- Chapter 1, "Overview," describes the major features of the modules, as well as the supported software and accessories for the modules, and provides an overview of the DT9820 Series getting started procedure.
- Chapter 2, "Installing a Module," describes how to install the DT9820 Series module.
- Chapter 3, "Configuring the Device Driver," describes how to configure the device driver and the module.
- Chapter 4, "Configuring and Attaching the Screw Terminal Panel," describes how to configure the STP9820 screw terminal and attach it to a DT9820 Series module.
- Chapter 5, "Wiring Signals," describes how to wire signals to a DT9820 Series module.
- Chapter 6, "Verifying the Operation of a Module," describes how to verify the operation of a DT9820 Series module with the Quick DataAcq application.
- Chapter 7, "Principles of Operation," describes all of the features of the modules and how to use them in your application.

- Chapter 8, "Supported Device Driver Capabilities," lists the data acquisition subsystems and the associated features accessible using the DT9820 Series Device Driver.
- Chapter 9, "Calibration," describes how to calibrate the analog output circuitry of the DT9822 modules.
- Chapter 10, "Troubleshooting," provides information that you can use to resolve problems with the modules and the device driver, should they occur.
- Appendix A, "Specifications," lists the specifications of the modules.
- Appendix B, "Connector Pin Assignments," shows the pin assignments for the connectors and the screw terminal assignments for the modules.
- Appendix C, "Using Your Own Screw Terminal Panel," describes additional considerations to keep in mind when designing your own screw terminal panel for use with a DT9820 Series board.
- An index completes this manual.

Conventions Used in this Manual

The following conventions are used in this manual:

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

Related Information

Refer to the following documents for more information on using the DT9820 Series modules:

- *Benefits of the Universal Serial Bus for Data Acquisition.* This white paper describes why USB is an attractive alternative for data acquisition. It is available on the Data Translation web site (www.datatranslation.com).
- *Measure Foundry Manual* (UM-19298) and online help. These documents describe how to use Measure Foundry™ to build drag-and-drop test and measurement applications for Data Translation® data acquisition devices without programming.
- *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.
- *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.

Where To Get Help

Should you run into problems installing or using a DT9820 Series module, the Data Translation Technical Support Department is available to provide technical assistance. Refer to Chapter 10 starting on page 87 for more information. If you are outside the United States or Canada, call your local distributor, whose number is listed on Data Translation's web site (www.datatranslation.com).

Overview

Features

The DT9820 Series is a high-resolution (24-bit) family of data acquisition modules for the Universal Serial Bus (USB).

Most computers have two or more USB ports that allow direct connection to USB devices. You can expand the number of USB devices attached to a single USB port by using expansion hubs. DT9820 Series modules are part of the high-power, bus-powered USB class; therefore, the modules do not require external power, but the expansion hubs do require external power.

DT9820 Series modules reside outside of the PC and install with a single cable to ease installation. Modules can be "hot swapped," or plugged and unplugged while the PC is on, making them useful for many data acquisition applications.

The DT9820 Series includes the DT9821 and DT9822. Table 1 lists the key features of each module.

Table 1: Key Features Among the DT9820 Series

Module	Analog Inputs	Analog Input Sample Rate		Analog Outputs	Digital I/O Lines
		60 Hz	50 Hz		
DT9821	4 with 24-bit resolution[a]	960 Hz	800 Hz	0	8 input[b], 8 output
DT9822	4 with 24-bit resolution[a]	960 Hz	800 Hz	2, 16-bit resolution	8 input[b], 8 output

a. The channels are configured as differential.
b. Digital input lines 0 to 3 can be used to start A/D conversions. Digital input lines 4 to 7 can be used to stop A/D conversions.

Both DT9820 Series modules share the following major features:

- USB compatibility
- Software configurable termination resistance for differential analog inputs on a channel-by-channel basis
- Input gains of 1, 2, 4, 8, 16, 32, and 64
- Continuously paced analog input operations
- One 8-bit digital input port; high-to-low transitions on digital input lines 0 to 3 can start A/D conversions on A/D subsystems 0 to 3; high-to-low transitions on digital input lines 4 to 7 can stop A/D conversions on A/D subsystems 0 to 3
- One 8-bit digital output port; digital outputs can drive external solid-state relays
- Automatic software calibration of the analog I/O subsystems

Supported Software

The following software is available for use with the DT9820 Series modules:

- **DT9820 Series Device Driver** – This software is provided on the Data Acquisition OMNI CD that is shipped with the module. The device driver allows you to use a DT9820 Series module with any of the supported software packages or utilities.
- **DT9820 Series Calibration Utility** – This software is provided on the Data Acquisition OMNI CD-ROM. The DT9820 Series Calibration Utility allows you to calibrate the analog output circuitry of the DT9822 modules. The analog input circuitry is automatically calibrated when the module is powered up. Refer to Chapter 9 starting on page 83 for more information on this utility.
- **Quick DataAcq application** – This software is provided on the Data Acquisition OMNI CD that is shipped with the module. The Quick DataAcq application provides a quick way to get up and running using a DT9820 Series module. Using this application, you can verify key features of the module, display data on the screen, and save data to disk.
- **The quickDAQ application –** An evaluation version of this .NET application is included on the Data Acquisition OMNI CD. quickDAQ lets you acquire analog data from all devices supported by DT-Open Layers for .NET software at high speed, plot it during acquisition, analyze it, and/or save it to disk for later analysis.
- **Measure Foundry** – An evaluation version of this software is included on the Data Acquisition OMNI CD. Measure Foundry is drag-and-drop test and measurement application builder designed to give you top performance with ease-of-use development. Order the full development version of this software package to develop your own application using real hardware.
- **DT-Open Layers for .NET Class Library** – Use this class library if you want to use Visual C# or Visual Basic for .NET to develop your own application software for a DT9820 Series module using Visual Studio 2003 or Visual Studio 2005; the class library complies with the DT-Open Layers standard.
- **DataAcq SDK** – Use the Data Acq SDK if you want to use Visual Studio 6.0 and Microsoft C or C++ to develop your own application software for a DT9820 Series module using Windows XP, Windows Vista, or Windows 7; the DataAcq SDK complies with the DT-Open Layers standard.
- **DTx-EZ** – Use this optional software package if you want to use ActiveX controls to access the capabilities of the DT9820 Series modules 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 LV-Link is included on the Data Acquisition OMNI CD. Use this optional software package if you want to use the LabVIEW graphical programming language to access the capabilities of the DT9820 Series modules.

Refer to the Data Translation web site (www.datatranslation.com) for more information on the appropriate software package for your application.

Accessories

The following accessories are provided for the DT9820 Series:

- **EP365** – a 1.83-meter, USB cable that connects the USB connector of the DT9820 Series module to the USB connector on the host computer. An EP365 cable is shipped with each DT9820 Series module. In addition, if you want to buy additional USB cables, EP365 is available as an accessory product for the DT9820 Series.
- **STP9820** – a 100 mm x 160 mm screw terminal panel that connects to the DT9820 Series module either directly or by using an EP777 cable. This screw terminal panel allows you to connect all of the input and output connections that are supported by aDT9820 Series module.
- **EP777** – a 6-foot cable that connects the DT9820 Series module to the STP9820 screw terminal panel.

Getting Started Procedure

The flow diagram shown in Figure 1 illustrates the steps needed to get started using the DT9820 Series modules. This diagram is repeated in each getting started chapter; the shaded area in the diagram shows you where you are in the getting started procedure.

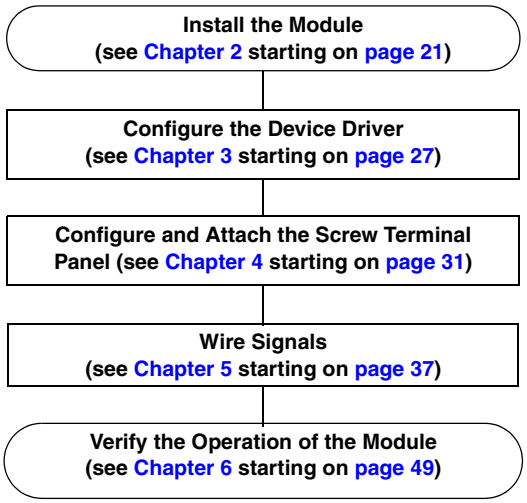
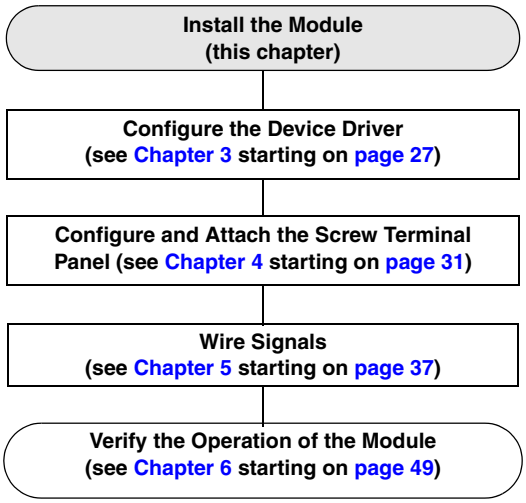


Figure 1: Getting Started Flow Diagram

Part 1: Getting Started

Installing a Module


Install the Module
(this chapter)
Configure the Device Driver
(see Chapter 3 starting on page 27)
Configure and Attach the Screw Terminal
Panel (see Chapter 4 starting on page 31)
Wire Signals
(see Chapter 5 starting on page 37)
Verify the Operation of the Module
(see Chapter 6 starting on page 49)

Unpacking

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

- DT9820 Series module
- EP365 USB cable
- Data Acquisition OMNI CD-ROM

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

Attaching Modules to the Computer

You can attach a DT9820 Series module to the host computer in one of two ways:

- Connect directly to a USB port of the host computer, described on page 24. Use this method if one or two DT9820 Series modules are sufficient for your application.
- Connect to one or more self-powered USB hubs, described on page 25. Use this method if your application requires more than two DT9820 Series modules connected to the host computer.

You **must** install the device driver before connecting your DT9820 Series module(s) to the host computer.

Note: DT9820 Series modules are low-power devices (using less than 500 mA); therefore, they do not require external power supplies.

Also, the DT9820 Series modules are automatically calibrated when you power the module. No calibration steps are required.

Connecting Directly to the Host Computer

Generally, host computers have two or more USB ports. These ports are completely independent. To connect a DT9820 Series module directly to a USB port of the computer, do the following:

1. Attach one end of the EP365 cable, which is shipped with the DT9820 Series module, to the USB port on the module.
2. Attach the other end of the EP365 cable to one of the USB ports on the host computer, as shown in Figure 2.
   The operating system automatically detects the USB device and starts the Found New Hardware wizard.

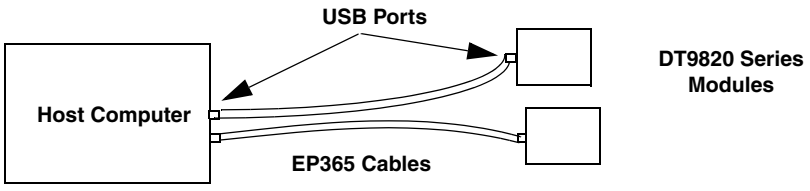


Figure 2: Attaching the DT9820 Series Module Directly to the Host Computer

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

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

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

For Windows XP:

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

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

Note: Windows 7 finds the device automatically.

4. Repeat these steps to attach another DT9820 Series module to the host computer, if desired.

Note: You can unplug a module, and then plug it in again, if you wish, without causing damage. This process is called hot-swapping.

Your application may take a few seconds to recognize a module once it is plugged back in.

Connecting to a Self-Powered USB Hub

Self-powered USB hubs are USB hubs that are powered by their own external power supply. The practical number of DT9820 Series modules that you can connect to a single USB port depends on the throughput you want to achieve.

Note: The bandwidth of the USB Ver. 1.1 bus is 12 Mbits/second. For each DT9820 Series module, the maximum throughput is 960 Hz and each buffer is four bytes wide. Therefore, if you want to achieve full throughput on each module, you should connect no more than four DT9820 Series modules to a single USB Ver. 1.1 port.

To connect a DT9820 Series module to a self-powered USB hub, do the following:

1. Attach one end of the EP365 cable to the DT9820 Series module and the other end of the EP365 cable to a self-powered USB hub.
2. Connect the power supply for the self-powered USB hub to an external power supply.
3. Connect the hub to the USB port on the host computer using another EP365 cable.
The operating system automatically detects the USB device and starts the Found New Hardware wizard.
4. *For Windows Vista*:

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

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

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

For Windows XP:

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

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

Note: Windows 7 finds the device automatically.

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

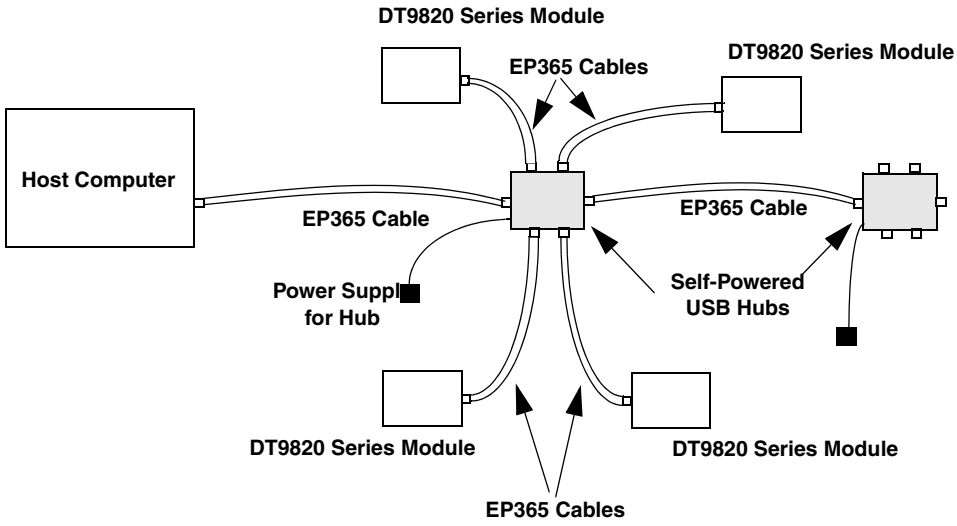

Figure 3: Attaching DT9820 Series Modules to the Host Computer Using Self-Powered USB Hubs

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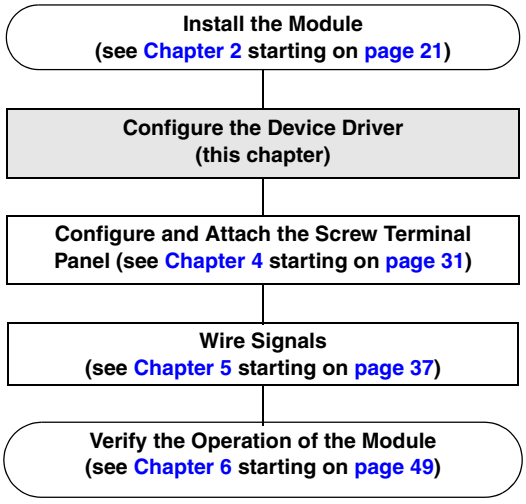
Note: You can unplug a module, and then plug it in again, if you wish, without causing damage. This process is called hot-swapping.

Your application may take a few seconds to recognize a module once it is plugged back in.

Configuring the Device Driver



This chapter describes how to configure the DT9820 Series Device Driver.

To configure the device driver, do the following:

1. If you have not already done so, power up the host computer and all peripherals.
2. From the Control Panel, double-click the **Open Layers Data Acquisition Control Panel** icon.
   The Open Layers dialog box appears.
3. Click the DT9820 Series module that you want to configure, and then click **Advanced**.
   The DT9820 Configuration dialog box appears.
4. We recommend that you select the **10k Ohm Resistor Terminations** checkbox for each analog input channel on the module. This ensures that 10 kΩ of bias return termination resistance is used for the analog input channels. (This is the default configuration.) Bias return termination resistance is particularly useful when your differential source is floating.
5. Select whether the DT9820 Series module will be used in 60 Hz operations (the default), or 50 Hz operations (used primarily in Europe).
6. To continuously power the analog and/or digital outputs, select the **Power Always On** checkbox. The DT9820 Series module will remain on even when you exit from the applications that use the module.

   If you want to shut down power to the module, you must uncheck this checkbox and close the control panel. Once all applications that use this module are exited, the module will power down. The module will remain off until you either run an application that uses the module or click the Advanced button from the Open Layers Data Acquisition Control Panel.
7. Click **OK**.
8. If you want to rename the module, click **Edit Name**; otherwise, go to step 10.

9. Enter a new name for the module, and then click **OK**.

Note: This name is used to identify the module in all subsequent applications.

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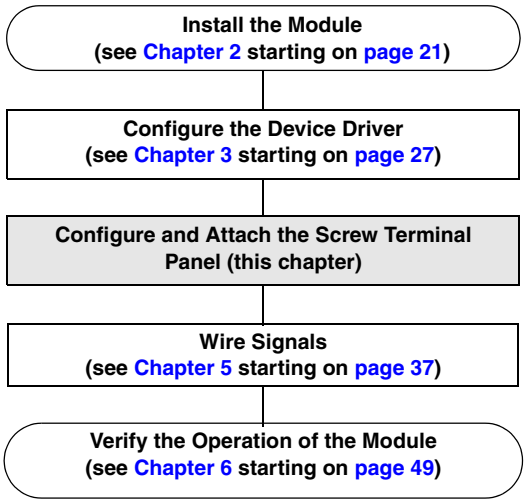
10. When you are finished configuring the module, click **Close**.
11. Repeat steps 3 to 10 for the other modules that you want to configure.
12. Close the Control Panel.

Configuring and Attaching the Screw Terminal Panel



Before you can wire signals to a DT9820 Series module, you first need to configure the STP9820 screw terminal panel, and then attach the STP9820 to the DT9820 Series module. Refer to Figure 4 for an illustration of the STP9820.

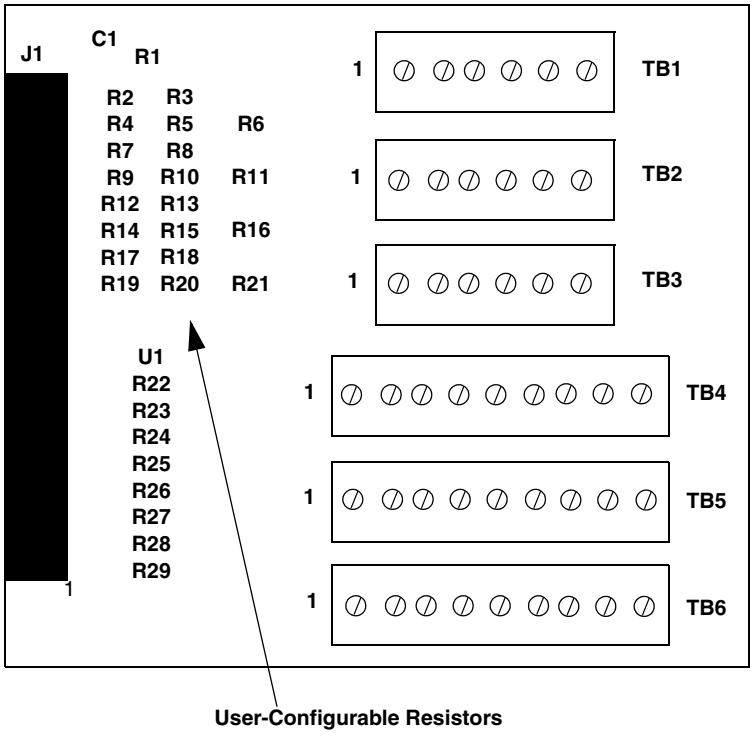


Figure 4: STP9820 Screw Terminal Panel

Configuring the STP9820

The STP9820 allows you to install a Toshiba TD62083AP (or equivalent) relay driver for use with the digital output lines on the DT9820 Series module. This driver, which works only with TTL digital output lines, allows the digital output lines of the DT9820 Series board to drive most commercially available +5 V relays with up to 100 mA of current and +5 V of user-supplied power.

CAUTION:

The external +5 V power supply voltage must not exceed 5.25 V or damage may result to the DT9820 Series module.

A logic "1" switches the appropriate relay driver on. A logic "0" switches the appropriate relay driver off.

If you wish to install a relay driver, do the following:

1. Remove resistors from locations R22 to R29.
2. Solder the relay driver in location U1 on the STP9820 while observing the correct polarity.

Continue with the next section to attach the STP9820 screw terminal panel to a DT9820 Series module.

Note: Refer to page 47 for information on how to connect relays to the STP9820 once the relay driver is installed.

Attaching the STP9820

You can connect the STP9820 directly to the J1 connector on your DT9820 Series module, or you can connect the STP9820 to the DT9820 Series module using the EP777 cable, which is available from Data Translation.

Figure 5 illustrates these connection methods.

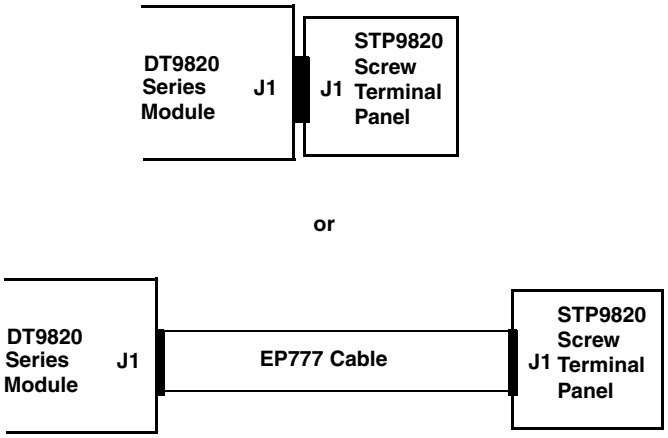


Figure 5: Attaching the STP9820 Screw Terminal Panel to a DT9820 Series Module

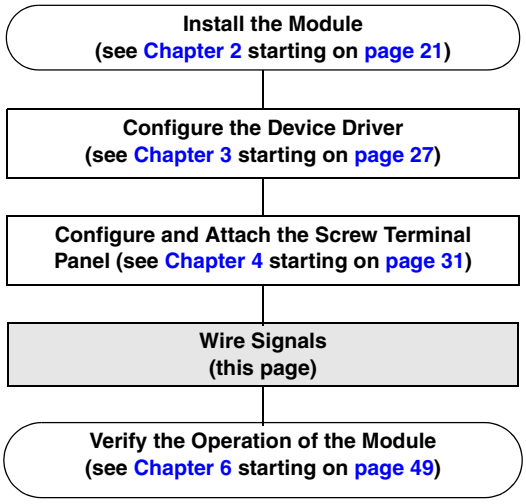
Table 2 lists the pin assignments of the J1 connector on the DT9820 Series modules and on the STP9820 screw terminal panel.

Table 2: Pin Assignments for Connector J1 on the DT9820 Series Module and on the STP9820 Screw Terminal Panel

Pin	Signal Description	Pin	Signal Description
1	Isolated Digital Ground	2	Digital Output Line 3
3	Digital Output Line 2	4	Digital Output Line 1
5	Digital Output Line 0	6	Digital Input Line 3
7	Digital Input Line 2	8	Digital Input Line 1
9	Digital Input Line 0	10	+5 V Isolated Input/Output[a]
11	Isolated Digital Ground	12	Isolated Analog Common
13	Analog Input Subsystem 03	14	Isolated Analog Common
15	Analog Input Subsystem 02	16	2.5 V Reference
17	Analog Input Subsystem 01	18	Isolated Analog Common
19	Analog Input Subsystem 00	20	Digital Output Line 7
21	Digital Output Line 6	22	Digital Output Line 5
23	Digital Output Line 4	24	Digital Input Line 7
25	Digital Input Line 6	26	Digital Input Line 5
27	Digital Input Line 4	28	Analog Output 0
29	Isolated Analog Common	30	Isolated Analog Common
31	Analog Input Subsystem 03 Return	32	Isolated Analog Common
33	Analog Input Subsystem 02 Return	34	Analog Output 1
35	Analog Input Subsystem 01 Return	36	Isolated Analog Common
37	Analog Input Subsystem 00 Return		

a. +5 V output is available only when one of the subsystems is activated, which, in turn, activates power to the module. You can externally power the +5 V isolated output signal. This allows you to retain the last value that was written to the digital output lines when the DT9820 Series module is in low-power mode.

Wiring Signals


Install the Module
(see Chapter 2 starting on page 21)
Configure the Device Driver
(see Chapter 3 starting on page 27)
Configure and Attach the Screw Terminal
Panel (see Chapter 4 starting on page 31)
Wire Signals
(this page)
Verify the Operation of the Module
(see Chapter 6 starting on page 49)

Preparing to Wire Signals

Keep the following recommendations in mind when wiring signals to the DT9820 Series modules:

- Follow standard ESD procedures when wiring signals to the module.
- Use individually shielded twisted-pair wire (size 14 to 26 AWG) when using the DT9820 Series module 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 DT9820 Series modules 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 DT9820 Series modules are operational.
- Connect all unused analog input channels to analog ground.
- When first installing the module, try wiring the signals as follows:
  - Wire a function generator or a known voltage source to analog input subsystem 0 using the differential configuration.
  - Wire an oscilloscope or voltage meter to analog output channel 0.
  - Wire a digital input to digital input line 0.
  - Wire a digital output to digital output line 0.
  - Then, run the Quick DataAcq application (described in Chapter 6 starting on page 49) to verify that the module is operating properly.

    Once you have determined that the module is operating properly, wire the signals according to your application's requirements.

Note: Connector J1 is tied to the host computer's chassis ground.

Table 3 lists the assignments of the screw terminals on the STP9820 screw terminal panel.

Table 3: Screw Terminal Assignments of the STP9820 Screw Terminal Panel

Screw Terminal Block	Terminal Number	Terminal Label	Signal Description
TB1	1	CH0H	Analog Input Subsystem 0 High
	2	CH0L	Analog Input Subsystem 0 Low
	3	AGND	Analog Ground
	4	CH1H	Analog Input Subsystem 1 High
	5	CH1L	Analog Input Subsystem 1 Low
	6	AGND	Analog Ground
TB2	1	CH2H	Analog Input Subsystem 2 High
	2	CH2L	Analog Input Subsystem 2 Low
	3	AGND	Analog Ground
	4	CH3H	Analog Input Subsystem 3 High
	5	CH3L	Analog Input Subsystem 3 Low
	6	AGND	Analog Ground
TB3	1	VREF	2.5 V Reference
	2	AGND	Analog Ground
	3	DAC0	Analog Output 0
	4	DAC1	Analog Output 1
	5	DGND	Digital Ground
	6	+5VD	+5 V[a]
TB4	1	DOUT0	Digital Output 0
	2	DOUT1	Digital Output 1
	3	DOUT2	Digital Output 2
	4	DOUT3	Digital Output 3
	5	DOUT4	Digital Output 4
	6	DOUT5	Digital Output 5
	7	DOUT6	Digital Output 6
	8	DOUT7	Digital Output 7
	9	DGND	Digital Ground

Table 3: Screw Terminal Assignments of the STP9820 Screw Terminal Panel (cont.)

Screw Terminal Block	Terminal Number	Terminal Label	Signal Description
TB5	1	DIN0	Digital Input 0
	2	DIN1	Digital Input 1
	3	DIN2	Digital Input 2
	4	DIN3	Digital Input 3
	5	DIN4	Digital Input 4
	6	DIN5	Digital Input 5
	7	DIN6	Digital Input 6
	8	DIN7	Digital Input 7
	9	DGND	Digital Ground

a. +5 V output is available only when one of the subsystems is activated, which, in turn, activates power to the module. You can externally power the +5 V isolated output signal. This will allow you to retain the last value that was written to the digital output lines when the DT9820 Series module is in low-power mode.

Connecting Analog Input Signals

You can connect analog input signals to the DT9820 Series modules in the differential configuration only.

Figure 6A illustrates how to connect a floating signal source to a DT9820 Series module using differential inputs. (A floating signal source is a voltage source that has no connection with earth ground.)

Note: For floating signal sources, it is recommended that you provide a bias return path for the differential channels by adding 10 kΩ of termination resistance from the low side of the channel to isolated analog ground.

For more information on configuring termination resistance, refer to Chapter 3 starting on page 27.

Figure 6B illustrates how to connect a nonfloating signal source to a DT9820 Series module using differential inputs. In this case, the signal source itself provides the bias return path; therefore, you do not need to provide bias return resistance through software.

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

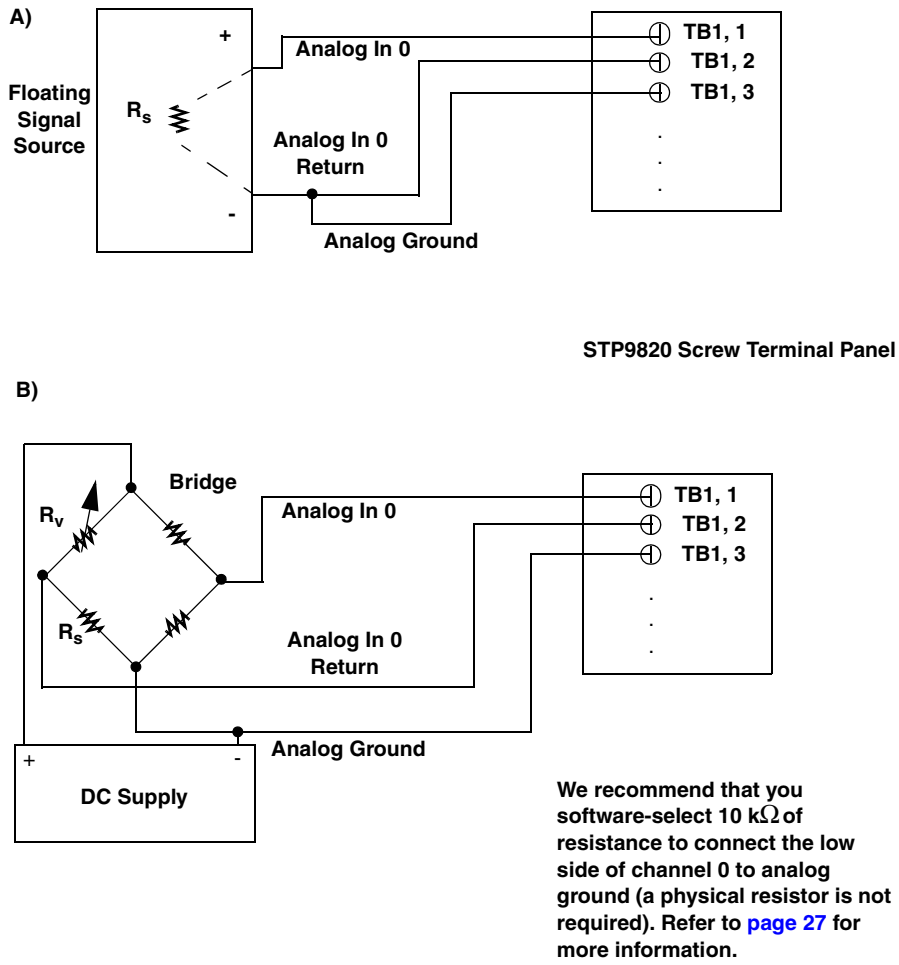


Figure 6: Connecting Differential Voltage Inputs (Shown for Subsystem 0)

Note that since they measure the difference between the signals at the high (+) and low (-) inputs, differential connections usually cancel any common-mode voltages, leaving only the signal. However, if you are using a grounded signal source and ground loop problems arise, connect the differential signals to the DT9820 Series module as shown in Figure 7. In this case, make sure that the low side of the signal (-) is connected to ground at the signal source, not at the DT9820 Series module, and do not tie the two grounds together.

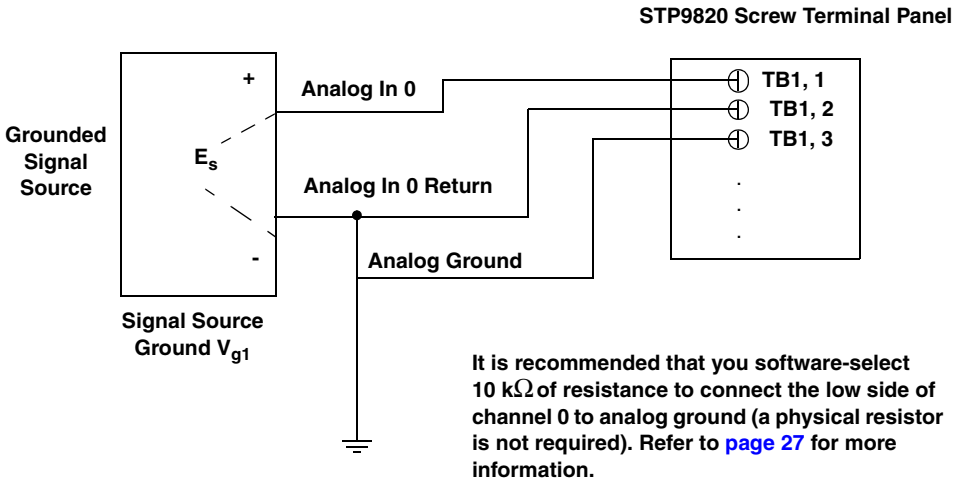
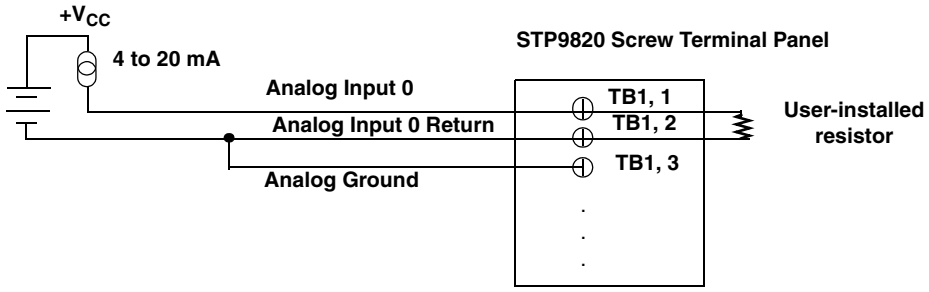


Figure 7: Connecting Differential Voltage Inputs from a Grounded Signal Source (Shown for Subsystem 0)

Figure 8 shows how to connect a current loop input (channel 0, in this case) to a DT9820 Series module.



The user-installed resistor connects the high side of the channel to the low side of the corresponding channel, thereby acting as a shunt. If, for example, you add a 250 Ω resistor, and then connect a 4 to 20 mA current loop input to channel 0, the input range is converted to 1 to 5 V.

We recommend that you software-select 10 kΩ of termination resistance to connect the low side of channel 0 to analog ground (a physical resistor is not required). Refer to page 27 for more information.

Figure 8: Connecting Current Inputs (Shown for Subsystem 0)

Note: If you are using current loop inputs, set up the software so that bias return resistance is used. For more information, refer to Chapter 3 starting on page 27.

Connecting Analog Output Signals

Figure 9 shows how to connect an analog output voltage signal (channel 0, in this case) to a DT9822 module.

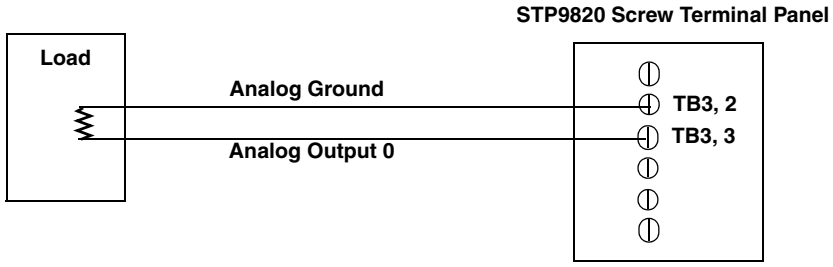


Figure 9: Connecting Analog Output Voltages (Shown for Channel 0)

Connecting Digital Input Signals

Figure 10 shows how to connect digital input signals (lines 0 and 1, in this case) to a DT9820 Series module.

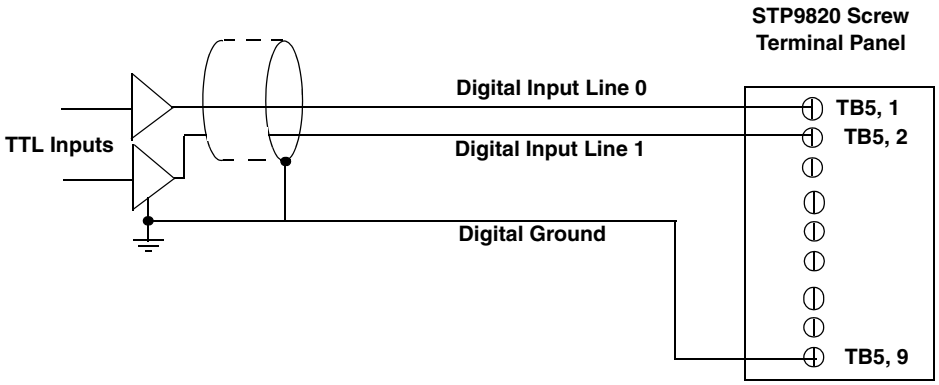


Figure 10: Connecting Digital Inputs (Shown for Lines 0 and 1)

Connecting Digital Output Signals

Figure 11 shows how to connect a digital output (line 0, in this case) to a DT9820 Series module.

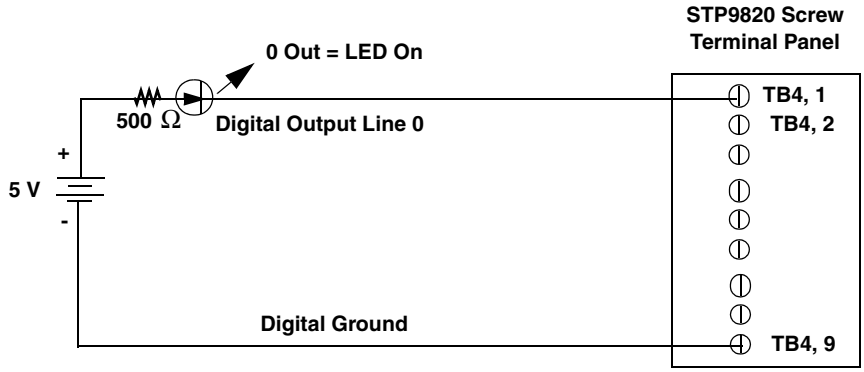


Figure 11: Connecting Digital Outputs (Shown for Line 0)

Figure 12 illustrates how to connect a relay to the STP9820. (Refer to page 33 for information on how to install the relay driver that is needed to drive this relay.) In this scheme, one side of the relay is connected to the +Vcc power supply; this connection allows the internal cache diodes to limit the voltage spikes from the relay coil. The other side of the relay is connected to the appropriate digital output terminal (in this case, digital output 0 or TB4, 1) on the STP9820.

CAUTION:

The external +5 V power supply voltage must not exceed 5.25 V or damage may result to the DT9820 Series module.

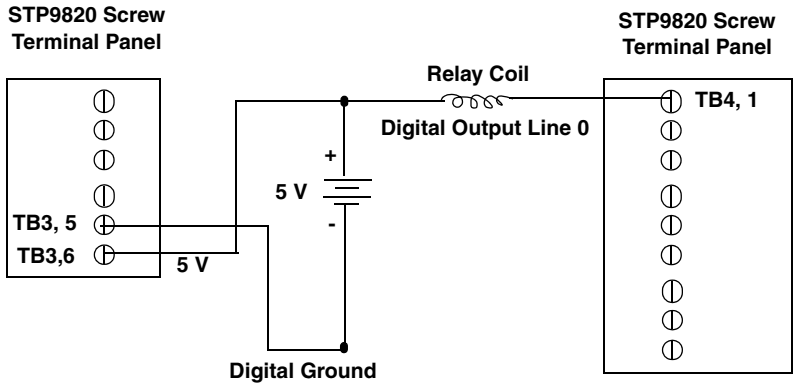
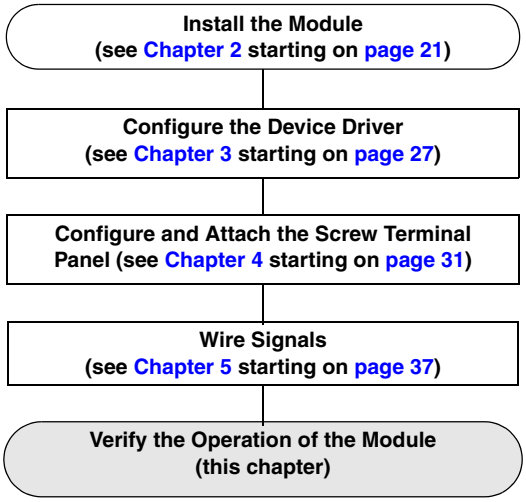


Figure 12: Connecting a Relay Driver to the STP9820 Screw Terminal Panel

Verifying the Operation of a Module



You can verify the operation of a DT9820 Series module using the Quick DataAcq application. The Quick DataAcq application allows you to 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
- Output data from a single analog output channel or digital output port
- Save the input data to disk

This chapter describes how to install and run the Quick DataAcq application.

Running the Quick DataAcq Application

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

To run the Quick DataAcq application, do the following:

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

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

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

Testing Single-Value Analog Input

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

1. Connect a voltage source, such as a function generator, to analog input channel 0 (differential mode) on the DT9820 Series module. Refer to page 43 for information on connecting differential analog input signals.
2. In the Quick DataAcq application, choose **Single Analog Input** from the **Acquisition** menu.
3. Select the appropriate DT9820 Series module from the Board list box.

Note: Once you select the module, the LED on the module turns green.

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 ±2.5 V.
6. Select **Differential**.
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 Single-Value Analog Output

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

1. Connect an oscilloscope or voltmeter to DAC0 on the DT9822 module. Refer to page 45 for an example of how to connect analog output signals.
2. In the Quick DataAcq application, choose **Single Analog Output** from the **Control** menu.
3. Select the appropriate DT9820 Series module from the Board list box.

Note: Once you select the module, the LED on the module turns green.

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4. In the Channel list box, select analog output channel 0.
5. In the Range list box, select the output range of DAC0.
   The default is ±5 V.
6. Enter an output value, or use the slider to select a value to output from DAC0.
7. Click **Send** to output a single value from DAC0.
   The application displays the output 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 DT9820 Series module (using the differential configuration). Refer to page 43 for more information on connecting differential analog input signals.
2. In the Quick DataAcq application, choose **Scope** from the **Acquisition** menu.
3. Select the appropriate DT9820 Series module from the Board list box.

Note: Once you select the module, the LED on the module turns green.

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4. In the Sec/Div list box, select the number of seconds per division (.1 to .00001) for the display.
5. Click **Config** from the Toolbar.
6. From the Config menu, select **ChannelType**, and then select **Differential**.
7. From the Config menu, select **Range**, and then select **Bipolar** or **Unipolar** depending on the configuration of your module.
   The default is Bipolar.
8. From the Scope view, double-click the input range of the channel to change the input range of the module (±2.5 V, ±1.25 V, ±0.625 V, ±0.3125 V, ±0.15625 V, ±0.078125 V, or ±0.0390625 V for bipolar ranges, 0 to 2.5 V, 1.25 V, 0.625 V, 0.3125 V, 0.15625 V, 0.078125 V, or 0.0390625 V for unipolar ranges, or -0.1 to 2.5 V,
   1.25 V, 0.625 V, 0.3125 V, 0.15625 V, 0.078125 V, or 0.0390625 V for offset unipolar ranges).
   The display changes to reflect the selected range for all the analog input channels on the module.
9. 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.
10. 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.

Note: When the module is performing a continuous Scope or FFT operation, the LED on the module turns green (the resulting color may appear yellow).

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11. Click **Stop** from the Toolbar to stop the operation.

Testing Single-Value Digital Input

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

1. Connect a digital input to digital input line 0 of port A on the DT9820 Series module. Refer to page 46 for more information on connecting digital inputs.
2. In the Quick DataAcq application, choose **Digital Input** from the **Acquisition** menu.
3. Select the appropriate DT9820 Series module from the Board list box.

Note: Once you select the module, the LED on the module turns green.

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4. Select digital input port A by clicking **Port A**.
5. Click **Get**.
   The application displays the value of each digital input line in port A on the screen in both text and graphical form.

Testing Single-Value Digital Output

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

1. Connect a digital output to digital output line 0 of port B on the DT9820 Series module. Refer to page 47 for more information on connecting digital outputs.
2. In the Quick DataAcq application, choose **Digital Output** from the **Control** menu.
3. Select the appropriate DT9820 Series module from the Board list box.

Note: Once you select the module, the LED on the module turns green.

4. Select digital output port B by clicking **Port B**.
5. Click the appropriate bits to select the type of signal to write from the digital output lines. If the bit is selected, a high-level signal is output from the digital output line; if the bit is not selected, a low-level signal is output from the digital output line. Optionally, you can enter an output value in the Hex text box.
6. Click **Send**.
   The application outputs and displays the value of each digital output line of digital port B on the screen in both text and graphical form.

Part 2: Using Your Module

7

Principles of Operation

Figure 13 shows a block diagram of the DT9820 Series modules. Note that bold entries indicate signals you can access.

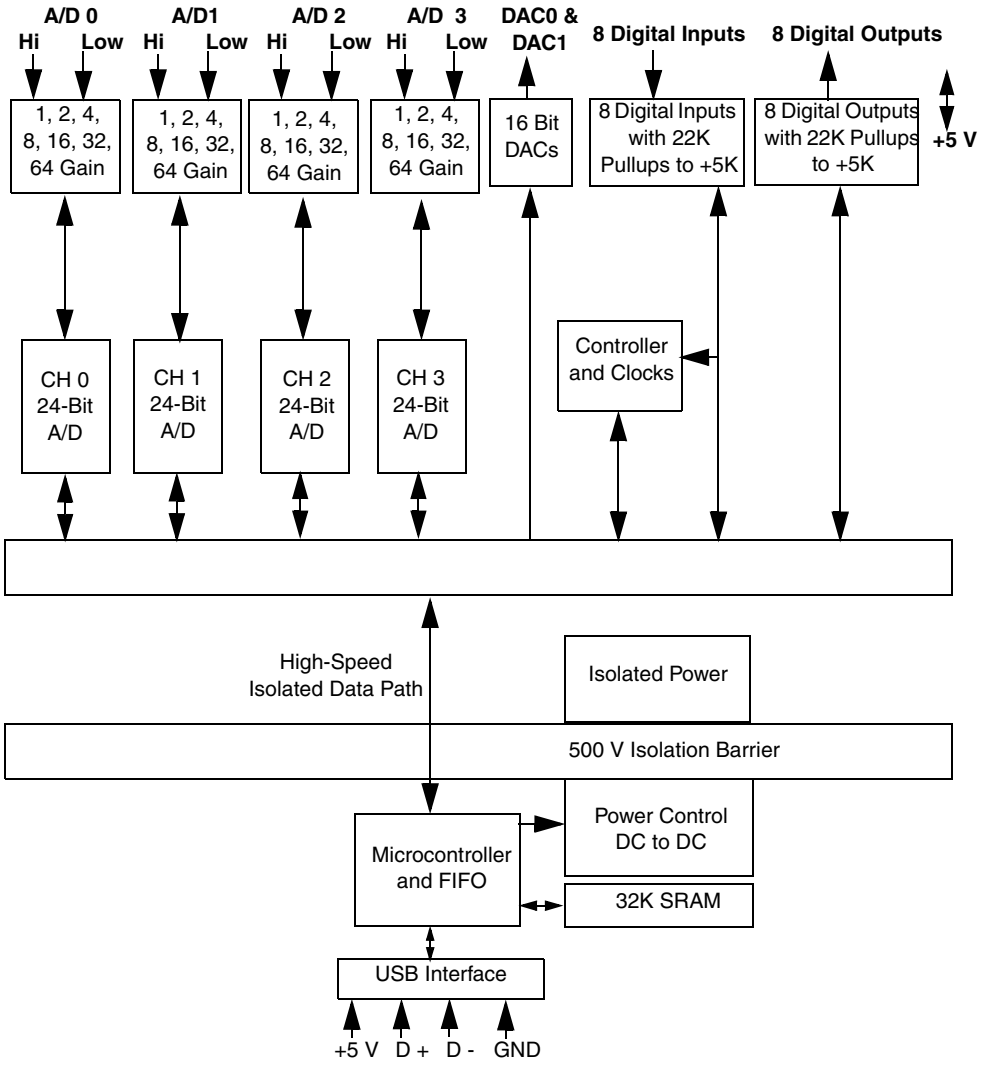

Figure 13: Block Diagram of the DT9820 Series Modules

Analog Input Features

The DT9820 Series modules contain four separate analog input (A/D) subsystems that can be run simultaneously or independently from one another.

This section describes the features of each A/D subsystem, including the following:

- Input resolution, described below
- Analog input channels, described on page 61
- Input ranges and gains, described on page 61
- A/D sample clock sources, described on page 62
- Analog input conversion modes, described on page 64
- Triggers, described on page 63
- Data formats, described on page 65
- Data transfer, described on page 67
- Error conditions, described on page 67
- Synchronizing A/D subsystems, described on page 67

Input Resolution

The analog input resolution of the DT9820 Series modules is fixed at 24 bits.

Analog Input Channels

Each A/D subsystem on the DT9820 Series modules supports one differential analog input channel. You configure the channel type as differential through software.

Using software, you can also select whether to use 10 kΩ termination resistance between the low side of each differential channel and isolated analog ground. This feature is particularly useful with floating signal sources. Refer to Chapter 5 for more information on wiring to inputs and to Chapter 3 for more information on configuring the driver to use bias return termination resistance.

The simplest way to acquire data from a single channel is to specify channel 0 of each subsystem for a single-value analog input operation using software; refer to page 64 for more information on single-value operations.

If you want to clock A/D conversions, specify channel 0 in a channel list.

Input Ranges and Gains

The DT9820 Series modules support a unipolar input range of 0 to 2.5 V, an offset unipolar range of -0.10 V to 2.5 V, and a bipolar range of 2.5 V. In addition, you can choose from up to 7 gains (1, 2, 4, 8, 16, 32, and 64). Table 4 lists the supported gains and effective input range of each DT9820 Series module.

Table 4: Effective Input Range

Gain	Unipolar Input Range		Bipolar Input Range
1	0 to 2.5 V	–0.10 V to 2.5 V	±2.5 V
2	0 to 1.25 V	–0.05 V to 1.25 V	±1.25 V
4	0 to 0.6250 V	–0.025 V to 0.625 V	±0.6250 V
8	0 to 0.3125 V	–0.0125 V to 0. 3125 V	±0.3125 V
16	0 to 0.15625 V	–0.00625 V to 0.15625 V	±0.15625 V
32	0 to 0.078125 V	–0.003125 V to 0.078125 V	±0.078125
64	0 to 0.0390625 V	–0.0015625 V to 0.0390625 V	±0.0390625

For each A/D subsystem, choose the gain that has the smallest effective range that includes the signal you want to measure. For example, if you are using a DT9822 and the range of your analog input signal is ±1.05 V, specify a range of –2.5 V to +2.5 V for the module and use a gain of 2 for the channel; the effective input range for this channel is then ±1.25 V, which provides the best sampling accuracy for that channel.

You can either specify the gain as part of the single-value operation. If you want to clock A/D conversions, specify the gain for the channel entry in the channel list.

A/D Sample Clock

If you specified channel 0 in a channel list, you can clock the A/D conversions using an internal A/D sample clock on the DT9820 Series module.

The internal A/D sample clock uses a 4.9152 MHz time base for 60 Hz operations or a 4.0960 MHz time base for 50 Hz operations. You specify whether you want to use 60 Hz or 50 Hz operations using the Control Panel applet; refer to Chapter 3 for information on how to configure the driver.

Using software, specify the clock source as internal and the clock frequency at which to pace the operation. Table 5 lists the supported frequencies and the effective number of bits at each frequency.

Table 5: Sampling Rate

Operating Mode	Sampling Rate	Effective Number of Bits
60 Hz	960 Samples/s	16.5
	480 Samples/s	17.0
	240 Samples/s	17.5
	120 Samples/s	20.9
	60 Samples/s	21.4
	30 Samples/s	21.9
	15 Samples/s	22.4
	7.5 Samples/s	22.9
50 Hz	800 Samples/s	16.5
	400 Samples/s	17.0
	200 Samples/s	17.5
	100 Samples/s	20.9
	50 Samples/s	21.4
	25 Samples/s	21.9
	12.5 Samples/s	22.4
	6.25 Samples/s	22.9

According to sampling theory (Nyquist Theorem), specify a frequency that is at least twice as fast as the input's highest frequency component. For example, to accurately sample a 20 Hz signal, specify a sampling frequency of at least 40 Hz. Doing so avoids an error condition called *aliasing*, in which high frequency input components erroneously appear as lower frequencies after sampling.

Triggers

A trigger is an event that occurs based on a specified set of conditions. The DT9820 Series module supports the following trigger sources:

- **Software trigger** – A software trigger event occurs when you start the analog input operation (the computer issues a write to the module to begin conversions). Using software, specify the trigger source as a software trigger.
- **External trigger** – An external digital trigger occurs when the DT9820 Series module detects a falling-edge on a digital input line. Depending on the digital input line, the A/D conversion is either started or paused, as shown in Table 6. For example, to start A/D subsystem 0, you need a falling-edge on digital input line 0. Likewise, to pause A/D subsystem 0, you need a falling-edge on digital input line 4.

Table 6: Triggering A/D Conversions with Digital Input Lines

To Start an A/D Conversion on A/D Subsystem..	Need a High-to-Low Transition on Digital Input Line...	To Pause or Stop an A/D Conversion on A/D Subsystem..	Need a High-to-Low Transition on Digital Input Line...
0	0	0	4
1	1	1	5
2	2	2	6
3	3	3	7

When the operation is paused, the driver does not empty the data buffers; therefore, the buffers contain the data that was acquired before the operation was paused. When the operation is restarted (another external trigger of the same type occurs), this data is emptied and sent to the host application program and the buffers are refilled with new data.

Using software, specify the trigger source as an external, negative digital (TTL) trigger.

- **Digital Event trigger** – A digital event trigger occurs when the DT9820 Series module detects a falling-edge on a digital input line. Depending on the digital input line, the A/D conversion is either started or stopped, as shown in Table 6 on page 64.

  When the operation is stopped, the driver empties the data buffers, sends the data to the host application program, and reports an event. It is up to your program to manage this event appropriately for your application. For example, if you want to restart the operation when another digital event trigger occurs, you might want to set up new A/D buffers when the trigger error message occurs.

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

Note: All the digital inputs must be in the high state before the DT9820 Series module can detect a falling-edge on the digital input lines.

Analog Input Conversion Modes

DT9820 Series modules support the following conversion modes:

- **Single-value operations** are the simplest to use but offer the least flexibility and efficiency. Using software, you can specify the range, gain, and analog input channel, and acquire the data from that channel. The data is returned immediately. For a single-value operation, you cannot specify a clock source, trigger source, or buffer. Single-value operations use a clock frequency of 60 Hz or 50 Hz to acquire data; this provides the best line frequency selection.

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

- **Continuous mode** takes full advantage of the capabilities of the DT9820 Series module. You can specify a trigger source and buffer using software. (Refer to page 67 for more information on buffers.)

  In addition to pausing or stopping a continuous operation using a hardware trigger (see page 63 for more information), you can stop a continuous operation by performing either an orderly stop or an abrupt stop using software. In an orderly stop, the module finishes acquiring the data, stops all subsequent acquisition, and transfers the acquired data to host memory; all subsequent triggers are ignored. In an abrupt stop, the module stops acquiring samples immediately; the acquired data is not transferred to host memory, and all subsequent triggers or retriggers are ignored.

  The conversion rate is determined by the frequency of the A/D sample clock; refer to page 62 for more information on the A/D sample clock.

Data Format

The DT9820 Series modules use binary/offset binary data encoding for the 0 to 2.5 V and -0.1 to 2.5 V unipolar ranges, and twos complement data encoding for the ±2.5 V bipolar range.

In software, the analog input value is returned as a code. To convert the code to voltage, use the information in the following subsections.

Note: When the DT9820 Series module is above range, the value FFFFFFh (plus full-scale) is returned. When the DT9820 Series module is below range, the value 000000h (minus full-scale) is returned.

Converting an Offset Code to a Voltage

To convert an offset code into a voltage, use the following formulas:

$$LSB = \frac{FSR}{2^N}$$

Voltage = Code * LSB + Offset

where,

- *LSB* is the least significant bit.
- *FSR* is the full-scale range. For the DT9820 Series, the full-scale range is 2.5 for the 0 to 2.5 V range or 2.6 for the -0.10 to 2.5 V range.
- *N* is the input resolution (24 bits).
- *Voltage* is the analog voltage.
- *Code* is the raw count used by the software to represent the voltage in binary notation.
- *Offset* is the actual minus full-scale value. The minus full-scale value is 0.0 V for the 0 to 2.5 V rang e or -0.10 V for the -0.10 to 2.5 V input range.

For example, assume that you are using a DT9821 with a unipolar input range of -0.10 to 2.5 V. If the software returns a code of C00000h for the analog input operation, determine the analog input voltage as follows:

$$LSB = \frac{2.6}{16777216} = 0.00000015497$$

Voltage = C00000h * 0.00000015497 + -0.10 V

Voltage = 1.85 V

Converting a Twos Complement Code to a Voltage

To convert a twos complement code into a voltage, use the following formulas:

$$LSB = \frac{FSR}{2^N}$$

$$Code_{Offset\ Binary} = Code_{Twos\ Complement}\ XOR\ 2^{N-1}$$

$$Voltage = Code_{Offset\ Binary} * LSB + Offset$$

where,

- *LSB* is the least significant bit.
- *FSR* is the full-scale range. For the DT9820 Series, the full-scale range is 5.0 V for twos complement coding.
- *N* is the input resolution (24 bits).
- *Voltage* is the analog voltage.
- $Code_{OffsetBinary}$ is the raw count used by the software to represent the voltage in offset binary notation.
- $Code_{Twos\ Complement}$ is the raw count used by the software to represent the voltage in twos complement notation.
- *Offset* is the actual minus full-scale value. The minus full-scale value is -2.5 V for twos complement coding.

For example, assume that you are using a DT9822 with a range of ±2.5 V. If the software returns a code of C00000h for the analog input operation, determine the analog input voltage as follows:

LSB = 5.0/16777216 = 0.000000298023

$Code_{Offset\ Binary}$ = C00000h XOR 2^{23} = 400000h

Voltage = 400000h * 0.000000298023 + -2.5 V

Voltage = -1.25 V

Data Transfer

The DT9820 module transfers data to a user buffer that you allocate in the host computer. Keep the following recommendations in mind when allocating user buffers for continuous analog input operations on the DT9820 Series:

- Allocate a minimum of two user buffers.
- Specify the width of the buffer as 4 bytes.

Data is written to the allocated buffers continuously until no more empty buffers are available or you stop the operation. The data is gap-free.

Error Conditions

The DT9820 Series modules can report an A/D overrun error if the A/D sample clock rate is too fast. The error occurs if a new A/D sample clock pulse occurs while the ADC is busy performing a conversion from the previous A/D sample clock pulse. The host computer can clear this error. To avoid this error, use a slower sampling rate.

Note: The LED on the front panel will not blink green if the hardware detects an error.

Synchronizing A/D Subsystems

You synchronize the operation of the A/D subsystems in two ways: by synchronizing the triggers and by synchronizing the clocks. This section describes these two methods.

Synchronizing the Triggers

You can synchronize the triggers of the A/D subsystems as follows:

- **Software trigger –** Using software, specify the trigger source for the A/D subsystems as the software trigger. Then, using software, allocate a start list, put the A/D subsystems on the start list, prestart the subsystems, and start the subsystems. When started, the subsystems are triggered simultaneously.
- **External trigger –** Using software, specify the trigger source for the first A/D subsystem (lowest subsystem number) that you want to start simultaneously as an external digital (TTL) trigger. Then, wire the appropriate external digital line, as listed in Table 6 on page 64, to that A/D subsystem.

  For example, if you want to trigger A/D subsystems 0 and 1 simultaneously, wire the digital source to digital input line 0 (do not wire the digital source to digital input line 1). Using software, allocate a start list, put the A/D subsystems on the start list, prestart the subsystems, then start the subsystems. When started, the subsystems are triggered simultaneously when a high-to-low transition occurs on digital input line 0.

Similarly, if you want to trigger A/D subsystems 2 and 3 simultaneously, wire the digital source to digital input line 2 (do not wire the digital source to digital input line 3). Using software, allocate a start list, put the A/D subsystems on the start list, prestart the subsystems, then start the subsystems. When started, the subsystems are triggered simultaneously when a high-to-low transition occurs on digital input line 2.

Refer to the example programs on the Data Acq OMNI CD for an example of synchronizing subsystems using an external trigger.

Note: To achieve more flexibility, you can simultaneous start two channels, and once started, simultaneously start the other two channels, if desired.

Synchronizing the Clocks

To synchronize the clocks of the A/D subsystems, specify the clock source as the internal A/D sample clock for the A/D subsystems using software. Ensure that you specify the same frequency for the internal clock sources. Then, specify the trigger source for the A/D subsystems as the software trigger. When started, both subsystems are triggered and clocked simultaneously.

Analog Output Features

Two analog output (D/A) subsystems are provided on the DT9822 module. The DT9821 does not support analog outputs. This section describes the following features of the D/A subsystem:

- Output resolution, described below
- Analog output channels, described below
- Output ranges and gains, described on page 69
- Conversion modes, described on page 69
- Data format, described on page 70

Output Resolution

The output resolution of the DT9822 module is fixed at 16 bits.

Analog Output Channels

The DT9822 module supports two DC-level analog output channels (DAC0 and DAC1). Each DAC is a separate D/A subsystem. Refer to Chapter 5 for information on how to wire analog output signals to the module using the screw terminal panel. You configure the channel type through software.

Within each DAC, the digital data is double-buffered to prevent spurious outputs, then output as an analog signal. Both DACs power up to a value of 0 V ±10 mV. Resetting the module does not clear the values in the DACs.

The DT9822 module can output data from a single analog output channel only. Specify the channel for a single-value analog output operation using software; refer to "Conversion Modes," on page 69 for more information on single-value operations.

Output Ranges and Gains

The output range for each DAC is ±5 V. Specify the range using software; set the gain to 1.

Conversion Modes

DT9822 modules can perform single-value analog output operations only. Use software to specify the range, gain, and analog output channel, then output the data from the specified channel. You cannot specify a clock source, trigger source, or buffer.

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

Data Format

Data from the host computer must use offset binary data encoding for analog output signals. Using software, specify the data encoding as binary.

In software, you need to supply a code that corresponds to the analog output value you want the module to output. To convert a voltage to a code, use the following formulas:

$$LSB = \frac{FSR}{2^N}$$

$$Code = \frac{Vout - offset}{LSB}$$

where,

- *LSB* is the least significant bit.
- *FSR* is the full-scale range (10).
- *N* is the output resolution (16 bits).
- *Code* is the raw count used by the software to represent the voltage.
- *Vout* is the analog voltage.
- *Offset* is the minus full-scale value, or –5 V.

For example, if you want to output a voltage of 4.7 V, determine the code value as follows:

$$LSB = \frac{10\ V}{65536} = 0.0001526\ V$$

$$Code = \frac{4.7\ V - (-5\ V)}{0.0001526\ V}$$

Code = 63565 = 784Dh

Digital I/O Features

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

- Digital I/O lines, described below
- Resolution, described below
- Operation modes, described on page 71

Digital I/O Lines

DT9820 Series modules support eight digital input lines (Port A, lines 0 to 7) through the DIN subsystem and eight digital output lines (Port B, lines 0 to 7) through the DOUT subsystem. The inputs are pulled up to +5 V through a 22 kΩ resistor.

You can use falling-edge transitions on digital inputs 0 to 3 to start A/D conversions; you can use falling-edge transitions on digital inputs 4 to 7 to stop A/D conversions. Refer to page 63 for more information.

Note: All the digital inputs must be in the high state before the DT9820 Series module can detect a falling-edge transition on the digital input lines. Therefore, if you are using the digital inputs to trigger the A/D subsystems, we recommend that you do not perform a single-value operation on the DIN subsystem.

On power up or module reset, no digital data is output from the modules. All the outputs include diode protection to the isolated ground and the isolated +5 V. In addition, you can externally power the +5 V output so that the digital outputs retain their current values when the module is powered down.

Note: +5 V output is available only when one of the subsystems is activated, which, in turn, activates power to the module.

Resolution

The resolution of the digital input port is fixed at 8; the resolution of the digital output port is also fixed at 8.

Operation Modes

The DT9820 Series modules support the single-value digital I/O operation mode.

Use software to specify the digital I/O port (the gain is ignored). Data is then read from or written to 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.

Note: All the digital inputs must be in the high state before the DT9820 Series module can detect a falling-edge transition on the digital input lines. Therefore, if you are using the digital inputs to trigger the A/D subsystems, it is recommended that you do not perform a single-value operation on the DIN subsystem.

Supported Device Driver Capabilities

The DT9820 Series Device Driver provides support for the analog input (A/D), analog output (D/A), digital input (DIN), and digital output (DOUT) subsystems. For information on how to configure the device driver, refer to Chapter 3.

Table 7: DT9820 Series Subsystems

DT9820 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Total Subsystems on Module	4	1[a]	1	1	0	0

a. D/A subsystems are supported by the DT9822 module only.

The tables in this chapter summarize the features available for use with the DT-Open Layers for .NET Class Library and the DT9820 Series modules. The DT-Open Layers for .NET Class Library provides properties that return support information for specified subsystem capabilities.

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

Note: Blank fields represent unsupported options.

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

Data Flow and Operation Options

Table 8: DT9820 Series Data Flow and Operation Options

DT9820 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Single-Value Operation Support **SupportsSingleValue**	Yes	Yes	Yes	Yes		
Simultaneous Single-Value Output Operations **SupportsSetSingleValues**						
Continuous Operation Support **SupportsContinuous**	Yes					
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**						

Buffering

Table 9: DT9820 Series Buffering Options

DT9820 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Buffer Support **SupportsBuffering**	Yes					
Single Buffer Wrap Mode Support **SupportsWrapSingle**						
Inprocess Buffer Flush Support **SupportsInProcessFlush**	Yes					

Triggered Scan Mode

Table 10: DT9820 Series Triggered Scan Mode Options

DT9820 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Triggered Scan Support **SupportsTriggeredScan**						
Maximum Number of CGL Scans per Trigger **MaxMultiScanCount**	0	0	0	0	0	0
Maximum Retrigger Frequency **MaxRetriggerFreq**	0	0	0	0	0	0
Minimum Retrigger Frequency **MinRetriggerFreq**	0	0	0	0	0	0

Data Encoding

Table 11: DT9820 Series Data Encoding Options

DT9820 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Binary Encoding Support **SupportsBinaryEncoding**	Yes[a]	Yes	Yes	Yes		
Twos Complement Support **SupportsTwosCompEncoding**	Yes[a]					
Returns Floating-Point Values ReturnsFloats						

a. Binary encoding is used for the 0 to 2.5 V range and for the –0.1 to 2.5 V range. Twos complement encoding is used for the –2.5 V to 2.5 V range.

Channels

Table 12: DT9820 Series Channel Options

DT9820 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Number of Channels **NumberOfChannels**	1	2	1	1	0	0
SE Support **SupportsSingleEnded**						
SE Channels **MaxSingleEndedChannels**	0	0	0	0	0	0
DI Support **SupportsDifferential**	Yes	Yes	Yes	Yes		
DI Channels **MaxDifferentialChannels**	1	2	1	1	0	0
Maximum Channel-Gain List Depth **CGLDepth**	1	0	0	0	0	0
Simultaneous Sample-and-Hold Support **SupportsSimultaneousSampleHold**						
Channel-List Inhibit **SupportsChannelListInhibit**						

Gain

Table 13: DT9820 Series Gain Options

DT9820 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Programmable Gain Support **SupportsProgrammableGain**	Yes					
Number of Gains **NumberOfSupportedGains**	7	1	1	1	0	0
Gains Available **SupportedGains**	1, 2, 4, 8, 16, 32, 64	1	1	1		

Ranges

Table 14: DT9820 Series Range Options

DT9820 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Number of Voltage Ranges **NumberOfRanges**	3	1	0	0	0	0
Available Ranges **SupportedVoltageRanges**	0 to 2.5 V, –.10 to 2.5 V, ±2.5 V	±5 V				
Current Output Support **SupportsCurrentOutput**						

Resolution

Table 15: DT9820 Series Resolution Options

DT9820 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Software Programmable Resolution **SupportsSoftwareResolution**						
Number of Resolutions **NumberOfResolutions**	1	1	1	1	0	0
Available Resolutions **SupportedResolutions**	24	16	8	8		

Thermocouple and RTD Support

Table 16: DT9820 Series Thermocouple and RTD Support Options

DT9820 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Thermocouple Support **SupportsThermocouple**						
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 17: DT9820 Series IEPE Support Options

DT9820 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
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 18: DT9820 Series Trigger Options

DT9820 Series	A/D	D/A	DIN[a]	DOUT	C/T	QUAD
Software Trigger Support **SupportsSoftwareTrigger**	Yes	Yes	Yes	Yes		
External Positive TTL Trigger Support **SupportsPosExternalTTLTrigger**						
External Negative TTL Trigger Support **SupportsNegExternalTTLTrigger**	Yes[a]					
External Positive TTL Trigger Support for Single-Value Operations **SupportsSvPosExternalTTLTrigger**						
External Negative TTL Trigger Support for Single-Value Operations **SupportsSvNegExternalTTLTrigger**						
Positive Threshold Trigger Support **SupportsPosThresholdTrigger**						
Negative Threshold Trigger Support **SupportsNegThresholdTrigger**						
Digital Event Trigger Support **SupportsDigitalEventTrigger**	Yes[a]					

a. A falling-edge transition on digital input line 0 can trigger acquisition of A/D subsystem 0; a falling-edge transition on digital input line 1 can trigger the acquisition of A/D subsystem 1, a falling-edge transition on digital input line 2 can trigger the acquisition of A/D subsystem 2, and a falling-edge transition on digital input line 3 can triggerthe acquisition of A/D subsystem 3.

Similarly, a falling-edge transition on digital input line 4 can stop the A/D operation on subsystem 0; a falling-edge transition on digital input line 5 can stop the A/D operation on subsystem 1, a falling-edge transition on digital input line 6 can stop the A/D operation on subsystem 2, and a falling-edge transition on digital input line 7 can stop the A/D operation on subsystem 3.

Clocks

Table 19: DT9820 Series Clock Options

DT9820 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Internal Clock Support **SupportsInternalClock**	Yes					
External Clock Support **SupportsExternalClock**						
Simultaneous Input/Output on a Single Clock Signal **SupportsSimultaneousClocking**						
Base Clock Frequency **BaseClockFrequency**	4.9152 MHz[a]	0	0	0	0	0
Maximum Clock Divider **MaxExtClockDivider**	1.0	1.0	1.0	1.0	1.0	1.0
Minimum Clock Divider **MinExtClockDivider**	1.0	1.0	1.0	1.0	1.0	1.0
Maximum Frequency **MaxFrequency**	960 Hz[b]	0	0	0	0	0
Minimum Frequency **MinFrequency**	7.5 Hz[b]	1.0	0	0	0	0

a. The internal oscillator is 4.9152 MHz for 60 Hz operation and 4.0960 MHz for 50 Hz operation.
b. The maximum throughput for analog input channels is 960 Samples/s in 60 Hz mode and 800 Samples/s in 50 Hz mode.

Counter/Timers

Table 20: DT9820 Series Counter/Timer Options

DT9820 Series	A/D	D/A	DIN	DOUT	C/T	QUAD
Cascading Support **SupportsCascading**						
Event Count Mode Support **SupportsCount**						
Generate Rate Mode Support **SupportsRateGenerate**						
One-Shot Mode Support **SupportsOneShot**						
Repetitive One-Shot Mode Support **SupportsOneShotRepeat**						
Up/Down Counting Mode Support **SupportsUpDown**						
Edge-to-Edge Measurement Mode Support **SupportsMeasure**						
Continuous Edge-to-Edge Measurement Mode Support **SupportsContinuousMeasure**						
High to Low Output Pulse Support **SupportsHighToLowPulse**						
Low to High Output Pulse Support **SupportsLowToHighPulse**						
Variable Pulse Width Support **SupportsVariablePulseWidth**						
None (internal) Gate Type Support **SupportsGateNone**						
High Level Gate Type Support **SupportsGateHighLevel**						
Low Level Gate Type Support **SupportsGateLowLevel**						
High Edge Gate Type Support **SupportsGateHighEdge**						
Low Edge Gate Type Support **SupportsGateLowEdge**						
Level Change Gate Type Support **SupportsGateLevel**						
Clock-Falling Edge Type **SupportsClockFalling**						
Clock-Rising Edge Type **SupportsClockRising**						
Gate-Falling Edge Type **SupportsGateFalling**						
Gate-Rising Edge Type **SupportsGateRising**						
Interrupt-Driven Operations **SupportsInterrupt**						

Calibration

The analog input circuitry of the DT9820 Series modules is automatically calibrated when the module is powered up. The analog output circuitry of the DT9822 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 output circuitry on the DT9822 modules every six months.

Note: Ensure that you installed the DT9820 Series software and configured the device driver prior to using the DT9820 Series Calibration Utility.

This chapter describes how to run the DT9820 Series Calibration Utility and calibrate the analog output circuitry of the DT9822 modules.

Running the Calibration Utility

To run the DT9820 Series Calibration Utility, do the following:

1. Click **Start** from the Task Bar.
2. Browse to **Programs | Data Translation, Inc | Calibration | DT9820 Calibration Utility**. *The main menu appears.*
3. Select the name of the DT9822 module to configure from the combo box, and then click **OK**.

Once the DT9820 Series Calibration Utility is running, you can calibrate the analog output circuitry, as described in the following section.

Calibrating the Analog Output Subsystem

To calibrate the analog output circuitry of the DT9822 module, use an external precision meter to do the following:

1. Connect Analog Output 0 (TB3, 3) to the positive side of the precision voltage meter.
2. Connect Analog Ground from the return of the analog output signal (TB3, 2) to the negative side of the precision voltage meter.
3. In the DAC0 Voltage box, click **0.000 V**.
4. In the DAC0 Adjustment box, click the increment or decrement arrows until your external meter display reads 0 V (within 0.0005 V).
5. In the DAC0 Voltage box, click **+9.375 V** and verify that your external meter display reads +9.375 V (within ±12 mV.)
6. Connect Analog Output 1+ (TB3, 4) to the positive side of the precision voltage meter.
7. Connect Analog Ground from the return of the analog output signal (TB3, 2) to the negative side of the precision voltage meter.
8. In the DAC1 Voltage box, click **0.000 V**.
9. In the DAC1 Adjustment box, click the increment or decrement arrows until your external meter display reads 0 V (within 0.0005 V).
10. In the DAC1 Voltage box, click **+9.375 V** and verify that your external meter display reads +9.375 V (within ±12 mV.)

Note: If you are not satisfied with the analog output calibration, you can load the factory default settings stored in the EEPROM by clicking **Restore** in the D/A Calibration Factory Settings box.

Once you have finished this procedure, the analog output circuitry is calibrated.

To close the Calibration Utility, click **Done**.

10

Troubleshooting

General Checklist

Should you experience problems using the DT9820 Series modules, follow these steps:

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 3.
6. Search the DT Knowledgebase in the Support section of the Data Translation web site (at www.datatranslation.com) for an answer to your problem.

If you still experience problems, try using the information in Table 21 to isolate and solve the problem. If you cannot identify the problem, refer to page 88.

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.
	The module is damaged.	Contact Data Translation for technical support; refer to page 90.
Intermittent operation.	Loose connections or vibrations exist.	Check your wiring and tighten any loose connections or cushion vibration sources.
	The module is overheating.	Check environmental and ambient temperature; consult the module's specifications on page 98 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.

Table 21: Troubleshooting Problems (cont.)

Symptom	Possible Cause	Possible Solution
Device failure error reported.	The DT9820 Series module cannot communicate with the Microsoft bus driver or a problem with the bus driver exists.	Check your cabling and wiring and tighten any loose connections.
	The DT9820 Series module was removed while an operation was being performed.	Ensure that your DT9820 Series module is properly connected.
Data appears to be invalid.	An open connection exists.	Check your wiring and fix any open connections.
	A transducer is not connected to the channel being read.	Check the transducer connections.
	The module is set up for differential inputs while the transducers are wired as single-ended inputs or vice versa.	Check your wiring and ensure that what you specify in software matches your hardware configuration; the A/D configuration should be differential.
Computer does not boot.	The power supply of the computer is too small to handle all the system resources.	Check the power requirements of your system resources and, if needed, get a larger power supply; consult the module's specifications on page 98 of this manual.

Technical Support

If you have difficulty using the DT9800 Series module, Data Translation's Technical Support Department is available to provide technical assistance.

To request technical support, to go 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 you 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 board.

   – Place in a secure shipping container.

3. Return the board 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

Specifications

Analog Input Specifications

Table 22 lists the specifications for the A/D subsystem.

Table 22: A/D Subsystem Specifications

Feature	DT9821/DT9822 Specifications
Number of analog inputs	4 Differential
Number of gains	7 (1, 2, 4, 8, 16, 32, 64)
Resolution	24 bits
Data encoding	Binary/Offset Binary
System accuracy (full-scale) Gain = 1: Gain = 2: Gain = 4: Gain = 8: Gain = 16: Gain = 32: Gain = 64:	 0.003% 0.004% 0.005% 0.006% 0.007% 0.008% 0.010%
Nonlinearity (integral)	±1.0 LSBs
Differential linearity	±0.5 LSBs (no missing codes)
Range Unipolar: Offset Unipolar: Bipolar:	 0 to 0.0390625 V, 0 to 0.078125 V, 0 to 0.15625 V, 0 to 0. 3125 V, 0 to 0.625 V, 0 to 1.25 V, 0 to 2.5 V –0.0015625 V to 0.0390625 V, –0.003125 V to 0.078125 V, –0.00625 V to 0.15625 V, –0.0125 V to 0. 3125 V, –0.025 V to 0.625 V, –0.05 V to 1.25 V, –0.10 V to 2.5 V ±0.0390625 V, ±0.078125 V, ±0.15625 V, ±0.3125 V, ±0.625 V, ±1.25 V, ±2.5 V
Drift Zero: Gain:	 ±100 nV+ (±5 nV * Gain)/° C ±30 ppm/° C
Input impedance Power Off: Power On:	 1.5 kΩ 100 MΩ/3 kΩ in series with 4700 pF
Input bias current	±10 nA
Common mode voltage	±3 V maximum (operational)
Common mode rejection	–72 dB

Table 22: A/D Subsystem Specifications (cont.)

Feature	DT9821/DT9822 Specifications
Normal mode rejection	74 dB typical
Maximum input voltage	±40 V maximum (protection)
A/D converter noise	1.0 LSB rms
Amplifier input noise	10 μV rms + (2 μV rms * gain) 200 pA rms (current)
Channel-to-channel offset	±200 μV
Effective number of bits (ENOB) at 7.5 Hz input	18 bits typical
Channel crosstalk	–120 dB @ 1 kHz
Isolation Voltage	±500 V DC to computer ground
Minimum Data Throughput (Internal Clock)	7.5 S/s at 60 Hz word frequency 6.25 S/s in 50 Hz word frequency

Analog Output Specifications

Table 23 lists the specifications for the D/A subsystem.

Table 23: D/A Subsystem Specifications

Feature	DT9822 Specifications
Number of analog output channels	2
Resolution	16 bits
Data encoding (input)	Offset binary
Nonlinearity (integral)	±4 LSBs
Differential linearity	±1.0 LSB (monotonic)
Output range	±5 V bipolar
Zero error	Software-adjustable to zero
Gain error	±6 LSBs
Current output	±2.5 mA minimum (5 V/ 2 kΩ)
Output impedance	0.3 Ω typical
Capacitive drive capability	0.001 µF minimum (no oscillations)
Protection	Short Circuit to Analog Common
Power-on voltage	0 V ±10 mV maximum
Settling time to 0.01% of FSR	50 µs, 10 V step 10 µs, 100 mV step
Throughput (Full Scale)	Single value 1kHz (system dependent)
Slew rate	2 V/µs

Digital I/O Specifications

Table 24 lists the specifications for the digital input subsystem.

Table 24: DIN Subsystem Specifications

Feature	Specifications
Number of lines	8 (Port A)[a]
Termination	22 kΩ Pullup to +5V_I[b]
Inputs Input type: Input load: High-level input voltage: Low-level input voltage: High-level input current: Low-level input current:	 Level sensitive 1 (HCT) 2.0 V minimum 0.8 V maximum 3 µA -3 µA
Back EMF diodes	No

a. A high to low transition on digital input lines 0 to 3 interrupts the module to start A/D conversions, where line 0 corresponds to A/D channel 0, line 1 corresponds to A/D channel 1, line 2 corresponds to A/D channel 2, and line 3 corresponds to A/D channel 3.

A low to high transition on digital input lines 4 to 7 interrupts the module to stop A/D conversions, where line 4 corresponds to A/D channel 0, line 5 corresponds to A/D channel 1, line 6 corresponds to A/D channel 2, and line 7 corresponds to A/D channel 3.

b. You can drive the +5V_I isolated output pin from an external power supply. This will allow the last digital output value to be latched to the input stage; therefore, if the power is reduced by the host, the digital output values will not change. Current requirements are 1 mA plus load.

Table 25 lists the specifications for the digital output subsystem.

Table 25: DOUT Subsystem Specifications

Feature	Specifications
Number of lines	8 (Port B)
Termination	22 Ω series resistor
Outputs Output driver: Output driver high voltage: Output driver low voltage:	 TTL 2.4 V minimum (IOH = -1 mA) 0.5 V maximum (IOL = 12 mA)
Back EMF diodes	Yes

Power, Physical, and Environmental Specifications

Table 26 lists the power, physical, and environmental specifications for the DT9820 Series modules.

Table 26: Power, Physical, and Environmental Specifications

Feature	Specifications
Power	
+5 V Standby:	500 µA maximum
+5 V Enumeration:	100 mA maximum (55 mA typical)
+5 V Power ON:	500 mA maximum (380 mA typical)
+5 V Isolated Power Out:	10 mA maximum
Physical	
Dimensions:	6.1 inches x 4.25 inches x 1.7 inches
Weight:	15 ounces (420 grams)
Environmental	
Operating temperature range:	0° C to 55° C
Storage temperature range:	–25° C to 85° C
Relative humidity:	To 95%, noncondensing

Cable and Connector Specifications

Table 27 lists the cable and connector specifications for the DT9820 Series modules.

Table 27: DT9820 Series Cable and Connector Specifications

Feature	Specifications
USB cable	2-meter, Type A-B, USB cable Data Translation part#17394, or AMP part# 974327-1
Connector	37-pin D, AMP #74882-1 (male on the module)

Regulatory Specifications

Table 28 lists the regulatory specifications for the DT9820 Series modules.

Table 28: 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)

B

Connector Pin Assignments

Connector J1 on the DT9820 Series

Table 29 lists the pin assignments of connector J1 on the DT9820 Series modules and the STP9820 screw terminal panel.

Table 29: Pin Assignments for Connector J1 on the DT9820 Series Modules and on the STP9820 Screw Terminal Panel

Pin	Signal Description	Pin	Signal Description
1	Isolated Digital Ground	2	Digital Output Line 3
3	Digital Output Line 2	4	Digital Output Line 1
5	Digital Output Line 0	6	Digital Input Line 3
7	Digital Input Line 2	8	Digital Input Line 1
9	Digital Input Line 0	10	+5 V Isolated Input/Output[a]
11	Isolated Digital Ground	12	Isolated Analog Common
13	Analog Input Subsystem 03	14	Isolated Analog Common
15	Analog Input Subsystem 02	16	2.5 V Reference
17	Analog Input Subsystem 01	18	Isolated Analog Common
19	Analog Input Subsystem 00	20	Digital Output Line 7
21	Digital Output Line 6	22	Digital Output Line 5
23	Digital Output Line 4	24	Digital Input Line 7
25	Digital Input Line 6	26	Digital Input Line 5
27	Digital Input Line 4	28	Analog Output 0
29	Isolated Analog Common	30	Isolated Analog Common
31	Analog Input Subsystem 03 Return	32	Isolated Analog Common
33	Analog Input Subsystem 02 Return	34	Analog Output 1
35	Analog Input Subsystem 01 Return	36	Isolated Analog Common
37	Analog Input Subsystem 00 Return		

a. +5 V output is available only when one of the subsystems is activated, which, in turn, activates power to the module. You can externally power the +5 V isolated output signal. This allows you to retain the last value that was written to the digital output lines when the DT9820 Series module is in low-power mode.

Screw Terminal Assignments of the STP9820

Table 30 lists the screw terminal assignments of the STP9820 screw terminal panel.

Table 30: Screw Terminal Assignments of the STP9820 Screw Terminal Panel

Screw Terminal Block	Terminal Number	Terminal Label	Signal Description
TB1	1	CH0H	Analog Input Subsystem 0 High
	2	CH0L	Analog Input Subsystem 0 Low
	3	AGND	Analog Ground
	4	CH1H	Analog Input Subsystem 1 High
	5	CH1L	Analog Input Subsystem 1 Low
	6	AGND	Analog Ground
TB2	1	CH2H	Analog Input Subsystem 2 High
	2	CH2L	Analog Input Subsystem 2 Low
	3	AGND	Analog Ground
	4	CH3H	Analog Input Subsystem 3 High
	5	CH3L	Analog Input Subsystem 3 Low
	6	AGND	Analog Ground
TB3	1	VREF	2.5 V Reference
	2	AGND	Analog Ground
	3	DAC0	Analog Output 0
	4	DAC1	Analog Output 1
	5	DGND	Digital Ground
	6	5VD	+5 V[a]
TB4	1	DOUT0	Digital Output 0
	2	DOUT1	Digital Output 1
	3	DOUT2	Digital Output 2
	4	DOUT3	Digital Output 3
	5	DOUT4	Digital Output 4
	6	DOUT5	Digital Output 5
	7	DOUT6	Digital Output 6
	8	DOUT7	Digital Output 7
	9	DGND	Digital Ground

Table 30: Screw Terminal Assignments of the STP9820 Screw Terminal Panel (cont.)

Screw Terminal Block	Terminal Number	Terminal Label	Signal Description
TB5	1	DIN0	Digital Input 0
	2	DIN1	Digital Input 1
	3	DIN2	Digital Input 2
	4	DIN3	Digital Input 3
	5	DIN4	Digital Input 4
	6	DIN5	Digital Input 5
	7	DIN6	Digital Input 6
	8	DIN7	Digital Input 7
	9	DGND	Digital Ground

a. +5 V output is available only when one of the subsystems is activated, which, in turn, activates power to the module. You can externally power the +5 V isolated output signal. This will allow you to retain the last value that was written to the digital output lines when the DT9820 Series module is in low-power mode.

Using Your Own Screw Terminal Panel

Data acquisition boards and modules can perform only as well as the input connections and signal integrity you provide. If you choose not to use the STP9820 screw terminal panel, considerations must be given as to how the signals interact in the real world as well as how they interact with each other.

This appendix describes additional considerations to keep in mind when designing your own screw terminal panel for use with a DT9820 Series module.

Analog Inputs

The DT9820 Series modules provide differential analog output channels only.

Differential inputs offer the maximum noise rejection. For the best results, shielded twisted pairs are a must. The shield must connect at one end so that ground currents do not travel over the shield. In low-level voltage applications, differential inputs reduce problems not only due to electrostatic and magnetic noise, but due to cross-talk and thermal errors.

One problem to consider with differential inputs is the bias current error. The differential impedance is usually hundreds of megaohms. With a very small bias current multiplied by this high input impedance, the voltage produced is out of the common-mode input range of the instrumentation amplifier.

An external resistor must be provided to return this bias current to the analog common of the data acquisition board. This resistor is typically in the order of 1 kΩ to 100 kΩ from the input low side to analog common. Alternatively, the external common can be returned through a 10 Ω to 100 kΩ resistor to analog common (it cannot be 0 Ω due to ground currents).

Analog Outputs

The DT9822 module provides two analog output channels with a resolution of 16 bits.

The design of the DT9822 ensures that the analog outputs do not break into a high frequency oscillation with high capacitance loads that may be experienced with long cables. Typically, the analog outputs drive 1,000 pF without degradation and bandwidth-limit with higher capacitive loads.

The grounds of most boards are optimized for analog inputs at the expense of some logic or high-frequency noise on the analog outputs. This is because the analog and digital grounds of the board are connected at the ADC's input.

The analog outputs are brought out as a high and a low signal, but the low side is the analog ground at the DAC's output buffer. To remove the high-frequency noise and smooth the glitch energy on the analog outputs, you can install a 15 kHz RC filter on the output, a 100 Ω resistor in series with the output, and a 0.1 µF capacitor between the output side of the 100 Ω resistor and output low.

Digital Inputs

TTL-type inputs must have current limiting so that circuitry is not damaged when power is removed. On all Data Translation USB modules, current limiting is used to prevent damage in this fault condition.

Digital Outputs

If you are using the high drive capability of any of the Data Translation USB modules, ensure that the load is returned to the digital ground provided in the connector next to the outputs.

If just eight of the digital outputs are switching 16 mA per output, then 128 mA of current flows. To minimize problems with ringing, loading, and EMI, a 22 Ω resistor is used in series with all digital outputs. You must consider this 22 Ω resistor if you are matching cable impedance to the far end.

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